APPLICATION FOR PERMIT TO CONSTRUCT
REPUBLIC SERVICES OF NORTH CAROLINA, LLC

VOLUME I OF II
DESIGN HYDROGEOLOGIC REPORT

EAST CAROLINA REGIONAL LANDFILL
PHASE FIVE
PERMIT NO. 08-03
BERTIE COUNTY, NORTH CAROLINA

JULY 2007
REVISED DECEMBER 2007

PREPARED FOR:

APPROVED
DIVISION OF WASTE MANAGEMENT
SOLID WASTE SECTION
DATE 5/14/08 BY Brian Wootton

REPUBLIC SERVICES OF NC, LLC
1922 REPUBLICAN ROAD
AULANDER, NORTH CAROLINA 27805

NORTH CAROLINA LICENSED SEAL 1993 12-5-07 GEOLOGIST DAVID YATES RANDOLPH II

PREPARED BY:

Golder Associates

NORTH CAROLINA LICENSED SEAL 1811 12-5-07 GEOLOGIST RACHEL P. KIRKMAN

GOLDER ASSOCIATES NC, INC.
4900 KOGER BOULEVARD, SUITE 140
GREENSBORO, NORTH CAROLINA 27407

Project No. 063-66507.203

North Carolina Department of Environment and Natural Resources
Dexter R. Matthews, Director **Division of Waste Management** Michael F. Easley, Governor
William G. Ross Jr., Secretary

May 14. 2008

Ray Hoffman, P.E.
Republic Services of NC, LLC
1220 Commerce Street, SW
Hickory, NC 28613

RE: Permit to Construct (PTC) Application - Volume I of II Design Hydrogeologic Report – Phase 5
Volume II of II – PTC Application for proposed Phase 5 East Carolina Regional Landfill– MSWLF
Bertie County Landfill
Permit No. 08-03
Document No. 4504

Dear Mr. Hoffman:

I have reviewed the Design Hydrogeologic Study (Volume I of II) and portions of the Permit to Construct Application (Volume II of II - pertaining to hydrogeology) for proposed Phase 5 (Cells 13 & 14 - 24.1 acres) Expansion. **The Study and supporting information meets the criteria required in the Rules [(i.e. 15A NCAC 13B .1623(b) and 15A NCAC 13B .1624(b)(4)]; therefore, I have no objection to issuance of this portion to Permit to Construct based on these rules.**

Any piezometers, ground-water monitoring wells, and borings, located in proposed cells 13 and 14 to be constructed, may be abandoned now or after a Permit to Construct permit is issued by the Solid Waste Section. Please adhere to the following conditions:

Prior to construction of cell(s), all piezometers, ground-water monitoring wells, and borings, located in the proposed cell(s), shall be properly abandoned in accordance with 15A NCAC 2C.0113(b)(1), titled "Abandonment of Wells".

a. In areas where soil is to be undercut, abandoned wells should not be grouted to pre-grade land surface, but to the proposed base grade surface to prevent having to cut excess grout and possibly damaging the wells.

b. Well abandonment records for each piezometer, ground-water monitoring well and boring shall be certified by the permit holder's geologist and submitted to the Solid Waste Section in accordance with 15A NCAC 02C.0114(b).

==========

If you have any questions please call me at 919-508-8524.

Sincerely,

Brian Wootton
Hydrogeologist
Solid Waste Section

cc:	Dusty Y. Reedy II, P.G.	Golder Associates, NC, Inc.
	Ed Mussler	Solid Waste Section
	Donna Wilson	Solid Waste Section
	Central File	Solid Waste Section

Golder Associates NC, Inc.

4900 Koger Boulevard, Suite 140
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December 5, 2007

Project No. 063-6507.203

Department of Environment and Natural Resources
Division of Waste Management
Solid Waste Section
401 Oberlin Road, Suite 150
Raleigh, North Carolina 27605
919-508-8507

Attention: Mr. Brian Wootton
Hydrogeologist

Re: Response to Comments
Design Hydrogeologic Report for Proposed Phase 5
East Carolina Regional Landfill, Permit No. 08-03
Bertie County, North Carolina

Dear Brian,

On behalf of East Carolina Environmental, a subsidiary of Republic Services of North Carolina, LLC (Republic), Golder Associates NC, Inc. (Golder) is submitting this response to comments presented in the November 8, 2007, letter from the Solid Waste Section regarding the *Design Hydrogeologic Report for Phase 5,* for the East Carolina Regional Landfill. The comments from the November 8, 2007, letter are presented below in italics followed by Golder's response.

Design Hydrogeologic Report
Section 3.2.2 Soil Testing
Table 4 – Summary of Laboratory Soils Test Data

Page 5, Section 3.2.2 states in-part: "Soil samples consisted of seven Shelby Tubes"…….. "(PZ-117B (22'-24'), and PZ-177B (48'-49.5')) and one composite split tube sample (PZ-177A (10'-18'))".

PZ-177B and PZ-177A are probably typo errors. Please modify to read: PZ-117A and PZ-117B.

Golder agrees with the recommendation. Section 3.2.2 has been revised and replacement page 5 is attached to this letter.

Design Hydrogeologic Report
Section 4.2.4 Layer IV Hydrogeologic Unit
Table 5 – Summary of Aquifer Test Data

Page 10, Section 4.2.4 states in-part: "Hydrogeologic conductivity derived from aquifer testing of piezometers in and around Phase 5 and screened in Layer II ranged from 2.12E-05 cm/sec to 5.23E-04 cm/sec with an average hydraulic conductivity value of 9.94E-05 cm/sec".

Layer II is probably a typo error. Please modify to read: Layer IV.

Golder agrees with the recommendation. Section 4.2.4 has been revised and replacement page 10 is attached to this letter.

Since the July 30, 2007, submittal, the Solid Waste Section Limits have been revised. Please replace the table in Appendix B of the Water Quality Monitoring Plan with the enclosed revised table.

Three copies of revised cover pages, report text pages, and table are attached to this letter. Please replace the original pages with the revised pages. Also, a CD has also been included that contains PDF files of this letter report and attachments, as well as, the complete revised *Design Hydrogeologic Report for Phase 5* text.

If you have any questions, please contact the undersigned at 336-852-4903. We appreciate your assistance with this project.

Sincerely,
GOLDER ASSOCIATES NC, INC.

David "Dusty" Y. Reedy II, P.G.
Project Hydrogeologist

Rachel P. Kirkman, P.G.
Senior Project Geologist

Enclosures

C: William Cooksey, General Manager, Republic Services of North Carolina, LLC, 1922 Republican Road, Aulander, North Carolina, 27805. 252-348-3322.
Ray Hoffman, P.E., Area Engineer, Republic Services, 1220 Commerce Street, SW, Hickory, North Carolina, 28613. HoffmanRJ@repsrvnc.com. 828-464-2414.

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Golder Associates NC, Inc.

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July 30, 2007

Project No. 063-6507.203

Department of Environment and Natural Resources
Division of Waste Management
Solid Waste Section
401 Oberlin Road, Suite 150
Raleigh, North Carolina 27605
919-508-8507

Attention: Mr. Bobby Lutfy
Hydrogeologist

Re: East Carolina Regional Landfill, Permit No. 08-03
Bertie County, North Carolina
Phase 5 Design Hydrogeologic Report and Water Quality Monitoring Plan

Dear Bobby,

On behalf of East Carolina Environmental, a subsidiary of Republic Services of North Carolina, LLC (Republic), Golder Associates NC, Inc. (Golder) is submitting the enclosed *Design Hydrogeologic Report for Phase 5,* for the above-referenced facility. The *Water Quality Monitoring Plan* is included as an appendix to this report. If you have any questions, please contact the undersigned at 336-852-4903. We appreciate your assistance with this project.

Sincerely,
GOLDER ASSOCIATES NC, INC.

David "Dusty" Y. Reedy II, P.G.
Staff Hydrogeologist

Rachel P. Kirkman, P.G.
Senior Project Geologist

Enclosure

C: William Cooksey, General Manager, Republic Services of North Carolina, LLC, 1922 Republican Road, Aulander, North Carolina, 27805. 252-348-3322.
Ray Hoffman, P.E., Area Engineer, Republic Services, 1220 Commerce Street, SW, Hickory, North Carolina, 28613. HoffmanRJ@repsrvnc.com. 828-464-2414.

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PREPARED FOR:

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4900 KOGER BOULEVARD, SUITE 140
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1.0 INTRODUCTION

In accordance with Title 15A of the North Carolina Administrative Code (NCAC) Subchapter 13B.1623, Republic Services of North Carolina, LLC (Republic) is submitting this Design Hydrogeologic Report for the Phase 5 lateral expansion of the municipal solid waste (MSW) landfill at East Carolina Regional Landfill. The East Carolina Regional Landfill is operated by East Carolina Environmental, a subsidiary of Republic Services of North Carolina, LLC under Permit No. 08-03 issued by the North Carolina Department of Environment and Natural Resources (DENR). The purpose of this report is to characterize the hydrogeologic conditions in and around the Phase 5 waste footprint and compliance boundary. This report will also discuss the relationship of the site groundwater flow regime relative to local and regional hydrogeologic features, with emphasis on the relationship of MSW landfill units to potential groundwater receptors and groundwater discharge features.

2.0 SITE DESCRIPTION

The East Carolina Regional Landfill is a Subtitle D landfill located on Republican Road near the town of Aulander, North Carolina. The facility encompasses approximately 470 acres, of which approximately 149 acres is approved by the Solid Waste Section for a lined landfill and ancillary features. The facility began accepting waste in October 1993 and contains a capped area of approximately 4.5 acres and an approximately 82-acre, lined landfill (Cells 3 through 11). The proposed Phase 5 waste footprint will comprise a 24.1-acre lined cell. The site location, property boundaries, and surrounding topography are shown on an inset topographic map on Drawing DH-1. The site is located in the Coastal Plain Physiographic Province.

The facility is bound to the north and east by undeveloped property and the Connaritsa Swamp, to the west by State Route 1225 and undeveloped and agricultural property, and to the south by State Route 1221, wooded property, and undeveloped bottomlands associated with the easterly flowing Cashie River.

Topographic elevations at the facility range from approximately 30 to 70 feet above mean sea level. Along the northern and eastern portions of the facility, surface drainage from the facility and surrounding areas is routed by drainage channels and storm water control structures to tributaries of the southerly flowing Connaritsa Swamp, a tributary system of the Cashie River. Along the western and southern portions of the facility, surface drainage from the facility and surrounding areas is routed by drainage channels and storm water control structures to tributaries of the southeasterly flowing Cashie River. The Cashie River discharges to the greater Roanoke River south of the Town of Windsor. Two sediment ponds are located near the southwest corner of the waste footprint and are shown on Drawing DH-1.

Prior to construction of the landfill, the site consisted primarily of farmland and timber. Current site improvements consist of previously permitted waste cells, borrow areas, maintenance buildings and access roads. A large portion of the property is undeveloped. The proposed Phase 5 expansion area consists mainly of pine timber and some farmland in the northern portion of the proposed waste footprint.

3.0 FIELD INVESTIGATIONS

The following sections summarize the previous and current field investigation activities. Pertinent data from previous investigations are also summarized in select tables as described below.

3.1 Previous Investigations

The first hydrogeologic investigation performed at the site was associated with the initial siting requirements of the MSW landfill and was submitted to NC DENR in December 1992. Since then, four phases have been proposed, approved and constructed. Hydrogeologic investigations have been performed with each of these phases. A number of hydrogeologic investigations have been performed since the initial site characterization and a summary of available reports is listed below.

- *Report of Geologic and Hydrogeologic Assessment of Proposed Solid Waste Landfill, Spruil Farms Property*, Law Engineering Job Number 2490472602, dated December 1, 1992.
- *Submittal in Response to Completeness Review by the NCSWMD, Report of Geologic and Hydrogeologic Assessment of Proposed Solid Waste Landfill*, Law Engineering Job Number 2490472605, dated April 28, 1993.
- *Design Hydrogeologic Report, Cells 3-6 (Phase 1)*, Law Engineering Job Number 2490472607, dated July 21-29, 1993.
- *Submittal of Additional Soil Test Borings and Piezometer Data, Design Hydrogeologic Report, Cells 3-6 (Phase I)*, Law Engineering job Number 2490472607, dated July 21, 1993.
- *Report of Monitoring Well Installation*, Law Engineering Job Number 2490472612, dated September 29, 1993.
- *Site Transition Plan*, Law Engineering Job Number 249472618, dated March 31, 1994 and April 29, 1994.
- *Design Hydrogeologic Report*, Cells 7-8 (Phase II), Law Engineering Job Number 30220-5-4726.36, dated March 12, 1996 and revised August 7, 1996.
- *Ground-Water Monitoring Well Installation Report: GW-10*, Law Engineering Job number 2490472642, dated September 16, 1996.
- *Ground-Water Monitoring Well Installation Report: Phase II [GW-11]*, Bunnell-Lammons Engineering (BLE) Project Number J97-1001-11, dated May 7, 1997.
- *Site Hydrogeologic Report*, BLE Project Number J96-1001-03, dated July 16, 1998, revised April 11, 2003.
- *Design Hydrogeologic Report, Cells 9-11 (Phase III)*, BLE Project Number J98-1001-18, dated January 25, 2000.
- *Ground-Water Monitoring Well Installation Report: GW-13*, BLE Project Number J00-1001-32, dated November 20, 2000.
- *Design Hydrogeologic Report, Phase 4 (Cells 11-12)*, BLE Project Number J01-1001-46, dated January 7, 2005, revised May 2, 2005.

- *Ground-Water Monitoring Well and Gas Probe Installation Report, Cell No. 11 Lower End*, BLE Project Number J05-1001-53, dated February 10, 2006.

Since field activities began in 1992, 16 monitoring wells and more than 160 piezometers and borings have been installed at the facility. The boring logs and well and piezometer construction records for the previously installed monitoring wells and piezometers can be located in the reports documented above. The monitoring well and piezometer construction data are summarized in Table 1 and the locations are provided on Drawing DH-1.

During previous investigations, three piezometers (PZ-10A, PZ-72A, and PZ-73A) and one monitoring well (GW-14) were installed in the proposed Phase 5 footprint. An additional 12 piezometers (PZ-41A, PZ-41B, PZ-56A, PZ-67A, PZ-68A, PZ-88A, PZ-95A, PZ-97A, PZ-106A, BE-5, BE-6, and C8.7) were installed in close proximity to the proposed Phase 5 waste cell during previous investigations. All of the previously installed piezometers have been properly decommissioned except PZ-10A. Monitoring well GW-14 is part of the compliance monitoring well network. Groundwater elevations, aquifer tests, and soil tests were performed during the previous investigations. The pertinent data collected in the proposed Phase 5 area have been incorporated into the current investigation.

3.2 Current Investigation

The field activities for this investigation were performed in May through October 2006. The initial fieldwork consisted of the installation of 22 piezometers, a field survey of the new piezometers, well development and aquifer testing of selected piezometers, and measurement of groundwater elevations.

3.2.1 Drilling Program

Twenty-two piezometers (PZ-107A, PZ-107B, PZ-108, PZ-109A, PZ-109B, PZ-110, PZ-111, PZ-112, PZ-113, PZ-114, PZ-115A, PZ-115B, PZ-116, PZ-117A, PZ-117B, PZ-118, PZ-119, PZ-120, PZ-121, PZ-122, PZ-123A, and PZ-123B) were installed in and around the proposed Phase 5 footprint between May 9 and May 23, 2006. Monitoring well GW-16 was also installed on May 24, 2006, to monitor the newly constructed Cell 11 of Phase 4. Geologic Exploration of Statesville, North Carolina performed drilling and well installation activities. The drilling equipment consisted of a Deidrich D-50 track-mounted drilling rig equipped with 4.25-inch inner diameter (ID) hollow-stem augers and a 3.75-inch outer diameter (OD) tricone bit for mud-rotary drilling. Continuous split-spoon samples were obtained and logged by the geologist for the boreholes, except in locations where nested piezometer pairs were installed. A licensed Golder geologist was present to observe the drilling, log the boreholes, and supervise the piezometer construction. An experienced Golder field technician developed monitoring wells and piezometers selected for aquifer testing. The boring logs, piezometer construction records, and well development forms for the newly installed piezometers are included as Appendix A. The piezometer and well construction data are summarized in Table 1 and the locations are provided on Drawing DH-1. Well and piezometer construction was performed in accordance with the standards described in the *RCRA Technical Enforcement Guidance Document* (1986) and the

Draft North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities (1995).

Seventeen piezometers (PZ-107A, PZ-108, PZ-109A, PZ-110, PZ-111, PZ-112, PZ-113, P-114, PZ-115A, PZ-116, PZ-117A, PZ-118, PZ-119, PZ-120, PZ-121, PZ-122, and PZ-123A) were installed in the uppermost aquifer in and around the proposed Phase 5 footprint and range in depth from 14 to 28 feet below ground surface with screen lengths that range from 4 to 15 feet, depending on the aquifer thickness. Five piezometers (PZ-107B, PZ-109B, PZ-115B, PZ-117B, and PZ-123B) were installed in the lower aquifer, which is separated from the uppermost aquifer by a confining unit. The lower aquifer piezometers range in depth from 50 to 52 feet below ground surface with screen lengths that range from 5 to 20 feet.

Unless specified below, piezometers were grouted to ground surface and lockable expansion caps installed in each casing. Piezometers PZ-110 and PZ-118 were covered by lockable anodized aluminum protective casings installed into 3x3x0.5-foot concrete aprons to protect their integrity. Piezometers that may be converted into monitoring wells will have lockable protective casings and concrete aprons installed prior to the first compliance sampling event. Wells and piezometers within the Phase 5 footprint will be decommissioned prior to construction.

On June 27 and 28, 2006, piezometers PZ-110 and PZ-118 and monitoring well GW-16 were developed with a submersible pump to remove accumulated sediments resulting from the drilling and construction process, and to hydraulically connect the piezometers with the surrounding soils. On August 28 and 29, 2006, piezometers PZ-107A, PZ-107B, PZ-109A, PZ-109B, PZ-115, PZ-115B, PZ-117A, PZ-117B were also developed with a submersible pump. The piezometers exhibited continuous recharge during development, with approximately 15 to 37 gallons of water were purged from each piezometer. Well development forms are included in Appendix A. The remaining piezometers that will be converted into permanent monitoring wells will be developed using similar procedures prior to the first sampling event.

The 22 newly installed piezometers and monitoring well GW-16 were surveyed in July 2006 by Wright and Fields Land Surveying, Inc. of Troy, North Carolina. Elevations and horizontal locations were referenced to the N.C. Grid Coordinate System. The piezometer survey map and a sealed letter prepared by Wright and Fields Land Surveying are provided in Appendix B.

A historical summary of the static groundwater elevations for monitoring wells and Phase 5 investigation piezometers screened in the uppermost aquifer is included in Table 2. A historical summary of the static groundwater elevations for monitoring wells and Phase 5 investigation piezometers screened in the lower aquifer is included in Table 3. Static water level measurements of the newly installed piezometers were collected at the time of drilling, approximately 24 hours after construction, and on or about 7 days after construction. Water levels were periodically measured for existing site monitoring wells and Phase 5 investigation piezometers during additional site visits through October 2006.

3.2.2 Soil Testing

Soil samples were collected from each piezometer or piezometer pair location during drilling activities. Standard penetration tests were performed continuously for each boring using a 2-foot long split spoon sampler. Soil samples from the split spoons were collected so that select samples could be reviewed at a later date or sent to a soil testing laboratory. Undisturbed soil samples were collected using Shelby Tubes at select boring locations to be analyzed at a soil testing laboratory.

Soil samples were sent to the Golder Associates Inc. Soil Testing Laboratory in Atlanta, Georgia. Soil samples consisted of seven Shelby Tubes (PZ-109A (4'-6'), PZ-109A (14'-16'), PZ-109B (33'-35'), PZ-109B (45.5'-47'), PZ-115B (44'-44.5'), PZ-117B (22'-24'), and PZ-117B (48'-49.5')) and one composite split spoon sample (PZ-117A (10'-18')). Samples were analyzed for gradation, Atterberg limits, USCS classification, permeability, total porosity, total unit weight, moisture content, triaxial shear, and consolidation. The results of the soil analysis are summarized in Table 4 and the laboratory report is provided as Appendix C.

3.2.3 Hydrogeologic Testing

The potentiometric surface in the newly installed monitoring wells was measured at the time of well construction, and approximately 24 hours and approximately 7 days after well construction. The potentiometric surface in the existing monitoring wells and piezometers and newly installed piezometers were measured periodically over several months and the data are summarized on Tables 2 and 3. The measurements were collected using a decontaminated electric water level indicator. The surveyed point on the top of the well casing was used as reference, and the measurements were recorded to within 0.01 foot. The groundwater elevation data measured on October 31, 2006, were used to prepare potentiometric surface contour maps and to infer groundwater flow directions for the uppermost and lower aquifers at the site, and are included as Drawings DH-2 and DH-3.

Following development, 5 piezometers (PZ-109A, PZ-110, PZ-115A, PZ-117A, and PZ-118) and 1 monitoring well (GW-16) screened in the uppermost aquifer and 3 piezometers (PZ-109B, PZ-115B, and PZ-117B) screened in the lower aquifer were chosen for aquifer testing (slug tests) during the field investigation. The purpose of the testing was to assess the value of horizontal hydraulic conductivity at various locations within the two aquifers at the site. *In situ* rising- and falling-head slug tests were chosen for the assessment.

Slug tests were conducted between October 31, 2006, and November 3, 2006, by an experienced Golder geologist. Rising- and falling-head tests were performed on each piezometer and well because the water table was above the screened intervals; thus the results were not significantly affected by the porosity of the sand pack.

Prior to slug testing, the piezometers were opened and groundwater levels were allowed to equilibrate. Water level measurements were then collected using an electric water level probe referenced to a point on the top of casing. A stainless steel pressure transducer rated for 15 pounds per square inch (psi) was then lowered inside the well casing and placed 10 to 15 feet

below the top of the water table. A polyvinyl chloride (PVC) slug measuring 5 feet in length was used to displace water inside the wells. Downhole equipment used during the slug testing was decontaminated prior to use and between wells.

The first portion of the test was a falling-head test that measured the rate of water level decline following the injection of the PVC slug. The transducer was used to record water level changes on a logarithmic time interval. An electronic water level indicator was used to obtain periodic depth to water readings during the tests for the purpose of verifying the data recorded by the pressure transducer. Falling-head tests were terminated after water levels had recovered to within approximately 99% of their pre-test level. A rising-head test was performed on each well after the falling-head test was completed. The rising-head test was conducted by initiating a new logarithmic recording step on the data logger simultaneous with the removal of the PVC slug. The transducer recorded data were checked with hand held readings, and the tests were terminated after water levels had recovered to within approximately 99% of the pre-test level.

In situ rising- and falling-head tests provide a quantitative estimate of horizontal hydraulic conductivity (K) and a qualitative estimate of aquifer anisotropy in water-bearing units. The slug test data were analyzed using the Bouwer and Rice (1976 and 1989) equation, which is applicable to fully or partially penetrating wells in unconfined or confined aquifers. Well or piezometer specific aquifer thicknesses of 4.2 to 22 feet were assumed for the uppermost aquifer based upon information available from the boring logs. An aquifer thickness of 50 feet was assumed for the lower aquifer. A packing porosity of 25% was assumed for the well filter pack. Computer software AQTESOLV, produced by HydroSOLVE, Inc., was utilized to assist in the analysis and plotting of data. The individual data points, computer plots of time versus groundwater displacement, and associated formulae are presented in Appendix D. A summary of aquifer testing results from wells in and around the proposed Phase 5 footprint is included in Table 5. A geometric mean for hydraulic conductivity values for each of the hydrogeologic units was calculated as shown on Table 5.

As presented, the geometric mean of the horizontal hydraulic conductivity of Layer II is approximately 4.72E-04 centimeters per second (cm/sec), and the geometric mean of the horizontal hydraulic conductivity for Layer IV is approximately 9.94E-05 cm/sec.

4.0 REGIONAL AND LOCAL GEOLOGY

This section describes the geology in the region of the landfill and site specific geological conditions that may affect the performance of engineered features upon the land surface in the proposed cell area, the groundwater flow regime, and the ability to effectively monitor water quality at the site.

4.1 Regional Geology

The East Carolina Regional Landfill is located within the Coastal Plain Physiographic Province. The Coastal Plain of North Carolina comprises approximately 45 percent of the state. It consists of a 'wedge' of mostly marine sediments that thickens to the east. Coastal Plain sediments

typically range in age from Cretaceous to present. A generalized geologic map of North Carolina is provided as Figure 1.
The portion of Bertie County, where the site is located, is underlain by the Yorktown and Black Creek Formations. The Yorktown Formation is Tertiary in age and generally consists of alternating sand and clay deposits representing a series of transgression and regression events. The Yorktown Formation correlates stratigraphically with the Duplin Formation, which has a similar lithology. The two formations are separated laterally by the Neuse River.

Underlying the Yorktown Formation is the Black Creek Formation. The Black Creek Formation consists of lignitic sand and clay that represent fluvial and shallow marine environments from the late Cretaceous. Locally, the formation consists of an upper sandy clay confining layer and a lower sandy unit with thinly laminated clay units that contain lignitic wood fragments.

4.2 Local Geology

The drilling and installation of 22 piezometers and one monitoring well performed during this investigation provided geological and hydrogeological information consistent with previous investigations, which includes information from more than 160 borings across the site. In general, the subsurface consists of 4 distinguishable hydrogeologic units. The uppermost unit consists primarily of silty clay and acts as an aquitard. The second unit consists mainly of silty sand and is the uppermost aquifer at the site. Based on regional geologic descriptions, these two units are believed to be part of the Yorktown Formation. The third unit consists of primarily of sandy fat clay that acts as an aquitard. The fourth unit consists mainly of silty sand and is the lower aquifer at the site. The third and fourth units are believed to be part of the Black Creek Formation based on regional geologic descriptions. In order to maintain consistency with previous investigations, these units will be referred to as Layers I through IV with Layer I being the uppermost unit. These layers are described further in the sections below.

4.2.1 Layer I Hydrogeologic Unit

Layer I is the uppermost unit in the Phase 5 area and extends from ground surface to depths of 3 to 18 feet below ground surface. Based on soil boring data, the layer appears to be continuous across the proposed Phase 5 area with an average thickness of approximately 11 feet. Soil borings advanced in and around the Phase 5 area encountered Layer I. A summary of the thicknesses of Layer I encountered during installation of piezometer and monitoring wells in and around the Phase 5 footprint is presented in Table 6. The associated depths and elevations for each layer are shown on Tables 7 and 8. An isopach map of Layer I showing the thickness of the unit across the Phase 5 area is provided as Drawing DH-4.

Layer I primarily consists of silty clay, but may vary locally from fat clay, sandy clay, sandy silt, or clayey sand based on boring logs and laboratory analysis utilizing the USCS classification system. The soil type from ground surface to approximately 1 foot below ground sometimes consists of silty sand. During previous investigations, four samples from borings adjacent to the Phase 5 footprint were analyzed by a soil testing laboratory. The results are summarized in Table 4. Two samples were analyzed from borings advanced inside the proposed waste footprint during the current investigation, the results from which are also summarized in Table 4 and

included in Appendix C. Effective porosity calculations were performed utilizing the soil testing results and the textural classification triangle (Johnson, 1967). Effective porosities of 1.6 and 4.2 percent were calculated for the Layer I samples. An additional effective porosity calculation was determined to be within Johnson's "Area of No Samples," is indicative of a low effective porosity. Laboratory derived permeabilities for the samples were 4.20E-06 cm/sec and 9.9E-08 cm/sec. In other areas of the site, the permeability results for Layer I typically range from E-08 to E-07 cm/sec. The 4.20E-06 cm/sec result most likely represents a localized variation in soil type with limited vertical extent.

Based on laboratory permeability test results and field observations, Layer I is considered to be an aquitard that comprises a confining unit for the underlying Layer II. This is further substantiated by previous investigations. During the 1996 field investigation associated with the Phase Design Hydrogeologic Investigation, test pits were advanced adjacent to existing piezometers. These test pits were advanced to depths greater than depth-to-water measurements taken from the piezometers and no water was observed to enter the test pits during the investigation, confirming that Layer I is a confining unit to the underlying Layer II and that water level measurements collected from piezometers screened in Layer II represent potentiometric heads and not the depth of the groundwater surface.

4.2.2 Layer II Hydrogeologic Unit

Layer II underlies Layer I and appears to be continuous across the proposed Phase 5 area based on the data obtained from the soil borings advanced in the study area. The thickness of the unit is highly variable in the Phase 5 area with observed thicknesses ranging from 4.2 to 25 feet. The average thickness of the unit in the Phase 5 area is approximately 15 feet. A summary of the thicknesses of Layer II encountered during installation of piezometers and monitoring wells in and around the Phase 5 footprint is provided in Table 6. The associated depths and elevations for each layer are shown on Tables 7 and 8. An isopach map of Layer II showing the thickness of the unit across the Phase 5 area is provided as Drawing DH-5.

Layer II primarily consists of fine to silty sand based on field descriptions and laboratory analyses utilizing the USCS classification system. Three samples from borings adjacent to the Phase 5 footprint were analyzed by a soil testing laboratory during previous investigations. An additional sample was analyzed from a boring inside the proposed waste footprint during the current investigation. A summary of these soil test results are included in Table 4 and the laboratory data from the current investigation is included in Appendix C. Laboratory soil classifications of the samples collected from Layer II range from silty sand to poorly sorted sand. Effective porosity calculations were performed utilizing the soil testing results and the textural classification triangle (Johnson, 1967). Effective porosities of the Layer II samples range from 28 to 38 percent. Laboratory derived permeability for Layer II media was 5.80E-04 cm/sec. These results are consistent with those obtained during previous investigations across the site.

Aquifer tests for 5 piezometers and 1 monitoring well screened in Layer II were performed in and around the Phase 5 footprint during previous investigations. Aquifer tests were performed for 5 additional piezometers and one monitoring well screened in Layer II in and around the proposed Phase 5 cell during the current investigation. One piezometer (PZ-117A) that

underwent aquifer testing is partially screened in Layer I. As presented in Table 5, hydraulic conductivities derived from aquifer testing of piezometers in and around Phase 5 and screened in Layer II ranged from E-05 cm/sec to E-03 cm/sec with a geometric mean of 4.72E-04 cm/sec (Table 5).

Based on laboratory soil testing data and aquifer test data, Layer II is considered to be the site's uppermost aquifer. Due to the properties of the overlying unit, Layer I, and the underlying unit, Layer III, Layer II is a confined aquifer. Water levels obtained from piezometers and monitoring wells screened in Layer II represent potentiometric heads and not the groundwater surface, as groundwater measurements typically extend above the Layer I and Layer II interface.

4.2.3 Layer III Hydrogeologic Unit

Layer III underlies Layer II and ranges in thickness from 3.5 to 18 feet in the Phase 5 area based on field observations summarized in the soil boring logs. The layer appears to be continuous across the proposed Phase 5 area with an average thickness of approximately 10 feet. A summary of the thicknesses of Layer III encountered during advancement of the soil borings used for the construction of piezometer and monitoring wells in and around the Phase 5 footprint is summarized in Table 6. The associated depths and elevations for each layer are presented in Tables 7 and 8. An isopach map of Layer III showing the thickness of the unit across the Phase 5 area is provided as Drawing DH-6.

During previous investigations, four samples of Layer III material from soil borings advanced in areas adjacent to the Phase 5 footprint were analyzed by a soil testing laboratory. The results of these analyses are summarized in Table 4. Two samples were analyzed from soil borings advanced inside the proposed waste footprint during the current investigation, the results from which are also summarized in Table 4 and included in Appendix C. Laboratory soil classification of samples from Layer III ranged from clayey silt, silty clay, and lean silt. Effective porosity calculations were performed utilizing the soil testing results and the textural classification triangle (Johnson, 1967). Effective porosities of the Layer III samples range from less than 1 percent to 5 percent. Laboratory derived permeability for Layer III media was 3.70E-08 cm/sec. These results are consistent with those obtained during previous investigations across the site.

Based on laboratory permeability test results and field observations, Layer III is considered to be an aquitard that separates the uppermost aquifer of Layer II and an underlying aquifer in Layer IV. Water level measurements taken from nested piezometers show significant head differences between piezometers screened in Layer II and Layer IV. Water level measurements obtained on October 31, 2006, which are consistent with historical water level obtained from site wells, indicate that there is a downward gradient across Layer III from Layer II to Layer IV, with potentiometric surface differentials ranging from 1.1 to 4.9 feet between the layers. These data support that Layer III is a confining unit, separating the Layer II aquifer from the Layer IV aquifer.

4.2.4 Layer IV Hydrogeologic Unit

Layer IV underlies Layer III and appears to be continuous across the proposed Phase 5 area based on field observations. One boring in the Phase 5 area (PZ-73A) was documented to have fully penetrated Layer IV indicating a thickness of 15 feet. Other borings in the area were advanced up to 22 feet into Layer IV without locating the bottom of the unit. The thickness of Layer IV is expected to be variable and may exceed 50 feet in some locations. The unit is expected to be continuous under the proposed Phase 5 area based on available data. A summary of the thicknesses observed in available piezometers and monitoring wells extending into Layer IV in and around the Phase 5 footprint is provided in Table 6. The associated depths and elevations for each layer are shown on Tables 7 and 8.

Three sediment samples from soil borings from Layer IV advanced inside the Phase 5 footprint were analyzed by a soil testing laboratory during the current investigation. These soil test results are summarized in Table 4 and included in Appendix C. Field and laboratory soil classifications of the samples collected from Layer IV range from fine sand to a sandy clay. The sandy clay is considered to be a minor lithology for the layer and was only encountered locally. Effective porosity calculations were performed utilizing the soil testing results and the textural classification triangle (Johnson, 1967). Effective porosities of the Layer IV samples range from 13.5 to 35 percent. Laboratory-derived vertical permeabilities for Layer IV range from 3.0E-06 cm/sec to 9.0E-04 cm/sec. These results are consistent with those obtained during previous investigations across the site.

An aquifer test for one piezometer screened in Layer IV was performed in the Phase 5 area during previous investigations. Aquifer tests were performed for 3 additional piezometers screened in Layer IV in and around the proposed Phase 5 cell during the current investigation. Aquifer testing results for four piezometers constructed in the vicinity of Phase 5 are presented in Table 5. Hydraulic conductivities derived from aquifer testing of piezometers in and around Phase 5 and screened in Layer IV ranged from 2.12E-05 cm/sec to 5.23E-04 cm/sec with an average hydraulic conductivity value of 9.94E-05 cm/sec.

Based on site observations, laboratory soil testing data, and aquifer test data, Layer IV is considered to be the lower aquifer at the site. Due to the properties of the overlying unit (Layer III), Layer IV is a confined aquifer.

5.0 SITE HYDROGEOLOGY

A significant amount of hydrogeologic investigation has been performed on the site including the drilling of 39 borings in and around the proposed Phase 5 area as described above. The following section discusses the hydrogeologic aspects of the site, with emphasis on the proposed Phase 5 disposal area, based on field and laboratory data obtained from the 39 soil borings.

5.1 Hydrology and Discharge Features

As discussed in Section 2.0, topographic elevations at the facility range from approximately 30 to 70 feet above mean sea level. Along the northern and eastern portions of the facility, surface drainage from the facility and surrounding areas is routed by drainage channels and storm water

control structures to tributaries of the southerly flowing Connaritsa Swamp, a tributary system of the Cashie River. Along the western and southern portions of the facility, surface drainage from the facility and surrounding areas is routed by drainage channels and storm water control structures to tributaries of the southeasterly flowing Cashie River. The Cashie River discharges to the greater Roanoke River.

Site investigations indicate that there is no water table aquifer present in the vicinity of Phase 5, and that the uppermost aquifer beneath the site (Layer II) is naturally confined. Site data indicate that the upper confining layer (Layer I) may have been breached locally by stormwater control structures, resulting in direct connection between surface water and Layer II locally (e.g., area of PZ-117A/B and PZ-118).

5.2 Site Groundwater Flow Regime

As previously discussed, shallow groundwater flow (upper 50 feet) occurs in two separate confined aquifers. Layer II is the uppermost aquifer and Layer IV is the lower aquifer. Each of these aquifers is bound by overlying sandy to silty clay aquitards. Potentiometric surface contour maps for water level measurements taken on October 31, 2006, for each aquifer are provided as Drawings DH-2 and DH-3 and the potentiometric surface elevations for each aquifer are summarized in Tables 2 and 3.

Several hydrogeologic cross-sections are provided to further illustrate the structural components of the aquifers and provide additional representation of groundwater flow (Drawing DH-8). Groundwater flow arrows on Drawings DH-2 and DH-3 and site-specific data were used to determine groundwater flow directions and velocities.

5.2.1 Layer II Aquifer

The sediments that comprise Layer II are expected to exhibit properties on a macroscopic scale such that groundwater flow directions are expected to be perpendicular to the potentiometric surface contours developed based on data obtained from the piezometer and monitoring wells. Locally, variation in soil type, clay microtards (laminations), and aquifer structure results in an irregular potentiometric surface and flow paths. Because of the confined nature of the aquifer, groundwater flow is not expected to mimic the site's topography. The overlying confining unit is an aquitard and is not totally impenetrable to water, but recharge will be severely limited except in areas where the Layer II aquifer is not overlain by Layer I. The overlying confining unit is continuous in and around the Phase 5 footprint and very little vertical recharge is expected to occur in this area. Recharge is anticipated to occur further west, where Layer II is the uppermost unit.

A northwest-southeast trending groundwater divide is located in the southern portion of the proposed Phase 5 footprint (Drawing DH-2). North of this divide, groundwater flow is to the east-northeast. South of the groundwater divide, groundwater flow is primarily to the south-southwest. An irregular groundwater high exists in the southeastern corner of the proposed Phase 5 cell at piezometer pair PZ-117A/B. This feature is believed to be due to the thinning of the aquifer from an average thickness of 15 feet to 4.2 feet in that area as seen on hydrogeologic

cross-sections B-B' and C-C' on Drawing DH-8. Also, in the area of PZ-117A/B, the Layer II aquifer is composed of clayey silt to lean clay. This material is much finer than the typical Layer II aquifer soil type of silty sand. The combination of finer aquifer material and a thinning of the aquifer in this area cause greater hydraulic head around PZ-117A/B and a higher potentiometric surface.

5.2.2 Layer IV Aquifer

The sediments that comprise Layer IV are expected to exhibit properties on a macroscopic scale, such that groundwater flow directions conform to the potentiometric surface defined by the piezometers. Locally, variation in soil type, clay microtards (laminations), and aquifer structure may result in an irregular potentiometric surface and flow paths. Because of the confined nature of the aquifer, groundwater flow is not expected to mimic the site's topography. The overlying confining unit is an aquitard and is not totally impenetrable to water, but vertical recharge from the Layer II aquifer will be severely limited except in areas where the overlying confining unit thins or pinches out. The overlying confining unit is continuous in and around the Phase 5 footprint and very little vertical recharge is expected to occur in this area. The primary recharge area for the Layer IV aquifer is believed to be located west of the site where the formation outcrops.

Groundwater flow in the Layer IV aquifer is to the east-northeast in the proposed Phase 5 area (Drawing DH-3). South of the Phase 5 area groundwater flow is to the southeast. Based on the information available, groundwater flow velocity and direction in the Layer IV aquifer is uniform.

5.2.3 Horizontal Gradient Calculations

Horizontal hydraulic gradients for the proposed Phase 5 disposal area were calculated using gradient segments from the October 31, 2006, potentiometric surface contour maps for Layers II and IV shown on Drawings DH-2 and DH-3. These gradient segments were selected to represent gradients within the two confined aquifers. The gradient calculations were focused within the Phase 5 area.

Estimates of hydraulic conductivity were obtained from slug tests and laboratory permeability tests performed on piezometers and wells in and around the proposed Phase 5 disposal area during the current and previous investigations. Hydraulic conductivity values generated by slug test recovery data on individual wells at this site are considered to be higher than actual conductivities for site-scale movement of groundwater. Curves generated by the slug test recovery data indicate that the data are dominated by near-field, or 'skin effects,' and are reflective, in part, of the properties of the well screen filter pack judged to have greater hydraulic conductivity than the surrounding *in-situ* soils. The hydraulic conductivities (Ks), as determined by the single well aquifer tests, range from 5.48E-03 to 2.65E-05 cm/sec in the Layer II aquifer and range from 5.25E-04 to2.13E-05 cm/sec in the Layer IV aquifer. The geometric mean of K values was calculated for each of the two confined aquifers (Layer II = 4.72E-04; Layer IV = 9.94E-05) and used for groundwater flow calculations.

The average horizontal gradients for gradient calculation segments, estimated effective porosities, and the geometric mean of available K values for each aquifer were used to estimate linear groundwater flow velocities. Average linear groundwater flow velocities were computed using the following modified Darcy equation:

$$V = Ki/n_e$$

where V = average linear velocity (feet per day), K = hydraulic conductivity (ft/day), i = horizontal hydraulic gradient (unitless), and n_e = effective porosity (unitless). Effective porosity values were calculated for each of the three hydrogeologic units, as described in Section 4.2. and are shown on Table 4.

Data and calculations for the horizontal gradients are presented in Table 9. The calculated horizontal gradients in the Layer II aquifer from groundwater flow segments on Drawing DH-2 in the vicinity of the proposed Phase 5 area range from approximately 0.002 to 0.004 foot per foot. Calculated linear groundwater flow velocities are approximately 1.5 to 7.0 feet per year for Layer II. The calculated horizontal gradient in the Layer IV aquifer from groundwater flow segments in the vicinity of the proposed Phase 5 area was 0.002 foot per foot. Calculated linear groundwater flow velocity is approximately 1.5 feet per year for Layer IV.

5.2.4 Vertical Gradient Calculations

Five nested piezometer pairs (PZ-107A/B, PZ-109A/B, PZ-115A/B, PZ-117A/B, and PZ-123A/B) were utilized for the purpose of measuring a vertical hydraulic gradient. Four of these pairs are located in each quadrant of the proposed phase. The PZ-123A/B pair is located outside of the proposed Phase 5 area to the east. For each of the piezometer pairs, the piezometers that are identified with an "A" are screened in Layer II and those identified with a "B" are screened in Layer IV. The only piezometer pair that does not meet this criterion is PZ-117A/B. Piezometer PZ-117A is screened across Layer I and Layer II.

Calculations were performed using water levels measured on three different dates. Vertical gradients were calculated using the vertical distance between the screen midpoints of the pairs. The screened intervals were fully submerged at the time of water level measurements. As discussed previously, the potentiometric surface elevations in the piezometer pairs indicate that Layer II and Layer IV are separated by an aquitard. Though the piezometers screened in Layer II have a higher potentiometric head than piezometers screened in Layer IV, the downward gradient is going to be limited by Layer III, which has a hydraulic conductivity of 3.7E-08 cm/sec and has an average thickness of 10 feet. Seepage velocities through the Layer III unit were calculated to average less than 0.2 foot per year. A summary of available vertical gradient and velocity data is presented in Table 10. Several hydrogeologic cross-sections are also provided to illustrate the limitations on the vertical component of groundwater flow (Drawing DH-8).

6.0 SITE SUITABILITY

The following sections discuss the proposed site's suitability as a MSW management facility with attention to the proposed area

6.1 Relationship Between Hydrogeology and The Proposed Phase 5 Waste Disposal Unit

Numerous borings and piezometers have been drilled and data collected on site, and available site information indicates that the area has been adequately characterized. The geologic characteristics of the site are typical of those observed in other locations of the Coastal Plain. Specifically, the site is underlain by a sequence of strata composed of interbedded units that alternately exhibit aquitard and aquifer properties. At this facility, the uppermost aquifer is confined, with the top of the uppermost aquifer located between 2 and 17 feet below grade in the Phase 5 area. Since the base grades for Phase 5 will generally be at elevations close to the existing grades, the naturally occurring Layer I unit will supplement the Phase 5 liner in providing a physical barrier to the potential migration of contaminants from the landfill to the uppermost aquifer in the event of a release. There appear to be no conditions that would limit the ability to effectively monitor groundwater in the proposed Phase 5 area. Base grades for Phase 5 are designed to be above-grade.

6.1.1 Vertical Separation From Bedrock

Bedrock was not encountered in the upper 50 feet of the subsurface. Thus the bedrock will not affect landfill design, nor will it affect the ability to effectively monitor groundwater beneath the facility.

6.1.2 Vertical Separation From Seasonal High Water Table

The potentiometric surface elevations of onsite monitoring wells and piezometers in and around the proposed Phase 5 expansion are included as Tables 2 and 3. Table 2 includes wells and piezometers screened in Layer II and Table 3 includes wells and piezometers screened in Layer IV. The tables document potentiometric surface elevations from 1993 to present. Data from selected site monitoring wells screened in the uppermost Layer II aquifer are presented on the hydrograph illustrated as Figure 2. As presented, significant fluctuations in the potentiometric surface have occurred at the site in the Layer II aquifer since monitoring was initiated in 1993. In general, the degree and type of fluctuation is similar across the site, with the most significant fluctuations observed in upgradient well GW-2. It is noted that the range in fluctuation is less in GW-7, GW-8, GW-9 and GW-10, relative to GW-2, GW-3 and GW-5, possibly indicating a stabilizing influence associated with the site stormwater ponds.

The potentiometric surface fluctuations appear to be influenced by precipitation events. Historical precipitation data from 1933 to present for the nearby town of Edenton, North Carolina is provided as Table 11. A graphic representation of the precipitation data since 1993 is shown on Figure 3. A comparison of the precipitation data on Figure 3 with the potentiometric surface data on Figure 2 shows that periods of greater precipitation typically result in increases in potentiometric surface elevations. This is more evident in the winter and spring months, due to

the effects of evapotranspiration during the summer months that limit the amount of recharge to the aquifers, even though the summer months typically experience the most precipitation.

Potentiometric surface maps for Layer II and Layer IV have been included as Drawings DH-2 and DH-3 for water level data obtained on October 31, 2006. Because the aquifers underlying the site are confined, the water levels obtained from monitoring wells and piezometers at the site represent potentiometric surfaces rather than the groundwater surface. Layer I is an aquitard above the Layer II aquifer that restricts the upward movement of groundwater. Therefore, the potentiometric surface elevation is higher than the actual depth to groundwater. A map showing the top of Layer II is provided as Drawing DH-9, which also represents the highest elevation that saturated conditions can vertically extend as supported by previous investigations. Therefore, the top of Layer II also represent the seasonal and long-term seasonal high groundwater elevation for the proposed Phase 5 area. To account for capillary fringe, an extra foot of separation was taken into account in the design of base grades for Phase 5, such that the base grades were designed at least 9 feet above the top of Layer II. This separation is adequate to account for settlement of the landfill over time. Detailed discussion of anticipated settlement will be addressed in the *Engineering Plan*. Hydrogeologic cross-sections showing the separation between the seasonal high groundwater contours and the proposed Phase 5 base grades are included on Drawing DH-8.

6.2 Potential Groundwater Receptors

There is one onsite water supply wells located approximately 2,125 feet southwest of the proposed Phase 5 limits of waste. The location of the well is represented as PW-1 on Drawing DH-1. The well is screened at a depth of 349 feet below ground surface. With a separation of at least 300 feet vertically, there is little to no interaction between the well screens and the confined uppermost aquifer. Also, the wells are tested semiannually for Appendix I parameters. There are no other known potential groundwater receptors between the Phase 5 area and onsite downgradient groundwater discharge features (i.e., swamps) for the uppermost aquifer.

6.3 Ability To Effectively Monitor Groundwater

No known or potential significant sources of contamination have been identified within 2,000 feet of the facility boundary. Groundwater flowing east-northeast and south-southwest in the uppermost aquifer from the Phase 5 area will be monitored by the well network described in the *Water Quality Monitoring Plan* presented as Appendix E.

There are no known conditions, physical or hydrogeologic, which will interfere with the effective monitoring of the proposed Phase 5 waste unit or previously permitted phases. The discharge features (i.e., swamps) along the southern facility boundary serve as effective groundwater flow boundaries between the proposed cell and potential receptors that may be located further to the south of the site. Surface water monitoring points are included in the proposed monitoring program as additional safeguards for detecting a release from the facility.

7.0 CONCLUSIONS

The purpose of the Hydrogeologic Report is to present the assessment of geologic and hydrogeologic characteristics of the proposed site, especially as they relate to proposed MSW landfill construction. Furthermore, the report must present data in support (or non-support) of the site's use for MSW waste management activities. This report presents the current understanding of the hydrogeologic characteristics of the site and the relationship of the solid waste management units to groundwater receptors and groundwater discharge features. In addition, this report demonstrates that the proposed site can be monitored effectively for potential releases using a conventional groundwater monitoring network.

In summary, a review of the geologic and hydrogeologic data indicates that the site is located within typical Coastal Plain terrane. The uppermost aquifer is confined by overlying and underlying silty to sandy clay units that act as aquitards. A second confined aquifer lies under the uppermost aquifer, separated by a confining unit. Site observations indicate that each of the aquifers and confining units are laterally continuous across the proposed Phase 5 area. No geologic or hydrogeologic features that would affect the ability to monitor Phase 5 were discovered during this investigation.

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TABLES

TABLE 1
Monitoring Well and Piezometer Completion Summary
East Carolina Regional Landfill

PIEZOMETER NUMBER	DATE INSTALLED	CASING DIAMETER	WELL ELEVATIONS		TOTAL DEPTH DRILLED		SCREENED INTERVAL				LITHOLOGY OF SCREENED INTERVAL	STATUS
			GROUND SURFACE	T.O.C.	DEPTH	ELEV.	DEPTH B.G.S.		ELEVATION (feet M.S.L.)			
		inches	feet above M.S.L.		feet B.G.S.	feet M.S.L.	from	to	from	to		
GW-1	8/19/1993	2	63.70	65.87	62	1.7	52.00	62.00	11.7	1.7	Black Creek Formation	Existing
GW-2	8/19/1993	2	64.00	66.36	26	38	16.00	26.00	48	38	Yorktown Formation	Compliance Well
GW-3	8/25/1993	2	63.70	66.23	26	37.7	16.00	26.00	47.7	37.7	Yorktown Formation	Existing
GW-4	8/24/1993	2	60.70	62.53	59	1.7	49.00	59.00	11.7	1.7	Black Creek Formation	Existing
GW-5	8/20/1993	2	60.90	62.60	24	36.9	14.00	24.00	46.9	36.9	Yorktown Formation	Existing
GW-6	8/23/1993	2	57.50	58.95	63	-5.5	53.00	63.00	4.5	-5.5	Black Creek Formation	Existing
GW-7	8/20/1993	2	57.40	58.79	18	39.4	8.00	18.00	49.4	39.4	Yorktown Formation	Compliance Well
GW-8	8/24/1993	2	58.60	60.04	18	40.6	8.00	18.00	50.6	40.6	Yorktown Formation	Compliance Well
GW-9	8/24/1993	2	50.10	51.94	13	37.1	3.00	13.00	47.1	37.1	Yorktown Formation	Compliance Well
GW-10	9/3/1992	2	50.40	53.22	22	28.4	10.00	20.00	38.4	28.4	Yorktown Formation	Compliance Well
GW-11	4/13/1997	2	68.60	72.42	28	40.6	19.00	29.00	55.6	40.6	Yorktown Formation	Compliance Well
GW-12	8/26/1993	2	63.70	66.13	54	9.7	44.00	54.00	19.7	9.7	Black Creek Formation	Existing
GW-13	10/26/2000	2	72.20	74.76	41.3	30.9	26.30	41.30	45.9	30.9	Yorktown Formation	Compliance Well
GW-14	8/26/2003	2	76.70	78.74	47.8	28.9	37.78	47.78	38.9	28.9	Yorktown Formation	Compliance Well
GW-15	9/9/1992	2	75.23	78.23	42.6	32.61	24.2	39.2	24.2	39.2	Yorktown Formation	Compliance Well
GW-16	5/24/2006	2	60.46	63.02	24	36.46	13.00	23.00	47.46	37.46	Yorktown Formation	Compliance Well
PZ-3A	8/27/1992	2	58.62	61.03	17	41.62	4.00	14.00	54.62	44.62	Yorktown Formation	Existing
PZ-3B	9/13/1992	2	58.43	60.73	52	6.43	41.00	51.00	17.43	7.43	Black Creek Formation	Existing
PZ-5A	09/01/92	2	58.65	60.98	20	38.65	6.50	16.50	52.15	42.15	Yorktown Formation	Existing
PZ-6A	09/01/92	2	60.05	62.40	17	43.05	7.00	17.00	53.05	43.05	Yorktown Formation	Existing
PZ-8A	09/02/92	2	56.90	59.75	14	42.9	4.00	14.00	52.90	42.90	Yorktown Formation	Decommissioned
PZ-9A	9/3/1992	2	62.03	64.22	15	47.03	4.00	14.00	58.03	48.03	Yorktown Formation	Existing
PZ-10A	9/3/1992	2	63.15	65.57	15	48.15	5.00	15.00	58.15	48.15	Yorktown Formation	Existing
PZ-11A	9/4/1992	2	63.12	65.51	15	48.12	5.00	15.00	58.21	48.21	Yorktown Formation	Decommissioned
PZ-12A	9/8/1992	2	51.81	53.68	15	36.81	5.00	15.00	46.80	36.80	Yorktown Formation	Decommissioned
PZ-12B	9/15/1992	2	51.73	54.33	45	6.73	35.00	45.00	16.70	6.70	Black Creek Formation	Decommissioned
PZ-13A	9/9/1992	2	58.07	60.34	16	42.07	6.00	16.00	52.10	42.10	Yorktown Formation	Decommissioned
PZ-13B	9/13/1992	2	57.89	60.9	46	11.89	35.00	45.00	22.90	12.90	Black Creek Formation	Decommissioned
PZ-14	9/9/1992	2	58.13	60.34	18.5	39.63	8.00	18.00	50.10	40.10	Yorktown Formation	Decommissioned
PZ-15	9/9/1992	2	53.75	55.74	15	38.75	5.00	15.00	18.80	28.80	Yorktown Formation	Decommissioned
PZ-16A	9/10/1992	2	64.50	66.47	15.5	49	5.00	15.00	59.50	49.50	Yorktown Formation	Decommissioned
PZ-16B	9/12/1992	2	64.68	67.47	58	6.68	44.00	54.00	20.68	10.68	Black Creek Formation	Decommissioned
PZ-17	9/10/1992	2	48.25	50.68	15.5	32.75	5.00	15.00	43.30	33.30	Yorktown Formation	Existing
PZ-18A	9/11/1992	2	62.04	63.49	15.5	46.54	5.00	15.00	57.04	47.04	Yorktown Formation	Existing
PZ-18B	9/22/1992	2	62.05	65.20	47	15.05	37.00	47.00	25.05	15.05	Black Creek Formation	Existing
PZ-19A	9/11/1992	2	56.60	58.69	16	40.6	5.00	15.00	51.60	41.60	Yorktown Formation	Existing
PZ-19B	9/24/1992	2	56.59	59.22	47	9.59	37.00	47.00	19.59	9.59	Black Creek Formation	Existing
PZ-20A	9/11/1992	2	65.51	68.02	15.5	50.01	5.00	15.00	60.51	50.51	Yorktown Formation	Existing
PZ-21	9/14/1992	2	56.01	58.32	18.5	37.51	7.00	17.00	49.00	39.00	Yorktown Formation	Decommissioned
PZ-22	9/14/1992	2	49.64	51.66	17	32.64	7.00	17.00	42.60	32.60	Yorktown Formation	Decommissioned
PZ-23	9/15/1992	2	53.93	56.42	15	38.93	5.00	15.00	48.90	38.90	Yorktown Formation	Decommissioned
PZ-24	9/16/1992	2	55.58	57.96	15	40.58	5.00	15.00	50.60	40.60	Yorktown Formation	Decommissioned
PZ-25	9/16/1992	2	50.81	53.42	15	35.81	5.00	15.00	45.80	35.80	Yorktown Formation	Decommissioned
PZ-26A	9/17/1992	2	62.13	64.48	15	47.13	5.00	15.00	57.13	47.13	Yorktown Formation	Decommissioned
PZ-27 (C8.5)	9/17/1992	2	61.15	63.45	15	46.15	5.00	15.00	56.20	46.20	Yorktown Formation	Decommissioned
PZ-28 (C8.2)	9/18/1992	2	60.12	62.45	15	45.12	5.00	15.00	55.10	45.10	Yorktown Formation	Decommissioned
PZ-29A	9/25/1992	2	55.67	58.22	20	35.67	10.00	20.00	45.70	35.70	Yorktown Formation	Decommissioned
PZ-29B	9/25/1992	2	55.73	58.73	50	5.73	35.00	45.00	20.70	10.70	Black Creek Formation	Decommissioned
PZ-30	9/26/1992	2	44.53	47.07	15	29.53	4.00	14.00	40.50	30.50	Yorktown Formation	Decommissioned
PZ-31	---	2	51.65	53.90	51.65	53.9	3.00	13.00	48.70	38.70	Yorktown Formation	Decommissioned
PZ-32	---	2	55.21	58.04	55.21	58.04	5.00	15.00	50.20	40.20	Black Creek Formation	Existing
PZ-33B	---	2	41.71	44.46	41.72	44.49	15.00	25.00	26.70	16.70	Yorktown Formation	Decommissioned
PZ-34	---	2	53.25	56.26	53.25	56.26	5.00	15.00	48.30	38.80	Yorktown Formation	Decommissioned
PZ-35	---	2	58.58	61.62	58.63	61.67	5.00	15.00	53.60	43.60	Yorktown Formation	Existing
PZ-36	---	2	45.48	48.39	45.48	48.39	5.00	15.00	40.50	30.50	Yorktown Formation	Abandoned
PZ-37	---	2	57.80	60.68	57.93	60.85	5.00	15.00	52.80	42.80	Yorktown Formation	Existing
PZ-38	---	2	47.73	50.51	47.73	50.51	5.00	15.00	42.70	32.70	Yorktown Formation	Decommissioned
PZ-39	---	2	59.33	62.09	59.33	62.09	5.00	15.00	54.30	44.30	Yorktown Formation	Decommissioned
PZ-41A	6/14/1996	2	59.23	61.33	18.3	40.93	12.89	17.89	46.34	41.34	Yorktown Formation	Decommissioned
PZ-41B	6/14/1996	2	59.19	61.49	40	19.19	32.92	37.92	26.27	21.27	Black Creek Formation	Decommissioned
PZ-42	6/15/1996	2	60.71	62.66	40	20.71	13.60	18.60	47.10	42.10	Yorktown Formation	Existing
PZ-44	6/16/1996	2	54.33	56.33	40	14.33	13.70	18.70	40.70	35.70	Yorktown Formation	Decommissioned
PZ-45A	6/17/1996	2	55.49	57.69	50	5.49	12.70	17.70	42.80	37.80	Yorktown Formation	Decommissioned
PZ-45B	6/19/1996	2	55.66	57.66	50	5.66	44.60	49.60	11.00	6.00	Black Creek Formation	Decommissioned
PZ-46A	6/17/1996	2	61.46	63.51	60	1.46	11.00	18.80	48.00	43.00	Yorktown Formation	Decommissioned
PZ-47A	6/18/1996	2	56.50	58.70	40	16.5	13.50	18.50	43.00	38.00	Yorktown Formation	Decommissioned
PZ-48A	6/18/1996	2	60.59	62.74	45	15.59	11.60	16.60	49.00	44.00	Yorktown Formation	Existing
PZ-49A	6/18/1996	2	64.34	67.19	50	14.34	13.20	18.20	51.10	46.10	Yorktown Formation	Decommissioned
PZ-50A	6/19/1996	2	64.59	68.09	50	14.59	12.20	17.20	52.40	47.40	Yorktown Formation	Existing
PZ-51A	6/19/1996	2	53.77	55.92	45	8.77	12.80	17.80	40.90	35.90	Yorktown Formation	Existing
PZ-52A	6/19/1996	2	60.64	63.39	60	0.64	12.90	17.90	47.70	42.70	Yorktown Formation	Existing
PZ-53A	6/20/1996	2	60.88	63.43	55	5.88	14.60	19.60	46.30	41.30	Yorktown Formation	Existing
PZ-54A	6/20/1996	2	62.53	65.53	60	2.53	12.60	17.60	50.00	45.00	Yorktown Formation	Existing
PZ-55A	6/21/1996	2	60.80	63.15	45	15.8	13.40	18.40	47.40	42.40	Yorktown Formation	Existing
PZ-56A	6/24/1996	2	61.46	63.51	50	11.46	13.40	18.40	48.10	43.10	Yorktown Formation	Decommissioned
PZ-57A	6/26/1996	2	61.18	63.38	18.2	42.98	14.8	19.8	47.50	42.50	Yorktown Formation	Existing
PZ-57B	6/25/1996	2	61.24	63.39	47.64	13.6	42.2	47.2	19.00	14.00	Yorktown Formation	Existing

TABLE 1
Monitoring Well and Piezometer Completion Summary
East Carolina Regional Landfill

PIEZOMETER NUMBER	DATE INSTALLED	CASING DIAMETER	WELL ELEVATIONS		TOTAL DEPTH DRILLED		SCREENED INTERVAL				LITHOLOGY OF SCREENED INTERVAL	STATUS
			GROUND SURFACE	T.O.C.	DEPTH	ELEV.	DEPTH B.G.S.		ELEVATION (feet M.S.L.)			
		inches	feet above M.S.L.		feet B.G.S.	feet M.S.L.	from	to	from	to		
PZ-58 (C9.1)	6/6/1995	2	60.15	62.17	30	58.2	15.2	25.2	45.00	35.00	Yorktown Formation	Decommissioned
PZ-59A (C9.2A)	6/6/1995	2	61.52	63.48	25	59.7	13.0	23.0	48.50	38.50	Yorktown Formation	Decommissioned
PZ-59B (C9.2B)	6/1/1995	2	61.35	64.29	66	59.5	55.1	65.1	6.30	3.70	Black Creek Formation	Decommissioned
PZ-60 (C9.3)	6/6/1995	2	61.59	64.14	25	59.7	12.4	22.4	49.20	39.20	Yorktown Formation	Decommissioned
PZ- 61 (C9.4)	6/6/1995	2	61.90	64.61	30	60.2	14.9	24.9	47.00	37.00	Yorktown Formation	Decommissioned
PZ-62 (C9.5)	6/6/1995	2	62.79	65.14	26.5	61.1	12.9	22.9	49.90	39.90	Yorktown Formation	Decommissioned
PZ-63 (C9.6)	6/4/1995	2	61.69	63.84	22	61.7	9.9	19.9	51.80	41.80	Yorktown Formation	Decommissioned
PZ-64 (C9.7)	6/7/1995	2	62.93	64.66	30	62.9	10.0	20.0	52.90	42.90	Yorktown Formation	Decommissioned
PZ-65 (BE.1)	6/5/1995	2	62.14	65.1	30	60.3	15.5	25.5	46.60	36.60	Yorktown Formation	Decommissioned
PZ-66 (BE.2)	6/8/1995	2	62.83	64.65	30	62.8	10.3	20.3	52.50	42.50	Yorktown Formation	Decommissioned
PZ-66A (BE.2)	6/8/1995	2	62.83	64.65	30	32.83	10.30	20.30	52.53	42.53	Yorktown Formation	Decommissioned
PZ-67A (BE.3)	6/7/1995	2	59.99	62.09	25	34.99	11.60	21.60	48.39	38.39	Yorktown Formation	Decommissioned
PZ-68A	6/7/1995	2	61.30	64.49	25	36.3	8.0	18.0	53.30	43.30	Yorktown Formation	Decommissioned
PZ-69 (BW.1)	6/5/1995	2	59.96	61.78	33.5	58	11.7	21.7	48.30	38.30	Yorktown Formation	Decommissioned
PZ-70 (BW.2)	6/8/1995	2	58.66	60.39	40	58.7	10.8	20.8	47.90	37.90	Yorktown Formation	Decommissioned
PZ-71A	5/6/1998	2	61.00	63.87	28	33	23.00	28.00	38.00	33.00	Yorktown Formation	Decommissioned
PZ-72A	5/7/1998	2	58.90	61.82	18	40.9	13.00	18.00	45.90	40.90	Yorktown Formation	Decommissioned
PZ-73A	5/7/1998	2	59.00	61.52	19	40	14.00	19.00	45.00	40.00	Yorktown Formation	Decommissioned
PZ-74A	5/8/1998	2	63.40	66.9	19	44.4	14.00	19.00	49.40	44.40	Yorktown Formation	Decommissioned
PZ-75A	5/11/1998	2	62.80	65.1	19	43.8	14.00	19.00	48.80	43.80	Yorktown Formation	Decommissioned
PZ-76A	5/12/1998	2	63.80	65.75	23.5	40.3	18.50	23.50	45.30	40.30	Yorktown Formation	Decommissioned
PZ-77A	5/12/1998	2	60.90	63.14	23	37.9	18.00	23.00	42.90	37.90	Yorktown Formation	Decommissioned
PZ-78A	5/13/1998	2	61.80	64.54	23	38.8	18.00	23.00	43.80	38.80	Yorktown Formation	Decommissioned
PZ-79A	5/13/1998	2	62.10	64.78	18	44.1	13.00	18.00	49.10	44.10	Yorktown Formation	Decommissioned
PZ-80A	5/13/1998	2	62.20	64.77	19	43.2	14.00	19.00	48.20	43.20	Yorktown Formation	Decommissioned
PZ-81A	5/14/1998	2	62.70	65.21	19	43.7	14.00	19.00	48.70	43.70	Yorktown Formation	Decommissioned
PZ-82A	8/24/2004	2	62.15	65.55	27.05	35.1	16.80	26.80	45.35	35.35	Yorktown Formation	Decommissioned
PZ-83A	8/28/2004	2	62.13	65.19	27.02	35.11	16.77	26.77	45.36	35.36	Yorktown Formation	Decommissioned
PZ-84A	8/28/2004	2	62.16	65.37	22.09	40.07	11.84	21.84	50.32	40.32	Yorktown Formation	Decommissioned
PZ-85A	6/28/2004	2	62.54	64.54	27.25	35.29	17.00	27.00	45.54	35.54	Yorktown Formation	Decommissioned
PZ-86A	6/29/2004	2	61.30	63.16	22.27	39.03	12.02	22.02	49.28	39.28	Yorktown Formation	Decommissioned
PZ-87A	6/29/2004	2	58.82	61.99	22.14	36.68	11.89	21.89	46.93	36.93	Yorktown Formation	Decommissioned
PZ-88A	6/29/2004	2	58.74	61.71	22.26	36.48	12.01	22.01	46.73	36.73	Yorktown Formation	Decommissioned
PZ-89A	7/7/2004	2	64.60	68.34	23.35	41.25	13.10	23.10	51.50	41.50	Yorktown Formation	Decommissioned
PZ-90A	6/29/2004	2	64.80	68.18	28.2	36.6	17.95	27.95	46.85	36.85	Yorktown Formation	Decommissioned
PZ-91A	6/29/2004	2	63.70	67.35	32.6	31.1	22.35	32.35	41.35	31.35	Yorktown Formation	Decommissioned
PZ-92A	6/30/2004	2	62.92	66.21	28	34.92	17.75	27.75	45.17	35.17	Yorktown Formation	Decommissioned
PZ-92B	7/13/2004	2	62.56	66.18	43	19.56	37.70	42.70	24.86	19.86	Black Creek Formation	Decommissioned
PZ-93A	7/8/2004	2	62.19	65.96	23.42	38.77	13.17	23.17	49.02	39.02	Yorktown Formation	Decommissioned
PZ-94A	7/8/2004	2	59.34	62.83	23.4	35.94	13.15	23.15	46.19	36.19	Yorktown Formation	Decommissioned
PZ-95A	7/8/2004	2	58.77	62.24	23	35.77	12.75	22.75	46.02	36.02	Yorktown Formation	Decommissioned
PZ-96A	7/9/2004	2	59.16	62.73	23.1	36.06	12.85	22.85	46.31	36.31	Yorktown Formation	Decommissioned
PZ-97A	7/9/2004	2	59.29	62.74	23	36.29	12.75	22.75	46.54	36.54	Yorktown Formation	Decommissioned
PZ-98A	7/15/2004	2	64.26	70.92	24.05	40.21	13.80	23.80	50.46	40.46	Yorktown Formation	Decommissioned
PZ-98B	7/16/2004	2	64.37	72.81	47.39	16.98	42.09	47.09	22.28	17.28	Black Creek Formation	Decommissioned
PZ-99A	7/15/2004	2	64.55	71.04	24.2	40.35	13.95	23.95	50.60	40.60	Yorktown Formation	Decommissioned
PZ-100A	7/15/2004	2	65.35	72.33	28.4	36.95	18.15	28.15	47.20	37.20	Yorktown Formation	Decommissioned
PZ-101A	7/8/2004	2	61.06	64.68	23.5	37.56	13.25	23.25	47.81	37.81	Yorktown Formation	Decommissioned
PZ-102A	7/13/2004	2	59.54	62.56	22.7	36.84	12.45	22.45	47.09	37.09	Yorktown Formation	Decommissioned
PZ-102B	7/14/2004	2	59.54	63.39	37.1	22.44	31.80	36.80	27.74	22.74	Black Creek Formation	Decommissioned
PZ-103A	7/16/2004	2	64.90	71.84	28.7	36.2	18.45	28.45	46.45	36.45	Yorktown Formation	Decommissioned
PZ-104A	7/15/2004	2	59.50	62.92	22.6	36.9	12.35	22.35	47.15	37.15	Yorktown Formation	Decommissioned
PZ-105A	7/13/2004	2	58.64	62.12	22.9	35.74	12.65	22.65	45.99	35.99	Yorktown Formation	Decommissioned
PZ-106A	07/13/04	2	59.85	63.01	23.62	36.23	13.37	23.37	45.99	36.48	Yorktown Formation	Decommissioned
PZ-107A	5/17/2006	2	58.07	61.02	27	31.07	17.00	27.00	41.07	31.07	Yorktown Formation	Existing
PZ-107B	5/17/2006	2	57.86	60.46	50	7.86	40.0	50.0	17.86	7.86	Black Creek Formation	Existing
PZ-108	5/9/2006	2	58.47	60.63	22	36.47	13.0	18.0	45.47	40.47	Yorktown Formation	Existing
PZ-109A	5/10/2006	2	61.94	65.32	28	33.94	14.0	24.0	47.94	37.94	Yorktown Formation	Existing
PZ-109B	5/12/2006	2	62.61	65.42	52	10.61	47.0	52.0	15.61	10.61	Black Creek Formation	Existing
PZ-110	5/18/2006	2	60.86	62.98	32	28.86	13.0	28.0	47.86	32.86	Yorktown Formation	Existing
PZ-111	5/23/2006	2	59.19	61.58	20	39.19	10.0	18.0	49.19	41.19	Yorktown Formation	Existing
PZ-112	5/17/2006	2	58.44	61.48	24	34.44	17.0	22.0	41.44	36.44	Yorktown Formation	Existing
PZ-113	5/9/2006	2	60.25	63.14	26	34.25	17.0	22.0	43.25	38.25	Yorktown Formation	Existing
PZ-114	5/16/2006	2	62.64	65.25	26	36.64	16.0	21.0	46.64	41.64	Yorktown Formation	Existing
PZ-115A	5/22/2006	2	58.46	60.95	20	38.46	12.0	17.0	46.46	41.46	Yorktown Formation	Existing
PZ-115B	5/23/2006	2	58.44	61.65	50	8.44	30.0	50.0	28.44	8.44	Black Creek Formation	Existing
PZ-116	5/9/2006	2	58.05	60.64	22	36.05	14.5	19.5	43.55	38.55	Yorktown Formation	Existing
PZ-117A	5/10/2006	2	60.06	62.00	20	40.06	13.0	18.0	47.06	42.06	Yorktown Formation	Existing
PZ-117B	5/16/2006	2	60.05	63.28	50	10.05	40.0	50.0	20.05	10.05	Black Creek Formation	Existing
PZ-118	5/16/2006	2	64.52	67.42	24	40.52	11.0	21.0	53.52	43.52	Yorktown Formation	Existing
PZ-119	5/23/2006	2	58.74	61.24	24	34.74	10.0	20.0	48.74	38.74	Yorktown Formation	Existing
PZ-120	5/22/2006	2	60.53	62.96	24	36.53	11.0	21.0	49.53	39.53	Yorktown Formation	Existing
PZ-121	5/9/2006	2	59.70	62.26	26	33.7	15.0	20.0	44.70	39.70	Yorktown Formation	Existing
PZ-122	5/22/2006	2	59.77	62.25	26	33.77	14.0	24.0	45.77	35.77	Yorktown Formation	Existing
PZ-123A	5/18/2006	2	59.94	62.97	23	36.94	19.0	23.0	40.94	36.94	Yorktown Formation	Existing
PZ-123B	5/18/2006	2	59.88	62.66	50	9.88	37.0	50.0	22.88	9.88	Black Creek Formation	Existing

TABLE 1
Monitoring Well and Piezometer Completion Summary
East Carolina Regional Landfill

PIEZOMETER NUMBER	DATE INSTALLED	CASING DIAMETER	WELL ELEVATIONS		TOTAL DEPTH DRILLED		SCREENED INTERVAL				LITHOLOGY OF SCREENED INTERVAL	STATUS
			GROUND SURFACE	T.O.C.	DEPTH	ELEV.	DEPTH B.G.S.		ELEVATION (feet M.S.L.)			
		inches	feet above M.S.L.		feet B.G.S.	feet M.S.L.	from	to	from	to		
C3.1	6/30/1993	2	57.59	61.23	50	7.59	14.5	24.5	43.10	33.10	Yorktown Formation	Decommissioned
C3.2	6/29/1993	2	56.06	59.19	85	-28.94	5.0	15.0	51.10	41.10	Yorktown Formation	Decommissioned
C3.3	6/30/1993	2	56.96	59.99	75.5	-18.54	5.5	15.5	51.50	41.50	Yorktown Formation	Decommissioned
C3.4	6/29/1993	2	57.25	60.48	84	-26.75	4.0	14.0	53.30	43.30	Yorktown Formation	Decommissioned
C3.5	7/1/1993	2	54.31	57.91	30	24.31	7.0	17.0	47.30	37.30	Yorktown Formation	Decommissioned
C3.6	7/2/1993	2	56.54	60.04	40	16.54	9.0	19.0	47.50	37.50	Yorktown Formation	Decommissioned
C3.7	7/1/1993	2	56.34	59.49	85	-28.66	5.0	15.0	51.30	41.30	Yorktown Formation	Decommissioned
C4.1	7/9/1993	2	51.41	54.55	20	31.41	3.0	13.0	48.40	38.40	Yorktown Formation	Decommissioned
C4.3	7/2/1993	2	56.02	59.09	50	6.02	5.0	15.0	51.00	41.00	Yorktown Formation	Decommissioned
C5.1	7/9/1993	2	53.74	56.91	25	28.74	5.0	15.0	48.70	38.70	Yorktown Formation	Decommissioned
C5.2	7/8/1993	2	51.31	54.34	30	21.31	3.0	13.0	48.30	38.30	Yorktown Formation	Decommissioned
C5.3	7/8/1993	2	54.10	57.49	20	34.1	4.0	14.0	50.10	40.10	Yorktown Formation	Decommissioned
C5.4	7/8/1993	2	56.68	59.27	35	21.68	6.0	16.0	50.70	40.70	Yorktown Formation	Decommissioned
C5.5	7/7/1993	2	56.88	60.34	25	31.88	7.0	17.0	49.90	39.90	Yorktown Formation	Decommissioned
C6.1	7/8/1993	2	57.90	60.91	35	22.9	5.0	15.0	52.90	42.90	Yorktown Formation	Decommissioned
C6.2	7/8/1993	2	55.66	58.95	25	30.66	7.0	17.0	48.70	38.70	Yorktown Formation	Decommissioned
C6.4	7/8/1993	2	57.35	60.69	25	32.35	7.0	17.0	50.40	40.40	Yorktown Formation	Decommissioned
C6.6	7/6/1993	2	58.55	61.99	25	33.55	10.0	20.0	48.60	38.60	Yorktown Formation	Decommissioned
C6.7	7/6/1993	2	58.99	61.87	40	18.99	10.2	20.0	49.00	39.00	Yorktown Formation	Decommissioned
C6.8	7/8/1993	2	56.79	59.57	35	21.79	6.0	16.0	50.80	40.80	Yorktown Formation	Decommissioned
C6.9	7/2/1993	2	56.94	60.59	20	36.94	7.0	17.0	49.90	39.90	Yorktown Formation	Decommissioned
C6.10	7/6/1993	2	54.83	57.73	20	34.83	7.0	17.0	47.80	37.80	Yorktown Formation	Decommissioned
C6.11	7/7/1993	2	57.09	59.77	80	-22.91	10.0	20.0	47.10	37.10	Yorktown Formation	Decommissioned
C6.12	7/7/1993	2	59.31	62.77	30	29.31	15.0	25.0	44.30	34.30	Yorktown Formation	Decommissioned
C6.13	7/2/1993	2	59.64	62.88	40	19.64	3.5	13.5	56.10	46.10	Yorktown Formation	Decommissioned
C6.14	7/8/1993	2	59.08	62.17	25	34.08	7.0	17.0	52.10	42.10	Yorktown Formation	Decommissioned
C7.1	5/31/1995	2	54.37	56.89	20	34.37	7.5	17.5	46.90	36.90	Yorktown Formation	Decommissioned
C7.2A	6/3/1995	2	58.50	60.24	25	33.5	10.0	20.0	48.50	38.50	Yorktown Formation	Decommissioned
C7.2B	5/25/1995	2	58.29	60.84	45	13.29	31.0	41.0	27.30	17.30	Black Creek Formation	Decommissioned
C7.3	5/31/1995	2	58.72	60.48	23.5	35.22	8.0	18.0	50.70	40.70	Yorktown Formation	Decommissioned
C7.4	5/31/1995	2	57.85	59.60	24.5	33.35	8.0	18.0	49.80	39.80	Yorktown Formation	Decommissioned
C7.5	6/1/1995	2	58.94	61.09	30	28.94	12.0	22.0	46.90	36.90	Yorktown Formation	Decommissioned
C7.6A	6/3/1995	2	60.77	62.77	30	30.77	19.0	29.0	41.80	31.80	Yorktown Formation	Decommissioned
C7.6B	5/26/1995	2	60.90	63.25	52.5	8.4	39.5	49.5	21.40	11.40	Black Creek Formation	Decommissioned
C7.7	6/1/1995	2	61.67	63.68	25	36.67	10.2	20.2	51.50	41.50	Yorktown Formation	Decommissioned
C7.8	6/5/1995	2	59.15	61.19	25	34.15	7.9	17.9	51.30	41.30	Yorktown Formation	Decommissioned
C8.1	6/7/1995	2	58.81	60.36	33.5	25.31	13.5	23.5	45.30	35.30	Yorktown Formation	Decommissioned
C8.3	6/5/1995	2	60.4	63.29	30	30.4	16.4	26.4	44.00	34.00	Yorktown Formation	Decommissioned
C8.4A	6/3/1995	2	60.93	62.73	26	34.93	14.1	24.1	46.80	36.80	Yorktown Formation	Decommissioned
C8.4B	5/30/1995	2	60.96	62.48	50	10.96	37.9	47.9	23.10	13.10	Black Creek Formation	Decommissioned
C8.6	6/7/1995	2	64.54	66.52	30	34.54	15.0	25.0	46.50	36.50	Yorktown Formation	Decommissioned
C8.7	6/7/1995	2	64.20	65.71	30	34.2	14.9	24.9	49.30	39.30	Yorktown Formation	Decommissioned
C8.8	6/5/1995	2	61.52	63.52	30	31.52	15.0	25.0	46.50	36.50	Yorktown Formation	Decommissioned
BE.5	6/7/1995	2	61.94	64.39	30	31.94	18.0	28.0	43.90	33.90	Yorktown Formation	Decommissioned
BE.6	6/2/1995	2	61.61	63.39	26.5	35.11	5.0	15.0	56.60	46.60	Yorktown Formation	Decommissioned
BW.3	6/5/1995	2	56.88	59.93	25	31.88	7.1	17.1	49.80	39.80	Yorktown Formation	Decommissioned
BW.4	5/30/1995	2	57.04	58.7	30	27.04	15.0	25.0	42.00	32.00	Yorktown Formation	Decommissioned
BW.5	6/8/1995	2	52.26	53.98	20	32.26	8.3	18.3	44.00	34.00	Yorktown Formation	Decommissioned

NOTES:
1. All elevations are referenced to mean sea level (M.S.L.); depths are referenced to ground surface (B.G.S.).
2. --- = no data available
3. B.G.S. = below ground surface
4. M.S.L = mean sea level
5. T.O.C. = top of casing
6. Piezometers P-107A through P-23B were installed by Golder Associates on May 9 through May 23, 2006.
7. The status of piezometers is based on available information and may not be accurate.

TABLE 2
Summary of Groundwater Elevations for Monitoring Wells and Piezometers - Yorktown Formation
East Carolina Regional Landfill

WELL & PIEZOMETER IDENTIFICATION	G.S. ELEV.	APPROXIMATE STICKUP (feet)	TOC ELEV.	GROUNDWATER ELEVATIONS (feet AMSL)																			
				TOD	24-HOUR	09/01/93	10/04/93	1/95	06/09/95	06/28/95	7/95	12/04/95	1/96	01/30/96	02/27/96	03/12/96	04/29/96	05/23/96	06/27/96	07/16/96	10/96	11/22/96	01/05/97	02/06/97
GW-2	64.00	2.36	66.36	---	53.10	53.10	---	51.79	---	56.83	55.85	54.09	58.36	59.18	59.58	59.57	58.19	---	54.64	55.36	59.92	58.21	59.68	58.46
GW-3	63.70	2.53	66.23	---	53.33	53.33	---	54.53	---	52.36	51.80	51.09	53.73	54.54	55.43	55.56	55.04	---	51.85	51.97	55.53	54.66	52.83	52.18
GW-5	60.90	1.70	62.60	---	49.58	49.58	---	48.45	---	50.68	50.42	49.84	51.42	52.25	53.22	56.30	52.93	---	50.29	50.25	53.05	52.22	52.14	51.18
GW-7	57.40	1.39	58.79	---	45.16	45.16	---	47.12	---	48.97	53.84	49.22	49.89	50.18	50.59	50.77	50.45	---	49.04	49.40	49.87	48.92	49.95	48.44
GW-8	58.60	1.44	60.04	---	46.73	46.73	---	46.43	---	48.44	48.12	48.70	49.09	49.26	49.39	49.63	49.40	---	48.22	48.73	49.14	48.23	49.02	48.03
GW-9	50.10	1.84	51.94	---	48.14	48.14	---	47.89	---	48.62	48.13	49.32	49.43	50.12	50.17	50.21	49.99	---	48.39	48.96	50.32	49.72	49.83	49.32
GW-10	50.40	2.82	53.22	46.60	50.65	---	---	---	---	---	---	---	---	---	---	---	---	---	---	49.50	50.32	49.90	49.93	49.61
GW-11	68.60	3.82	72.42	50.75	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
GW-13	72.20	2.56	74.76	48.30	47.66	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
GW-14	76.70	2.04	78.74	53.60	53.88	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
GW-15	75.23	3.00	78.23	53.13	56.38	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
GW-16	60.46	2.56	63.02	50.24	51.75	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-10A	63.15	2.42	65.57	58.43	58.33	51.94	51.49	---	---	54.92	---	52.85	---	59.45	60.05	60.13	59.20	57.21	54.42	54.61	---	59.31	58.45	55.42
PZ-107A	58.07	2.95	61.02	50.17	52.44	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-108	58.47	2.16	60.63	49.98	51.23	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-109A	61.94	3.38	65.32	51.73	51.85	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-110	60.86	2.12	62.98	51.88	51.94	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-111	59.19	2.39	61.58	49.49	49.50	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-112	58.44	3.04	61.48	48.58	49.58	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-113	60.25	2.89	63.14	50.46	49.71	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-114	62.64	2.61	65.25	51.77	51.84	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-115A	58.46	2.49	60.95	48.75	49.31	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-116	58.05	2.59	60.64	54.74	50.58	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-117A	60.06	1.94	62.00	54.85	52.61	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-118	64.52	2.90	67.42	50.49	51.93	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-119	58.74	2.50	61.24	48.54	48.52	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-120	60.53	2.43	62.96	49.37	49.27	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-121	59.70	2.56	62.26	52.16	50.31	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-122	59.77	2.48	62.25	48.86	49.36	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-123A	59.94	3.03	62.97	48.02	49.42	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

TABLE 2
Summary of Groundwater Elevations for Monitoring Wells and Piezometers - Yorktown Formation
East Carolina Regional Landfill

WELL & PIEZOMETER IDENTIFICATION	GROUNDWATER ELEVATIONS (feet AMSL)																						
	4/97	10/01/97	4/98	05/20/98	06/09/98	08/19/98	10/98	10/30/98	01/20/99	03/11/99	04/07/99	05/26/99	10/20/99	10/26/99	11/30/99	02/29/00	04/11/00	04/26/00	05/17/00	10/18/00	10/26/06	11/21/00	01/10/01	04/18/01
GW-2	57.00	47.84	55.12	55.16	53.36	---	51.35	50.24	51.05	54.00	53.54	---	57.26	56.80	---	54.95	---	54.01	---	52.69	---	---	---	53.52
GW-3	51.96	45.52	51.65	51.83	51.06	---	49.25	49.02	51.21	51.41	51.25	---	52.67	52.13	---	51.26	---	50.91	---	49.68	---	---	---	50.34
GW-5	50.85	45.04	50.52	50.78	49.85	---	48.24	48.02	49.80	50.10	50.01	---	51.25	50.71	---	50.07	---	49.52	---	48.52	---	---	---	48.90
GW-7	47.77	43.40	47.78	47.87	47.21	---	46.30	46.00	47.97	48.32	48.15	---	48.79	48.46	---	48.39	---	47.98	---	46.76	---	---	---	47.33
GW-8	47.50	42.97	47.26	47.31	46.59	45.85	45.58	45.47	47.71	47.81	47.50	---	52.38	47.89	---	47.81	---	47.52	---	46.23	---	---	---	46.85
GW-9	49.15	43.77	48.01	47.77	46.85	---	47.82	45.87	47.92	47.81	47.45	---	49.12	48.32	---	47.55	---	47.42	---	45.53	---	---	---	46.28
GW-10	49.67	42.59	47.00	46.45	45.75	---	45.43	45.25	46.94	46.67	45.85	---	47.80	46.26	---	45.19	---	45.68	---	43.33	---	---	---	43.86
GW-11	50.20	39.85	44.22	43.97	43.74	---	---	43.56	44.41	44.39	---	---	45.82	---	---	42.83	---	---	---	---	---	---	---	---
GW-13	---	---	---	---	---	---	---	---	---	---	---	---	---	47.66	---	---	---	---	---	---	47.66	47.30	---	48.35
GW-14	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
GW-15	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
GW-16	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-10A	---	---	---	53.86	53.00	51.83	---	51.35	52.05	53.32	---	52.44	---	55.17	53.44	53.57	53.04	---	52.66	---	52.55	---	51.67	---
PZ-107A	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-108	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-109A	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-110	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-111	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-112	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-113	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-114	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-115A	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-116	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-117A	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-118	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-119	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-120	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-121	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-122	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-123A	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

TABLE 2
Summary of Groundwater Elevations for Monitoring Wells and Piezometers - Yorktown Formation
East Carolina Regional Landfill

WELL & PIEZOMETER IDENTIFICATION	GROUNDWATER ELEVATIONS (feet AMSL)																						
	10/24/01	04/22/02	10/21/02	04/01/03	10/27/03	04/26/04	09/22/04	10/26/04	11/08/04	01/27/05	02/22/05	03/15/05	03/25/05	04/26/05	07/12/05	01/19/06	05/24/06	05/30/06	06/28/06	07/11/06	08/16/06	08/29/06	10/31/06
GW-2	50.76	51.62	50.04	56.56	54.59	55.22	53.94	53.01	52.68	54.09	54.89	54.56	57.55	55.47	53.25	55.12	---	53.44	---	54.89	54.37	53.54	**54.83**
GW-3	47.95	49.08	47.71	51.53	50.12	50.57	49.35	52.67	48.28	48.56	49.04	49.40	50.07	50.03	49.82	49.82	---	49.27	52.90	49.63	49.87	49.41	**49.37**
GW-5	46.96	47.90	46.37	50.33	48.82	49.21	47.97	51.25	47.13	47.16	47.56	47.93	48.23	48.60	47.74	48.23	---	48.09	48.49	48.44	48.61	48.23	**48.13**
GW-7	45.46	46.88	45.66	48.65	46.95	47.65	46.52	48.79	45.59	46.30	46.62	46.88	47.38	47.20	46.35	46.81	---	46.56	47.34	47.28	46.77	46.34	**47.10**
GW-8	44.75	46.38	45.30	48.07	46.42	47.10	46.24	52.38	45.26	46.04	46.36	46.57	47.29	46.77	46.60	46.60	---	46.15	46.93	46.79	46.32	45.89	**46.81**
GW-9	44.80	45.63	46.18	48.26	47.77	48.41	47.46	49.12	46.65	47.30	47.61	47.72	48.47	47.81	47.22	48.28	---	47.02	48.16	47.78	47.60	47.24	**47.86**
GW-10	44.41	46.39	47.00	49.74	48.50	48.75	48.19	47.80	47.84	48.27	48.47	48.48	49.02	48.29	47.98	48.74	---	47.84	49.56	48.06	47.94	47.65	**47.51**
GW-11	43.99	46.07	46.61	48.94	48.63	48.74	48.44	45.82	48.06	48.17	48.44	48.42	48.79	48.45	48.34	48.40	---	48.25	48.33	48.25	48.16	48.15	**48.34**
GW-13	47.99	49.34	48.86	53.12	51.95	52.06	---	50.79	50.56	51.23	51.76	51.96	52.93	52.01	51.00	51.66	---	51.13	51.46	51.46	51.48	51.10	**51.71**
GW-14	---	---	---	---	53.62	54.53	53.20	52.11	51.84	53.66	54.03	54.34	55.68	54.34	52.71	53.92	---	52.55	53.21	53.16	53.33	52.89	**53.06**
GW-15	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	53.10	---	52.34	52.92	52.87	52.58	52.07	**52.81**
GW-16	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	50.95	50.51	49.77	**51.45**
PZ-10A	---	---	---	---	---	---	52.28	---	51.62	52.06	52.48	---	53.50	53.12	---	---	---	---	---	52.67	---	---	**52.14**
PZ-107A	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	52.00	51.72	51.96	52.10	52.23	51.92	**52.30**
PZ-108	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	50.85	50.62	51.41	51.21	51.25	---	**51.22**
PZ-109A	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	51.68	51.60	52.12	51.98	52.29	51.95	**51.81**
PZ-110	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	51.78	51.71	52.26	52.06	52.30	---	**51.87**
PZ-111	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	49.50	49.28	50.27	50.03	49.81	---	**50.23**
PZ-112	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	49.95	49.80	50.26	50.48	50.42	---	**50.62**
PZ-113	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	50.65	50.40	52.63	51.04	51.03	---	**50.98**
PZ-114	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	51.66	51.59	52.21	51.93	52.26	---	**51.86**
PZ-115A	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	49.23	49.02	50.55	49.83	49.66	49.04	**50.05**
PZ-116	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	50.02	49.77	50.45	50.46	50.31	---	**50.44**
PZ-117A	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	53.15	52.70	53.39	53.45	53.40	52.89	**53.03**
PZ-118	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	51.88	51.81	51.71	52.11	52.25	---	**52.08**
PZ-119	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	48.52	48.81	49.28	49.06	48.99	---	**49.33**
PZ-120	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	49.18	49.02	48.95	49.73	49.56	---	**49.70**
PZ-121	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	49.71	49.44	50.37	50.11	49.95	---	**50.06**
PZ-122	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	49.29	49.07	50.06	49.61	49.52	---	**49.47**
PZ-123A	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	49.24	48.07	48.46	49.59	49.71	---	**49.30**

Notes:

1. G.S. = ground surface
2. TOD = Time of Drilling
3. TOC = Top of Casing
4. GW = groundwater
5. Elev. = elevation
6. --- = no data available
7. All elevations are in feet above mean sea level.
8. The 24-hour groundwater elevation for GW-15 was measured after approximately 72 hours.
9. The 24-hour groundwater elevation for GW-16 was measured after approximately 120 hours.
10. Elevations measured on October 31, 2006 (shown in blue) were used in the construction of potentiometric surface contours shown on Drawing 2.

TABLE 3
Summary of Groundwater Elevations for Monitoring Wells and Piezometers - Black Creek Formation
East Carolina Regional Landfill

Well & Piezometer Identification	G.S. Elev.	Approximate Stickup	TOC Elev.	Groundwater Elevations (feet AMSL)																			
				TOD	24-Hour	09/01/93	10/04/93	1/95	06/09/95	06/28/95	7/95	12/04/95	1/96	01/30/96	02/27/96	03/12/96	04/29/96	05/23/96	06/27/96	07/16/96	10/96	11/22/96	01/05/97	02/06/97
GW-1	63.7	2.17	65.87	---	50.92	50.92	---	48.13	52.86	53.05	51.12	52.78	51.98	54.58	55.78	55.79	55.66	---	53.07	52.61	53.44	55.53	56.44	56.15
GW-4	60.7	1.83	62.53	---	51.42	51.42	---	47.31	---	50.98	49.35	50.98	49.68	51.93	53.05	53.12	53.33	---	51.35	51.01	51.38	53.33	53.53	53.18
GW-6	57.5	1.45	58.95	---	48.96	48.96	---	47.78	---	51.06	49.95	51.12	50.10	51.55	53.04	53.14	53.32	---	51.44	51.09	51.85	53.35	53.59	53.25
GW-12	63.7	2.43	66.13	---	54.38	54.38	---	51.62	---	51.61	49.51	51.71	49.89	52.74	53.88	53.98	54.19	---	52.10	51.76	51.70	54.17	54.37	54.05
PZ-107B	57.86	2.60	60.46	35.10	42.41	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-109B	62.61	2.81	65.42	48.07	48.93	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-115B	58.44	3.21	61.65	42.37	46.69	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-117B	60.05	3.23	63.28	45.23	47.60	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-123B	59.88	2.78	62.66	37.16	46.45	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

TABLE 3
Summary of Groundwater Elevations for Monitoring Wells and Piezometers - Black Creek Formation
East Carolina Regional Landfill

Well & Piezometer Identification	Groundwater Elevations (feet AMSL)																						
	4/97	10/01/97	4/98	05/20/98	06/09/98	08/19/98	10/98	10/30/98	01/20/99	03/11/99	04/07/99	05/26/99	10/20/99	10/26/99	11/30/99	02/29/00	04/11/00	04/26/00	05/17/00	10/18/00	10/26/06	11/21/00	01/10/01	04/18/01
GW-1	53.46	47.00	52.44	54.27	53.42	---	48.24	50.27	52.16	54.12	51.94	---	52.13	54.93	---	55.17	---	54.30	---	53.19	---	---	---	54.29
GW-4	51.00	46.10	50.03	51.80	51.28	---	48.23	49.34	50.31	51.24	49.27	---	49.56	51.67	---	51.49	---	50.98	---	49.94	---	---	---	50.25
GW-6	51.60	46.44	50.33	51.67	51.15	---	48.00	49.23	50.21	51.18	49.64	---	49.45	51.54	---	51.47	---	51.02	---	49.91	---	---	---	50.23
GW-12	51.38	46.24	50.29	52.61	52.09	---	47.70	50.04	51.09	52.09	49.50	---	49.83	52.55	---	52.36	---	51.80	---	50.79	---	---	---	51.07
PZ-107B	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-109B	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-115B	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-117B	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PZ-123B	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

TABLE 3
Summary of Groundwater Elevations for Monitoring Wells and Piezometers - Black Creek Formation
East Carolina Regional Landfill

Well & Piezometer Identification	Groundwater Elevations (feet AMSL)																					
	10/24/01	04/22/02	10/21/02	04/01/03	10/27/03	04/26/04	09/22/04	10/26/04	11/08/04	01/27/05	02/22/05	03/15/05	03/25/05	04/26/05	07/12/05	01/19/06	05/24/06	05/30/06	06/28/06	07/11/06	08/16/06	08/29/06	10/31/06
GW-1	50.73	52.55	50.23	55.55	54.22	54.98	53.69	50.57	52.45	54.14	54.69	53.10	55.72	55.67	50.96	52.27	---	---	---	50.95	50.89	50.13	**50.77**
GW-4	48.14	49.26	47.78	51.50	50.76	50.90	49.86	49.56	49.09	49.43	49.84	48.31	50.48	50.78	47.51	48.24	---	47.62	48.93	47.82	48.08	47.68	**47.88**
GW-6	48.15	49.27	47.79	51.60	50.74	51.08	49.96	48.00	49.18	49.62	50.05	48.96	50.70	51.06	48.29	48.85	---	48.19	48.44	48.30	48.60	48.17	**48.25**
GW-12	50.63	51.88	48.36	52.18	51.46	51.59	50.56	49.83	49.73	50.16	50.56	48.47	51.22	51.56	47.82	48.40	---	47.70	47.97	47.92	48.14	47.73	**47.74**
PZ-107B	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	46.15	46.90	47.84	48.22	48.40	48.06	**48.55**
PZ-109B	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	48.85	48.70	49.01	49.12	49.26	48.71	**49.00**
PZ-115B	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	46.69	46.89	47.39	47.50	47.66	47.02	**47.44**
PZ-117B	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	48.01	47.81	48.27	48.18	48.38	47.87	**48.08**
PZ-123B	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	46.97	46.97	47.07	47.11	47.18	---	**47.45**

Notes:

1. G.S. = ground surface
2. TOD = Time of Drilling
3. TOC = Top of Casing
4. GW = groundwater
5. Elev. = elevation
6. --- = no data available
7. All elevations are in feet above mean sea level
8. The 24 hour groundwater elevation for PZ-109B was measured after approximately 72 hours.

TABLE 4
Summary of Laboratory Soils Test Data
East Carolina Regional Landfill

Hydrogeologic Layer	BORING NUMBER	SAMPLE DEPTH (feet)	SAMPLE TYPE	USCS CLASSIFICATION	USCS SYMBOL	NATURAL MOISTURE CONTENT (%)	UNIT WEIGHT (pcf)		GRADATION RESULTS (% passing)											USDA SOIL CLASSIFICATION SYSTEM			ASTM SOIL CLASSIFICATION SYSTEM			WENTWORTH SOIL CLASSIFICATION SYSTEM			ATTERBERG LIMITS			EFFECTIVE POROSITY (%)	TOTAL POROSITY (%)	PERMEABILITY (cm/sec)
							WET	DRY	1"	3/4"	1/2"	3/8"	#4	#10	#20	#40	#60	#100	#200	% SAND	% SILT	% CLAY	% SAND	% SILT	% CLAY	% SAND	% SILT	% CLAY	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX			
I	PZ-41	1-2.5	Split Spoon	high plasticity clay	CH	26.8	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	66	31.1	35	---	---	---
	PZ-41	3.5-5	Split Spoon	---	---	34.9	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	PZ-88	6-7.5	Split Spoon	silty clay	CH	25.4	---	---	100	100	100	100	100	100	100	100	100	100	97	13	48	40	3	51	46	8	49	43	58	19	39	1.6	52.5	---
	PZ-96	6-7.5	Split Spoon	silty clay	CH	30.9	---	---	100	100	100	100	100	100	100	100	100	99	97	---	---	---	---	---	---	---	---	---	58	18	40	---	---	---
	PZ-109A	4-6	Shelby Tube	fine sand	SC	25.9	---	97.2	100	100	100	100	100	100	100	99	92	63	44	56	9	36	56	6	38	56	8	36	44	25	19	ANS	43.0	4.20E-06
	PZ-117A	10-18	Split Spoon	silty clay	CL	30.0	---	83.8	100	100	100	100	100	100	99	97	96	95	74	34	39	27	26	41	33	30	40	30	41	23	18	4.2	51.0	9.90E-08
II	GW-14	38.5-40	Split Spoon	sand	SP	---	---	---	100	100	100	100	100	100	100	74	27	8	5	95	3	3	95	2	3	95	2	3	---	---	---	38	---	---
	PZ-87	13.5-15	Split Spoon	silty sand	SM	25.8	---	---	100	100	100	100	100	100	100	93	63	33	15	---	---	---	---	---	---	---	---	---	16	NP	NP	---	---	---
	PZ-97	13.5-15	Split Spoon	silty sand	SM	32.6	---	---	100	100	100	100	100	100	100	99	98	27	15	87	8	5	85	9	7	86	8	6	18	NP	NP	28.0	44.0	---
	PZ-109A	14-16	Shelby Tube	fine sand	SM	28.0	---	85.4	100	100	100	100	100	100	100	99	89	39	19	84	12	4	81	14	5	81	15	4	NP	NP	NP	30.0	49.0	5.80E-04
III	PZ-41	23.5-25	Split Spoon	silt	ML	64.3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	48.1	30.3	17.8	---	---	---
	PZ-41	28.5-30	Split Spoon	clay	CL	55.2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	49.8	26.4	23.4	---	---	---
	PZ-87	23.5-25	Split Spoon	---	---	61.8	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	PZ-88	23.5-25	Split Spoon	silty clay	CL	53.8	---	---	100	100	100	100	100	100	100	100	100	100	99	20	70	11	1	79	20	11	72	17	46	23	23	5.0	52.5	---
	PZ-109B	33-35	Shelby Tube	clayey silt	MH	---	---	57.2	100	100	100	100	100	100	100	100	100	99	98	8	48	45	2	44	54	5	45	50	53	30	23	<1.0	66.0	3.70E-08
	PZ-117B	22-24	Shelby Tube	silty clay	CL	---	---	62.1	100	100	100	100	100	100	99	99	99	93	89	20	55	26	11	55	34	14	56	30	35	22	13	3.7	63.0	---
IV	PZ-109B	45.5-47	Shelby Tube	fine sand	SP-SM	26.0	---	98.2	100	100	100	100	100	100	100	99	83	27	8	92	2	5	92	3	5	92	3	5	NP	NP	NP	35.0	41.0	9.00E-04
	PZ-115B	44-45.5	Shelby Tube	fine sand	SM	31.1	---	91.4	100	100	100	100	100	100	100	100	100	93	48	61	24	16	52	30	18	56	27	17	30	25	5	13.5	46.0	3.00E-06
	PZ-117B	48-49.5	Shelby Tube	sandy clay	SC	41.7	---	78.2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	54.0	---

NOTES:

1. --- = no data available
2. NP = non-plastic
3. ANS = area of no samples
4. cm/sec = centimeters per second
5. Hydrogeologic Layer I = confining unit in the Yorktown Formation
6. Hydrogeologic Layer II = aquifer unit in the Yorktown Formation
7. Hydrogeologic Layer III = confining unit in the Black Creek Formation
8. Hydrogeologic Layer IV = aquifer unit in the Black Creek Formation
9. Soils analysis for monitoring well GW-14 and piezometers PZ-87, PZ-88, PZ-96, and PZ-97 performed by Bunnell-Lammons Engineering, Inc.
10. Soils analysis for piezometer PZ-41 performed by Law Engineering, Inc.
11. Soils analysis for piezometers PZ-109A, PZ-109B, PZ-155B, PZ-177A, and PZ-177B performed by Golder Associates.

TABLE 5
Summary of Aquifer Test Data
East Carolina Regional Landfill

Piezometer or Well ID	Aquifer Test Type	Aquifer Unit	Screen Length (feet)	Well Diameter (inches)	Aquifer Analysis Method	Hydraulic Conductivity (cm/sec)
PZ-117A	Rising	Layer I & II	5	2	Bouwer-Rice	3.665E-05
PZ-117A	Falling	Layer I & II	5	2	Bouwer-Rice	8.610E-05
GW-14	---	Layer II	10	2	Cooper, et al.	1.160E-03
GW-16	Falling	Layer II	10	2	Bouwer-Rice	2.690E-04
PZ-41A	---	Layer II	10	2	Cooper, et al.	4.358E-03
PZ-86A	---	Layer II	10	2	Cooper, et al.	9.100E-04
PZ-95A	---	Layer II	10	2	Cooper, et al.	1.120E-03
PZ-102A	---	Layer II	10	2	Cooper, et al.	2.880E-03
PZ-109A	Falling	Layer II	10	2	Bouwer-Rice	1.875E-04
PZ-110	Rising	Layer II	15	2	Bouwer-Rice	5.478E-03
PZ-110	Falling	Layer II	15	2	Bouwer-Rice	6.137E-05
PZ-115A	Rising	Layer II	5	2	Bouwer-Rice	4.238E-03
PZ-115A	Falling	Layer II	5	2	Bouwer-Rice	4.669E-05
PZ-118	Rising	Layer II	10	2	Bouwer-Rice	4.343E-05
PZ-118	Falling	Layer II	10	2	Bouwer-Rice	2.650E-05
					Layer II geomean=	4.717E-04
PZ-41B	---	Layer IV	10	2	Cooper et al.	5.253E-04
PZ-109B	Rising	Layer IV	5	2	Bouwer-Rice	1.830E-04
PZ-109B	Falling	Layer IV	5	2	Bouwer-Rice	3.309E-04
PZ-115B	Rising	Layer IV	20	2	Bouwer-Rice	3.995E-05
PZ-115B	Falling	Layer IV	20	2	Bouwer-Rice	2.126E-05
PZ-117B	Rising	Layer IV	10	2	Bouwer-Rice	1.172E-04
PZ-117B	Falling	Layer IV	10	2	Bouwer-Rice	3.019E-05
					Layer IV geomean=	9.936E-05

NOTES:

1. Aquifer tests for GW-16, PZ-109A, PZ-110, PZ-115A, PZ-117A, PZ-118, PZ-109B, PZ-115B and PZ-117B were conducted by Golder Associates. Other test data shown were conducted by others.
2. Geomean = geometric mean
3. Slug test results for PA-117A were not used in the calculation of the geometric mean of Layer II because the well is screened across 2 units.
4. Layer I = confining unit in the Yorktown Formation
5. Layer II = aquifer unit in the Yorktown Formation
6. Layer III = confining unit in the Black Creek Formation
7. Layer IV = aquifer unit in the Black Creek Formation

TABLE 6
Summary of Hydrogeologic Layer Thicknesses
East Carolina Regional Landfill

	Layer I Thickness (feet)	Layer II Thickness (feet)	Layer III Thickness (feet)	Layer IV Thickness (feet)
GW-1	14.0	18.0	19.5	>10.5
GW-2	16.0	15.5	>0.5	---
GW-3	15.0	20.5	>0.0	---
GW-4	9.5	29.0	10.5	9.0
GW-5	12.0	26.5	>0.0	---
GW-6	7.5	14.5	32.5	>6.5
GW-7	6.5	15.5	>0.0	---
GW-8	8.5	11.0	>0.5	---
GW-9	2.0	11.0	>1.0	---
GW-10	---	---	---	---
GW-11	17.0	5.0	>8.0	---
GW-12	9.0	28.0	5.0	>12.0
GW-13	10.5	11.0	22.5	>1.0
GW-14	19.0	11.0	>1.0	---
GW-15	10.0	>15	---	---
GW-16	9.5	14.0	>0.0	---
PZ-10A	3.0	26.5	12.5	>8.0
PZ-41A	5.5	>12.8	---	---
PZ-41B	5.5	16.5	8.0	>10.0
PZ-56A	12.0	25.0	5.0	>8.0
PZ-67A	8.0	14.0	>3.0	---
PZ-68A	3.0	19.0	>3.0	---
PZ-72A	8.0	14.5	16.5	>21.0
PZ-73A	12.0	15.0	15.0	15.0
PZ-88A	14.0	8.0	>3.0	---
PZ-95A	8.0	14.0	>3.0	---
PZ-97A	9.0	13.0	>3.0	---
PZ-106A	5.5	16.5	>3.0	---
PZ-107A	13.5	>13.5	---	---
PZ-107B	13.5	16.3	3.7	>16.5
PZ-108	11.0	8.8	>0.2	---
PZ-109A	7.8	17.7	>2.5	---
PZ-109B	7.8	17.7	15.0	>11.5
PZ-110	9.8	22.0	>0.2	---
PZ-111	7.3	11.2	>1.5	---
PZ-112	12.0	11.0	>1.0	---
PZ-113	13.3	12.5	>0.2	---

TABLE 6
Summary of Hydrogeologic Layer Thicknesses
East Carolina Regional Landfill

	Layer I Thickness (feet)	Layer II Thickness (feet)	Layer III Thickness (feet)	Layer IV Thickness (feet)
PZ-114	5.8	19.7	>0.5	---
PZ-115A	8.0	9.8	>2.2	---
PZ-115B	8.0	9.8	10.2	>22
PZ-116	10.0	11.8	>0.2	---
PZ-117A	15.3	4.2	>0.5	---
PZ-117B	15.3	4.2	18.3	>12.2
PZ-118	5.0	18.8	>0.2	---
PZ-119	9.0	14.8	>0.2	---
PZ-120	10.0	12.0	>2.0	---
PZ-121	11.5	12.3	>2.2	---
PZ-122	11.9	13.1	>1.0	---
PZ-123A	17.5	>5.5	---	---
PZ-123B	17.5	6.0	10.5	>16.4
BE-5A	17.0	10.0	>3.0	---
BE-6A	8.0	>18.5	---	---
C8.7	12.0	15.0	>3.0	---

Notes:

1. --- = no data available
2. Layer I = confining unit in the Yorktown Formation
3. Layer II = aquifer unit in the Yorktown Formation
4. Layer III = confining unit in the Black Creek Formation
5. Layer IV = aquifer unit in the Black Creek Formation

TABLE 7
Summary of Hydrogeologic Layer Limit Elevations
East Carolina Regional Landfill

	G.S. Elevation	Layer I (feet AMSL)		Layer II (feet AMSL)		Layer III (feet AMSL)		Layer IV (feet AMSL)	
GW-1	63.70	63.7	49.7	49.7	31.7	31.7	12.2	12.2	<1.7
GW-2	64.00	64.0	48.0	48.0	32.5	32.5	<32.0	---	---
GW-3	63.70	63.7	48.7	48.7	28.2	28.2	<28.2	---	---
GW-4	60.70	60.7	51.2	51.2	22.2	22.2	11.7	11.7	2.7
GW-5	60.90	60.9	48.9	48.9	22.4	22.4	<22.4	---	---
GW-6	57.50	57.5	50.0	50.0	35.5	35.5	3.0	3.0	<-3.5
GW-7	57.40	57.4	50.9	50.9	35.4	35.4	<35.4	---	---
GW-8	58.60	58.6	50.1	50.1	39.1	39.1	<38.6	---	---
GW-9	50.10	50.1	48.1	48.1	37.1	37.1	<36.1	---	---
GW-10	50.40	50.4	---	---	<28.4	---	---	---	---
GW-11	68.60	68.6	51.6	51.6	46.6	46.6	<38.6	---	---
GW-12	63.70	63.7	54.7	54.7	26.7	26.7	21.7	21.7	<9.7
GW-13	72.20	72.2	61.7	61.7	50.7	50.7	28.2	28.2	<27.2
GW-14	76.70	57.7	38.7	38.7	27.7	27.7	<26.7	---	---
GW-15	75.23	60.2	50.2	50.2	<35.2	---	---	---	---
GW-16	60.46	60.5	51.0	51.0	37.0	37.0	<37.0	---	---
PZ-10A	63.15	63.2	60.2	60.2	33.7	33.7	21.2	21.2	<13.2
PZ-41A	59.23	59.2	53.7	53.7	<40.9	---	---	---	---
PZ-41B	59.19	59.2	53.7	53.7	37.2	37.2	29.2	29.2	<19.2
PZ-56A	61.46	61.5	49.5	49.5	24.5	24.5	19.5	19.5	<11.5
PZ-67A	59.99	60.0	52.0	52.0	38.0	38.0	<35.0	---	---
PZ-68A	61.30	61.3	58.3	58.3	39.3	39.3	<36.3	---	---
PZ-72A	58.90	58.9	50.9	50.9	36.4	36.4	19.9	19.9	<-11
PZ-73A	59.00	59.0	47.0	47.0	32.0	32.0	17.0	17.0	2.0
PZ-88A	58.74	58.7	44.7	44.7	36.7	36.7	<33.7	---	---
PZ-95A	58.77	58.8	50.8	50.8	36.8	36.8	<33.8	---	---
PZ-97A	59.29	59.3	50.3	50.3	37.3	37.3	<34.3	---	---
PZ-106A	59.85	59.9	54.4	54.4	37.9	37.9	<34.9	---	---
PZ-107A	58.07	58.1	44.6	44.6	<31.1	---	---	---	---
PZ-107B	57.86	57.9	44.4	44.4	28.1	28.1	24.4	24.4	<7.9
PZ-108	58.47	58.5	47.5	47.5	38.7	38.7	<38.5	---	---
PZ-109A	61.94	61.9	54.1	54.1	36.4	36.4	<33.9	---	---
PZ-109B	62.61	62.6	54.8	54.8	37.1	37.1	22.1	22.1	<10.6
PZ-110	60.86	60.9	51.1	51.1	29.1	29.1	<28.9	---	---
PZ-111	59.19	59.2	51.9	51.9	40.7	40.7	<39.2	---	---
PZ-112	58.44	58.4	46.4	46.4	35.4	35.4	<34.4	---	---
PZ-113	60.25	60.3	47.0	47.0	34.5	34.5	<34.3	---	---
PZ-114	62.64	62.6	56.8	56.8	37.1	37.1	<36.6	---	---
PZ-115A	58.46	58.5	50.5	50.5	40.7	40.7	<38.5	---	---
PZ-115B	58.44	58.4	50.4	50.4	40.6	40.6	30.4	30.4	<8.4
PZ-116	58.05	58.1	48.1	48.1	36.3	36.3	<36.1	---	---

TABLE 7
Summary of Hydrogeologic Layer Limit Elevations
East Carolina Regional Landfill

	G.S. Elevation	Layer I (feet AMSL)		Layer II (feet AMSL)		Layer III (feet AMSL)		Layer IV (feet AMSL)	
PZ-117A	60.06	60.1	44.8	44.8	40.6	40.6	<40.1	---	---
PZ-117B	60.05	60.1	44.8	44.8	40.6	40.6	22.3	22.3	<10.1
PZ-118	64.52	64.5	59.5	59.5	40.7	40.7	<40.5	---	---
PZ-119	58.74	58.7	49.7	49.7	34.9	34.9	<34.7	---	---
PZ-120	60.53	60.5	50.5	50.5	38.5	38.5	<36.5	---	---
PZ-121	59.70	59.7	48.2	48.2	35.9	35.9	<33.7	---	---
PZ-122	59.77	59.8	47.9	47.9	34.8	34.8	<33.8	---	---
PZ-123A	59.94	59.9	42.4	42.4	<36.9	---	---	---	---
PZ-123B	59.88	59.9	42.4	42.4	36.4	36.4	25.9	25.9	<9.5
BE-5A	61.94	61.9	44.9	44.9	34.9	34.9	<31.9	---	---
BE-6A	61.61	61.6	53.6	53.6	<35.1	---	---	---	---
C8.7	64.20	64.2	52.2	52.2	37.2	37.2	<34.2	---	---

Notes:

1. --- = no data available
2. G.S. = ground surface
3. AMSL = above mean sea level
4. Layer I = confining unit in the Yorktown Formation
5. Layer II = aquifer unit in the Yorktown Formation
6. Layer III = confining unit in the Black Creek Formation
7. Layer IV = aquifer unit in the Black Creek Formation

TABLE 8
Summary of Hydrogeologic Unit Depths
East Carolina Regional Landfill

	Layer I (feet bgs)		Layer II (feet bgs)		Layer III (feet bgs)		Layer IV (feet bgs)	
GW-1	0.0	14.0	14.0	32.0	32.0	51.5	51.5	>62.0
GW-2	0.0	16.0	16.0	31.5	31.5	>32.0	---	---
GW-3	0.0	15.0	15.0	35.5	35.5	>35.5	---	---
GW-4	0.0	9.5	9.5	38.5	38.5	49.0	49.0	58.0
GW-5	0.0	12.0	12.0	38.5	38.5	>38.5	---	---
GW-6	0.0	7.5	7.5	22.0	22.0	54.5	54.5	>61.0
GW-7	0.0	6.5	6.5	22.0	22.0	>22.0	---	---
GW-8	0.0	8.5	8.5	19.5	19.5	>20.0	---	---
GW-9	0.0	2.0	2.0	13.0	13.0	>14.0	---	---
GW-10	0.0	---	---	>22.0	---	---	---	---
GW-11	0.0	17.0	17.0	22.0	22.0	>30.0	---	---
GW-12	0.0	9.0	9.0	37.0	37.0	42.0	42.0	>54.0
GW-13	0.0	10.5	10.5	21.5	21.5	44.0	44.0	>45.0
GW-14	19.0	38.0	38.0	49.0	49.0	>50.0	---	---
GW-15	15.0	25.0	25.0	>40.0	---	---	---	---
GW-16	0.0	9.5	9.5	23.5	23.5	>23.5	---	---
PZ-10A	0.0	3.0	3.0	29.5	29.5	42.0	42.0	>50.0
PZ-41A	0.0	5.5	5.5	>18.3	---	---	---	---
PZ-41B	0.0	5.5	5.5	22.0	22.0	30.0	30.0	>40.0
PZ-56A	0.0	12.0	12.0	37.0	37.0	42.0	42.0	>50.0
PZ-67A	0.0	8.0	8.0	22.0	22.0	>25.0	---	---
PZ-68A	0.0	3.0	3.0	22.0	22.0	>25.0	---	---
PZ-72A	0.0	8.0	8.0	22.5	22.5	39.0	39.0	>60.0
PZ-73A	0.0	12.0	12.0	27.0	27.0	42.0	42.0	57.0
PZ-88A	0.0	14.0	14.0	22.0	22.0	>25.0	---	---
PZ-95A	0.0	8.0	8.0	22.0	22.0	>25.0	---	---
PZ-97A	0.0	9.0	9.0	22.0	22.0	>25.0	---	---
PZ-106A	0.0	5.5	5.5	22.0	22.0	>25.0	---	---
PZ-107A	0.0	13.5	13.5	>27.0	---	---	---	---
PZ-107B	0.0	13.5	13.5	29.8	29.8	33.5	33.5	>50.0
PZ-108	0.0	11.0	11.0	19.8	19.8	>20.0	---	---
PZ-109A	0.0	7.8	7.8	25.5	25.5	>28.0	---	---
PZ-109B	0.0	7.8	7.8	25.5	25.5	40.5	40.5	>52.0
PZ-110	0.0	9.8	9.8	31.8	31.8	>32.0	---	---
PZ-111	0.0	7.3	7.3	18.5	18.5	>20.0	---	---
PZ-112	0.0	12.0	12.0	23.0	23.0	>24.0	---	---
PZ-113	0.0	13.3	13.3	25.8	25.8	>26.0	---	---
PZ-114	0.0	5.8	5.8	25.5	25.5	>26.0	---	---
PZ-115A	0.0	8.0	8.0	17.8	17.8	>20.0	---	---

TABLE 8
Summary of Hydrogeologic Unit Depths
East Carolina Regional Landfill

	Layer I (feet bgs)		Layer II (feet bgs)		Layer III (feet bgs)		Layer IV (feet bgs)	
PZ-115B	0.0	8.0	8.0	17.8	17.8	28.0	28.0	>50.0
PZ-116	0.0	10.0	10.0	21.8	21.8	>22.0	---	---
PZ-117A	0.0	15.3	15.3	19.5	19.5	>20.0	---	---
PZ-117B	0.0	15.3	15.3	19.5	19.5	37.8	37.8	>50.0
PZ-118	0.0	5.0	5.0	23.8	23.8	>24.0	---	---
PZ-119	0.0	9.0	9.0	23.8	23.8	>24.0	---	---
PZ-120	0.0	10.0	10.0	22.0	22.0	>24.0	---	---
PZ-121	0.0	11.5	11.5	23.8	23.8	>26.0	---	---
PZ-122	0.0	11.9	11.9	25.0	25.0	>26.0	---	---
PZ-123A	0.0	17.5	17.5	>23.0	---	---	---	---
PZ-123B	0.0	17.5	17.5	23.5	23.5	34.0	34.0	>50.4
BE-5A	0.0	17.0	17.0	27.0	27.0	>30.0	---	---
BE-6A	0.0	8.0	8.0	>26.5	---	---	---	---
C8.7	0.0	12.0	12.0	27.0	27.0	>30.0	---	---

Notes:

1. --- = no data available
2. bgs = below ground surface
3. Layer I = confining unit in the Yorktown Formation
4. Layer II = aquifer unit in the Yorktown Formation
5. Layer III = confining unit in the Black Creek Formation
6. Layer IV = aquifer unit in the Black Creek Formation

TABLE 9
Hydraulic Gradients and Linear Flow Velocities
East Carolina Regional Landfill

Gradient Segment	Aquifer Unit	Hydraulic Conductivity (K, cm/sec)	Gradient Segment Length (feet)	Effective Porosity	Flow Direction	October 31, 2006, Potentiometric Surface Contours		
						Elevation (ft, MSL)	Gradient (ft/ft)	Velocity (ft/yr)
i_1	Layer II	4.72E-04	450	0.280	ENE	52 50	0.004	6.98
i_2	Layer II	4.72E-04	636	0.280	ENE	52 50	0.003	5.23
i_3	Layer II	4.72E-04	595	0.280	S	52 50	0.003	5.23
i_4	Layer II	4.72E-04	917	0.280	SSW	52 50	0.002	3.49
i_5	Layer IV	9.94E-05	974	0.135	NE	49 47	0.002	1.52
i_6	Layer IV	9.94E-05	450	0.135	ENE	49 48	0.002	1.52

NOTES:
1. The geometric mean of K from individual well aquifer tests was used to calculate the hydraulic conductivity for each aquifer unit.
2. The effective porosity values for each aquifer were the lowest recorded on Table 4.

TABLE 10
Summary of Vertical Gradients and Seepage Velocities
East Carolina Regional Landfill

		LAYER III		06/28/06				08/16/06				10/31/06			
WELL PAIR	**SCREENED INTERVALS (feet AMSL)**	**HYDRAULIC CONDUCTIVITY (K, cm/sec)**	**EFFECTIVE POROSITY**	**DISTANCE BETWEEN SCREEN MIDPOINTS (feet)**	**ELEVATION ABOVE MEAN SEA LEVEL (feet)**	**VERTICAL GRADIENT (ft./ft.)**	**VELOCITY (ft./year)**	**DISTANCE BETWEEN SCREEN MIDPOINTS (feet)**	**ELEVATION ABOVE MEAN SEA LEVEL (feet)**	**VERTICAL GRADIENT (ft./ft.)**	**VELOCITY (ft./year)**	**DISTANCE BETWEEN SCREEN MIDPOINTS (feet)**	**ELEVATION ABOVE MEAN SEA LEVEL (feet)**	**VERTICAL GRADIENT (ft./ft.)**	**VELOCITY (ft./year)**
PZ-107B	17.86-7.86	3.70E-08	0.026	23.21	47.84	0.178	0.257	23.21	48.40	0.165	0.239	23.21	48.55	0.162	0.234
PZ-107A	41.07-31.07				51.96				52.23				52.30		
PZ-109B	15.61-10.61	3.70E-08	0.026	29.83	49.01	0.104	0.151	29.83	49.26	0.102	0.147	29.83	49.00	0.094	0.136
PZ-109A	47.94-37.94				52.12				52.29				51.81		
PZ-115B	28.44-8.44	3.70E-08	0.026	25.52	47.39	0.124	0.179	25.52	47.66	0.078	0.113	25.52	47.44	0.102	0.148
PZ-115A	46.46-41.46				50.55				49.66				50.05		
PZ-117B	20.05-10.05	3.70E-08	0.026	34.51	48.27	0.148	0.215	34.51	48.38	0.145	0.211	34.51	48.08	0.143	0.208
PZ-117A	47.06-42.06				53.39				53.40				53.03		
PZ-123B	22.88-9.88	3.70E-08	0.026	22.56	47.07	0.062	0.089	22.56	47.18	0.112	0.162	22.56	47.45	0.082	0.119
PZ-123A	40.94-36.94				48.46				49.71				49.30		
					Average:	**0.123**	**0.178**		**Average:**	**0.121**	**0.174**		**Average:**	**0.117**	**0.169**

NOTES:

1. AMSL = above mean sea level
2. cm/sec = centimeters per second
3. ft./ft. = foot per foot
4. ft./year = feet per year
5. Positive vertical gradient values indicate downward flow direction and negative vertical gradient values indicate upward flow direction.
6. The Layer III hydraulic conductivity is from laboratory soil testing results presented on Table 4.
7. The Layer III effective porosity is the geomean of the Layer III effective porosity values presented on Table 4.
8. Velocity values are the calculated rate for groundwater to travel vertically through Layer III.

TABLE 11
Historical Precipitation Data
Edenton, North Carolina

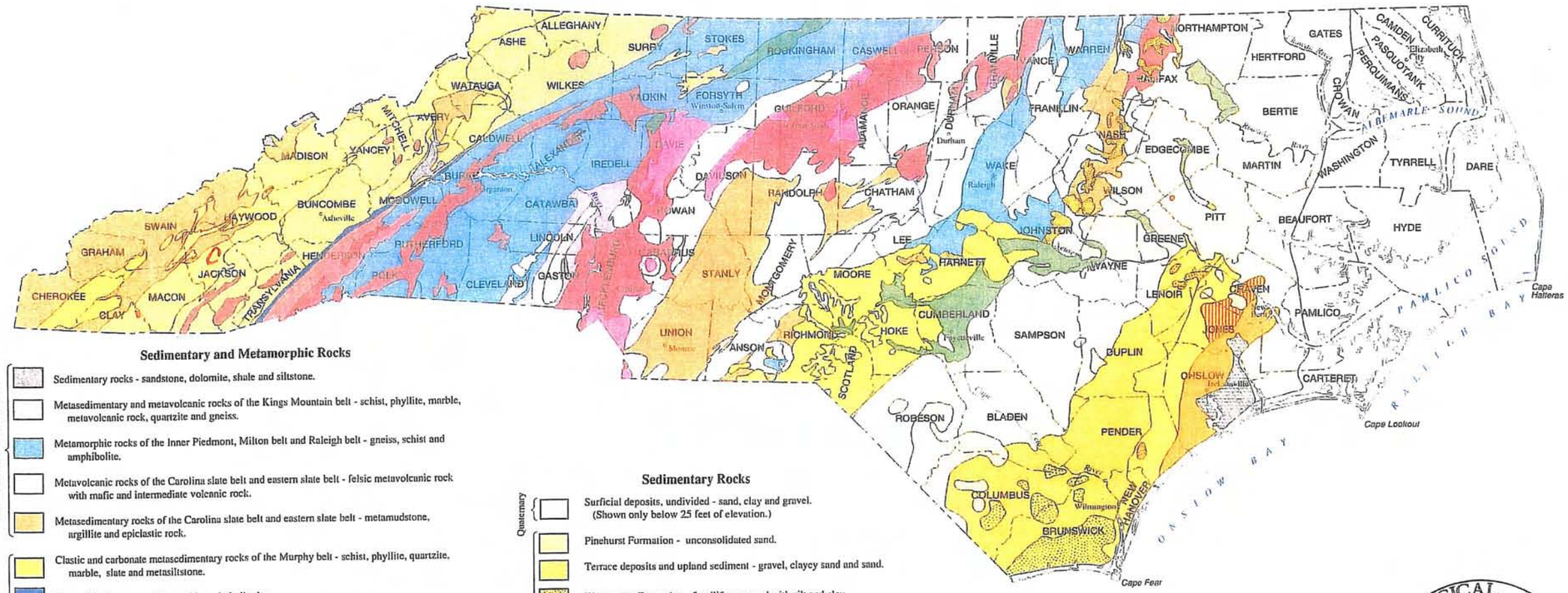
Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual
1933	3.12	3.71	2.42	2.12	2.63	1.75	5.53	5.63	5.59	0.16	0.40	1.10	**34.16**
1934	2.54	4.80	5.45	5.19	4.39	2.68	7.01	7.68	4.87	0.15	2.53	2.44	**49.73**
1935	3.26	2.55	5.28	4.93	1.82	2.58	10.90	2.83	4.42	0.17	3.61	2.20	**44.55**
1936	5.41	4.49	3.99	4.07	0.50	6.79	10.26	3.11	2.85	5.73	2.63	6.10	**55.93**
1937	8.44	4.91	1.56	4.00	0.60	1.52	12.65	6.85	2.49	2.40	5.94	2.58	**53.94**
1938	2.46	1.70	2.00	7.13	8.35	8.54	7.87	3.54	12.71	2.65	2.91	2.65	**62.51**
1939	4.81	6.52	4.02	4.60	3.16	2.66	12.88	10.15	1.15	5.64	2.41	1.81	**59.81**
1940	3.42	2.11	3.08	4.19	2.90	4.54	6.08	8.83	1.67	1.15	3.97	2.85	**44.79**
1941	2.36	2.69	3.85	2.98	0.72	4.34	5.89	5.54	2.39	2.13	1.12	4.89	**38.90**
1942	2.87	1.59	5.54	0.69	2.12	1.50	3.21	7.29	2.71	8.91	1.66	4.59	**42.68**
1943	4.17	1.19	5.59	1.65	3.56	3.54	6.10	3.30	0.42	2.70	1.32	2.66	**36.20**
1944	4.68	5.64	6.88	3.13	2.36	2.62	3.48	3.92	9.33	1.87	3.54	2.61	**50.06**
1945	2.27	5.26	0.70	1.28	2.58	6.08	13.31	6.23	5.61	0.95	3.08	5.46	**52.81**
1946	3.32	4.42	1.43	4.26	5.98	5.31	7.64	4.42	5.37	1.32	4.43	1.20	**49.10**
1947	5.11	0.71	3.86	3.62	1.95	4.34	6.36	7.04	7.37	3.86	11.39	2.33	**57.94**
1948	4.65	4.09	3.12	2.51	6.21	3.31	5.82	2.54	4.00	3.59	9.17	4.72	**53.73**
1949	1.76	2.94	3.36	3.15	5.45	12.88	5.54	13.74	6.60	2.56	3.80	1.76	**63.54**
1950	2.85	0.00	1.97	2.08	8.69	7.56	14.27	3.56	7.73	1.91	1.31	3.39	**55.32**
1951	1.17	2.90	3.57	2.50	1.50	5.16	2.03	4.95	2.32	2.65	3.76	2.15	**34.66**
1952	2.53	4.28	5.81	2.45	2.26	3.78	5.10	7.03	2.77	0.74	5.25	2.67	**44.67**
1953	2.14	4.52	1.91	2.84	2.43	1.70	0.61	7.61	3.95	0.37	2.79	4.82	**35.69**
1954	5.47	0.92	4.51	3.27	4.86	1.37	5.20	8.20	3.18	1.07	1.51	2.50	**42.06**
1955	2.78	2.11	3.31	2.00	3.80	6.63	3.66	13.55	10.15	0.52	1.91	0.93	**51.35**
1956	2.73	5.65	4.15	4.36	2.58	4.15	9.68	8.50	5.80	6.93	0.90	0.75	**56.18**
1957	4.14	4.95	4.80	2.36	2.77	1.11	2.66	2.21	7.54	4.55	5.78	3.68	**46.55**
1958	4.60	2.25	4.45	2.68	4.80	4.92	4.09	8.40	1.26	6.76	1.68	3.74	**49.63**
1959	1.28	4.23	5.35	5.84	1.47	5.58	8.50	4.52	3.37	4.71	2.15	3.20	**50.20**
1960	7.11	4.62	5.32	7.00	3.75	3.36	9.06	5.84	7.25	2.58	1.37	2.30	**59.56**
1961	1.85	7.35	3.45	3.50	5.46	6.51	3.78	4.29	4.11	2.28	1.97	3.93	**48.48**
1962	5.95	2.81	4.87	3.17	3.42	10.96	4.87	2.53	2.93	2.42	3.67	3.30	**50.90**
1963	6.25	3.32	3.24	1.40	3.25	6.30	3.06	3.18	6.74	0.77	4.30	2.47	**44.28**
1964	4.28	6.59	2.79	2.55	1.14	1.53	3.24	7.09	9.49	8.96	1.62	3.55	**52.83**
1965	1.31	4.01	3.59	1.65	1.47	5.34	13.69	3.63	1.83	1.58	0.83	0.62	**39.55**
1966	6.28	5.12	2.17	1.99	9.34	4.45	2.02	9.74	3.25	0.32	1.45	3.50	**49.63**
1967	4.47	5.24	1.19	1.10	2.91	4.06	9.14	11.75	3.44	1.20	2.16	3.95	**50.61**
1968	5.62	1.13	5.52	3.35	7.64	3.81	2.95	0.90	1.69	5.93	3.46	2.12	**44.12**
1969	2.86	3.43	4.86	4.01	2.10	4.32	7.17	6.25	5.18	1.84	4.59	4.44	**51.05**
1970	2.84	4.80	3.34	6.93	3.24	3.45	12.00	1.59	1.30	1.27	1.25	3.05	**45.06**
1971	3.92	5.47	5.53	2.27	4.50	5.48	8.32	5.29	5.26	10.19	2.56	1.78	**60.57**
1972	4.52	3.83	2.86	2.23	4.85	3.39	6.56	2.94	2.22	4.78	4.70	3.18	**46.06**
1973	2.65	3.16	4.69	4.23	4.94	3.44	2.32	7.45	1.68	2.42	1.75	7.14	**45.87**
1974	4.13	3.72	4.35	2.62	6.03	6.07	9.63	9.55	4.60	2.43	1.20	3.87	**58.20**
1975	5.24	3.21	5.50	4.05	4.04	2.01	7.18	1.06	4.54	2.73	1.83	4.96	**46.35**
1976	3.83	1.65	2.60	3.13	5.22	3.11	5.89	1.46	6.00	2.37	1.91	4.18	**41.35**
1977	3.13	1.74	4.36	4.25	7.89	3.87	2.36	4.80	2.27	8.91	4.62	6.08	**54.28**
1978	6.92	1.95	5.85	4.14	5.54	4.68	4.64	3.09	0.21	3.34	4.38	1.67	**46.41**
1979	5.56	4.99	3.63	5.89	8.48	4.66	2.39	2.83	12.15	3.57	3.50	1.09	**58.74**
1980	5.75	2.52	5.99	4.05	2.24	1.86	4.86	2.27	3.18	4.22	1.51	2.00	**40.45**
1981	0.93	2.64	1.95	1.77	2.79	4.72	3.95	8.62	0.97	1.50	0.83	4.50	**35.17**
1982	4.81	5.05	2.56	2.61	3.00	4.88	5.02	5.14	6.81	3.61	4.19	4.08	**51.76**
1983	3.25	6.74	8.66	3.81	4.12	8.68	2.35	3.41	5.01	2.96	3.76	4.59	**57.34**
1984	3.33	4.66	3.40	6.08	9.83	0.93	8.39	6.21	4.76	0.20	0.93	1.16	**49.88**
1985	5.48	3.22	2.00	0.65	1.73	4.21	6.03	3.39	10.54	5.86	5.76	0.37	**49.24**
1986	1.90	1.41	1.96	1.07	1.79	3.85	4.41	11.79	0.44	0.95	1.31	4.44	**35.32**
1987	9.16	3.08	3.47	3.27	1.90	4.05	2.47	5.44	6.67	0.79	3.00	3.39	**46.69**
1988	3.41	2.72	2.09	4.26	4.85	6.10	1.91	7.33	4.71	3.07	4.88	0.67	**46.00**
1989	2.28	6.02	8.05	6.89	5.14	6.50	9.56	7.39	5.21	3.01	2.82	4.41	**67.28**
1990	3.22	2.21	4.68	2.55	5.88	1.36	2.72	10.26	1.15	3.56	2.45	2.19	**42.23**
1991	4.65	2.40	5.63	3.18	0.91	3.80	9.99	4.99	4.68	3.08	1.88	3.16	**48.35**
1992	2.80	1.74	0.00	1.57	4.81	6.18	4.08	9.01	4.05	3.05	3.80	2.50	**43.59**
1993	7.32	1.96	6.41	2.80	2.62	4.75	3.47	2.62	3.05	4.81	1.27	3.22	**44.30**
1994	4.87	2.90	7.91	0.00	3.75	2.25	4.44	3.00	3.44	2.67	3.07	1.28	**39.58**
1995	3.36	4.97	4.45	1.50	3.95	6.81	5.43	5.24	1.88	4.19	3.68	1.82	**47.28**
1996	3.56	2.72	5.61	3.47	4.23	5.75	6.43	5.88	6.59	6.68	3.00	2.75	**56.67**
1997	2.81	2.53	3.94	4.00	1.54	2.18	3.76	3.62	3.57	1.01	3.23	3.00	**35.19**
1998	5.81	7.89	3.97	2.21	3.53	7.15	4.76	4.01	3.01	2.28	2.52	5.15	**52.29**
1999	1.22	1.22	2.95	2.07	2.21	3.60	7.92	3.93	18.87	10.91	1.40	0.97	**57.27**
2000	4.41	1.33	0.99	4.34	4.44	8.17	3.86	6.94	3.31	0.00	2.37	0.95	**41.11**
2001	1.07	2.02	3.46	1.23	1.78	7.79	6.53	4.20	2.04	0.72	1.05	0.78	**32.67**
2002	6.49	1.90	5.95	2.42	1.71	2.56	6.95	6.25	1.71	4.54	4.79	3.30	**48.57**
2003	1.88	5.47	3.64	3.32	6.73	2.19	7.07	7.04	13.09	3.74	1.80	5.19	**61.16**
2004	0.37	2.18	2.63	4.00	4.07	4.50	6.07	7.91	3.57	1.88	2.77	1.07	**41.02**
2005	2.77	3.03	4.26	2.80	5.30	2.56	11.13	3.75	1.65	10.64	2.50	3.44	**53.83**
2006	3.34	1.11	1.45	3.20	4.71	12.68	4.74	2.98	4.65	1.63	---	---	**---**
Monthly Averages	**3.83**	**3.44**	**3.92**	**3.22**	**3.85**	**4.56**	**6.15**	**5.66**	**4.63**	**3.21**	**2.94**	**2.98**	
												1933-2005 Average =	**48.42**
												1993-2005 Average =	**47.00**

Notes:
1. --- = data not available
2. Data obtained from Southeast Regional Climate Center web site (http://cirrus.dnr.state.sc.us/cgi-bin/sercc/cliMAIN.pl?nc2635).

FIGURES

FIGURE 1

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.)
- Pinehurst Formation - unconsolidated sand.
- Terrace deposits and upland sediment - gravel, claycy sand and sand.
- Waccamaw Formation - fossiliferous sand with silt and clay.

Tertiary

- 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

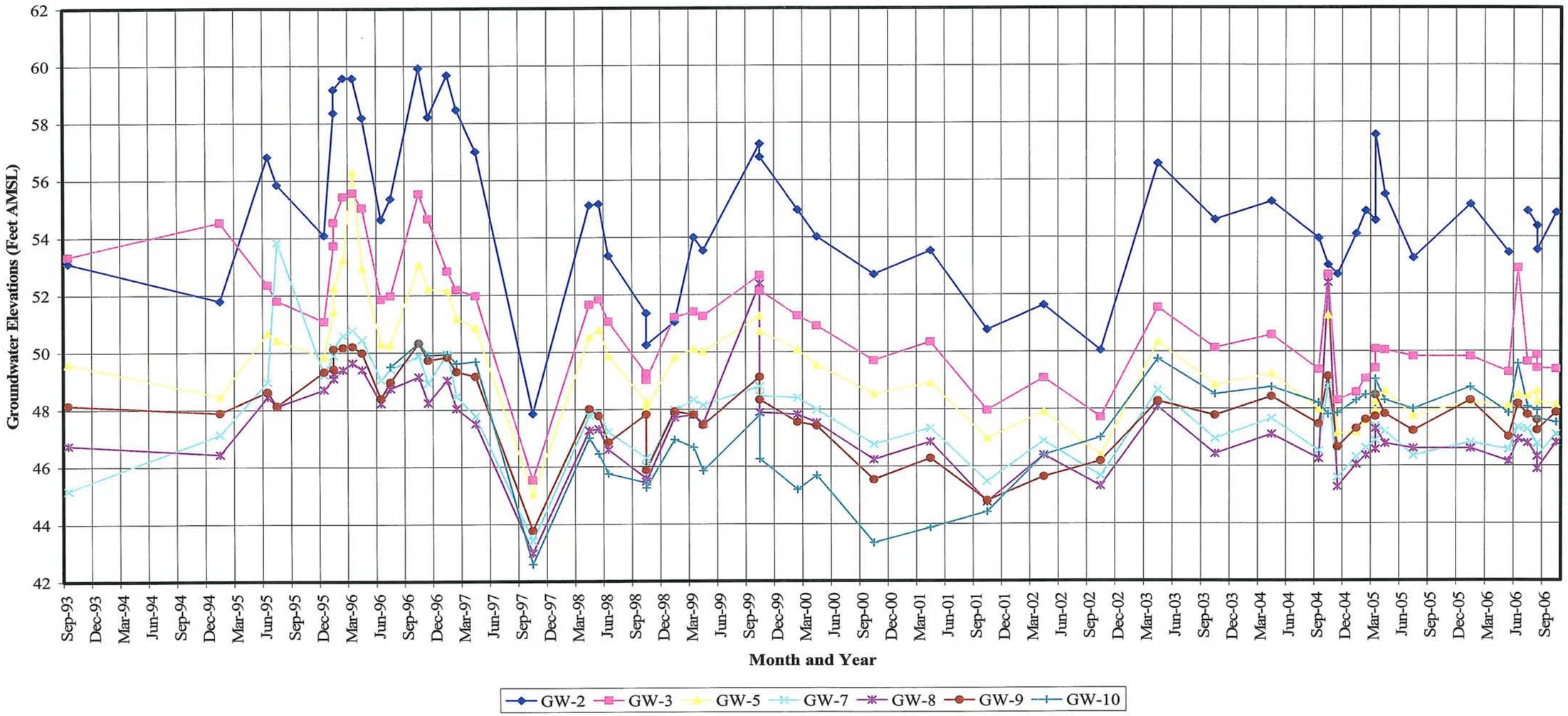
- Dan River Group, undivided -
  Stoneville Formation - conglomerate, sandstone and mudstone.
  Cow Branch Formation - mudstone.
  Pine Hall Formation - sandstone, mudstone and conglomerate.
- Chatham Group, undivided -
  Sanford Formation - conglomerate, sandstone and mudstone.
  Cumnock Formation -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

50 Miles

GEOLOGICAL SURVEY
N.C.
1823

1991

Reprinted, 1996



Golder Associates

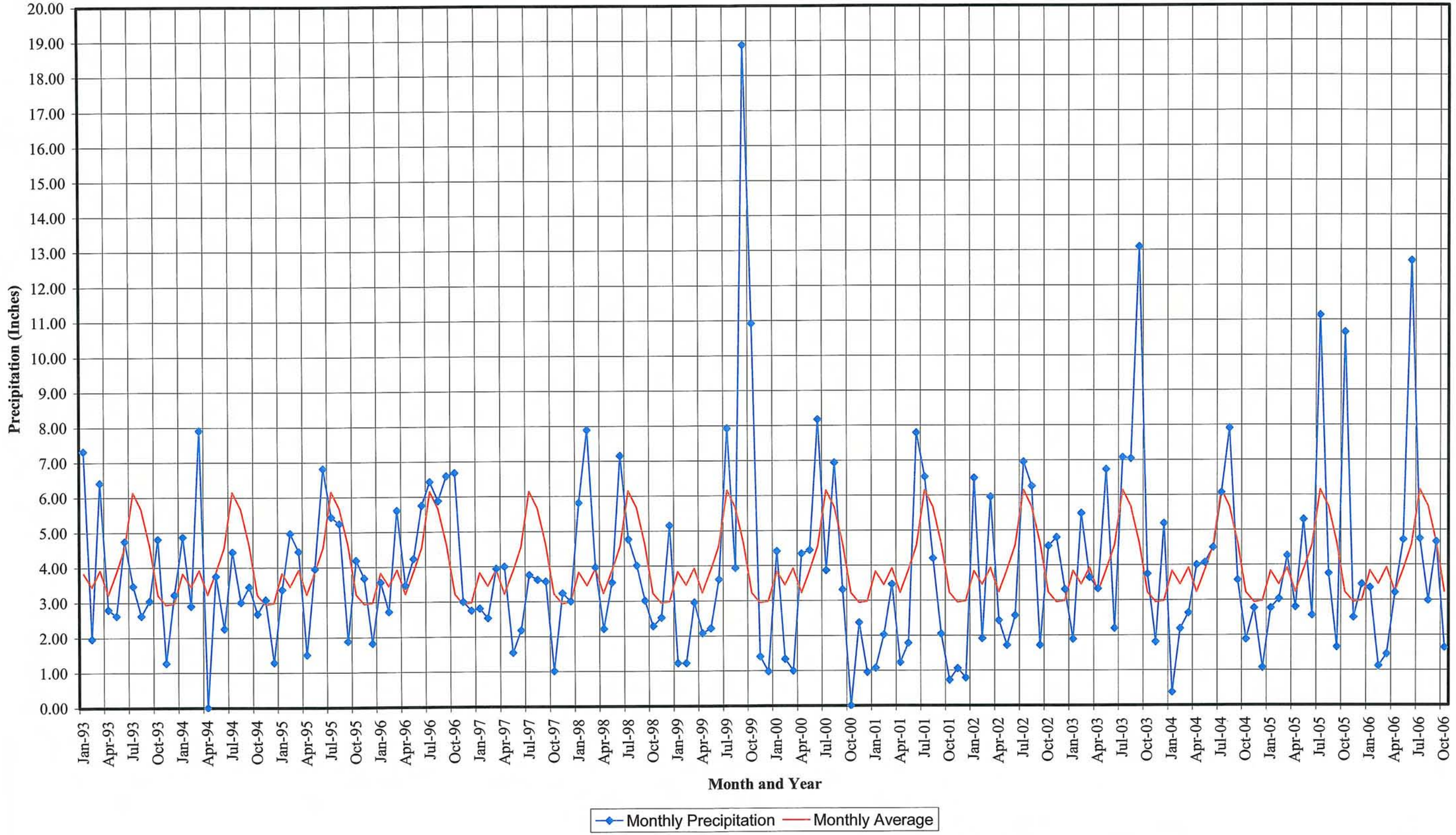
DATE: 07/16/2007
Project #: 063-6507
Prepared By: DYR
Reviewed By: RPK

Title:

MONITORING WELL HYDROGRAPH

East Carolina Regional Landfill

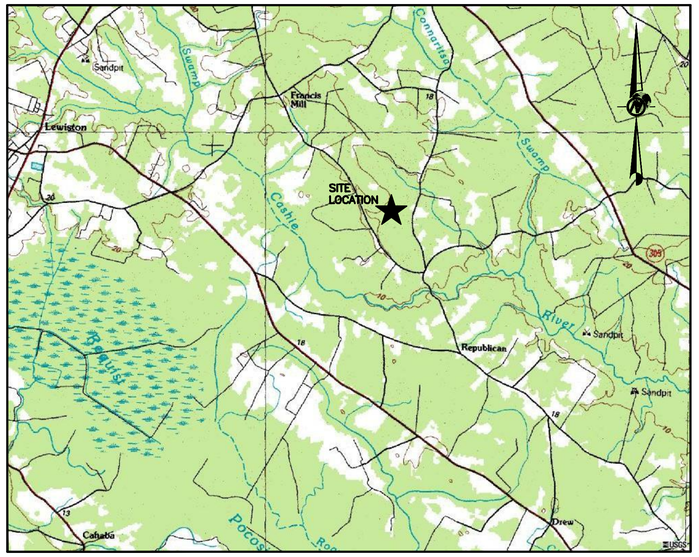
Figure No. 2



Golder Associates	DATE: 07/16/2007 Project #: 063-6507 Prepared By: DYR Reviewed By: RPK	Title: ***HISTORICAL PRECIPITATION DATA SUMMARY*** ***Edenton, North Carolina***	**Figure No. 3**

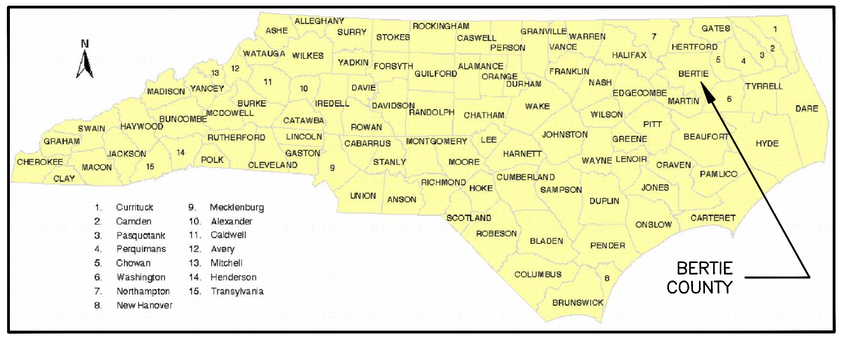
DRAWINGS

REPUBLIC SERVICES OF NORTH CAROLINA, L.L.C.
EAST CAROLINA REGIONAL MSW LANDFILL
PERMIT NUMBER 08-03
BERTIE COUNTY, NORTH CAROLINA



Source:TerraServer USA, Image courtesy of the U.S. Geological Survey.

VICINITY MAP
NOT TO SCALE



NORTH CAROLINA
COUNTY LOCATION MAP

DRAWING NO.	DESCRIPTION
DH-0	COVER SHEET
DH-1.	BORING,PIEZOMETER, AND MONITORING WELL LOCATION MAP
DH-2.	YORKTOWN FORMATION, OCTOBER 31, 2006, POTENTIOMETRIC SURFACE CONTOUR MAP
DH-3.	BLACK CREEK FORMATION, OCTOBER 31, 2006, POTENTIOMETRIC SURFACE CONTOUR MAP
DH-4.	LAYER I ISOPACH MAP
DH-5	LAYER II ISOPACH MAP
DH-6.	LAYER III ISOPACH MAP
DH-7.	HYDROGEOLOGIC CROSS-SECTION-LOCATION OF LINES OF SECTION
DH-8.	HYDROGEOLOGIC CROSS-SECTIONS A-A' AND B-B', AND C-C'
DH-9.	SEASONAL HIGH GROUNDWATER SURFACE MAP/LAYER II SURFACE CONTOUR MAP
WQMP-1	WATER QUALITY MONITORING PLAN WITH THE YORKTOWN FORMATION POTENTIOMETRIC SURFACE

PREPARED BY:

Golder Associates
Golder Associates NC, Inc.

PREPARED FOR:

REPUBLIC SERVICES, INC.

Golder Associates
Golder Associates NC IN

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

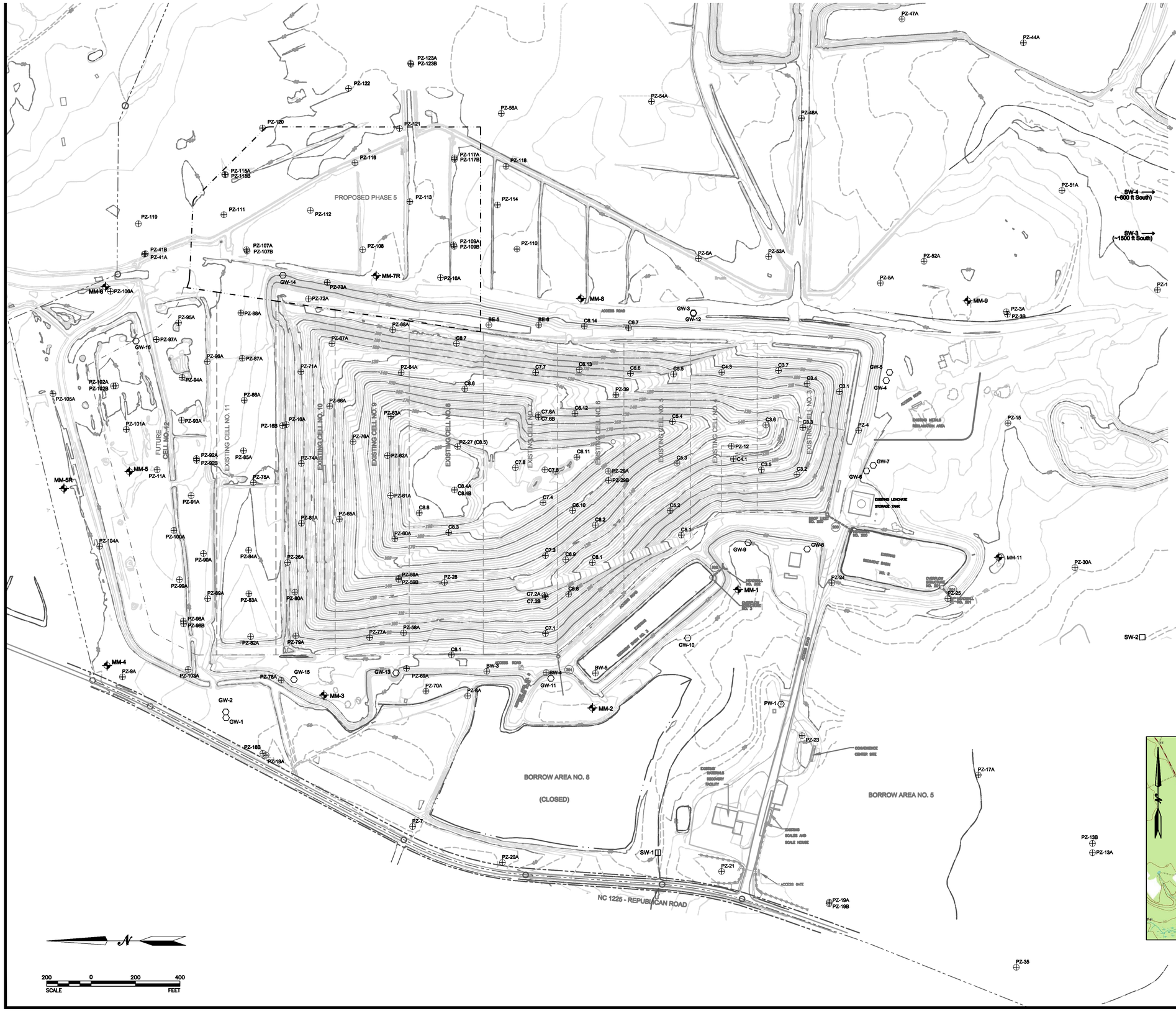
EAST CAROLINA REGIONAL
MSW LANDFILL
BERTIE COUNTY, NC

COVER SHEET

TITLE

PROJECT No.		063-8507
FILE No.	0636506A	EP-01&02
REV. 1	SCALE	AS SHOWN
DESIGN	CDH	01/15/07
CADD	OSY	01/15/07
CHECK		
REVIEW		

DH-0

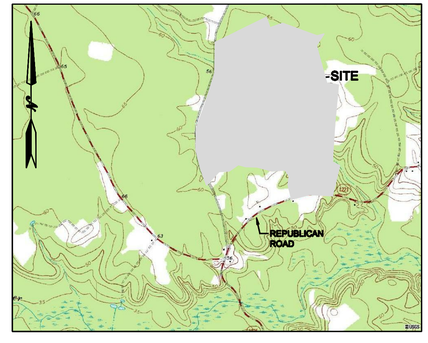


LEGEND

EXISTING TOPOGRAPHIC CONTOUR	
PROPERTY BOUNDARY	
LIMITS OF WASTE	
PROPOSED LIMITS OF WASTE	
GROUNDWATER MONITORING WELL	GW-2
SURFACE WATER MONITORING POINT	SW-1
METHANE MONITORING WELL	MM-1
PRIVATE WATER SUPPLY WELL	PW-1
PIEZOMETER OR BORING	C5.1

NOTES:

1. TOPOGRAPHIC CONTOUR INTERVAL = 2 FEET.
2. THE LOCATION OF PW-1 IS APPROXIMATE.
3. REFER TO TABLE 1 TO DETERMINE THE STATUS OF BORINGS, PIEZOMETERS AND MONITORING WELLS.
4. SURFACE WATER POINTS SW-3 AND SW-4 ARE OUTSIDE OF THE LIMITS OF MAPPING.



SITE LOCATION MAP

1.0 0 1.0
SCALE MILE
(SCALE IS APPROXIMATE)

Golder Associates
GOLDER ASSOCIATES INC., INC.

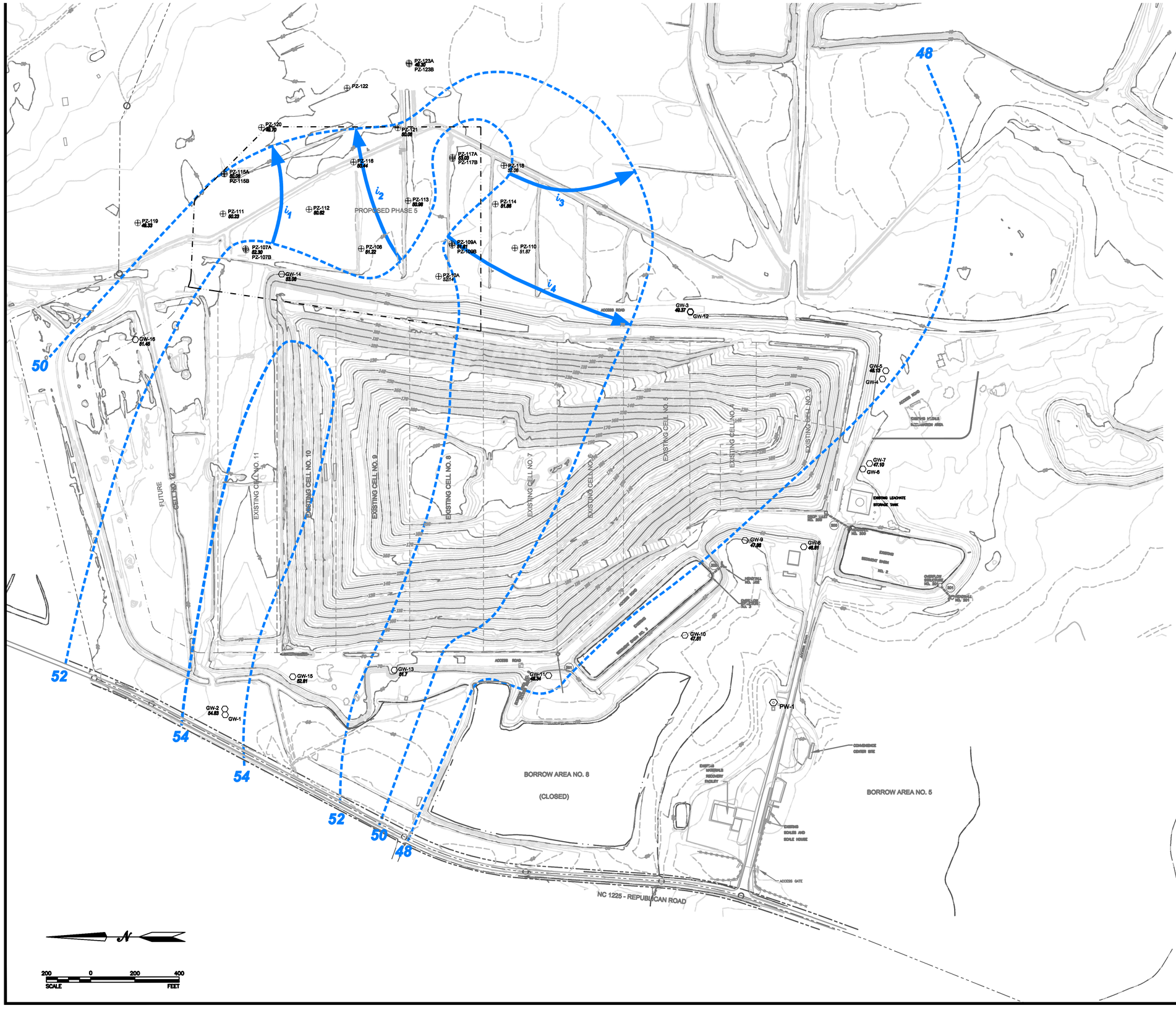
REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT
EAST CAROLINA REGIONAL
MSW LANDFILL
REPUBLIC SERVICES OF NORTH
CAROLINA, LLC
BERTIE COUNTY, NORTH
CAROLINA

TITLE
BORING, PIEZOMETER,
AND MONITORING WELL
LOCATION MAP

PROJECT No.		063-6507
FILE No.		
REV. 0	SCALE	AS SHOWN
DESIGN	DYR	07/16/07
CADD	LKB	07/16/07
CHECK		
REVIEW		

DH-1



LEGEND

- EXISTING TOPOGRAPHIC CONTOUR
- PROPERTY BOUNDARY
- LIMITS OF WASTE
- PROPOSED LIMITS OF WASTE
- **GROUNDWATER SURFACE CONTOURS** — 48
- APPROXIMATE GROUNDWATER FLOW SEGMENT USED TO CALCULATE GRADIENT — i_1
- GROUNDWATER MONITORING WELL WITH GROUNDWATER ELEVATION — GW-2 54.83
- PRIVATE WATER SUPPLY WELL — PW-1
- PIEZOMETER WITH GROUNDWATER ELEVATION — PZ-112 50.62

NOTES:

1. TOPOGRAPHIC CONTOUR INTERVAL = 2 FEET.
2. GROUNDWATER SURFACE CONTOUR INTERVAL = 2 FEET.
3. GROUNDWATER ELEVATIONS MEASURED ON OCTOBER 31, 2006.
4. GROUNDWATER CONTOURS ARE BASED ON LINEAR INTERPOLATION BETWEEN AND EXTRAPOLATION FROM KNOWN DATA, TOPOGRAPHIC CONTOURS, AND KNOWN FIELD CONDITIONS. THEREFORE, GROUNDWATER CONTOURS MAY NOT REFLECT ACTUAL GROUNDWATER CONDITIONS.
5. GROUNDWATER CONTOUR LINES SHOW THE WATER TABLE SHAPE AND ELEVATION. THESE CONTOURS ARE INFERRED LINES FOLLOWING THE GROUNDWATER SURFACE AT A CONSTANT ELEVATION ABOVE SEA LEVEL. THE GROUNDWATER FLOW DIRECTION IS GENERALLY PERPENDICULAR TO THE GROUNDWATER SURFACE CONTOURS, SIMILAR TO THE RELATIONSHIP BETWEEN SURFACE WATER FLOW AND TOPOGRAPHIC CONTOURS.
6. MONITORING WELLS AND PIEZOMETERS WITHOUT GROUNDWATER ELEVATIONS ARE SCREENED IN THE LOWER BLACK CREEK FORMATION AND GROUNDWATER ELEVATION DATA WERE NOT USED IN THE CONSTRUCTION OF CONTOURS.
7. THE LOCATION OF PW-1 IS APPROXIMATE.

Golder Associates
GOLDER ASSOCIATES INC., INC

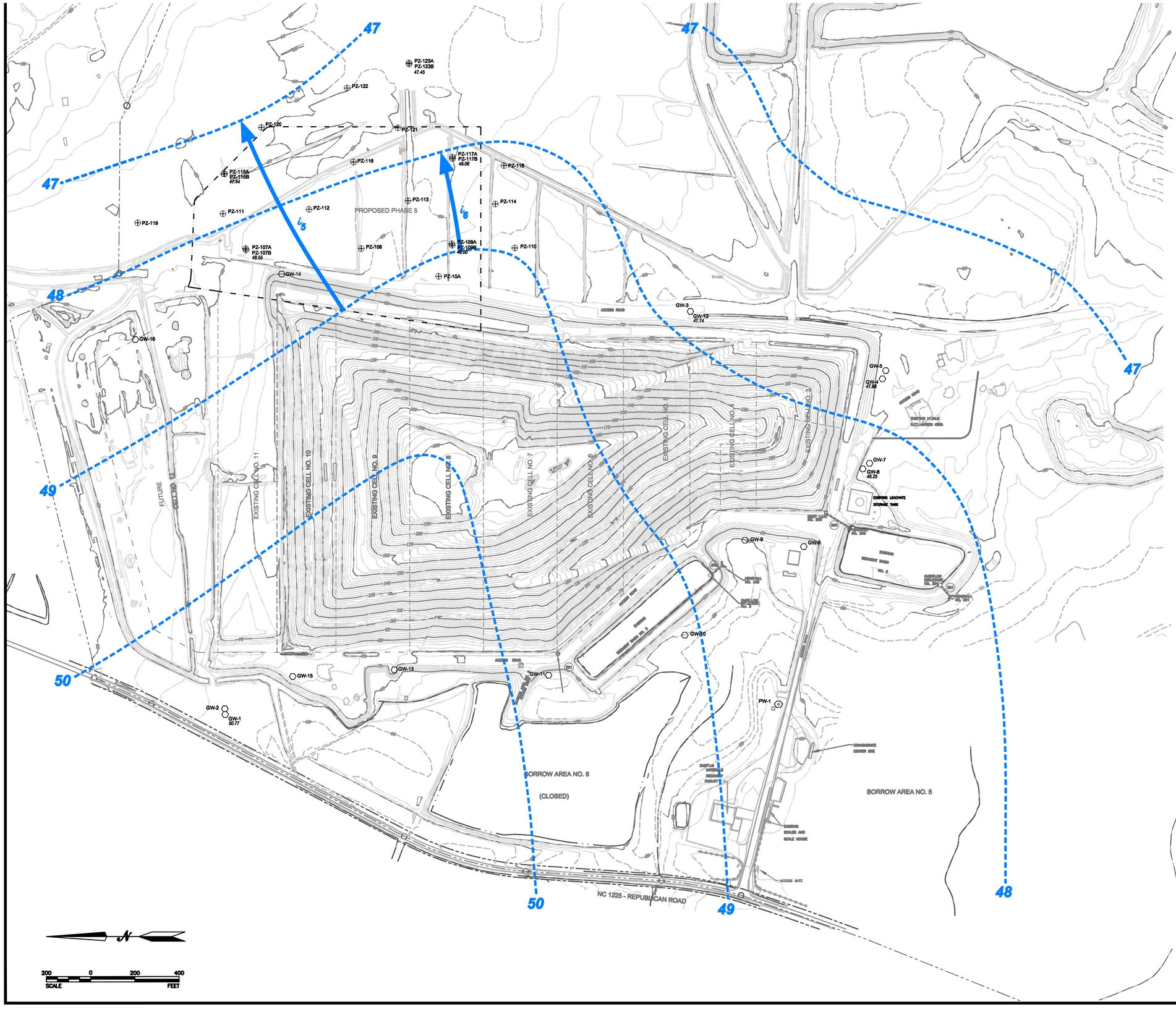
REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT
EAST CAROLINA REGIONAL
MSW LANDFILL
REPUBLIC SERVICES OF NORTH
CAROLINA, LLC
BERTIE COUNTY, NORTH
CAROLINA

TITLE
YORKTOWN FORMATION
OCTOBER 31, 2006
POTENTIOMETRIC SURFACE
CONTOUR MAP

PROJECT No.	063-6507	
FILE No.		
REV. 0	SCALE	AS SHOWN
DESIGN	DYR	07/16/07
CADD	LKB	07/16/07
CHECK		
REVIEW		

DH-2



LEGEND

- EXISTING TOPOGRAPHIC CONTOUR
- PROPERTY BOUNDARY
- LIMITS OF WASTE
- PROPOSED LIMITS OF WASTE
- GROUNDWATER SURFACE CONTOURS — 48
- APPROXIMATE GROUNDWATER FLOW SEGMENT USED TO CALCULATE GRADIENT — i_1
- GROUNDWATER MONITORING WELL WITH GROUNDWATER ELEVATION — GW-1 50.77
- PRIVATE WATER SUPPLY WELL — PW-1
- PIEZOMETER WITH GROUNDWATER ELEVATION — PZ-107B 48.55

NOTES:

1. TOPOGRAPHIC CONTOUR INTERVAL = 2 FEET.
2. GROUNDWATER SURFACE CONTOUR INTERVAL = 1 FOOT.
3. GROUNDWATER ELEVATIONS MEASURED ON OCTOBER 31, 2006.
4. GROUNDWATER CONTOURS ARE BASED ON LINEAR INTERPOLATION BETWEEN AND EXTRAPOLATION FROM KNOWN DATA, TOPOGRAPHIC CONTOURS, AND KNOWN FIELD CONDITIONS. THEREFORE, GROUNDWATER CONTOURS MAY NOT REFLECT ACTUAL GROUNDWATER CONDITIONS.
5. GROUNDWATER CONTOUR LINES SHOW THE WATER TABLE SHAPE AND ELEVATION. THESE CONTOURS ARE INFERRED LINES FOLLOWING THE GROUNDWATER SURFACE AT A CONSTANT ELEVATION ABOVE SEA LEVEL. THE GROUNDWATER FLOW DIRECTION IS GENERALLY PERPENDICULAR TO THE GROUNDWATER SURFACE CONTOURS, SIMILAR TO THE RELATIONSHIP BETWEEN SURFACE WATER FLOW AND TOPOGRAPHIC CONTOURS.
6. MONITORING WELLS AND PIEZOMETERS WITHOUT GROUNDWATER ELEVATIONS ARE SCREENED IN THE YORKTOWN FORMATION AND GROUNDWATER ELEVATION DATA WERE NOT USED IN THE CONSTRUCTION OF CONTOURS.
7. THE LOCATION OF PW-1 IS APPROXIMATE.

Golder Associates
GOLDER ASSOCIATES INC., INC

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT

EAST CAROLINA REGIONAL MSW LANDFILL
REPUBLIC SERVICES OF NORTH CAROLINA, LLC
BERTIE COUNTY, NORTH CAROLINA

TITLE

BLACK CREEK FORMATION
OCTOBER 31, 2006
POTENTIOMETRIC SURFACE CONTOUR MAP

PROJECT No.		063-6507
FILE No.		
REV. 0	SCALE	AS SHOWN
DESIGN	DYR	07/16/07
CADD	LKB	07/16/07
CHECK		
REVIEW		

DH-3

LEGEND

- EXISTING TOPOGRAPHIC CONTOUR
- PROPERTY BOUNDARY
- LIMITS OF WASTE
- PROPOSED LIMITS OF WASTE
- LAYER I ISOPACHS — 48
- GROUNDWATER MONITORING WELL WITH LAYER I THICKNESS — GW-14 19.0
- PIEZOMETER OR BORING WITH LAYER I THICKNESS — PZ-117B 15.3

NOTES:

1. TOPOGRAPHIC CONTOUR INTERVAL = 2 FEET.
2. LAYER I ISOPACH INTERVAL = 2 FEET.
3. ISOPACHS ARE BASED ON LINEAR INTERPOLATION BETWEEN AND EXTRAPOLATION FROM KNOWN DATA, TOPOGRAPHIC CONTOURS, AND KNOWN FIELD CONDITIONS. THEREFORE, ISOPACHS MAY NOT REFLECT ACTUAL CONDITIONS.

PROPOSED PHASE 5

ACCESS ROAD

PZ-123A 17.5
PZ-123B 17.5
PZ-122 11.9
PZ-120 10.0
PZ-121 11.5
PZ-56A 12.0
PZ-116 10.0
PZ-115A 8.0
PZ-115B 8.0
PZ-117A 15.3
PZ-117B 15.3
PZ-118 5.0
PZ-111 7.3
PZ-112 12.0
PZ-113 13.3
PZ-114 5.8
PZ-119 9.0
PZ-41B 5.5
PZ-41A 5.5
PZ-107A 13.5
PZ-107B 13.5
PZ-108 11.0
PZ-109A 7.8
PZ-109B 7.8
PZ-110 9.8
GW-14 19.0
PZ-73A 12.0
PZ-10A 3.0
PZ-106A 5.5
PZ-72A 8.0
PZ-88A 14.0
PZ-95A 8.0
PZ-97A 9.0
GW-16 9.5
PZ-68A 3.0
BE-5 17.0
BE-6 8.0
PZ-67A 8.0
C8.7 12.0

N

100 0 100 200
SCALE FEET

Golder Associates
GOLDER ASSOCIATES INC, INC

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT
EAST CAROLINA REGIONAL MSW LANDFILL
REPUBLIC SERVICES OF NORTH CAROLINA, LLC
BERTIE COUNTY, NORTH CAROLINA

TITLE
LAYER I ISOPACH MAP

PROJECT No.	063-6507	
FILE No.		
REV. 0	SCALE	AS SHOWN
DESIGN	DYR	07/16/07
CADD	LKB	07/16/07
CHECK		
REVIEW		

DH-4

LEGEND

- EXISTING TOPOGRAPHIC CONTOUR
- PROPERTY BOUNDARY
- LIMITS OF WASTE
- PROPOSED LIMITS OF WASTE
- LAYER I ISOPACHS — 48
- GROUNDWATER MONITORING WELL WITH LAYER I THICKNESS — GW-14 11.0
- PIEZOMETER OR BORING WITH LAYER I THICKNESS — PZ-110 22.0

NOTES:

1. TOPOGRAPHIC CONTOUR INTERVAL = 2 FEET.
2. LAYER II ISOPACH INTERVAL = 2 FEET.
3. ISOPACHS ARE BASED ON LINEAR INTERPOLATION BETWEEN AND EXTRAPOLATION FROM KNOWN DATA, TOPOGRAPHIC CONTOURS, AND KNOWN FIELD CONDITIONS. THEREFORE, ISOPACHS MAY NOT REFLECT ACTUAL CONDITIONS.

PROPOSED PHASE 5

ACCESS ROAD

PZ-123A >5.5
PZ-123B 6.0
PZ-122 13.1
PZ-120 12.0
PZ-121 12.3
PZ-56A 25.0
PZ-116 11.8
PZ-115A 9.8
PZ-115B 9.8
PZ-117A 4.2
PZ-117B 4.2
PZ-118 18.8
PZ-113 12.5
PZ-114 19.7
PZ-112 11.0
PZ-111 11.2
PZ-119 14.8
PZ-109A 17.7
PZ-109B 17.7
PZ-110 22.0
PZ-108 8.8
PZ-107A >13.5
PZ-107B 16.3
PZ-41B 16.5
PZ-41A >12.8
PZ-10A 26.5
GW-14 11.0
PZ-73A 15.0
PZ-106A 16.5
PZ-72A 14.5
PZ-88A 8.0
PZ-95A 14.0
PZ-97A 13.0
GW-16 14.0
PZ-68A 19.0
BE-5 10.0
BE-6 >18.5
PZ-67A 14.0
C8.7 15.0

100 0 100 200
SCALE FEET

Golder Associates
GOLDER ASSOCIATES INC, INC

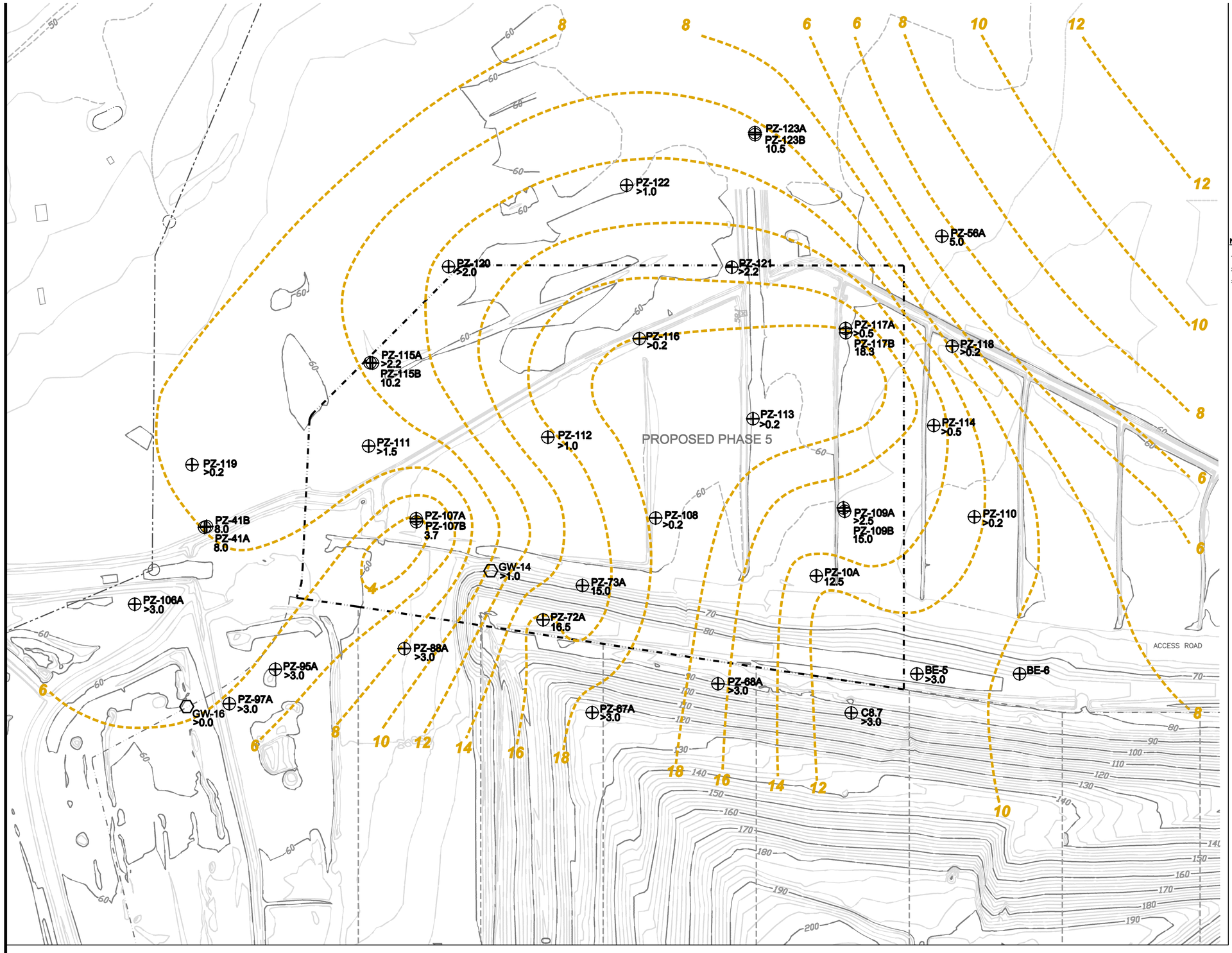
REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT
EAST CAROLINA REGIONAL MSW LANDFILL
REPUBLIC SERVICES OF NORTH CAROLINA, LLC
BERTIE COUNTY, NORTH CAROLINA

TITLE
LAYER II ISOPACH MAP

PROJECT No.		063-6507
FILE No.		
REV. 0	SCALE	AS SHOWN
DESIGN	DYR	07/16/07
CADD	LKB	07/16/07
CHECK		
REVIEW		

DH-5



LEGEND

- EXISTING TOPOGRAPHIC CONTOUR
- PROPERTY BOUNDARY
- LIMITS OF WASTE
- PROPOSED LIMITS OF WASTE
- LAYER I ISOPACHS — 48
- GROUNDWATER MONITORING WELL WITH LAYER I THICKNESS — GW-14 >1.0
- PIEZOMETER OR BORING WITH LAYER I THICKNESS — PZ-107B 3.7

NOTES:

1. TOPOGRAPHIC CONTOUR INTERVAL = 2 FEET.
2. LAYER III ISOPACH INTERVAL = 2 FEET.
3. ISOPACHS ARE BASED ON LINEAR INTERPOLATION BETWEEN AND EXTRAPOLATION FROM KNOWN DATA, TOPOGRAPHIC CONTOURS, AND KNOWN FIELD CONDITIONS. THEREFORE, ISOPACHS MAY NOT REFLECT ACTUAL CONDITIONS.

Golder Associates
GOLDER ASSOCIATES INC, INC

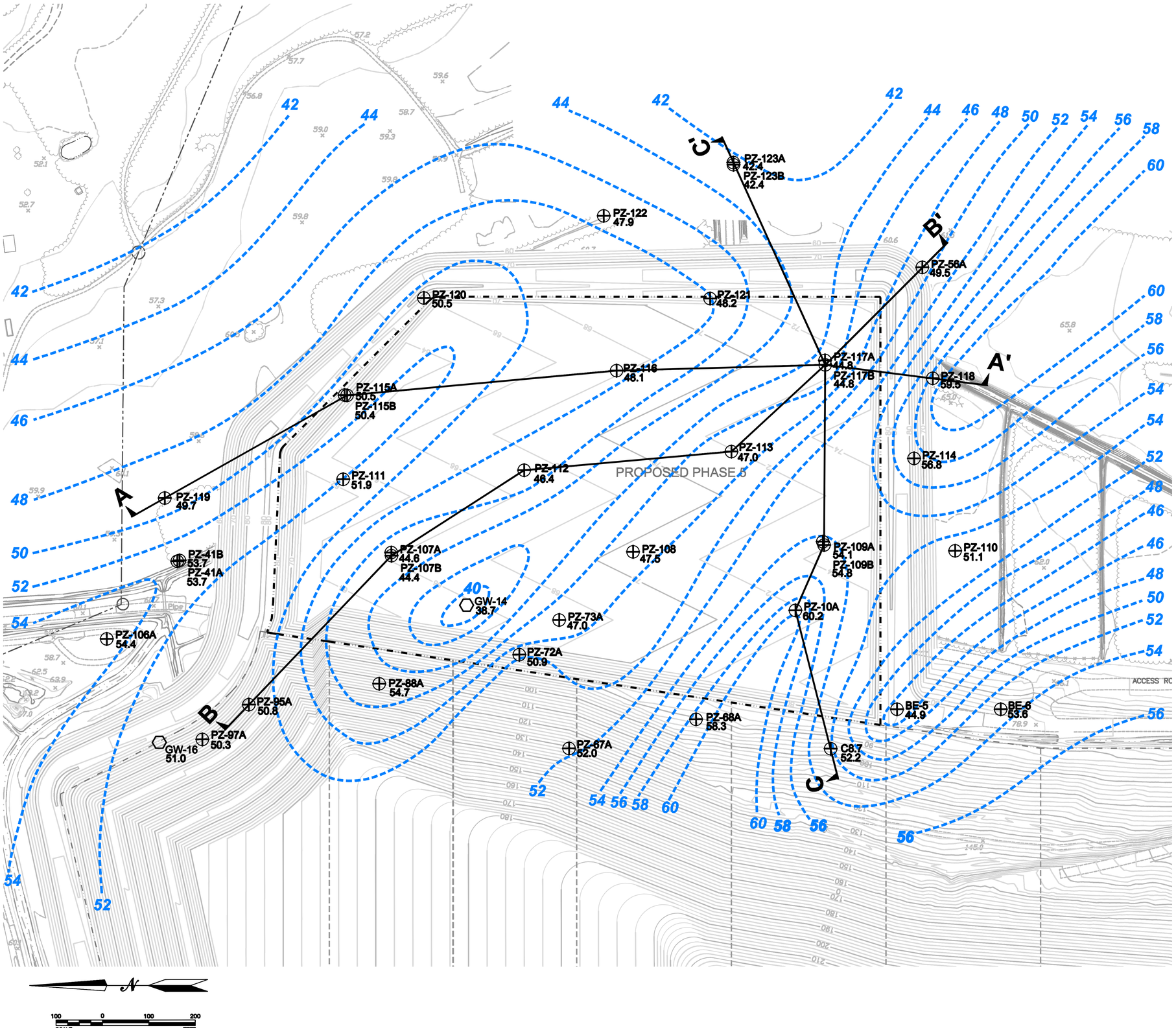
REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT
EAST CAROLINA REGIONAL
MSW LANDFILL
REPUBLIC SERVICES OF NORTH
CAROLINA, LLC
BERTIE COUNTY, NORTH
CAROLINA

TITLE
LAYER III ISOPACH MAP

PROJECT No.		063-6507
FILE No.		
REV. 0	SCALE	AS SHOWN
DESIGN	DYR	07/16/07
CADD	LKB	07/16/07
CHECK		
REVIEW		

DH-6



LEGEND

EXISTING TOPOGRAPHIC CONTOUR	
PROPERTY BOUNDARY	
LIMITS OF WASTE	
PROPOSED LIMITS OF WASTE	
LAYER II SURFACE CONTOURS	48
LINES OF SECTION	A
GROUNDWATER MONITORING WELL WITH TOP OF LAYER II ELEVATION	GW-16 51.0
PIEZOMETER WITH TOP OF LAYER II ELEVATION	PZ-108 47.5

NOTES:

1. TOPOGRAPHIC CONTOUR INTERVAL = 2 FEET.
2. LAYER II SURFACE CONTOUR INTERVAL = 2 FEET.
3. LAYER II CONTOURS ARE BASED ON LINEAR INTERPOLATION BETWEEN AND EXTRAPOLATION FROM KNOWN DATA, TOPOGRAPHIC CONTOURS, AND KNOWN FIELD CONDITIONS. THEREFORE, LAYER II CONTOURS MAY NOT REFLECT ACTUAL CONDITIONS.
4. AT WELL PAIRS, THE HIGHEST ELEVATION OF THE LAYER II SURFACE WAS USED IN THE CONSTRUCTION OF THE CONTOURS.

Golder Associates
GOLDER ASSOCIATES INC., INC.

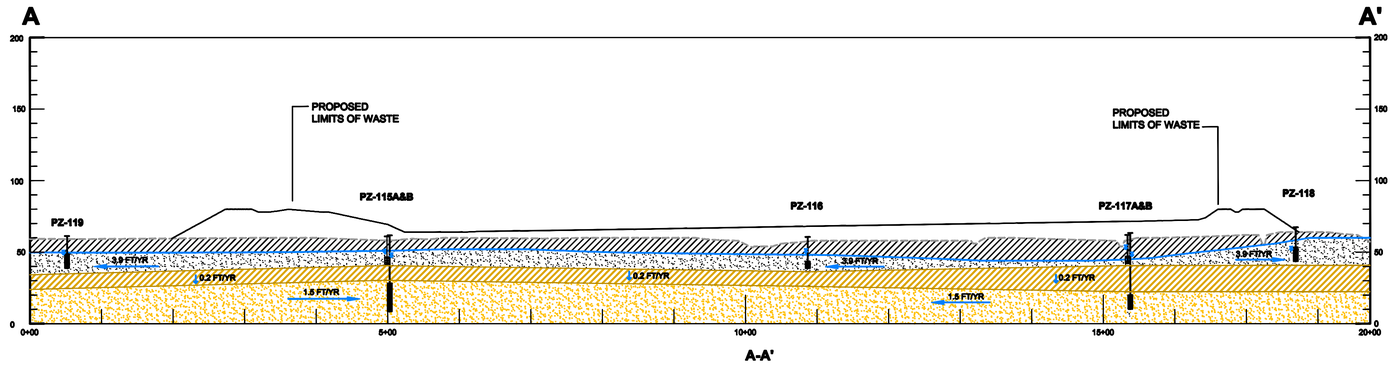
REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT
EAST CAROLINA REGIONAL MSW LANDFILL
REPUBLIC SERVICES OF NORTH CAROLINA, LLC
BERTIE COUNTY, NORTH CAROLINA

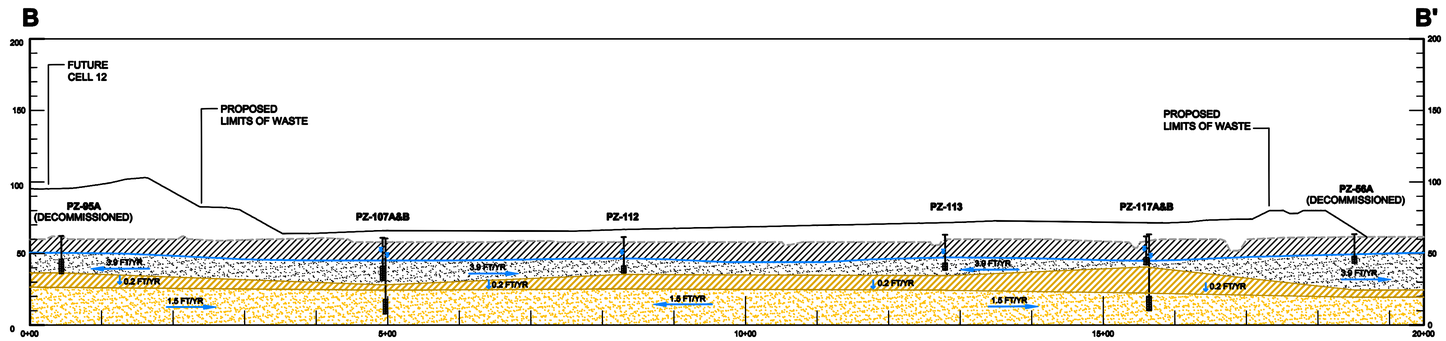
TITLE
LOCATION OF HYDROGEOLOGIC CROSS-SECTIONS

PROJECT No.		063-6507
FILE No.		
REV.	SCALE	AS SHOWN
DESIGN	DYR	07/16/07
CADD	LKB	07/16/07
CHECK		
REVIEW		

DH-7



A-A'



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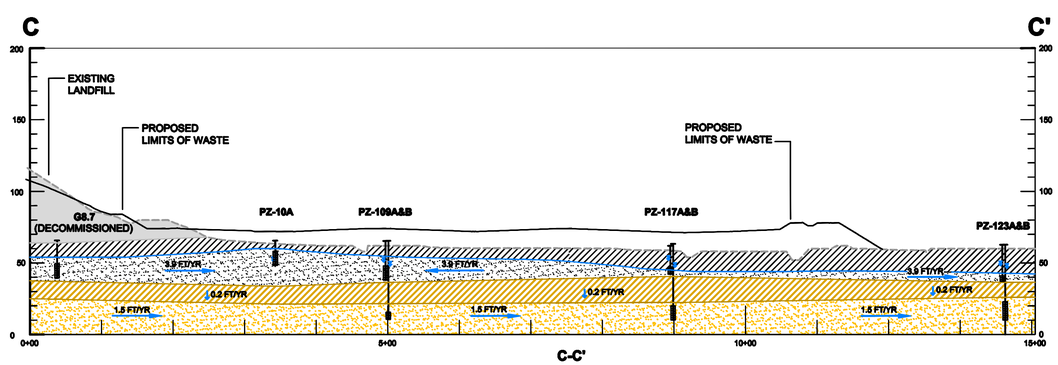

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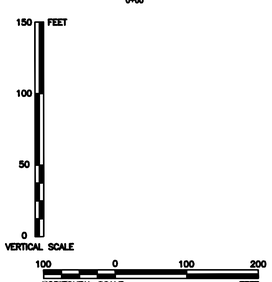

LEGEND

- EXISTING GROUND SURFACE
- PROPOSED BASE GRADE
- SEASONAL HIGH GROUNDWATER SURFACE
- ANTICIPATED DIRECTION OF GROUNDWATER FLOW WITH ESTIMATED FLOW RATE — 1.5 FT/YR
- PIEZOMETER WITH SCREEN INTERVAL
- POTENTIOMETRIC SURFACE (MEASURED ON OCTOBER 31, 2006)
- EXISTING LANDFILL
- LAYER I HYDROGEOLOGIC UNIT
- LAYER II HYDROGEOLOGIC UNIT
- LAYER III HYDROGEOLOGIC UNIT
- LAYER IV HYDROGEOLOGIC UNIT

NOTES:

1. THE POTENTIOMETRIC SURFACE ELEVATIONS WERE MEASURED ON OCTOBER 31, 2006.
2. FLOW VELOCITIES ARE AVERAGES OF CALCULATIONS FOR EACH HYDROGEOLOGIC UNIT USING OCTOBER 31, 2006, POTENTIOMETRIC SURFACE ELEVATIONS (SEE TABLE 9 AND 10 IN THE DESIGN HYDROGEOLOGIC REPORT).

Golder Associates
GOLDER ASSOCIATES INC, INC.

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT
EAST CAROLINA REGIONAL MSW LANDFILL
REPUBLIC SERVICES OF NORTH CAROLINA, LLC
BERTIE COUNTY, NORTH CAROLINA

TITLE
HYDROGEOLOGIC CROSS-SECTIONS

PROJECT No.	063--6507	
FILE No.		
REV.	SCALE	AS SHOWN
DESIGN	DYR	07/16/07
CADD	LKB	07/16/07
CHECK		
REVIEW		

DH-8

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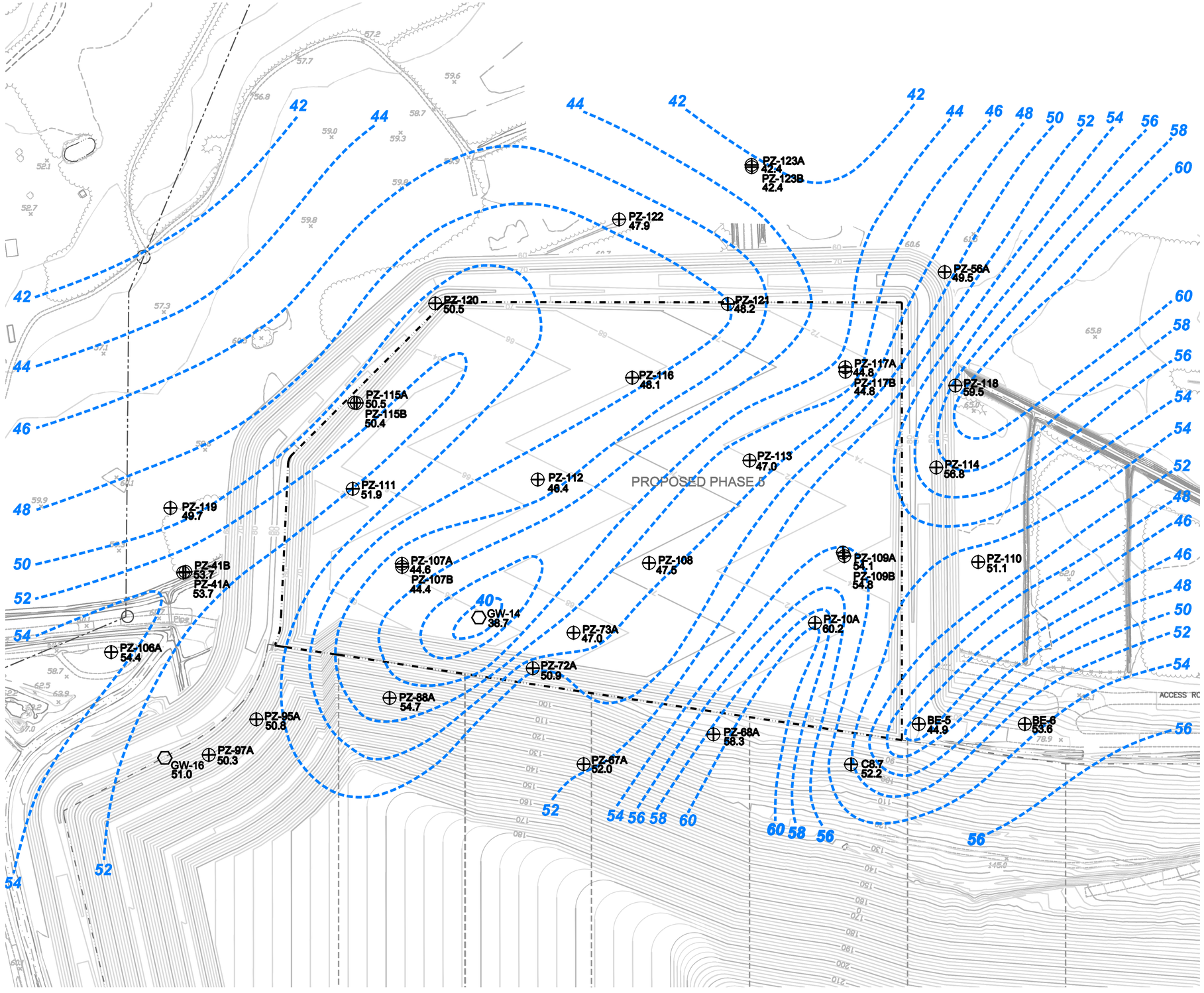


LEGEND

EXISTING TOPOGRAPHIC CONTOUR	
PROPERTY BOUNDARY	
LIMITS OF WASTE	
PROPOSED LIMITS OF WASTE	
LAYER II SURFACE CONTOURS	48
GROUNDWATER MONITORING WELL WITH TOP OF LAYER II ELEVATION	GW-16 51.0
PIEZOMETER WITH TOP OF LAYER II ELEVATION	PZ-108 47.5

NOTES:

1. TOPOGRAPHIC CONTOUR INTERVAL = 2 FEET.
2. LAYER II SURFACE CONTOUR INTERVAL = 2 FEET.
3. LAYER II CONTOURS ARE BASED ON LINEAR INTERPOLATION BETWEEN AND EXTRAPOLATION FROM KNOWN DATA, TOPOGRAPHIC CONTOURS, AND KNOWN FIELD CONDITIONS. THEREFORE, LAYER II CONTOURS MAY NOT REFLECT ACTUAL CONDITIONS.
4. AT WELL PAIRS, THE HIGHEST ELEVATION OF THE LAYER II SURFACE WAS USED IN THE CONSTRUCTION OF THE CONTOURS.

Golder Associates

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT
EAST CAROLINA REGIONAL MSW LANDFILL
REPUBLIC SERVICES OF NORTH CAROLINA, LLC
BERTIE COUNTY, NORTH CAROLINA

TITLE
SEASONAL HIGH GROUNDWATER SURFACE CONTOUR MAP/LAYER II SURFACE CONTOUR MAP

PROJECT No.	063-6507	
FILE No.		
REV.	SCALE	AS SHOWN
DESIGN	DYR	07/16/07
CADD	LKB	07/16/07
CHECK		
REVIEW		

DH-9

APPENDIX A

BORING LOGS FOR PIEZOMETERS AND MONITORING WELLS, WELL CONSTRUCTION DIAGRAMS, WELL DEVELOPMENT FORMS, WELL CONSTRUCTION RECORDS, AND FIELD LOGS

RECORD OF BOREHOLE 0803-GW-16

SHEET 1 of 1

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 24.0 ft
LOCATION: Aulander, NC

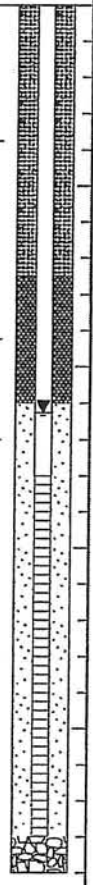
DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/24/06
DATE COMPLETED: 5/24/06

NORTHING: 869,514.6
EASTING: 2,572,042.8
GS ELEVATION: 61.0 ft
TOC ELEVATION: 63.0 ft

DEPTH W.L.: 11.3 ft
ELEVATION W.L.: 51.8 ft
DATE W.L.: 5/30/06
TIME W.L.: 11:36 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC
0	60	0.0 - 0.5 SILTY SAND - black fine grained silty sand with abundant organics	SM		60.5 0.5		SPT	2-1-2-3	3	50.0 2.0
		0.5 - 9.5 LEAN CLAY - tan fine grained sandy clay Orange and gray fine grained sandy clay at 2 ft, moist					SPT	3-4-7-12	11	50.0 2.0
5	55	Orange and gray silty clay at 6 ft, moist	CL				SPT	2-4-7-9	11	90.0 2.0
							SPT	4-6-7-12	13	100.0 2.0
					51.5		SPT	5-4-5-8	9	100.0 2.0
10	50	9.5 - 10.0 CLAYEY SAND - fine grained clayey sand	SC		51.0 10.0		SPT	3-3-2-4	5	80.0 2.0
		10.0 - 19.0 SILTY SAND - orange and gray mottled fine grained silty sand, saturated Orange fine grained silty sand, saturated at 12 ft					SPT	2-2-3-2	5	90.0 2.0
15	45	Tan fine graine silty sand, saturated at 14 ft	SM				SPT	2-1-2-3	3	90.0 2.0
							SPT	2-2-2-4	4	100.0 2.0
					42.0		SPT	3-5-8-12	13	100.0 2.0
20	40	19.0 - 19.3 CLAYEY SAND - fine grained clayey sand	SC SM		41.1					
		19.3 - 19.9 SILTY SAND - orange medium grained silty sand			19.9		SPT	3-4-7-10	11	100.0 2.0
		19.9 - 23.0 POORLY GRADED SAND - white and brown medium grained well sorted sand with organics, saturated	SP		38.0		SPT	1-2-1-2	3	100.0 2.0
		Augers terminated at 23 ft	CL CH		37.5 37.0					
25	35	23.0 - 23.5 LEAN CLAY - orange silty clay								
		23.5 - 24.0 FAT CLAY - blue gray fat clay								
		Boring completed at 24.0 ft								
30	30									
35	25									
40										

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: -2.03-13 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 13-23 ft
Material: PVC
Diameter: 2-inch
Slot Size: 0.010
End Cap: Threaded

FILTER PACK
Interval: 11-23 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 7.5-11 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-7.5 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: 3x3x0.5 ft concrete
Protective Casing: 4-inch Aluminum

DRILLING METHODS
Type: 4.25-inch ID Hollow Stem Augers

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 11/30/06

RECORD OF BOREHOLE PZ-107A

SHEET 1 of 1

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 27.0 ft
LOCATION: Aulander, NC

DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/17/06
DATE COMPLETED: 5/17/06

NORTHING: 869,050.6
EASTING: 2,572,486.5
GS ELEVATION: 58.1 ft
TOC ELEVATION: 61.0 ft

DEPTH W.L.: 8.6 ft
ELEVATION W.L.: 52.4 ft
DATE W.L.: 5/18/06
TIME W.L.: 11:43 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0	58	0.0 - 13.5 SANDY CLAY - gray and orange fine grained sandy clay, moist	CL		44.6				Grout	**WELL CASING** Interval: -2.95-17 ft Material: PVC Diameter: 2-inch Joint Type: Threaded **WELL SCREEN** Interval: 17-27 ft Material: PVC Diameter: 2-inch Slot Size: .010-inch End Cap: Threaded **FILTER PACK** Interval: 11-27 ft Type: #2 Sand **FILTER PACK SEAL** Interval: 8.5-11 ft Type: 3/8 Bentonite chip **ANNULUS SEAL** Interval: 0-8.5 ft Type: Portland/Bentonite mix **WELL COMPLETION** Pad: None Protective Casing: None **DRILLING METHODS** Type: 4.25-inch ID Hollow Stem Augers
5	55								Bentonite	
10	50								#2 Sand	
15	45	13.5 - 27.0 SILTY SAND - orange silty sand, saturated Changes to gray at 16 ft	SM		13.5				Screen	
20	40									
25	35				31.1				Collapsed Material	
30	30	Boring completed at 27.0 ft								
35	25									
40	20									

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 11/30/06

RECORD OF BOREHOLE PZ-107B

SHEET 1 of 2

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 50.0 ft
LOCATION: Aulander, NC

DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/16/06
DATE COMPLETED: 5/17/06

NORTHING: 869,047.8
EASTING: 2,572,480.7
GS ELEVATION: 57.9 ft
TOC ELEVATION: 60.5 ft

DEPTH W.L.: 18.1 ft
ELEVATION W.L.: 42.4 ft
DATE W.L.: 5/18/06
TIME W.L.: 11:46 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES
0		0.0 - 13.5 SANDY CLAY - black, fine grained sandy clay, changes to gray at 1.25 ft, moist					SPT	3-3-4-8	7	100.0 / 2.0	
	55	Gray and orange mottled fine grained sandy clay at 2 ft					SPT	6-6-8-11	14	60.0 / 2.0	
5							SPT	4-3-5-8	8	80.0 / 2.0	
		Becomes more sandy with fine grained sand at 6 ft	CL				SPT	6-9-11-15	20	100.0 / 2.0	
	50	Thin silty sand zone (<1 inch) at 8 ft that produces water Thin silty sand zones (<1 inch) at 9 ft and 9.25 ft that produces water					SPT	4-3-4-6	7	90.0 / 2.0	
10							SPT	5-8-8-13	16	100.0 / 2.0	
		Gray fine grained sandy clay at 12 ft					SPT	4-6-8-16	14	100.0 / 2.0	
	45				44.4						
		13.5 - 29.5 SILTY SAND - orange fine grained silty sand, saturated			13.5						
15		Changes to gray at 15 ft					SPT	4-7-6-11	13	100.0 / 2.0	
							SPT	5-7-5-3	12	100.0 / 2.0	
	40	More clayey at 17.75 ft Gray silty sand at 18 ft, saturated					SPT	3-3-4-5	7	100.0 / 2.0	Grout
20							SPT	2-2-1-2	3	100.0 / 2.0	
			SM								
		Thin clayey sand zone from 21.9 to 22 ft Orange silty sand with some clay at 22 ft, saturated					SPT	3-3-7-9	10	100.0 / 2.0	
	35										
25		Approximate 1 inch thick sandy clay zone at 25 ft Ten fine grained silty sand at 26 ft, saturated					SPT	2-1-2-3	3	100.0 / 2.0	
							SPT	4-3-5-8	8	100.0 / 2.0	
	30										
					28.4		SPT	4-4-4-4	8	100.0 / 2.0	
30		29.5 - 29.8 SANDY CLAY - light gray sandy clay	CL		29.8						
		29.8 - 33.5 FAT CLAY - blue gray fat clay	CH				SPT	2-1-1-2	2	100.0 / 2.0	
	25						SPT	1-1-0-1	1	60.0 / 2.0	
					24.4						
		33.5 - 34.0 CLAYEY SAND - gray medium grained clayey sand	SC		23.9						
		34.0 - 40.0 SILTY SAND - gray medium grained silty sand, saturated Some pebble size fragments of quartz at 36 ft	SM		34.0		SPT	2-1-2-7	3	100.0 / 2.0	
35							SPT	10-10-13-20	23	100.0 / 2.0	Bentonite
	20	Gray fine grained silty sand at 38 ft									
							SPT	20-10-13-15	23	100.0 / 2.0	#2 Sand
40					17.9						
		Log continued on next page									

WELL CASING
Interval: -2.60-40 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 40-50 ft
Material: PVC
Diameter: 2-inch
Slot Size: .010-inch
End Cap: Threaded

FILTER PACK
Interval: 38-50 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 36-38 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-36 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: None
Protective Casing: None

DRILLING METHODS
Type: 4.25-inch ID Hollow Stem Augers

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 11/30/06

RECORD OF BOREHOLE PZ-107B

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 50.0 ft
LOCATION: Aulander, NC

DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/16/06
DATE COMPLETED: 5/17/06

NORTHING: 869,047.8
EASTING: 2,572,480.7
GS ELEVATION: 57.9 ft
TOC ELEVATION: 60.5 ft

DEPTH W.L.: 18.1 ft
ELEVATION W.L.: 42.4 ft
DATE W.L.: 5/18/06
TIME W.L.: 11:46 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
40		40.0 - 45.8			40.0		SPT	5-6-7-6	13	100.0 / 2.0		
	15		SM				SPT	6-5-4-14	9	100.0 / 2.0		
45		Gray medium grained silty sand at 44 ft					SPT	4-4-6-12	10	100.0 / 2.0	Screen–	
		45.8 - 46.0 CLAYEY SAND - fine grained clayey sand	SC		12.1							
		46.0 - 47.3 POORLY GRADED SAND - medium grained well sorted sand	SP		46.0		SPT	4-9-27-35	36	100.0 / 2.0		
	10		SM		10.6							
		47.3 - 47.8 SILTY SAND - fine grained silty sand	SP		10.1							
50		47.8 - 48.0 POORLY GRADED SAND - medium grained well sorted sand	SM		48.0		SPT	7-9-8-6	17	90.0 / 2.0		
		48.0 - 50.0 SILTY SAND - gray medium grained poorly sorted sand, saturated			7.9							
	5	Boring completed at 50.0 ft										
55												
	0											
60												
	-5											
65												
	-10											
70												
	-15											
75												
	-20											
80												

WELL CASING
Interval: -2.60-40 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 40-50 ft
Material: PVC
Diameter: 2-inch
Slot Size: .010-inch
End Cap: Threaded

FILTER PACK
Interval: 36-50 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 36-38 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-36 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: None
Protective Casing: None

DRILLING METHODS
Type: 4.25-inch ID Hollow Stem Augers

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 11/30/06

RECORD OF BOREHOLE PZ-108

SHEET 1 of 1

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 22.0 ft
LOCATION: Aulander, NC

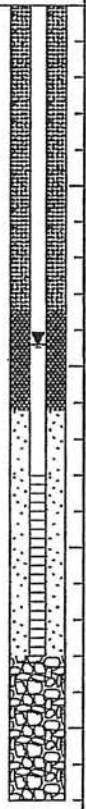
DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/9/06
DATE COMPLETED: 5/9/06

NORTHING: 868,529.5
EASTING: 2,572,527.7
GS ELEVATION: 58.5 ft
TOC ELEVATION: 60.6 ft

DEPTH W.L.: 9.4 ft
ELEVATION W.L.: 51.2 ft
DATE W.L.: 5/10/06
TIME W.L.: 3:03 pm

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC
0	55	0.0 - 4.0 LEAN CLAY - gray clay with some fine grained sand	CL		54.5		SPT	3-3-3-3	6	80.0 / 2.0
							SPT	3-3-3-3	6	80.0 / 2.0
5	50	4.0 - 8.8 FAT CLAY - gray fat clay with some fine grained sand, moist Slightly mottled appearance at 6 ft	CH		4.0 49.7		SPT	3-2-5-8	7	100.0 / 2.0
							SPT	5-7-9-12	16	100.0 / 2.0
		8.8 - 9.5 LEAN CLAY - sandy lean clay	CL		49.0		SPT	3-4-5-8	9	100.0 / 2.0
10	45	9.5 - 11.0 FAT CLAY - gray fat clay	CH		9.5 47.5		SPT	5-6-8-11	14	100.0 / 2.0
		11.0 - 19.0 SILTY SAND - orange fine grained silty sand, saturated Some organics at 14 ft	SM		11.0		SPT	4-4-5-9	9	100.0 / 2.0
15	40	Some organics at 16 ft					SPT	0-2-2-6	4	100.0 / 2.0
							SPT	4-3-8-12	11	100.0 / 2.0
					39.5		SPT	3-3-2-3	5	100.0 / 2.0
20	35	19.0 - 19.8 LEAN CLAY - thinly layered fine grained sandy clay	CL		19.0 38.7					
		19.8 - 22.0 FAT CLAY - gray fat clay with fine grained sand Augers terminated at 20 ft Boring completed at 22.0 ft	CH		19.8 36.5		SPT	2-1-2-1	3	100.0 / 2.0
25	30									
30	25									
35	20									
40										

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: -2.16-13 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 13-18 ft
Material: PVC
Diameter: 2-inch
Slot Size: .010-inch
End Cap: Threaded

FILTER PACK
Interval: 11.2-18 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 8.5-11.2 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-8.5 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: None
Protective Casing: None

DRILLING METHODS
Type: 4.25-inch ID Hollow Stem Augers

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 11/30/06

RECORD OF BOREHOLE PZ-109A

SHEET 1 of 1

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 28.0 ft
LOCATION: Aulander, NC

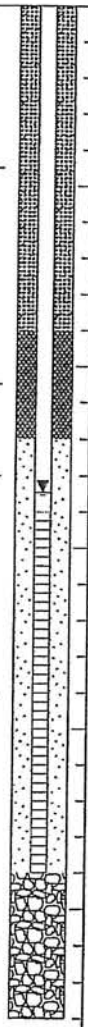
DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/9/06
DATE COMPLETED: 5/10/06

NORTHING: 868,123.3
EASTING: 2,572,581.9
GS ELEVATION: 61.9 ft
TOC ELEVATION: 65.3 ft

DEPTH W.L.: 16.5 ft
ELEVATION W.L.: 51.9 ft
DATE W.L.: 5/11/06
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC
0		0.0 - 1.3 SILTY SAND - brown silty sand, changes to tan fine grained sandy clay at 0.5 ft	SM		60.7		SPT	2-1-2-5	3	95.0 2.0
	60	1.3 - 4.0 LEAN CLAY - gray to orange fine grained sandy clay, moist	CL		1.3 57.9		SPT	5-7-12-16	19	100.0 2.0
5		4.0 - 7.8 CLAYEY SAND - orange and gray mottled clayey sand Shelby tube taken from 4 to 6 ft	SC		4.0		SH			100.0 2.0
	55	Very sandy orange and gray mottled lean clay at 6 ft			54.2		SPT	6-6-8-11	14	100.0 2.0
		7.8 - 21.8 SILTY SAND - orange fine grained silty sand, wet			7.8		SPT	3-4-3-4	7	100.0 2.0
10		Saturated by 10 ft					SPT	2-2-3-2	5	100.0 2.0
	50	Shelby tube taken from 12 to 14 ft and 14 to 16 ft					SH			0.0 2.0
15			SM				SH			100.0 2.0
	45	Tan and orange silty sand with organics at 16 ft					SPT	0-2-3-6	5	100.0 2.0
		Tan fine grained to medium grained silty sand with layering at 18 ft					SPT	4-4-5-8	9	100.0 2.0
20		Thin layer of tan fine grained sandy clay at 19.8 ft Tan and orange fine grained to medium grained silty sand at 20 ft					SPT	1-1-3-8	4	100.0 2.0
	40	21.8 - 22.0 LEAN CLAY - very sandy lean clay with layering	CL		40.2 22.0		SPT	3-5-8-12	13	100.0 2.0
		22.0 - 25.5 SILTY SAND - highly layered medium grained silty sand, saturated Augers terminated at 24 ft	SM		36.4		SPT	3-2-3-5	5	100.0 2.0
25		25.5 - 28.0 FAT CLAY - orange and gray fat clay with some fine grained sand Gray fat clay at 26 ft	CH		25.5		SPT	2-3-2-2	5	100.0 2.0
	35	Boring completed at 28.0 ft			33.9					
30										
	30									
35										
	25									
40										

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: -3.38-14 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 14-24 ft
Material: PVC
Diameter: 2-inch
Slot Size: .010-inch
End Cap: Threaded

FILTER PACK
Interval: 12-24 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 9-12 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-9 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: None
Protective Casing: None

DRILLING METHODS
Type: 4.25-inch ID Hollow Stem Augers

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 12/4/06

RECORD OF BOREHOLE PZ-109B

SHEET 1 of 2

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 52.0 ft
LOCATION: Aulander, NC

DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/10/06
DATE COMPLETED: 5/12/06

NORTHING: 868,120.8
EASTING: 2,572,575.2
GS ELEVATION: 62.6 ft
TOC ELEVATION: 65.4 ft

DEPTH W.L.: 16.4 ft
ELEVATION W.L.: 49.0 ft
DATE W.L.: 5/15/06
TIME W.L.: 12:30 pm

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0	60	0.0 - 4.0 LEAN CLAY - fine grained sandy clay	CL		58.6							
5	55	4.0 - 7.8 CLAYEY SAND - orange and gray clayey sand	SC		4.0 54.9							
10	50	7.8 - 25.5 SILTY SAND - fine grained silty sand, wet	SM		7.8							
15	45											
20	40										Grout	
25	35	25.5 - 40.5 FAT SILT - blue gray fat silt			37.1 25.5		SPT	0-0-0-0	0	100.0 2.0		
30	30	Blue gray silt at 30 ft					SPT	0-0-0-0	0	90.0 2.0		
35	25	Shelby tube taken from 33 to 35 ft Small sandy zone (< 1 inch thick) at 36 ft	MH				SH			100.0 2.0		
40							SPT	0-0-0-0	0	100.0 2.0		
							SPT	0-0-2-1	2	100.0 2.0		
							SPT	0-0-2-1	2	100.0 2.0		

Log continued on next page

WELL CASING
Interval: -2.81-47 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 47-52 ft
Material: PVC
Diameter: 2-inch
Slot Size: .010-inch
End Cap: Threaded

FILTER PACK
Interval: 45-52 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 41-45 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-41 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: None
Protective Casing: None

DRILLING METHODS
Type: Mud Rotary with 6-inch bit

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 12/4/06

RECORD OF BOREHOLE PZ-109B

SHEET 2 of 2

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 52.0 ft
LOCATION: Aulander, NC

•DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/10/06
DATE COMPLETED: 5/12/06

NORTHING: 868,120.8
EASTING: 2,572,575.2
GS ELEVATION: 62.6 ft
TOC ELEVATION: 65.4 ft

DEPTH W.L.: 16.4 ft
ELEVATION W.L.: 49.0 ft
DATE W.L.: 5/15/06
TIME W.L.: 12:30 pm

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC
40			MH		22.1		SPT	0-0-2-1	2	100.0 / 2.0
		40.5 - 44.0 CLAYEY SAND - blue gray clayey sand			40.5					
	20	A few weathered pebbles at 43 ft	SC				SPT	1-1-1-1	2	100.0 / 2.0
					18.6		SPT	7-10-15-22	25	100.0 / 2.0
45		44.0 - 52.0 POORLY GRADED SILTY SAND - tan and orange fine grained silty sand Shelby tube taken fron 45-47 ft			44.0		SH			75.0 / 2.0
	15	White and orange fine grained silty sand, saturated at 47 ft	SP-SM				SPT	2-3-5-15	8	50.0 / 2.0
50		White and yellow fine grained silty sand and well sorted medium grained sand at 49 ft					SPT	5-10-15-15	25	100.0 / 2.0
					10.6					
	10	Boring completed at 52.0 ft								
55										
	5									
60										
	0									
65										
	-5									
70										
	-10									
75										
	-15									
80										

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: -2.61-47 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 47-52 ft
Material: PVC
Diameter: 2-inch
Slot Size: .010-inch
End Cap: Threaded

FILTER PACK
Interval: 45-52 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 41-45 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-41 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: None
Protective Casing: None

DRILLING METHODS
Type: Mud Rotary with 6-inch bit

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 12/4/06

RECORD OF BOREHOLE PZ-110/0803-GW-18

SHEET 1 of 1

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 32.0 ft
LOCATION: Aulander, NC

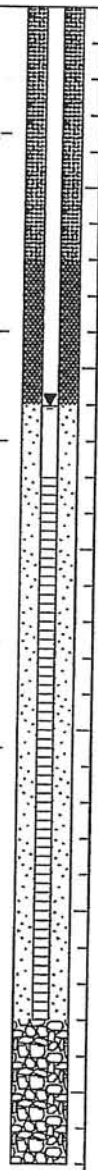
DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/17/06
DATE COMPLETED: 5/18/06

NORTHING: 867,828.0
EASTING: 2,572,575.0
GS ELEVATION: 61.0 ft
TOC ELEVATION: 63.0 ft

DEPTH W.L.: 11.0 ft
ELEVATION W.L.: 51.9 ft
DATE W.L.: 5/19/06
TIME W.L.: 7:42 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC
0	60	0.0 - 0.5 SILTY SAND - black fine grained silty sand	SM		60.5		SPT	1-0-1-4	1	100.0 / 2.0
		0.5 - 7.8 LEAN CLAY - gray fine grained sandy clay Orange and gray mottled fine grained sandy clay at 2 ft, moist	CL		0.5		SPT	4-4-8-11	12	100.0 / 2.0
5	55						SPT	4-5-8-11	13	100.0 / 2.0
							SPT	10-10-11-14	21	100.0 / 2.0
		7.8 - 8.0 CLAYEY SILT - light gray clayey silt	ML		53.3					
		8.0 - 9.8 LEAN CLAY - light gray fine grained sandy clay with abundant sand	CL		8.0 / 51.3		SPT	4-2-3-7	5	100.0 / 2.0
10	50	9.8 - 15.9 SILTY SAND - medium grained silty sand Light gray and orange medium grained silty sand at 10 ft, saturated Orange medium grained silty sand with some layering at 12.75 ft, wet	SM		9.8		SPT	5-4-5-5	9	100.0 / 2.0
							SPT	4-5-8-7	13	90.0 / 2.0
15	45				45.1		SPT	3-6-6-7	12	90.0 / 2.0
		15.9 - 25.9 WELL GRADED SAND - pink, tan, and orange poorly sorted medium grained sand, saturated Layering at 18 ft	SW		15.9		SPT	4-7-7-10	14	80.0 / 2.0
							SPT	6-8-8-14	16	100.0 / 2.0
20	40	No layering visible at 20 ft					SPT	3-4-5-8	9	80.0 / 2.0
							SPT	8-8-10-13	18	90.0 / 2.0
25	35				35.1		SPT	3-3-5-6	8	100.0 / 2.0
		25.9 - 26.3 LEAN CLAY - tan sandy clay with coarse grained sand	CL		26.3					
		26.3 - 27.3 WELL GRADED SAND - tan poorly sorted medium grained sand	SW		33.8		SPT	4-5-5-12	10	100.0 / 2.0
		27.3 - 27.8 LEAN CLAY - light gray fine grained sandy clay	CL		33.3					
30	30	27.8 - 30.0 SILTY SAND - gray fine grained silty sand with layering Augers terminated at 28 ft Medium grained sandy clay layers from 29 to 29.25 ft and 29.75 to 29.9 ft	SM		27.8 / 31.0		SPT	4-6-5-5	11	100.0 / 2.0
		30.0 - 31.8 WELL GRADED SAND - orange poorly sorted sand	SW		30.0 / 29.3		SPT	3-2-2-2	4	100.0 / 2.0
35	25	31.8 - 32.0 FAT CLAY - blue gray fat clay	CH							
		Boring completed at 32.0 ft								
40										

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: -1.95-13 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 13-28 ft
Material: PVC
Diameter: 2-inch
Slot Size: .010-inch
End Cap: Threaded

FILTER PACK
Interval: 11-28 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 7-11 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-7 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: 3x3x0.5 ft concrete
Protective Casing: 4-inch Aluminum

DRILLING METHODS
Type: 4.25-inch ID Hollow Stem Augers

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 11/30/06

RECORD OF BOREHOLE PZ-111

SHEET 1 of 1

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 20.0 ft
LOCATION: Aulander, NC

DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/23/06
DATE COMPLETED: 5/23/06

NORTHING: 869,165.1
EASTING: 2,572,635.7
GS ELEVATION: 59.2 ft
TOC ELEVATION: 61.6 ft

DEPTH W.L.: 12.1 ft
ELEVATION W.L.: 49.5 ft
DATE W.L.: 5/24/06
TIME W.L.: 10:51 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0		0.0 - 1.5 SILTY SAND - brown to tan fine grained silty sand	SM		57.7		SPT	5-6-5-7	11	50.0 / 2.0		
		1.5 - 7.3 LEAN CLAY - orange and gray mottled fine grained sandy clay, moist			1.5		SPT	8-8-11-15	19	60.0 / 2.0	Grout	
5	55		CL				SPT	4-5-8-14	13	100.0 / 2.0		
							SPT	8-11-14-18	25	100.0 / 2.0	Bentonite	
		7.3 - 8.0 CLAYEY SAND - gray fine grained clayey sand	SC		51.9 51.2							
		8.0 - 18.5 SILTY SAND - orange and gray mottled fine grained silty sand, saturated			8.0		SPT	3-3-5-6	8	100.0 / 2.0	#2 Sand	
10	50						SPT	4-4-3-8	7	100.0 / 2.0		
			SM				SPT	3-3-3-5	6	100.0 / 2.0		
	45						SPT	0-4-4-4	8	100.0 / 2.0	Screen	
15		Gray and orange medium grained silty sand at 16 ft, saturated					SPT	4-4-5-6	9	100.0 / 2.0		
		Augers terminated at 18 ft			40.7							
		18.5 - 20.0 FAT CLAY - blue gray fat clay	CH		18.5		SPT	0-1-2-1	3	100.0 / 2.0	Collapsed Material	
20	40	Boring completed at 20.0 ft			39.2							
	35											
25												
	30											
30												
	25											
35												
	20											
40												

WELL CASING
Interval: -2.39-10 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 10-18 ft
Material: PVC
Diameter: 2-inch
Slot Size: .010-inch
End Cap: Threaded

FILTER PACK
Interval: 8-18 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 4.5-8 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-4.5 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: None
Protective Casing: None

DRILLING METHODS
Type: 4.25-inch ID Hollow Stem Augers

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 11/30/06

RECORD OF BOREHOLE PZ-112

SHEET 1 of 1

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 24.0 ft
LOCATION: Aulander, NC

DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/17/06
DATE COMPLETED: 5/17/06

NORTHING: 868,778.7
EASTING: 2,572,686.0
GS ELEVATION: 58.4 ft
TOC ELEVATION: 61.5 ft

DEPTH W.L.: 11.9 ft
ELEVATION W.L.: 49.6 ft
DATE W.L.: 5/18/06
TIME W.L.: 11:40 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC
0	55	0.0 - 0.3 SANDY SILT - black sandy silt	SM		0.3		SPT	6-6-6-8	12	40.0 / 2.0
		0.3 - 12.0 LEAN CLAY - gray fine grained sandy clay, moist					SPT	5-10-10-13	20	70.0 / 2.0
5	50	Gray and orange mottled silty clay at 4 ft	CL				SPT	4-5-7-8	12	100.0 / 2.0
							SPT	5-7-10-15	17	70.0 / 2.0
10	45						SPT	4-3-4-7	7	80.0 / 2.0
		Thin fine grained silty sand zone (<1 inch thick) at 11.5 ft			46.4		SPT	6-6-9-11	15	100.0 / 2.0
		12.0 - 20.8 SILTY SAND - light gray fine grained silty sand, saturated			12.0		SPT	3-2-4-6	6	60.0 / 2.0
15	40	Orange fine grained silty sand at 15.5 ft, saturated	SM				SPT	4-4-6-8	10	100.0 / 2.0
		Medium grained silty sand at 18 ft					SPT	3-4-6-10	10	100.0 / 2.0
20	35						SPT	4-6-7-10	13	100.0 / 2.0
					37.7					
		20.8 - 21.0 LEAN CLAY - gray fine grained sandy clay	CL		21.0		SPT	4-4-6-7	10	100.0 / 2.0
		21.0 - 23.0 SILTY SAND - medium grained silty sand Orange fine grained silty sand at 21.5 ft	SM		35.4		SPT	4-3-2-3	5	100.0 / 2.0
25	30	Medium grained silty sand at 22 ft Augers terminated at 22 ft	CH		23.0 34.4					
		23.0 - 24.0 FAT CLAY - blue gray fat clay								
		Boring completed at 24.0 ft								
30	25									
35	20									
40										

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: -3.04-17 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 17-22 ft
Material: PVC
Diameter: 2-inch
Slot Size: .010-inch
End Cap: Threaded

FILTER PACK
Interval: 15-22 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 11-15 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-11 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: None
Protective Casing: None

DRILLING METHODS
Type: 4.25-inch ID Hollow Stem Augers

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 11/30/06

RECORD OF BOREHOLE PZ-113

SHEET 1 of 1

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 26.0 ft
LOCATION: Aulander, NC

DRILL RIG: Deldrich D-50 Turbo
DATE STARTED: 5/8/06
DATE COMPLETED: 5/9/06

NORTHING: 868,335.0
EASTING: 2,572,760.1
GS ELEVATION: 60.3 ft
TOC ELEVATION: 63.1 ft

DEPTH W.L.: 13.4 ft
ELEVATION W.L.: 49.7 ft
DATE W.L.: 5/10/06
TIME W.L.: 3:15 pm

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC
0	60	0.0 - 1.8 FAT CALY - tan, gray, and orange mottled fat clay	CH		58.5		SPT	3-4-6-12	10	75.0 2.0
		1.8 - 2.3 LEAN CLAY - hard gray silty clay	CL		58.0 2.3					
		2.3 - 12.0 FAT CLAY - gray fat clay, moist	CH				SPT	5-7-9-13	16	100.0 2.0
5	55	Gray with some orange fat clay at 4 ft					SPT	3-5-6-10	11	100.0 2.0
		Light gray fat clay with some silt at 8 ft					SPT	9-12-13-18	25	100.0 2.0
							SPT	4-5-8-16	13	100.0 2.0
10	50	Fat clay with sand at 11 ft			48.3		SPT	10-12-15-18	27	80.0 2.0
		12.0 - 13.3 LEAN CLAY - gray fine grained sandy clay	CL		12.0 47.0		SPT	3-3-4-8	7	100.0 2.0
		13.3 - 16.0 SANDY SILT - orange fine grained sandy silt, very moist	SM		13.3		SPT	4-3-5-9	8	100.0 2.0
15	45	Gray and orange fine grained sandy silt at 14 ft, saturated			44.3					
		16.0 - 23.5 SILTY SAND - orange and yellow fine grained silty sand, saturated	SM		16.0		SPT	4-4-4-8	8	100.0 2.0
		Some organics present at 18 ft					SPT	2-3-6-13	9	100.0 2.0
20	40						SPT	2-2-3-6	5	100.0 2.0
					36.8		SPT	4-4-7-10	11	100.0 2.0
		23.5 - 25.8 LEAN CLAY - orange and gray thinly layered silty clay Very layered sandy clay at 24 ft Augers terminated at 24 ft	CL		23.5		SPT	3-2-1-3	3	100.0 2.0
25	35				34.5					
		25.8 - 26.0 FAT CLAY -gray fat clay Boring completed at 26.0 ft	CH							
30	30									
35	25									
40										

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: -2.89-17 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 17-22 ft
Material: PVC
Diameter: 2-inch
Slot Size: .010-inch
End Cap: Threaded

FILTER PACK
Interval: 13.5-22 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 10-13.5 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-10 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: None
Protective Casing: None

DRILLING METHODS
Type: 4.25-inch ID Hollow Stem Augers

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 11/30/06

RECORD OF BOREHOLE PZ-114

SHEET 1 of 1

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 26.0 ft
LOCATION: Aulander, NC

DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/16/06
DATE COMPLETED: 5/16/06

NORTHING: 867,940.6
EASTING: 2,572,776.2
GS ELEVATION: 62.6 ft
TOC ELEVATION: 65.3 ft

DEPTH W.L.: 13.4 ft
ELEVATION W.L.: 51.8 ft
DATE W.L.: 5/17/06
TIME W.L.: 7:57 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES
0		0.0 - 1.8 SILTY SAND - tan fine grained silty sand with organics	SM		60.9		SPT	5-3-4-5	7	80.0 2.0	
	60	1.8 - 5.8 LEAN CLAY - orange fine grained sandy clay	CL		1.8		SPT	5-7-8-13	15	80.0 2.0	
5					56.9		SPT	5-8-10-13	18	100.0 2.0	Grout
		5.8 - 18.0 SILTY SAND - orange and gray mottled fine grained clayey to silty sand Orange and gray mottled fine grained silty sand at 6 ft, moist			5.8		SPT	7-10-12-15	22	100.0 2.0	
	55						SPT	7-7-7-9	14	100.0 2.0	
10							SPT	4-4-5-7	9	80.0 2.0	
		Orange fine grained silty sand with organics at 12 ft, saturated	SM				SPT	3-3-4-5	7	90.0 2.0	Bentonite
	50										
15		Medium grained silty sand at 15.5 ft, saturated Tan to orange medium grained silty sand with organics, saturated					SPT	4-4-4-7	8	100.0 2.0	#2 Sand
							SPT	4-3-5-7	8	100.0 2.0	
	45				44.6						
		18.0 - 19.5 POORLY GRADED SAND - tan well sorted medium grained sand	SP		18.0 43.1		SPT	4-5-7-11	12	100.0 2.0	Screen
20		19.5 - 21.5 SILTY SAND - orange fine grained silty sand	SM		19.5 41.1		SPT	4-5-7-6	12	100.0 2.0	
		21.5 - 25.5 LEAN CLAY - tan and orange thinly layered fine grained sandy clay with organics			21.5		SPT	6-5-6-15	11	100.0 2.0	Collapsed Material
	40	Augers terminated at 24 ft	CL								
25					37.1		SPT	6-6-4-5	10	100.0 2.0	
		25.5 - 26.0 FAT CLAY - gray fat clay	CH		36.6						
		Boring completed at 26.0 ft									
	35										
30											
	30										
35											
	25										
40											

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: -2.61-16 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 16-21 ft
Material: PVC
Diameter: 2-inch
Slot Size: .010-inch
End Cap: Threaded

FILTER PACK
Interval: 13.8-21 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 10-13.8 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-10 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: None
Protective Casing: None

DRILLING METHODS
Type: 4.25-inch ID Hollow Stem Augers

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 11/30/06

RECORD OF BOREHOLE PZ-115A

SHEET 1 of 1

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 20.0 ft
LOCATION: Aulander, NC

DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/22/06
DATE COMPLETED: 5/22/06

NORTHING: 869,175.6
EASTING: 2,572,816.2
GS ELEVATION: 58.5 ft
TOC ELEVATION: 61.0 ft

DEPTH W.L.: 11.6 ft
ELEVATION W.L.: 49.3 ft
DATE W.L.: 5/23/06
TIME W.L.: 10:32 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0	58.5	0.0 - 7.3 LEAN CLAY - gray fine grained sandy clay, dry					SPT	3-4-5-6	9	50.0 / 2.0		**WELL CASING** Interval: -2.49-12 ft Material: PVC Diameter: 2-inch Joint Type: Threaded
	55	Gray and orange mottled silty clay at 4 ft	CL				SPT	6-6-7-11	13	60.0 / 2.0	Grout	**WELL SCREEN** Interval: 12-17 ft Material: PVC Diameter: 2-inch Slot Size: .010-inch End Cap: Threaded
5							SPT	4-4-6-9	10	100.0 / 2.0		
					51.2		SPT	8-9-9-10	18	100.0 / 2.0		**FILTER PACK** Interval: 10-17 ft Type: #2 Sand
		7.3 - 7.8 FAT CLAY - black organic fat clay	CH		50.7							
	50	7.8 - 8.0 CLAYEY SAND - yellow fine grained clayey sand	SC		8.0		SPT	3-2-3-4	5	60.0 / 2.0	Bentonite	**FILTER PACK SEAL** Interval: 7.5-10 ft Type: 3/8 Bentonite chip
10		8.0 - 17.8 SILTY SAND - gray and yellow silty sand, saturated					SPT	3-4-5-6	9	100.0 / 2.0	#2 Sand	**ANNULUS SEAL** Interval: 0-7.5 ft Type: Portland/Bentonite mix
		Yellow fine grained silty sand at 12 ft, saturated	SM				SPT	4-3-3-5	6	100.0 / 2.0		**WELL COMPLETION** Pad: None Protective Casing: None
	45											**DRILLING METHODS** Soil Drill: 4.25-inch ID Hollow Stem Augers Rock Drill:
15		Yellow medium grained silty sand at 14 ft, saturated					SPT	2-2-3-6	5	100.0 / 2.0	Screen	
		Augers terminated at 17 ft					SPT	5-6-4-3	10	100.0 / 2.0		
					40.7							
	40	17.8 - 20.0 FAT CLAY - blue gray fat clay	CH		17.8		SPT	2-1-1-1	2	100.0 / 2.0	Collapsed Material	
20		Boring completed at 20.0 ft			38.5							
	35											
25												
	30											
30												
	25											
35												
	20											
40												

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ PIEDMONT.GDT 7/27/07

RECORD OF BOREHOLE PZ-115B

SHEET 1 of 2

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 50.0 ft
LOCATION: Aulander, NC

DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/23/06
DATE COMPLETED: 5/23/06

NORTHING: 869,171.4
EASTING: 2,572,815.6
GS ELEVATION: 58.4 ft
TOC ELEVATION: 61.7 ft

DEPTH W.L.: 15.0 ft
ELEVATION W.L.: 46.7 ft
DATE W.L.: 5/24/06
TIME W.L.: 10:54 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	SAMPLES BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0		0.0 - 8.0 LEAN CLAY - gray sandy clay, dry										WELL CASING Interval: +3.21-30 ft Material: PVC Diameter: 2-inch Joint Type: Threaded
	55	Orange silty clay at 4 ft	CL									WELL SCREEN Interval: 30-50 ft Material: PVC Diameter: 2-inch Slot Size: .010-inch End Cap: Threaded
5					50.4							FILTER PACK Interval: 28-50 ft Type: #2 Sand
	50	8.0 - 17.8 SILTY SAND - yellow silty sand, saturated			8.0							FILTER PACK SEAL Interval: 25-28 ft Type: 3/8 Bentonite chip
10												ANNULUS SEAL Interval: 0-25 ft Type: Portland/Bentonite mix
	45		SM								Grout	WELL COMPLETION Pad: None Protective Casing: None
15					40.6							DRILLING METHODS Type: 4.25-inch ID Hollow Stem Augers
	40	17.8 - 28.0 FAT CLAY - blue gray fat clay with occassional thin zones of fine grained sand			17.8		SPT	5-4-3-4	7	50.0 / 2.0		
20			CH				SPT	3-2-2-1	4	60.0 / 2.0		
	35						SPT	3-1-2-1	3	100.0 / 2.0		
25							SPT	2-1-1-2	2	100.0 / 2.0	Bentonite	
	30	28.0 - 40.0 CLAYEY SAND - gray fine grained clayey sand			30.4 28.0		SPT	0-0-4-4	4	100.0 / 2.0	#2 Sand	
30		Moisture increasing at 30 ft					SPT	0-0-4-6	4	100.0 / 2.0		
		Organic material at 31.75 ft					SPT	7-9-6-11	15	80.0 / 2.0		
	25	Becomes very dense at 34 ft	SC				SPT	6-7-10-24	17	100.0 / 2.0		
35		Organic material at 37.25 ft and 38 ft					SPT	5-5-6-12	11	80.0 / 2.0		
	20						SPT	8-7-8-12	15	100.0 / 2.0		
40		Log continued on next page			18.4							

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 12/4/06

RECORD OF BOREHOLE PZ-115B

SHEET 2 of 2

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 50.0 ft
LOCATION: Aulander, NC

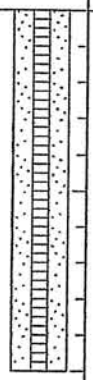
DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/23/06
DATE COMPLETED: 5/23/06

NORTHING: 869,171.4
EASTING: 2,572,815.6
GS ELEVATION: 58.4 ft
TOC ELEVATION: 61.7 ft

DEPTH W.L.: 15.0 ft
ELEVATION W.L.: 46.7 ft
DATE W.L.: 5/24/06
TIME W.L.: 10:54 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC
40		40.0 - 43.3	SC		40.0		SPT	5-6-7-17	13	100.0 / 2.0
	15				15.2		SPT	5-6-7-13	13	100.0 / 2.0
45		43.3 - 50.0 SILTY SAND - gray silty sand with organic material Shelby tube taken from 44 to 46 ft	SM		43.3		SH			75.0 / 2.0
	10						SPT	5-5-8-14	13	100.0 / 2.0
50							SPT	5-5-9-19	14	100.0 / 2.0
	5	Boring completed at 50.0 ft			8.4					
55										
	0									
60										
	-5									
65										
	-10									
70										
	-15									
75										
	-20									
80										

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: -3.21-30 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 30-50 ft
Material: PVC
Diameter: 2-inch
Slot Size: .010-inch
End Cap: Threaded

FILTER PACK
Interval: 28-50 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 25-28 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-25 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: None
Protective Casing: None

DRILLING METHODS
Type: 4.25-inch ID Hollow Stem Augers

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 12/4/06

RECORD OF BOREHOLE PZ-116

SHEET 1 of 1

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 22.0 ft
LOCATION: Aulander, NC

DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/9/06
DATE COMPLETED: 5/9/06

NORTHING: 868,595.4
EASTING: 2,572,915.4
GS ELEVATION: 58.1 ft
TOC ELEVATION: 60.6 ft

DEPTH W.L.: 10.1 ft
ELEVATION W.L.: 50.6 ft
DATE W.L.: 5/10/06
TIME W.L.: 3:08 pm

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC
0		0.0 - 8.0 LEAN CLAY - gray and brown fine grained sandy clay, dry					SPT	2-2-4-5	6	70.0 / 2.0
		Gray and orange mottled fine grained sandy clay at 2 ft					SPT	5-6-7-11	13	70.0 / 2.0
5	55	Gray clay with fine grained sand at 4 ft	CL				SPT	3-3-5-11	8	70.0 / 2.0
		More sandy at 7.5 ft					SPT	8-9-11-16	20	100.0 / 2.0
10	50	8.0 - 10.0 CLAYEY SAND - alternating layers of sandy clay and clayey sand	SC		50.1 8.0 48.1		SPT	4-5-6-9	11	100.0 / 2.0
		10.0 - 11.0 SILTY SAND - tan fine grained silty sand, saturated	SM CL		10.0 47.1 46.6		SPT	4-5-7-9	12	100.0 / 2.0
		11.0 - 11.5 LEAN CLAY - gray and orange fine grained sandy clay			11.5		SPT	0-2-1-1	3	90.0 / 2.0
15	45	11.5 - 20.0 SILTY SAND - orange fine grained silty sand, saturated Orange and gray mottled fine grained silty sand at 12 ft, saturated Thin sandy clay layer at 13.9 ft Orange and gray fine grained silty sand with layering at 14 ft Light gray silty sand at 16 ft Orange silty sand at 17.75 ft Tan and orange medium grained silty sand at 18 ft Augers terminated at 20 ft	SM				SPT	3-2-3-4	5	100.0 / 2.0
							SPT	2-2-3-7	5	100.0 / 2.0
20	40						SPT	4-5-6-6	11	100.0 / 2.0
		20.0 - 21.8 LEAN CLAY - gray and orange layered fine grained sandy clay	CL		38.1 20.0 36.3		SPT	3-3-4-6	7	100.0 / 2.0
		21.8 - 22.0 FAT CLAY - gray fat clay	CH							
	35	Boring completed at 22.0 ft								
25										
	30									
30										
	25									
35										
	20									
40										

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: -2.59-14.5 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 14.5-19.5 ft
Material: PVC
Diameter: 2-inch
Slot Size: .010-inch
End Cap: Threaded

FILTER PACK
Interval: 13.5-19.5 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 9.5-13.5 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-9.5 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: None
Protective Casing: None

DRILLING METHODS
Type: 4.25-inch ID Hollow Stem Augers

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 11/30/06

RECORD OF BOREHOLE PZ-117A

SHEET 1 of 1

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 20.0 ft
LOCATION: Aulander, NC

DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/10/06
DATE COMPLETED: 5/10/06

NORTHING: 868,151.1
EASTING: 2,572,972.3
GS ELEVATION: 60.1 ft
TOC ELEVATION: 62.0 ft

DEPTH W.L.: 9.4 ft
ELEVATION W.L.: 52.6 ft
DATE W.L.: 5/11/06
TIME W.L.: 1:35 pm

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC
0	60	0.0 - 15.3 LEAN CLAY - gray fine grained sandy clay, moist	CL				SPT	4-4-4-7	8	100.0 / 2.0
							SPT	5-5-7-9	12	100.0 / 2.0
5	55	Less sand at 4 ft					SPT	3-3-4-8	7	100.0 / 2.0
							SPT	5-6-12-18	18	100.0 / 2.0
		Shelby tube taken from 8 to 10 ft					SH			100.0 / 2.0
10	50	Thin silty sand layers at 10.75 ft, 11.25 ft, and 11.8 ft					SPT	4-7-10-15	17	100.0 / 2.0
		Becoming more sandy at 12 ft Thin silty sand layers at 12.75 ft, 13.5 ft, and 13.75 ft					SPT	5-10-15-19	25	100.0 / 2.0
		Gray sand to silty clay at 14 ft			44.8					
15	45	15.3 - 16.0 CLAYEY SILT - gray silt with some clay layers	ML		44.1		SPT	4-5-7-10	12	100.0 / 2.0
		16.0 - 19.5 LEAN CLAY - gray sandy to silty clay	CL		16.0		SPT	4-4-6-7	10	100.0 / 2.0
		Very thin alternating layers of sandy clay and silty sand at 18 ft Augers terminated at 18 ft			40.6		SPT	4-4-3-3	7	100.0 / 2.0
20	40	19.5 - 20.0 LEAN CLAY - blue gray clay with silt Boring completed at 20.0 ft	CL		40.1					
25	35									
30	30									
35	25									
40										

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: -1.94-13 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 13-18 ft
Material: PVC
Diameter: 2-inch
Slot Size: .010-inch
End Cap: Threaded

FILTER PACK
Interval: 11.2-18 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 9.2-11.2 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-9.2 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: None
Protective Casing: None

DRILLING METHODS
Type: 4.25-inch ID Hollow Stem Augers

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 12/4/06

RECORD OF BOREHOLE PZ-117B

SHEET 1 of 2

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 50.0 ft
LOCATION: Aulander, NC

DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/15/06
DATE COMPLETED: 5/16/06

NORTHING: 868,150.1
EASTING: 2,572,965.8
GS ELEVATION: 60.1 ft
TOC ELEVATION: 63.3 ft

DEPTH W.L.: 15.7 ft
ELEVATION W.L.: 47.6 ft
DATE W.L.: 5/17/06
TIME W.L.: 8:08 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0	60	0.0 - 15.3 LEAN CLAY - gray fine grained sandy clay, moist	CL									**WELL CASING** Interval: -3.23-40 ft Material: PVC Diameter: 2-inch Joint Type: Threaded **WELL SCREEN** Interval: 40-50 ft Material: PVC Diameter: 2-inch Slot Size: .010-inch End Cap: Threaded **FILTER PACK** Interval: 38.8-50 ft Type: #2 Sand **FILTER PACK SEAL** Interval: 34-38.8 ft Type: 3/8 Bentonite chip **ANNULUS SEAL** Interval: 0-34 ft Type: Portland/Bentonite mix **WELL COMPLETION** Pad: None Protective Casing: None **DRILLING METHODS** Type: 4.25-inch ID Hollow Stem Augers
5	55											
10	50											
15	45	Gray silty clay at 14 ft			44.8							
		15.3 - 16.0 CLAYEY SILT - gray silt with some clay	ML		44.1							
		16.0 - 19.5 LEAN CLAY - gray sandy to silty clay	CL		16.0						Grout	
20	40	19.5 - 37.8 LEAN CLAY - blue gray clay with some fine grained sand			19.5		SPT	4-3-3-4	6	60.0 / 2.0		
		Gray clay with some silt at 22 ft					SPT	0-2-1-2	3	100.0 / 2.0		
		Shelby tube taken from 24-26 ft					SH			100.0 / 2.0		
25	35	Gray clay with very thin layers of silt and very fine sand at 26 ft					SPT	0-0-0-0	0	100.0 / 2.0		
			CL				SPT	3-2-2-3	4	100.0 / 2.0		
30	30						SPT	2-2-2-2	4	100.0 / 2.0		
							SPT	3-2-3-3	5	100.0 / 2.0		
		Becomes more silty at 34 ft					SPT	2-2-1-3	3	100.0 / 2.0		
35	25				22.3		SPT	3-2-3-6	5	100.0 / 2.0	Bentonite	
		37.8 - 40.0 CLAYEY SAND - gray fine grained clayey sand	SC		37.8		SPT	3-4-8-21	12	100.0 / 2.0	#2 Sand	
40		Log continued on next page			20.1							

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 12/4/06

RECORD OF BOREHOLE PZ-117B

SHEET 2 of 2

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 50.0 ft
LOCATION: Aulander, NC

DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/15/06
DATE COMPLETED: 5/16/06

NORTHING: 868,150.1
EASTING: 2,572,965.8
GS ELEVATION: 60.1 ft
TOC ELEVATION: 63.3 ft

DEPTH W.L.: 15.7 ft
ELEVATION W.L.: 47.6 ft
DATE W.L.: 5/17/06
TIME W.L.: 8:08 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES
40	20	40.0 - 50.0 Light gray fine	SC		40.0		SPT	3-4-12-15	16	100.0 / 2.0	Screen
		Becomes darker at 46 ft					SPT	8-9-10-15	19	100.0 / 2.0	
45	15						SPT	4-5-6-11	11	100.0 / 2.0	
							SPT	9-9-10-11	19	100.0 / 2.0	
		Shelby tube from 48 to 50 ft					SH			75.0 / 2.0	
50	10	Boring completed at 50.0 ft			10.1						
55	5										
60	0										
65	-5										
70	-10										
75	-15										
80											

WELL CASING
Interval: -3.23-40 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 40-50 ft
Material: PVC
Diameter: 2-inch
Slot Size: .010-inch
End Cap: Threaded

FILTER PACK
Interval: 38.8-50 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 34-38.8 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-34 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: None
Protective Casing: None

DRILLING METHODS
Type: 4.25-inch ID Hollow Stem Augers

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 12/4/06

RECORD OF BOREHOLE PZ-118/0803-GW-19

SHEET 1 of 1

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 24.0 ft
LOCATION: Aulander, NC

DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/16/06
DATE COMPLETED: 5/16/06

NORTHING: 867,878.6
EASTING: 2,572,947.1
GS ELEVATION: 64.8 ft
TOC ELEVATION: 67.4 ft

DEPTH W.L.: 15.5 ft
ELEVATION W.L.: 51.9 ft
DATE W.L.: 5/17/06
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0		0.0 - 0.5 LEAN CLAY - orange and brown fine grained sandy clay, dry	CL		64.3							
			SM		0.5 63.3		SPT	3-4-4-4	8	100.0 2.0		
		0.5 - 1.5 SILTY SAND - tan fine grained silty sand			1.5							
		1.5 - 5.0 LEAN CLAY - orange fine grained sandy clay Orange and gray mottled fine grained sandy clay at 4 ft	CL				SPT	7-7-13-17	20	100.0 2.0	Grout	**WELL CASING** Interval: 2.58-11 ft Material: PVC Diameter: 2-inch Joint Type: Threaded **WELL SCREEN** Interval: 11-21 ft Material: PVC Diameter: 2-inch Slot Size: .010-inch End Cap: Threaded **FILTER PACK** Interval: 9-21 ft Type: #2 Sand **FILTER PACK SEAL** Interval: 6-9 ft Type: 3/8 Bentonite chip **ANNULUS SEAL** Interval: 0-6 ft Type: Portland/Bentonite mix **WELL COMPLETION** Pad: 3x3x0.5 ft concrete Protective Casing: 4-inch Aluminum **DRILLING METHODS** Type: 4.25-inch ID Hollow Stem Augers
5	60				59.8		SPT	3-6-8-12	14	100.0 2.0		
		5.0 - 11.5 SILTY SAND - orange and tan mottled silty sand, moist Orange fine grained silty sand with some clay at 6 ft			5.0		SPT	7-8-8-11	16	100.0 2.0	Bentonite	
		Orange and tan mottled fine grained silty sand at 8 ft	SM				SPT	5-7-8-10	15	100.0 2.0		
10	55	Saturated by 10 ft					SPT	6-6-9-7	15	100.0 2.0	#2 Sand	
					53.3							
		11.5 - 13.0 LEAN CLAY - gray and orange fine grained sandy clay Gray and red sandy clay at 12 ft	CL		11.5 51.8		SPT	4-5-6-9	11	100.0 2.0		
		13.0 - 14.0 CLAYEY SAND - gray and orange thinly bedded clayey sand	SC		13.0 50.8							
15	50	14.0 - 16.0 SANDY SILT - gray and orange fine grained sandy silt, saturated from 14 ft to 15 ft Becomes sandy silt with clay at 15 ft	SM		14.0 48.8		SPT	3-5-6-11	11	100.0 2.0	Screen	
		16.0 - 20.8 LEAN CLAY - gray thinly bedded sandy clay with organics Alternating thinly bedded gray sandy clay and sandy silt with organics at 18 ft	CL		16.0		SPT	4-4-4-9	8	100.0 2.0		
							SPT	4-5-6-11	11	100.0 2.0		
20	45	Orange and gray mottled sandy clay at 20 ft										
					44.1							
		20.8 - 21.3 CLAYEY SAND - fine grained clayey sand, saturated Augers terminated at 21 ft	SC		43.6 21.3		SPT	3-5-6-9	11	100.0 2.0		
		21.3 - 23.8 LEAN CLAY - gray sandy clay	CL		41.1		SPT	4-3-4-5	7	100.0 2.0	Collapsed Material	
		23.8 - 24.0 FAT CLAY - blue gray fat clay	CH									
25	40	Boring completed at 24.0 ft										
30	35											
35	30											
40	25											

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 11/30/06

RECORD OF BOREHOLE PZ-119

SHEET 1 of 1

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 24.0 ft
LOCATION: Aulander, NC

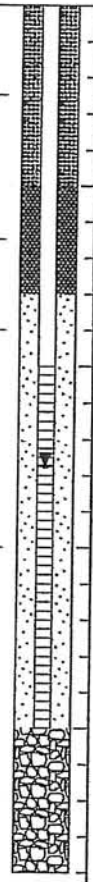
DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/23/06
DATE COMPLETED: 5/23/06

NORTHING: 869,545.6
EASTING: 2,572,564.3
GS ELEVATION: 58.7 ft
TOC ELEVATION: 61.2 ft

DEPTH W.L.: 12.7 ft
ELEVATION W.L.: 48.5 ft
DATE W.L.: 5/24/06
TIME W.L.: 10:47 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC
0		0.0 - 1.0 SILTY SAND - brown fine grained silty sand	SM		57.7		SPT	3-3-1-6	4	70.0 / 2.0
		1.0 - 9.0 LEAN CLAY - orange silty clay, moist Orange and gray mottled silty clay at 2 ft			1.0		SPT	3-3-4-6	7	60.0 / 2.0
5	55		CL				SPT	6-6-9-12	15	100.0 / 2.0
		More sandy at 5.75 ft Orange and gray mottled fine grained sandy clay at 6 ft					SPT	9-11-14-15	25	100.0 / 2.0
	50				49.7		SPT	5-4-5-8	9	100.0 / 2.0
10		9.0 - 16.0 SILTY SAND - orange and gray fine grained silty sand, saturated Gray fine grained silty sand at 10 ft, saturated			9.0		SPT	3-3-3-6	6	100.0 / 2.0
		Tan fine grained silty sand with some layering at 12 ft, saturated	SM				SPT	4-3-4-5	7	70.0 / 2.0
	45						SPT	3-4-3-6	7	100.0 / 2.0
15					42.7					
		16.0 - 22.0 LEAN CLAY - orange silty clay, saturated			16.0		SPT	4-4-6-9	10	100.0 / 2.0
	40		CL				SPT	4-4-6-11	10	100.0 / 2.0
20							SPT	4-6-7-11	13	100.0 / 2.0
		Augers terminated at 22 ft			36.7					
		22.0 - 23.8 WELL GRADED SAND - orange coarse grained poorly sorted sand	SW		22.0		SPT	3-2-2-2	4	100.0 / 2.0
	35	23.8 - 24.0 FAT CLAY - blue gray fat clay	CH		35.0					
25		Boring completed at 24.0 ft								
	30									
30										
	25									
35										
	20									
40										

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: -2.50-10 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 10-20 ft
Material: PVC
Diameter: 2-inch
Slot Size: .010-inch
End Cap: Threaded

FILTER PACK
Interval: 8-20 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 5-8 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-5 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: None
Protective Casing: None

DRILLING METHODS
Type: 4.25-inch ID Hollow Stem Augers

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 11/30/06

RECORD OF BOREHOLE PZ-120

SHEET 1 of 1

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 24.0 ft
LOCATION: Aulander, NC

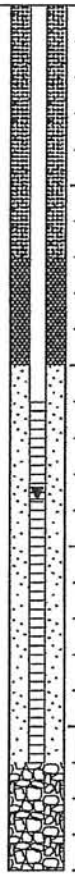
DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/22/06
DATE COMPLETED: 5/22/06

NORTHING: 869,022.2
EASTING: 2,573,038.5
GS ELEVATION: 60.5 ft
TOC ELEVATION: 63.0 ft

DEPTH W.L.: 13.7 ft
ELEVATION W.L.: 49.3 ft
DATE W.L.: 5/23/06
TIME W.L.: 12:42 pm

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC
0	60	0.0 - 2.0 SILTY SAND - brown fine grained silty sand Tan fine grained silty sand at 1 ft	SM		58.5		SPT	1-1-2-2	3	100.0 / 2.0
		2.0 - 8.0 LEAN CLAY - orange and gray mottled fine grained sandy clay, moist			2.0		SPT	3-5-7-11	12	100.0 / 2.0
5	55		CL				SPT	3-4-9-11	13	100.0 / 2.0
							SPT	7-9-11-17	20	100.0 / 2.0
					52.5					
		8.0 - 10.0 CLAYEY SAND - orange and gray mottled fine grained clayey sand, moist	SC		8.0		SPT	4-4-7-10	11	100.0 / 2.0
10	50				50.5					
		10.0 - 19.5 SILTY SAND - orange and gray mottled fine grained silty sand, wet			10.0		SPT	7-7-8-10	15	100.0 / 2.0
		Saturated by 12 ft					SPT	3-4-3-5	7	50.0 / 2.0
		Light gray fine grained silty sand at 14 ft, saturated	SM				SPT	2-4-4-10	8	100.0 / 2.0
15	45						SPT	0-0-4-5	4	100.0 / 2.0
							SPT	0-5-5-7	10	100.0 / 2.0
					41.0					
20	40	19.5 - 21.8 WELL GRADED SAND - orange medium to coarse grained poorly sorted sand, saturated Augers terminated at 21 ft	SW		19.5		SPT	3-3-3-2	6	50.0 / 2.0
					38.7					
		21.8 - 22.0 LEAN CLAY - dark gray sandy clay	CL		22.0		SPT	1-0-1-0	1	70.0 / 2.0
		22.0 - 24.0 FAT CLAY - blue gray fat clay	CH							
					36.5					
		Boring completed at 24.0 ft								
25	35									
30	30									
35	25									
40										

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: -2.43-11 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 11-21 ft
Material: PVC
Diameter: 2-inch
Slot Size: .010-inch
End Cap: Threaded

FILTER PACK
Interval: 10-21 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 7-10 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-7 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: None
Protective Casing: None

DRILLING METHODS
Type: 4.25-inch ID Hollow Stem Augers

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 11/30/06

RECORD OF BOREHOLE PZ-121

SHEET 1 of 1

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 26.0 ft
LOCATION: Aulander, NC

DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/9/06
DATE COMPLETED: 5/9/06

NORTHING: 868,407.6
EASTING: 2,573,085.1
GS ELEVATION: 59.7 ft
TOC ELEVATION: 62.3 ft

DEPTH W.L.: 12.0 ft
ELEVATION W.L.: 50.3 ft
DATE W.L.: 5/10/06
TIME W.L.: 3:25 pm

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC
0		0.0 - 0.5 FAT CLAY - tan fat clay	CH		59.2					
			CL		58.5		SPT	2-3-3-6	6	50.0 / 2.0
		0.5 - 1.3 LEAN CLAY - dark brown lean clay			1.3					
		1.3 - 10.0 FAT CLAY - tan fat clay, moist Gray and orange mottled fat clay at 2 ft, very dense					SPT	4-6-8-11	14	100.0 / 2.0
5	55		CH				SPT	6-6-6-12	12	100.0 / 2.0
							SPT	7-10-12-17	22	100.0 / 2.0
		Gray fat clay with some very fine grained sand at 8 ft					SPT	4-4-8-12	12	100.0 / 2.0
10	50				49.7					
		10.0 - 11.5 LEAN CLAY - gray fine grained sandy clay	CL		10.0		SPT	10-11-11-14	22	90.0 / 2.0
					48.2					
		11.5 - 16.0 SILTY SAND - gray and orange fine grained silty sand, saturated			11.5		SPT	5-3-4-8	7	100.0 / 2.0
15	45	Dark orange fine grained silty sand with some coarse grained sand at 13.9 ft Tan fine grained silty sand at 14.5 ft	SM				SPT	2-2-3-8	5	100.0 / 2.0
					43.7					
		16.0 - 17.0 CLAYEY SAND - orange clayey sand	SC		16.0		SPT	0-4-5-9	9	100.0 / 2.0
					42.7					
		17.0 - 21.5 SILTY SAND - orange fine grained silty sand			17.0		SPT	4-5-9-11	14	100.0 / 2.0
20	40	Orange silty sand with few organics at 19.25 ft Dark orange silty sand at 21.25 ft	SM				SPT	2-3-5-8	8	100.0 / 2.0
					38.2					
		21.5 - 22.0 LEAN CLAY - thinly layered sandy clay	CL		37.7					
		22.0 - 23.8 SILTY SAND - dark brown silty sand	SM		22.0		SPT	4-4-5-5	9	100.0 / 2.0
					36.0					
25	35	23.8 - 26.0 FAT CLAY - gray thinly layered fat clay with some sand Augers terminated at 24 ft	CH		23.8		SPT	3-2-1-2	3	100.0 / 2.0
					33.7					
		Boring completed at 26.0 ft								
30	30									
35	25									
40	20									

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0-15 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 15-20 ft
Material: PVC
Diameter: 2-inch
Slot Size: .010-inch
End Cap: Threaded

FILTER PACK
Interval: 12.5-20 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 9.5-12.5 ft
Type: 3/8 bentonite chip

ANNULUS SEAL
Interval: 0-9.5 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: None
Protective Casing: None

DRILLING METHODS
Type: 4.25-inch ID Hollow Stem Augers

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 11/30/06

RECORD OF BOREHOLE PZ-122/0803-GW-20

SHEET 1 of 1

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 26.0 ft
LOCATION: Aulander, NC

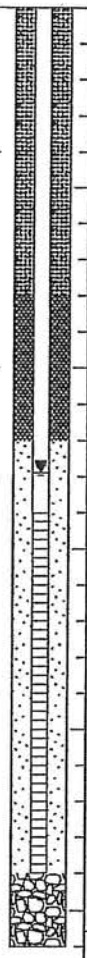
DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/18/06
DATE COMPLETED: 5/22/06

NORTHING: 868,650.4
EASTING: 2,573,246.2
GS ELEVATION: 59.8 ft
TOC ELEVATION: 62.3 ft

DEPTH W.L.: 12.9 ft
ELEVATION W.L.: 49.4 ft
DATE W.L.: 5/23/06
TIME W.L.: 12:48 pm

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC
0		0.0 - 4.0 LEAN CLAY - gray and orange silty clay	CL		55.8		SPT	1-0-0-2	0	0.0 / 2.0
							SPT	2-1-2-4	3	80.0 / 2.0
		4.0 - 4.8 ORGANIC SILT - black organic silt	OL		55.0					
5	55	4.8 - 11.9 LEAN CLAY - tan silty clay, saturated Orange and gray mottled silty clay at 6 ft	CL		4.8		SPT	0-2-3-3	5	100.0 / 2.0
							SPT	2-2-6-8	8	100.0 / 2.0
		Gray fine grained sandy clay at 8 ft Saturated from 8.5 ft to 9.5 ft					SPT	5-7-10-13	17	100.0 / 2.0
10	50	Gray and orange mottled fine grained sandy clay at 10 ft			47.9		SPT	8-11-13-16	24	100.0 / 2.0
		11.9 - 16.8 SILTY SAND - orange and tan fine grained silty sand Orange and tan layered fine grained silty sand at 12 ft No visible layering at 14 ft, saturated	SM		11.9 43.0		SPT	7-7-10-14	17	100.0 / 2.0
15	45						SPT	4-5-10-14	15	100.0 / 2.0
		16.8 - 17.3 LEAN CLAY - dark gray sandy clay	CL		42.5		SPT	6-7-10-15	17	100.0 / 2.0
		17.3 - 18.5 SILTY SAND - orange fine grained silty sand	SM		17.3 41.3					
		18.5 - 18.8 LEAN CLAY - dark gray sandy clay	CL		18.8		SPT	5-6-7-9	13	100.0 / 2.0
20	40	18.8 - 21.9 SILTY SAND - tan and orange fine grained silty sand with layering and some organics	SM		37.9		SPT	6-6-10-19	16	100.0 / 2.0
		21.9 - 23.3 WELL GRADED SAND - poorly sorted coarse grained sand, saturated	SW		21.9 36.5		SPT	7-5-3-4	8	100.0 / 2.0
		23.3 - 25.0 LEAN CLAY - orange, gray, and brown sandy clay with layering Orange sandy clay at 24 ft Augers terminated at 24 ft	CL		23.3 34.8		SPT	2-1-1-2	2	— / 2.0
25	35	25.0 - 26.0 FAT CLAY - blue gray fat clay Boring completed at 26.0 ft	CH		25.0 33.8					
30	30									
35	25									
40	20									

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: -2.48-14 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 14-24 ft
Material: PVC
Diameter: 2-inch
Slot Size: .010-inch
End Cap: Threaded

FILTER PACK
Interval: 12-24 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 8-12 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-8 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: None
Protective Casing: None

DRILLING METHODS
Type: 4.25-inch ID Hollow Stem Augers

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 11/30/06

RECORD OF BOREHOLE PZ-123A

SHEET 1 of 1

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 23.0 ft
LOCATION: Aulander, NC

DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/18/06
DATE COMPLETED: 5/18/06

NORTHING: 868,380.6
EASTING: 2,573,381.7
GS ELEVATION: 59.9 ft
TOC ELEVATION: 63.0 ft

DEPTH W.L.: 13.6 ft
ELEVATION W.L.: 49.4 ft
DATE W.L.: 5/19/06
TIME W.L.: 8:05 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0		0.0 - 17.5 LEAN CLAY - orange and gray fine grained sandy clay	CL						Grout–	**WELL CASING** Interval: -3.03-19 ft Material: PVC Diameter: 2-inch Joint Type: Threaded **WELL SCREEN** Interval: 19-23 ft Material: PVC Diameter: 2-inch Slot Size: .010-inch End Cap: Threaded **FILTER PACK** Interval: 18-23 ft Type: #2 Sand **FILTER PACK SEAL** Interval: 15-18 ft Type: 3/8 Bentonite chip **ANNULUS SEAL** Interval: 0-15 ft Type: Portland/Bentonite mix **WELL COMPLETION** Pad: None Protective Casing: None **DRILLING METHODS** Type: 4.25-inch ID Hollow Stem Augers
5	55									
10	50									
15	45								Bentonite–	
					42.4					
		17.5 - 23.0 POORLY GRADED SAND - white medium grained well sorted sand	SP		17.5				#2 Sand–	
20	40								Screen–	
					36.9					
		Boring completed at 23.0 ft								
25	35									
30	30									
35	25									
40	20									

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 11/30/06

RECORD OF BOREHOLE PZ-123B

SHEET 1 of 2

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 50.4 ft
LOCATION: Aulander, NC

DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/18/06
DATE COMPLETED: 5/18/06

NORTHING: 868,378.8
EASTING: 2,573,376.9
GS ELEVATION: 59.9 ft
TOC ELEVATION: 62.7 ft

DEPTH W.L.: 16.2 ft
ELEVATION W.L.: 46.5 ft
DATE W.L.: 5/19/06
TIME W.L.: 8:06 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0		0.0 - 1.8 SILTY SAND - gray fine grained silty sand	SM		58.1 / 1.8		SPT	5-4-4-5	8	40.0 / 2.0		
		1.8 - 17.5 LEAN CLAY - gray and orange mottled fine grained sandy clay, moist					SPT	5-6-7-10	13	80.0 / 2.0		
5	55	Gray and orange mottled silty clay at 4 ft					SPT	2-3-4-5	7	80.0 / 2.0		
							SPT	6-7-8-12	15	90.0 / 2.0		
							SPT	3-3-8-12	11	100.0 / 2.0		
10	50	Gray and orange fine grained sandy clay at 9.5 ft	CL				SPT	8-11-13-15	24	70.0 / 2.0		
							SPT	4-5-7-9	12	100.0 / 2.0		
		Orange and gray mottled silty clay at 14 ft, very dense					SPT	6-7-9-12	16	100.0 / 2.0	Grout	
15	45				42.4 / 17.5		SPT	4-5-7-17	12	100.0 / 2.0		
		17.5 - 21.5 POORLY SORTED SAND - white to tan medium grained well sorted quartz sand, saturated	SP				SPT	4-6-8-10	14	100.0 / 2.0		
20	40				38.4		SPT	4-4-6-7	10	100.0 / 2.0		
		21.5 - 22.0 LEAN CLAY - dark orange fine grained sandy clay	CL		37.9 / 22.0							
		22.0 - 23.5 POORLY GRADED SAND - well sorted medium grained sand Coarse grained well sorted sand at 23 ft	SP		36.4 / 23.5		SPT	4-4-2-2	6	100.0 / 2.0		
25	35	23.5 - 34.0 FAT CLAY - blue gray fat clay					SPT	1-2-0-1	2	70.0 / 2.0		
							SPT	0-0-1-2	1	70.0 / 2.0		
			CH				SPT	0-0-1-1	1	90.0 / 2.0		
30	30						SPT	0-0-2-1	2	100.0 / 2.0		
							SPT	1-2-3-3	5	100.0 / 2.0	Bentonite	
					25.9							
35	25	34.0 - 42.0 LEAN CLAY - gray silty clay with layering, very dense			34.0		SPT	2-3-6-11	9	100.0 / 2.0		
		Silty clay with interlayered clayey sand at 36 ft, very dense and dry									#2 Sand	
			CL				SPT	4-5-8-15	13	100.0 / 2.0		
		Dark gray fine grained sandy clay at 38 ft, very dense					SPT	7-8-9-12	17	100.0 / 2.0		
40	20	Log continued on next page										

WELL CASING
Interval: -2.78-37 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 37-50 ft
Material: PVC
Diameter: 2-inch
Slot Size: .010-inch
End Cap: Threaded

FILTER PACK
Interval: 34-50 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 31-34 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-31 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: None
Protective Casing: None

DRILLING METHODS
Type: 4.25-inch ID Hollow Stem Augers

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 11/30/06

RECORD OF BOREHOLE PZ-123B

SHEET 2 of 2

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 50.4 ft
LOCATION: Aulander, NC

DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/18/06
DATE COMPLETED: 5/18/06

NORTHING: 868,378.8
EASTING: 2,573,376.9
GS ELEVATION: 59.9 ft
TOC ELEVATION: 62.7 ft

DEPTH W.L.: 16.2 ft
ELEVATION W.L.: 46.5 ft
DATE W.L.: 5/19/06
TIME W.L.: 8:06 am

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
40			CL		17.9		SPT	3-4-6-9	10	100.0 / 2.0		
		42.0 - 50.0 CLAYEY SAND - dark grey fine grained clayey sand, very dense			42.0		SPT	7-7-8-12	15	100.0 / 2.0	Screen	
45	15		SC				SPT	5-5-11-17	16	100.0 / 2.0		
							SPT	5-5-7-11	12	100.0 / 2.0		
50	10						SPT	5-7-8-14	15	100.0 / 2.0		
		Boring completed at 50.4 ft			9.9 / 50.0							
55	5											
60	0											
65	-5											
70	-10											
75	-15											
80	-20											

WELL CASING
Interval: -2.78-37 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 37-50 ft
Material: PVC
Diameter: 2-inch
Slot Size: .010-inch
End Cap: Threaded

FILTER PACK
Interval: 34-50 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 31-34 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-31 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: None
Protective Casing: None

DRILLING METHODS
Type: 4.25-inch ID Hollow Stem Augers

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 11/30/06

DATE: 08/28/06

Golder Associates

WELL DEVELOPMENT LOG

Project Name: Republic/East Carolina
Well ID: PZ-115A
Well Diameter: 2 inches
Depth to Bottom: 19.71 feet
Well Location: _____
Equipment: Oakton PH/CON 10 meter, Oakton T-100 turbitiy meter, Supertwister 12V pump

Project No./Task No.: 063-6507.201
Sampler(s): Joe Church
Initial Depth to Water: 11.91 feet
Water Column Thickness: 7.80 feet

Time	pH (s.u.)	Cond. (uS)	Turb. (NTU)	Temp. (°C)	Gallons
10:41	4.82	0.215	-	20.4	0
10:44	4.65	0.198	-	20.7	5
10:47	4.84	0.165	-	18.5	10
10:49	4.66	0.123	-	18.3	15
10:52	4.88	0.112	-	18.4	20
10:54	4.91	0.085	-	18.2	25
10:56	4.92	0.087	-	18.4	30

Comments (weather conditions, color, silt, type of sample, purge-water management, etc.): cloudy, 70's, water was allowed in the turbity meter which produced error readings, water was orange/brown in color and turbid with a small amount of well sorted fine sand.

Signature: Joe Church Date: 8-28-06

QA/QC Sign Off: [signature] Date: 12-19-2006

DATE: 08/28/06

Golder Associates

WELL DEVELOPMENT LOG

Project Name: Republic/East Carolina
Project No./Task No.: 063-6507.201
Well ID: PZ-115B
Sampler(s): Joe Church
Well Diameter: 2 **inches**
Initial Depth to Water: 14.63 **feet**
Depth to Bottom: 52.15 **feet**
Water Column Thickness: 37.52 **feet**
Well Location: _____
Equipment: Oakton PH/CON 10 meter, Oakton T-100 turbitiy meter, Supertwister 12V pump

Time	pH (s.u.)	Cond. (uS)	Turb. (NTU)	Temp. (°C)	Gallons
11:16	8.04	0.167	-	18.8	0
11:18	9.79	0.199	-	18.3	5
11:21	8.05	0.219	-	18.3	10
11:23	7.48	0.231	-	16.9	15
11:24	7.20	0.238	-	17.8	20
11:26	6.99	0.257	-	17.3	25
11:28	7.05	0.256	-	17.1	30
11:31	6.87	0.249	-	18.1	35

Comments (weather conditions, color, silt, type of sample, purge-water management, etc.): cloudy, 70's, water was allowed into the turbity meter which produced error readings, water was dark grey in color and turbid with a small amount of well sorted fine grey sand.

Signature: Joe Church Date: 8-28-06

QA/QC Sign Off: _____ Date: 12-19-2006

DATE: 08/28/06

Golder Associates

WELL DEVELOPMENT LOG

Project Name: Republic/East Carolina
Well ID: PZ-117B
Well Diameter: 2 inches
Depth to Bottom: 53.60 feet
Well Location: _____
Project No./Task No.: 063-6507.201
Sampler(s): Joe Church
Initial Depth to Water: 15.41 feet
Water Column Thickness: 37.19 feet
Equipment: Oakton PH/CON 10 meter, Oakton T-100 turbitiy meter, Supertwister 12V pump

Time	pH (s.u.)	Cond. (uS)	Turb. (NTU)	Temp. (°C)	Gallons
12:18	6.36	0.224	>1000	19.2	0
12:21	6.30	0.201	>1000	18.6	5
12:23	6.37	0.193	>1000	18.0	10
12:26	6.30	0.192	>1000	17.9	15
12:28	6.33	0.187	589	17.5	20
12:31	6.26	0.187	488	19.4	25
12:33	6.29	0.186	444	17.6	30
12:36	6.33	0.188	630	17.2	35

Comments (weather conditions, color, silt, type of sample, purge-water management, etc.): cloudy, 80's, water was dark grey in color and turbid.

Signature: Joe Church Date: 8-28-06

QA/QC Sign Off: _____ Date: 12-19-2006

DATE: 08/28/06

Golder Associates

WELL DEVELOPMENT LOG

Project Name: Republic/East Carolina
Project No./Task No.: 063-6507.201
Well ID: PZ-109B
Sampler(s): Joe Church
Well Diameter: 2 inches
Initial Depth to Water: 16.71 feet
Depth to Bottom: 54.85 feet
Water Column Thickness: 38.14 feet
Well Location: _____
Equipment: Oakton PH/CON 10 meter, Oakton T-100 turbitiy meter, Supertwister 12V pump

Time	pH (s.u.)	Cond. (uS)	Turb. (NTU)	Temp. (°C)	Gallons
13:09	6.49	0.359	102	18.7	0
13:11	6.68	0.224	240	18.3	5
13:13	6.31	0.154	573	18.2	10
13:16	6.12	0.114	644	17.6	15
13:20	5.93	0.096	546	17.7	20
13:25	5.76	0.075	194	17.4	25
13:28	5.89	0.085	161	17.6	30
13:32	5.74	0.071	80.5	17.3	35

Comments (weather conditions, color, silt, type of sample, purge-water management, etc.): clear, 80's, water began as brown/grey in color and cleared as purge continued.

Signature: Joe Church Date: 8-28-06

QA/QC Sign Off: [signature] Date: 12-19-2006

DATE: 08/28/06

Golder Associates

WELL DEVELOPMENT LOG

Project Name: Republic/East Carolina
Well ID: PZ-107A
Well Diameter: 2 inches
Depth to Bottom: 29.25 feet
Well Location: _____
Project No./Task No.: 063-6507.201
Sampler(s): Joe Church
Initial Depth to Water: 9.10 feet
Water Column Thickness: 20.15 feet
Equipment: Oakton PH/CON 10 meter, Oakton T-100 turbitiy meter, Supertwister 12V pump

Time	pH (s.u.)	Cond. (uS)	Turb. (NTU)	Temp. (°C)	Gallons
14:07	5.38	0.053	988	19.2	0
14:10	5.47	0.051	958	18.3	5
14:15	5.35	0.053	52.9	18.0	10
14:21	5.33	0.053	23.8	18.2	15
14:27	5.32	0.054	342	17.8	20
14:33	5.33	0.054	19.95	18.0	25
14:40	5.33	0.054	6.94	17.7	30

Comments (weather conditions, color, silt, type of sample, purge-water management, etc.): clear, 80's, water was light brown in color and cleared as purge continued.

Signature: Joe Church Date: 8-28-06

QA/QC Sign Off: [signature] Date: 12-19-2006

DATE: 08/28/06

Golder Associates

WELL DEVELOPMENT LOG

Project Name: Republic/East Carolina
Project No./Task No.: 063-6507.201
Well ID: PZ-107B
Sampler(s): Joe Church
Well Diameter: 2 inches
Initial Depth to Water: 12.40 feet
Depth to Bottom: 50.80 feet
Water Column Thickness: 38.40 feet
Well Location: _____
Equipment: Oakton PH/CON 10 meter, Oakton T-100 turbitiy meter, Supertwister 12V pump

Time	pH (s.u.)	Cond. (uS)	Turb. (NTU)	Temp. (°C)	Gallons
14:56	6.75	0.187	>1000	17.6	0
14:58	6.79	0.199	654	17.5	5
15:15	6.76	0.199	158	21.4	10
15:37	6.80	0.191	82.6	21.0	15
08/29/06					
11:05	6.13	0.190	159	18.7	0
11:08	6.77	0.186	142	18.1	5
11:21	6.88	0.195	199	19.8	10
11:37	6.92	0.198	45.5	19.8	15

Comments (weather conditions, color, silt, type of sample, purge-water management, etc.): clear, 80's, water was light grey in color, purge was broken into two days since aquifer recharge was slow.

Signature: Joe Church Date: 8-28-06

QA/QC Sign Off: _____ Date: 12-19-2006

DATE: 08/28/06

Golder Associates

WELL DEVELOPMENT LOG

Project Name: Republic/East Carolina
Project No./Task No.: 063-6507.201
Well ID: PZ-109A
Sampler(s): Joe Church
Well Diameter: 2 **inches**
Initial Depth to Water: 13.37 **feet**
Depth to Bottom: 27.08 **feet**
Water Column Thickness: 13.71 **feet**
Well Location: _____
Equipment: Oakton PH/CON 10 meter, Oakton T-100 turbitiy meter, Supertwister 12V pump

Time	pH (s.u.)	Cond. (uS)	Turb. (NTU)	Temp. (°C)	Gallons
16:01	6.75	0.034	694	22.3	0
16:04	4.99	0.034	273	18.7	5
16:06	4.71	0.032	163	18.5	10
16:08	4.70	0.033	311	18.5	15
16:10	4.72	0.033	550	18.4	20
16:13	4.71	0.032	81	18.4	25
16:15	4.72	0.032	12.12	18.4	30
16:17	4.66	0.032	23.7	18.3	35

Comments (weather conditions, color, silt, type of sample, purge-water management, etc.): clear, 80's.

Signature: Joe Church Date: 8-28-06

QA/QC Sign Off: _____ Date: 12-15-2006

DATE: 08/29/06

Golder Associates

WELL DEVELOPMENT LOG

Project Name: Republic/East Carolina
Project No./Task No.: 063-6507.201
Well ID: PZ-117A
Sampler(s): Joe Church
Well Diameter: 2 inches
Initial Depth to Water: 9.11 feet
Depth to Bottom: 20 feet
Water Column Thickness: 10.89 feet
Well Location: _____
Equipment: Oakton PH/CON 10 meter, Oakton T-100 turbitiy meter, Supertwister 12V pump

Time	pH (s.u.)	Cond. (uS)	Turb. (NTU)	Temp. (°C)	Gallons
9:07	4.50	0.197	687	20.6	0
9:09	4.41	0.192	386	18.3	5
9:21	4.44	0.199	150	19.7	10
9:43	4.45	0.191	462	20.3	15
10:01	4.40	0.189	88.0	20.7	20
10:22	4.44	0.191	247	21.3	25
10:41	4.45	0.189	31.2	21.4	30

Comments (weather conditions, color, silt, type of sample, purge-water management, etc.): clear, 80's, water began as orange/brown in color and cleared as purge continued, small amount of sand was found in purge water.

Signature: Joe Church Date: 8-29-06

QA/QC Sign Off: _____ Date: 12-15-2006

Golder Associates

MONITORING WELL DEVELOPMENT DATA SHEET

Project: Republic Waste--East Carolina
Date: 06/27/06
Casing Type: PVC
Well/Boring Number (GW-16)
Casing Diameter in inches (Dr): 2
Screened Interval: 13-23 ft
Riser Elevation: 2.56 ft
Total Well Depth (Lw) in feet: 25 ft
Depth to Water (Lf) in feet: 11.81 ft
Time of Measurement: 11:51

Volume of water in well, using $V=0.041\ (Dr)^2\ (Lw - Lf)$ = 2.2 Gallons

FIELD MEASUREMENT OF PHYSICAL PARAMETERS

	Temp (C)	pH	Conductivity (µS/cm)	Clarity/ Color	Volume (gallons)	Water Level (ft)	Time
Before Development					2.2	11.81	11:51
After Purging							
1 Well Vol	17.47	4.56	999		2.2	11.91	12.:31
2 Well Vol	17.66	4.08	999		4.4	11.91	12:45
3 Well Vol	17.34	4.13	999		6.6	12.04	12:52
4 Well Vol	17.29	4.1	789		8.8	12.09	12:56
5 Well Vol	17.29	4.12	797		10	12.09	12:58
6 Well Vol	17.28	4.15	800		12.2	12.09	13:00
7 Well Vol	17.29	4.17	799		14.4	12.09	13:04
8 Well Vol	17.26	4.21	987		16.6	12.09	13:10
9 Well Vol	17.3	4.26	852		18.8	12.09	13:15
10 Well Vol	17.29	4.29	832		20	12.01	13:19
11 Well Vol	17.31	4.33	833		20.2	12.09	13:23
12 Well Vol	17.25	4.33	800		22.2	12.09	13:26
13 Well Vol	17.26	4.33	717		24.4	12.09	13:28
14 Well Vol	17.28	4.36	772		26.6	12.09	13:30

(Fill in one or more of the above columns depending on available equipment)

Method of purging (bailer or pump) pump
If pumped, pumping rate: 400 ml/10 sec max.
Well Purged Dry no
Continuous Recharge yes
Notes concerning condition of well, odors, color, etc.:

Developer's Signature

Golder Associates

MONITORING WELL DEVELOPMENT DATA SHEET

Project: Republic Waste--East Carolina
Date: 06/28/06
Casing Type: PVC
Well/Boring Number PZ-110
Casing Diameter in inches (Dr): 2
Screened Interval: 13-28 ft
Riser Elevation: 2.12 ft
Total Well Depth (Lw) in feet: 24 ft
Depth to Water (Lf) in feet: 10.72 ft
Time of Measurement: 8:28

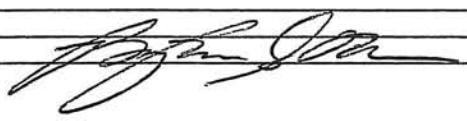
Volume of water in well, using $V=0.041 (Dr^2 (Lw - Lf)$ = 2.18 Gallons

FIELD MEASUREMENT OF PHYSICAL PARAMETERS

	Temp (C)	pH	Conductivity (µS/cm)	Clarity/ Color	Volume (gallons)	Water Level (ft)	Time
Before Development					2.2	10.72	8:28
After Purging							
1 Well Vol	17.74	4.14	593		2.2	10.82	8:33
2 Well Vol	17.38	4.14	342		4.4	10.87	8:38
3 Well Vol	17.37	4.13	351		6.6	10.87	8:44
4 Well Vol	17.38	4.06	343		8.8	10.88	8:50
5 Well Vol	17.46	4.01	361		10	10.88	8:57
6 Well Vol	17.46	4.01	587		12.2	10.88	9:02
7 Well Vol	17.47	4.01	585		14.4	10.88	9:06
8 Well Vol	17.44	4	582		16.6	10.88	9:11
9 Well Vol	17.56	4.11	355		18.8	10.88	9:15
10 Well Vol	17.47	4.2	301		20	10.88	9:19
11 Well Vol	17.53	4.23	278		22.2	10.88	9:24
12 Well Vol	17.51	4.28	262		24.4	10.88	9:27
13 Well Vol	17.53	4.39	245		26.6	10.88	9:30
14 Well Vol	17.41	4.42	260		28.8	10.88	9:35
15 Well Vol	17.44	4.67	224		30	10.88	9:40
16 Well Vol	17.4	4.59	234		32.2	10.88	9:44
17 Well Vol	17.4	4.58	230		34.4	10.88	9:47
18 Well Vol	17.38	4.6	222		36.6	10.88	9:50

(Fill in one or more of the above columns depending on available equipment)

Method of purging (bailer or pump) pump
If pumped, pumping rate: 250 ml/10 sec
Well Purged Dry no
Continuous Recharge yes
Notes concerning condition of well, odors, color, etc.:

Developer's Signature 

Golder Associates

MONITORING WELL DEVELOPMENT DATA SHEET

Project: Republic Waste--East Carolina
Date: 06/27/06
Casing Type: PVC
Well/Boring Number PZ 118
Casing Diameter in inches (Dr): 2
Screened Interval: 11-21 ft
Riser Elevation: 2.90 ft
Total Well Depth (Lw) in feet: 30 ft
Depth to Water (Lf) in feet: 15.71 ft
Time of Measurement: 14:38

Volume of water in well, using $V=0.041\ (Dr)^2\ (Lw - Lf)$ = 2.34 Gallons

FIELD MEASUREMENT OF PHYSICAL PARAMETERS

	Temp (C)	pH	Conductivity (µS/cm)	Clarity/ Color	Volume (gallons)	Water Level (ft)	Time
Before Development					2.4	15.71	14:38
After Purging							
1 Well Vol	18.51	5.05	203		2.4	17.01	14:41
2 Well Vol	18.01	4.47	532		4.8	17.41	14:47
3 Well Vol	17.86	4.31	544		6.2	18.98	14:51
4 Well Vol	17.87	4.3	565		8.8	19.49	15:00
5 Well Vol	17.84	4.31	596		10.2	20.09	15:04
6 Well Vol	17.86	4.34	592		12.6	20.41	15:08
7 Well Vol	18.06	4.39	560		15	20.39	15:12
8 Well Vol	18.01	4.4	490		17.4	20.37	15:22
9 Well Vol	18.2	4.52	427		19.8	19.99	15:30
10 Well Vol	18.11	4.51	424		22.2	19.97	15:36
11 Well Vol	18.12	4.49	423		24.6	19.97	15:43

(Fill in one or more of the above columns depending on available equipment)

Method of purging (bailer or pump) pump
If pumped, pumping rate: 1000 ml/min
Well Purged Dry no
Continuous Recharge yes
Notes concerning condition of well, odors, color, etc.: pump shut off at 15:43 due to heavy rain/wind

Developer's Signature

Project Name	East Coulee LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahay
Ground Elevation		Rig Type	Diedrich D-50 Turbo
Groundwater elevation		Logged By	Dusty Reedy
Date Start/Finish	5-17-06	Total Depth	27

BORING NO. P2-107A

Page 1 of 1

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
								Gray and orange fine grained sandy clay
	5							
	10							
								@13.5 Orange silty sand, saturated
	15							changes to silty @ 16 ft.
	20							
	25					End @ 27'		Terminated boring @ 27 ft
	30							
	35							

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
P - Penetration Length of Sampler or Core Barrell
Rec - Recovery Length of Sample RQD
RQD - Lenght of Sound Cores >4in./Length Cored %
SS - Split Spoon Sample U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Carolina IF	Project Number	063507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	M. Ko McConahay
Ground Elevation		Rig Type	Deidrich D-50 Turbo
oundwater elevation		Logged By	Dusty Reedy
Date Start/Finish	5-16-06 / 5-17-06	Total Depth	50

BORING NO. PZ-107B

Page 1 of 3

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			3 3 4		100			Black fine grained sandy clay, changes to Gray @ 1.25 ft
	2		8 6 6		60			Gray and orange mottled fine grained sandy clay
	4		8 4 4 3		80			Same material
	6		5 8 6 9		100			Same material, but becoming more sandy with fine grained sand Gray fine grained silty sand by 7.9 ft.
	8		11 15 4 3		90			Orange and gray mottled sandy clay with thin zones of silty sand @ 8ft, 9ft, 9.25ft. that produce water.
	10		4 6 5 8		100			Orange and gray mottled sandy clay.
	12		8 13 4 6		100			Gray fine grained sandy clay to 13ft. changes to a gray fine grained silty sand. changes @ 13.5 ft to an orange silty sand, saturated. (orange only)
	14		8 16 4 7		100			Orange fine grained silty sand, saturated to 15 ft, changes to gray
	16		6 11 5 7		100			Gray fine grained silty sand, saturated. more clayey @ 17.75 ft.
			5 3					

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
- - Penetration Length of Sampler or Core Barrel
Recovery Length of Sample RQD
.ght of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Coeline EF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahay
Ground Elevation		Rig Type	Deitrich D-50 Truck
Groundwater elevation		Logged By	Dusty Roedl
Date Start/Finish	5-16-06 / 5-17-06	Total Depth	50

BORING NO. PZ-107AB

Page 2 of 3

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			3 3 4 5		100			Gray silty sand, saturated
	20		2 2 1 2		100			Same as above to 21.5 ft, becomes more clayey, clayey sand by 21.9 ft.
	22		3 3 5 9		100			Brown silty sand with some clay, saturated.
	24		2 1 2 3		100			Same as above with a sandy clay layer @ 25 ft ~1 inch thick
	26		4 3 5 8		100			Tan fine grained silty sand, saturated.
	28		4 4 4 4		100			Same as above to 29.5 ft, changes to light gray sandy clay. changes @ 29.75 ft to blue gray fat clay.
	30		2 1 1 2		100			Blue gray fat clay
	32		1 1 0		60	5-17-06 weight of hammer		Same material to 33.5 ft, changes to a gray clayey sand, medium grained.
	34		2 1 2 7		100			Gray medium grained silty sand, saturated

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
- Penetration Length of Sampler or Core Barrell
Recovery Length of Sample RQD
Lenght of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Carolina LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahey
Ground Elevation		Rig Type	Deidrich D-50 Tur So
Groundwater elevation		Logged By	Dusty Roedy
Date Start/Finish	5-16-06 / 5-17-06	Total Depth	50

BORING NO. P2-107B

Elev. Ft.	Depth ft.	Sample Type & No.	Blows per 6"	Pen in.	Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			10 10 13 20		100			Gray medium grained silty sand with some pebble size pieces of quartz, saturated.
	38		20 10 13 15		100			Gray fine grained silty sand
	40		5 6 7 6		100			Same material
	42		6 5 4 14		100			Same material
	44		4 4 6 12		100			Medium grained gray silty sand to 45.75ft, changes fine grained clayey sand.
	46		4 9 27 35		100			Medium grained well sorted sand to 47.25ft, changes to a fine grained silty sand, changes back to a well sorted medium grained sand @ 47.75ft.
	48		7 9 8 6		90			Gray medium grained poorly sorted sand, saturated
	50							Terminated boring @ 50ft. Last spoon @ 50ft.
	52							

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
n - Penetration Length of Sampler or Core Barrell
Rec - Recovery Length of Sample RQD
- Lenght of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U -
Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Cushing	Project Number	0636567.201
Project Location		Client	Republic Services
Drilling Company	Geologic Expl.	Driller Name	Mike McConahay
Ground Elevation		Rig Type	Diedrich D-50 Turbo
oundwater elevation		Logged By	Dusty Reed
Date Start/Finish	5-5-06	Total Depth	20

BORING NO. P2W8

Page 1 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Blows per 6"	Pen in.	Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
		3 3 3 3			80			Gray sandy clay to 1 ft., changes to a clay with some fine grained sand @ 1 ft
	2	3 3 3 3			80			Gray lean clay with some fine grained sand
	4	3 2 5 8			100			Gray fat clay with some fine grained sand
	6	5 7 9 12			100			Same material with a slightly mottled appearance
	8	3 4 5 8			100			Gray fat clay to 8.75 ft, changes to a sandy lean clay from 8.75 to 9.5 ft., then changes back to a gray fat clay.
	10	5 6 8 11			100			changes to an orange fine grained silty sand @ 11 ft. saturated.
	12	4 4 5 9			100			Same material
	14	0 2 2 6			100	weight of rods		Some material, some organics
	16	4 3 8 12			100			Some material, some organics

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
- Penetration Length of Sampler or Core Barrel
Recovery Length of Sample RQD
ght of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U -
Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" HSA

Golder Associates

Project Name	East Carolina LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahey
Ground Elevation		Rig Type	Deidrich D-50 Turbo
Groundwater elevation		Logged By	Dusty Reeder
Date Start/Finish	5-9-06	Total Depth	20

BORING NO. PZ-108

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			3 3 2 3		100			Thinly layered fine grained sandy clay @ 19 ft. gray + orange, changed to gray fat clay @ 19.8 ft.
	20		2 1 2 1		100			Gray fat clay with some fine grained sand. terminated boring @ 20 ft last spoon @ 22 ft
	22							

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
- - Penetration Length of Sampler or Core Barrel
Recovery Length of Sample RQD
ght of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U -
Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" HSA
ID

Golder Associates

Project Name	East Carolina LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConnaughey
Ground Elevation		Rig Type	Diedrich D-50 Turbo
Groundwater elevation		Logged By	Dusty Rady
Date Start/Finish	5-9-06/5-10-06	Total Depth	24

BORING NO. PZ-109A

Page 1 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			2					Brown sandy silt, changes to a tan fine grained silty sand @ 0.5 ft., changes to a fine grained sandy clay by 1.25 ft
			1		95			
			2					
			5					
	2							
			5					Gray to orange fine grained sandy lean clay. moist.
			7		100			
			12					
			16					
	4					Shelby Tube from 4-6 ft		Gray and orange mottled fine grained lean clay.
	6							Very sandy orange and gray mottled lean clay. changes to orange silty sand by 7.75 ft.
			6					
			6		100			
			8					
			11					
	8		3					Tan and orange silty sand, wet, fine grained
			4		100			
			3					
			4					
	10		2					Some material, saturated
			2					
			3		100			
			2					
	12					Shelby Tube from 12-14 Lost sample		
	14					Shelby Tube from 14-16		Some material
	16		0			weight of rods		Tan and orange silty sand with some organics.
			2					
			3		100			
			6					

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
Penetration Length of Sampler or Core Barrell
Recovery Length of Sample RQD
Lenght of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)
6" ID HSA

Golder Associates

Project Name	East Circulation CF	Project Number	063507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahey
Ground Elevation		Rig Type	Diedrich D-50 Turbo
Groundwater elevation		Logged By	Dusty Rood
Date Start/Finish	5-9-06/5-10-06	Total Depth	24

BORING NO. PZ-109A

Page 2 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			4 4 5 8		100			Tan fine to medium grained silty sand with visible layering, changes to a tan fine grained sandy clay @ 19.8 ft
	20		1 1 3 8		100			Medium to fine grained tan and orange silty sand, changes to a very sandy tan clay with layering @ 21.75 ft.
	22		3 5 8 12		100			Highly layered, medium grained silty sand, saturated.
	24		3 2 3 5		100			Same, then changes @ 25.5 ft to a highly layered orange and gray fat clay with some fine grained sand.
	26		2 3 2 2		100			Gray fat clay
	28							Terminated boring @ 24 ft last spoon taken to 28 ft.
	30							
	32							
	34							

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
- Penetration Length of Sampler or Core Barrell
Recovery Length of Sample RQD
ight of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Carolina	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahey
Ground Elevation		Rig Type	Diedrich D-50 Track
oundwater elevation		Logged By	Dusty Reedy
Date Start/Finish	5-10-06 / 5-12-06	Total Depth	52

BORING NO. PZ-109B

Page 1 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
								Fine grained sandy clay
	5							
								Fine grained silty sand @ 7.75 ft
	10							
	15							
	20							
	25							Fat clay, gray @ 25.5
						start spoons at 28 ft.		
			0					Stopped @ 28 ft on 5-10-06
			0		100	weight of rods		Blue gray fat clay
	30		0					
			0		90	weight of rods		Same material
			0					
	32							
						Shelby Tube from 33 35'		Same material
	34							
	35		C					
			O		100	weight of rods		Blue gray fat clay / small sandy zone < 1" @ 36 ft.

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
- Penetration Length of Sampler or Core Barrel
Recovery Length of Sample RQD
ength of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U
Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

Mud Rotary
6" bit

Golder Associates

Project Name	East Carolina LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConaghy
Ground Elevation		Rig Type	Deidrich D-50 Track
Groundwater elevation		Logged By	Dusty Roads
Date Start/Finish	5-10-06 / 5-12-06	Total Depth	52

BORING NO. P2-1068

Page 2 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			0			weight of rods		
	37		0					Blue gray fat clay
			0			weight of rods		
	38		2		100			
			4					
	39		0			weight of hammer		Blue gray fat clay, changes to a clayey sand to silty sand, SI-S gray @ 40.5 ft
	40		0		100			
			2					
	41		1					
			1					Blue gray clayey sand, a few weathered pebbles, brown @ 43 ft.
	42		1		100			
			1					
	43		1					
			7					Blue gray clayey sand to 44 ft., changes to a tan and orange silty sand, fine grained.
	44		16		100			
			15					
			22					
	45					Shelby tube from 45.5 to 47.5 ft caving only push 1.5 ft		
	46							
	47							
			2			5-12-06		White and orange fine grained silty sand, saturated
			3					
	48		5		50			
			15					
	49		5					White and yellow fine grained silty sand and well sorted medium grained sand
			10					
	50		15		100			
			15					Terminated Boring @ 52-ft
	51							
	52							

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
- Penetration Length of Sampler or Core Barrell Recovery Length of Sample RQD
- Length of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

Mud Rotary 6" bit.

Golder Associates

Project Name	East Carolina LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConaghy
Ground Elevation		Rig Type	Geoprobe 7720 DT
oundwater elevation		Logged By	Dusty Reedy
Date Start/Finish	5-17-06 / 5-18-06	Total Depth	28

BORING NO. PZ-110 GW-18

Page 1 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			1					Topsoil - black fine grained sandy silt. to 0.5ft.
			0			weight of hammer		changes to gray fine grained sandy clay.
			1		100			
			4					
	2		4					Orange and gray mottled fine grained sandy clay.
			4		100			
			8					
			11					
	4		4					Same material
			5					
			8		100			
			11					
	6		10					Same material to 7.75 ft. changes to a light
			10					gray clayey silt.
			11		100			
			14					
	8		4					Light gray fine grained sandy clay with some shell
			2					sand. Changes @ 9.75 ft to medium
			3		100			grained silty sand.
			7					
	10		5					Light gray and orange medium grained
			4					silty sand, saturated.
			5		100			
			5					
	12		4					Same material to 12.75 ft. changes to an
			5					orange medium grained silty sand that
			8		90			shows some layering, wet
			7					
	14		3					Same material to 15.9 ft, changes to a
			6					poorly sorted pink sand, saturated
			6		90			
			7					
	16		4					~~Sand~~ Pink, tan, and orange poorly sorted medium
			7					grained sand, saturated.
			7		80			
			10					

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
- Penetration Length of Sampler or Core Barrel
Recovery Length of Sample RQD
ght of Sound Cores >4in./Length Cored %
S - Split Spoon Sample
Undisturbed Samples U -

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Carolina LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConaghey
Ground Elevation		Rig Type	Diedrich D-50 Turbo
Groundwater elevation		Logged By	Dusty Roach
Date Start/Finish	5-17-06 / 5-18-06	Total Depth	28

BORING NO. RZ-110 MW-18

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			6 8 8 14		100			Same material, layering present saturated
	20		3 4 5 8		80			Same material without layering
	22		8 8 10 13		90			Same material
	24		3 3 5 6		100			Same material to 25.9 ft, becomes coarse grained with ten sandy clay at 26 ft.
	26		4 5 5 12		100			Sandy clay to 26.25 ft, changes back to ten medium grained, poorly sorted sand. Changes @ 27.25 ft to fine grained light gray sandy clay. changes @ 27.75 ft to layered gray fine grained silty sand.
	28		4 6 5 5		100			Medium grained poorly sorted, sandy clay layers from 29 to 29.25 ft and 29.75 to 29.90 ft.
	30		3 2 2 2		100			poorly grained poorly sorted sand, orange. changes to a blue gray fat clay @ 31.75
	32							Boring terminated @ 28 ft. last spoon to 32
	34							

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
Pen - Penetration Length of Sampler or Core Barrel
Rec - Recovery Length of Sample RQD
% - Lenght of Sound Cores >4in./Length Cored %
SS - Split Spoon Sample U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

31
10
21

Golder Associates

Project Name	East Creek Landfill	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Explorations	Driller Name	Mike McConahey
Ground Elevation		Rig Type	Diedrich D-50 Truck
roundwater elevation		Logged By	Dusty Roach
Date Start/Finish	5-23-06	Total Depth	18

BORING NO. PZ-111

Page 1 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			5					Brown to tan fine grained silty sand to 1.5ft. changes to an orange and gray mottled fine grained sandy clay.
			6		50			
			5					
			7					
	2		8					Orange and gray mottled fine grained sandy clay.
			8		60			
			11					
			15					
	4		4					Orange and gray mottled silty clay
			5		100			
			8					
			14					
	6		8					Orange and gray mottled fine grained sandy clay to 7.25 ft. changes to a gray fine grained clayey sand.
			11		100			
			14					
			18					
	8		3				→	Orange and gray mottled fine grained silty sand saturated.
			3		100			
			5					
			6					
	10		4					Same material
			4		100			
			3					
			8					
	12		3					Same material
			3		100			
			3					
			5					
	14		0			weight of rods		Same material
			4		100			
			4					
			4					
	16		4					Gray to orange medium grained silty sand, saturated
			4		100			
			5					
			6					

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
n - Penetration Length of Sampler or Core Barrel
Rec - Recovery Length of Sample RQD
- Lenght of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	~~East Carolina LF~~	Project Number	C636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahey
Ground Elevation		Rig Type	Deidrich D-50 Turbo
Groundwater elevation		Logged By	Dusty Reeds
Date Start/Finish	5-23-06	Total Depth	18

BORING NO. P2-111

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			0 ← 1 2 1		100	- weight of rods		Same material to 18.5 ft. Changes to blue gray fat clay.
	20							Terminate boring @ 18 ft Last spoon to 20
	22							
	24							
	26							
	28							
	30							
	32							
	34							

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
Pen - Penetration Length of Sampler or Core Barrel
R Recovery Length of Sample RQD
of Sound Cores >4in./Length Cored %'
S Spoon Sample U -
Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Coulina LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	M. Ko McCumsey
Ground Elevation		Rig Type	Diedrich D-50 Turbo
oundwater elevation		Logged By	Dusty Roody
Date Start/Finish	5-17-06	Total Depth	22

BORING NO. P2-112

Page 1 of 2

Elev.. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			6 6 6 8		40			Topsoil, black sandy silt to 0.25ft, changes to a gray fine grained sandy clay.
	2		5 10 10 13		70			Gray fine grained sandy clay.
	4		4 5 7 8		100			Gray and orange mottled silty clay.
	6		5 7 10 15		70			Same as above.
	8		4 3 4 7		80			Same as above
	10		6 6 9 11		100			Same as above, with a thin fine grained silty sand @ 11.5 and @ 12ft., both less than 1 inch thick.
	12		3 2 4 6		60			Light gray fine grained silty sand, saturated.
	14		4 4 6 8		100			Same as above to 15.5 ft, changes to an orange fine grained silty sand, saturated
	16		3 4 6 10		100			Same as above

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
Penetration Length of Sampler or Core Barrel
Recovery Length of Sample RQD
ught of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U
Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)
6" ID HSA

Golder Associates

Project Name	Eastcreek LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McCauley
Ground Elevation		Rig Type	Deghil D 50 Turbo
oundwater elevation		Logged By	Dusty Roady
Date Start/Finish	5-17-06	Total Depth	22

BORING NO. P2-112

Page 2 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			4 6 7 10		100			Same as above to 21.9 ft, changes to medium grained silty sand.
	20		4 4 6 7		100			Same material to 20.75 ft, changes to fine grained gray sandy clay, At 21ft changes back to medium grained silty sand. At 21.5ft changes to orange fine grained silty sand. orange medium grained silty sand to 23 ft changes to blue gray fat clay.
	22		4 3 2 3		100			Terminate augers @ 22 ft Last spoon to 24 ft.
	24							
	26							
	28							
	30							
	32							
	34							

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
P - Penetration Length of Sampler or Core Barrell
Rc - Recovery Length of Sample RQD
R - Lenght of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Carolina ULF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Explorations	Driller Name	Mike Mc
Ground Elevation		Rig Type	Diedrich D-50 Turbo
Groundwater elevation		Logged By	Dust+Ready
Date Start/Finish	5.8.06 / 5.9.06	Total Depth	24

BORING NO. P2-113

Page 1 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			3 4 6 12		75%			Tan, gray, and orange mottled fat clay, becomes gray and silty, lenses @ 1.75 ft.
	2		5 7 9 13		100%			Hard gray silty clay to 2.25 ft, then change to a moist gray fat clay.
	4		3 5 6 10		100%			Gray with some orange fat clay
	8		9 12 13 18		100			Gray with some orange fat clay
	8		4 5 8 16		100			Light gray fat clay with some silt.
	10		10 12 15 18		88			Becomes a sandy fat clay by 11 ft., then sandy clay by 12 ft., gray, fine grained sand
	12		3 3 4 8		100			Fine grained sandy clay, changes to a fine grained sandy silt by 13.25 ft, orange, very moist
	14		4 3 5 9		100			Saturated fine grained sandy silt, gray + orange
	16		4 4 4 8		100			Fine grained silty sand, orange and yellow, saturated,
	18							

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
- Penetration Length of Sampler or Core Barrel
- Recovery Length of Sample RQD
Lenght of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

4" HSA

Golder Associates

Project Name	East Carolina LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConchey
Ground Elevation		Rig Type	Deitrich D-50 Turbo
roundwater elevation		Logged By	Dusty Roady
Date Start/Finish	5-8-06 / 5-9-06	Total Depth	24

BORING NO. P2-113

Page 2 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			2 3 6 13		100			Some material with some organics.
	20		2 2 3 6.		100			Some material
	22		4 4 7 10		100			Some material to 23.5 ft, changes to thinly layered silty clay, orange and gray.
	24		WOH WOH		100			Sandy clay and very layered to 25.75 ft, changes to gray fat clay.
	26							Terminated augers @ 24 ft. Spoon @ 26 ft.
	28							
	30							
	32							
	34							
	36							

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
- Penetration Length of Sampler or Core Barrel
- Recovery Length of Sample RQD
- Length of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

HSA 6" ID

Golder Associates

Project Name	East Carolina LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahey
Ground Elevation		Rig Type	Deidrich D-T-O Turbo
oundwater elevation		Logged By	Dusty Reedy
Date Start/Finish	5-16-06	Total Depth	24

BORING NO. PZ-114

Elev. Ft.	Depth ft.	Sample Type & No.	Blows per 6"	Pen in.	Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			5 3 4 5		80			Tan fine grained silty sand with organics to 1.75 ft, changes to an orange fine grained sandy clay.
	2		5 7 8 13		80			Orange and gray mottled fine grained sandy clay.
	4		5 8 10 13		100			Same material to 5.75 ft, changes to orange and gray mottled fine grained, clayey to silty sand.
	6		7 10 12 15		100			Orange and tan mottled fine grained silty sand, moist.
	8		7 7 7 9		100			Same material
	10		4 4 5 7		80			Same material
	12		3 3 4 5		90			Orange fine grained silty sand with organics, saturated.
	14		4 4 4 7		100			Same as above to 15.5 ft, sand becomes medium grained, saturated.
	16		4 3 5 7		100			Tan to orange medium grained silty sand with organics, saturated.

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
- Penetration Length of Sampler or Core Barrell
Recovery Length of Sample RQD
ight of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U -
Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Carolina LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahey
Ground Elevation		Rig Type	Deidrich D-50 Turbo
Groundwater elevation		Logged By	Dusty Reedy
Date Start/Finish	5-16-06	Total Depth	24

BORING NO. PZ-114

Elev. Ft.	Depth ft.	Sample Type & No.	Blows per 6"	Pen in.	Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			4 5 7 11		100			Tan well sorted medium grained sand from 18 ft to 19.5 ft, changes to a fine-grained silty sand, orange.
	20		4 5 7 6		100			Tan fine grained silty sand to 21.5 ft, changes to a thinly bedded fine grained sandy clay with organics.
	22		6 5 6 15		100			Tan and orange thinly bedded sandy clay.
	24		6 6 4 5		100			Same as above to 25.5 ft, changes to to gray fat clay.
	26							Terminated boring @ 24 ft Last spoon to 26 ft.
	28							
	30							
	32							
	34							

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
Penetration Length of Sampler or Core Barrel
Recovery Length of Sample RQD
Length of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U -
Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Carolina LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McGonagle
Ground Elevation		Rig Type	Diedrich D-50-Turbo
Groundwater elevation		Logged By	Dusty Reed
Date Start/Finish	5-22-06	Total Depth	17

BORING NO. P2-115A

Page 1 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Blows per 6"	Pen in.	Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			3 4 5 6		50			Dry gray sandy clay - fine grained
	2		6 6 7 11		66			Same material
	4		4 4 6 9		100			Gray and orange mottled silty clay
	6		8 9 9 10		100			Same material to 7.25 ft, changes to a black organic fat clay to 7.75ft, changes to a yellow fine grained clayey sand.
	8		3 2 3 4		60			Gray and yellow silty sand, saturated.
	10		3 4 5 6		100			Same material; saturated.
	12		4 3 3 5		100			Yellow fine grained silty sand, saturated
	14		2 2 3 6		100			Yellow medium grained silty sand, saturated
	16		5 6 4 3		100			Same material to 17.8 ft, changes to blue gray fat clay

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
Pen - Penetration Length of Sampler or Core Barrel
Rec - Recovery Length of Sample
RQD of Sound Cores >4in./Length Cored %
S - Spoon Sample
U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	Easy Cleaning LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Godaya Exploration	Driller Name	Mike McConahey
Ground Elevation		Rig Type	Diedrich D-50 Turbo
Groundwater elevation		Logged By	Dusty Reedy
Date Start/Finish	5-22-06	Total Depth	17

BORING NO. DZ-115A

Page 2 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			2					Blue gray fat clay
			1		100			
			1					Terminated boring @ 17 ft
	20		1					last spoon @ 20 ft
	22							
	24							
	26							
	28							
	30							
	32							
	34							

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
Pen - Penetration Length of Sampler or Core Barrell
Rec - Recovery Length of Sample
RQD of Sound Cores >4in./Length Cored %
S - Spoon Sample
U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Casting CF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahey
Ground Elevation		Rig Type	Dietrich D-50 Turbo
Groundwater elevation		Logged By	Dusty Rood
Date Start/Finish	5-23-06	Total Depth	50

BORING NO. PZ-1158

Page 1 of 3

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
								Gray sandy clay
								Orange silty clay
	5							
								Yellow silty sand
	10							
	15							
								Blue gray fat clay at 17.5 ft.
	20		5 4 3 4		50			Blue gray fat clay with occasional very thin zones of fine grained sand
	22		3 2 2 1		60			Same material
	24		3 1 2 1		100			Same material
	26		2 1 1 2		100			Same material
	28		0 0 4 4		100	weight of rods		Gray fine grained clayey sand

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
Pen - Penetration Length of Sampler or Core Barrel
R - Recovery Length of Sample
RQD of Sound Cores >4in./Length Cored %
S - Spoon Sample
U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" TD HSA

Golder Associates

Project Name	Enbridge Line 6B	Project Number	0636507-201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahey
Ground Elevation		Rig Type	Diedrich D-50 Turbo
Groundwater elevation		Logged By	Dusty Reddy
Date Start/Finish	5-23-06	Total Depth	50

BORING NO. B2-13B

Elev. Ft.	Depth ft.	Sample Type & No.	Blows per 6"	Pen in.	Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			0					
			0					Some material, moist
			4		100			
			6					
	32		7					Some material, wood @ 31.75 ft,
			4					
			6		80			
			11					
	34		6					Some material, very dense
			7					
			10		100			
			24					
	36		5					Some material, with wood @ 37.25 ft
			5		80			and @ 38 ft.
			6					
			12					
	38		8					Some material
			7		100			
			8					
			12					
	40		5					Some material
			6		100			
			7					
			17					
	42		5					Some material, less clay starting @ 43.25 ft,
			6					
			7		(100			
			13					
	44					Shelby Tube from 44 to 45.5 ft,		Some material with wood
	46		5					
			5					Some material
			8		100			
			14					

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
Pen - Penetration Length of Sampler or Core Barrel
R - Recovery Length of Sample RQD
of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Carolina CF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConaughey
Ground Elevation		Rig Type	Deidrich D-50 Turbo
Groundwater elevation		Logged By	Dusty Rood
Date Start/Finish	5-23-06	Total Depth	50

BORING NO. P2-115B

Page 3 of 3

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			5					Fill material
			5		100			
			9					
	50		19					Terminated boring @ 50ft
								Cast Spoon @ 50ft
	52							
	54							
	56							
	58							
	60							

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
Pen - Penetration Length of Sampler or Core Barrel
Recovery Length of Sample
RQD of Sound Cores >4in./Length Cored %
Split Spoon Sample
U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Carolina LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahey
Ground Elevation		Rig Type	Dodrich D-50 Turbo
Groundwater elevation		Logged By	Dusty Roady
Date Start/Finish	5-9-06	Total Depth	20

BORING NO. PZ-116

Page 1 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			2 2 4 5		70			Gray and brown loam clay with fine grained sand.
	2		5 6 7 11		70			Gray and orange mottled clay with fine grained sand.
	4		3 3 5 1		70			Gray clay with fine grained sand
	4		8 9 11 16		100			Becomes more sandy @ 7.5 ft. changes to a silty sand with clay by 7.9 ft
	8		4 5 6 9		100			Alternating layers of sandy clay and clayey sand, all gray
	10		4 5 7 9		100			Tan silty sand to 11 ft. changes to gray and orange sandy clay, changes to orange silty sand @ 11.5 ft, changes to gray sandy clay @ 12 ft. All sand fine grained and silty sand areas saturated.
	12		0 2 1 1		90	weight of hammer		Orange and gray mottled silty sand, fine grained, saturated sandy clay @ 13.9 ft.
	14		3 2 3 4		100			Orange and gray fine grained silty sand with visible strata
	16		2 2 3 7		100			Light gray silty sand to 17.75 ft, changes to an orange silty sand

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
- - Penetration Length of Sampler or Core Barrel
Recovery Length of Sample RQD
.ght of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" SD HSA

Golder Associates

Project Name	East Carolina UF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahey
Ground Elevation		Rig Type	Deidrich D-50 Turbo
Groundwater elevation		Logged By	Dudley Reed
Date Start/Finish	5-9-06	Total Depth	20

BORING NO. P2-116

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			4 5 6 6		100			Tan and orange medium grained silty sand
	20		3 3 4 6		100			Gray and orange layered lean clay with fine grained sand, becomes gray fat clay @ 21.8 ft
	22							Terminated boring @ 20 ft Last spoon to 22 ft
	24							
	26							
	28							
	30							
	32							
	34							

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
- Penetration Length of Sampler or Core Barrel
Recovery Length of Sample RQD
Weight of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U -
Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Fenceline CF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahey
Ground Elevation		Rig Type	Deidrich D-50 Truck
Groundwater elevation		Logged By	Dusty Reed
Date Start/Finish	5-10-06	Total Depth	18

BORING NO. PZ-117A

Page 1 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			2 4 4 7	100				Gray sandy clay, fine grained
	2		5 5 7 9	100				Same material
	4		3 3 4 8	100				Same material, but less sand
	6		5 6 12 18	100				Gray fine grained sandy clay
	8					Shelby Tube Taken @ 8ft-10ft		Gray sandy clay
	10		4 7 10 15		100			Gray sandy clay with thin silty sand layers @ 10.75 ft, 11.25 ft, and @ 11.8 ft.
	12		5 10 15 14		100			Sandy clay becoming more sandy, silty sand layers @ 12.75, 13.5, and 13.75 ft
	14		4 5 7 10		100			Gray sandy to silty clay to 15.25 ft, changes to a gray silt with some clay layers.
	16		4 4 6 7		100			Gray sandy to silty clay

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
Pen - Penetration Length of Sampler or Core Barrel
Recovery Length of Sample RQD
ght of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U -
Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East corridor	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConnahey
Ground Elevation		Rig Type	Deidrich D-50 Turbo
roundwater elevation		Logged By	Dusty Reedy
Date Start/Finish	5-16-06	Total Depth	18

BORING NO. P2-117A

Elev. Ft.	Depth ft.	Sample Type & No.	Blows per 6"	Pen in.	Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
		4 4 3 3			100			very thin layers of sandy clay and silty sand changes to gray fat clay @ 14.5 ft
	20							Terminated boring @ 18 ft Last spoon @ 20 ft.
	22							
	24							
	26							
	28							
	30							

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
- - Penetration Length of Sampler or Core Barrell
Recovery Length of Sample RQD
ght of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U -
Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Elevation LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahay
Ground Elevation		Rig Type	Diedrich D-50 Truck
oundwater elevation		Logged By	Dusty Reedy
Date Start/Finish	5-15-06 / 5-16-06	Total Depth	

BORING NO. P2-117B

Page 1 of 3

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
								Gray fine grained sandy clay
	5							
	10							
								Gray silty clay @ 14 ft
	15							
	20		4			start sampling at 20 ft.		Gray fat clay @ 19.5 ft.
			3					Gray fat clay with some fine grained sand
			3					
			4		60			
	22		0			weight of rods		Gray fat clay with some silt
			2					
			1		100	shelby Tube taken from 22 to 24 ft.		
			2					
	24							
	26		0			weight of rods		Gray fat clay with very thin layers of silt and very fine sand
			0					
			0		100			
			0					
	28		3					Sand material
			2		100			
			2					
			3					
	30							

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
- - Penetration Length of Sampler or Core Barrel
Recovery Length of Sample RQD
ght of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)
4¼" ID HSA

Golder Associates

Project Name	East Carolina LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McCumbey
Ground Elevation		Rig Type	Deidrich D-50 Turbo
Groundwater elevation		Logged By	Dusty Roddy
Date Start/Finish	5-15-06 / 5-16-06	Total Depth	50

BORING NO. P-24-178

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			2 2 2 2		100			Same material
	32		3 2 3 3		100			Same material.
	34		2 2 1 3		100			Same, but becoming more silty
	36		3 2 3 6		100			Same material to 37.75 ft, changes to a fine grained clayey sandy gray
	38		3 4 8 21		100			Gray clayey sand, becoming less clayey.
	40		3 4 12 15		100			Light gray clayey sand, fine grained.
	42		8 9 10 15		100			Same material
	44		4 5 6 11		100			Same material
	46		9 9 10 11		100			Same material, darker

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
Pen - Penetration Length of Sampler or Core Barrel
Recovery Length of Sample RQD
ght of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Carolina	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahey
Ground Elevation		Rig Type	Doidrich D-50 Turbo
Groundwater elevation		Logged By	Dusty Roody
Date Start/Finish	5-15-06 / 5-16-06	Total Depth	50

BORING NO. P2-117B

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
						Shelby tube from 48-49.5 ft Dent. trust top material		Same material
	50							Terminated boring @ 50 ft

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
- Penetration Length of Sampler or Core Barrell
Recovery Length of Sample RQD
Weight of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U -
Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" I-D HSA

Golder Associates

Project Name	East Carolina LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahey
Ground Elevation		Rig Type	Diedrich D-50 Track
oundwater elevation		Logged By	Dusty Roedy
Date Start/Finish	5-16-06	Total Depth	21

BORING NO. PZ-118 (GW-19)

Page 1 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			3 4 4 4		100			Orange and brown fine grained sandy clay to 0.5 ft, changes to a tan fine grained silty sand to 1.5 ft. changes to an orange fine grained sandy clay.
	2		7 7 13 17		100			Orange fine grained sandy clay.
	4		3 6 8 12		100			Orange and gray mottled fine grained sandy clay to 5ft. changes to an orange and tan mottled silty sand.
	6		7 8 8 11		100			Orange fine grained silty sand with some clay.
	8		5 7 8 10		100			Orange and tan mottled fine grained silty sand.
	10		6 6 9 7		100			Same as above to 11.5 ft, changes to a gray and orange fine grained sandy clay. The sandy section is wet.
	12		4 5 6 9		100			Gray and red sandy clay to 13 ft. changes to a thinly bedded gray and orange clayey sand.
	14		3 5 6 11		100			Gray and orange fine grained sandy silty, saturated from 14 to 15 ft becomes a sandy silt with clay from 15 to 16 ft.
	16		4 4 4 9		100			Thinly layered gray sandy clay with organics

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
- - Penetration Length of Sampler or Core Barrel
Recovery Length of Sample RQD
ght of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Carolina LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McCumby
Ground Elevation		Rig Type	Diedrich D-50 Turbo
Groundwater elevation		Logged By	Dusty Reedy
Date Start/Finish	5-16-06	Total Depth	21

BORING NO. P-118 (GW-19)

Page 2 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			4 5 6		100			thinly layed gray sandy clay and sandy silt with organics
	20		11 3 5		100			Orange and gray mottled sandy clay to 20.75ft. changes to a fine grained clayey sand, saturated to 21.25ft, changes to a gray sandy clay.
	22		6 9 4					Gray fine grained sandy clay to 23.75ft. changes to blue gray fat clay.
			3 4 5		100			Terminated boring @ 21 ft
	24							Last spoon to 24 ft.
	26							
	28							
	30							
	32							
	34							

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
Penetration Length of Sampler or Core Barrel
Recovery Length of Sample RQD
Weight of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	Eastern Ave LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahay
Ground Elevation		Rig Type	Diedrich D-50 Fuigo
Groundwater elevation		Logged By	Dusty Roach
Date Start/Finish	5-23-06	Total Depth	24

BORING NO. PZ-119

Page 1 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			3 3 1 6		80			Brown fine grained silty sand to 1ft, changes to an orange ~~fine~~ silty clay.
	2		3 3 4 6		60			Orange and gray mottled silty clay.
	4		6 6 9 12		100			Same material, but becoming more sandy at 5.75ft.
	6		9 11 14 15		100			Orange and gray mottled fine grained sandy clay
	8		5 4 5 7		100			Orange and gray fine grained clayey sand to 9ft, changes to an orange and gray fine grained silty sand, saturated
	10		3 3 3 6		100			Gray fine grained silty sand, saturated.
	12		4 3 4 5		70			Tan fine grained silty sand with some layering saturated
	14		3 4 3 6		100			Same material, saturated.
	16		4 4 6 9		100			Orange medium grained silty clay, saturated

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
Pen - Penetration Length of Sampler or Core Barrel
P Recovery Length of Sample RQD
of Sound Cores >4in./Length Cored %
Split Spoon Sample U
Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Circling CF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahey
Ground Elevation		Rig Type	Deidrich D-50 Turbo
Groundwater elevation		Logged By	Dusty Reddy
Date Start/Finish	5-23-06	Total Depth	

BORING NO. D2-19

Page 2 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			4 4 6 11		100			Same as above.
	20		4 6 7 11		100			Same material
	22		3 2 2 2		100			Orange coarse grained poorly sorted sand to 23.75 ft, changes to blue gray fat clay.
	24							Terminated boring @ 22 ft. Lost spoon to 24. ft.
	26							
	28							
	30							

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
Pen - Penetration Length of Sampler or Core Barrel
R[illegible]ecovery Length of Sample RQD
[illegible] of Sound Cores >4in./Length Cored %
S[illegible]t Spoon Sample U
Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Carolina LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahey
Ground Elevation		Rig Type	Deidrich D-50 Turbo
Groundwater elevation		Logged By	Dusty Reedy
Date Start/Finish	5-22-06	Total Depth	21

BORING NO. PZ-120

Page 1 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Blows per 6"	Pen in.	Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			1 1 2 2		100			Topsoil - brown silty sand to 1ft, tan silty sand fine grained
	2		3 5 7 8 11		100			Orange and gray mottled, fine grained sandy clay
	4		3 4 9 11		100			Same material
	6		7 9 11 17		100			Same material
	8		4 4 7 10		100			Orange and gray mottled fine grained clayey sand, moist
	10		7 7 8 10		100			Orange and gray mottled fine grained silty sand, ~~mottled~~ wet.
	12		3 4 3 5		50			Same material, saturated
	14		2 4 4 10		100			Light gray, fine gray silty sand, saturated.
	16		0 0 4 5		100	weight of rods		Same material

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
- Penetration Length of Sampler or Core Barrel
Recovery Length of Sample RQD
Weight of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U -
Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Carolina LF	Project Number	6507
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McCombey
Ground Elevation		Rig Type	Deadrich D-50 Turbo
Groundwater elevation		Logged By	Dusty Reedy
Date Start/Finish	5-22-06	Total Depth	21

BORING NO. P2-120

Elev. Ft.	Depth ft.	Sample Type & No.	Blows per 6"	Pen in.	Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			0 5 5 7		100			Same material to 19.5 ft, changes to an orange medium to coarse grained poorly sorted sand, saturated.
	20		3 3 3 2		50			Coarse grained poorly sorted sand to 21.8 ft, changes to dark gray sandy clay
	22		1 0 1 0		70	weight of hammer		Blue gray fat clay
								Terminate drilling @ 21 ft. Last spoon to 24
	24							
	26							
	28							
	30							
	32							
	34							

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
Pen - Penetration Length of Sampler or Core Barrel
P[illegible] Recovery Length of Sample RQD
[illegible] of Sound Cores >4in./Length Cored %
S[illegible] Spoon Sample U
Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Section	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahay
Ground Elevation		Rig Type	Diedrich D-50 Track
Groundwater elevation		Logged By	Dusty Reedy
Date Start/Finish	5-9-06	Total Depth	24

BORING NO. PZ-121

Page 1 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			2 3 3 6		50			Tan fat clay to 0.5 ft, change to a dark brown lean clay to 1.25 ft, changes back to tan fat clay.
	2		4 6 8 11		100			Gray and orange mottled fat clay, very dense
	4		6 6 6 12		100			Same material
	6		7 10 12 17		100			Same material
	8		4 4 8 12		100			Gray fat clay with some very fine grained sand.
	10		10 11 11 14		90			Gray lean clay with fine grained sand. changes to gray and orange fine grained silty sand @ 11.5 ft, saturated.
	12		5 3 4 8		100			Orange and gray fine grained silty sand. changes to dark orange @ 13.90 ft with some coarse grained sand.
	14		2 2 3 8		100			Dark orange sand continues to 14.5 ft, changes to tan fine grained silty sand.
	16		0 4 5 9		100	weight of rods		Orange clayey sand from 16 to 17 ft, changes back to orange fine grained silty sand.

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
Pen - Penetration Length of Sampler or Core Barrel
Recovery Length of Sample RQD
ght of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" HSA

Golder Associates

Project Name		Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Explor.	Driller Name	Mike McGaughey
Ground Elevation		Rig Type	Diedrich D-50 Truck
Groundwater elevation		Logged By	Dusty Roady
Date Start/Finish	5-9-06	Total Depth	24

BORING NO. P2-21

Page 2 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			4					Tan fine grained silty sand, changes to an orange silty sand @ 19.25 ft, a few organics present
			5		100			
			9					
			11					
	20		2					
			3					Dark orange silty sand from 21.25 to 21.5 ft. changes to thinly layered sandy clay @ 21.5 ft.
			5		100			
			8					
	22		4					
			4					Dark brown silty sand to 23.75 ft Grades to thinly layered fat clay with some sand.
			5		100			
			5					
	24		3					Gray fat clay
			2		100			
			1					
			2					
	26							Terminated boring @ 24 ft
								Last spoon @ 26 ft.
	28							
	30							
	32							
	34							

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
Penetration Length of Sampler or Core Barrell
Recovery Length of Sample RQD
Weight of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Carrollton LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahey
Ground Elevation		Rig Type	Diedrich D 50 Turbo
Groundwater elevation		Logged By	Dusty Reedy
Date Start/Finish	5.18.06	Total Depth	24

BORING NO. P2-122

Page 1 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			1 0 0 2		0	weight of hammer		Topsoil
	2		2 1 2 4		80			Gray and orange silty clay
	4		0 2 3 3		100	weight of rods		Black organic silt from 4 ft to 4.75 ft. changes to a silty clay, saturated tan
	6		2 2 6 8		100			Orange and gray mottled silty clay
	8		5 7 10 13		100			Gray fine grained sandy clay, saturated from 8.5 to 9.5 ft.
	10		8 11 13 10		100			Gray and orange mottled, fine grained sandy clay to 11.5 ft, changes to an orange and tan fine grained silty sand,
	12		7 7 10 14		100			Orange and tan layered fine grained silty sand
	14		4 5 10 14		100			Same material without the layering, saturated
	16		6 7 10 15		100			Same material to 16.75 ft, changes to a dark gray sandy clay to 17.25 ft, changes back to an orange fine grained silty sand,

Blows per 6 in. 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
- Penetration Length of Sampler or Core Barrel
- Recovery Length of Sample RQD
Lenght of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Carolina LF	Project Number	0636507.201
Project Location		Client	Republic services
Drilling Company	Geologic Exploration	Driller Name	Mike McConchey
Ground Elevation		Rig Type	Diedrich D-50 Track
Groundwater elevation		Logged By	Dusty Reed
Date Start/Finish	5-18-06	Total Depth	24

BORING NO. B2-122

Page 2 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			5 6 7 9		100			Brown material to 18.5 ft, changes to dark gray sandy clay to 18.75 ft, changes to a tan and orange layered fine grained silty sand with some organics.
	20		6 6 10 19		100			Tan and orange layered fine grained silty sand to 21.5 ft, changes to a poorly sorted coarse grained sand, saturated throughout
	22		7 5 3 4		100			Orange coarse grained poorly sorted clay to 23.25 ft, changes to an orange, gray and brown layered sandy clay.
	24		2 1 1 2		100			Orange sandy clay to 25 ft, changes to blue gray fat clay.
	26							Terminated boring @ 24 ft. Grout from 24 ft to 26 ft
	28							
	30							
	32							
	34							

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
- Penetration Length of Sampler or Core Barrel
Recovery Length of Sample RQD
Lenght of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Carolina LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConaughey
Ground Elevation		Rig Type	Deutsag D-50 Turbo
Groundwater elevation		Logged By	Dusty Reedy
Date Start/Finish	5-18-06	Total Depth	23

BORING NO. P2-123A

Page 1 of 1

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
	5					23-18		Orange and gray fine grained sandy clay
	10							
	15							@ 17.5 becomes a white medium grained sand, well sorted
	20							Terminated boring @ 23ft.
	25							
	30							

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
- - Penetration Length of Sampler or Core Barrel
Recovery Length of Sample RQD
ght of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	Eastern Shore LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConaughey
Ground Elevation		Rig Type	Diedrich D-50 Truck
Groundwater elevation		Logged By	Dusty Roady
Date Start/Finish	5-18-06	Total Depth	50

BORING NO. P2-123B

Page 1 of 3

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			5					Gray fine grained silty sand to 1.75 ft. changes to a gray and orange mottled fine grained sandy clay.
			4		40			
			4					
			5					
	2		5					
			6		80			Gray and orange mottled fine grained sandy clay.
			7					
			10					
	4		2					Gray and orange mottled silty clay.
			3					
			4		80			
			6					
	6		6					Same material
			7					
			8		90			
			12					
	8		3					Same material to 9.5 ft. changes to gray fine grained sandy clay.
			3					
			8		100			
			12					
	10		8					Orange and gray mottled fine grained sandy clay.
			11		70			
			13					
			15					
	12							Same material
			4					
			5		100			
			7					
			9					
	14		6					Orange and gray mottled silty clay very dense.
			7					
			9		100			
			12					
	16		4					Same material to 17.5 ft, changes to a well sorted medium grained quartz sand, white, saturated.
			5		100			
			7					
			17					

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
Penetration Length of Sampler or Core Barrel
Recovery Length of Sample RQD
Length of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Carolina LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike Mclaughlin
Ground Elevation		Rig Type	Diedrich D-50 Turbo
Groundwater elevation		Logged By	Dusty Reed
Date Start/Finish	5-18-06	Total Depth	50

BORING NO. 02-1238

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			4 6 8 10		100	18-23		Tan to white well sorted medium grained sand, saturated
	20		4 4 6 7		100			Same material to 21.5 ft, changes to a dark orange fine grained sandy clay.
	22		4 4 2 2		100			medium well sorted sand to 23 ft. Changes to well sorted course grained sand to 23.5 ft. changes to blue gray fat clay.
	24		1 2 0 1		70	weight of hammer		Blue gray fat clay.
	26		0 0 1 2		70	weight of rods		Same material
	28		0 0 1 1		90	weight of rods		Same material
	30		0 0 2 1		100	weight of rods		Same material
	32		1 2 3 3		100			Same material
	34		2 3 6 11		100			Gray silty clay with visible layering, very dense.

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
- Penetration Length of Sampler or Core Barrel
- Recovery Length of Sample RQD
- Lenght of Sound Cores >4in./Length Cored %
S - Split Spoon Sample
U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Carolina LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahey
Ground Elevation		Rig Type	Deidrich D-50 [illegible]
Groundwater elevation		Logged By	Dusty Reedy
Date Start/Finish	5-18-06	Total Depth	50

BORING NO. D2-123B

Elev. Ft.	Depth ft.	Sample Type & No.	Blows per 6"	Pen in.	Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			4 5 8 15		100			Same material, dry, very dense, with interlayered clayey sand, no sign of water.
	38		7 8 9 12		100			Dark gray fine grained sandy clay, very dense
	40		3 4 6 9		100			Same material
	42		7 7 8 12		100			Dark gray fine grained clayey sand, very dense
	44		5 5 11 17		100			Same material
	46		5 5 7 11		100			Same material
	48		5 7 8 14		100			Same material
	50							Terminated boring @ 50 ft. Last spoon @ 50 ft
	52							

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
- - Penetration Length of Sampler or Core Barrel
Recovery Length of Sample RQD
Weight of Sound Cores >4in./Length Cored %
S - Split Spoon Sample U -
Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Carolina LF	Project Number	0636507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahey
Ground Elevation		Rig Type	Deidrich D-50 Turbo
Groundwater elevation		Logged By	Dusty Reedy
Date Start/Finish	5-24-06	Total Depth	23

BORING NO. GW-16

Page 1 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			2 1 2 3		50			Black fine grained silty sand with abundant organics to 0.5 ft. changes to a tan fine grained sandy clay.
	2		3 4 7 12		50			Orange and gray fine grained sandy clay
	4		2 4 7 9		90			Same material
	6		4 6 7 12		100			Orange and gray silty clay
	8		5 4 5 8		100			Same material to 9.5 ft, changes to a fine grained clayey sand.
	10		3 3 2 4		80			Orange and gray mottled fine grained silty sand, saturated.
	12		2 2 3 2		90			Orange fine grained silty sand, saturated
	14		2 1 2 3		90			Tan fine grained silty sand, saturated
	16		2 2 2 4		100			Same material

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
Pen - Penetration Length of Sampler or Core Barrel
P ecovery Length of Sample RQD
of Sound Cores >4in./Length Cored %
S t Spoon Sample
Undisturbed Samples U

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)

6" ID HSA

Golder Associates

Project Name	East Carolina LF	Project Number	063507.201
Project Location		Client	Republic Services
Drilling Company	Geologic Exploration	Driller Name	Mike McConahey
Ground Elevation		Rig Type	DrillTech D-50 Turbo
Groundwater elevation		Logged By	Dusty Roady
Date Start/Finish	5-24-06	Total Depth	23

BORING NO. GW-16

Page 2 of 2

Elev. Ft.	Depth ft.	Sample Type & No.	Sample Blows per 6"	Sample Pen in.	Sample Rec %	Remarks	Graphic Log (USCS)	Soil and Rock Descriptions
			3 5 8		100			Same material to 14 ft, changes to a fine-grained clayey sand to 19.25 ft. changes to an orange medium grained silty sand to 19.9 ft. changes to a white coarse grained poorly sorted sand
	20		12 5 4		100			medium grained white and brown well sorted sand, organics present, saturated.
	22		7 10 1					Same material to 23 ft. changes to an orange silty clay to 23.5 ft, changes to blue gray fat clay.
			2 1 2		100			Terminate boring @ 23 ft
	24							Last spoon to 24 ft,
	26							
	28							
	30							
	32							
	34							

Blows per 6 in. - 140lb hammer falling 30 in. to drive a 2.0 in. OD split spoon sampler.
Pen - Penetration Length of Sampler or Core Barrel
Rec - Recovery Length of Sample
RQD of Sound Cores >4in./Length Cored %
S - Spoon Sample
U - Undisturbed Samples

Notes: (Rig Type, drilling method, bit or auger size, PSI, Equipment Failures, possible contamination, deviations from drilling plan, drilling difficulties, ect.)
6" ID HSA

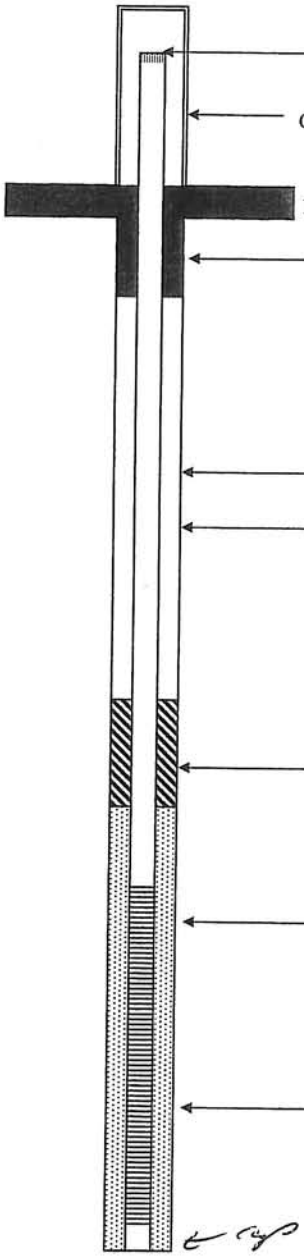
Golder Associates

Golder Associates

MONITORING WELL INSTALLATION SKETCH

Project: East Carolina LF
Drilling Subcontractor: Geologic Exploration
Driller: Mike McConahey
Logged By: Dusty Rapp

Monitoring Well No.: BZ-107A
Date/time of Well Installation: 5-17-06
Depth to Bottom of Well From Top of Monitoring Well Pipe:



Depth or Height (ft) From Ground Surface

0

8.5

11

Had some collapse that raised the sand to 51 high.

17

27

27.4

Approx. Stickup: 3
O.D. of Outer Protective Casing:
Dimensions of Concrete Pad: NA
Type of Surface Seal:
Type of Backfill: Portland / Bentonite mix
Diameter of Borehole: 8"
Type of Seal: 3/8 bentonite chip
I.D. of screen: 2"
Size of Screen Opening: 0.010
Type of Screen: PVC
Size of Filter Sand: #2
Cap

WATER LEVEL MEASUREMENTS

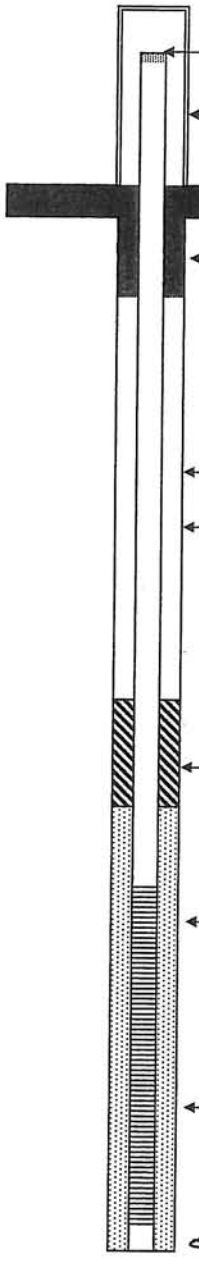
Date	5-17-06						
Depth from TOC	10.85						
Time	1112						

Golder Associates

MONITORING WELL INSTALLATION SKETCH

Project: East Carolina LF
Drilling Subcontractor: Geologic Exploration
Driller: Mike McConahey
Logged By: Dusty Reedy

Monitoring Well No.: PZ-107B
Date/time of Well Installation: 5-17-06
Depth to Bottom of Well From Top of Monitoring Well Pipe:



Depth or Height (ft) From Ground Surface

0

36

38

40

50

50.4

Approx. Stickup 3

O.D. of Outer Protective Casing

Dimensions of Concrete Pad NA

Type of Surface Seal

Type of Backfill Portland/Bentonite Mix

Diameter of Borehole 8"

Type of Seal 3/8 Bentonite Chip

I.D. of screen 2"

Size of Screen Opening 0.010

Type of Screen PVC

Size of Filter Sand #2

← cap

WATER LEVEL MEASUREMENTS

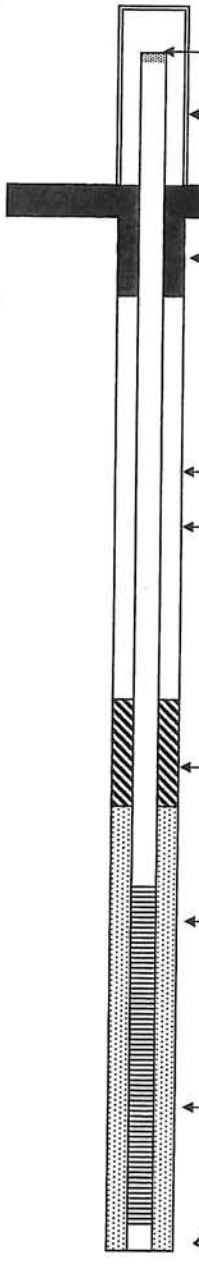
Date	5-17-06						
Depth from TOC	25.36						
Time	10-10						

Golder Associates

MONITORING WELL INSTALLATION SKETCH

Project: East Carolina CF
Drilling Subcontractor: Geologic Exploration
Driller: Mike McConaghey
Logged By: Dusty Reedy

Monitoring Well No.: PZ-108
Date/time of Well Installation: 5-9-06
Depth to Bottom of Well From Top of Monitoring Well Pipe:



Depth or Height (ft) From Ground Surface

0

8.5

11.2

13

18
18.4
22

Approx. Stickup 2
O.D. of Outer Protective Casing
Dimensions of Concrete Pad NA
Type of Surface Seal
Type of Backfill Portland/Bentonite Mix
Diameter of Borehole 8"
Type of Seal 3/8 Bentonite chip
I.D. of screen 2"
Size of Screen Opening 0.010
Type of Screen PVC
Size of Filter Sand #2

← cap collapsed material

WATER LEVEL MEASUREMENTS

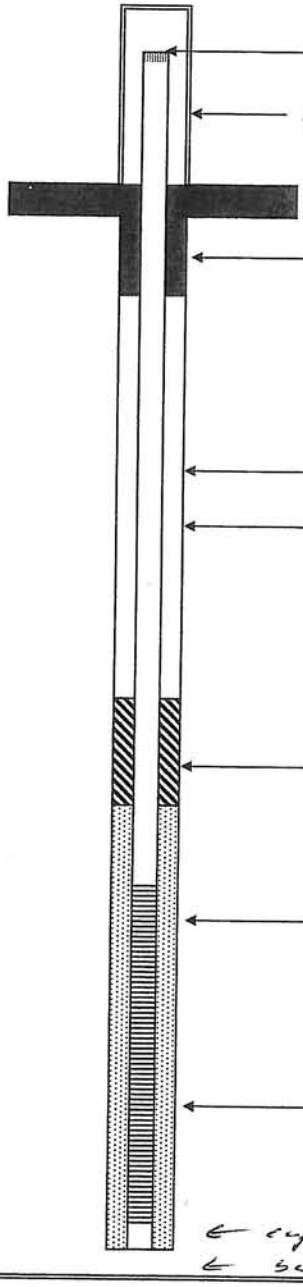
Date	5-9-06						
Depth from TOC	10.65						
Time	1720						

Golder Associates

MONITORING WELL INSTALLATION SKETCH

Project: Evaporation CF
Drilling Subcontractor: Geologic Exploration
Driller: Mike McConahey
Logged By: Dusty Reedy

Monitoring Well No.: PZ-109A
Date/time of Well Installation: 5-10-06
Depth to Bottom of Well From Top of Monitoring Well Pipe:



Depth or Height (ft) From Ground Surface

0

9

12

14

24
24.4
28

Approx. Stickup 3
O.D. of Outer Protective Casing
Dimensions of Concrete Pad NA
Type of Surface Seal
Type of Backfill Portland / Bentonite Mix
Diameter of Borehole 8"
Type of Seal 3/8 bentonite chip
I.D. of screen 2"
Size of Screen Opening 0.010
Type of Screen PVC
Size of Filter Sand #2

← cap
← backfill from formation

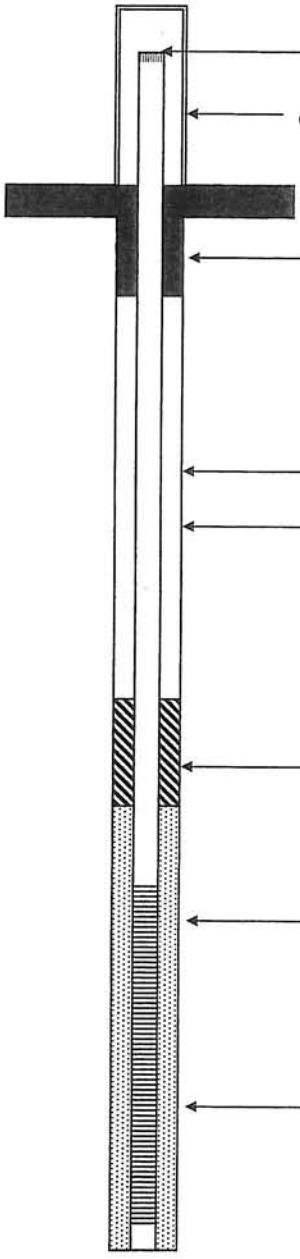
WATER LEVEL MEASUREMENTS

Date	5-10-06						
Depth from TOC	13.55						
Time	1335						

Golder Associates

MONITORING WELL INSTALLATION SKETCH

Project:	East Carbon LF	Monitoring Well No.:	PZ-109B
Drilling Subcontractor:	Geologic Exploration	Date/time of Well Installation:	5-12-06
Driller:	Mike McConahey	Depth to Bottom of Well From Top of Monitoring Well Pipe:	
Logged By:	Dusty Redd		



Depth or Height (ft) From Ground Surface

0

41

45

47

52

Approx. Stickup 3

O.D. of Outer Protective Casing

Dimensions of Concrete Pad NA

Type of Surface Seal

Type of Backfill Portland/Bentonite mix

Diameter of Borehole 6"

Type of Seal 3/8 bentonite chips

I.D. of screen 2"

Size of Screen Opening 0.010

Type of Screen PVC

Size of Filter Sand #2

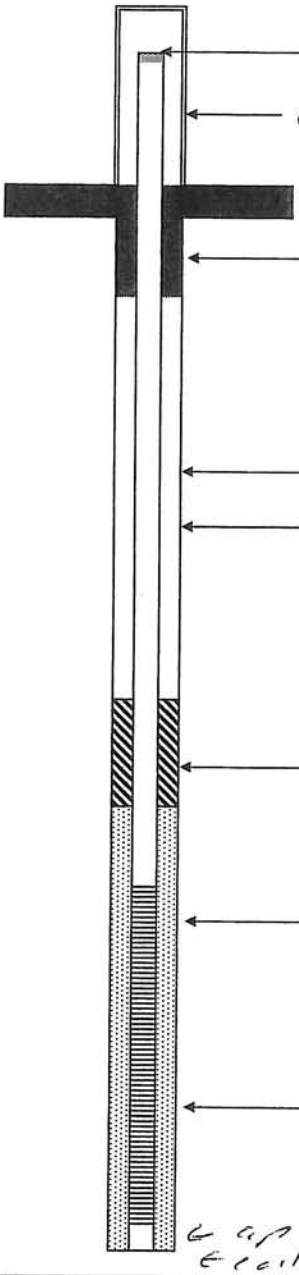
WATER LEVEL MEASUREMENTS

Date	5-12-06						
Depth from TOC	17.35						
Time	1017						

Golder Associates

MONITORING WELL INSTALLATION SKETCH

Project:	East Carolina LF	Monitoring Well No.:	PZ-110 (GW-18)
Drilling Subcontractor:	Geologic Exploration	Date/time of Well Installation:	5-18-06
Driller:	Mike McConahey	Depth to Bottom of Well From Top of Monitoring Well Pipe:	
Logged By:	Dusty Reedy		



Depth or Height (ft) From Ground Surface

0

1

7

11

13

28

28.4

32

Approx. Stickup 2.2

O.D. of Outer Protective Casing

Dimensions of Concrete Pad ~~N/A~~ 3x3x0.5

Type of Surface Seal concrete

Type of Backfill Portland/Bentonite mix

Diameter of Borehole #8

Type of Seal 3/8 bentonite chip

I.D. of screen 2"

Size of Screen Opening 0.010

Type of Screen PVC

Size of Filter Sand #2

← cap

← collapsed material

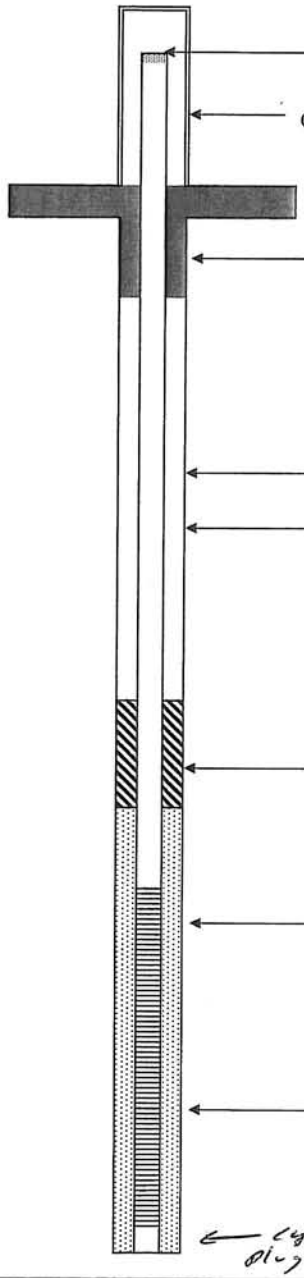
WATER LEVEL MEASUREMENTS

Date	5-18-06						
Depth from TOC	11.10						
Time	8:38						

Golder Associates

MONITORING WELL INSTALLATION SKETCH

Project:	East Carolina LF	Monitoring Well No.:	PZ-111
Drilling Subcontractor:	Geologic Exploration	Date/time of Well Installation:	5-23-06
Driller:	Mike McConahey	Depth to Bottom of Well From Top of Monitoring Well Pipe:	
Logged By:	Dusty Reed		



Depth or Height (ft) From Ground Surface

0

4.5

8

10

18

20

Approx. Stickup 3

O.D. of Outer Protective Casing

Dimensions of Concrete Pad NA

Type of Surface Seal

Type of Backfill Portland/Bentonite Mix

Diameter of Borehole 8"

Type of Seal 3/8 bentonite chips

I.D. of screen 2"

Size of Screen Opening 0.010

Type of Screen PVC

Size of Filter Sand #2

Cap plug material

WATER LEVEL MEASUREMENTS

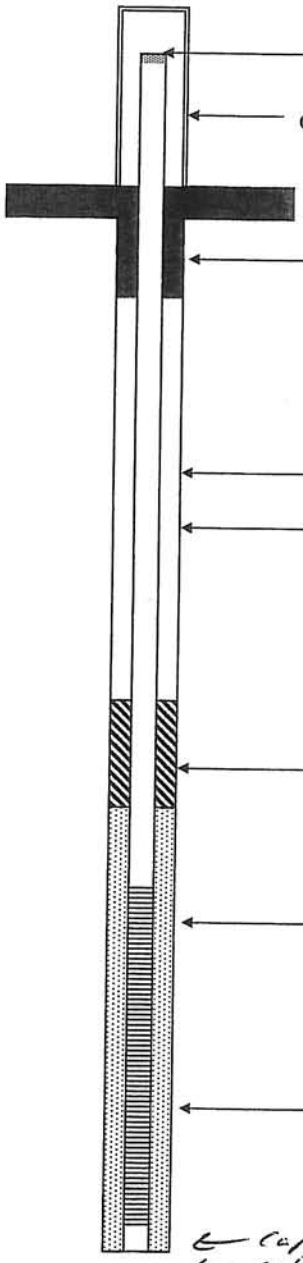
Date	5-23-06						
Depth from TOC	12.09						
Time	1219						

Golder Associates

MONITORING WELL INSTALLATION SKETCH

Project: East Carolina CF
Drilling Subcontractor: Geologic Exploration
Driller: Mike McConahey
Logged By: Rusty Reedy

Monitoring Well No.: 82-112
Date/time of Well Installation: 5-17-06
Depth to Bottom of Well From Top of Monitoring Well Pipe:



Depth or Height (ft) From Ground Surface

0

11

15

17

22
22.4
24

Approx. Stickup: 3
O.D. of Outer Protective Casing:
Dimensions of Concrete Pad: NA
Type of Surface Seal:
Type of Backfill: Portland / Bentonite Mix
Diameter of Borehole: 8"
Type of Seal: 3/8 Sandentite chip
I.D. of screen: 2"
Size of Screen Opening: 0.010
Type of Screen: PVC
Size of Filter Sand: #2

← cap
← collapsed material

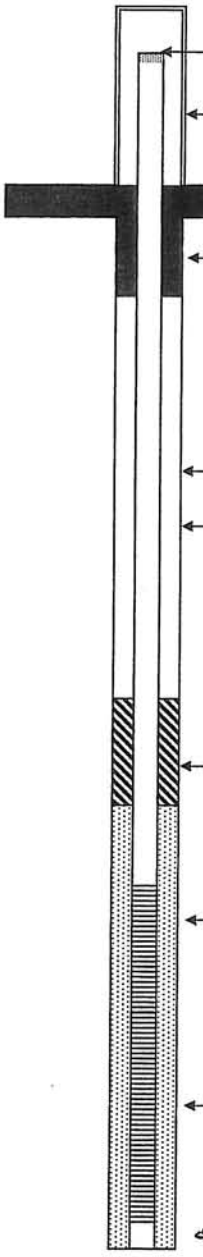
WATER LEVEL MEASUREMENTS

Date	5-17-06						
Depth from TOC	12.91						
Time	1325						

MONITORING WELL INSTALLATION SKETCH

Golder Associates

Project:	East Landing LF	Monitoring Well No.:	PZ-13
Drilling Subcontractor:	Geologic Exploration	Date/time of Well Installation:	5-9-06
Driller:	Mike McCumbey	Depth to Bottom of Well From Top of Monitoring Well Pipe:	
Logged By:	Dusty Roody		



Depth or Height (ft) From Ground Surface

0

10

13.5

17

22

26 22.4

Approx. Stickup 3

O.D. of Outer Protective Casing

Dimensions of Concrete Pad NA

Type of Surface Seal

Type of Backfill Portland / Bentonite Mix

Diameter of Borehole 8"

Type of Seal 3/8 Bentonite chips

I.D. of screen 2"

Size of Screen Opening 0.01 inch

Type of Screen PVC

Size of Filter Sand #2

← cap

collapsed material

WATER LEVEL MEASUREMENTS

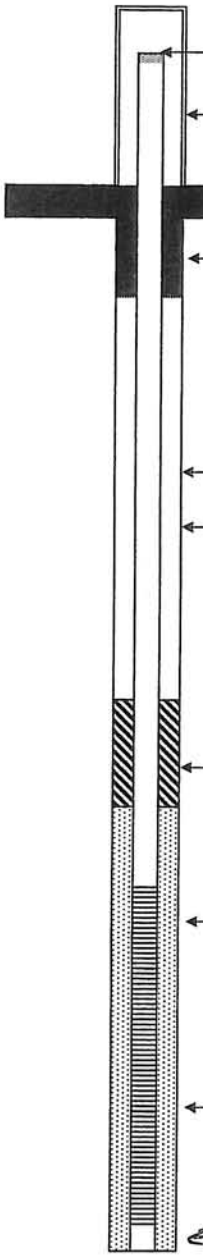
Date	5-9-06						
Depth from TOC	@ 9.68 SGS						
Time	9:35						

Golder Associates

MONITORING WELL INSTALLATION SKETCH

Project: East Carolina EF
Drilling Subcontractor: Geologic Exploration
Driller: Mike McConahey
Logged By: Dusty Reedy

Monitoring Well No.: PZ-114
Date/time of Well Installation: 5-16-06
Depth to Bottom of Well From Top of Monitoring Well Pipe:



Depth or Height (ft) From Ground Surface

0

10

13.8

16

21
21.4
26

Approx. Stickup: 2.5
O.D. of Outer Protective Casing:
Dimensions of Concrete Pad: NA
Type of Surface Seal:
Type of Backfill: Portland/Bentonite Mix
Diameter of Borehole: 8"
Type of Seal: 3/8 bentonite chips
I.D. of screen: 2"
Size of Screen Opening: 0.010
Type of Screen: PVC
Size of Filter Sand: #2
← cap
collapsed material

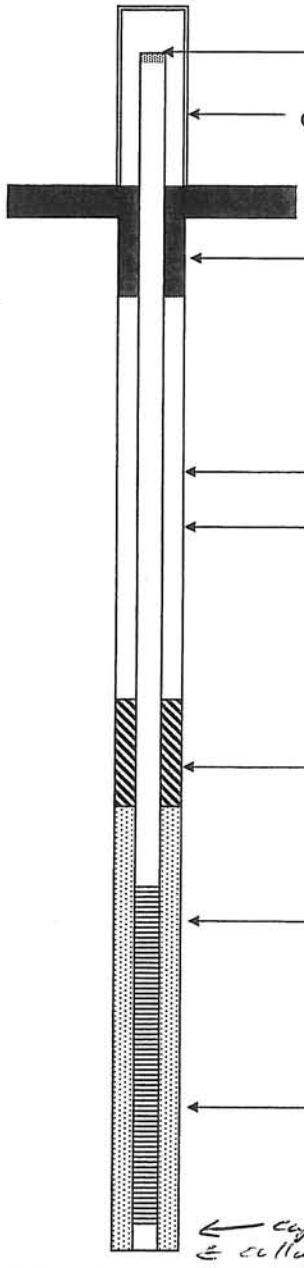
WATER LEVEL MEASUREMENTS

Date	5-16-06						
Depth from TOC	13.48						
Time	1113						

Golder Associates

MONITORING WELL INSTALLATION SKETCH

Project:	East Carolina LF	Monitoring Well No.:	PZ-113A
Drilling Subcontractor:	Geologic Exploration	Date/time of Well Installation:	5-22-06
Driller:	M. Ke McConahey	Depth to Bottom of Well From Top of Monitoring Well Pipe:	
Logged By:	Dusty Reedy		



Depth or Height (ft) From Ground Surface

0

Approx. Stickup 2.5

O.D. of Outer Protective Casing

Dimensions of Concrete Pad NA

Type of Surface Seal

Type of Backfill Portland / Bentonite mix

Diameter of Borehole 8"

7.5

Type of Seal 3/8 Sentonite chip

10

12

I.D. of screen 2"

Size of Screen Opening 0.010

Type of Screen PVC

Size of Filter Sand #2

17

20

← cap & collapsed material

WATER LEVEL MEASUREMENTS

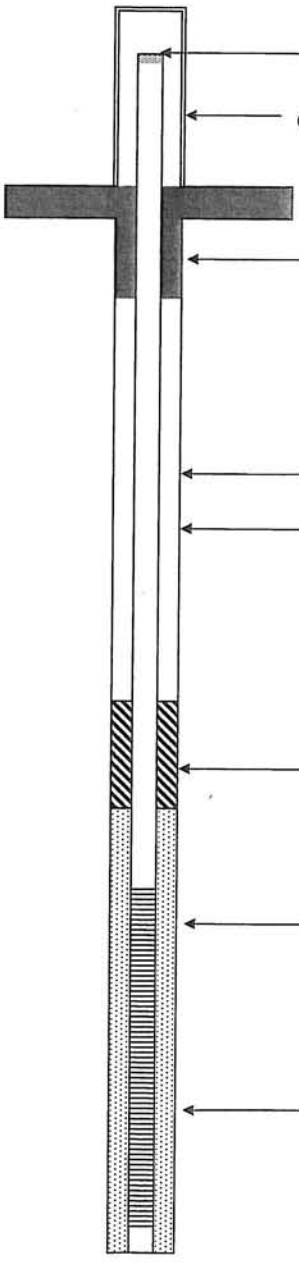
Date	5-22-06						
Depth from TOC	12.20						
Time	1635						

Golder Associates

MONITORING WELL INSTALLATION SKETCH

Project: East Carolina EF
Drilling Subcontractor: Geologic Exploration
Driller: Mike McConathy
Logged By: Dusty Reedy

Monitoring Well No.: PZ-115B
Date/time of Well Installation: 5-23-06
Depth to Bottom of Well From Top of Monitoring Well Pipe:



Depth or Height (ft) From Ground Surface

0

25

28

30

50

Approx. Stickup 3
O.D. of Outer Protective Casing
Dimensions of Concrete Pad NA
Type of Surface Seal
Type of Backfill Bentonite/Portland Mix
Diameter of Borehole 8"
Type of Seal 3/8 bentonite chip
I.D. of screen 2"
Size of Screen Opening 0.010
Type of Screen PVC
Size of Filter Sand #2

WATER LEVEL MEASUREMENTS

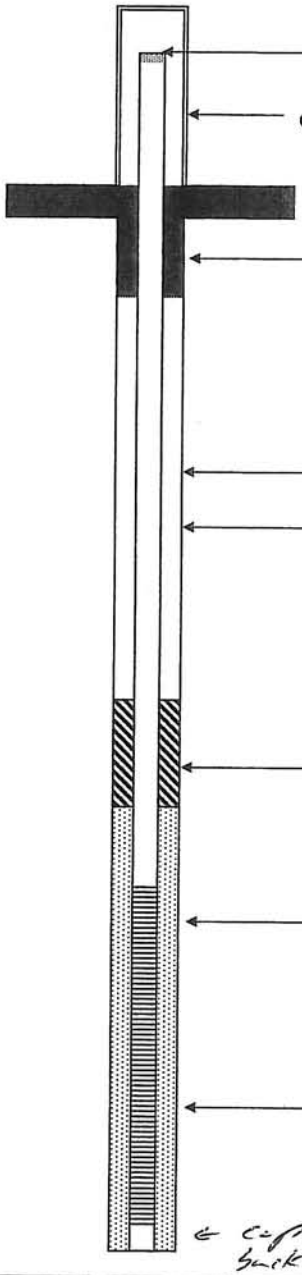
Date	5-23-06						
Depth from TOC	19.28						
Time	1053						

Golder Associates

MONITORING WELL INSTALLATION SKETCH

Project: East Carolina LF
Drilling Subcontractor: Geologic Exploration
Driller: Mike McConahey
Logged By: Dusty Roady

Monitoring Well No.: 02-116
Date/time of Well Installation: 5-9-06
Depth to Bottom of Well From Top of Monitoring Well Pipe:



Depth or Height (ft) From Ground Surface

0

9.5

13.5

14.5

~~20~~ 19.5
~~Land~~ 19.9
22

Approx. Stickup 2.6
O.D. of Outer Protective Casing
Dimensions of Concrete Pad NA
Type of Surface Seal
Type of Backfill Portland / Bentonite Mix
Diameter of Borehole 8"
Type of Seal 3/8 Bentonite chip
I.D. of screen 2"
Size of Screen Opening 0.010
Type of Screen PVC
Size of Filter Sand #2

← Cap
Backfill material

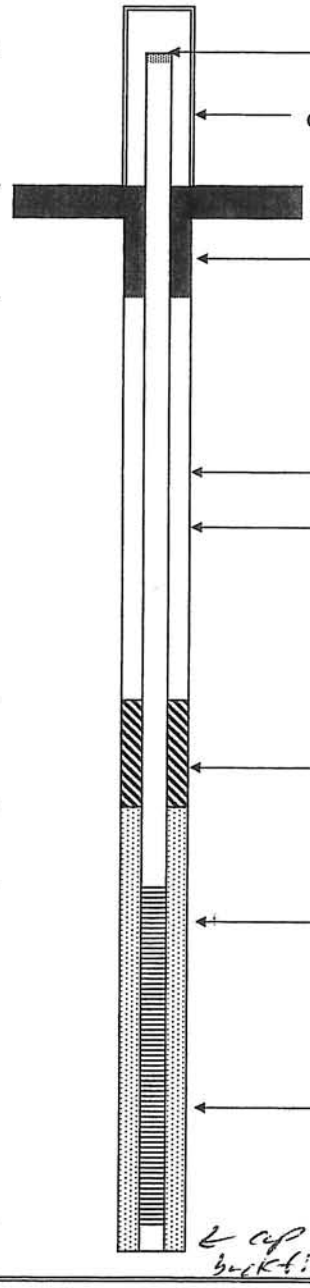
WATER LEVEL MEASUREMENTS

Date	5-9-06						
Depth from TOC	5.90						
Time	1715						

Golder Associates

MONITORING WELL INSTALLATION SKETCH

Project:	East Carolina LF	Monitoring Well No.:	02-117A
Drilling Subcontractor:	Geologic Exploration	Date/time of Well Installation:	5-10-06
Driller:	Mike McConachy	Depth to Bottom of Well From Top of Monitoring Well Pipe:	
Logged By:	Dusty Roady		



Depth or Height (ft) From Ground Surface

0

9.2

11.2

13

18
18.4
20

Approx. Stickup: 2

O.D. of Outer Protective Casing:

Dimensions of Concrete Pad: NA

Type of Surface Seal:

Type of Backfill: Portland/Bentonite mix

Diameter of Borehole: 8"

Type of Seal: 3/8 bentonite chip

I.D. of screen: 2"

Size of Screen Opening: 0.010

Type of Screen: PVC

Size of Filter Sand: #2

2' of backfill

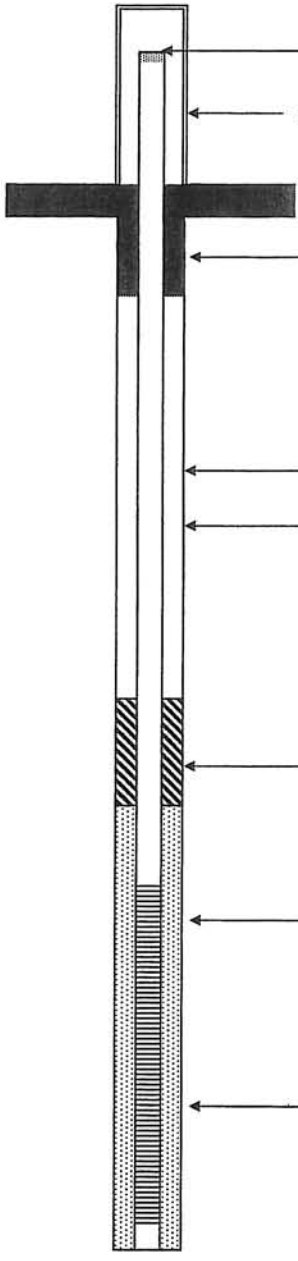
WATER LEVEL MEASUREMENTS

Date	5-10-06						
Depth from TOC	7.15						
Time	1330						

Golder Associates

MONITORING WELL INSTALLATION SKETCH

Project:	East Carolina LF	Monitoring Well No.:	PZ-117B
Drilling Subcontractor:	Geologic Exploration	Date/time of Well Installation:	5-16-06
Driller:	Mike McConahay	Depth to Bottom of Well From Top of Monitoring Well Pipe:	
Logged By:	Dusty Reedy		



Depth or Height (ft) From Ground Surface

0

34

38.8

40

50

Approx. Stickup 3

O.D. of Outer Protective Casing

Dimensions of Concrete Pad NA

Type of Surface Seal

Type of Backfill Portland / Bentonite mix

Diameter of Borehole 8"

Type of Seal 3/8 bentonite chip

I.D. of screen 2"

Size of Screen Opening 0.010

Type of Screen PVC

Size of Filter Sand #2

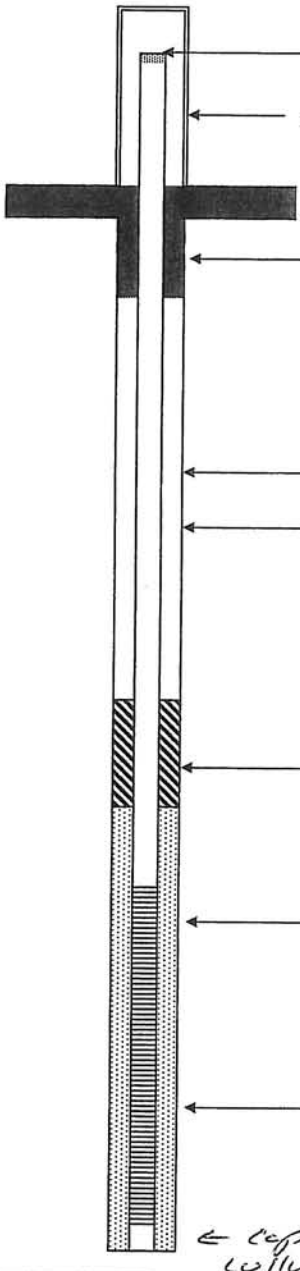
WATER LEVEL MEASUREMENTS

Date	5-16-06						
Depth from TOC	18.05						
Time	5:05						

Golder Associates

MONITORING WELL INSTALLATION SKETCH

Project:	East Carolina CF	Monitoring Well No.:	PZ-118C (GW-19)
Drilling Subcontractor:	Geologic Exploration	Date/time of Well Installation:	5-16-06
Driller:	Mike McConahey	Depth to Bottom of Well From Top of Monitoring Well Pipe:	
Logged By:	Dusty Reedy		



Depth or Height (ft) From Ground Surface

0

1

6

9

11

21

20.4

24

Approx. Stickup 3

O.D. of Outer Protective Casing Aluminum

Dimensions of Concrete Pad 3 x 3 x 0.5

Type of Surface Seal Concrete

Type of Backfill Portland / Bentonite Mix

Diameter of Borehole 8"

Type of Seal 3/8 bentonite chip

I.D. of screen 2"

Size of Screen Opening 0.010

Type of Screen PVC

Size of Filter Sand # 2

← top collapsed material

WATER LEVEL MEASUREMENTS

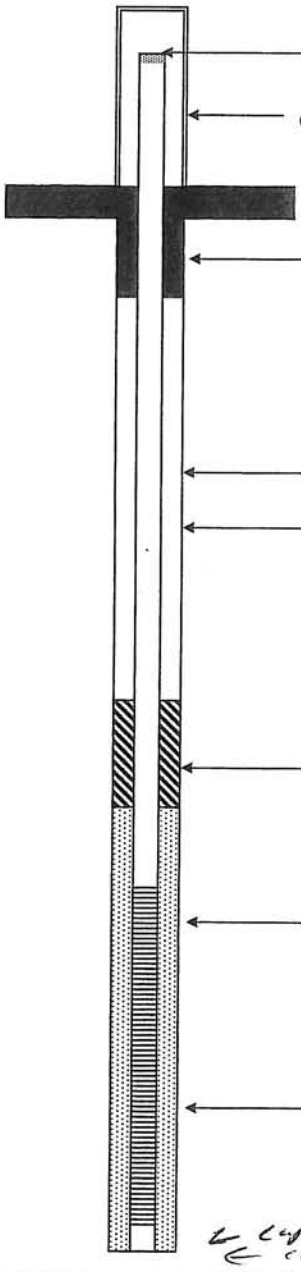
Date	5-16-06						
Depth from TOC	16.93						
Time	1336						

Golder Associates

MONITORING WELL INSTALLATION SKETCH

Project: East Landing LF
Drilling Subcontractor: Geologic Exploration
Driller: Mike McConahey
Logged By: Dusty Roach

Monitoring Well No.: PZ-119
Date/time of Well Installation: 5-23-06
Depth to Bottom of Well From Top of Monitoring Well Pipe:



Depth or Height (ft) From Ground Surface

0

5

8

10

20

24

Approx. Stickup: 3
O.D. of Outer Protective Casing:
Dimensions of Concrete Pad: NA
Type of Surface Seal:
Type of Backfill: Portland / Bentonite mix
Diameter of Borehole: 8"
Type of Seal: 3/8 bentonite chip
I.D. of screen: 2"
Size of Screen Opening: 0.010
Type of Screen: PVC
Size of Filter Sand: #2

4" cap collapsed material 2 plug

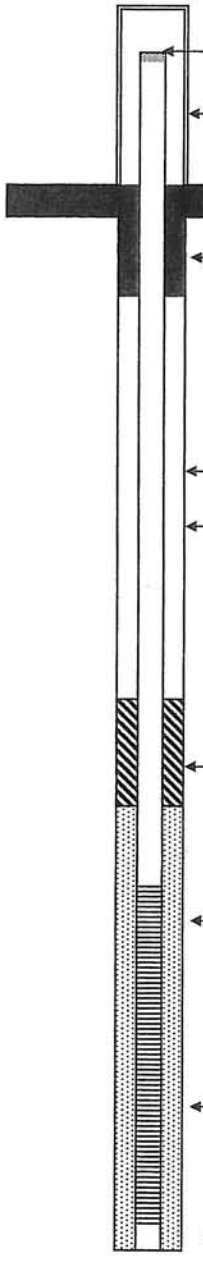
WATER LEVEL MEASUREMENTS

Date	5-23-06						
Depth from TOC	12.70						
Time	1542						

Golder Associates

MONITORING WELL INSTALLATION SKETCH

Project:	East Carolina LF	Monitoring Well No.:	P2-120
Drilling Subcontractor:	Geologic Exploration	Date/time of Well Installation:	5-22-06
Driller:	Mike McGinley	Depth to Bottom of Well From Top of Monitoring Well Pipe:	
Logged By:	Dusty Reed		



Depth or Height (ft) From Ground Surface

0

7

10

11

21

24

Approx. Stickup 2.5

O.D. of Outer Protective Casing

Dimensions of Concrete Pad NA

Type of Surface Seal

Type of Backfill Portland/Bentonite mix

Diameter of Borehole 8"

Type of Seal 3/8 bentonite chips

I.D. of screen 2"

Size of Screen Opening 0.010

Type of Screen PVC

Size of Filter Sand #2

← cap

← ellipsoidal manhole

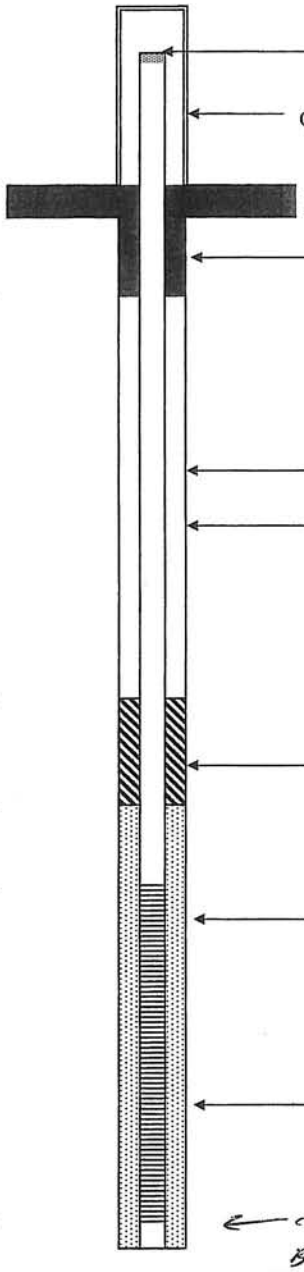
WATER LEVEL MEASUREMENTS

Date	5-22-06						
Depth from TOC	13.54						
Time	1346						

Golder Associates

MONITORING WELL INSTALLATION SKETCH

Project:	East Carolina LF	Monitoring Well No.:	P2-121
Drilling Subcontractor:	Geologic Exploration	Date/time of Well Installation:	5-9-06
Driller:	Mike McConahey	Depth to Bottom of Well From Top of Monitoring Well Pipe:	
Logged By:	Dusty Roady		



Depth or Height (ft) From Ground Surface

0

9.5

12.5

15

20

26 20.4

Approx. Stickup 2.5

O.D. of Outer Protective Casing

Dimensions of Concrete Pad NA

Type of Surface Seal

Type of Backfill Portland / Bentonite Mix

Diameter of Borehole 8"

Type of Seal 3/8 bentonite chip

I.D. of screen 2"

Size of Screen Opening 0.010

Type of Screen PVC

Size of Filter Sand #2

← cap

Backfilled with collapsed material

WATER LEVEL MEASUREMENTS

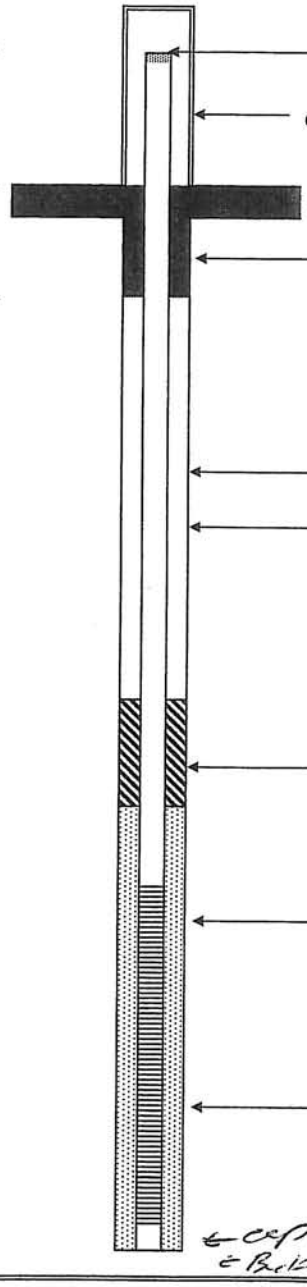
Date	5-9-06						
Depth from TOC	10.10						
Time	1205						

Golder Associates

MONITORING WELL INSTALLATION SKETCH

Project: East Carolina ELF
Drilling Subcontractor: Geologic Exploration
Driller: Mike McCann 424
Logged By: Dusty Reedy

Monitoring Well No.: PZ-122
Date/time of Well Installation: 5-22-06
Depth to Bottom of Well From Top of Monitoring Well Pipe:



Depth or Height (ft) From Ground Surface

0

8

12

14

24

24

20

Approx. Stickup 2.5
O.D. of Outer Protective Casing
Dimensions of Concrete Pad NA
Type of Surface Seal
Type of Backfill Portland/Bentonite mix
Diameter of Borehole 8"
Type of Seal 3/8 bentonite chip
I.D. of screen 2"
Size of Screen Opening 0.010
Type of Screen PVC
Size of Filter Sand #2

← cap
← Backfill

WATER LEVEL MEASUREMENTS

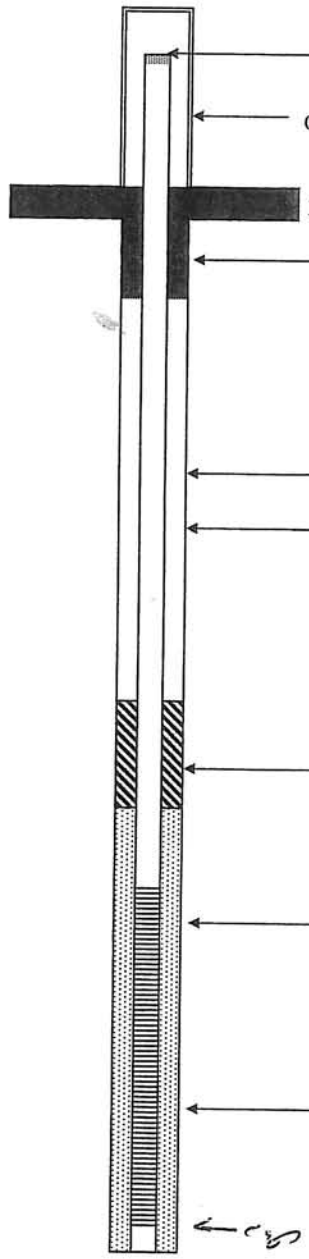
Date	5-22-06						
Depth from TOC	13.39						
Time	1217						

N 14 24

Golder Associates

MONITORING WELL INSTALLATION SKETCH

Project:	East Carbon LF	Monitoring Well No.:	PZ-123A
Drilling Subcontractor:	Geologic Exploration	Date/time of Well Installation:	5-18-06
Driller:	Mike McConkey	Depth to Bottom of Well From Top of Monitoring Well Pipe:	
Logged By:	Dusty Reeds		



Depth or Height (ft) From Ground Surface

0

15

18

19

23

Approx. Stickup 3

O.D. of Outer Protective Casing

Dimensions of Concrete Pad NA

Type of Surface Seal

Type of Backfill Portland / Bentonite Mix

Diameter of Borehole 8"

Type of Seal 3/8 bentonite chips

I.D. of screen 2"

Size of Screen Opening 0.010

Type of Screen PVC

Size of Filter Sand #2

WATER LEVEL MEASUREMENTS

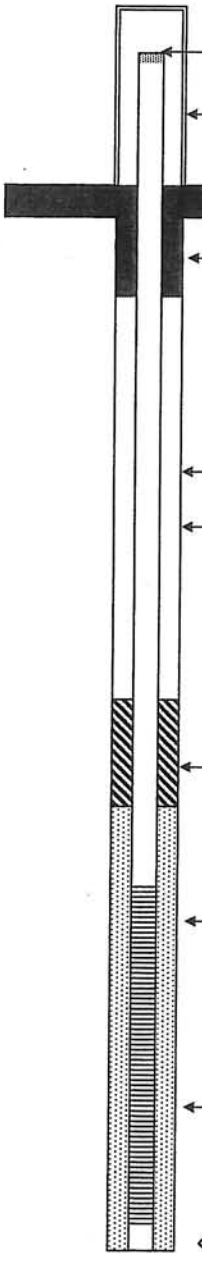
Date	5-18-06						
Depth from TOC	14.45						
Time	1530						

Golder Associates

MONITORING WELL INSTALLATION SKETCH

Project: East Landfill CF
Drilling Subcontractor: Geologic Exploration
Driller: Mike McConahey
Logged By: Dusty Ready

Monitoring Well No.: P2-123B
Date/time of Well Installation: 5-18-06
Depth to Bottom of Well From Top of Monitoring Well Pipe:



Depth or Height (ft) From Ground Surface

0

31

34

37

50
50.4

Approx. Stickup 2.5
O.D. of Outer Protective Casing
Dimensions of Concrete Pad NA
Type of Surface Seal
Type of Backfill Portland/Bentonite mix
Diameter of Borehole 8"
Type of Seal 3/8 bentonite chip
I.D. of screen 2"
Size of Screen Opening 0.010
Type of Screen PVC
Size of Filter Sand #2

← cap

WATER LEVEL MEASUREMENTS

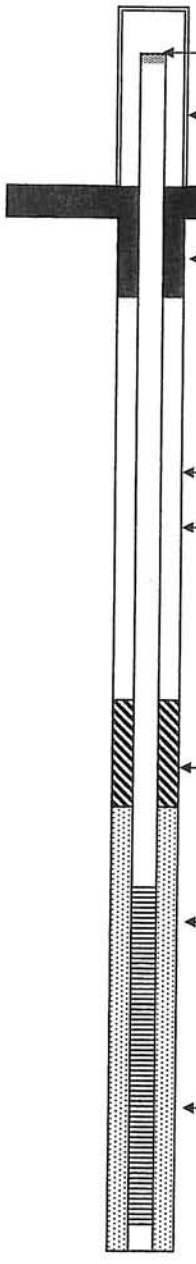
Date	5-18-06						
Depth from TOC	25.56						
Time	1250						

Golder Associates

MONITORING WELL INSTALLATION SKETCH

Project: East Carolina LF
Drilling Subcontractor: Geologic Exploration
Driller: Mike McConahey
Logged By: Dusty Roddy

Monitoring Well No.: GW-16
Date/time of Well Installation: 5-24-06
Depth to Bottom of Well From Top of Monitoring Well Pipe:



Depth or Height (ft) From Ground Surface

0
1
7.5
11
13
23
24

Approx. Stickup: 2.5
O.D. of Outer Protective Casing: 4" aluminum, square
Dimensions of Concrete Pad: 3 x 3 x 0.5
Type of Surface Seal: concrete
Type of Backfill: Bentonite Chips
Diameter of Borehole: 8"
Type of Seal: 3/8 bentonite chip
I.D. of screen: 2"
Size of Screen Opening: 0.010
Type of Screen: PVC
Size of Filter Sand: #2
Plug and collapsed material

WATER LEVEL MEASUREMENTS

Date	5-24-06						
Depth from TOC	12.78						
Time	1020						

WELL CONSTRUCTION RECORD

North Carolina – Department of Environmental and Natural Resources – Division of Water Quality – Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) MIKE MCCONAHEY CERTIFICATION # 2402

WELL CONTRACTOR COMPANY NAME GEOLOGIC EXPLORATION., INC. PHONE # (704) 872-7686

STATE WELL CONSTRUCTION PERMIT# (if applicable) _____ ASSOCIATED WQ PERMIT# (if applicable) _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultural ☐
Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☒ If Other, list Use Piezometer

2. WELL LOCATION:
Nearest Town: AULANDER County BERTIE
1922 REPUBLICAN ROAD
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☐ Valley ☒ Flat
(check appropriate box)
Latitude/longitude of well location
_____
(degrees/minutes/seconds)
Latitude/longitude source: ☐ GPS ☐ Topographic map
(check box)

3. OWNER: REPUBLIC SERVICES OF NORTH CAROLINA
Address 1220 COMMERCE STREET
(Street or Route No.)
CONOVER NC 28613
City or Town State Zip Code
( )
Area Code – Phone Number

4. DATE DRILLED 05-16-05
5. TOTAL DEPTH: 50.0 FT
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
7. STATIC WATER LEVEL Below Top of Casing: 16.0 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 0.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A
11. DISINFECTION: Type N/A Amount _____
12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	0.0	To 40.0	Ft	2 INCH	SCH 40	PVC
From		To	Ft.			
From		To	Ft.			

13. Grout:

	Depth			Material	Method
From	0.0	To 35.0	Ft.	Portland Bentonite	Slurry
From		To	Ft.		

14. SCREEN:

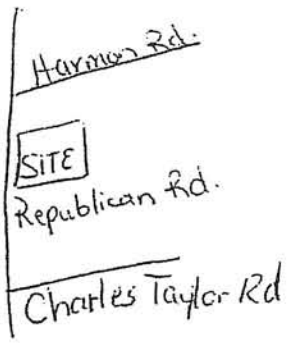
	Depth			Diameter	Slot Size	Material
From	40.0	To 50.0	Ft.	2 INCH in.	.010 in.	PVC
From		To	Ft.	in.	in.	

15. SAND/GRAVEL PACK:

	Depth			Size	Material
From	38.0	To 50.0	Ft.	20-40	FINE SILICA SAND
From		To	Ft.		

DEPTH From	DEPTH To	DRILLING LOG Formation Description
0.0	1.0	WEEDS & TOPSOIL
1.0	4.0	Tan/ Brown / Red Sandy Silty Clay
4.0	12.0	Tan / White Sandy Silty Clay
12.0	22.0	Tan/Brown/Orange Silty Sand
22.0	38.0	GRAY SILTY CLAY
38.0	50.0	Blue/Gray Clayey Silty Sand

LOCATION SKETCH
Show direction and distance in miles from at least two State Roads or County Roads, inculed the road numbers and common road names.



16. REMARKS: PZ-107B BENTONITE SEAL FROM 35.0 TO 38.0 FEET

I DO HEARBY 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

Mike McConahey
SIGNATURE OF PERSON CONSTRUCTING THE WELL

6/15/06
DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center – Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

WELL CONSTRUCTION RECORD

North Carolina – Department of Environmental and Natural Resources – Division of Water Quality – Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) MIKE MCCONAHEY CERTIFICATION # 2402

WELL CONTRACTOR COMPANY NAME GEOLOGIC EXPLORATION, INC. PHONE # (704) 872-7686

STATE WELL CONSTRUCTION PERMIT# (if applicable) _____ ASSOCIATED WQ PERMIT# (if applicable) _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultural ☐
Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☒ If Other, list Use Piezometer

2. WELL LOCATION:
Nearest Town: AULANDER County BERTIE
1922 REPUBLICAN ROAD
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☐ Valley ☒ Flat
(check appropriate box)
Latitude/longitude of well location
_____
(degrees/minutes/seconds)
Latitude/longitude source: ☐ GPS ☐ Topographic map
(check box)

3. OWNER: REPUBLIC SERVICES OF NORTH CAROLINA
Address 1220 COMMERCE STREET
(Street or Route No.)
CONOVER NC 28613
City or Town State Zip Code
( )
Area Code – Phone Number

4. DATE DRILLED 05-17-05
5. TOTAL DEPTH: 27.0 FT
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
7. STATIC WATER LEVEL Below Top of Casing: 9.0 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 0.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A
11. DISINFECTION: Type N/A Amount _____
12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	0.0	To 17.0	Ft	2 INCH	SCH 40	PVC
From		To	Ft.			
From		To	Ft.			

13. Grout:

	Depth			Material	Method
From	0.0	To 12.0	Ft.	Portland Bentonite	Slurry
From		To	Ft.		

14. SCREEN:

	Depth			Diameter	Slot Size	Material
From	17.0	To 27.0	Ft.	2 INCH in.	.010 in.	PVC
From		To	Ft.	in.	in.	

15. SAND/GRAVEL PACK:

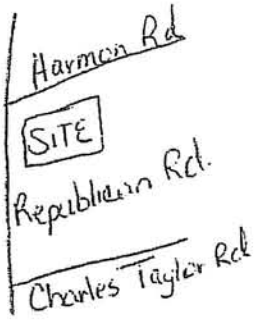
	Depth			Size	Material
From	15.0	To 27.0	Ft.	20-40	FINE SILICA SAND
From		To	Ft.		

16. REMARKS: PZ-107A BENTONITE SEAL FROM 12.0 TO 15.0 FEET

DEPTH / DRILLING LOG

From	To	Formation Description
0.0	1.0	WEEDS & TOPSOIL
1.0	4.0	Tan/ Brown / Red Sandy Silty Clay
4.0	12.0	Tan / White Sandy Silty Clay
12.0	25.0	Tan / Orange Silty Sand
25.0	27.0	GRAY SILTY CLAY

LOCATION SKETCH
Show direction and distance in miles from at least two State Roads or County Roads. inculed the road numbers and common road names.



I DO HEARBY 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

Mike McConahey
SIGNATURE OF PERSON CONSTRUCTING THE WELL

6/15/06
DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center – Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

WELL CONSTRUCTION RECORD

North Carolina – Department of Environmental and Natural Resources – Division of Water Quality – Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) MIKE MCCONAHEY CERTIFICATION # 2402

WELL CONTRACTOR COMPANY NAME GEOLOGIC EXPLORATION, INC. PHONE # (704) 872-7686

STATE WELL CONSTRUCTION PERMIT# (if applicable) _____ ASSOCIATED WQ PERMIT# (if applicable) _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultural ☐
Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☒ If Other, list Use Piezometer

2. WELL LOCATION:
Nearest Town: AULANDER County BERTIE
1922 REPUBLICAN ROAD
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☐ Valley ☒ Flat
(check appropriate box)
Latitude/longitude of well location
_____
(degrees/minutes/seconds)
Latitude/longitude source: ☐ GPS ☐ Topographic map
(check box)

3. OWNER: REPUBLIC SERVICES OF NORTH CAROLINA
Address 1220 COMMERCE STREET
(Street or Route No.)
CONOVER NC 28613
City or Town State Zip Code
( )
Area Code – Phone Number

4. DATE DRILLED 05-17-05
5. TOTAL DEPTH: 22.0 FT
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
7. STATIC WATER LEVEL Below Top of Casing: 9.0 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 0.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A
11. DISINFECTION: Type N/A Amount _____
12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From 0.0	To 17.0	Ft	2 INCH	SCH 40	PVC
From _____	To _____	Ft.	_____	_____	_____
From _____	To _____	Ft.	_____	_____	_____

13. Grout:

	Depth			Material	Method
From 0.0	To 12.0	Ft.	Portland Bentonite	Slurry
From _____	To _____	Ft.	_____	_____

14. SCREEN:

	Depth			Diameter	Slot Size	Material
From 17.0	To 22.0	Ft.	2 INCH	in. .010	in.	PVC
From _____	To _____	Ft.	_____	in. _____	in.	_____

15. SAND/GRAVEL PACK:

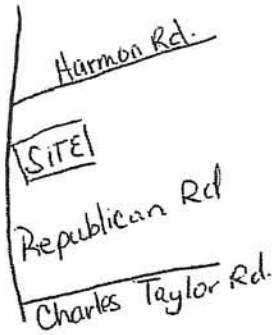
	Depth			Size	Material
From 15.0	To 22.0	Ft.	20-40	FINE SILICA SAND
From _____	To _____	Ft.	_____	_____

16. REMARKS: PZ-112 BENTONITE SEAL FROM 12.0 TO 15.0 FEET

DRILLING LOG

DEPTH From	DEPTH To	Formation Description
0.0	1.0	WEEDS & TOPSOIL
1.0	4.0	Tan/ Brown / Red Sandy Silty Clay
4.0	12.0	Tan / White Sandy Silty Clay
12.0	22.0	Tan / Orange Silty Sand

LOCATION SKETCH
Show direction and distance in miles from at least two State Roads or County Roads, inculed the road numbers and common road names.



I DO HEARBY 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

Mike McConahey
SIGNATURE OF PERSON CONSTRUCTING THE WELL

6/15/06
DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center – Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

WELL CONSTRUCTION RECORD

North Carolina – Department of Environmental and Natural Resources – Division of Water Quality – Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) MIKE MCCONAHEY CERTIFICATION # 2402

WELL CONTRACTOR COMPANY NAME GEOLOGIC EXPLORATION., INC. PHONE # (704) 872-7686

STATE WELL CONSTRUCTION PERMIT# (if applicable) _____ ASSOCIATED WQ PERMIT# (if applicable) _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultural ☐
Monitoring ☒ Recovery ☐ Heat Pump Water Injection ☐ Other ☒ If Other, list Use Piezometer

2. WELL LOCATION:
Nearest Town: AULANDER County BERTIE
1922 REPUBLICAN ROAD
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☐ Valley ☒ Flat
(check appropriate box)
Latitude/longitude of well location
_____
(degrees/minutes/seconds)
Latitude/longitude source: ☐ GPS ☐ Topographic map
(check box)

3. OWNER: REPUBLIC SERVICES OF NORTH CAROLINA
Address 1220 COMMERCE STREET
(Street or Route No.)
CONOVER NC 28613
City or Town State Zip Code
( )
Area Code – Phone Number

4. DATE DRILLED 05-18-05
5. TOTAL DEPTH: 50.0 FT
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
7. STATIC WATER LEVEL Below Top of Casing: 16.0 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 0.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A
11. DISINFECTION: Type N/A Amount _____
12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	0.0	To	37.0 Ft	2 INCH	SCH 40	PVC
From		To	Ft			
From		To	Ft			

13. Grout:

	Depth			Material	Method
From	0.0	To	32.0 Ft.	Portland Bentonite	Slurry
From		To	Ft.		

14. SCREEN:

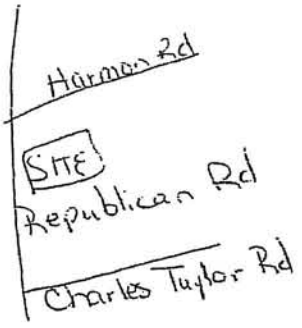
	Depth			Diameter		Slot Size		Material
From	37.0	To	50.0 Ft.	2 INCH	in.	.010	in.	PVC
From		To	Ft.		in.		in.	

15. SAND/GRAVEL PACK:

	Depth			Size	Material
From	35.0	To	50.0 Ft.	20-40	FINE SILICA SAND
From		To	Ft.		

DEPTH From	To	DRILLING LOG Formation Description
0.0	1.0	WEEDS & TOPSOIL
1.0	4.0	Tan/ Brown / Red Sandy Silty Clay
4.0	12.0	Tan / White Sandy Silty Clay
12.0	22.0	Tan/Brown/Orange Silty Clayey Sand
22.0	38.0	GRAY SILTY CLAY
38.0	50.0	Blue/Gray Clayey Silty Sand

LOCATION SKETCH
Show direction and distance in miles from at least two State Roads or County Roads, inculed the road numbers and common road names.



16. REMARKS: PZ-123B BENTONITE SEAL FROM 32.0 TO 35.0 FEET

I DO HEARBY 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

Mike McConahey
SIGNATURE OF PERSON CONSTRUCTING THE WELL

6/15/06
DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center – Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

WELL CONSTRUCTION RECORD

North Carolina – Department of Environmental and Natural Resources – Division of Water Quality – Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) MIKE MCCONAHEY CERTIFICATION # 2402

WELL CONTRACTOR COMPANY NAME GEOLOGIC EXPLORATION., INC. PHONE # (704) 872-7686

STATE WELL CONSTRUCTION PERMIT# (if applicable) _____ ASSOCIATED WQ PERMIT# (if applicable) _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultural ☐
Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☒ If Other, list Use Piezometer

2. WELL LOCATION:
Nearest Town: AULANDER County BERTIE
1922 REPUBLICAN ROAD
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☐ Valley ☒ Flat
(check appropriate box)
Latitude/longitude of well location
_____
(degrees/minutes/seconds)
Latitude/longitude source: ☐ GPS ☐ Topographic map
(check box)

3. OWNER: REPUBLIC SERVICES OF NORTH CAROLINA
Address 1220 COMMERCE STREET
(Street or Route No.)
CONOVER NC 28613
City or Town State Zip Code
( )
Area Code – Phone Number

4. DATE DRILLED 05-18-05
5. TOTAL DEPTH: 23.0 FT
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
7. STATIC WATER LEVEL Below Top of Casing: 9.0 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 0.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A
11. DISINFECTION: Type N/A Amount _____

DEPTH From	DEPTH To	DRILLING LOG Formation Description
0.0	1.0	WEEDS & TOPSOIL
1.0	4.0	Tan/ Brown / Red Sandy Silty Clay
4.0	12.0	Tan / White Sandy Silty Clay
12.0	21.0	TAN / ORANGE SILTY SAND
21.0	23.0	GRAY SILTY CLAY

12. CASING:

	Depth From	To		Diameter	Wall Thickness or Weight/Ft.	Material
From	0.0	To 19.0	Ft	2 INCH	SCH 40	PVC
From		To	Ft.			
From		To	Ft.			

13. Grout:

	Depth From	To		Material	Method
From	0.0	To 14.0	Ft.	Portland Bentonite	Slurry
From		To	Ft.		

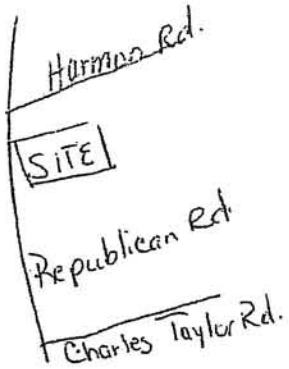
14. SCREEN:

	Depth From	To		Diameter	Slot Size	Material
From	19.0	To 23.0	Ft.	2 INCH in.	.010 in.	PVC
From		To	Ft.	in.	in.	

15. SAND/GRAVEL PACK:

	Depth From	To		Size	Material
From	17.0	To 23.0	Ft.	20-40	FINE SILICA SAND
From		To	Ft.		

LOCATION SKETCH
Show direction and distance in miles from at least two State Roads or County Roads, inculed the road numbers and common road names.



16. REMARKS: PZ-123A BENTONITE SEAL FROM 14.0 TO 17.0 FEET

I DO HEARBY 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

Mike McConahey 6/15/06
SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center – Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

WELL CONSTRUCTION RECORD

North Carolina – Department of Environmental and Natural Resources – Division of Water Quality – Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) MIKE MCCONAHEY CERTIFICATION # 2402

WELL CONTRACTOR COMPANY NAME GEOLOGIC EXPLORATION., INC. PHONE # (704) 872-7686

STATE WELL CONSTRUCTION PERMIT# (if applicable) _____ ASSOCIATED WQ PERMIT# (if applicable) _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultural ☐
Monitoring ☑ Recovery ☐ Heat Pump Water Injection ☐ Other ☒ If Other, list Use Piezometer

2. WELL LOCATION:
Nearest Town: AULANDER County BERTIE
1922 REPUBLICAN ROAD
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☐ Valley ☒ Flat
(check appropriate box)
Latitude/longitude of well location
_____
(degrees/minutes/seconds)
Latitude/longitude source: ☐ GPS ☐ Topographic map
(check box)

3. OWNER: REPUBLIC SERVICES OF NORTH CAROLINA
Address 1220 COMMERCE STREET
(Street or Route No.)
CONOVER NC 28613
City or Town State Zip Code
( )
Area Code – Phone Number

4. DATE DRILLED 05-22-05
5. TOTAL DEPTH: 21.0 FT
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
7. STATIC WATER LEVEL Below Top of Casing: 9.0 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 0.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A
11. DISINFECTION: Type N/A Amount _____
12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	0.0	To 11.0	Ft	2 INCH	SCH 40	PVC
From		To	Ft.			
From		To	Ft.			

13. Grout:

	Depth			Material	Method
From	0.0	To 6.0	Ft.	Portland Bentonite	Slurry
From		To	Ft.		

14. SCREEN:

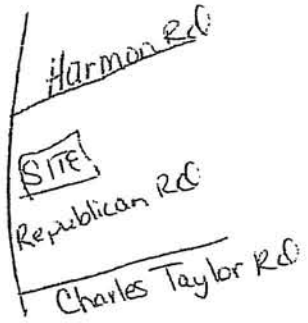
	Depth			Diameter	Slot Size	Material
From	11.0	To 21.0	Ft.	2 INCH in.	.010 in.	PVC
From		To	Ft.	in.	in.	

15. SAND/GRAVEL PACK:

	Depth			Size	Material
From	9.0	To 21.0	Ft.	20-40	FINE SILICA SAND
From		To	Ft.		

DEPTH From	To	DRILLING LOG Formation Description
0.0	1.0	WEEDS & TOPSOIL
1.0	4.0	Tan/ Brown / Red Sandy Silty Clay
4.0	12.0	Tan / White Sandy Silty Clay
12.0	21.0	TAN / ORANGE SILTY SAND

LOCATION SKETCH
Show direction and distance in miles from at least two State Roads or County Roads, inculed the road numbers and common road names.



16. REMARKS: PZ-120 BENTONITE SEAL FROM 6.0 TO 9.0 FEET

I DO HEARBY 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

Mike McConahey
SIGNATURE OF PERSON CONSTRUCTING THE WELL

6/15/06
DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center – Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

WELL CONSTRUCTION RECORD

North Carolina – Department of Environmental and Natural Resources – Division of Water Quality – Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) MIKE MCCONAHEY CERTIFICATION # 2402

WELL CONTRACTOR COMPANY NAME GEOLOGIC EXPLORATION., INC. PHONE # (704) 872-7686

STATE WELL CONSTRUCTION PERMIT# (if applicable) _____ ASSOCIATED WQ PERMIT# (if applicable) _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultural ☐
Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☒ If Other, list Use Piezometer

2. WELL LOCATION:
Nearest Town: AULANDER County BERTIE
1922 REPUBLICAN ROAD
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☐ Valley ☒ Flat
(check appropriate box)
Latitude/longitude of well location
_____
(degrees/minutes/seconds)
Latitude/longitude source: ☐ GPS ☐ Topographic map
(check box)

3. OWNER: REPUBLIC SERVICES OF NORTH CAROLINA
Address 1220 COMMERCE STREET
(Street or Route No.)
CONOVER NC 28613
City or Town State Zip Code
( )
Area Code – Phone Number

4. DATE DRILLED 05-18-05
5. TOTAL DEPTH: 24.0 FT
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
7. STATIC WATER LEVEL Below Top of Casing: 9.0 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 0.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A
11. DISINFECTION: Type N/A Amount _____
12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From 0.0	To 14.0	Ft	2 INCH	SCH 40	PVC
From _____	To _____	Ft.			
From _____	To _____	Ft.			

13. Grout:

	Depth			Material	Method
From 0.0	To 9.0	Ft.	Portland Bentonite	Slurry
From _____	To _____	Ft.		

14. SCREEN:

	Depth			Diameter	Slot Size	Material
From 14.0	To 24.0	Ft.	2 INCH	in. .010	in.	PVC
From _____	To _____	Ft.	_____	in. _____	in.	

15. SAND/GRAVEL PACK:

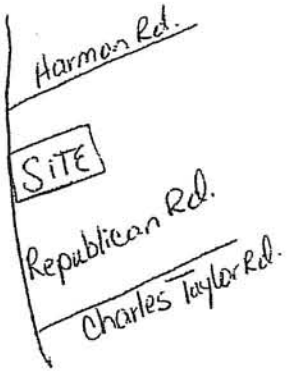
	Depth			Size	Material
From 12.0	To 24.0	Ft.	20-40	FINE SILICA SAND
From _____	To _____	Ft.		

16. REMARKS: PZ-122 BENTONITE SEAL FROM 9.0 TO 12.0 FEET

DEPTH / DRILLING LOG

From	To	Formation Description
0.0	1.0	WEEDS & TOPSOIL
1.0	4.0	Tan/ Brown / Red Sandy Silty Clay
4.0	12.0	Tan / White Sandy Silty Clay
12.0	24.0	TAN / ORANGE SILTY SAND

LOCATION SKETCH
Show direction and distance in miles from at least two State Roads or County Roads, inculed the road numbers and common road names.



I DO HEARBY 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

Mike McConahey
SIGNATURE OF PERSON CONSTRUCTING THE WELL

6/15/06
DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center – Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

WELL CONSTRUCTION RECORD

North Carolina – Department of Environmental and Natural Resources – Division of Water Quality – Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) MIKE MCCONAHEY CERTIFICATION # 2402

WELL CONTRACTOR COMPANY NAME GEOLOGIC EXPLORATION., INC. PHONE # (704) 872-7686

STATE WELL CONSTRUCTION PERMIT# (if applicable) _____ ASSOCIATED WQ PERMIT# (if applicable) _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultural ☐
Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☒ If Other, list Use Piezometer

2. WELL LOCATION:
Nearest Town: AULANDER County BERTIE
1922 REPUBLICAN ROAD
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☐ Valley ☒ Flat
(check appropriate box)
Latitude/longitude of well location
_____
(degrees/minutes/seconds)
Latitude/longitude source: ☐ GPS ☐ Topographic map
(check box)

3. OWNER: REPUBLIC SERVICES OF NORTH CAROLINA
Address 1220 COMMERCE STREET
(Street or Route No.)
CONOVER NC 28613
City or Town State Zip Code
( ) _____
Area Code – Phone Number

4. DATE DRILLED 05-22-05
5. TOTAL DEPTH: 17.0 FT
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
7. STATIC WATER LEVEL Below Top of Casing: 9.0 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 0.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A
11. DISINFECTION: Type N/A Amount _____
12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	0.0	To 12.0	Ft	2 INCH	SCH 40	PVC
From		To	Ft.			
From		To	Ft.			

13. Grout:

	Depth			Material	Method
From	0.0	To 7.0	Ft.	Portland Bentonite	Slurry
From		To	Ft.		

14. SCREEN:

	Depth			Diameter	Slot Size	Material
From	12.0	To 17.0	Ft.	2 INCH in.	.010 in.	PVC
From		To	Ft.	in.	in.	

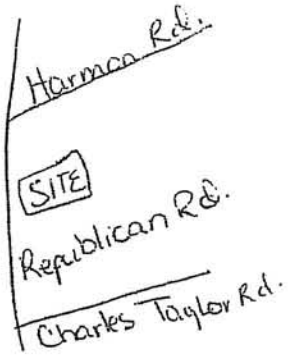
15. SAND/GRAVEL PACK:

	Depth			Size	Material
From	10.0	To 17.0	Ft.	20-40	FINE SILICA SAND
From		To	Ft.		

DRILLING LOG

From	To	Formation Description
0.0	1.0	WEEDS & TOPSOIL
1.0	4.0	Tan/ Brown / Red Sandy Silty Clay
4.0	12.0	Tan / White Sandy Silty Clay
12.0	17.0	TAN / ORANGE SILTY SAND

LOCATION SKETCH
Show direction and distance in miles from at least two State Roads or County Roads, inculed the road numbers and common road names.



16. REMARKS: PZ-115-A BENTONITE SEAL FROM 7.0 TO 10.0 FEET

I DO HEARBY 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

Mike McConahey 6/15/06
SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center – Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

WELL CONSTRUCTION RECORD

North Carolina – Department of Environmental and Natural Resources – Division of Water Quality – Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) MIKE MCCONAHEY CERTIFICATION # 2402

WELL CONTRACTOR COMPANY NAME GEOLOGIC EXPLORATION., INC. PHONE # (704) 872-7686

STATE WELL CONSTRUCTION PERMIT# (if applicable) _____ ASSOCIATED WQ PERMIT# (if applicable) _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultural ☐
Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☒ If Other, list Use Piezometer

2. WELL LOCATION:
Nearest Town: AULANDER County BERTIE
1922 REPUBLICAN ROAD
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☐ Valley ☒ Flat
(check appropriate box)
Latitude/longitude of well location
(degrees/minutes/seconds)
Latitude/longitude source: ☐ GPS ☐ Topographic map
(check box)

3. OWNER: REPUBLIC SERVICES OF NORTH CAROLINA
Address 1220 COMMERCE STREET
(Street or Route No.)
CONOVER NC 28613
City or Town State Zip Code
( )
Area Code – Phone Number

4. DATE DRILLED 05-22-05
5. TOTAL DEPTH: 50.0 FT
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
7. STATIC WATER LEVEL Below Top of Casing: 16.0 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 0.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A
11. DISINFECTION: Type N/A Amount _____
12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	0.0	To 30.0	Ft	2 INCH	SCH 40	PVC
From		To	Ft.			
From		To	Ft.			

13. Grout:

	Depth			Material	Method
From	0.0	To 25.0	Ft.	Portland Bentonite	Slurry
From		To	Ft.		

14. SCREEN:

	Depth			Diameter	Slot Size	Material
From	30.0	To 50.0	Ft.	2 INCH in.	.010 in.	PVC
From		To	Ft.	in.	in.	

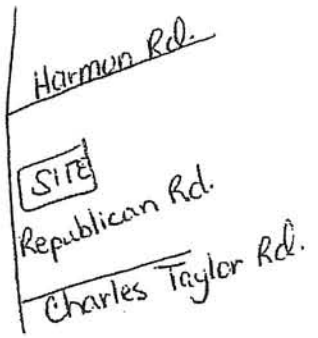
15. SAND/GRAVEL PACK:

	Depth			Size	Material
From	28.0	To 50.0	Ft.	20-40	FINE SILICA SAND
From		To	Ft.		

DRILLING LOG

DEPTH From	DEPTH To	Formation Description
0.0	1.0	WEEDS & TOPSOIL
1.0	4.0	Tan/ Brown / Red Sandy Silty Clay
4.0	12.0	Tan / White Sandy Silty Clay
12.0	22.0	Tan/Brown/Orange Silty Clayey Sand
22.0	38.0	GRAY SILTY CLAY
38.0	50.0	Blue/Gray Clayey Silty Sand

LOCATION SKETCH
Show direction and distance in miles from at least two State Roads or County Roads, inculed the road numbers and common road names.



16. REMARKS: PZ-115-B BENTONITE SEAL FROM 25.0 TO 28.0 FEET

I DO HEARBY 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

Mike McConahey 6/15/06
SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center – Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

WELL CONSTRUCTION RECORD

North Carolina – Department of Environmental and Natural Resources – Division of Water Quality – Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) MIKE MCCONAHEY CERTIFICATION # 2402

WELL CONTRACTOR COMPANY NAME GEOLOGIC EXPLORATION., INC. PHONE # (704) 872-7686

STATE WELL CONSTRUCTION PERMIT# (if applicable) _____ ASSOCIATED WQ PERMIT# (if applicable) _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultural ☐
Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☒ If Other, list Use Piezometer

2. WELL LOCATION:
Nearest Town: AULANDER County BERTIE
1922 REPUBLICAN ROAD
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☐ Valley ☒ Flat
(check appropriate box)
Latitude/longitude of well location
_____
(degrees/minutes/seconds)
Latitude/longitude source: ☐ GPS ☐ Topographic map
(check box)

3. OWNER: REPUBLIC SERVICES OF NORTH CAROLINA
Address 1220 COMMERCE STREET
(Street or Route No.)
CONOVER NC 28613
City or Town State Zip Code
( ) _____
Area Code – Phone Number

4. DATE DRILLED 05-23-05
5. TOTAL DEPTH: 18.0 FT
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
7. STATIC WATER LEVEL Below Top of Casing: 9.0 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 0.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A
11. DISINFECTION: Type N/A Amount _____
12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	0.0	To 10.0	Ft	2 INCH	SCH 40	PVC
From		To	Ft.			
From		To	Ft.			

13. Grout:

	Depth			Material	Method
From	0.0	To 5.0	Ft.	Portland Bentonite	Slurry
From		To	Ft.		

14. SCREEN:

	Depth			Diameter	Slot Size	Material
From	10.0	To 18.0	Ft.	2 INCH in.	.010 in.	PVC
From		To	Ft.	in.	in.	

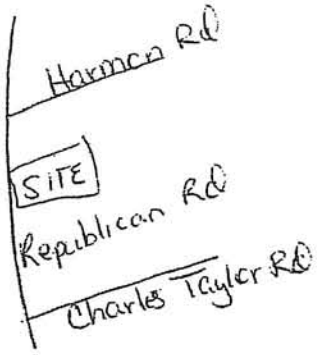
15. SAND/GRAVEL PACK:

	Depth			Size	Material
From	8.0	To 18.0	Ft.	20-40	FINE SILICA SAND
From		To	Ft.		

DRILLING LOG

From	To	Formation Description
0.0	1.0	WEEDS & TOPSOIL
1.0	4.0	Tan/ Brown / Red Sandy Silty Clay
4.0	12.0	Tan / White Sandy Silty Clay
12.0	18.0	TAN / ORANGE SILTY SAND

LOCATION SKETCH
Show direction and distance in miles from at least two State Roads or County Roads, inculed the road numbers and common road names.



16. REMARKS: PZ-111 BENTONITE SEAL FROM 5.0 TO 8.0 FEET

I DO HEARBY 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

Mike McConahey 6/15/06
SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center – Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

WELL CONSTRUCTION RECORD

North Carolina – Department of Environmental and Natural Resources – Division of Water Quality – Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) MIKE MCCONAHEY CERTIFICATION # 2402

WELL CONTRACTOR COMPANY NAME GEOLOGIC EXPLORATION., INC. PHONE # (704) 872-7686

STATE WELL CONSTRUCTION PERMIT# (if applicable) _____ ASSOCIATED WQ PERMIT# (if applicable) _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultural ☐
Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☒ If Other, list Use Piezometer

2. WELL LOCATION:
Nearest Town: AULANDER County BERTIE
1922 REPUBLICAN ROAD
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☐ Valley ☒ Flat
(check appropriate box)
Latitude/longitude of well location
_____
(degrees/minutes/seconds)
Latitude/longitude source: ☐ GPS ☐ Topographic map
(check box)

3. OWNER: REPUBLIC SERVICES OF NORTH CAROLINA
Address 1220 COMMERCE STREET
(Street or Route No.)
CONOVER NC 28613
City or Town State Zip Code
( )
Area Code – Phone Number

4. DATE DRILLED 05-23-05
5. TOTAL DEPTH: 20.0 FT
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
7. STATIC WATER LEVEL Below Top of Casing: 9.0 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 0.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A
11. DISINFECTION: Type N/A Amount _____
12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From 0.0	To 10.0	Ft	2 INCH	SCH 40	PVC
From _____	To _____	Ft.	_____	_____	_____
From _____	To _____	Ft.	_____	_____	_____

13. Grout:

	Depth			Material	Method
From 0.0	To 5.0	Ft.	Portland Bentonite	Slurry
From _____	To _____	Ft.	_____	_____

14. SCREEN:

	Depth			Diameter		Slot Size		Material
From 10.0	To 20.0	Ft.	2 INCH	in.	.010	in.	PVC
From _____	To _____	Ft.	_____	in.	_____	in.	_____

15. SAND/GRAVEL PACK:

	Depth			Size	Material
From 8.0	To 20.0	Ft.	20-40	FINE SILICA SAND
From _____	To _____	Ft.	_____	_____

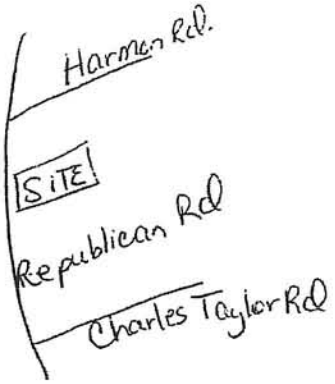
16. REMARKS: PZ-119 BENTONITE SEAL FROM 5.0 TO 8.0 FEET

DEPTH / DRILLING LOG

From	To	Formation Description
0.0	1.0	WEEDS & TOPSOIL
1.0	4.0	Tan/ Brown / Red Sandy Silty Clay
4.0	12.0	Tan / White Sandy Silty Clay
12.0	20.0	TAN / ORANGE SILTY SAND

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads, inculed the road numbers and common road names.



I DO HEARBY 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

Mike McConahey
SIGNATURE OF PERSON CONSTRUCTING THE WELL

6/15/06
DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center – Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

WELL CONSTRUCTION RECORD

North Carolina – Department of Environmental and Natural Resources – Division of Water Quality – Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) MIKE MCCONAHEY CERTIFICATION # 2402

WELL CONTRACTOR COMPANY NAME GEOLOGIC EXPLORATION., INC. PHONE # (704) 872-7686

STATE WELL CONSTRUCTION PERMIT# (if applicable) _____ ASSOCIATED WQ PERMIT# (if applicable) _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultural ☐
Monitoring ☒ Recovery ☐ Heat Pump Water Injection ☐ Other ☐ If Other, list Use _____

2. WELL LOCATION:
Nearest Town: AULANDER County BERTIE
1922 REPUBLICAN ROAD
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☐ Valley ☒ Flat
(check appropriate box)
Latitude/longitude of well location
_____
(degrees/minutes/seconds)
Latitude/longitude source: ☐ GPS ☐ Topographic map
(check box)

3. OWNER: REPUBLIC SERVICES OF NORTH CAROLINA
Address 1220 COMMERCE STREET
(Street or Route No.)
CONOVER NC 28613
City or Town State Zip Code
( )
Area Code – Phone Number

4. DATE DRILLED 05-24-05
5. TOTAL DEPTH: 23.0 FT
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
7. STATIC WATER LEVEL Below Top of Casing: 9.0 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 2.5 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A
11. DISINFECTION: Type N/A Amount _____

DEPTH From	To	DRILLING LOG Formation Description
0.0	1.0	WEEDS & TOPSOIL
1.0	4.0	Tan/ Brown / Red Sandy Silty Clay
4.0	12.0	Tan / White Sandy Silty Clay
12.0	21.0	TAN / ORANGE SILTY SAND

12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From 0.0	To 11.0	Ft		2 INCH	SCH 40	PVC
From	To	Ft.				
From	To	Ft.				

13. Grout:

	Depth			Material	Method
From 0.0	To 6.0	Ft.		Portland Bentonite	Slurry
From	To	Ft.			

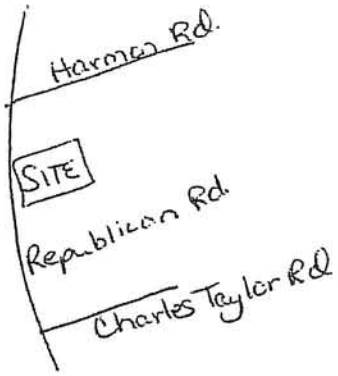
14. SCREEN:

	Depth			Diameter	Slot Size	Material
From 11.0	To 21.0	Ft.		2 INCH in.	.010 in.	PVC
From	To	Ft.		in.	in.	

15. SAND/GRAVEL PACK:

	Depth			Size	Material
From 9.0	To 21.0	Ft.		20-40	FINE SILICA SAND
From	To	Ft.			

LOCATION SKETCH
Show direction and distance in miles from at least two State Roads or County Roads, inculed the road numbers and common road names.



16. REMARKS: GW-19 BENTONITE SEAL FROM 6.0 TO 9.0 FEET

I DO HEARBY 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

Mike McConahey 6/15/06
SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center – Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

WELL CONSTRUCTION RECORD

North Carolina – Department of Environmental and Natural Resources – Division of Water Quality – Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) MIKE MCCONAHEY CERTIFICATION # 2402

WELL CONTRACTOR COMPANY NAME GEOLOGIC EXPLORATION., INC. PHONE # (704) 872-7686

STATE WELL CONSTRUCTION PERMIT# (if applicable) _____ ASSOCIATED WQ PERMIT# (if applicable) _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultural ☐
Monitoring ☒ Recovery ☐ Heat Pump Water Injection ☐ Other ☐ If Other, list Use _____

2. WELL LOCATION:
Nearest Town: AULANDER County BERTIE
1922 REPUBLICAN ROAD
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☐ Valley ☒ Flat
(check appropriate box)
Latitude/longitude of well location
_____
(degrees/minutes/seconds)
Latitude/longitude source: ☐ GPS ☐ Topographic map
(check box)

3. OWNER: REPUBLIC SERVICES OF NORTH CAROLINA
Address 1220 COMMERCE STREET
(Street or Route No.)
CONOVER NC 28613
City or Town State Zip Code
( )
Area Code – Phone Number

4. DATE DRILLED 05-17-05
5. TOTAL DEPTH: 28.0 FT
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
7. STATIC WATER LEVEL Below Top of Casing: 9.0 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 2.5 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A
11. DISINFECTION: Type N/A Amount _____

DEPTH From	DEPTH To	DRILLING LOG Formation Description
0.0	1.0	WEEDS & TOPSOIL
1.0	4.0	Tan/ Brown / Red Sandy Silty Clay
4.0	12.0	Tan / White Sandy Silty Clay
12.0	28.0	TAN / ORANGE SILTY SAND

12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From 0.0	To 13.0	Ft		2 INCH	SCH 40	PVC
From	To	Ft.				
From	To	Ft.				

13. Grout:

	Depth			Material	Method
From 1.0	To 8.0	Ft.		Portland Bentonite	Slurry
From	To	Ft.			

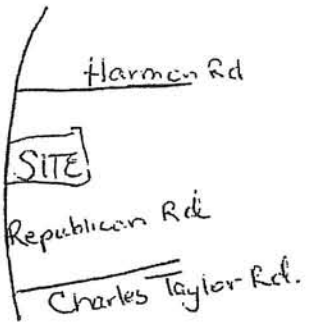
14. SCREEN:

	Depth			Diameter	Slot Size	Material
From 13.0	To 28.0	Ft.		2 INCH in.	.010 in.	PVC
From	To	Ft.		in.	in.	

15. SAND/GRAVEL PACK:

	Depth			Size	Material
From 11.0	To 28.0	Ft.		20-40	FINE SILICA SAND
From	To	Ft.			

LOCATION SKETCH
Show direction and distance in miles from at least two State Roads or County Roads, inculed the road numbers and common road names.



16. REMARKS: GW-18 BENTONITE SEAL FROM 8.0 TO 11.0 FEET

I DO HEARBY 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

Mike McConahey
SIGNATURE OF PERSON CONSTRUCTING THE WELL

6/15/06
DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center – Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

WELL CONSTRUCTION RECORD

North Carolina – Department of Environmental and Natural Resources – Division of Water Quality – Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) MIKE MCCONAHEY CERTIFICATION # 2402

WELL CONTRACTOR COMPANY NAME GEOLOGIC EXPLORATION., INC. PHONE # (704) 872-7686

STATE WELL CONSTRUCTION PERMIT# (if applicable) _____ ASSOCIATED WQ PERMIT# (if applicable) _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultural ☐
Monitoring ☒ Recovery ☐ Heat Pump Water Injection ☐ Other ☐ If Other, list Use _____

2. WELL LOCATION:
Nearest Town: AULANDER County BERTIE
1922 REPUBLICAN ROAD
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☐ Valley ☒ Flat
(check appropriate box)
Latitude/longitude of well location
_____
(degrees/minutes/seconds)
Latitude/longitude source: ☐ GPS ☐ Topographic map
(check box)

3. OWNER: REPUBLIC SERVICES OF NORTH CAROLINA
Address 1220 COMMERCE STREET
(Street or Route No.)
CONOVER NC 28613
City or Town State Zip Code
( ) _____
Area Code – Phone Number

4. DATE DRILLED 05-24-05
5. TOTAL DEPTH: 23.0 FT
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
7. STATIC WATER LEVEL Below Top of Casing: 9.0 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 2.5 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A
11. DISINFECTION: Type N/A Amount _____
12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	0.0	To	13.0 Ft	2 INCH	SCH 40	PVC
From		To	Ft.			
From		To	Ft.			

13. Grout:

	Depth			Material	Method
From	0.0	To	8.0 Ft.	Portland Bentonite	Slurry
From		To	Ft.		

14. SCREEN:

	Depth			Diameter	Slot Size	Material
From	13.0	To	23.0 Ft.	2 INCH in.	.010 in.	PVC
From		To	Ft.	in.	in.	

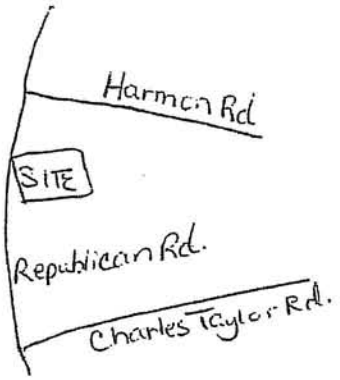
15. SAND/GRAVEL PACK:

	Depth			Size	Material
From	11.0	To	23.0 Ft.	20-40	FINE SILICA SAND
From		To	Ft.		

DRILLING LOG

DEPTH From	DEPTH To	Formation Description
0.0	1.0	WEEDS & TOPSOIL
1.0	4.0	Tan/ Brown / Red Sandy Silty Clay
4.0	12.0	Tan / White Sandy Silty Clay
12.0	23.0	TAN / ORANGE SILTY SAND

LOCATION SKETCH
Show direction and distance in miles from at least two State Roads or County Roads, inculed the road numbers and common road names.



16. REMARKS: GW-16 BENTONITE SEAL FROM 8.0 TO 11.0 FEET

I DO HEARBY 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

Mike McConahey
SIGNATURE OF PERSON CONSTRUCTING THE WELL

6/15/06
DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center – Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

WELL CONSTRUCTION RECORD

North Carolina – Department of Environmental and Natural Resources – Division of Water Quality – Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) MIKE MCCONAHEY CERTIFICATION # 2402

WELL CONTRACTOR COMPANY NAME GEOLOGIC EXPLORATION., INC. PHONE # (704) 872-7686

STATE WELL CONSTRUCTION PERMIT# (if applicable) _____ ASSOCIATED WQ PERMIT# (if applicable) _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultural ☐
Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☒ If Other, list Use Piezometer

2. WELL LOCATION:
Nearest Town: AULANDER County BERTIE
1922 REPUBLICAN ROAD
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☐ Valley ☒ Flat
(check appropriate box)
Latitude/longitude of well location
(degrees/minutes/seconds)
Latitude/longitude source: ☐ GPS ☐ Topographic map
(check box)

3. OWNER: REPUBLIC SERVICES OF NORTH CAROLINA
Address 1220 COMMERCE STREET
(Street or Route No.)
CONOVER NC 28613
City or Town State Zip Code
( )
Area Code – Phone Number

4. DATE DRILLED 05-11-05
5. TOTAL DEPTH: 52.0 FT
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
7. STATIC WATER LEVEL Below Top of Casing: 16.0 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 0.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A
11. DISINFECTION: Type N/A Amount _____
12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	0.0	To	47.0 Ft	2 INCH	SCH 40	PVC
From		To	Ft.			
From		To	Ft.			

13. Grout:

	Depth			Material	Method
From	0.0	To	41.0 Ft.	Portland Bentonite	Slurry
From		To	Ft.		

14. SCREEN:

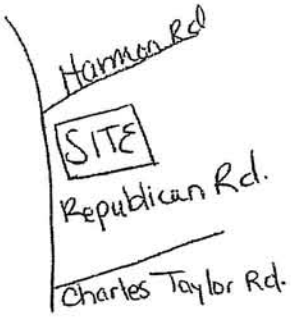
	Depth			Diameter	Slot Size	Material
From	47.0	To	52.0 Ft.	2 INCH in.	.010 in.	PVC
From		To	Ft.	in.	in.	

15. SAND/GRAVEL PACK:

	Depth			Size	Material
From	45.0	To	52.0 Ft.	20-40	FINE SILICA SAND
From		To	Ft.		

DEPTH From	To	DRILLING LOG Formation Description
0.0	1.0	WEEDS & TOPSOIL
1.0	4.0	Tan/ Brown / Red Sandy Silty Clay
4.0	12.0	Tan / White Sandy Silty Clay
12.0	22.0	Tan/Brown/Orange Silty Sand
22.0	38.0	GRAY SILTY CLAY
38.0	52.0	Blue/Gray Clayey Silty Sand

LOCATION SKETCH
Show direction and distance in miles from at least two State Roads or County Roads, inculed the road numbers and common road names.



16. REMARKS: PZ-109B BENTONITE SEAL FROM 41.0 TO 45.0 FEET

I DO HEARBY 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

Mike McConahey 6/15/06
SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center – Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

WELL CONSTRUCTION RECORD

North Carolina – Department of Environmental and Natural Resources – Division of Water Quality – Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) MIKE MCCONAHEY CERTIFICATION # 2402

WELL CONTRACTOR COMPANY NAME GEOLOGIC EXPLORATION., INC. PHONE # (704) 872-7686

STATE WELL CONSTRUCTION PERMIT# (if applicable) _____ ASSOCIATED WQ PERMIT# (if applicable) _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultural ☐
Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☒ If Other, list Use Piezometer

2. WELL LOCATION:
Nearest Town: AULANDER County BERTIE
1922 REPUBLICAN ROAD
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☐ Valley ☒ Flat
(check appropriate box)
Latitude/longitude of well location
_____
(degrees/minutes/seconds)
Latitude/longitude source: ☐ GPS ☐ Topographic map
(check box)

3. OWNER: REPUBLIC SERVICES OF NORTH CAROLINA
Address 1220 COMMERCE STREET
(Street or Route No.)
CONOVER NC 28613
City or Town State Zip Code
( ) _____
Area Code – Phone Number

4. DATE DRILLED 05-08-05
5. TOTAL DEPTH: 22.0 FT
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
7. STATIC WATER LEVEL Below Top of Casing: 9.0 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 0.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A

DEPTH From	DEPTH To	DRILLING LOG Formation Description
0.0	1.0	WEEDS & TOPSOIL
1.0	4.0	Tan/ Brown / Red Sandy Silty Clay
4.0	12.0	Tan / White Sandy Silty Clay
12.0	22.0	Tan/Orange Silty Sand

11. DISINFECTION: Type N/A Amount _____
12. CASING:

	Depth From	To	Ft	Diameter	Wall Thickness or Weight/Ft.	Material
	0.0	17.0	Ft	2 INCH	SCH 40	PVC
			Ft.			
			Ft.			

13. Grout:

	Depth From	To	Ft.	Material	Method
	0.0	12.0	Ft.	Portland Bentonite	Slurry
			Ft.		

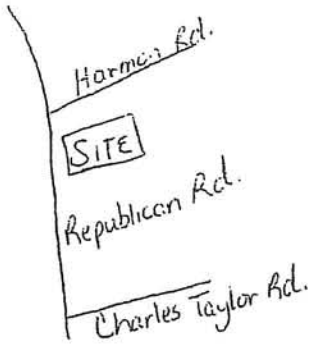
14. SCREEN:

	Depth From	To	Ft.	Diameter	Slot Size	Material
	17.0	22.0	Ft.	2 INCH in.	.010 in.	PVC
			Ft.	in.	in.	

15. SAND/GRAVEL PACK:

	Depth From	To	Ft.	Size	Material
	15.0	22.0	Ft.	20-40	FINE SILICA SAND
			Ft.		

LOCATION SKETCH
Show direction and distance in miles from at least two State Roads or County Roads, inculed the road numbers and common road names.



16. REMARKS: PZ-113 BENTONITE SEAL FROM 12.0 TO 15.0 FEET

I DO HEARBY 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

Mike McConahey 6/15/06
SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center – Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

WELL CONSTRUCTION RECORD

North Carolina – Department of Environmental and Natural Resources – Division of Water Quality – Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) MIKE MCCONAHEY CERTIFICATION # 2402

WELL CONTRACTOR COMPANY NAME GEOLOGIC EXPLORATION., INC. PHONE # (704) 872-7686

STATE WELL CONSTRUCTION PERMIT# (if applicable) _____ ASSOCIATED WQ PERMIT# (if applicable) _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultural ☐
Monitoring [ ] Recovery ☐ Heat Pump Water Injection ☐ Other ☒ If Other, list Use Piezometer

2. WELL LOCATION:
Nearest Town: AULANDER County BERTIE
1922 REPUBLICAN ROAD
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☐ Valley ☒ Flat
(check appropriate box)
Latitude/longitude of well location
(degrees/minutes/seconds)
Latitude/longitude source: ☐ GPS ☐ Topographic map
(check box)

3. OWNER: REPUBLIC SERVICES OF NORTH CAROLINA
Address 1220 COMMERCE STREET
(Street or Route No.)
CONOVER NC 28613
City or Town State Zip Code
( ) _____
Area Code – Phone Number

4. DATE DRILLED 05-08-05
5. TOTAL DEPTH: 20.0 FT
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
7. STATIC WATER LEVEL Below Top of Casing: 9.0 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 0.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A
11. DISINFECTION: Type N/A Amount _____
12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	0.0	To	15.0 Ft	2 INCH	SCH 40	PVC
From		To	Ft.			
From		To	Ft.			

13. Grout:

	Depth			Material	Method
From	0.0	To	10.0 Ft.	Portland Bentonite	Slurry
From		To	Ft.		

14. SCREEN:

	Depth			Diameter	Slot Size	Material
From	15.0	To	20.0 Ft.	2 INCH in.	.010 in.	PVC
From		To	Ft.	in.	in.	

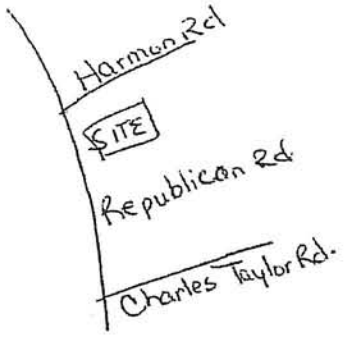
15. SAND/GRAVEL PACK:

	Depth			Size	Material
From	13.0	To	20.0 Ft.	20-40	FINE SILICA SAND
From		To	Ft.		

DRILLING LOG

From	To	Formation Description
0.0	1.0	WEEDS & TOPSOIL
1.0	4.0	Tan/ Brown / Red Sandy Silty Clay
4.0	12.0	Tan / White Sandy Silty Clay
12.0	20.0	Tan/Orange Silty Sand

LOCATION SKETCH
Show direction and distance in miles from at least two State Roads or County Roads, inculed the road numbers and common road names.



16. REMARKS: PZ-121 BENTONITE SEAL FROM 10.0 TO 13.0 FEET

I DO HEARBY 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

Mike McConahey
SIGNATURE OF PERSON CONSTRUCTING THE WELL

6/15/06
DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center – Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

WELL CONSTRUCTION RECORD

North Carolina – Department of Environmental and Natural Resources – Division of Water Quality – Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) MIKE MCCONAHEY CERTIFICATION # 2402

WELL CONTRACTOR COMPANY NAME GEOLOGIC EXPLORATION., INC. PHONE # (704) 872-7686

STATE WELL CONSTRUCTION PERMIT# (if applicable) _____ ASSOCIATED WQ PERMIT# (if applicable) _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultural ☐
Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☒ If Other, list Use Piezometer

2. WELL LOCATION:
Nearest Town: AULANDER County BERTIE
1922 REPUBLICAN ROAD
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☐ Valley ☒ Flat
(check appropriate box)
Latitude/longitude of well location
_____
(degrees/minutes/seconds)
Latitude/longitude source: ☐ GPS ☐ Topographic map
(check box)

3. OWNER: REPUBLIC SERVICES OF NORTH CAROLINA
Address 1220 COMMERCE STREET
(Street or Route No.)
CONOVER NC 28613
City or Town State Zip Code
( )
Area Code – Phone Number

4. DATE DRILLED 05-09-05
5. TOTAL DEPTH: 18.0 FT
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
7. STATIC WATER LEVEL Below Top of Casing: 9.0 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 0.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A
11. DISINFECTION: Type N/A Amount _____

DEPTH From	To	DRILLING LOG Formation Description
0.0	1.0	WEEDS & TOPSOIL
1.0	4.0	Tan/ Brown / Red Sandy Silty Clay
4.0	12.0	Tan / White Sandy Silty Clay
12.0	18.0	Tan/Orange Silty Sand

12. CASING:

	Depth From	To		Diameter	Wall Thickness or Weight/Ft.	Material
	0.0	13.0	Ft	2 INCH	SCH 40	PVC
			Ft.			
			Ft.			

13. Grout:

	Depth From	To		Material	Method
	0.0	8.0	Ft.	Portland Bentonite	Slurry
			Ft.		

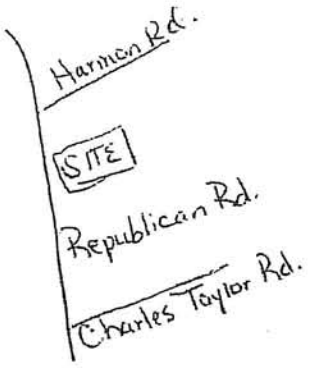
14. SCREEN:

	Depth From	To		Diameter		Slot Size		Material
	13.0	18.0	Ft.	2 INCH	in.	.010	in.	PVC
			Ft.		in.		in.	

15. SAND/GRAVEL PACK:

	Depth From	To		Size	Material
	11.0	18.0	Ft.	20-40	FINE SILICA SAND
			Ft.		

LOCATION SKETCH
Show direction and distance in miles from at least two State Roads or County Roads, inculed the road numbers and common road names.



16. REMARKS: PZ-108 BENTONITE SEAL FROM 8.0 TO 11.0 FEET

I DO HEARBY 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

Mike McConahey
SIGNATURE OF PERSON CONSTRUCTING THE WELL

6/15/06
DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center – Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

WELL CONSTRUCTION RECORD

North Carolina – Department of Environmental and Natural Resources – Division of Water Quality – Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) MIKE MCCONAHEY CERTIFICATION # 2402

WELL CONTRACTOR COMPANY NAME GEOLOGIC EXPLORATION., INC. PHONE # (704) 872-7686

STATE WELL CONSTRUCTION PERMIT# (if applicable) _____ ASSOCIATED WQ PERMIT# (if applicable) _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultural ☐
Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☒ If Other, list Use Piezometer

2. WELL LOCATION:
Nearest Town: AULANDER County BERTIE
1922 REPUBLICAN ROAD
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☐ Valley ☒ Flat
(check appropriate box)
Latitude/longitude of well location
(degrees/minutes/seconds)
Latitude/longitude source: ☐ GPS ☐ Topographic map
(check box)

3. OWNER: REPUBLIC SERVICES OF NORTH CAROLINA
Address 1220 COMMERCE STREET
(Street or Route No.)
CONOVER NC 28613
City or Town State Zip Code
( )
Area Code – Phone Number

4. DATE DRILLED 05-09-05
5. TOTAL DEPTH: 19.5 FT
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
7. STATIC WATER LEVEL Below Top of Casing: 9.0 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 0.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A
11. DISINFECTION: Type N/A Amount _____
12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	0.0	To 14.5	Ft	2 INCH	SCH 40	PVC
From		To	Ft.			
From		To	Ft.			

13. Grout:

	Depth			Material	Method
From	0.0	To 9.0	Ft.	Portland Bentonite	Slurry
From		To	Ft.		

14. SCREEN:

	Depth			Diameter	Slot Size	Material
From	14.5	To 19.5	Ft.	2 INCH in.	.010 in.	PVC
From		To	Ft.	in.	in.	

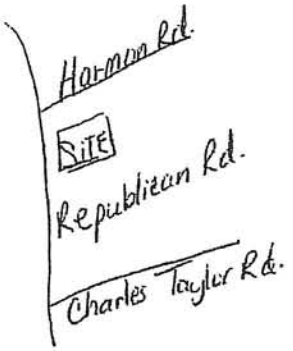
15. SAND/GRAVEL PACK:

	Depth			Size	Material
From	12.5	To 19.5	Ft.	20-40	FINE SILICA SAND
From		To	Ft.		

DRILLING LOG

DEPTH From	To	Formation Description
0.0	1.0	WEEDS & TOPSOIL
1.0	4.0	Tan/ Brown / Red Sandy Silty Clay
4.0	12.0	Tan / White Sandy Silty Clay
12.0	19.5	Tan/Orange Silty Sand

LOCATION SKETCH
Show direction and distance in miles from at least two State Roads or County Roads, inculed the road numbers and common road names.



16. REMARKS: PZ-116 BENTONITE SEAL FROM 9.0 TO 12.5 FEET

I DO HEARBY 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

Mike McConahey 6/15/06
SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center – Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

WELL CONSTRUCTION RECORD

North Carolina – Department of Environmental and Natural Resources – Division of Water Quality – Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) MIKE MCCONAHEY CERTIFICATION # 2402

WELL CONTRACTOR COMPANY NAME GEOLOGIC EXPLORATION., INC. PHONE # (704) 872-7686

STATE WELL CONSTRUCTION PERMIT# (if applicable) _____ ASSOCIATED WQ PERMIT# (if applicable) _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultural ☐
Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☒ If Other, list Use Piezometer

2. WELL LOCATION:
Nearest Town: AULANDER County BERTIE
1922 REPUBLICAN ROAD
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☐ Valley ☒ Flat
(check appropriate box)
Latitude/longitude of well location
_____
(degrees/minutes/seconds)
Latitude/longitude source: ☐ GPS ☐ Topographic map
(check box)

3. OWNER: REPUBLIC SERVICES OF NORTH CAROLINA
Address 1220 COMMERCE STREET
(Street or Route No.)
CONOVER NC 28613
City or Town State Zip Code
( )
Area Code – Phone Number

4. DATE DRILLED 05-10-05
5. TOTAL DEPTH: 24.0 FT
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
7. STATIC WATER LEVEL Below Top of Casing: 9.0 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 0.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A
11. DISINFECTION: Type N/A Amount _____

DEPTH From	To	DRILLING LOG Formation Description
0.0	1.0	WEEDS & TOPSOIL
1.0	4.0	Tan/ Brown / Red Sandy Silty Clay
4.0	12.0	Tan / White Sandy Silty Clay
12.0	24.0	Tan/Orange Silty Sand

12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	0.0	To	14.0 Ft	2 INCH	SCH 40	PVC
From		To	Ft.			
From		To	Ft.			

13. Grout:

	Depth			Material	Method
From	0.0	To	9.0 Ft.	Portland Bentonite	Slurry
From		To	Ft.		

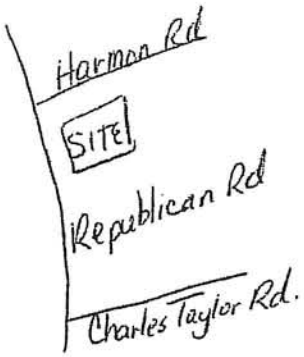
14. SCREEN:

	Depth			Diameter	Slot Size	Material
From	14.0	To	24.0 Ft.	2 INCH in.	.010 in.	PVC
From		To	Ft.	in.	in.	

15. SAND/GRAVEL PACK:

	Depth			Size	Material
From	12.0	To	24.0 Ft.	20-40	FINE SILICA SAND
From		To	Ft.		

LOCATION SKETCH
Show direction and distance in miles from at least two State Roads or County Roads, inculed the road numbers and common road names.



16. REMARKS: PZ-109A BENTONITE SEAL FROM 9.0 TO 12.0 FEET

I DO HEARBY 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

Mike McConahey 6/15/06
SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center – Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

WELL CONSTRUCTION RECORD

North Carolina – Department of Environmental and Natural Resources – Division of Water Quality – Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) MIKE MCCONAHEY CERTIFICATION # 2402

WELL CONTRACTOR COMPANY NAME GEOLOGIC EXPLORATION., INC. PHONE # (704) 872-7686

STATE WELL CONSTRUCTION PERMIT# (if applicable) _____ ASSOCIATED WQ PERMIT# (if applicable) Piezometer

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultural ☐
Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☒ If Other, list Use _____

2. WELL LOCATION:
Nearest Town: AULANDER County BERTIE
1922 REPUBLICAN ROAD
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☐ Valley ☒ Flat
(check appropriate box)
Latitude/longitude of well location
_____
(degrees/minutes/seconds)
Latitude/longitude source: ☐ GPS ☐ Topographic map
(check box)

3. OWNER: REPUBLIC SERVICES OF NORTH CAROLINA
Address 1220 COMMERCE STREET
(Street or Route No.)
CONOVER NC 28613
City or Town State Zip Code
( )
Area Code – Phone Number

4. DATE DRILLED 05-10-05
5. TOTAL DEPTH: 18.0 FT
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
7. STATIC WATER LEVEL Below Top of Casing: 9.0 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 0.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A
11. DISINFECTION: Type N/A Amount _____
12. CASING:

	Depth From	To		Diameter	Wall Thickness or Weight/Ft.	Material
	0.0	13.0	Ft	2 INCH	SCH 40	PVC
			Ft.			
			Ft.			

13. Grout:

	Depth From	To		Material	Method
	0.0	8.0	Ft.	Portland Bentonite	Slurry
			Ft.		

14. SCREEN:

	Depth From	To		Diameter	Slot Size	Material
	13.0	18.0	Ft.	2 INCH in.	.010 in.	PVC
			Ft.	in.	in.	

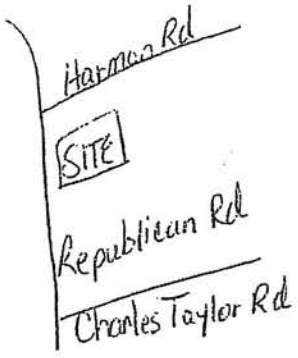
15. SAND/GRAVEL PACK:

	Depth From	To		Size	Material
	11.0	18.0	Ft.	20-40	FINE SILICA SAND
			Ft.		

DEPTH

From	To	DRILLING LOG Formation Description
0.0	1.0	WEEDS & TOPSOIL
1.0	4.0	Tan/ Brown / Red Sandy Silty Clay
4.0	12.0	Tan / White Sandy Silty Clay
12.0	18.0	Tan/Orange Silty Sand
18.0	20.0	GRAY SILTY CLAY

LOCATION SKETCH
Show direction and distance in miles from at least two State Roads or County Roads, inculed the road numbers and common road names.



16. REMARKS: PZ-117A BENTONITE SEAL FROM 8.0 TO 11.0 FEET

I DO HEARBY 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

Mike McConahey
SIGNATURE OF PERSON CONSTRUCTING THE WELL

6/15/06
DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center – Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

WELL CONSTRUCTION RECORD

North Carolina – Department of Environmental and Natural Resources – Division of Water Quality – Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) MIKE MCCONAHEY CERTIFICATION # 2402

WELL CONTRACTOR COMPANY NAME GEOLOGIC EXPLORATION., INC. PHONE # (704) 872-7686

STATE WELL CONSTRUCTION PERMIT# (if applicable) _____ ASSOCIATED WQ PERMIT# (if applicable) _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultural ☐
Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☒ If Other, list Use Piezometer

2. WELL LOCATION:
Nearest Town: AULANDER County BERTIE
1922 REPUBLICAN ROAD
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☐ Valley ☒ Flat
(check appropriate box)
Latitude/longitude of well location
_____
(degrees/minutes/seconds)
Latitude/longitude source: ☐ GPS ☐ Topographic map
(check box)

3. OWNER: REPUBLIC SERVICES OF NORTH CAROLINA
Address 1220 COMMERCE STREET
(Street or Route No.)
CONOVER NC 28613
City or Town State Zip Code
( )
Area Code – Phone Number

4. DATE DRILLED 05-16-05
5. TOTAL DEPTH: 21.0 FT
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
7. STATIC WATER LEVEL Below Top of Casing: 9.0 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 0.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A

DEPTH From	DEPTH To	DRILLING LOG Formation Description
0.0	1.0	WEEDS & TOPSOIL
1.0	4.0	Tan/ Brown / Red Sandy Silty Clay
4.0	12.0	Tan / White Sandy Silty Clay
12.0	21.0	TAN / ORANGE SILTY SAND

11. DISINFECTION: Type N/A Amount _____
12. CASING:

	Depth From	To		Diameter	Wall Thickness or Weight/Ft.	Material
From	0.0	16.0	Ft	2 INCH	SCH 40	PVC
From		To	Ft.			
From		To	Ft.			

13. Grout:

	Depth From	To		Material	Method
From	0.0	11.0	Ft.	Portland Bentonite	Slurry
From		To	Ft.		

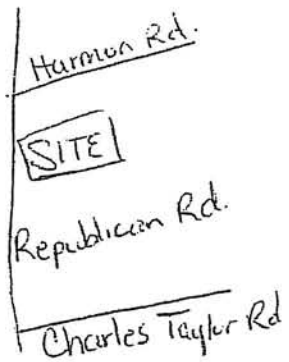
14. SCREEN:

	Depth From	To		Diameter	Slot Size	Material
From	16.0	21.0	Ft.	2 INCH in.	.010 in.	PVC
From		To	Ft.	in.	in.	

15. SAND/GRAVEL PACK:

	Depth From	To		Size	Material
From	14.0	26.0	Ft.	20-40	FINE SILICA SAND
From		To	Ft.		

LOCATION SKETCH
Show direction and distance in miles from at least two State Roads or County Roads. inculed the road numbers and common road names.



16. REMARKS: PZ-114 BENTONITE SEAL FROM 11.0 TO 14.0 FEET

I DO HEARBY 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

Mike McConahey 6/15/06
SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center – Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

WELL CONSTRUCTION RECORD

North Carolina – Department of Environmental and Natural Resources – Division of Water Quality – Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print) MIKE MCCONAHEY CERTIFICATION # 2402

WELL CONTRACTOR COMPANY NAME GEOLOGIC EXPLORATION., INC. PHONE # (704) 872-7686

STATE WELL CONSTRUCTION PERMIT# (if applicable) _____ ASSOCIATED WQ PERMIT# (if applicable) _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultural ☐
Monitoring ☐ Recovery ☐ Heat Pump Water Injection ☐ Other ☒ If Other, list Use Piezometer

2. WELL LOCATION:
Nearest Town: AULANDER County BERTIE
1922 REPUBLICAN ROAD
(Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting
☐ Ridge ☐ Slope ☐ Valley ☒ Flat
(check appropriate box)
Latitude/longitude of well location
_____
(degrees/minutes/seconds)
Latitude/longitude source: ☐ GPS ☐ Topographic map
(check box)

3. OWNER: REPUBLIC SERVICES OF NORTH CAROLINA
Address 1220 COMMERCE STREET
(Street or Route No.)
CONOVER NC 28613
City or Town State Zip Code
( )
Area Code – Phone Number

4. DATE DRILLED 05-15-05
5. TOTAL DEPTH: 50.0 FT
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☒
7. STATIC WATER LEVEL Below Top of Casing: 16.0 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 0.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A
11. DISINFECTION: Type N/A Amount _____
12. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	0.0	To 40.0	Ft	2 INCH	SCH 40	PVC
From		To	Ft.			
From		To	Ft.			

13. Grout:

	Depth			Material	Method
From	0.0	To 35.0	Ft.	Portland Bentonite	Slurry
From		To	Ft.		

14. SCREEN:

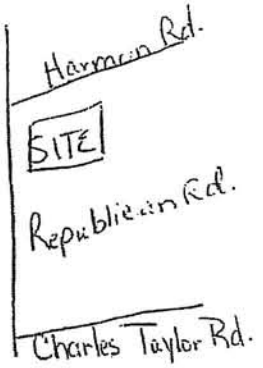
	Depth			Diameter	Slot Size	Material
From	40.0	To 50.0	Ft.	2 INCH in.	.010 in.	PVC
From		To	Ft.	in.	in.	

15. SAND/GRAVEL PACK:

	Depth			Size	Material
From	38.0	To 50.0	Ft.	20-40	FINE SILICA SAND
From		To	Ft.		

DEPTH From	To	DRILLING LOG Formation Description
0.0	1.0	WEEDS & TOPSOIL
1.0	4.0	Tan/ Brown / Red Sandy Silty Clay
4.0	12.0	Tan / White Sandy Silty Clay
12.0	22.0	Tan/Brown/Orange Silty Sand
22.0	38.0	GRAY SILTY CLAY
38.0	50.0	Blue/Gray Clayey Silty Sand

LOCATION SKETCH
Show direction and distance in miles from at least two State Roads or County Roads, inculed the road numbers and common road names.



16. REMARKS: PZ-117B BENTONITE SEAL FROM 35.0 TO 38.0 FEET

I DO HEARBY 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

Mike McConahey
SIGNATURE OF PERSON CONSTRUCTING THE WELL

6/15/06
DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center – Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

BLE INC.

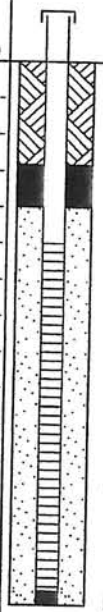
BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. PZ-10

PROJECT: East Carolina Landfill
CLIENT: HHNT
LOCATION: Bertie County, North Carolina
DRILLER: Law Engineering
DRILLING METHOD:
PROJECT NO.: J98-1001-18
START: 9-4-92 END: 9-4-92
ELEVATION: 63.15
LOGGED BY:
DEPTH TO - WATER> INITIAL: ▽ 4.72 AFTER 24 HOURS: ▼ 4.82 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)
60 / 2	Firm, brown, moist, fine, sandy, silty CLAY		6	
60 / 4	Stiff, brown, moist, fine, sandy, clayey SILT		14	
6	Loose, brown and red (mottled), moist to wet, clayey, silty, fine SAND		10	
55 / 8			5	
10				
12	Loose, tan and light gray, wet, silty, fine SAND		5	
50 / 14				
16				
45 / 18	Loose, brown, wet, fine to medium SAND		6	
20				
22				
40 / 24			4	
26	Soft, orange and light gray, moist, fine, sandy, silty CLAY			
35 / 28	Very loose, light tan and brown (mottled), wet, medium to coarse SAND		1	
30	Very soft to soft, dark gray, wet, silty CLAY			
32				
30 / 34			3	
36				
25 / 38			4	

MONITOR WELL INSTALLATION DETAILS



- Neat cement, 0 to 2.8 feet
- Bentonite seal, 2.8 to 4 feet
- Filter pack, sand 4 to 15 feet
- 2-inch diameter, .010-inch slotted Schedule 40 PVC well screen, 5 to 15 feet
- Pipe cap
- Total well depth, 15 feet
- Borehole diameter, 7.5-inches

GEOT_WELL ECLF-18.GPJ 4/10/03

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. PZ-10

PROJECT: East Carolina Landfill
PROJECT NO.: J98-1001-18
CLIENT: HHNT
START: 9-4-92 END: 9-4-92
LOCATION: Bertie County, North Carolina
ELEVATION: 63.15
DRILLER: Law Engineering
LOGGED BY:
DRILLING METHOD:
DEPTH TO - WATER> INITIAL: ▽ 4.72 AFTER 24 HOURS: ▼ 4.82 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT	MONITOR WELL INSTALLATION DETAILS
42 / 20	Loose, gray, wet, clayey, silty, fine SAND		6		
48 / 15	Firm, gray, wet, fine to medium SAND		14		
50 / 10	Boring terminated at 50 feet. Piezometer installed by Law Engineering.				

2 5 10 20 30 40 50 70 90

42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78
20 15 10 5 0 -5 -10 -15

GEOT_WELL ECLF-18.GPJ 4/10/03

PROJECT NAME AND SITE LOCATION

ECLF - Site Hydrogeologic (Eastern Expansion) -

PROJECT NO.	RIG TYPE	DATE	SHEET	BORING NO.
30290-5-4726.43	Mobile B-56 ATV	6/14/96	1 of 1	PZ-41A

DEPTH (FT)	SAMPLE ZONE	SAMPLE TYPE	BLOWS/FOOT	REC(%)	RQD(%)	LITHOLOGY	ELEVATION (FT)	DESCRIPTION	WELL
								Stiff, gray/brown (mottled), moist, very clayey SILT (MH)	
5							54.2	Stiff, gray/brown (mottled), moist, slightly sandy, fine silty CLAY (CL)	
								Stiff, light gray/dark gray (mottled), moist, clayey SILT (ML)	
10							49.2	Very loose to firm, light gray and brown, wet, silty fine SAND (SM)	
15							44.2		

Auger boring terminated at 18.3 feet. Ground water encountered at 7.91 feet at time of boring and at 7.99 feet after 17 hours. Piezometer installed to 18.3 feet on 6/14/96.

Piezometer consists of 2-inch diameter Schedule 40 PVC. The screen is 5-feet long with 0.010-inch slots. The sand filter pack is Morie #2. The bentonite seal is Baroid 0.25-inch chips. The auger boring diameter is 8.25 inches.

Ground Elevation = 59.23 ft.
Piezometer StickUp = 2.10 ft.

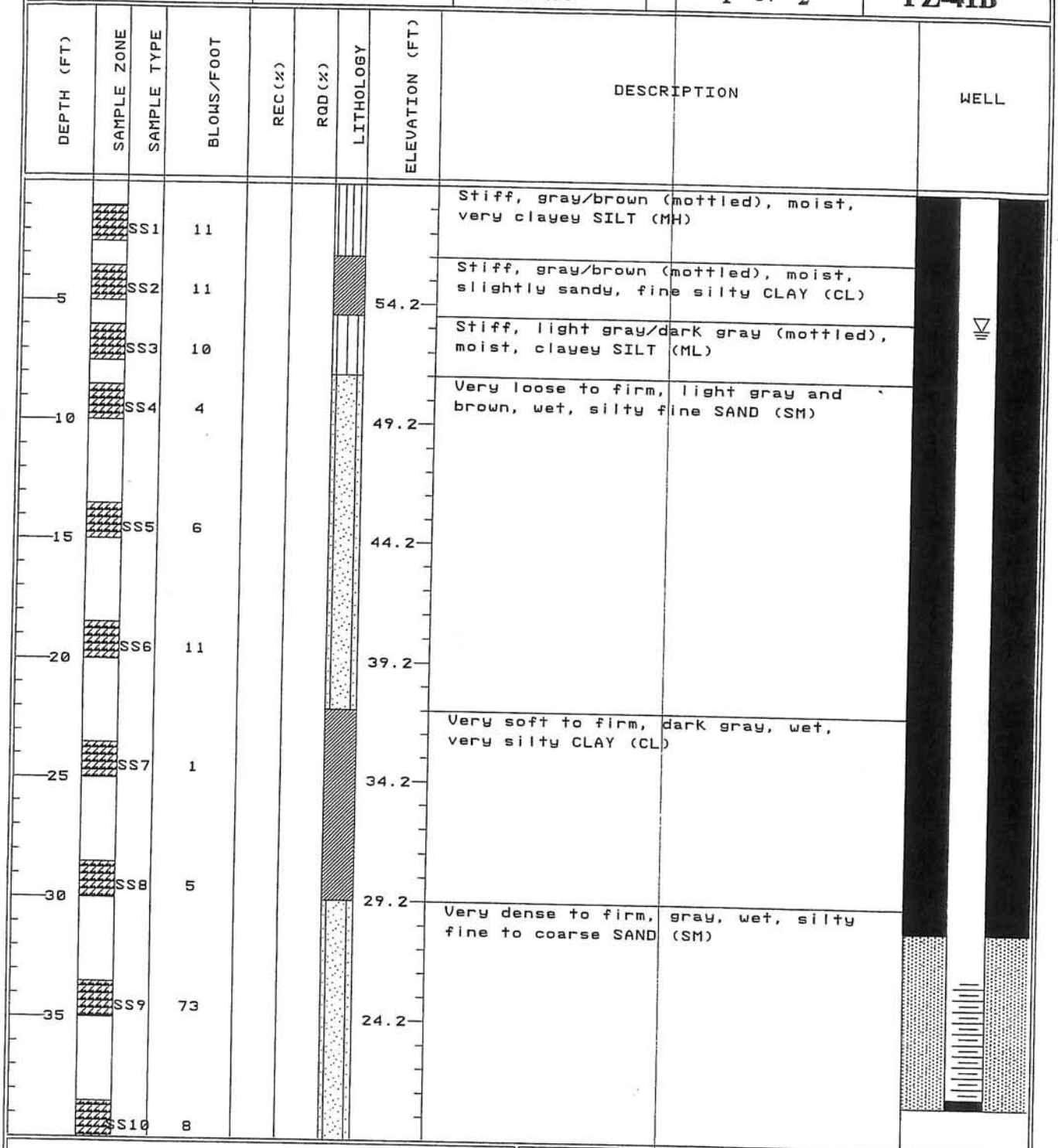
REMARKS:
Water levels measured on 11/22/96.

LAW
ENGINEERING & ENVIRONMENTAL SERVICES
GREENVILLE, SOUTH CAROLINA

PROJECT NAME AND SITE LOCATION

ECLF - Site Hydrogeologic (Eastern Expansion) -

PROJECT NO.	RIG TYPE	DATE	SHEET	BORING NO.
30290-5-4726.43	Mobile B-56 ATV	6/14/96	1 of 2	PZ-41B



REMARKS:

Water levels measured on 11/22/96.

LAW

ENGINEERING & ENVIRONMENTAL SERVICES

GREENVILLE, SOUTH CAROLINA

PROJECT NAME AND SITE LOCATION

ECLF - Site Hydrogeologic (Eastern Expansion) -

PROJECT NO.	RIG TYPE	DATE	SHEET	BORING NO.
30290-5-4726.43	Mobile B-56 ATV	6/14/96	2 of 2	PZ-41B

DEPTH (FT)	SAMPLE ZONE	SAMPLE TYPE	BLOWS/FOOT	REC(%)	RQD(%)	LITHOLOGY	ELEVATION (FT)	DESCRIPTION	WELL
								Boring terminated at 40.0 feet. Ground water encountered at 9.89 feet at time of boring and at 10.25 feet after 17 hours. Sample borehole filled with bentonite. PZ-41B installed on 6/14/96 in auger boring next to sample boring. Piezometer consists of 2-inch diameter Schedule 40 PVC. The screen is 5-feet long with 0.010-inch slots. The sand filter pack is Morie #2. The bentonite seal is Baroid 0.25-inch chips. The auger boring diameter is 8.25 inches. Ground Elevation = 59.19 ft. Piezometer Stickup = 2.30 ft.	

REMARKS:

Water levels measured on 11/22/96.

LAW

ENGINEERING & ENVIRONMENTAL SERVICES

GREENVILLE, SOUTH CAROLINA

PROJECT NAME AND SITE LOCATION

ECLF - Site Hydrogeologic (Eastern Expansion) -

PROJECT NO.	RIG TYPE	DATE	SHEET	BORING NO.
30290-5-4726.43	Mobile B-56 ATV	6/24/96	1 of 2	PZ-56A

DEPTH (FT)	SAMPLE ZONE	SAMPLE TYPE	BLOWS/FOOT	REC (%)	RQD (%)	LITHOLOGY	ELEVATION (FT)	DESCRIPTION	WELL
		SS1	5					Firm, gray/brown (mottled), moist, clayey SILT (ML)	
		SS2	6					Firm, gray/brown (mottled), moist, clayey SILT (MH)	
5							57.3		
		SS3	13					Stiff, gray/brown (mottled), moist clayey SILT (ML)	
		SS4	15						
10							52.3		
		SS5	9					Stiff to soft, brown/gray (layered), wet, clayey, fine sandy SILT (MH)	
15							47.3		
		SS6	4						
20							42.3		
		SS7	1					Very soft, dark gray, wet, very clayey SILT (ML)	
25							37.3		
		SS8	1					Very soft, dark gray, wet, very clayey SILT (MH) with 0.1-inch thick lamelli sand lenses	
30							32.3		
		SS9	1						
35							27.3		
		SS10	2					Very loose, dark gray, wet, silty, clayey, fine to medium SAND (SC)	

REMARKS:

Water levels measured on 11/22/96.

LAW

ENGINEERING & ENVIRONMENTAL SERVICES

GREENVILLE, SOUTH CAROLINA

PROJECT NAME AND SITE LOCATION

ECLF - Site Hydrogeologic (Eastern Expansion) -

PROJECT NO.	RIG TYPE	DATE	SHEET	BORING NO.
30290-5-4726.43	Mobile B-56 ATV	6/24/96	2 of 2	PZ-56A

DEPTH (FT)	SAMPLE ZONE	SAMPLE TYPE	BLOWS/FOOT	REC(%)	RQD(%)	LITHOLOGY	ELEVATION (FT)	DESCRIPTION	WELL
								Very loose, dark gray, wet, silty, clayey, fine to medium SAND (SC)	
								Stiff, dark gray, wet, clayey, fine sandy SILT (ML)	
45		SS11	10				17.3		
								Firm, gray, wet, silty, fine SAND (SM)	
50		SS12	12				12.3	Sample boring terminated at 50.0 feet on 6/24/96. Sample boring backfilled with bentonite 3/8" chips on 6/24/96. PZ-56A installed to 20.2 feet on 6/24/96 in auger boring next to sample boring.	

Piezometer consists of 2-inch diameter Schedule 40 PVC. The screen is 5-feet long with 0.010-inch slots. The sand filter pack is Morie #2. The bentonite seal is Baroid 0.25-inch chips. The auger boring diameter is 8.25 inches.

Ground Elevation = 62.29 ft.
Piezometer Stickup = 2.4 ft.

REMARKS:
Water levels measured on 11/22/96.

LAW
ENGINEERING & ENVIRONMENTAL SERVICES
GREENVILLE, SOUTH CAROLINA

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. PZ-67A

PROJECT: East Carolina Landfill
PROJECT NO.: J98-1001-18
CLIENT: HHNT
DATE START: 6-7-95 END: 6-7-95
LOCATION: Bertie County, North Carolina
ELEVATION: 59.99
DRILLER: Law Engineering, F. Cox
LOGGED BY: REM
DRILLING METHOD: Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ AFTER 24 HOURS: ▼ 5.18 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
55 / 2–6	Soft to very stiff, tan to gray with orange (mottled), silty CLAY (CL) - Layer I		4, 17, 15		Neat cement, 0 to 1 foot Bentonite seal, 1 to 9 feet
50 / 8–10	Firm, tan, wet, fine, sandy SILT (ML) - Layer II		6		
45 / 12–16	Very loose, tan, wet, silty, fine to medium SAND (SM)		4		Filter pack, sand 9 to 25 feet
40 / 18–20	Very soft, tan to brown, wet, clayey, fine, sandy SILT (ML)		2		2-inch diameter, .010-inch slotted Schedule 40 PVC well screen, 11 to 21 feet Pipe cap
35 / 22–24	Very soft, dark gray, wet, silty CLAY (CH) - Layer III		WOH WOH		
30 / 26–38	Boring terminated at 25 feet. Ground water encountered at 5.33 feet on 6/28/95. Piezometer installed to 21.9 feet on 6/7/95. Formerly designated BE-3A.				Total boring depth, 25 feet

GEOT_WELL ECLF-1, J 2/17/00

Revised 2-2-2000

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. PZ-68A

PROJECT: East Carolina Landfill
PROJECT NO.: J98-1001-18
CLIENT: HHNT
DATE START: 6-7-95 END: 6-7-95
LOCATION: Bertie County, North Carolina
ELEVATION: 61.30
DRILLER: Law Engineering, F. Cox
LOGGED BY: REM
DRILLING METHOD: Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ AFTER 24 HOURS: ▼ 5.56 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
60 / 2	Firm, gray with tan (mottled), moist, fine, sandy, silty CLAY (CL) - Layer I		5		Neat cement, 0 to 1 foot
4 / 55 / 6	Firm to loose, gray with tan (mottled), slightly moist, clayey, silty, fine SAND (SM) - Layer II		15		Bentonite seal, 1 to 6 feet
8			10		
10 / 50	Very loose to firm, tan, wet, silty, fine to medium SAND (SM)		3		
12					Filter pack, sand 6 to 25 feet
14 / 45			8		2-inch diameter, .010-inch slotted Schedule 40 PVC well screen, 8 to 18 feet
16					
18					Pipe cap
20 / 40			11		
22	Very soft, dark gray, wet, fine, sandy, very clayey SILT (MH) - Layer III				
24			2		
26 / 35	Boring terminated at 25 feet. Ground water encountered at 4.89 feet on 6/28/95. Piezometer installed to 18.3 feet on 6/7/95. Formerly designated BE-4A.				Total boring depth, 25 feet
28					
30 / 30					
32					
34					
36 / 25					
38					

GEOT_WELL ECLF-1, 2/17/00

Revised 2-2-2000

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. PZ-72

PROJECT: East Carolina Landfill — PROJECT NO.: J98-1001-18
CLIENT: HHNT — DATE START: 5-7-98 END: 5-7-98
LOCATION: Bertie County, North Carolina — ELEVATION: 58.9
DRILLER: SDI, S. Hancock — LOGGED BY: MSP
DRILLING METHOD: Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 14 AFTER 24 HOURS: ▼ 4.00 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)
58 – 0	1-foot of TOPSOIL			
57 – 1	Stiff, brown and gray (mottled), moist, silty CLAY - Layer I			
55 – 5	▽		9	•
			15	•
			14	•
50 – 10	Firm, brown, moist, silty, clayey, fine SAND - Layer II		11	•
45 – 15	▼ Loose, orange, wet, silty, fine SAND		8	•
	Loose, orange and brown, wet, silty, fine to medium SAND		8	•
40 – 20				
35 – 25	Very soft, dark gray, wet, clayey SILT - Layer III			
30 – 30			WOH	WOH •
25 – 35			WOH	WOH •
20 –	Very loose to very dense,		2	•

MONITOR WELL INSTALLATION DETAILS

SURFACE COMPLETION
2.92-foot stick-up

Bentonite seal, 0 to 12 feet

Filter pack, sand 12 to 18 feet

2-inch diameter, .010-inch slotted Schedule 40 PVC well screeen, 13 to 18 feet

Slip cap

Total well depth, 18 feet

Borehole diameter, 8.25-inches

GEOT_WELL ECLF-18.srf 9/22/98

BLB INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. PZ-72

PROJECT: East Carolina Landfill
PROJECT NO.: J98-1001-18
CLIENT: HHNT
DATE START: 5-7-98 END: 5-7-98
LOCATION: Bertie County, North Carolina
ELEVATION: 58.9
DRILLER: SDI, S. Hancock
LOGGED BY: MSP
DRILLING METHOD: Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 14 AFTER 24 HOURS: ▼ 4.00 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
15 / 45	gray, wet, silty, fine SAND - Layer IV		56		
10 / 50	Loose, gray, moist, fine SAND		5		
5 / 55	Very stiff, olive, moist, silty CLAY with wood fragments		44		
0 / 60	Dense, olive, wet, fine SAND		37		
-5 / 65	3-inch wash drill boring to 60 feet, grouted to surface. Ground water encountered at 14 feet at time of boring.				
-10 / 70					
-15 / 75					
-20					

GEOT_WELL ECLF-1b... J 9/22/98

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. PZ-73

PROJECT: East Carolina Landfill | PROJECT NO.: J98-1001-18
CLIENT: HHNT | DATE START: 5-7-98 END: 5-7-98
LOCATION: Bertie County, North Carolina | ELEVATION: 59
DRILLER: SDI, S. Hancock | LOGGED BY: MSP
DRILLING METHOD: Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 14 AFTER 24 HOURS: ▼ 4.21 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)
59 – 0	1-foot of TOPSOIL			
55 – 5	Firm to stiff, gray and brown (mottled), moist, silty CLAY - Layer I		5	5
				14
50 – 10	Stiff, gray and brown (mottled), moist, clayey SILT			10
45 – 15	Firm, brown, wet, slightly clayey, fine, sandy SILT - Layer II			6
40 – 20	Loose to very loose, brown, wet, silty, fine SAND			8
35 – 25				4
30 – 30	Very soft, dark gray, wet, very silty CLAY - Layer III			WOH
				WOH
25 – 35				WOH
				WOH
20	Very soft, dark gray, wet, very clayey SILT			2

MONITOR WELL INSTALLATION DETAILS

SURFACE COMPLETION
2.52-foot stick-up

Bentonite seal, 0 to 13 feet

Filter pack, sand 13 to 19 feet

2-inch diameter, .010-inch slotted Schedule 40 PVC well screen, 14 to 19 feet
Slip cap
Total well depth, 19 feet

Borehole diameter, 8.25-inches

GEOT_WELL ECLF-16.srJ 9/22/98

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. PZ-73

PROJECT: East Carolina Landfill | PROJECT NO.: J98-1001-18
CLIENT: HHNT | DATE START: 5-7-98 END: 5-7-98
LOCATION: Bertie County, North Carolina | ELEVATION: 59
DRILLER: SDI, S. Hancock | LOGGED BY: MSP
DRILLING METHOD: Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 14 AFTER 24 HOURS: ▼ 4.21 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
15 / 45	Loose to very dense, gray, moist, silty, fine to medium SAND - Layer IV		8		
10 / 50			56		
5 / 55	Very loose, dark gray, wet, silty, fine SAND		4		
0 / 60	Very stiff, dark gray, moist, clayey, fine to medium, sandy SILT with shell fragments - Layer V		21		
-5 / 65	3-inch wash drill boring to 60-feet, grouted to surface. Ground water encountered at 14 feet at time of boring.				
-10 / 70					
-15 / 75					
-20					

GEOT_WELL ECLF-1b... 9/22/98

BLE INC.

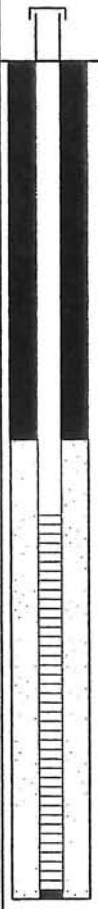
BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. PZ-88A

PROJECT: East Carolina Regional MSW Landfill — PROJECT NO.: J04-1001-46
CLIENT: HHNT/Republic — START: 6-25-04 END: 6-29-04
LOCATION: Bertie County, North Carolina — ELEVATION: 58.74
DRILLER: Terracon, R. Jordan and BLE, K. Thomas — LOGGED BY: M. Preddy
DRILLING METHOD: CME 550 ATV wash drilling and CME 750 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 18.50 AFTER 24 HOURS: ▽ 5.80 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)
55 / 2	Stiff, gray and brown, slightly moist, fine sandy, silty CLAY - Layer I			10
55 / 4				14
6	Stiff, light gray, silty CLAY			14
50 / 8				14
50 / 10				
12				
45 / 14	Loose, reddish-brown and yellowish-brown, moist, slightly clayey, silty, fine SAND - Layer II			10
16				
18 ▽	Stiff, yellowish-brown, wet, clayey, fine sandy SILT			
40 / 20				11
22	Soft, dark gray, very moist, very silty CLAY - Layer III			
35 / 24				3
26	3-inch wash drill with SPT to 25 feet; borehole grouted to surface. 8-1/4 inch auger boring for PZ-88A on 6-29-04 by BLE. Ground water encountered at 18.5 feet at time of drilling and at 5.80 after 24 hours.			
28				
30				
30				
32				
25 / 34				
36				
38				
20				

MONITOR WELL INSTALLATION DETAILS



SURFACE COMPLETION
2.97-foot stick-up

Bentonite seal, 0 to 10 feet

Filter pack, sand 10 to 22.26 feet

2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 12.01 to 22.01 feet

Pipe cap

Total well depth, 22.26 feet

OLD GEOT WELL 10v. ...3PJ 5/26/05

BLE INC.

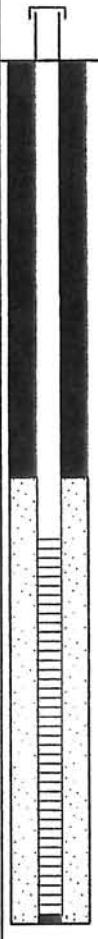
BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. PZ-95A

PROJECT: East Carolina Regional MSW Landfill — PROJECT NO.: J04-1001-46
CLIENT: HHNT/Republic — START: 6-28-04 END: 7-8-04
LOCATION: Bertie County, North Carolina — ELEVATION: 58.77
DRILLER: Terracon, R. Jordan and BLE, K. Thomas — LOGGED BY: M. Preddy
DRILLING METHOD: CME 550 ATV wash drilling and CME 750 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: 8.50 AFTER 24 HOURS: 5.87 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)
55 / 2	Stiff, gray and reddish-brown (mottled), slightly moist, silty CLAY - Layer I			10
55 / 4	Stiff, gray and reddish-brown, moist, silty CLAY			10
50 / 8	Loose, yellowish-brown, moist, slightly clayey, silty, fine SAND - Layer II			12
50 / 10				10
45 / 14				7
40 / 18	Firm, yellowish-brown, wet, silty, fine to medium SAND			13
35 / 22	Very soft, dark gray, very moist, very silty CLAY - Layer III			2
30 / 26	3-inch wash drill with SPT to 25 feet; grouted to surface. 8-1/4 inch auger boring for PZ-95A on 7-8-04 by BLE. Ground water encountered at 8.5 feet at time of drilling and at 5.87 feet after 24 hours.			
25 / 34				
20 / 38				

MONITOR WELL INSTALLATION DETAILS



SURFACE COMPLETION
3.47-foot stick-up

Bentonite seal, 0 to 11.1 feet

Filter pack, sand 11.1 to 23.0 feet

2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 12.75 to 22.75 feet

Pipe cap

Total well depth, 23.00 feet

OLD GEOT_WELL 100[illegible].GPJ 5/26/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. PZ-97A

PROJECT: East Carolina Regional MSW Landfill — PROJECT NO.: J04-1001-46
CLIENT: HHNT/Republic — START: 6-28-04 END: 7-9-04
LOCATION: Bertie County, North Carolina — ELEVATION: 59.29
DRILLER: Terracon, R. Jordan and BLE, K. Thomas — LOGGED BY: M. Preddy
DRILLING METHOD: CME 550 ATV wash drilling and CME 750 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 13.50 AFTER 24 HOURS: ▼ 6.17 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
55 / 2	Very stiff, gray and reddish-brown (mottled), moist, silty CLAY - Layer I			16	SURFACE COMPLETION 3.45-foot stick-up
55 / 4				18	
55 / 6	Stiff, light gray, moist, fine sandy, silty CLAY			9	Bentonite seal, 0 to 11.1 feet
50 / 8					
50 / 10	Firm to loose, light yellowish-brown and light gray, moist, slightly clayey, silty, fine SAND - Layer II			11	
50 / 12					Filter pack, sand 11.1 to 23 feet
45 / 14				7	
45 / 16					
45 / 18					2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 12.75 to 22.75 feet
40 / 20				9	
40 / 22	Very soft, dark gray, very moist, very silty CLAY - Layer III				
35 / 24				WOH WOH	Pipe cap
35 / 26	3-inch wash drill with SPT to 25 feet; grouted to surface. 8-1/4 inch auger boring for PZ-97A on 7-9-04 by BLE. Ground water encountered at 13.5 feet at time of drilling and at 6.17 feet after 24 hours.				Total well depth, 23.00 feet
35 / 28					
30 / 30					
30 / 32					
25 / 34					
25 / 36					
25 / 38					
20					

OLD GEOT_WELL 10... .GPJ 5/26/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. PZ-106A

PROJECT: East Carolina Regional MSW Landfill | PROJECT NO.: J04-1001-46

CLIENT: HHNT/Republic | START: 7-1-04 END: 7-13-04

LOCATION: Bertie County, North Carolina | ELEVATION: 59.85

DRILLER: Terracon, R. Jordan and BLE, K. Thomas | LOGGED BY: M. Preddy

DRILLING METHOD: CME 550 ATV wash drilling and CME 750 ATV Hollow stem auger

DEPTH TO - WATER> INITIAL: ▽ 13.50 AFTER 24 HOURS: ▼ 7.08 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
55 / 2	Very stiff, gray and reddish-brown (mottled), moist, fine sandy, silty CLAY - Layer I			18	SURFACE COMPLETION 3.16-foot stick-up
4				19	
55 / 6	Stiff, light gray, slightly moist, clayey, fine sandy SILT - Layer II			10	Bentonite seal, 0 to 10.8 feet
8					
50 / 10				11	
12	Loose, light gray, wet, silty, fine SAND				Filter pack, sand 10.8 to 23.62 feet
45 / 14				10	
16					
18	Firm, yellowish-brown, wet, silty, fine to medium SAND				2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 13.37 to 23.37 feet
40 / 20				15	
22	Firm, orange, very moist, very silty CLAY - Layer III				
24				8	Pipe cap
35					Total well depth, 23.62 feet
26	3-inch wash drill with SPT to 25 feet, grouted to surface. 8-1/4 inch auger boring for PZ-106A on 7-13-04 by BLE. Ground water encountered at 13.5 feet at time of drilling and at 7.08 feet after 24 hours.				
28					
30 / 30					
32					
34					
25 / 36					
38					

OLD GEOT_WELL 10c .PJ 5/26/05

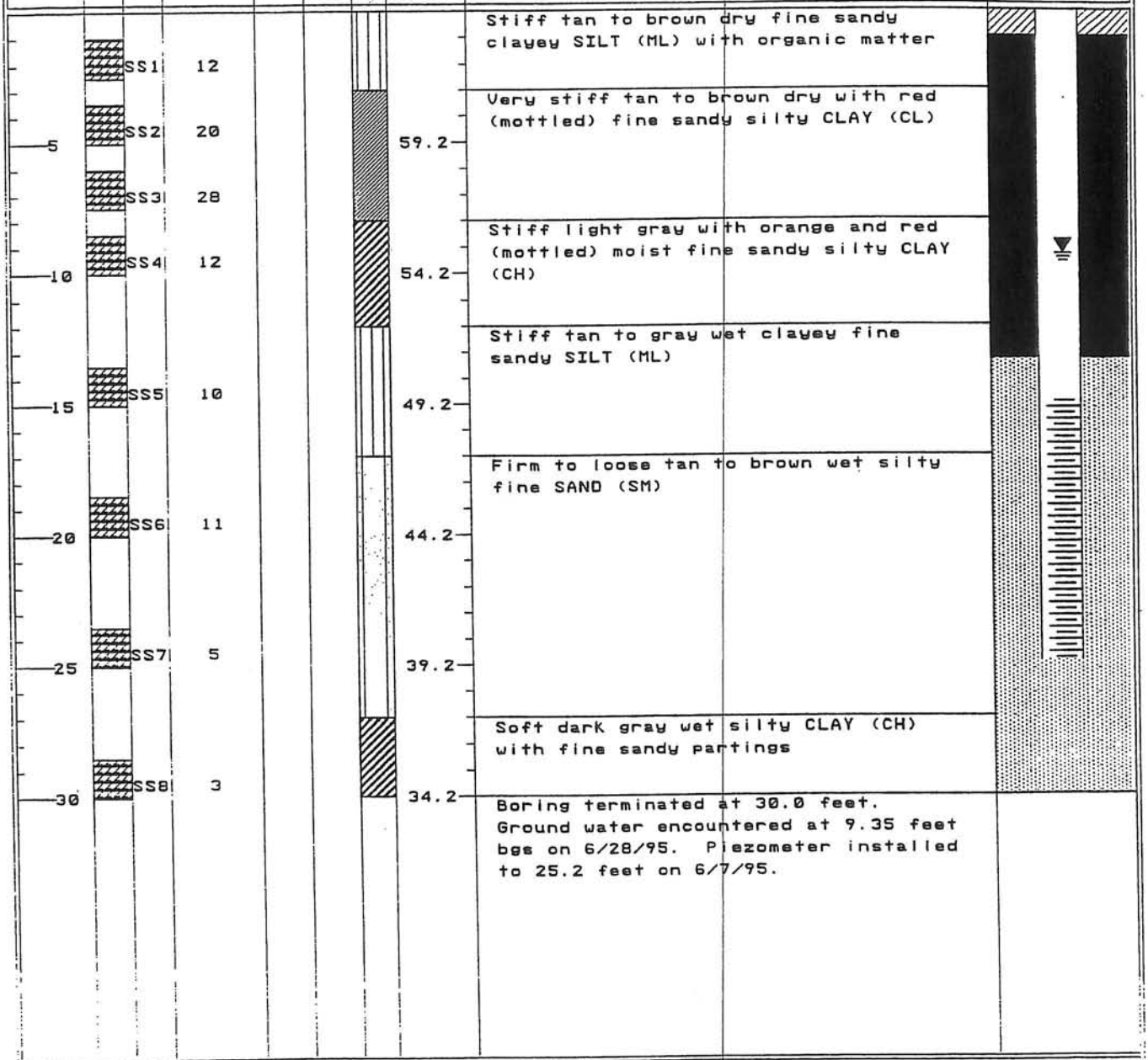
PROJECT NAME AND SITE LOCATION

ECLF - Design Hdyro. (Cells 7-9) -

PROJECT NO.	RIG TYPE	DATE	SHEET	BORING NO.
30290-5-4726.36	MOBILE B-45 ATV	6/7/95	1 of 1	C8.7A

DEPTH (FT)	SAMPLE ZONE	SAMPLE TYPE	BLOWS/FOOT	REC(%)	RQD(%)	LITHOLOGY	ELEVATION (FT)	DESCRIPTION
		SS1	12					Stiff tan to brown dry fine sandy clayey SILT (ML) with organic matter
5		SS2	20				59.2	Very stiff tan to brown dry with red (mottled) fine sandy silty CLAY (CL)
		SS3	28					
10		SS4	12				54.2	Stiff light gray with orange and red (mottled) moist fine sandy silty CLAY (CH)
								Stiff tan to gray wet clayey fine sandy SILT (ML)
15		SS5	10				49.2	
								Firm to loose tan to brown wet silty fine SAND (SM)
20		SS6	11				44.2	
25		SS7	5				39.2	
								Soft dark gray wet silty CLAY (CH) with fine sandy partings
30		SS8	3				34.2	Boring terminated at 30.0 feet. Ground water encountered at 9.35 feet bgs on 6/28/95. Piezometer installed to 25.2 feet on 6/7/95.

WELL



LAW
ENGINEERING & ENVIRONMENTAL SERVICES
GREENVILLE, SOUTH CAROLINA

PROJECT NAME AND SITE LOCATION

ECLF - Design Hdyro. (Cells 7-9) -

PROJECT NO.	RIG TYPE	DATE	SHEET	BORING NO.
30290-5-4726.36	ATV	6/7/95	1 of 1	**BE-5A**

DEPTH (FT)	SAMPLE ZONE	SAMPLE TYPE	BLOWS/FOOT	REC(%)	RQD(%)	LITHOLOGY	ELEVATION (FT)	DESCRIPTION	WELL
		SS1	7					Firm gray to tan (mottled) slightly moist fine sandy silty CLAY (CL)	
5		SS2	6				56.9		
		SS3	12					Stiff gray to tan moist silty CLAY (CH)	
10		SS4	12				51.9		
								Very soft tan to gray wet fine sandy silty CLAY (CL)	
15		SS5	2				46.9		
								Loose tan to red wet silty fine SAND (SM)	
20		SS6	7				41.9		
								Very loose tan to brown wet fine to coarse SAND (SP)	
25		SS7	2				36.9		
								Very soft orange wet fine sandy silty CLAY (CH) with laminae of a light gray wet silty clay	
30		SS8	2				31.9	Boring terminated at 30.0 feet. Ground water encountered at 7.85 feet bgs on 6/28/95. Piezometer installed to 28.3 feet on 6/7/95.	

LAW
ENGINEERING & ENVIRONMENTAL SERVICES
GREENVILLE, SOUTH CAROLINA

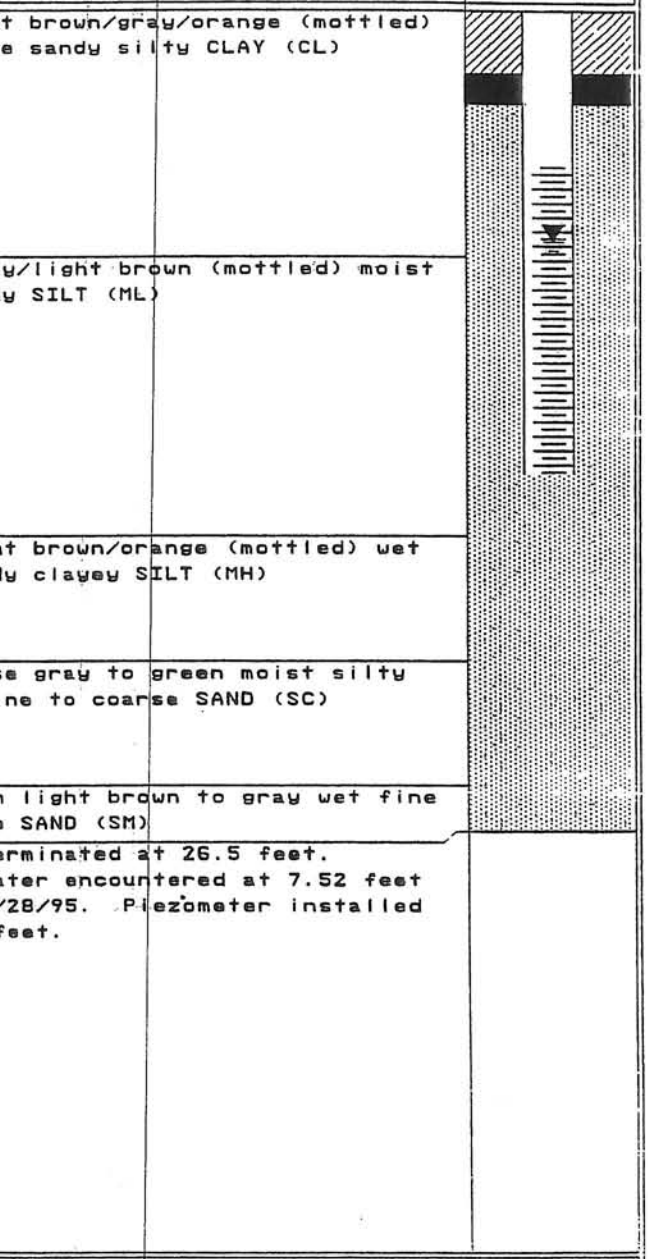
PROJECT NAME AND SITE LOCATION

ECLF - Design Hdyro. (Cells 7-9) -

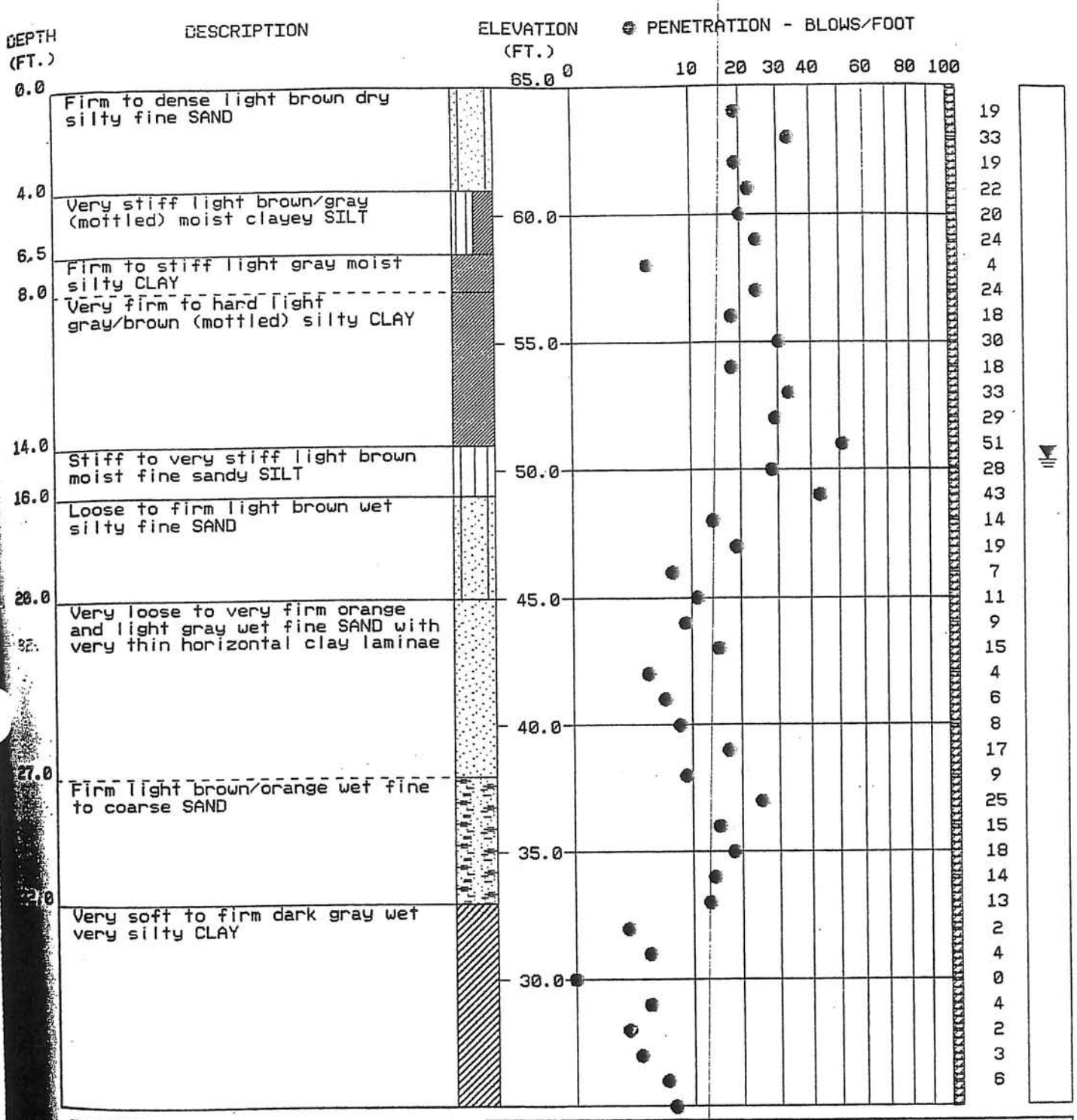
PROJECT NO.	RIG TYPE	DATE	SHEET	BORING NO.
30290-5-4726.36	MOBILE B-45 ATV	6/2/95	1 of 1	**BE-6A**

DEPTH (FT)	SAMPLE ZONE	SAMPLE TYPE	BLOWS/FOOT	REC(%)	RQD(%)	LITHOLOGY	ELEVATION (FT)	DESCRIPTION
		SS1	8					Firm light brown/gray/orange (mottled) moist fine sandy silty CLAY (CL)
5		SS2	17				56.6	
		SS3	15					
		SS4	10					Stiff gray/light brown (mottled) moist fine sandy SILT (ML)
10							51.6	
		SS5	9					
15							46.6	
								Soft light brown/orange (mottled) wet fine sandy clayey SILT (MH)
20		SS6	3				41.6	
		SS7	WOH					Very loose gray to green moist silty clayey fine to coarse SAND (SC)
25							36.6	
		SS8	22					Very firm light brown to gray wet fine to coarse SAND (SM)
								Boring terminated at 26.5 feet. Ground water encountered at 7.52 feet bgs on 6/28/95. Piezometer installed to 15.3 feet.

WELL



LAW
ENGINEERING & ENVIRONMENTAL SERVICES
GREENVILLE, SOUTH CAROLINA



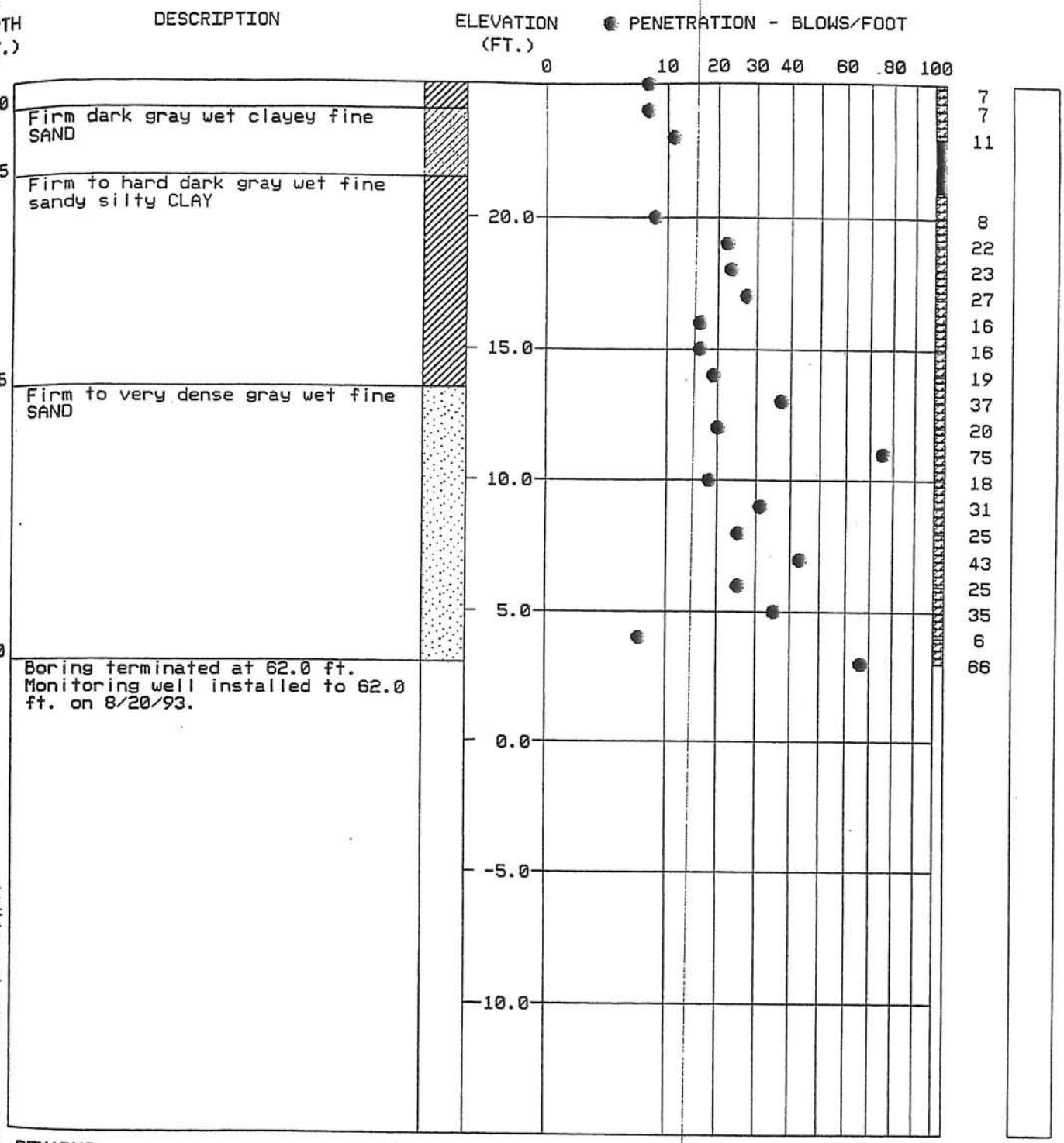
REMARKS:
UD sample analyzed for porosity.

TEST BORING RECORD

BORING NUMBER	GW-1
DATE DRILLED	August 19, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 1 OF 2	

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

LAW ENGINEERING



REMARKS:

UD sample analyzed for porosity.

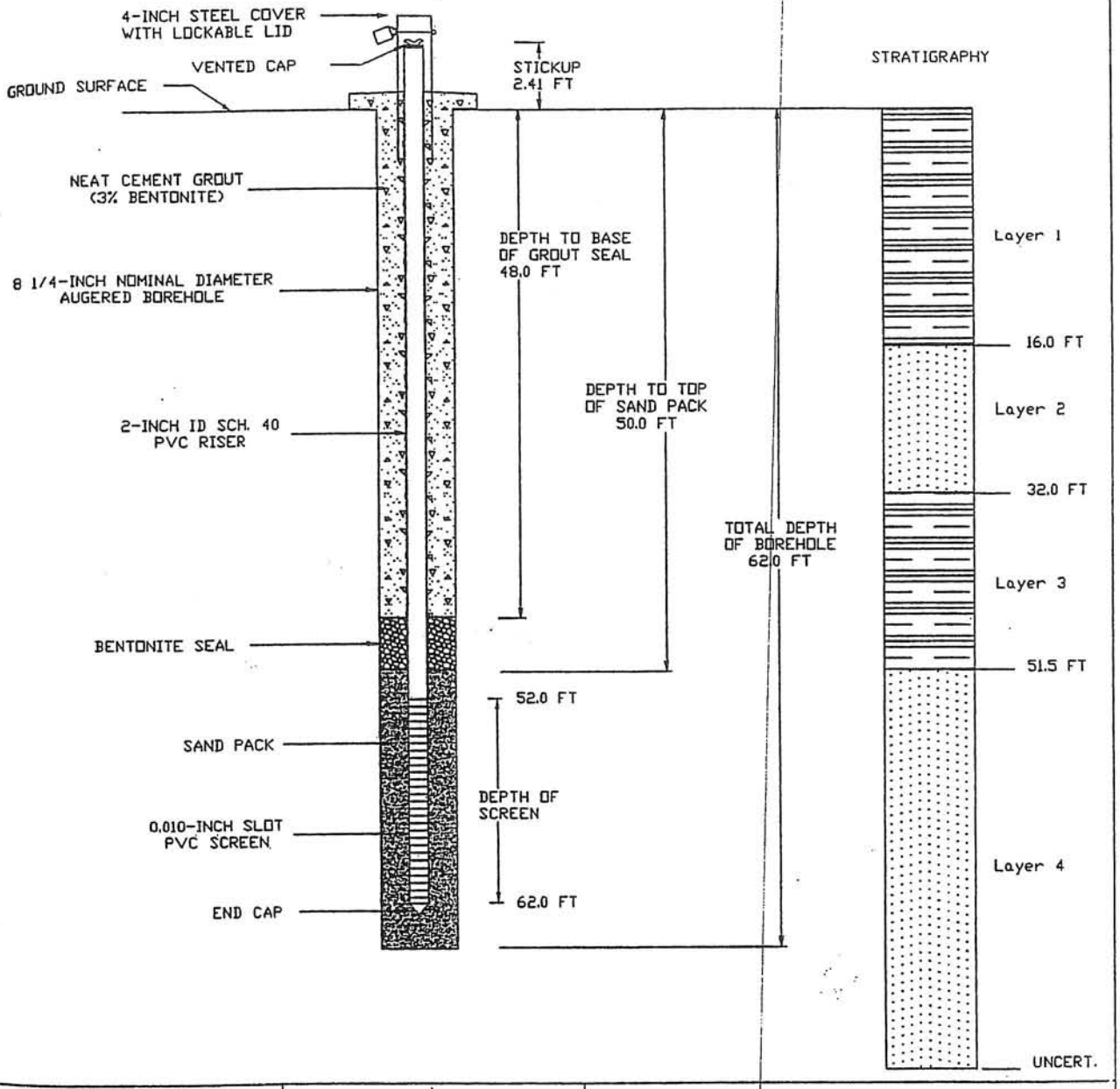
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GW-1
DATE DRILLED	August 19, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 2 OF 2	

LAW ENGINEERING

MONITORING WELL GW-1
CONSTRUCTION DIAGRAM



INSTALLATION DATE: 8/20/93

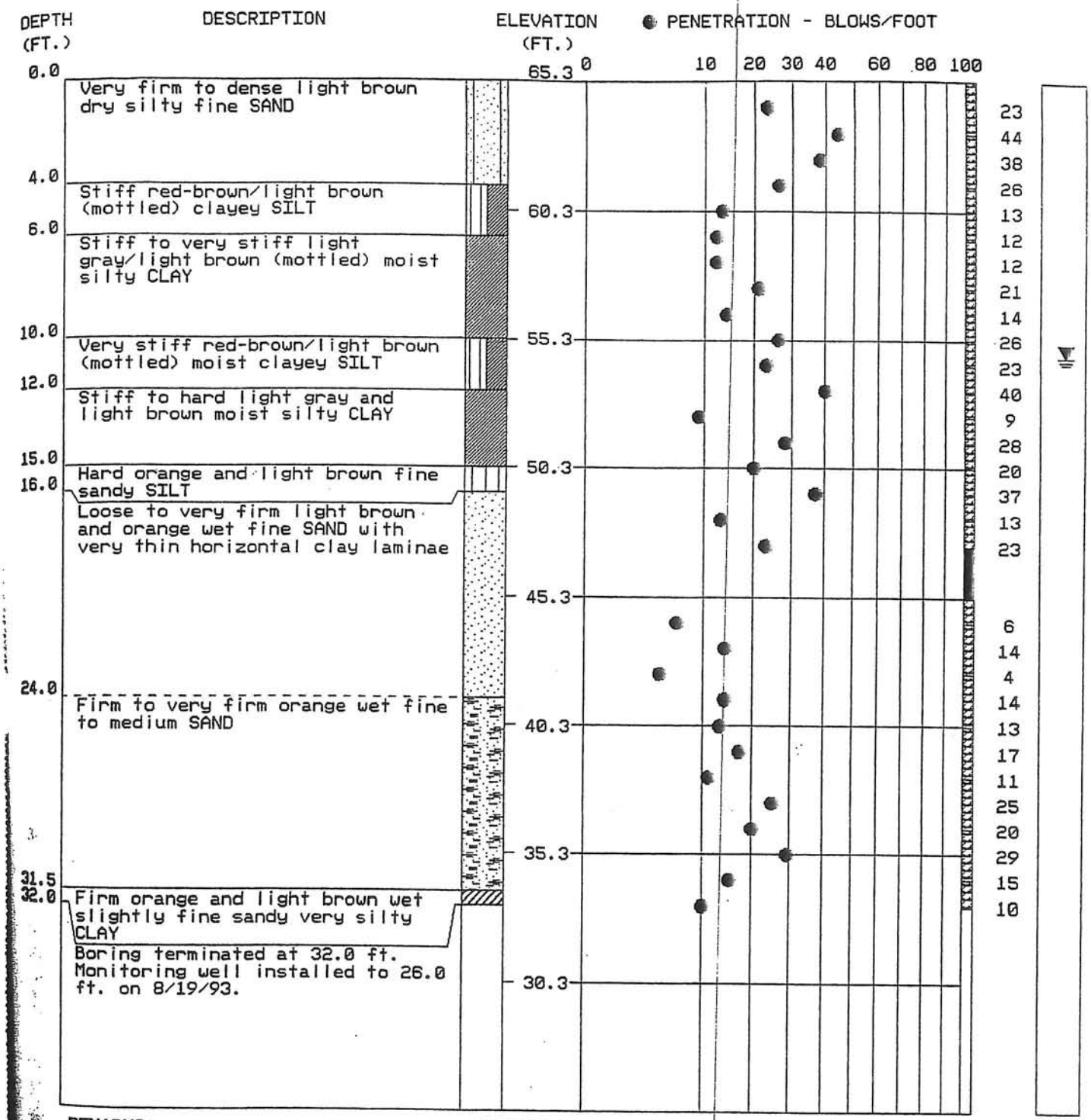
GROUND SURFACE EV. 64.96 FT MSL
MEASURING POINT EV. 67.37 FT MSL
SITE NORTHING: 13454.24 FT
SITE EASTING: 5518.52 FT

NOT TO SCALE

LAW ENGINEERING
GREENVILLE, SOUTH CAROLINA

GW-1 CONSTRUCTION DIAGRAM
EASTERN CAROLINA LANDFILL
BERTIE COUNTY, NORTH CAROLINA

JOB NO:2490472612



REMARKS:

UD sample analyzed for porosity.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GW-2
DATE DRILLED	August 19, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
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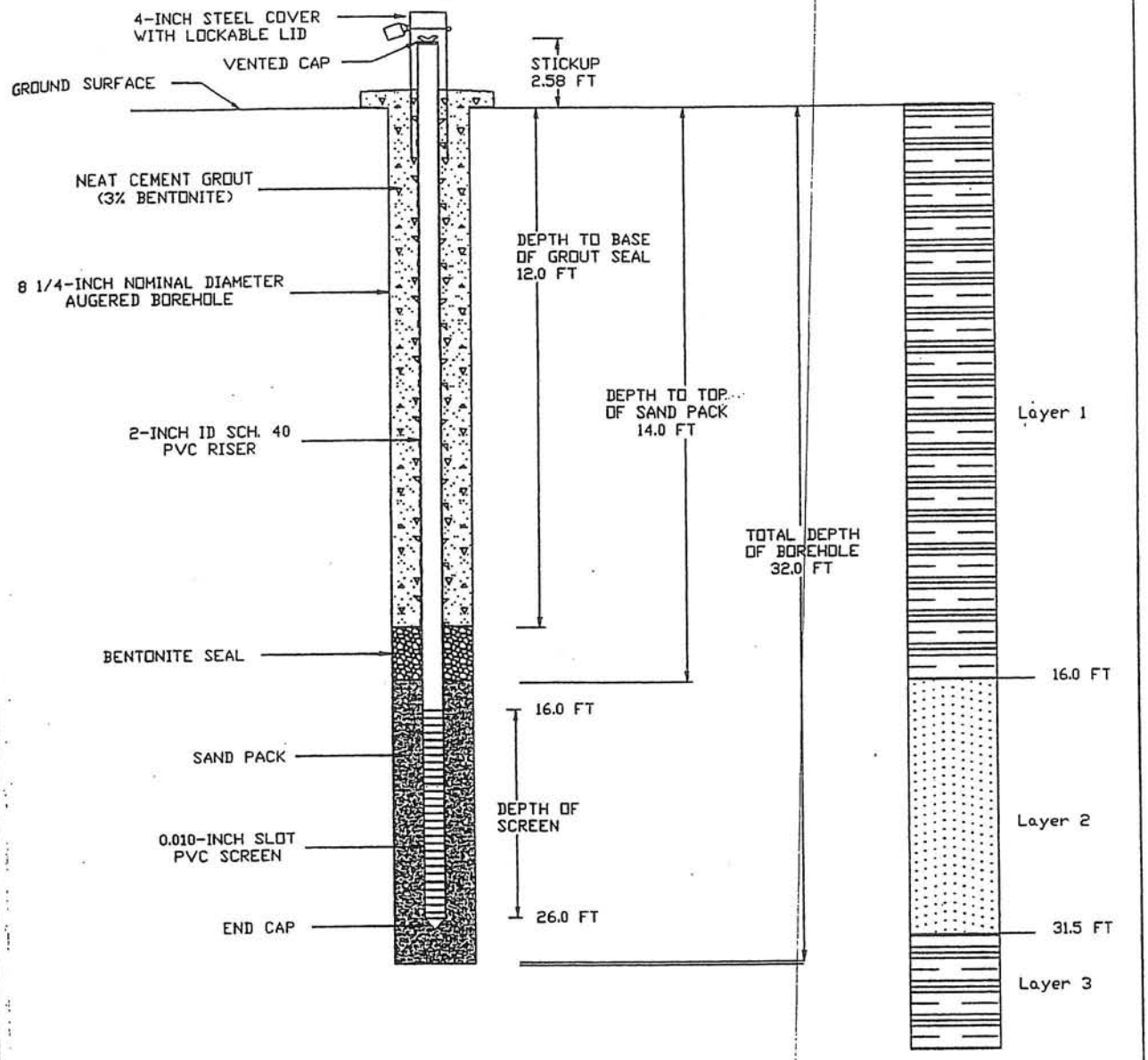
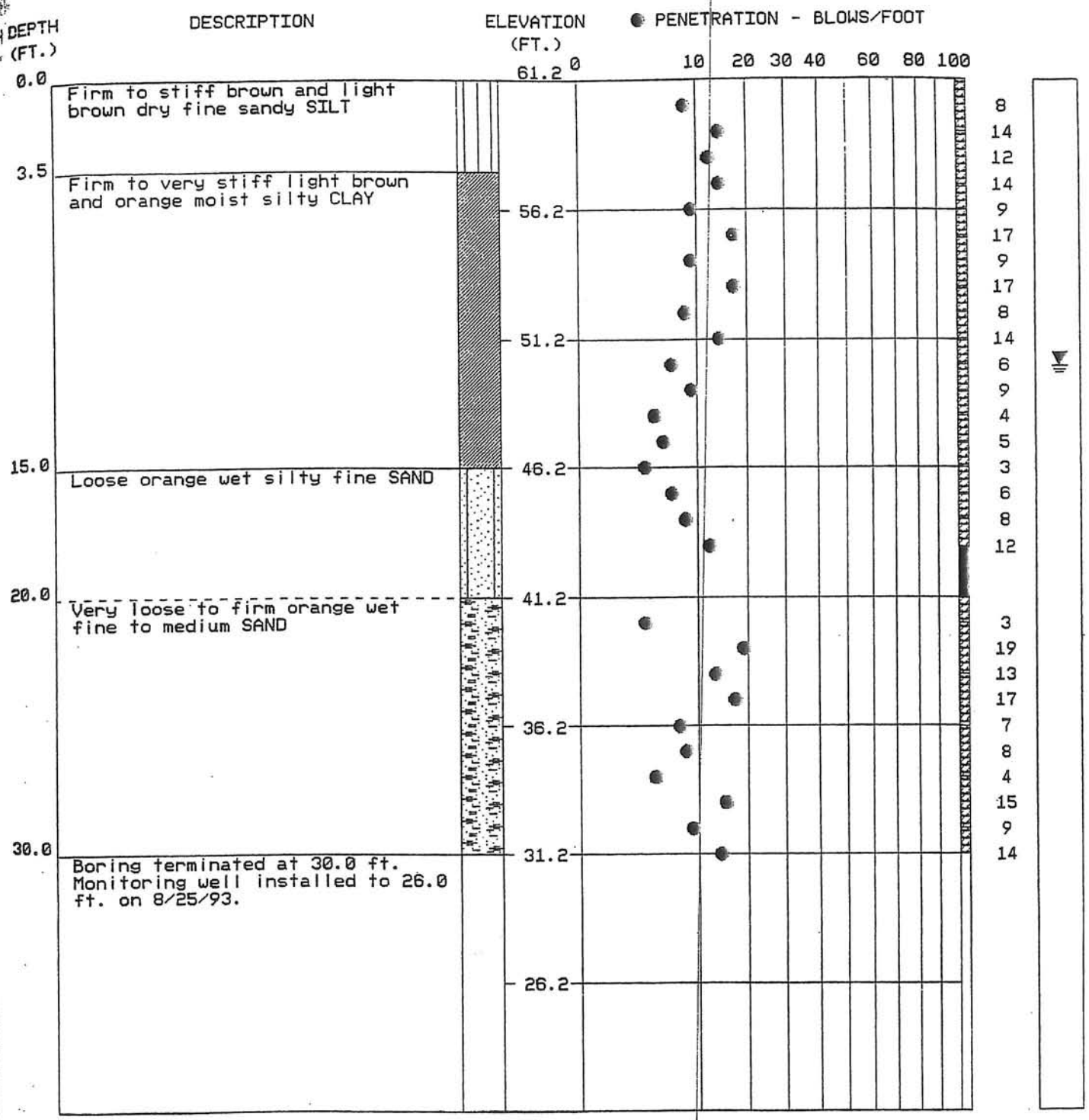
LAW ENGINEERING

MONITORING WELL GW-2
CONSTRUCTION DIAGRAM



INSTALLATION DATE: 8/19/93 GROUND SURFACE EV. 65.29 FT MSL MEASURING POINT EV. 67.87 FT MSL SITE NORTHING: 13457.23 FT SITE EASTING: 5544.03 FT NOT TO SCALE	LAW ENGINEERING GREENVILLE, SOUTH CAROLINA	GW-2 CONSTRUCTION DIAGRAM EASTERN CAROLINA LANDFILL BERTIE COUNTY, NORTH CAROLINA JOB NO:2490472612



REMARKS:
UD sample analyzed for porosity.

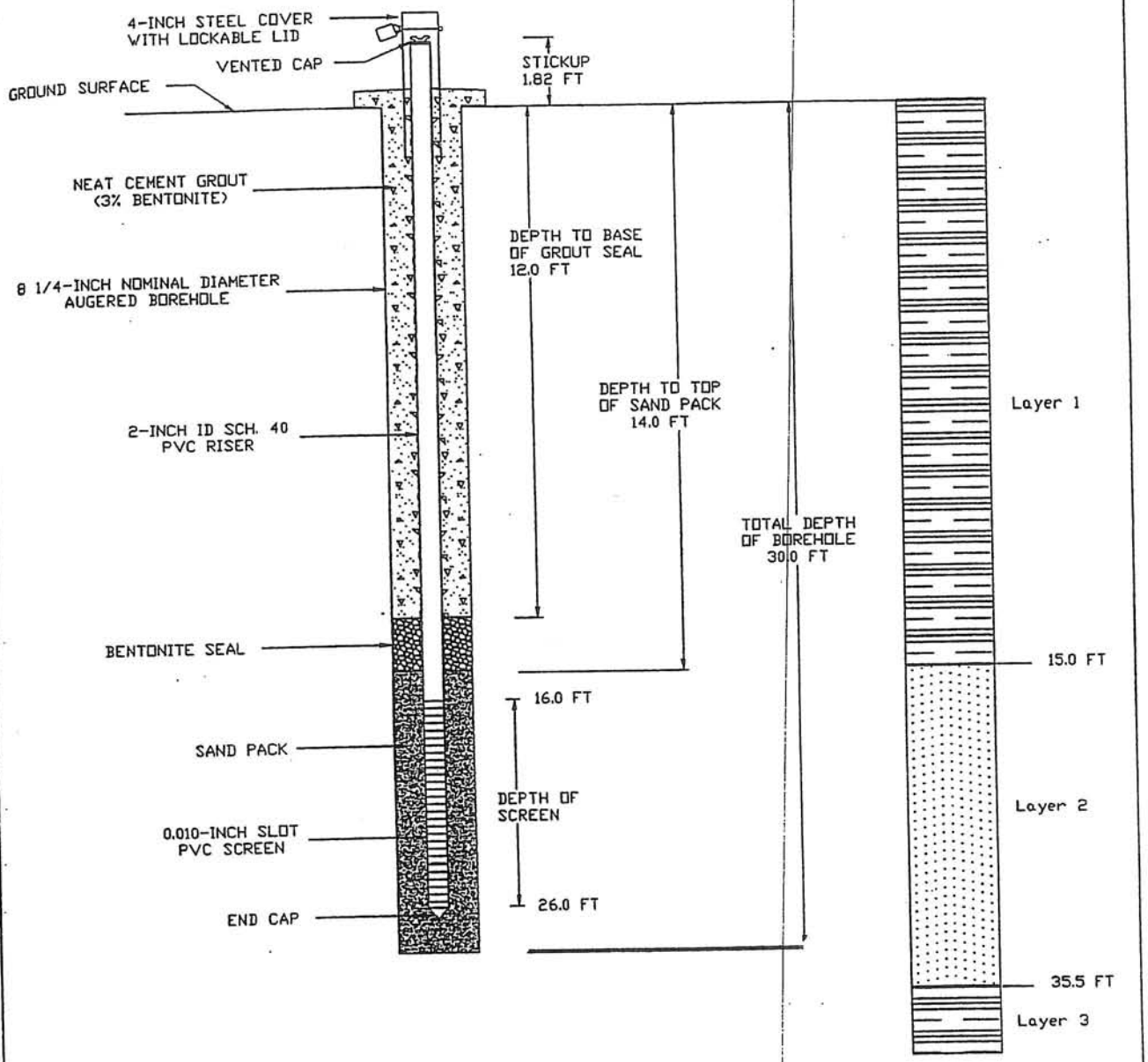
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GW-3
DATE DRILLED	August 25, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 1 OF 1	

LAW ENGINEERING

MONITORING WELL GW-3
CONSTRUCTION DIAGRAM



INSTALLATION DATE: 8/25/93

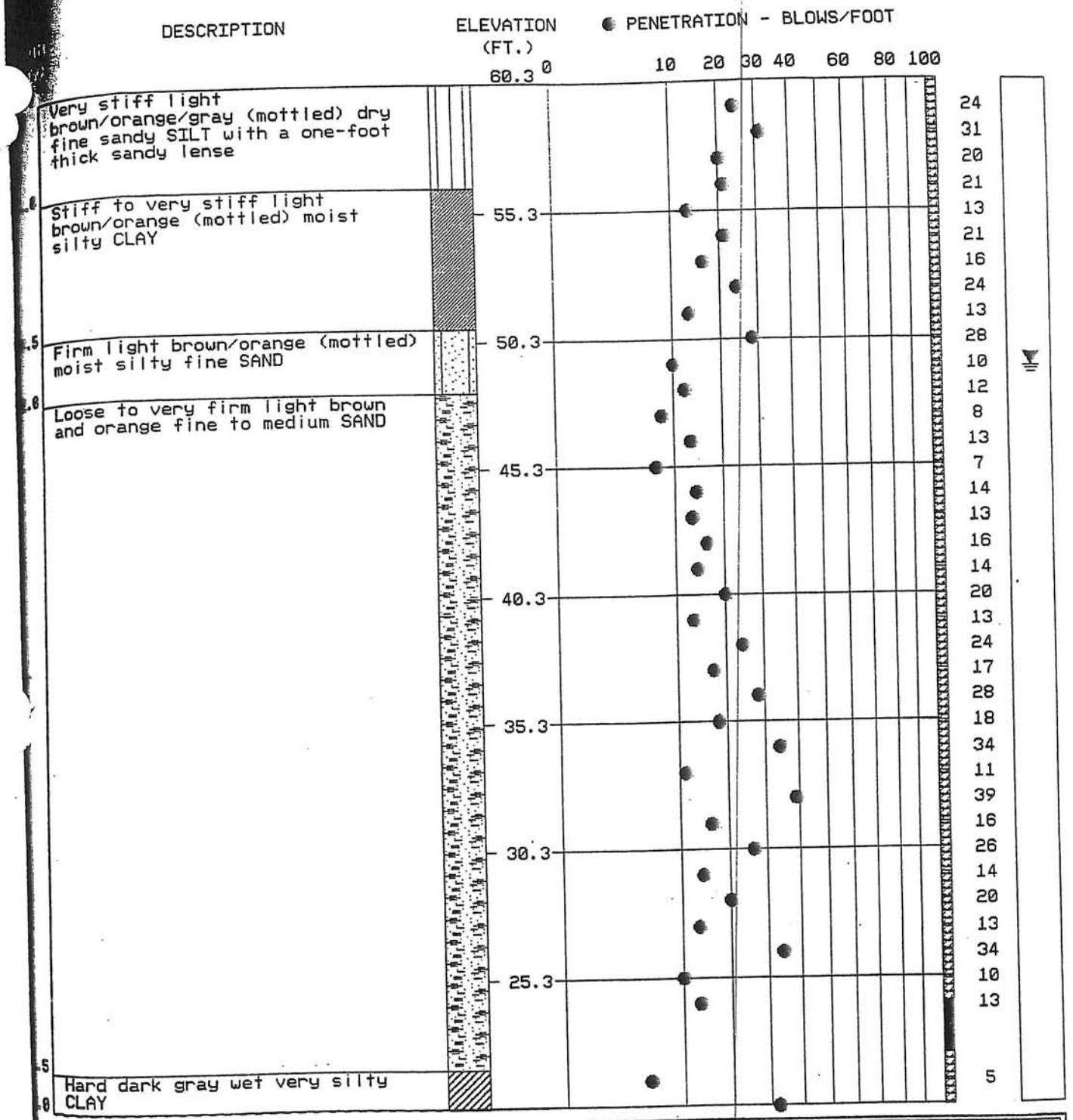
GROUND SURFACE EV. 61.19 FT MSL
MEASURING POINT EV. 63.01 FT MSL
SITE NORTHING: 11356.88 FT
SITE EASTING: 7340.78 FT

NOT TO SCALE

LAW ENGINEERING
GREENVILLE, SOUTH CAROLINA

GW-3 CONSTRUCTION DIAGRAM
EASTERN CAROLINA LANDFILL
BERTIE COUNTY, NORTH CAROLINA

JOB NO:2490472612



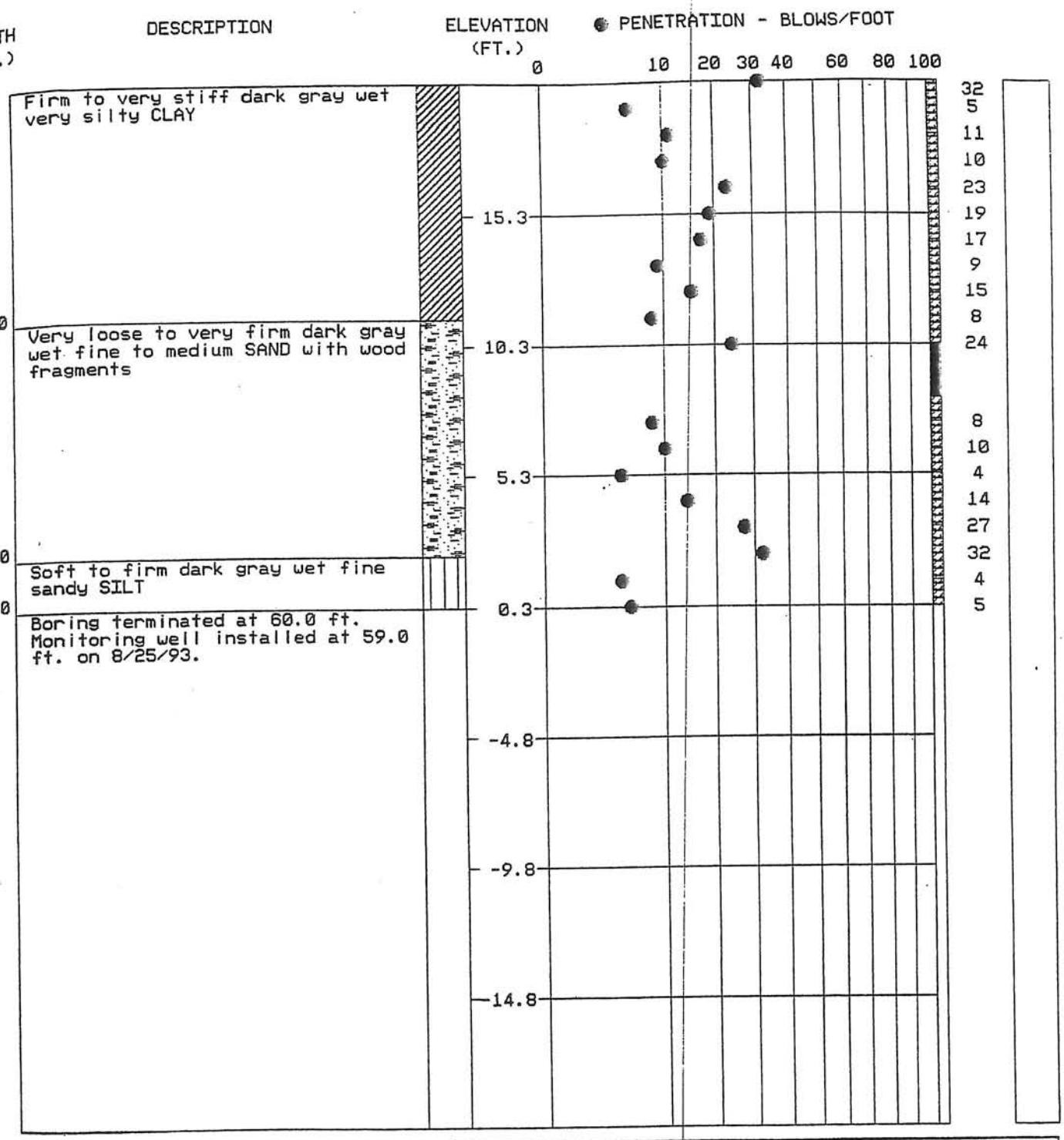
REMARKS:
UD sample analyzed for porosity.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GW-4
DATE DRILLED	August 24, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 1 OF 2	

LAW ENGINEERING



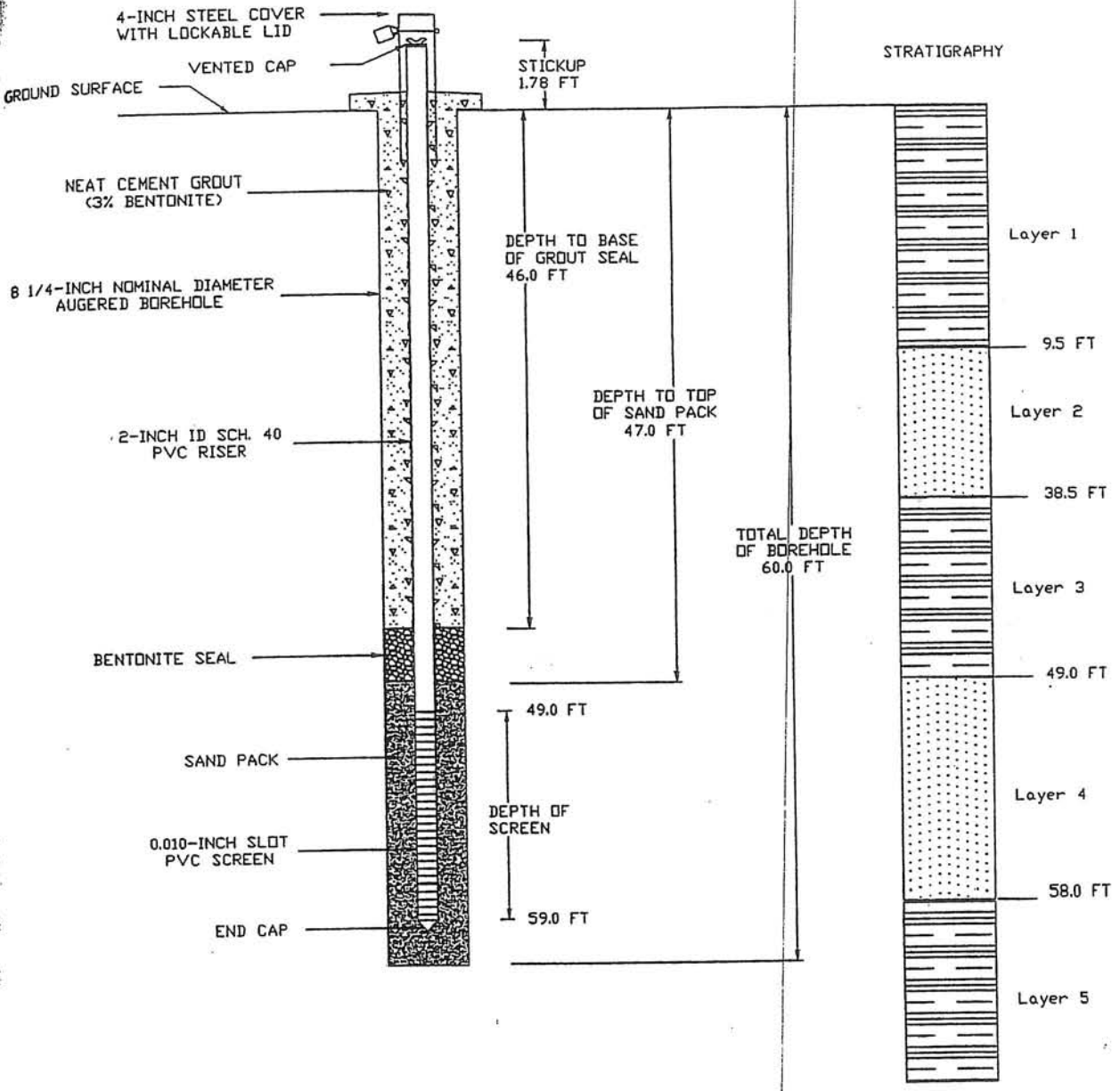
REMARKS:
UD sample analyzed for porosity.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD	
BORING NUMBER	GW-4
DATE DRILLED	August 24, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 2 OF 2	

LAW ENGINEERING

MONITORING WELL GW-4
CONSTRUCTION DIAGRAM



INSTALLATION DATE: 8/25/93

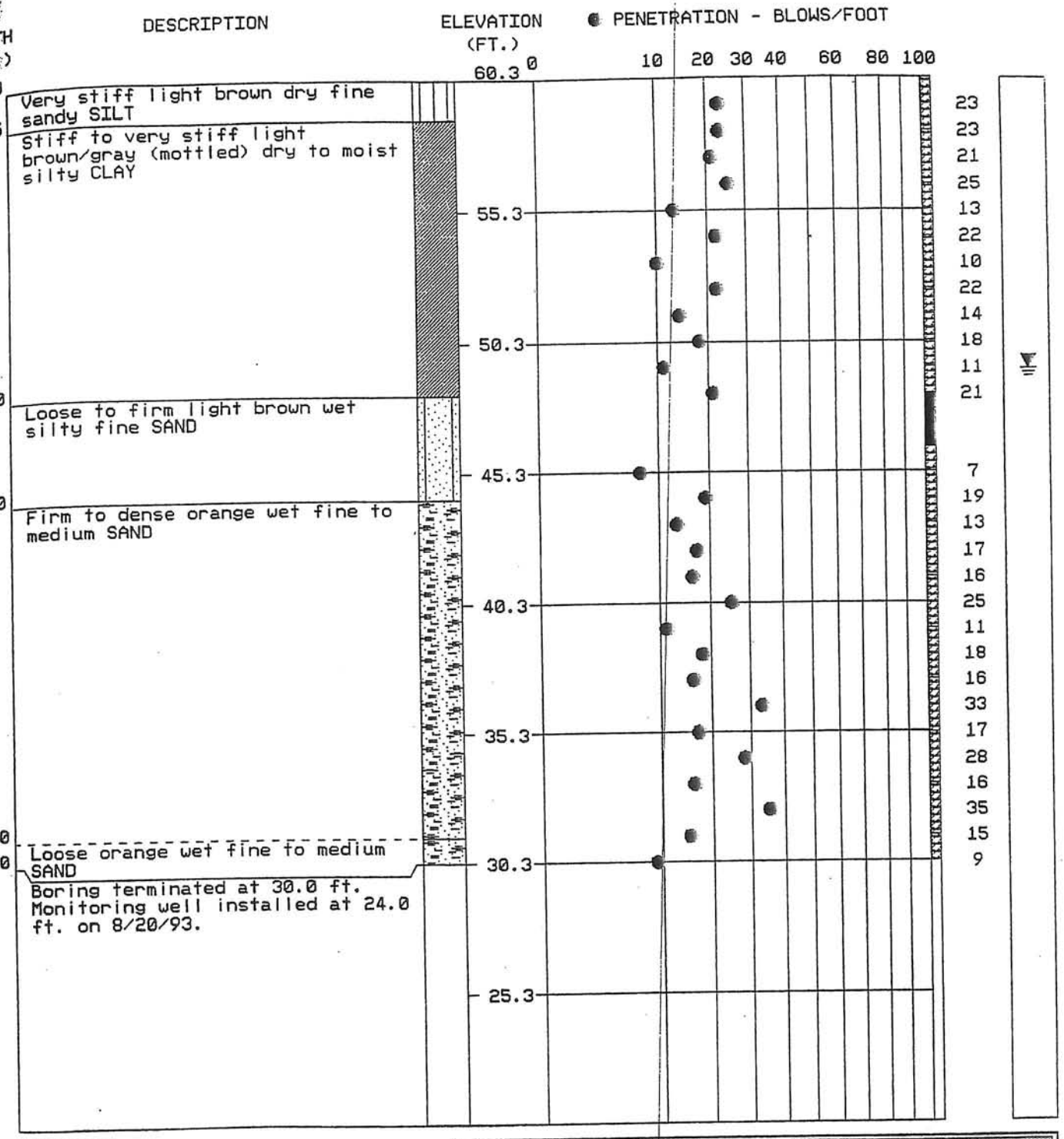
GROUND SURFACE EV. 60.25 FT MSL
MEASURING POINT EV. 62.03 FT MSL
SITE NORTHING: 10476.16 FT
SITE EASTING: 7048.20 FT

NOT TO SCALE

LAW ENGINEERING
GREENVILLE, SOUTH CAROLINA

GW-4 CONSTRUCTION DIAGRAM
EASTERN CAROLINA LANDFILL
BERTIE COUNTY, NORTH CAROLINA

JOB NO:2490472607.



REMARKS:
UD sample analyzed for porosity.

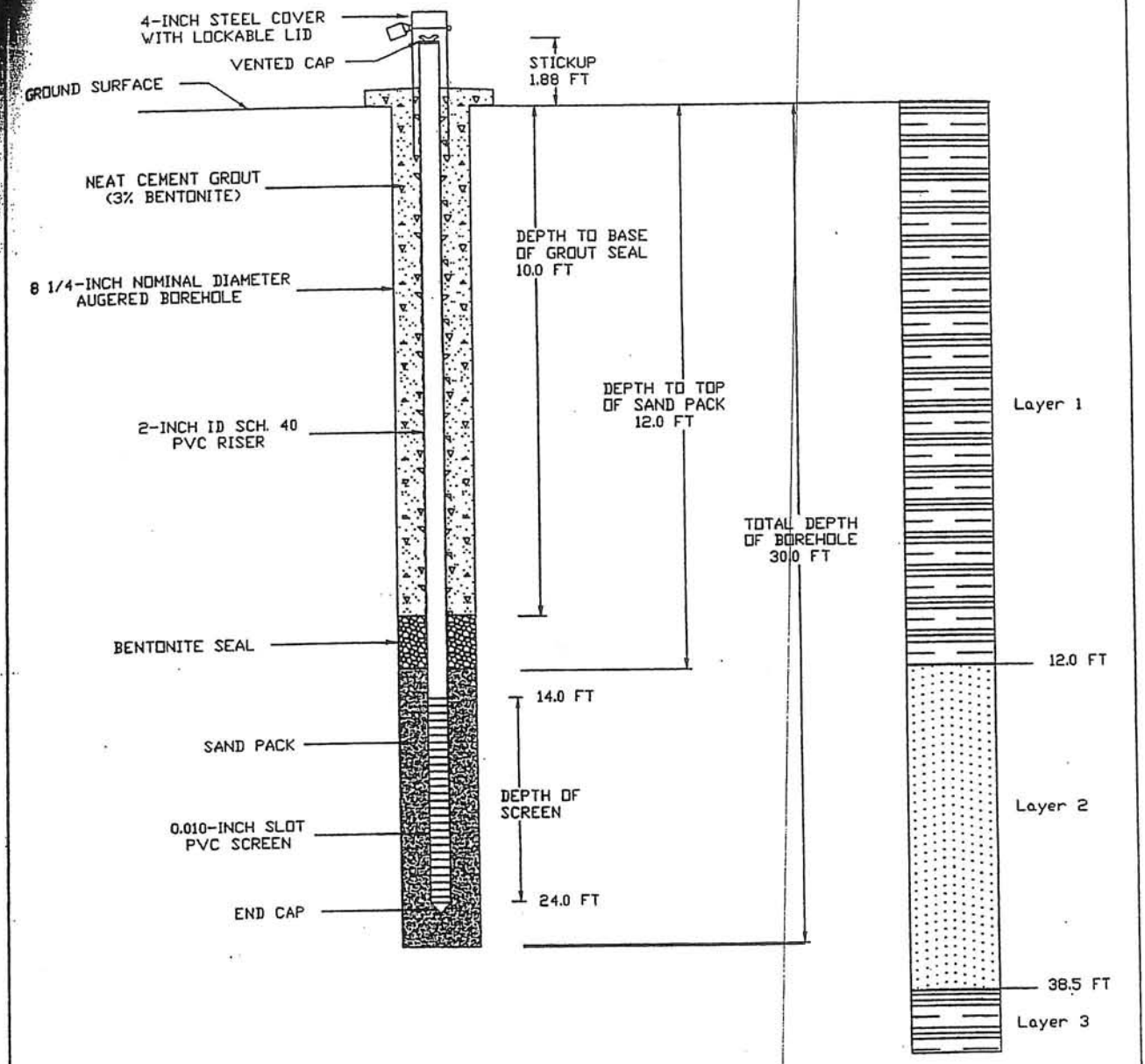
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GW-5
DATE DRILLED	August 20, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 1 OF 1	

LAW ENGINEERING

MONITORING WELL GW-5
CONSTRUCTION DIAGRAM



INSTALLATION DATE: 8/22/93

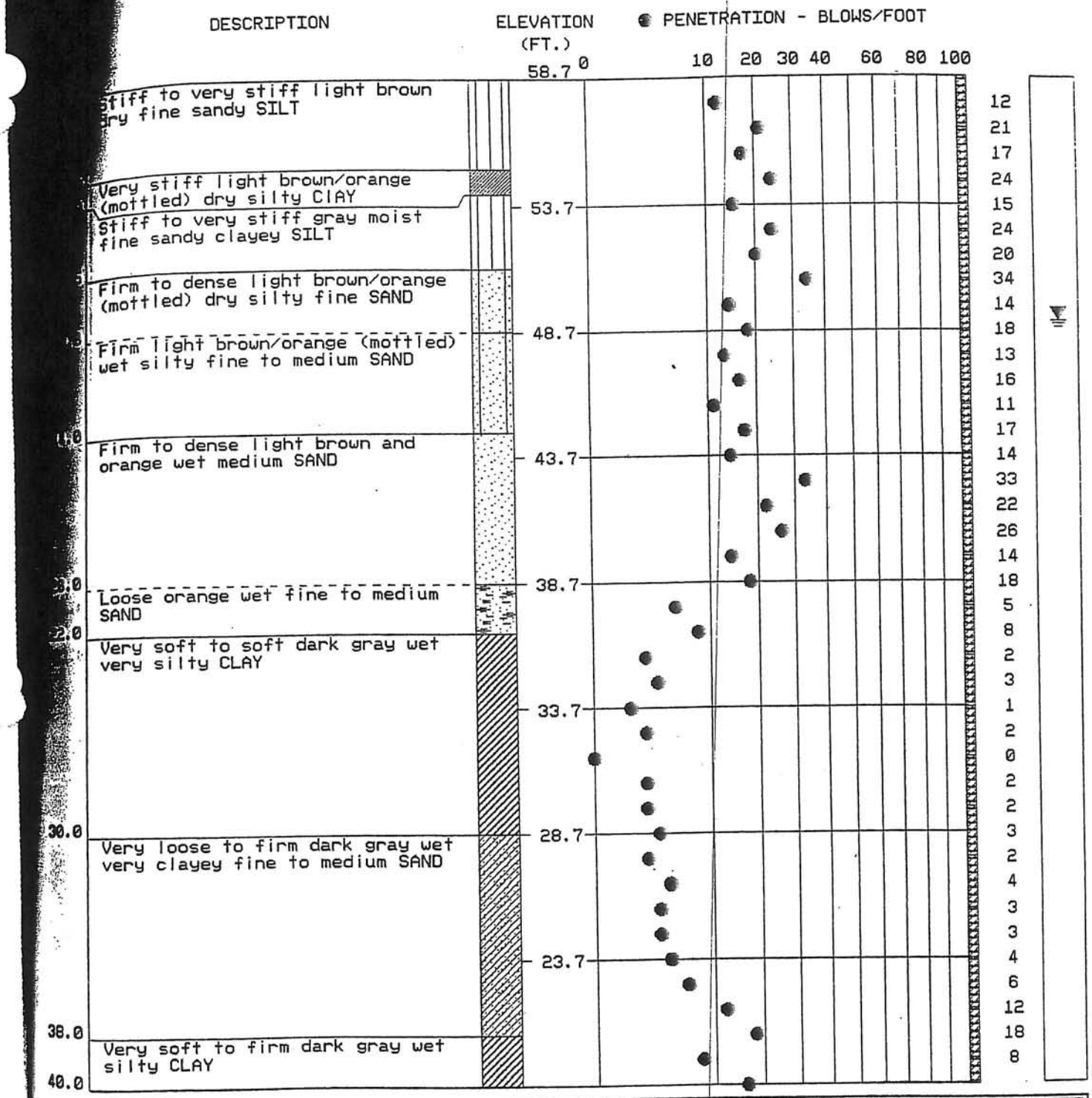
GROUND SURFACE EV. 60.28 FT MSL
MEASURING POINT EV. 62.16 FT MSL
SITE NORTHING: 10475.73 FT
SITE EASTING: 7060.51 FT

NOT TO SCALE

LAW ENGINEERING
GREENVILLE, SOUTH CAROLINA

GW-5 CONSTRUCTION DIAGRAM
EASTERN CAROLINA LANDFILL
BERTIE COUNTY, NORTH CAROLINA

JOB NO:2490472612



REMARKS:

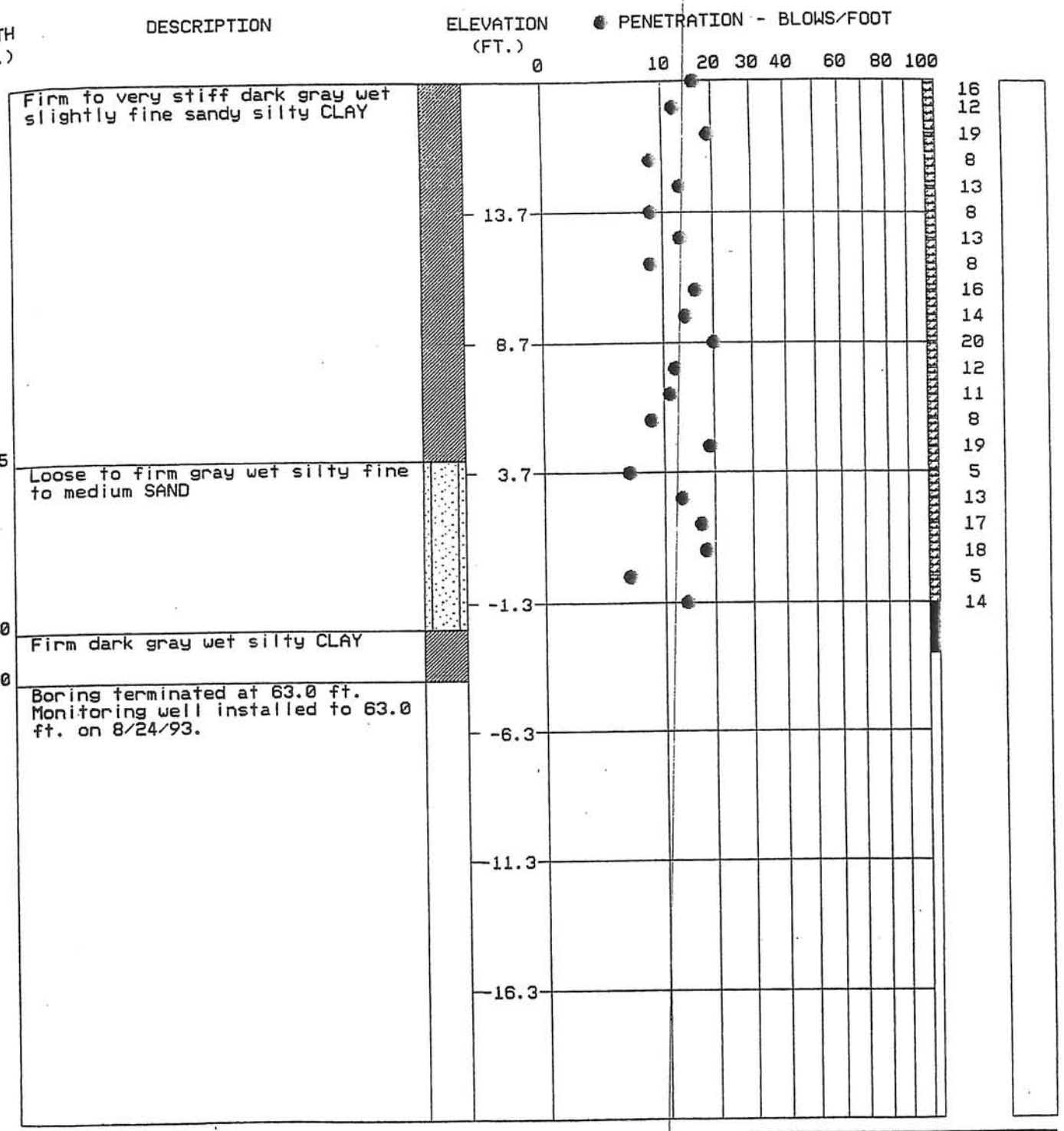
UD sample analyzed for porosity.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GW-6
DATE DRILLED	August 23, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 1 OF 2	

LAW ENGINEERING



REMARKS:
UD sample analyzed for porosity.

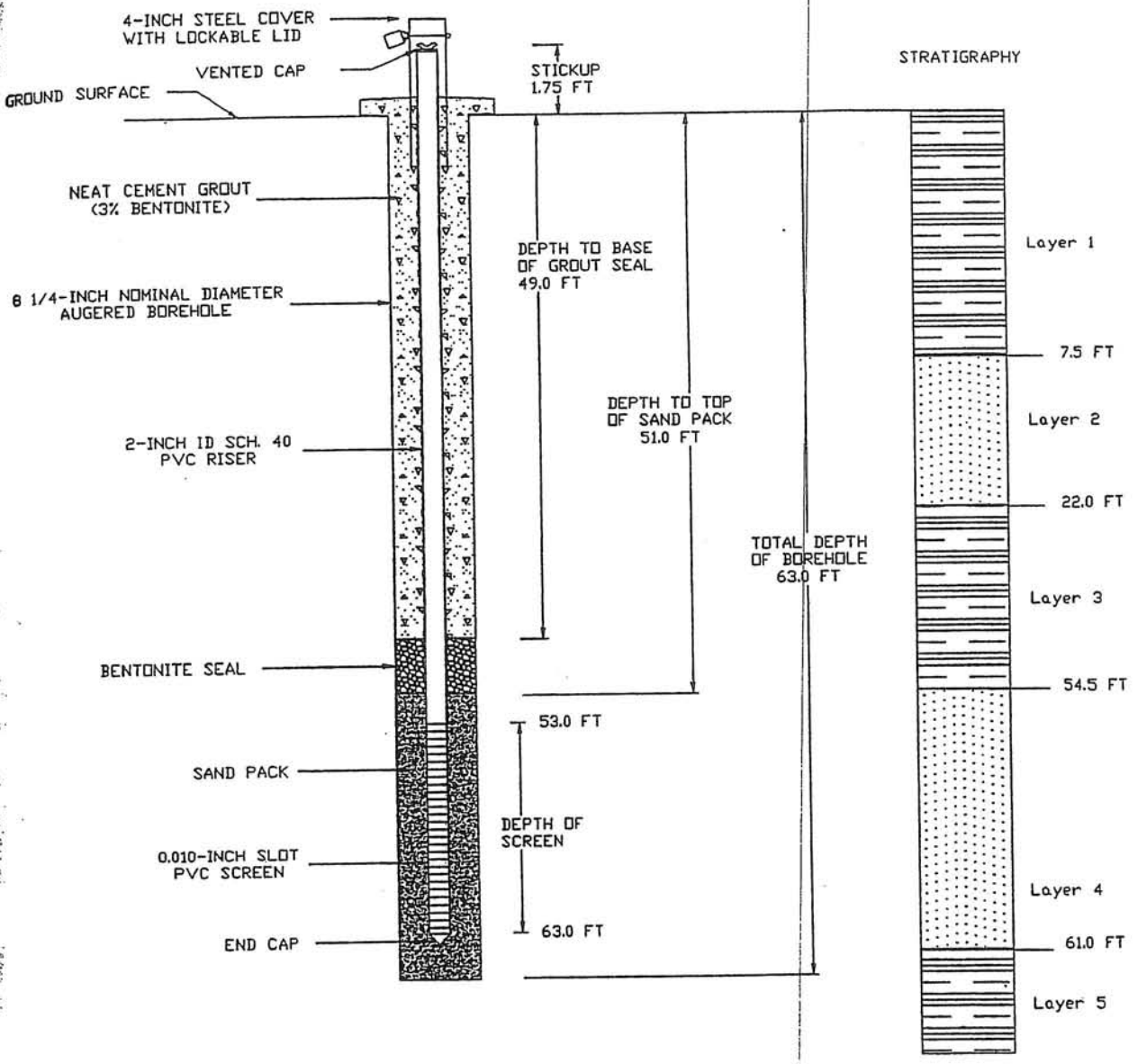
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GW-6
DATE DRILLED	August 23, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 2 OF 2	

LAW ENGINEERING

MONITORING WELL GW-6
CONSTRUCTION DIAGRAM



INSTALLATION DATE: 8/24/93

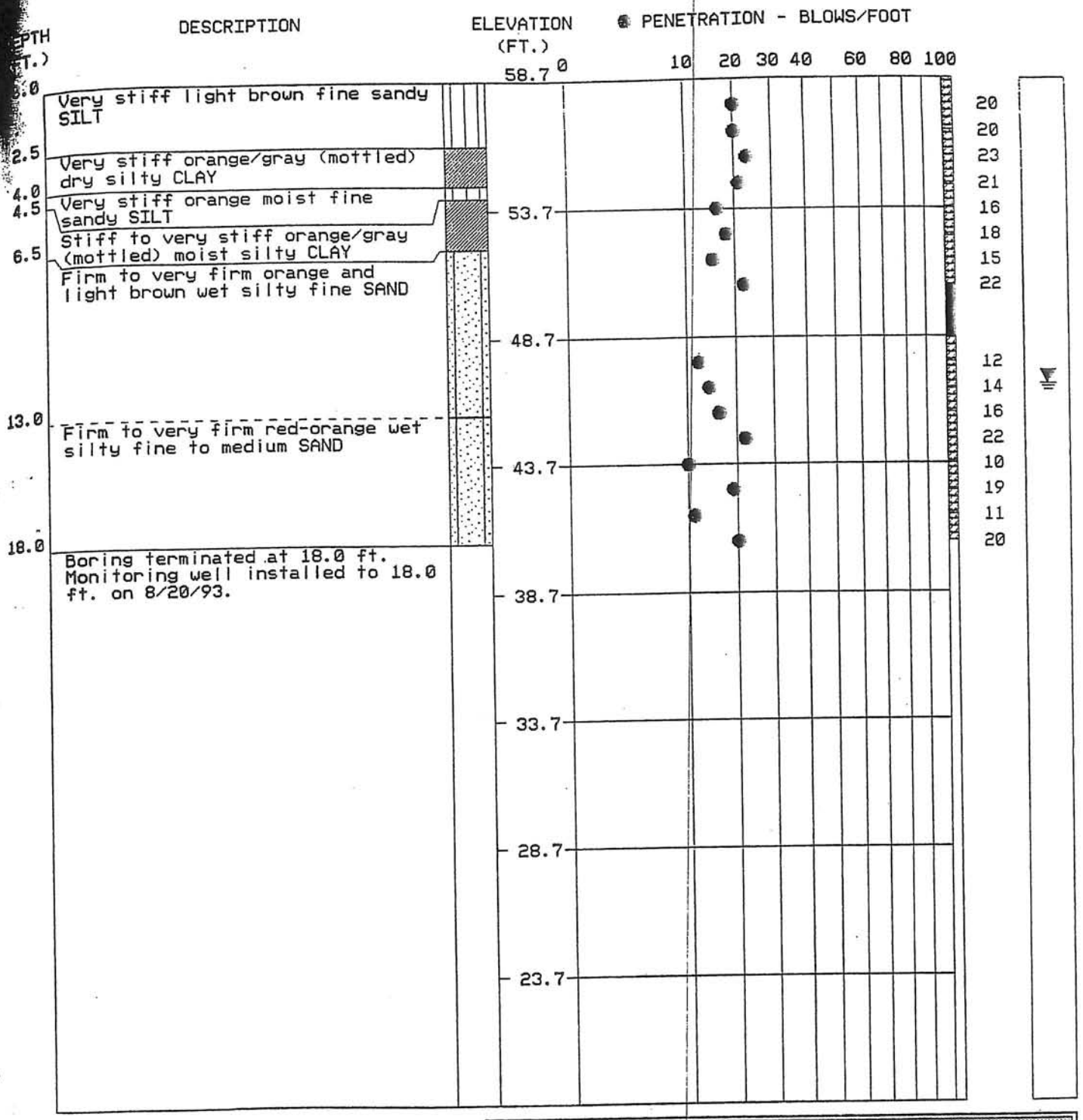
GROUND SURFACE EV. 58.69 FT MSL
MEASURING POINT EV. 60.44 FT MSL
SITE NORTHING: 10566.97 FT
SITE EASTING: 6636.89 FT

NOT TO SCALE

LAW ENGINEERING
GREENVILLE, SOUTH CAROLINA

GW-6 CONSTRUCTION DIAGRAM
EASTERN CAROLINA LANDFILL
BERTIE COUNTY, NORTH CAROLINA

JOB NO:2490472607



REMARKS:

UD sample analyzed for porosity.

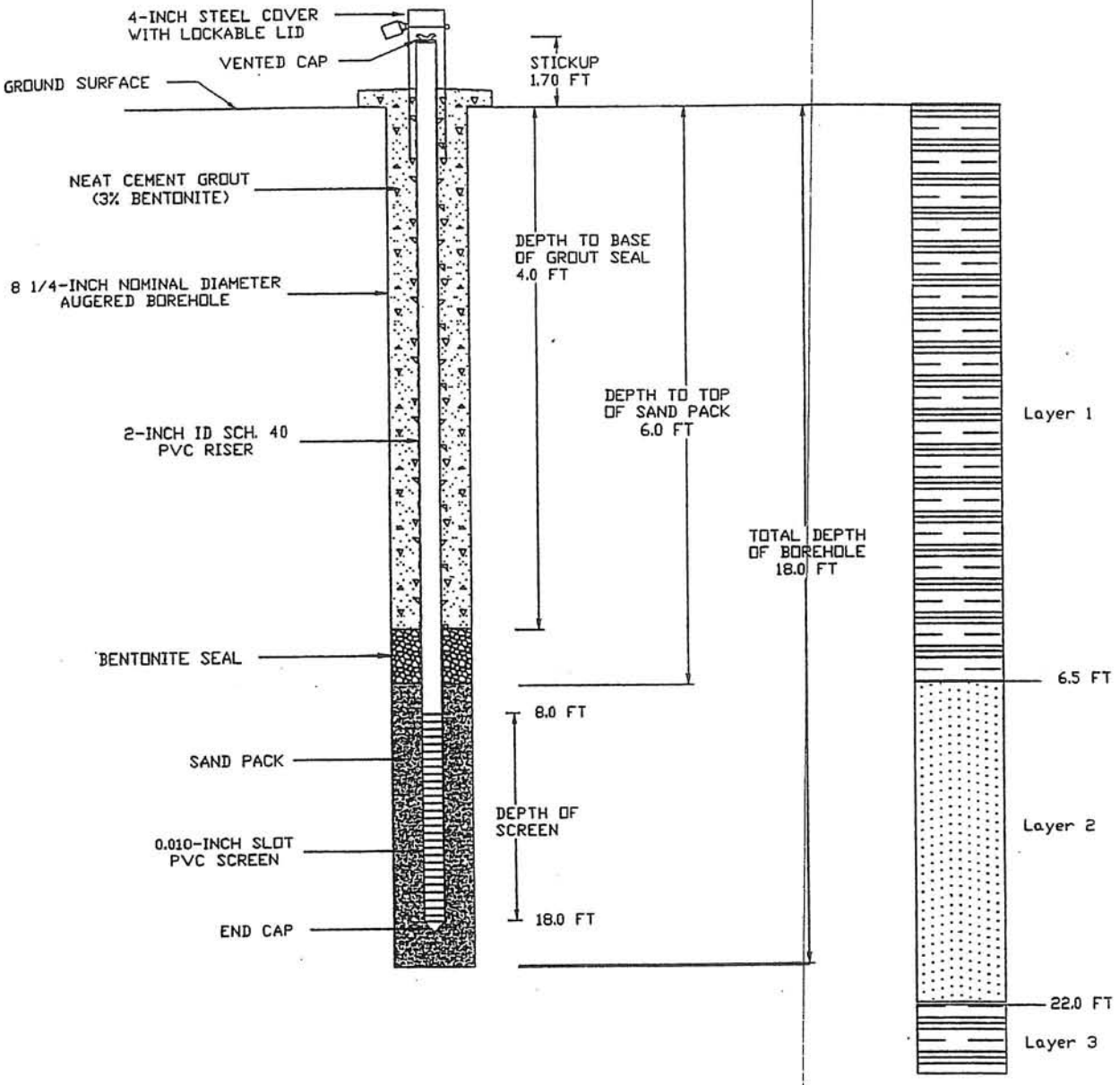
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GW-7
DATE DRILLED	August 20, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 1 OF 1	

LAW ENGINEERING

MONITORING WELL GW-7
CONSTRUCTION DIAGRAM



INSTALLATION DATE: 8/20/93

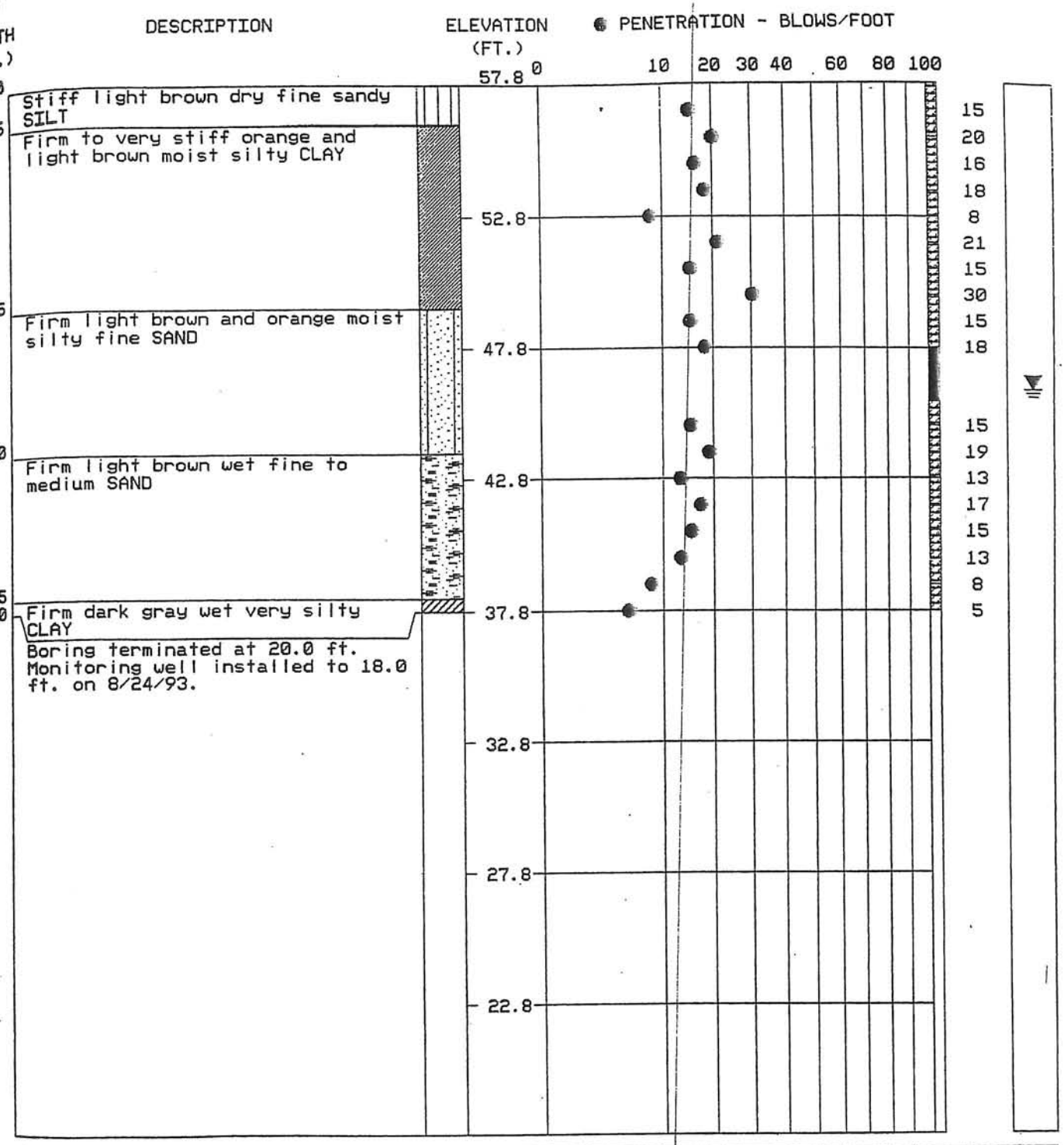
GROUND SURFACE EV. 58.71 FT MSL
MEASURING POINT EV. 60.41 FT MSL
SITE NORTHING: 10556.15 FT
SITE EASTING: 6643.44 FT

NOT TO SCALE

LAW ENGINEERING
GREENVILLE, SOUTH CAROLINA

GW-7 CONSTRUCTION DIAGRAM
EASTERN CAROLINA LANDFILL
BERTIE COUNTY, NORTH CAROLINA

JOB NO:2490472612



REMARKS:
UD sample analyzed for porosity.

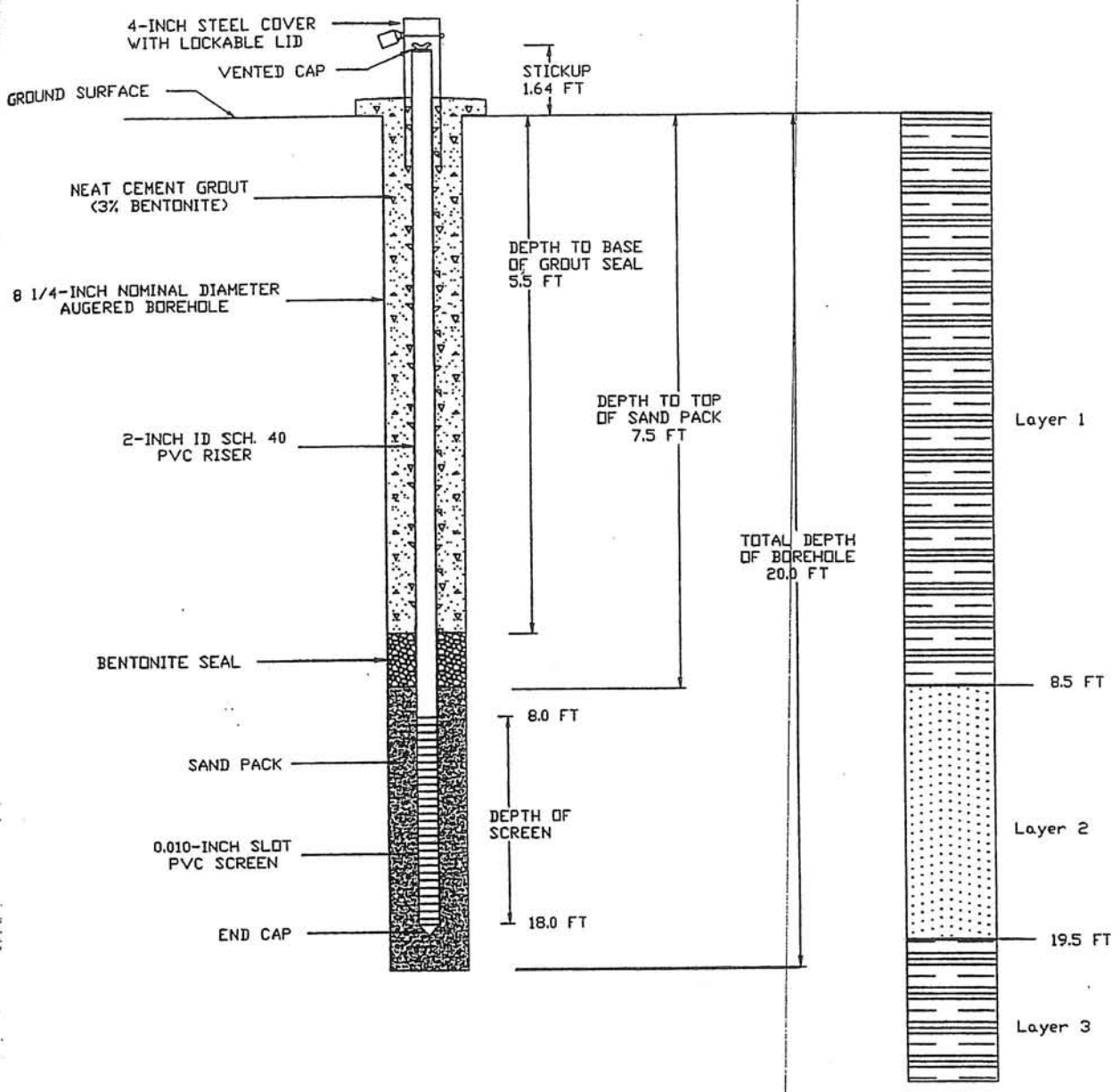
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GW-8
DATE DRILLED	August 24, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 1 OF 1	

LAW ENGINEERING

MONITORING WELL GW-8
CONSTRUCTION DIAGRAM



INSTALLATION DATE: 8/24/93

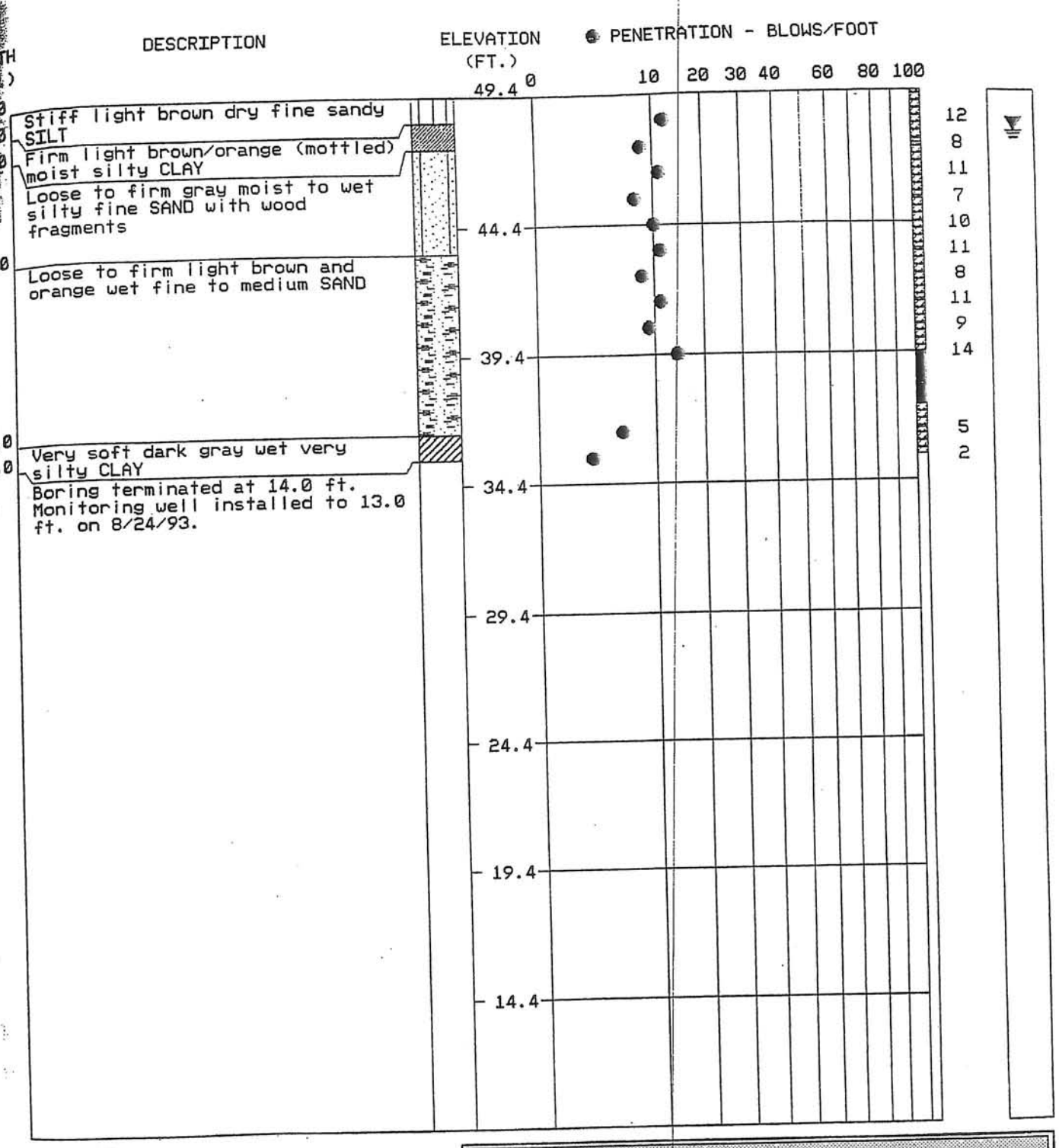
GROUND SURFACE EV. 57.84 FT MSL
MEASURING POINT EV. 59.48 FT MSL
SITE NORTHING: 10789.46 FT
SITE EASTING: 6302.08 FT

NOT TO SCALE

LAW ENGINEERING
GREENVILLE, SOUTH CAROLINA

GW-8 CONSTRUCTION DIAGRAM
EASTERN CAROLINA LANDFILL
BERTIE COUNTY, NORTH CAROLINA

JOB NO:2490472612



REMARKS:
UD sample analyzed for porosity.

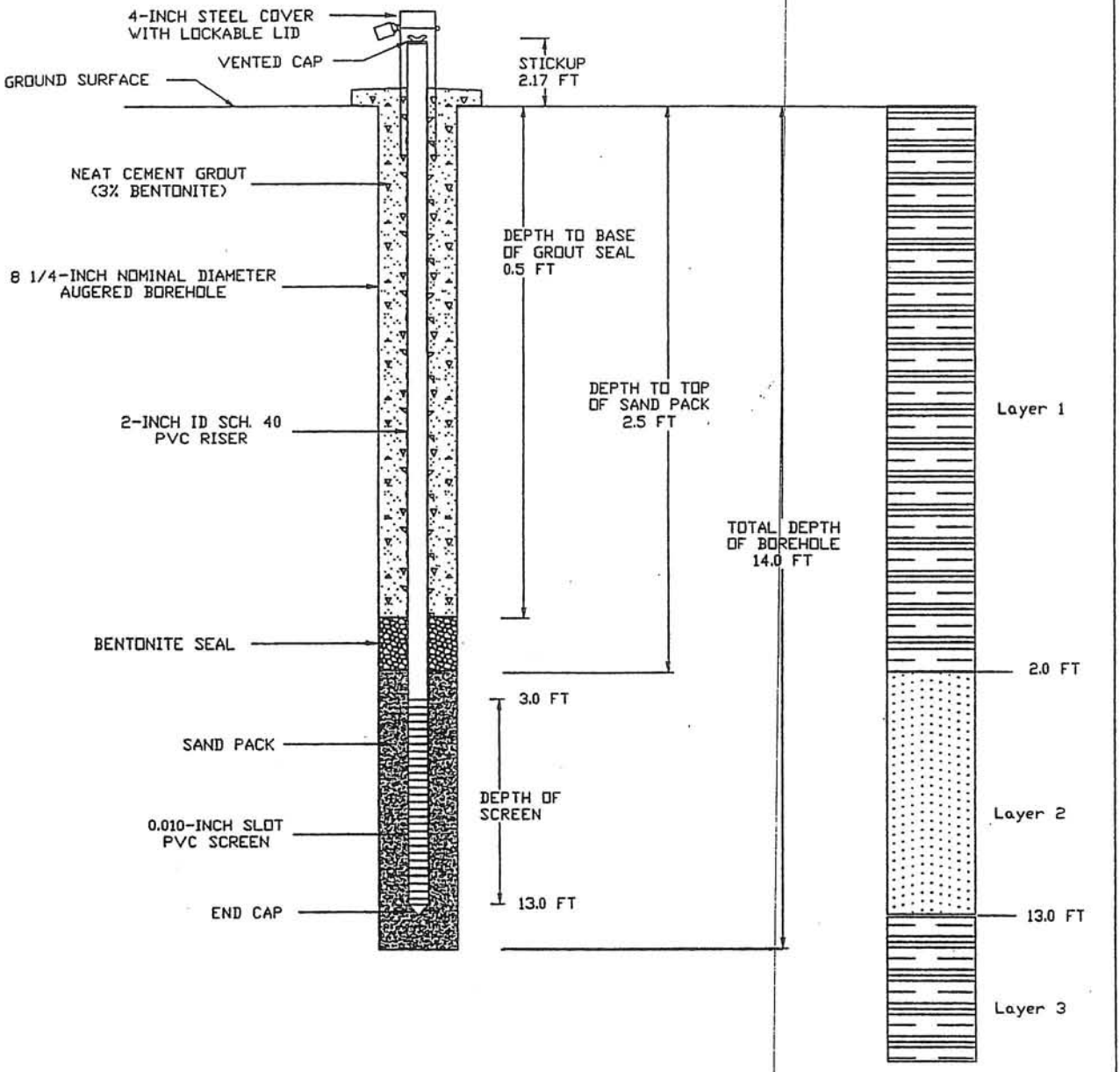
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GW-9
DATE DRILLED	August 24, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 1 OF 1	

LAW ENGINEERING

MONITORING WELL GW-9
CONSTRUCTION DIAGRAM



INSTALLATION DATE: 8/24/93 GROUND SURFACE EV. 49.36 FT MSL MEASURING POINT EV. 51.53 FT MSL SITE NORTHING: 11105.24 FT SITE EASTING: 6304.67 FT NOT TO SCALE	LAW ENGINEERING GREENVILLE, SOUTH CAROLINA	GW-9 CONSTRUCTION DIAGRAM EASTERN CAROLINA LANDFILL BERTIE COUNTY, NORTH CAROLINA JOB NO:2490472612

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

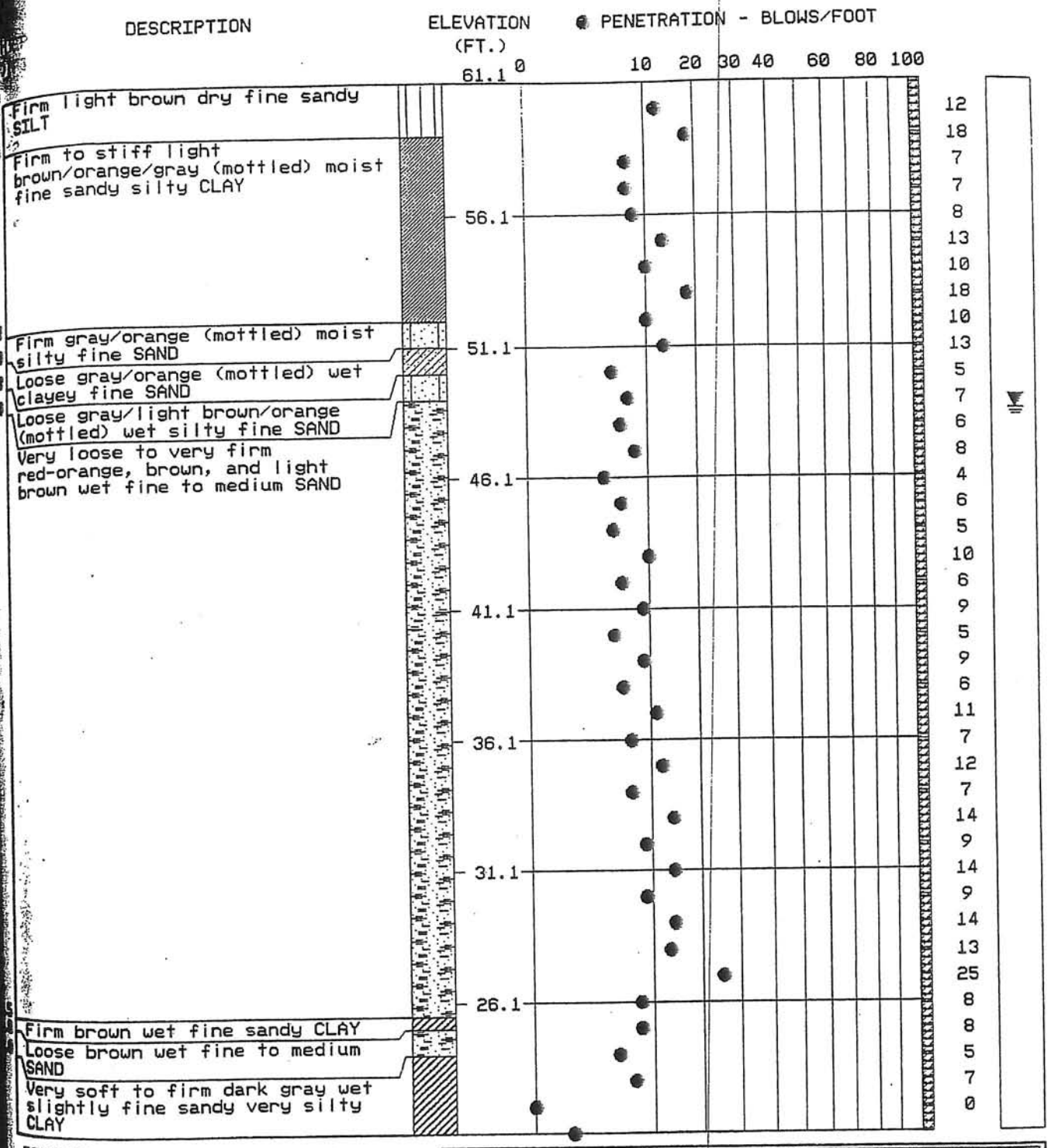
GROUND WATER MONITORING WELL NO. GW-11

PROJECT: ECLF-Monitoring Well Installation
PROJECT NO.: J97-1001.11
CLIENT: HHNT
DATE START: 4/13/97 END: 4/13/97
LOCATION: See Boring Plan
ELEVATION: 68.6 feet
DRILLER: Metro Drilling, Inc. - C. Gordon
LOGGED BY: M. Preddy
DRILLING METHOD: 8.25-Inch OD Hollow Stem Auger
DEPTH TO - WATER> INITIAL: ▽ 17.85 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
0	Firm brown slightly moist clayey fine sandy SILT- Fill		6		Well stickup 3.8 feet 4-inch steel locking protective surface casing 3' x 3' concrete pad at ground surface
5					Neat Cement, 0 to 11 feet
10	Very firm brown moist to wet silty fine to medium SAND-Fill		24		2-inch ID, sch. 40 PVC casing
15	Very stiff moist gray fine sandy silty CLAY-Fill		17		Bentonite Seal, 11 to 15.8 feet
20	▽ Stiff gray/brown (mottled) moist fine sandy silty CLAY - Layer I		15		Filter Pack, sand 15.8 to 30 feet Foster-Dixiana FX-50 sand
25	Firm gray/brown moist silty fine to medium SAND - Layer II		14		Well Screen, 19 to 29 feet
	As above, wet		16		2 inch ID, sch. 40 PVC, 0.01 inch machine slotted
30	Base of boring 30'				Well total depth, 29.3 feet
35					

This information pertains only to this boring at the time of drilling and should not be interpreted as being indictive of the site or of this location with the passage of time.

GEOT_WELL ECLFGW.GPJ 4/15/97



REMARKS:

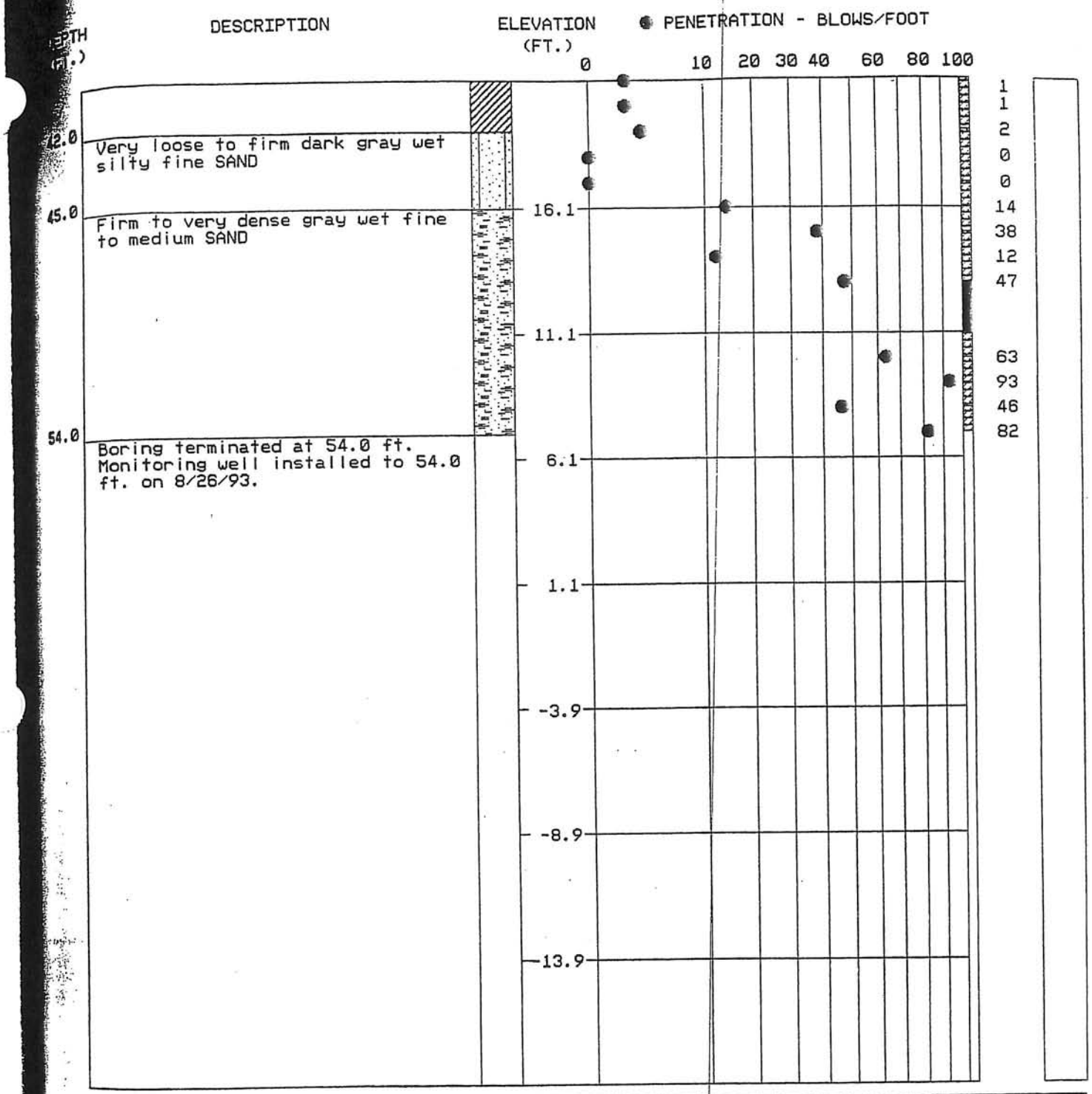
UD encountered very dense sand and was unable to obtain a sample.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GW-12
DATE DRILLED	August 26, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 1 OF 2	

LAW ENGINEERING



REMARKS:

UD encountered very dense sand and was unable to obtain a sample.

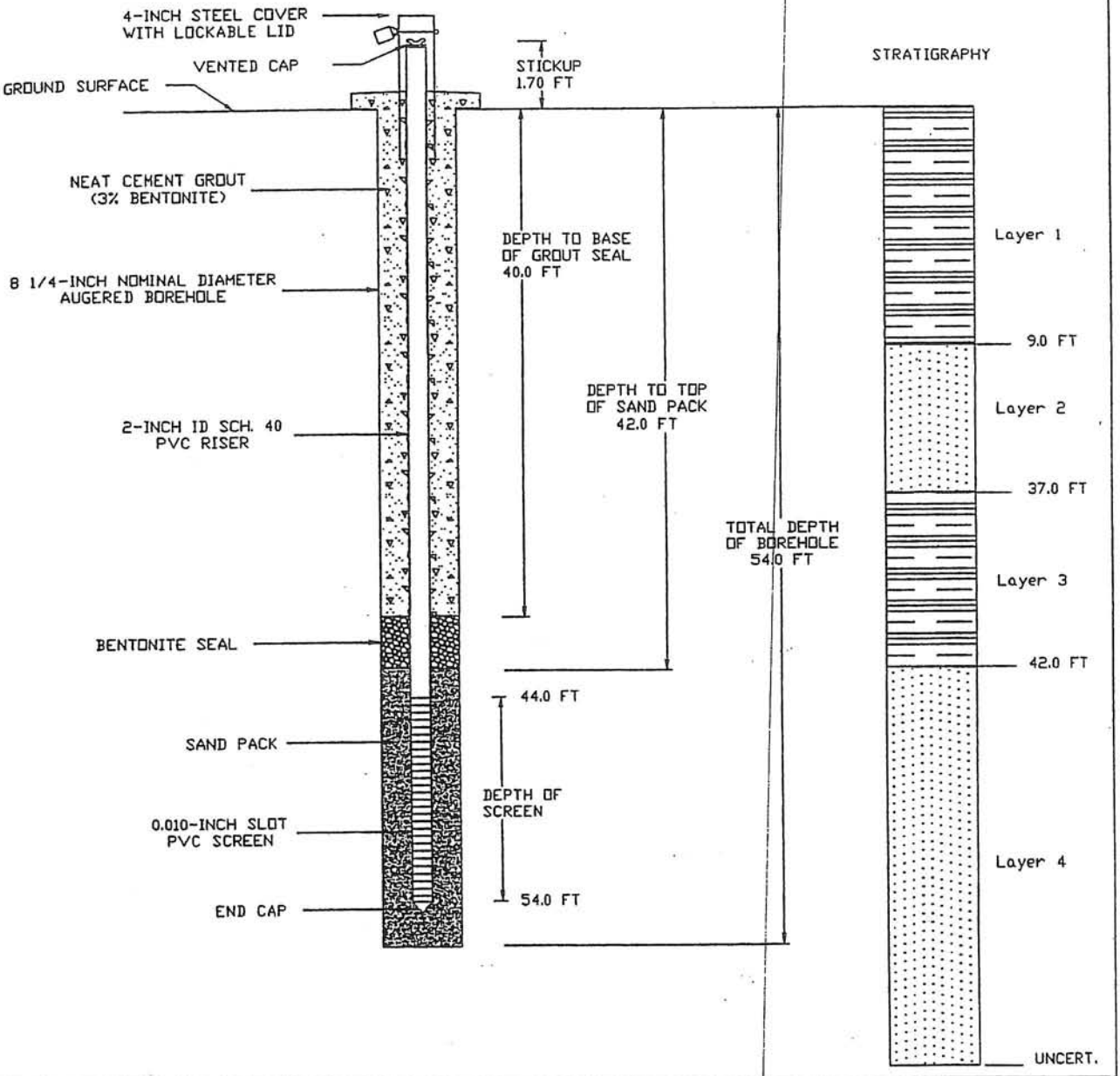
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GW-12
DATE DRILLED	August 26, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 2 OF 2	

LAW ENGINEERING

MONITORING WELL GW-12
CONSTRUCTION DIAGRAM



INSTALLATION DATE: 8/27/93

GROUND SURFACE EV. 61.12 FT MSL
MEASURING POINT EV. 62.82 FT MSL
SITE NORTHING: 11362.87 FT
SITE EASTING: 7336.30 FT

NOT TO SCALE

LAW ENGINEERING
GREENVILLE, SOUTH CAROLINA

GW-12 CONSTRUCTION DIAGRAM
EASTERN CAROLINA LANDFILL
BERTIE COUNTY, NORTH CAROLINA

JOB NO:2490472612

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUND WATER MONITORING WELL NO. GW-13

PROJECT: East Carolina Regional MSW Landfill
PROJECT NO.: J00-1001-32
CLIENT: HHNT
DATE START: 10-26-00 END: 10-26-00
LOCATION: Bertie County, North Carolina
ELEVATION: 72.16
DRILLER: SDI, B. Fletcher (CWD #2526)
LOGGED BY: M. Preddy
DRILLING METHOD: Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 23.9 AFTER 24 HOURS: ▼ 24.54 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)
70 / 2	Loose, brown, moist, clayey, silty, fine SAND - (fill)			8
4				
6				
8				6
10	TOPSOIL			
60 / 12	Firm to stiff, gray and brown, moist, fine sandy, silty CLAY - Layer I			6
14				
16				
18				13
20				
50 / 22	Loose, orange-brown, wet, silty, fine SAND - Layer II			8
24 ▽				
26				
28	Loose, light brown, wet, silty, fine to medium SAND			10
30				
40 / 32				
34				10
36				
38	Firm, orange-brown, wet, silty, fine to medium SAND			11
40				
30 / 42				
44	Firm, orange-brown, wet, very silty CLAY - Layer III			5
46	Boring terminated at 45 feet. Monitoring well installed to 41.6 feet.			
48				
50				
20 / 52				
54				

MONITOR WELL INSTALLATION DETAILS

SURFACE COMPLETION
Stand-up locking steel cover with a 4' x 4' concrete pad at the base

Neat cement, 0 to 20 feet

Bentonite seal, 20 to 23.5 feet

Filter pack, sand 23.5 to 41.6 feet

.010-inch slotted Schedule 40 PVC well screen, 26.3 to 41.3 feet

Pipe cap

Total well depth, 41.6 feet

Borehole diameter = 8.25-inches

Concrete Pad Elevation = 72.16 feet MSL
Top of PVC Elevation = 74.76 feet MSL
Northing = 12,693.52 feet
Easting = 5,719.85 feet

EOT WELL 1001-32.GPJ 0

GROUND WATER MONITORING WELL NO. GW-13
Sheet 1 of 1

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUND WATER MONITORING WELL NO. GW-14

PROJECT: East Carolina Regional MSW Landfill — PROJECT NO.: J03-1001-45
CLIENT: HHNT/Republic — START: 8-26-03 END: 8-26-03
LOCATION: Bertie County, North Carolina — ELEVATION: 76.72
DRILLER: Terracon, B. Fletcher — LOGGED BY: M. Preddy
DRILLING METHOD: CME 550 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 23.10 AFTER 24 HOURS: ▼ 22.82 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
75 / 2	Very loose, yellowish-brown, very slightly moist, slightly clayey, silty, fine SAND - (fill)				**SURFACE COMPLETION** 4" x 4" stand-up locking steel protective cover with 3' x 3' concrete pad with survey pin at the base
4				4	Gound Surface Elev. = 76.72 ft MSL
6 / 70					Top of PVC Casing Elev. = 78.74 ft MSL
8	Stiff, gray, very slightly moist, fine sandy, silty CLAY and firm, yellowish-brown, very slightly moist, slightly clayey, silty, fine SAND - (fill)				Northing = 13,200.13 feet
10				12	Easting = 7,507.13 feet
65 / 12	Very stiff, reddish-brown and yellowish-brown, moist, fine sandy, silty CLAY - (fill)				
14				17	
16 / 60					
18					Grout, 0 to 33.5 feet
	Stiff, gray, moist, silty CLAY - Layer 1			12	
20					
55 / 22	Very stiff to stiff, gray, moist, slightly fine sandy, silty CLAY with some wood pieces				
▼ 24				18	
26 / 50					
28					
				7	
30					
45 / 32	Stiff, yellowish-brown, moist, clayey, fine sandy SILT and gray, moist, fine sandy, silty CLAY				
34				13	
36 / 40					Bentonite seal, 33.5 to 35.5 feet
38	Very loose, light brown, wet, fine to medium SAND - Layer 2				Filter pack, sand 35.5 to 50 feet
				1	

OLD GEOT_WELL 10... ...GPJ 5/26/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUND WATER MONITORING WELL NO. GW-14

PROJECT: East Carolina Regional MSW Landfill
PROJECT NO.: J03-1001-45
CLIENT: HHNT/Republic
START: 8-26-03 END: 8-26-03
LOCATION: Bertie County, North Carolina
ELEVATION: 76.72
DRILLER: Terracon, B. Fletcher
LOGGED BY: M. Preddy
DRILLING METHOD: CME 550 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 23.10 AFTER 24 HOURS: ▼ 22.82 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
35 / 42	Very loose, light brown, wet, fine to medium SAND - Layer 2				Filter pack, sand 35.5 to 50 feet
	Very firm, dark reddish-brown and light brown, wet, slightly clayey, silty, fine SAND			21	2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 37.78 to 47.78 feet
30 / 46					
48					Pipe cap
	Very soft, dark gray, wet, very clayey SILT - Layer 3			1	
50	Boring terminated at 50 feet. Ground water encountered at 23.10 feet at time of drilling and at 22.82 feet after 24 hours.				Total well depth, 48.18 feet
25 / 52					PVC diameter = 2.0-inches
					Borehole diameter = 8.25-inches
54					
20 / 56					
58					
60					
15 / 62					
64					
66					
10 / 68					
70					
5 / 72					
74					
76					
0 / 78					

OLD GEOT WELL 100... .PJ 5/26/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUND WATER MONITORING WELL NO. GW-15

PROJECT: East Carolina Regional MSW Landfill
PROJECT NO.: J05-1001-53
CLIENT: HHNT/Republic
DATE START: 12-2-05 END: 1-9-06
LOCATION: Bertie County, North Carolina
ELEVATION: 75.25
DRILLER: BLE, K. Thomas
LOGGED BY: M. Preddy
DRILLING METHOD: 6620 DT Geoprobe, 8-1/4 inch hollow stem augers
DEPTH TO - WATER> INITIAL: ▽ 25.1 ON 1/12/06 ▼ 21.85 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	MONITOR WELL INSTALLATION DETAILS
75	Tan, gray and reddish-yellow, fine sandy, silty CLAY - (fill)		SURFACE COMPLETION 4" x 4" stand-up locking steel protective cover with a 3' x 3' concrete pad at the base
70			1/4-inch weep and vent holes installed in the steel cover and well casing, respectively
65			Ground elev. = 75.25 feet MSL Pad elev. = 75.38 feet MSL PVC elev. =78.23 feet MSL
60	Gray and tan, slightly sandy, silty CLAY - Layer I		Northing = 13,149.24 feet Easting = 5,688.85 feet Neat cement grout, 0 to 19.3 feet
55			Bentonite seal, 19.3 to 21.9 feet
50	Yellowish-red, slightly clayey, silty, fine to medium SAND - Layer II		Filter pack, sand 21.9 to 40 feet
	Gray and tan (mottled), fine to medium SAND - Layer II		
45			2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 24.22 to 39.22 feet
40	Reddish-yellow and tan, slightly silty, fine to medium SAND - Layer II		
35	Boring terminated at 40 feet. Ground water encountered at 25.1 feet at time of drilling and at 21.85 feet on 1-12-06.		Pipe cap Total well depth, 39.47 feet bgs Total well depth, 42.62 feet btoc Borehole diameter, 8.25-inches

GEOTWELLNB DATE 1001-53.GPJ 2/3/06

APPENDIX B

SURVEYS OF PIEZOMETER LOCATIONS

Compiled Plat for :

REPUBLIC SERVICES of NORTH CAROLINA, L.L.C.

d.b.a. East Carolina Environmental

A portion of the Spruill Farms, Inc. property
along the east side of N.C. Secondary Road 1225
Snakebite Township, Bertie County, North Carolina
Deed Reference Book 704 Page 315, Book 706 Page 898,
Book 549 Page 346, Book 675 Page 227,
Book 716 Page 677, and Book 725 Page 655.
Plat Cabinet A Slides 1094, 1095, and 1121.
Plat Cabinet B Slides 28, 36, and 81.

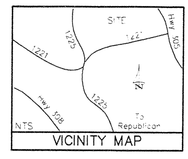
Surveyed by Thomas J. Fields, PLS-2906, on January 17, 1994
thru November 13, 1995.

REVISED & UPDATED on July 28, 2006.

TOTAL AREA = 662.59 Acres ±
by coordinates
(including area within Bunch Cemetery)

400 0 400
Scale is in Feet
1"= 400'

From the office of
WRIGHT & FIELDS LAND SURVEYING
1340 Albemarle Road, Suite C
Troy, N.C. 27371



No horizontal control within 2000 feet.

Willie W. Tripp & wife,
Evelyn B. Tripp
D.B. 613 Pg. 258
plat recorded at
D.B. 602 Pg. 585

Lease Agreement
D.B. 744 Pg. 337
Plat Cabinet B
Slide 172

Katherine S. Burden
D.B. 554 Pg. 55
plat recorded at
D.B. 686 Pg. 837

34.12 Acres ±

Spruill Farms, Inc.
Hoggard Tract
D.B. 483 Pg. 396
Item No. 31
D.B. 212 Pg. 390
Map Book 8 Page 24

Hubert Cherry
D.B. 760 Pg. 753
D.B. 603 Pg. 226
plat recorded at
D.B. 438 Pg. 110
Tract A

East Carolina Environmental
D.B. 706 Pg. 898
Plat Cabinet A Slide 1121

Spruill Farms, Inc.
Joe Pritchard Farm Tract
D.B. 483 Pg. 396
Item No. 19
D.B. 209 Pg. 599
Map Book 8 Page 24

Weyerhaeuser
Company
D.B. 549 Pg. 346

East Carolina Environmental
D.B. 725 Pg. 655
Plat Cabinet B Slide 81

East Carolina Environmental
D.B. 716 Pg. 677
Plat Cabinet B Slide 36

Charles R. Newsom
D.B. 695 Pg. 149
Map Book 2 Page 77

Mildred P. Bazemore
"Patsy Tract"
D.B. 314 Pg. 498

Mildred P. Bazemore
Gardner Land
D.B. 351 Pg. 580

East Carolina
Environmental
D.B. 705 Pg. 49
1.28 Acres ±

Weyerhaeuser Company
N.C. Pulp Company
Simon Cherry Tract
D.B. 394 Pg. 480
Map Book 1 Page 159

James W. Watson
D.B. 694 Pg. 656

Vanderbill Cherry, Sr.
D.B. 777 Pg. 148

William W. Pritchett, Jr.
D.B. 689 Pg. 237
(remainder)

James A. Garriss,
Theophilus M. Garriss, Jr.
and Theodora F. Garriss Oyelowo
D.B. 701 Pg. 776

Bianka, Inc
D.B. 709 Pg. 835

Panel #1 Panel #2 Panel #3 Panel #4 Panel #5 Panel #6 Panel #7 Panel #8 Panel #9 Panel #10

B.M.#1 B.M.#2 B.M.#3 B.M.#4 B.M.#5 B.M.#6 B.M.#7

GW-16 GW-18 GW-19

NCSR 1225 NCSR 1221

Mill Branch

North based on Local Coordinates at Site
NC State Plane North

Curve Data along center of NCSR 1225

CURVE	DELTA	RADIUS	ARC	CHORD	TANGENT	CHORD BRG
1	33°24'50"	587.81	342.80	337.96	176.43	S 21°29'17" E
2	9°42'28"	3842.00	650.96	650.19	326.26	S 00°42'12" W
3	14°18'27"	2000.57	499.57	498.27	251.09	S 13°27'20" W
4	2°48'38"	12174.49	597.21	597.15	298.67	N 19°22'28" E
5	11°26'08"	1833.79	366.00	365.39	183.61	N 10°19'01" E
6	23°34'38"	1396.59	574.70	570.65	291.47	S 16°04'03" W
7	5°34'33"	2922.38	284.39	284.28	142.31	N 24°20'38" E
8	5°18'12"	7201.84	666.61	666.38	333.54	N 18°09'48" E
9	5°50'10"	1123.35	114.42	114.37	57.26	N 11°00'03" E

Bearings & Distances along old marked and painted lines adjacent to Mill Branch and another small branch

LINE	BEARING	DISTANCE
27	N 56°45'09" W	321.27
28	N 56°59'28" W	169.99
29	N 84°11'57" W	109.99
30	N 30°25'14" W	91.46
31	S 69°55'54" W	30.70
32	N 84°55'07" W	35.03
33	N 56°42'25" W	63.46
34	N 59°23'26" W	171.12
35	S 69°16'03" W	83.39
36	N 19°32'21" W	33.44
37	S 55°11'09" W	76.59
38	N 81°03'05" W	168.60
39	S 62°39'46" W	77.59
40	N 86°43'47" W	117.72
41	S 33°09'45" W	120.11
42	S 62°12'07" W	49.08
43	S 38°45'10" W	120.49
44	S 73°48'49" W	95.01
45	S 52°31'59" W	82.07
46	S 49°40'47" W	97.95
47	S 68°47'05" W	79.40
48	N 76°23'29" W	211.38
49	N 88°51'29" W	111.70
50	S 66°14'18" W	76.38
51	S 37°40'50" W	190.55
52	S 39°12'04" W	182.63
53	S 19°52'22" W	232.01
54	S 26°19'56" W	258.02

Bearings & Distances around the Bunch Cemetery

LINE	BEARING	DISTANCE
55	S 84°10'06" E	78.04
56	S 05°50'51" W	56.69
57	N 84°08'54" W	78.04
58	N 05°50'55" E	56.66

containing 0.10 Acre ±

Bearings & Distances along center of NCSR 1221

LINE	BEARING	DISTANCE
L1	N 86°24'39" W	50.05
L2	N 87°16'44" W	195.01
L3	N 88°59'36" W	118.06
L4	S 89°09'36" W	178.50
L5	S 69°35'15" W	209.21
L6	S 80°17'27" W	141.65
L7	S 73°21'07" W	155.73
L8	S 77°17'39" W	358.67

Bearings & Distances along small branch

LINE	BEARING	DISTANCE
1	S 50°13'41" W	64.84
2	S 04°08'16" W	48.25
3	S 64°20'45" W	16.53
4	S 26°27'07" W	67.97
5	S 61°54'56" W	30.58
6	S 29°30'07" W	64.24
7	S 10°32'19" E	38.72
8	S 32°42'12" W	119.84
9	S 47°46'17" W	53.78
9A	S 44°41'09" W	18.34
10	S 82°29'41" W	31.12
11	S 14°35'49" E	57.81
12	S 46°42'58" W	26.06
13	S 32°55'29" W	73.40

Bearings & Distances along Mill Branch

LINE	BEARING	DISTANCE
14	S 30°19'39" E	44.00
15	S 53°15'01" E	75.70
16	S 38°17'29" E	63.40
17	S 41°20'26" E	56.92
18	S 15°00'04" E	54.75

NOTE: Bearings and distances shown are based on the original survey utilizing local control supplied at the site.

NOTE: The coordinates for this drawing are rotated to match the State Plane Coordinate System as supplied by Golder Associates.

NORTH CAROLINA
BERTIE COUNTY

I, Thomas J. Fields, certify that this plat was prepared from an actual survey done by me in Jan 94,Nov 95,July 06 and is in all respects correct to the best of my knowledge and belief. The ratio of precision as calculated by latitudes and departures is 1:20,000+. This plat was prepared in accordance with Board Rule .1600 Witness my original signature and official stamp this the 28th day of July 2006.

Thomas J. Fields
SURVEYOR PLS-2906

NORTH CAROLINA PROFESSIONAL SEAL L-2906 LAND SURVEYOR THOMAS J. FIELDS

Legend
⊕ ..... denotes monuments found or set as noted on plat.
D.B. ..... Deed Book
Pg. ..... Page

Job No. 2006-166

APPENDIX C

LABORATORY TEST RESULTS FOR SOIL SAMPLES

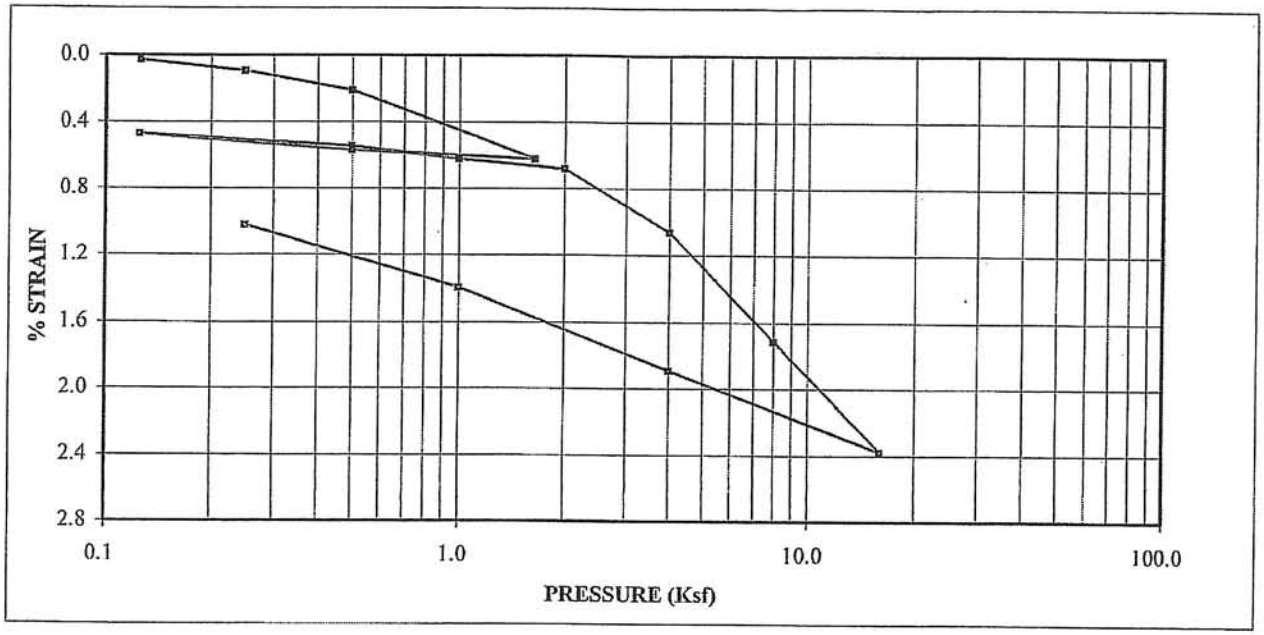
REPUBLIC/PHASE 6 PERMIT APP/NC
SUMMARY OF SOIL DATA

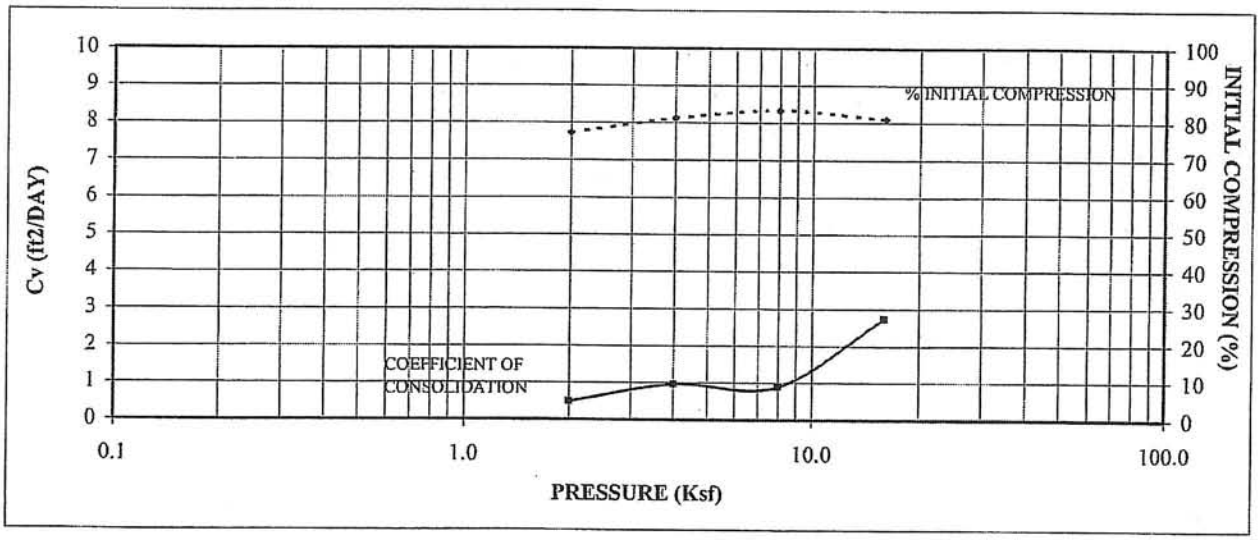
Sample Identification	Sample Type	Sample Depth	Soil Classification		Natural Moisture %	Atterberg Limits				Grain Size Distribution			Compaction		Gs	Porosity	Unit Weight		Permeability (cm/sec)	Additional Tests Conducted (See Notes)
			USCS	USDA		L.L.	P.L.	P.I.	L.I.	% Finer No. 4 Sieve	% Finer No. 200 Sieve	% Finer .005 mm	Maximum Dry Density (lb/cuft)	Optimum Moisture %			Moisture %	Dry (lb/cuft)		
PZ-109A	UD	4.0 - 6.0'	SC	Sandy Clay	25.9	44	25	19	0.04	100.0	44.1	38.0	-	-	2.76	43	25.9	97.2	4.2E-06	-
PZ-109A	UD	14.0 - 16.0'	SM	Loamy Sand	28.0	NP	NP	NP	NP	100.0	18.7	5.0	-	-	2.70	49	28.0	85.4	5.8E-04	-
PZ-109A	-	-	-	-	24.1	-	-	-	-	-	-	-	-	-	-	41	24.1	98.7	-	C
PZ-109B	UD	33.0 - 35.0'	MH	Silty Clay	-	53	30	23	-	100.0	97.6	54.5	-	-	2.70	66	72.0	57.2	3.7E-08	-
PZ-109B	UD	45.5 - 47.0'	SP-SM	Sand	26.0	NP	NP	NP	NP	100.0	7.8	5.2	-	-	2.66	41	26.0	98.2	9.0E-04	-
PZ-115B	UD	44.0 - 45.5'	SM	Sandy Loam	31.2	30	25	5	1.14	100.0	48.0	18.0	-	-	2.70	46	31.2	91.4	3.0E-06	-
PZ-117A	UD	8.0-10.0'	(CL)	-	-	-	-	-	-	-	-	-	-	-	2.73	44	27.2	96.0	-	C
PZ-117A	Bag	10.0-18.0'	CL	Loam	30.0	41	23	18	0.40	100.0	73.9	32.0	-	-	2.73	51	30.0	83.8	9.9E-08	-
PZ-117B	UD	22.0 - 24.0'	CL	Silty Loam	-	35	22	13	-	100.0	88.9	34.0	-	-	2.67	63	62.2	62.1	-	C
PZ-117B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.67	58	65.2	69.1	-	T-CU/WPP
PZ-117B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.68	54	50.5	77.0	-	T-CU/WPP
PZ-117B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.71	46	30.7	91.3	-	T-CU/WPP
PZ-117B	UD	48.0-49.5'	(SC)	-	41.7	-	-	-	-	-	-	-	-	-	2.72	54	41.7	78.2	-	C

ABBREVIATIONS: LIQUID LIMIT (LL)
PLASTIC LIMIT (PL)
PLASTICITY INDEX (PI)
LIQUIDITY INDEX (LI)
SPECIFIC GRAVITY (Gs)
MOISTURE (Mc)

NOTES: T = TRIAXIAL TEST
U = UNCONFINED COMPRESSION TEST
C = CONSOLIDATION TEST
DS = DIRECT SHEAR TEST
O = ORGANIC CONTENT
P = pH

ONE - DIMENSIONAL CONSOLIDATION
ASTM D 2435 Method B





SAMPLE ID	PZ-109A
SAMPLE TYPE	UD
SAMPLE DEPTH	14.0 - 16.0'

LL	-
PL	-
PI	-
Gs	2.70

	Initial	Final
Dry Unit Weight (pcf)	98.7	101.0
Wet Unit Weight (pcf)	122.5	124.9
Moisture Content	24.1%	23.7%
Void Ratio	0.7057	0.6673
Porosity, %	41	
Degree of Saturation	92.0%	96.0%

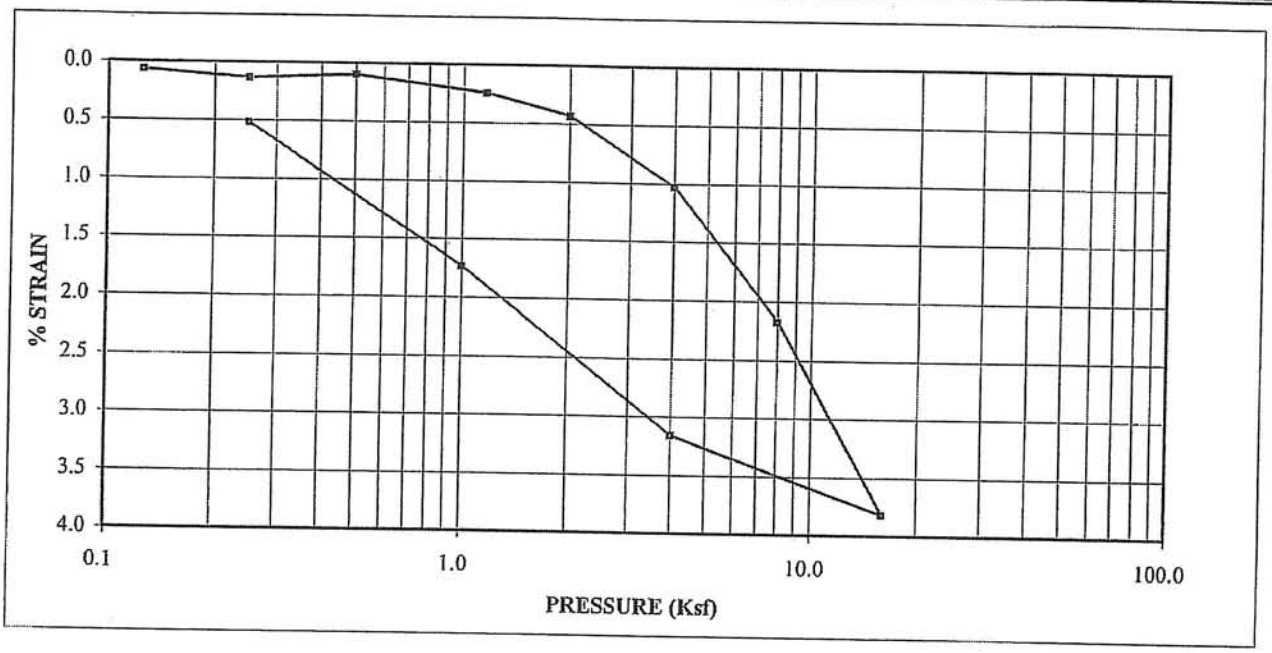
DESCRIPTION: Yellowish Red and Red, FINE SAND, little clayey silt.

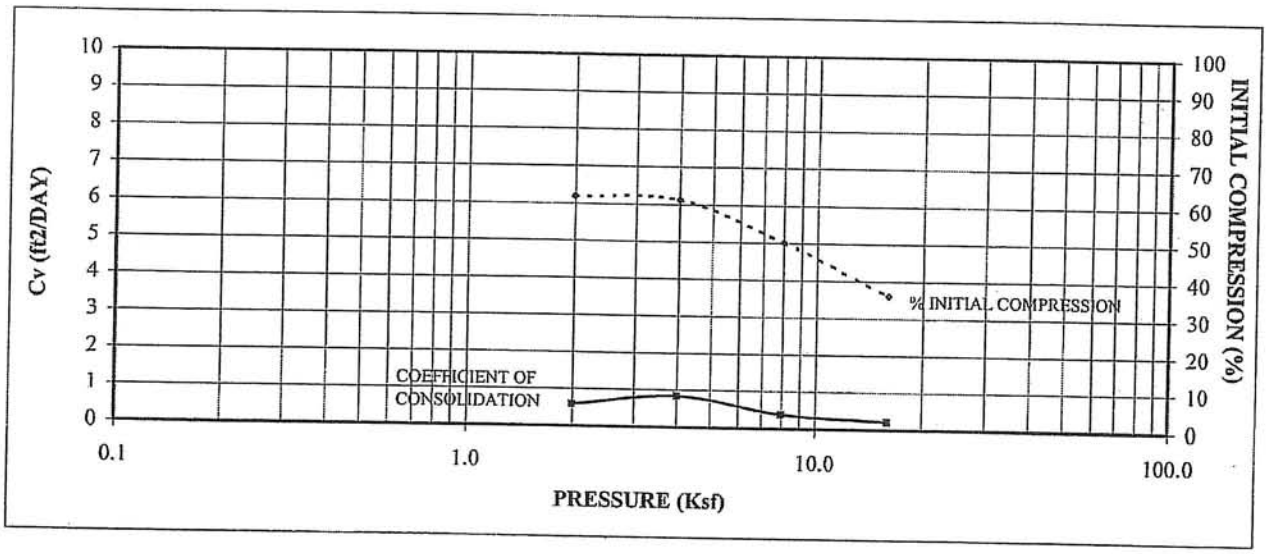
USCS: SM USDA: Loamy Sand

REPUBLIC/PHASE 6 PERMIT APP/NC
063-6507

TECH	SDM/SW
DATE	6/8/06
CHECK	
REVIEW	

ONE - DIMENSIONAL CONSOLIDATION
ASTM D 2435 Method B





SAMPLE ID	PZ-117A
SAMPLE TYPE	UD
SAMPLE DEPTH	8.0 - 10.0'

LL	-
PL	-
PI	-
Gs	2.73

	Initial	Final
Dry Unit Weight (pcf)	96.0	96.0
Wet Unit Weight (pcf)	122.1	123.3
Moisture Content	27.2%	28.4%
Void Ratio	0.776	0.776
Porosity, %	44	-
Degree of Saturation	95.6%	100.0%

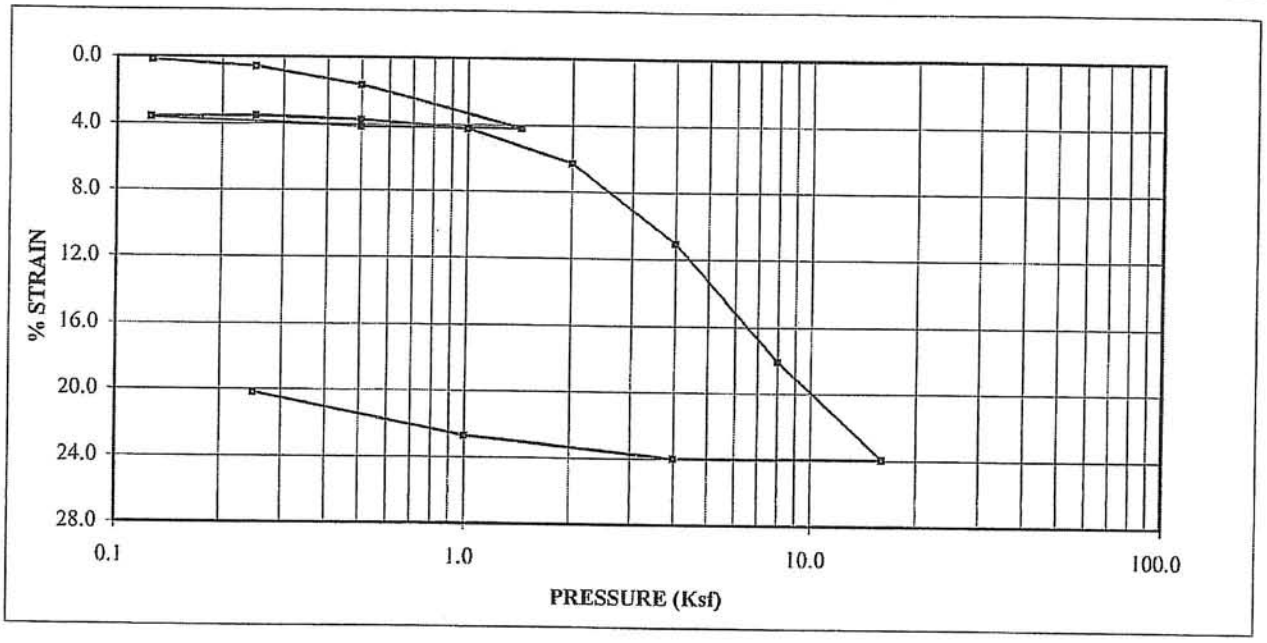
DESCRIPTION: Light Olive Gray, SILTY CLAY, some fine sand.
NOTE: Sample started swelling after inundating at overburnden.

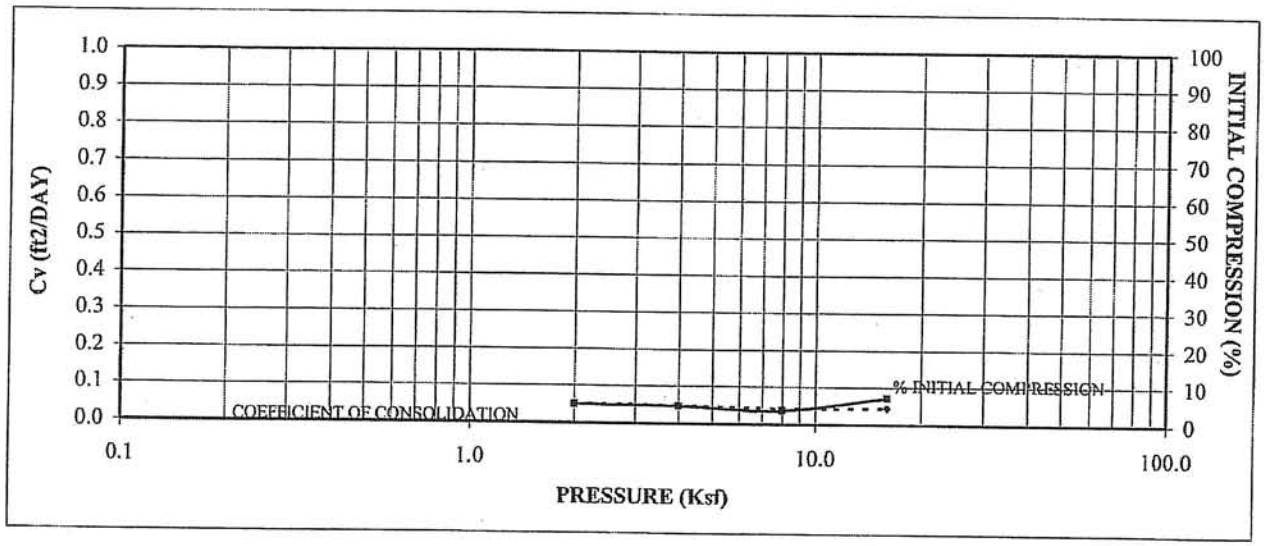
USCS: (CL)

REPUBLIC/PHASE 6 PERMIT APP/NC
063-6507

TECH	SDM/DW/AK
DATE	6/12//06
CHECK	
REVIEW	

ONE - DIMENSIONAL CONSOLIDATION
ASTM D 2435 Method B





SAMPLE ID	PZ-117B
SAMPLE TYPE	UD
SAMPLE DEPTH	22.0 - 24.0'

LL	35
PL	22
PI	13
Gs	2.67

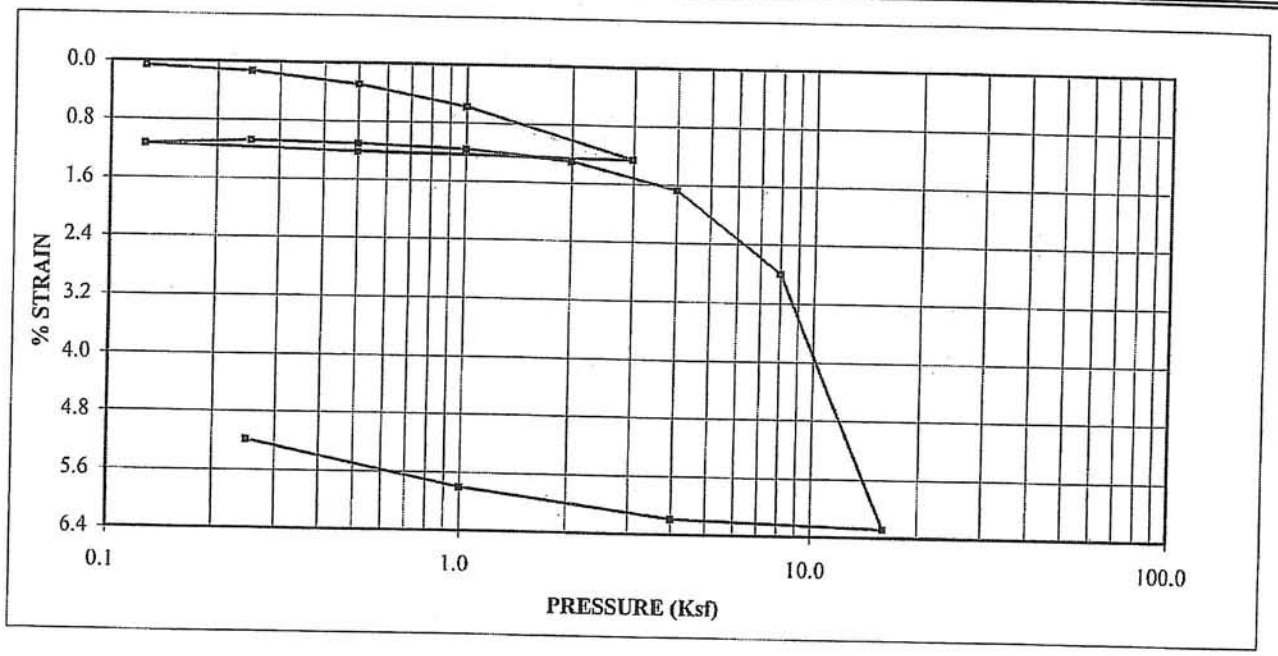
	Initial	Final
Dry Unit Weight (pcf)	62.1	77.1
Wet Unit Weight (pcf)	100.7	110.6
Moisture Content	62.2%	43.5%
Void Ratio	1.6813	1.1597
Porosity, %	63	-
Degree of Saturation	98.6%	100.0%

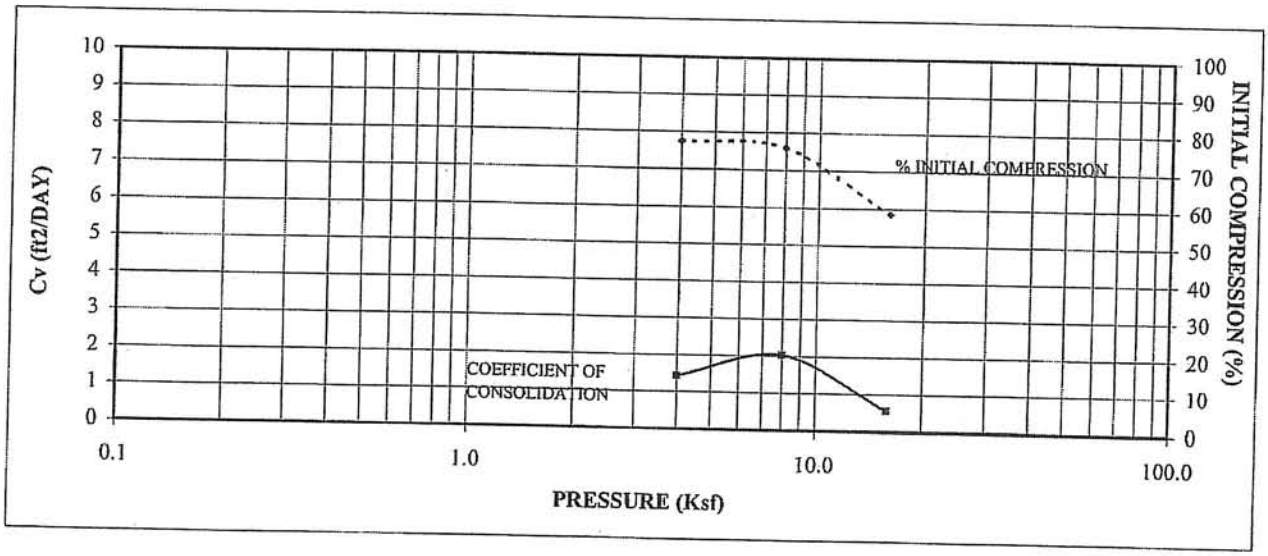
DESCRIPTION	Gray and Yellow, SILTY CLAY, little fine sand.
USCS	CL
USDA	Silty Loam

REPUBLIC/PHASE 6 PERMIT APP/NC
063-6507

TECH	SDM/TPC
DATE	6/06/06
CHECK	
REVIEW	

ONE - DIMENSIONAL CONSOLIDATION
ASTM D 2435 Method B





SAMPLE ID	PZ-117B
SAMPLE TYPE	UD
SAMPLE DEPTH	48.0 - 49.5'

LL	-
PL	-
PI	-
Gs	2.72

	Initial	Final
Dry Unit Weight (pcf)	78.2	80.8
Wet Unit Weight (pcf)	110.8	113.5
Moisture Content	41.7%	40.4%
Void Ratio	1.167	1.096
Porosity, %	54	
Degree of Saturation	97.1%	100.0%

DESCRIPTION: Dark Gray, FINE SAND, some silty clay.

USCS: (SC) USDA: -

REPUBLIC/PHASE 6 PERMIT APP/NC
063-6507

TECH	SDM/DW/AK
DATE	6/12//06
CHECK	
REVIEW	

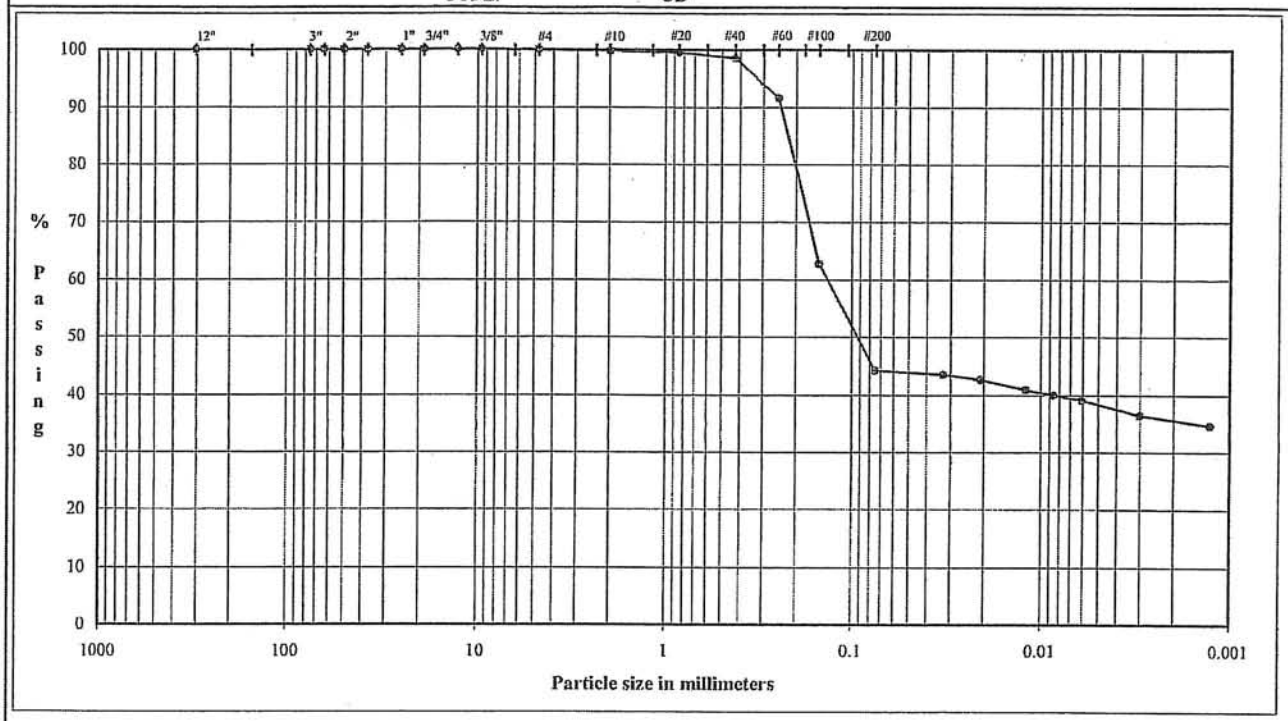
JUNE 2006

063-6507

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: REPUBLIC/PHASE 6 PERMIT APP/NC
SAMPLE ID: PZ-109A - Depth: 4.0 - 6.0'
TYPE: UD



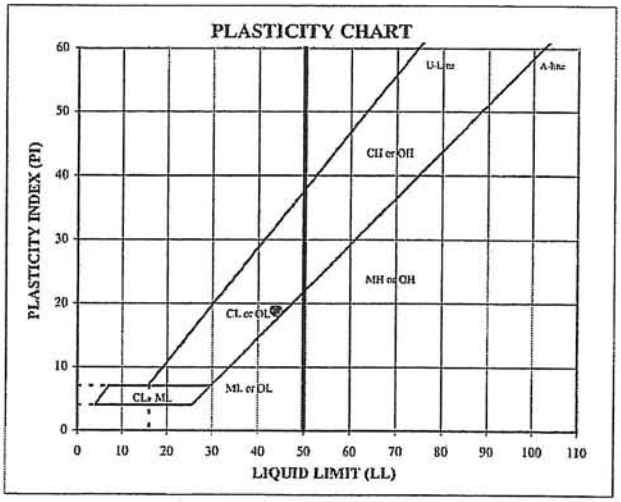
COBBLES	GRAVEL		SAND			FINES
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	ASTM Classification	Wentworth Classification
12.0"	304.8	100.0	Cobbles	
3.0"	75.0	100.0	0.0%	
2.5"	63.5	100.0		
2.0"	50.0	100.0		
1.5"	37.5	100.0	Coarse Gravel	
1.0"	25.0	100.0	0.0%	
0.75"	19.0	100.0		
0.50"	12.7	100.0	Fine Gravel	Gravel
0.375"	9.5	100.0	0.0%	0%
#4	4.8	100.0		
#10	2.00	99.8	Coarse Sand	
#20	0.85	99.6	Medium Sand	
#40	0.43	98.5	1.2%	
#60	0.25	91.5		Sand
#100	0.15	62.9	Fine Sand	56%
#200	0.075	44.1	54.4%	

Hydrometer Analysis

(mm)	%Finer		
0.033	43.5		
0.021	42.6		
0.012	40.8	Fines	Silt
0.0086	39.9	Silt or Clay	8%
0.0061	39.0	44.1%	
0.0030	36.4		Mud
0.0013	34.6		36%



ATTERBERG LIMITS
Method -B (Dry preparation)

M_c	LL	PL	PI	LI
25.9	44	25	19	0.04

LL (oven-dried) / < 0.75 = ORGANIC (OL/OH)

DESCRIPTION: Reddish Brown and Gray, FINE SAND, and silty clay.

USCS: SC
USDA: Sandy Clay

TECH	TJ
DATE	06/06/06
CHECK	
REVIEW	

Golder Associates Inc.

FLEXIBLE WALL PERMEABILITY
ASTM D 5084
METHOD D, CONSTANT RATE OF FLOW

PROJECT TITLE	REPUBLIC/PHASE 6 PERMIT APP/NC		
PROJECT NUMBER	063-6507		
SAMPLE ID	PZ-109A	4.0 - 6.0'	
SAMPLE TYPE	UD		

Board #	11
Flow Pump	1
Flow Pump Speed	5
Technician	SDM

COMMENTS

Sample Data, Initial			
Height, inches	2.974	B-Value, f	0.99
Diameter, inches	2.872	Cell Pres.	100.0
Area, cm²	41.80	Bot. Pres.	80.0
Volume, cm³	315.72	Top Pres.	80.0
Mass, g	618.80	Tot. B.P.	80.0
Moisture Content, %	25.86	Head, max.	53.46
Dry Density, pcf	97.17	Head, min.	53.46
Spec. Gravity	2.756	Max. Grad.	7.07
Volume Solids, cm³	178.39	Min. Grad.	7.07
Volume Voids, cm³	137.33		
Void Ratio	0.77		
Porosity, %	43		
Saturation, %	92.6%		

Flow Pump Rate 1.26E-03 cm³/sec

Sample Data, Final	
Height, inches	2.975
Diameter, inches	2.850
Area, cm²	41.16
Volume, cm³	311.01
Mass, g	623.91
Moisture Content, %	26.90
Dry Density, pcf	98.64
Volume Solids, cm³	178.39
Volume Voids, cm³	132.62
Void Ratio	0.74
Saturation, %	99.7%

USCS	SC
USDA	Sandy Clay

WATER CONTENTS		Sample Initial	Sample Final
Wt Soil & Tare, i	g	618.80	708.44
Wt Soil & Tare, f	g	491.64	576.25
Wt Tare	g	0.00	84.91
Wt Moisture Lost	g	127.16	132.19
Wt Dry Soil	g	491.64	491.34
Water Content	%	25.86%	26.90%

DESCRIPTION

Reddish Brown and Gray, FINE SAND, and silty clay.

TIME FUNCTIONS, SECONDS								dP				
DATE	DAY	HOUR	MIN	TEMP (°C)	dt (min)	dt,acc (min)	dt (sec)	dt,acc (sec)	Reading (psi)	Head (cm)	Gradient	Permeability (cm/sec)
06/07/06	38875	9	40	21.4	0	0	0	0	0.76	53.46	7.07	4.2E-06
06/07/06	38875	9	45	21.4	5	5	300	300	0.76	53.46	7.07	4.2E-06
06/07/06	38875	9	50	21.4	5	10	300	600	0.76	53.46	7.07	4.2E-06
06/07/06	38875	9	55	21.4	5	15	300	900	0.76	53.46	7.07	4.2E-06 *
06/07/06	38875	10	0	21.4	5	20	300	1200	0.76	53.46	7.07	4.2E-06 *
06/07/06	38875	10	5	21.4	5	25	300	1500	0.76	53.46	7.07	4.2E-06 *
06/07/06	38875	10	10	21.4	5	30	300	1800	0.76	53.46	7.07	4.2E-06 *

*TRANSCRIBED FROM ORIGINAL DATA SHEETS

PERMEABILITY REPORTED AS ** 4.2E-06 cm/sec **

DATE	6/7/2006
CHECK	
REVIEW	

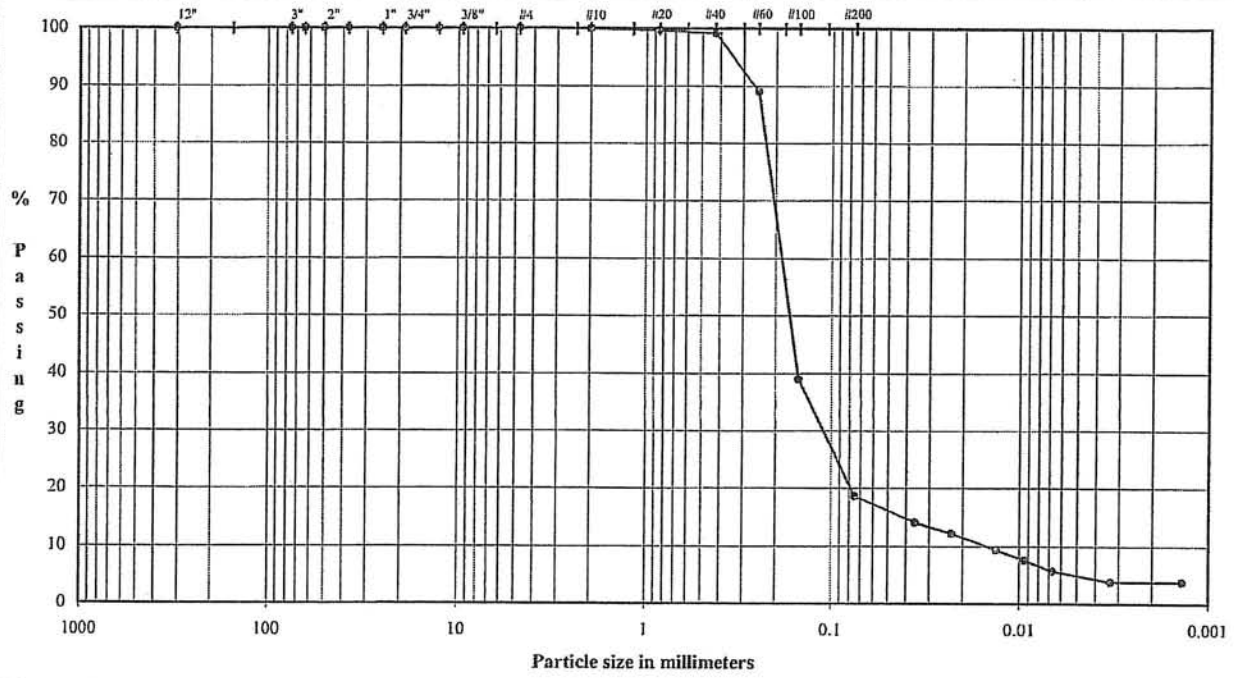
JUNE 2006

063-6507

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **REPUBLIC/PHASE 6 PERMIT APP/NC**
SAMPLE ID: **PZ-109A** Depth: **14.0 - 16.0'**
TYPE: **UD**



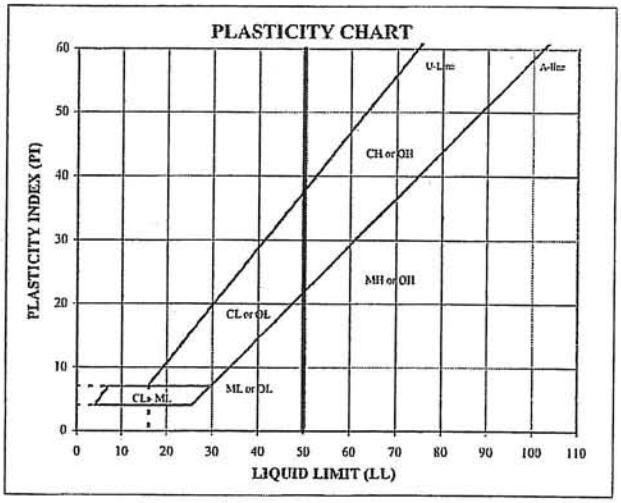
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
COBBLES	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	ASTM Classification	Wentworth Classification
12.0"	304.8	100.0	Cobbles	
3.0"	75.0	100.0	0.0%	
2.5"	63.5	100.0		
2.0"	50.0	100.0		
1.5"	37.5	100.0	Coarse Gravel	
1.0"	25.0	100.0	0.0%	
0.75"	19.0	100.0		
0.50"	12.7	100.0	Fine Gravel	Gravel
0.375"	9.5	100.0	0.0%	0%
#4	4.8	100.0		
#10	2.00	99.9	Coarse Sand	
#20	0.85	99.7	Medium Sand	
#40	0.43	99.2	0.8%	
#60	0.25	88.9		Sand
#100	0.15	39.0	Fine Sand	81%
#200	0.075	18.7	80.5%	

Hydrometer Analysis

(mm)	%Finer		
0.036	14.1		
0.023	12.2		
0.013	9.4	Fines	Silt
0.0094	7.5	Silt or Clay	15%
0.0067	5.6	18.7%	
0.0033	3.8		Mud
0.0014	3.8		4%



ATTERBERG LIMITS
Method -B (Dry preparation)

M.	LL	PL	PI	LI
28.0	NP	NP	NP	NP

LL (oven-dried) / 0.75 = ORGANIC (OL/OH)

DESCRIPTION: Yellowish Red and Red, FINE SAND, some clayey silt.

USCS: SM

USDA: Loamy Sand

TECH	TPC/SW
DATE	06/09/06
CHECK	
REVIEW	

Golder Associates Inc.

FLEXIBLE WALL PERMEABILITY
ASTM D 5084
METHOD D, CONSTANT RATE OF FLOW

PROJECT TITLE	REPUBLIC/PHASE 6 PERMIT APP/NC	
PROJECT NUMBER	063-6507	
SAMPLE ID	PZ-109A	14.0 - 16.0'
SAMPLE TYPE	UD	

Board #	2
Flow Pump	2
Flow Pump Speed	1
Technician	DA

COMMENTS

Sample Data, Initial			
Height, inches	2.955	B-Value, f	0.98
Diameter, inches	2.851	Cell Pres.	100.0
Area, cm²	41.19	Bot. Pres.	80.0
Volume, cm³	309.13	Top Pres.	80.0
Mass, g	541.59	Tot. B.P.	80.0
Moisture Content, %	27.99	Head, max.	7.03
Dry Density, pcf	85.42	Head, min.	7.03
Spec. Gravity	2.698	Max. Grad.	0.94
Volume Solids, cm³	156.84	Min. Grad.	0.94
Volume Voids, cm³	152.29		
Void Ratio	0.97		
Porosity, %	49		
Saturation, %	77.8%		

Flow Pump Rate 2.33E-02 cm³/sec

Sample Data, Final	
Height, inches	2.945
Diameter, inches	2.847
Area, cm²	41.07
Volume, cm³	307.22
Mass, g	571.07
Moisture Content, %	34.95
Dry Density, pcf	85.95
Volume Solids, cm³	156.84
Volume Voids, cm³	150.38
Void Ratio	0.96
Saturation, %	98.4%

USCS	SM
USDA	Loamy Sand

WATER CONTENTS		Sample Initial	Sample Final
Wt Soil & Tare, i	g	541.59	624.91
Wt Soil & Tare, f	g	423.17	477.33
Wt Tare	g	0.00	55.09
Wt Moisture Lost	g	118.42	147.58
Wt Dry Soil	g	423.17	422.24
Water Content	%	27.99%	34.95%

DESCRIPTION

Yellowish Red and Red, FINE SAND, some clayey silt.

TIME FUNCTIONS, SECONDS								dP				
DATE	DAY	HOUR	MIN	TEMP (°C)	dt (min)	dt,acc (min)	dt (sec)	dt,acc (sec)	Reading (psi)	Head (cm)	Gradient	Permeability (cm/sec)
06/10/06	38878	17	38	21.7	0	0	0	0	0.10	7.03	0.94	5.8E-04
06/10/06	38878	17	39	21.7	1	1	60	60	0.10	7.03	0.94	5.8E-04
06/10/06	38878	17	40	21.7	1	2	60	120	0.10	7.03	0.94	5.8E-04
06/10/06	38878	17	41	21.7	1	3	60	180	0.10	7.03	0.94	5.8E-04 *
06/10/06	38878	17	42	21.7	1	4	60	240	0.10	7.03	0.94	5.8E-04 *
06/10/06	38878	17	43	21.7	1	5	60	300	0.10	7.03	0.94	5.8E-04 *
06/10/06	38878	17	44	21.7	1	6	60	360	0.10	7.03	0.94	5.8E-04 *

*TRANSCRIBED FROM ORIGINAL DATA SHEETS

PERMEABILITY REPORTED AS ** 5.8E-04 cm/sec **

DATE	6/10/2006
CHECK	
REVIEW	

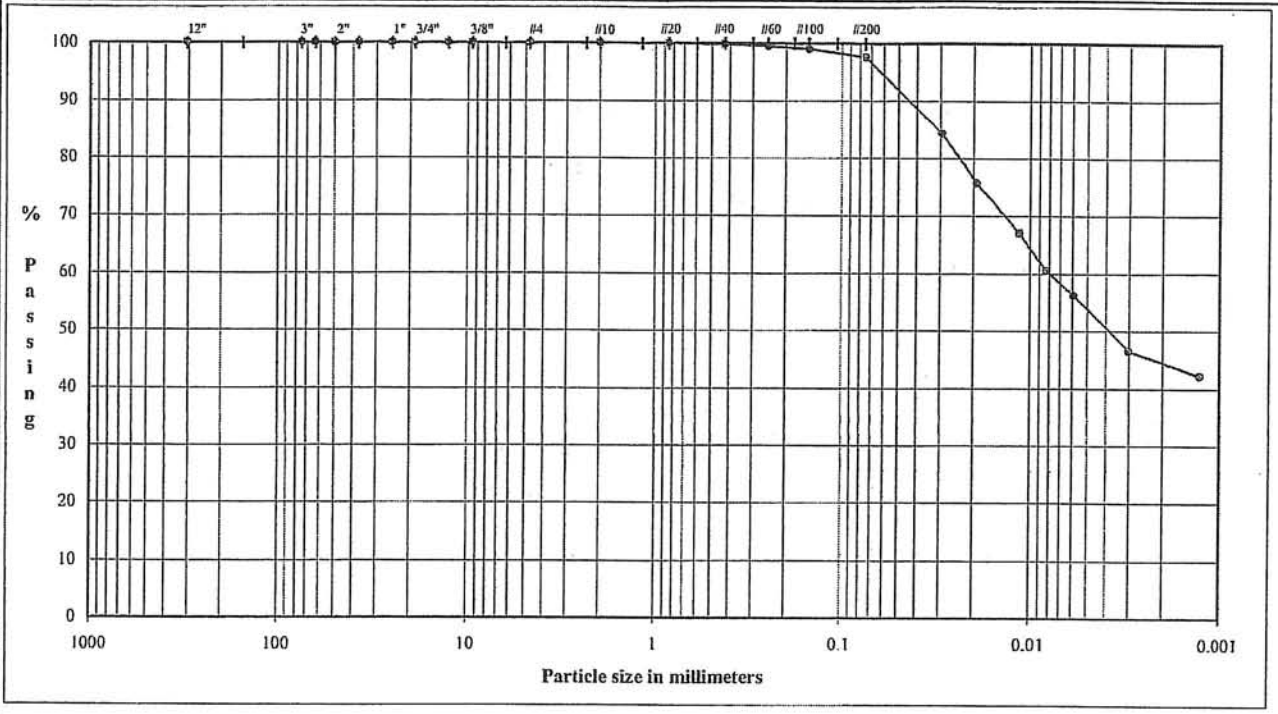
JUNE 2006

063-6507

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: REPUBLIC/PHASE 6 PERMIT APP/NC
SAMPLE ID: PZ-109B Depth: 33.0 - 35.0'
TYPE: UD



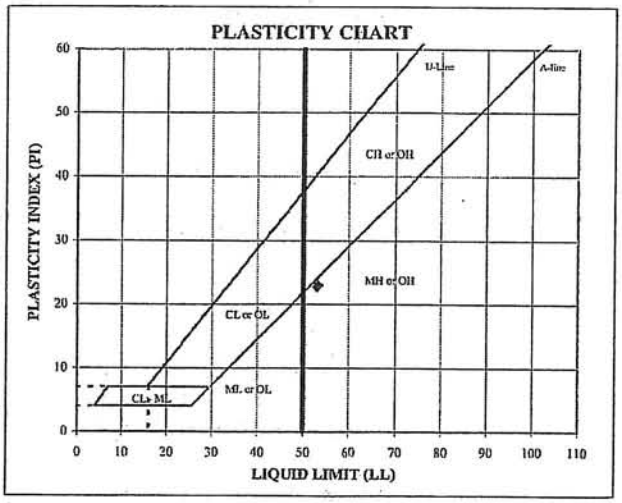
COBBLES	GRAVEL		SAND			FINES
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	ASTM Classification	Wentworth Classification
12.0"	304.8	100.0	Cobbles	
3.0"	75.0	100.0	0.0%	
2.5"	63.5	100.0		
2.0"	50.0	100.0		
1.5"	37.5	100.0	Coarse Gravel	
1.0"	25.0	100.0	0%	
0.75"	19.0	100.0		
0.50"	12.7	100.0	Fine Gravel	Gravel
0.375"	9.5	100.0	0%	0%
#4	4.8	100.0		
#10	2.00	100.0	Coarse Sand	
#20	0.85	99.9	Medium Sand	
#40	0.43	99.8	0%	
#60	0.25	99.5		Sand
#100	0.15	99.0	Fine Sand	5%
#200	0.075	97.6	2%	

Hydrometer Analysis

(mm)	%Finer		
0.030	84.4		
0.019	75.7		
0.011	67.1	Fines	Silt
0.0083	60.6	Silt or Clay	45%
0.0059	56.2	98%	
0.0030	46.5		Mud
0.0013	42.2		50%



ATTERBERG LIMITS
Method -B (Dry preparation)

M_c	LL	PL	PI	LI
72.0	53	30	23	1.83

LL (oven-dried) / LL (not dried) < 0.75 = ORGANIC (OL/OH)

DESCRIPTION: Dark Gray, CLAYEY SILT, trace fine sand.

USCS: MH
USDA: Silty Clay

TECH	SW/TPC
DATE	06/13/06
CHECK	
REVIEW	

Golder Associates Inc.

FLEXIBLE WALL PERMEABILITY
ASTM D 5084
METHOD D, CONSTANT RATE OF FLOW

PROJECT TITLE	REPUBLIC/PHASE 6 PERMIT APP/NC		
PROJECT NUMBER	063-6507		
SAMPLE ID	PZ-109B	33.0 - 35.0'	
SAMPLE TYPE	UD		

Board #	2
Flow Pump	1
Flow Pump Speed	10
Technician	SDM

COMMENTS

Sample Data, Initial			
Height, inches	2.942	B-Value, f	1.00
Diameter, inches	2.866	Cell Pres.	100.0
Area, cm²	41.62	Bot. Pres.	80.0
Volume, cm³	311.02	Top Pres.	80.0
Mass, g	489.89	Tot. B.P.	80.0
Moisture Content, %	71.99	Head, max.	116.06
Dry Density, pcf	57.15	Head, min.	116.06
Spec. Gravity	2.703	Max. Grad.	15.58
Volume Solids, cm³	105.38	Min. Grad.	15.58
Volume Voids, cm³	205.64		
Void Ratio	1.95		
Porosity, %	66		
Saturation, %	99.7%		

Flow Pump Rate 2.45E-05 cm³/sec

Sample Data, Final	
Height, inches	2.933
Diameter, inches	2.832
Area, cm²	40.64
Volume, cm³	302.75
Mass, g	478.59
Moisture Content, %	68.02
Dry Density, pcf	58.71
Volume Solids, cm³	105.38
Volume Voids, cm³	197.38
Void Ratio	1.87
Saturation, %	98.2%

USCS	MH
USDA	Silty Clay

WATER CONTENTS		Sample Initial	Sample Final
Wt Soil & Tare, i	g	489.89	584.74
Wt Soil & Tare, f	g	284.83	391.02
Wt Tare	g	0.00	106.24
Wt Moisture Lost	g	205.06	193.72
Wt Dry Soil	g	284.83	284.78
Water Content	%	71.99%	68.02%

DESCRIPTION

Dark Gray, CLAYEY SILT, trace fine sand.

TIME FUNCTIONS, SECONDS								dP				
DATE	DAY	HOUR	MIN	TEMP (°C)	dt (min)	dt,acc (min)	dt (sec)	dt,acc (sec)	Reading (psi)	Head (cm)	Gradient	Permeability (cm/sec)
06/12/06	38880	9	0	21.8	0	0	0	0	1.65	116.06	15.58	3.7E-08
06/12/06	38880	9	5	21.8	5	5	300	300	1.65	116.06	15.58	3.7E-08
06/12/06	38880	9	10	21.8	5	10	300	600	1.65	116.06	15.58	3.7E-08
06/12/06	38880	9	15	21.8	5	15	300	900	1.65	116.06	15.58	3.7E-08 *
06/12/06	38880	9	20	21.8	5	20	300	1200	1.65	116.06	15.58	3.7E-08 *
06/12/06	38880	9	25	21.8	5	25	300	1500	1.65	116.06	15.58	3.7E-08 *
06/12/06	38880	9	30	21.8	5	30	300	1800	1.65	116.06	15.58	3.7E-08 *

*TRANSCRIBED FROM ORIGINAL DATA SHEETS

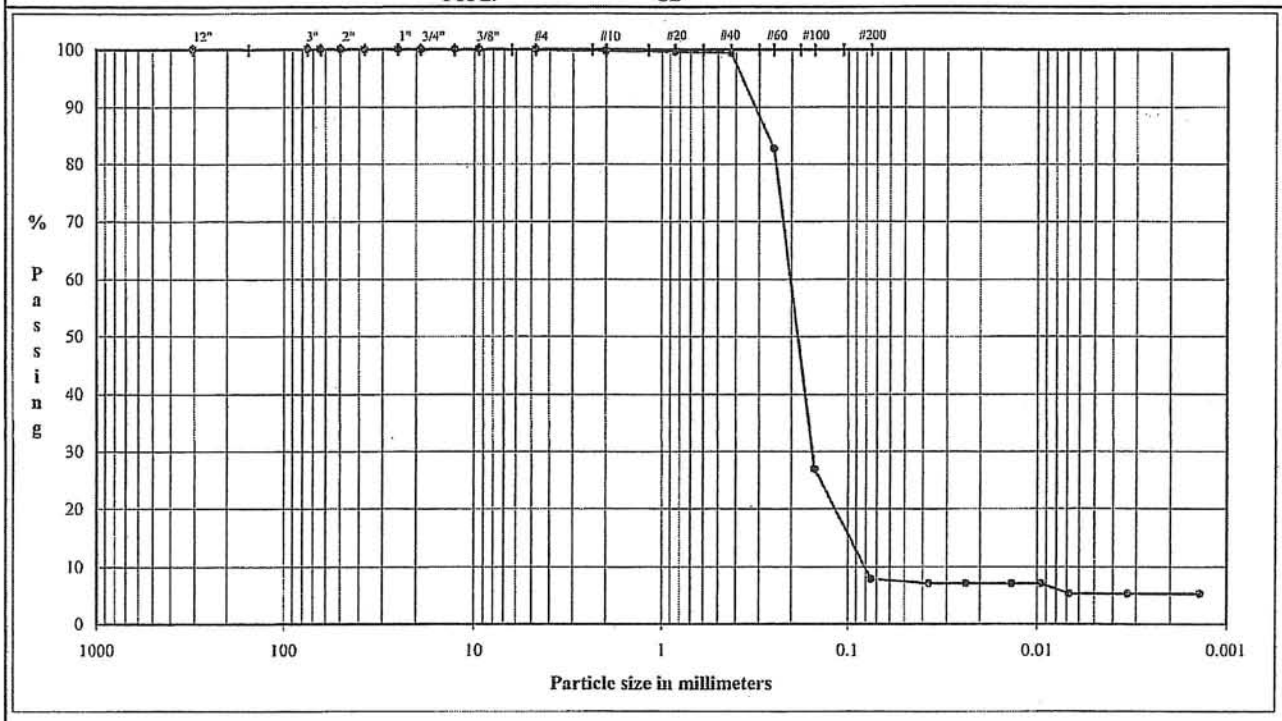
PERMEABILITY REPORTED AS ** 3.7E-08 cm/sec **

DATE	6/12/2006
CHECK	
REVIEW	

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: REPUBLIC/PHASE 6 PERMIT APP/NC
SAMPLE ID: PZ-109B Depth: 45.5 - 47.0'
TYPE: UD



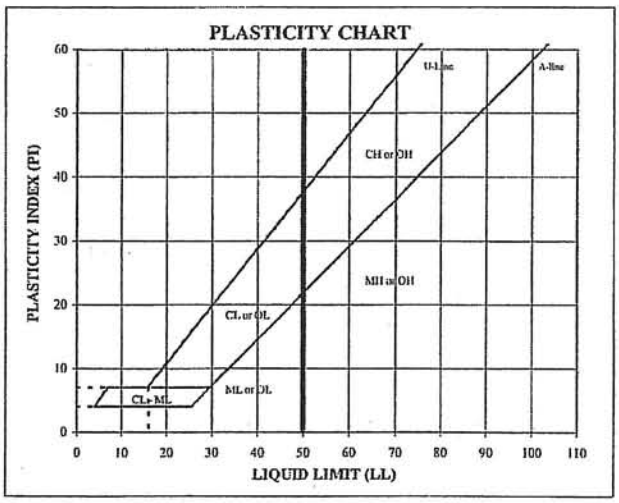
COBBLES	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	ASTM Classification	Wentworth Classification
12.0"	304.8	100.0	Cobbles	
3.0"	75.0	100.0	0.0%	
2.5"	63.5	100.0		
2.0"	50.0	100.0		
1.5"	37.5	100.0	Coarse Gravel	
1.0"	25.0	100.0	0.0%	
0.75"	19.0	100.0		
0.50"	12.7	100.0	Fine Gravel	Gravel
0.375"	9.5	100.0	0.0%	0%
#4	4.8	100.0		
#10	2.00	99.7	Coarse Sand	
#20	0.85	99.6	Medium Sand	
#40	0.43	99.4	0.3%	
#60	0.25	82.7		Sand
#100	0.15	26.9	Fine Sand	92%
#200	0.075	7.8	91.6%	

Hydrometer Analysis

(mm)	%Finer		
0.037	7.1		
0.023	7.1		
0.014	7.1	Fines	Silt
0.0096	7.1	Silt or Clay	3%
0.0068	5.3	7.8%	
0.0033	5.3		Mud
0.0014	5.3		5%



ATTERBERG LIMITS
Method -B (Dry preparation)

M_c	LL	PL	PI	LI
26.0	NP	NP	NP	NP

LL (oven-dried) / <0.75 – ORGANIC (OL/OH)

DESCRIPTION: Yellowish and Reddish Brown, FINE SAND, little clayey silt.

USCS: SP-SM
USDA: Sand

TECH	SW/TJ
DATE	06/13/06
CHECK	
REVIEW	

FLEXIBLE WALL TRIAXIAL PERMEABILITY
ASTM D 5084
METHOD C, FALLING HEAD W/INCREASING TAIL WATER PRESSURE

PROJECT TITLE	REPUBLIC/PHASE 6 PERMIT APP/NC		Using Pipettes Only	YES	COMMENTS
PROJECT NUMBER	063-6507		Using Pipettes & Burettes	NO	
SAMPLE ID	PZ-109B	45.5-47.0'	BOARD#	2 TECH SDM	
SAMPLE TYPE	UD		CELL #	2 DATE 6/14/06	

Sample Data, Initial

Height, inches	2.933
Diameter, inches	2.842
Area, cm^2	40.93
Volume, cm^3	304.90
Mass, g	604.48
Moisture Content, %	25.98
Dry Density, pcf	98.20
Spec. Gravity	2.660
Volume Solids, cm^3	180.38
Volume Voids, cm^3	124.51
Void Ratio	0.69
Porosity, %	41
Saturation	100.1%

B-Value,f	1.00
Cell Pres	100.00
Bot. Pres.	80.00
Top Pres.	80.00
Head, cm	0.00
Max. Grad.	3.29
Min. Grad.	0.74
Max. E.S.	20.00
Min. E.S.	20.00

Sample Data, Final

Height, inches	2.923
Diameter, inches	2.809
Area, cm^2	39.98
Volume, cm^3	296.84
Mass, g	600.64
Moisture Content %	25.18
Dry Density, pcf	100.86
Saturation	103.7%
Inflow Volume per (1 cc)	1.00
Outflow Volume per (1 cc)	1.00

PERMEANT: Deaired Tap Water

Water Contents	Initial	Final
Wt soil&tare, i	604.48	683.79
Wt soil&tare, f	479.81	563.15
Wt Tare	0.00	84.07
Wt Moisture Lost	124.67	120.64
Wt Dry Soil	479.81	479.08
Water Content	25.98%	25.18%

DESCRIPTION: Yellowish and Reddish Brown, FINE SAND, little clayey silt.

USCS: SP-SM USDA: Sand

TIME FUNCTION			READINGS			TIME IN MINUTES & SECONDS						VOLUME		PERMEABILITY
DATE	HOUR	MIN	Inflow (cc)	Outflow (cc)	Temp.	dt (min)	dt (sec)	dt, acc (sec)	Head (cm)	(H1/H2) (inc.)	Gradient	Inflow (cc)	Outflow (cc)	@ 20 Degrees C (cm/sec)
06/14/06	8	18.0	0.0	25.0	21.2	0.0	0.0	0	24.42		3.29	0.00	0.00	0.0
06/14/06	8	18.5	3.3	21.7	21.2	0.5	30	30	17.99	1.36	2.42	3.30	3.30	9.3E-04
06/14/06	8	19.0	5.6	19.4	21.2	0.5	30	60	13.50	1.33	1.82	2.30	2.30	8.7E-04 *
06/14/06	8	19.5	7.6	17.6	21.2	0.5	30	90	9.80	1.38	1.32	2.00	1.80	9.7E-04 *
06/14/06	8	20.0	8.7	16.3	21.2	0.5	30	120	7.46	1.31	1.00	1.10	1.30	8.3E-04 *
06/14/06	8	20.5	9.7	15.3	21.2	0.5	30	150	5.51	1.35	0.74	1.00	1.00	9.2E-04 *

Inflow Rate	0.0647
Outflow Rate	0.0647
Outflow/Inflow Ratio	1.00

PERMEABILITY REPORTED AS: 9.0E-04 cm/sec

*TRANSCRIBED FROM ORIGINAL DATA SHEETS

DATE: 6/14/2006
CHECK:
REVIEW:

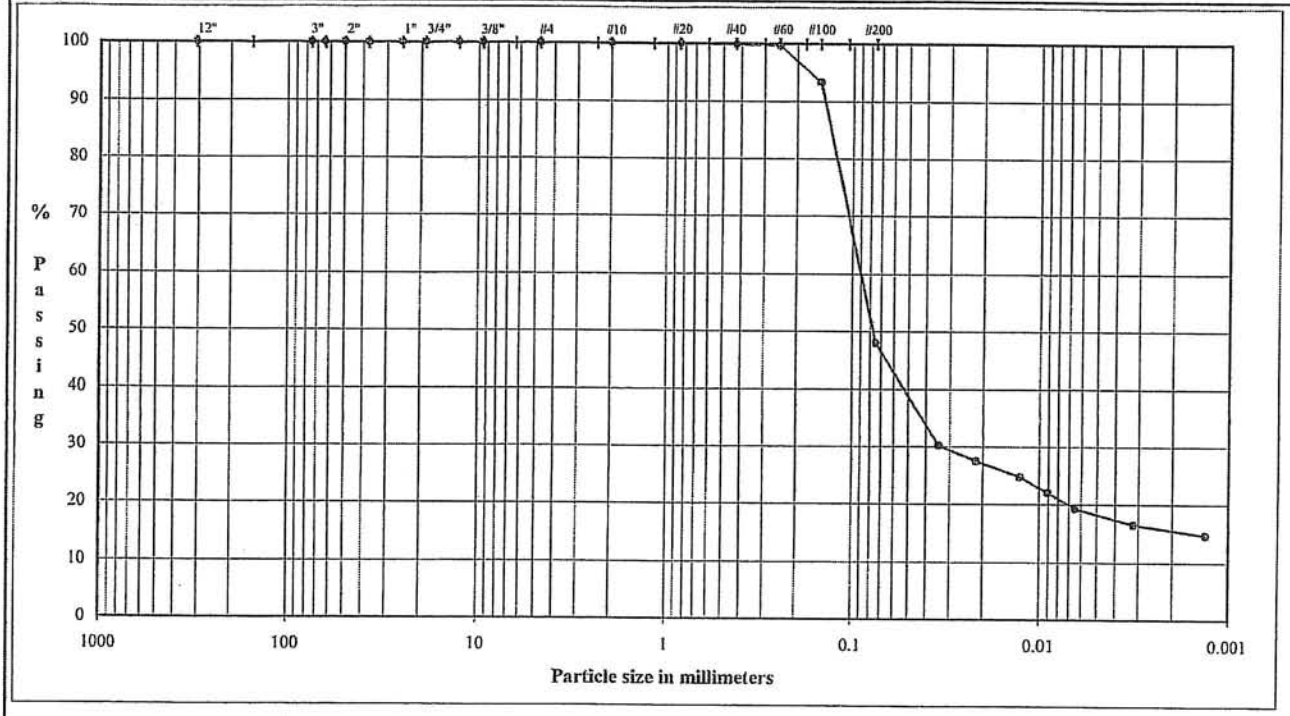
JUNE 2006

063-6507

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: REPUBLIC/PHASE 6 PERMIT APP/NC
SAMPLE ID: PZ-115B Depth: 44.0 - 45.5'
TYPE: UD



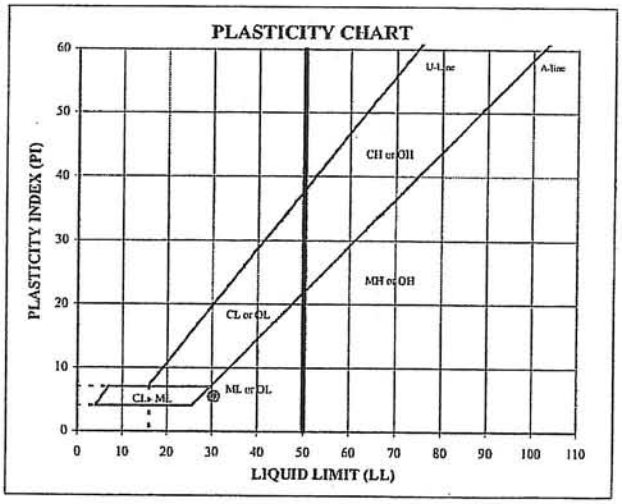
COBBLES	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	ASTM Classification	Wentworth Classification
12.0"	304.8	100.0	Cobbles 0.0%	Gravel 0%
3.0"	75.0	100.0		
2.5"	63.5	100.0	Coarse Gravel 0.0%	
2.0"	50.0	100.0		
1.5"	37.5	100.0		
1.0"	25.0	100.0		
0.75"	19.0	100.0		
0.50"	12.7	100.0	Fine Gravel 0.0%	
0.375"	9.5	100.0		
#4	4.8	100.0		
#10	2.00	100.0	Coarse Sand	Sand 56%
#20	0.85	100.0	Medium Sand 0.1%	
#40	0.43	99.9		
#60	0.25	99.6	Fine Sand 51.9%	
#100	0.15	93.3		
#200	0.075	48.0		

Hydrometer Analysis

(mm)	%Finer		
0.034	30.2	Fines Silt or Clay 48.0%	Silt 27%
0.022	27.4		
0.013	24.7		
0.0090	22.0		
0.0065	19.2		
0.0032	16.5		Mud 17%
0.0013	14.6		



ATTERBERG LIMITS
Method -B (Dry preparation)

M_r	LL	PL	PI	LI
31.1	30	25	5	1.14

LL (oven-dried) / LL (oven-dried) / <0.75 = ORGANIC (OL/OH)

DESCRIPTION: Gray, FINE SAND, and clayey silt.

USCS: SM
USDA: Sandy Loam

TECH	TJ/TPC/BW
DATE	06/13/06
CHECK	
REVIEW	

Golder Associates Inc.

FLEXIBLE WALL PERMEABILITY
ASTM D 5084
METHOD D, CONSTANT RATE OF FLOW

PROJECT TITLE	REPUBLIC/PHASE 6 PERMIT APP/NC		
PROJECT NUMBER	063-6507		
SAMPLE ID	PZ-115B	44.0 - 45.5'	
SAMPLE TYPE	UD		

Board #	1
Flow Pump	1
Flow Pump Speed	5
Technician	SDM

COMMENTS

Sample Data, Initial			
Height, inches	2.933	B-Value, f	1.00
Diameter, inches	2.857	Cell Pres.	100.0
Area, cm²	41.36	Bot. Pres.	80.0
Volume, cm³	308.12	Top Pres.	80.0
Mass, g	591.87	Tot. B.P.	80.0
Moisture Content, %	31.15	Head, max.	73.86
Dry Density, pcf	91.40	Head, min.	73.86
Spec. Gravity	2.698	Max. Grad.	9.98
Volume Solids, cm³	167.27	Min. Grad.	9.98
Volume Voids, cm³	140.85		
Void Ratio	0.84		
Porosity, %	46		
Saturation, %	99.8%		

Flow Pump Rate 1.26E-03 cm³/sec

Sample Data, Final	
Height, inches	2.915
Diameter, inches	2.853
Area, cm²	41.24
Volume, cm³	305.37
Mass, g	586.71
Moisture Content, %	30.00
Dry Density, pcf	92.22
Volume Solids, cm³	167.27
Volume Voids, cm³	138.10
Void Ratio	0.83
Saturation, %	98.0%

USCS	SM
USDA	Sandy Loam

WATER CONTENTS		Sample Initial	Sample Final
Wt Soil & Tare, i	g	591.87	668.01
Wt Soil & Tare, f	g	451.31	532.65
Wt Tare	g	0.00	81.49
Wt Moisture Lost	g	140.56	135.36
Wt Dry Soil	g	451.31	451.16
Water Content	%	31.15%	30.00%

DESCRIPTION

Gray, FINE SAND, and clayey silt.

TIME FUNCTIONS, SECONDS								dP				
DATE	DAY	HOUR	MIN	TEMP (°C)	dt (min)	dt,acc (min)	dt (sec)	dt,acc (sec)	Reading (psi)	Head (cm)	Gradient	Permeability (cm/sec)
06/14/06	38882	8	35	21.3	0	0	0	0	1.05	73.86	9.98	3.0E-06
06/14/06	38882	8	40	21.3	5	5	300	300	1.05	73.86	9.98	3.0E-06
06/14/06	38882	8	45	21.3	5	10	300	600	1.05	73.86	9.98	3.0E-06
06/14/06	38882	8	50	21.3	5	15	300	900	1.05	73.86	9.98	3.0E-06 *
06/14/06	38882	8	55	21.3	5	20	300	1200	1.05	73.86	9.98	3.0E-06 *
06/14/06	38882	9	0	21.3	5	25	300	1500	1.05	73.86	9.98	3.0E-06 *
06/14/06	38882	9	5	21.3	5	30	300	1800	1.05	73.86	9.98	3.0E-06 *

*TRANSCRIBED FROM ORIGINAL DATA SHEETS

PERMEABILITY REPORTED AS ** 3.0E-06 cm/sec **

DATE	6/14/2006
CHECK	
REVIEW	

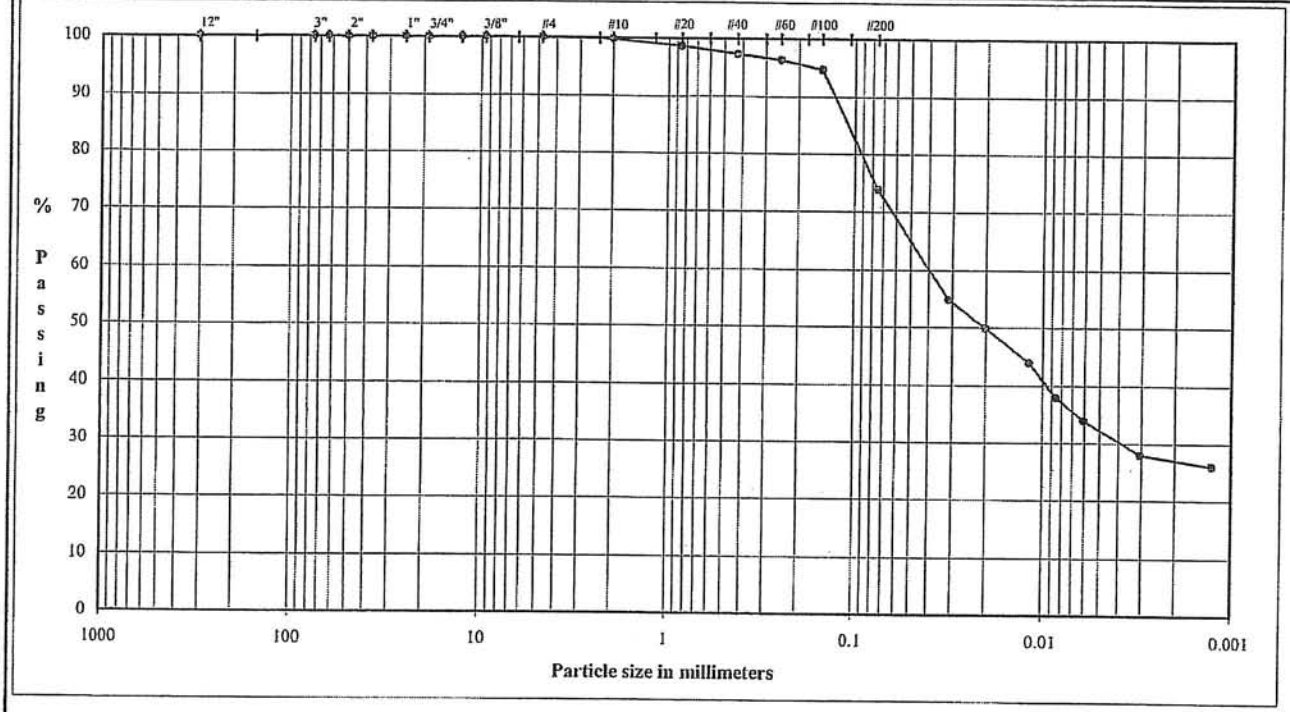
JUNE 2006

063-6507

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: REPUBLIC/PHASE 6 PERMIT APP/NC
SAMPLE ID: PZ-117A Depth: 10.0 - 18.0'
TYPE: Bags



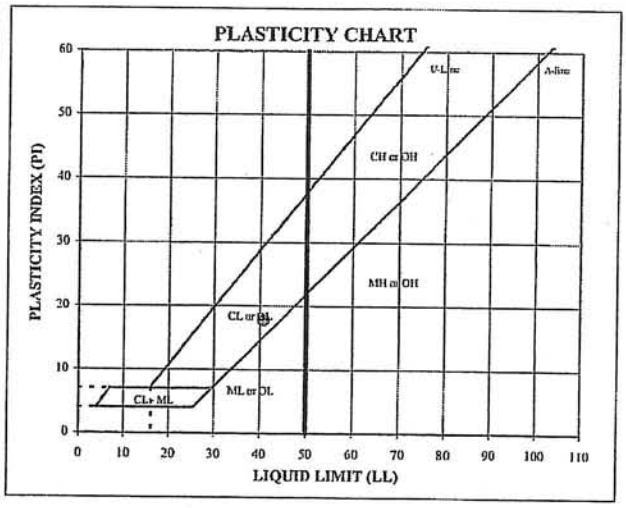
COBBLES	GRAVEL		SAND			FINES
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	ASTM Classification	Wentworth Classification
12.0"	304.8	100.0	Cobbles 0.0%	Gravel 0%
3.0"	75.0	100.0		
2.5"	63.5	100.0	Coarse Gravel 0.0%	
2.0"	50.0	100.0		
1.5"	37.5	100.0		
1.0"	25.0	100.0		
0.75"	19.0	100.0		
0.50"	12.7	100.0	Fine Gravel 0.0%	
0.375"	9.5	100.0		
#4	4.8	100.0		
#10	2.00	99.8	Coarse Sand	Sand 30%
#20	0.85	98.7	Medium Sand 2.5%	
#40	0.43	97.3		
#60	0.25	96.3	Fine Sand 23.5%	
#100	0.15	94.7		
#200	0.075	73.9		

Hydrometer Analysis

(mm)	%Finer		
0.031	54.8	Fines Silt or Clay 73.9%	Silt 40%
0.020	49.9		
0.012	43.9		
0.0086	37.9		
0.0061	33.9		
0.0031	27.9		Mud 30%
0.0013	25.9		



ATTERBERG LIMITS
Method -B (Dry preparation)

M_c	LL	PL	PI	LI
30.0	41	23	18	0.40

LL (oven-dried) / < 0.75 = ORGANIC (OL/OH)

DESCRIPTION: Yellowish Brown, SILTY CLAY, some fine sand.

USCS: CL
USDA: Loam

TECH	TJ/BW
DATE	06/13/06
CHECK	
REVIEW	

Golder Associates Inc.

FLEXIBLE WALL PERMEABILITY
ASTM D 5084
METHOD D, CONSTANT RATE OF FLOW

PROJECT TITLE	REPUBLIC/PHASE 6 PERMIT APP/NC	
PROJECT NUMBER	063-6507	
SAMPLE ID	PZ-117A	10.0 - 18.0'
SAMPLE TYPE	Bags	

Board #	10
Flow Pump	1
Flow Pump Speed	9
Technician	SDM

COMMENTS: Per instructions, bags samples were combined and targeted for a remold dry density and moisture content of shelby tube PZ - 109 - 14.0-16.0' - (85.4 pcf @ 28.0%)

Sample Data, Initial		B-Value, f	0.98
Height, inches	3.011	Cell Pres.	100.0
Diameter, inches	2.790	Bot. Pres.	80.0
Area, cm²	39.44	Top Pres.	80.0
Volume, cm³	301.65	Tot. B.P.	80.0
Mass, g	526.80	Head, max.	96.37
Moisture Content, %	29.97	Head, min.	96.37
Dry Density, pcf	83.84	Max. Grad.	12.75
Spec. Gravity	2.729	Min. Grad.	12.75
Volume Solids, cm³	148.52		
Volume Voids, cm³	153.13		
Void Ratio	1.03		
Porosity, %	51		
Saturation, %	79.3%		

Flow Pump Rate: 5.04E-05 cm³/sec

Sample Data, Final	
Height, inches	2.976
Diameter, inches	2.762
Area, cm²	38.65
Volume, cm³	292.19
Mass, g	535.42
Moisture Content, %	32.10
Dry Density, pcf	86.56
Volume Solids, cm³	148.52
Volume Voids, cm³	143.67
Void Ratio	0.97
Saturation, %	90.6%

USCS	CL
USDA	Loam

WATER CONTENTS		Sample Initial	Sample Final
Wt Soil & Tare, i	g	526.80	618.65
Wt Soil & Tare, f	g	405.32	488.61
Wt Tare	g	0.00	83.48
Wt Moisture Lost	g	121.48	130.04
Wt Dry Soil	g	405.32	405.13
Water Content	%	29.97%	32.10%

DESCRIPTION: Yellowish Brown, SILTY CLAY, some fine sand.

TIME FUNCTIONS, SECONDS								dP				
DATE	DAY	HOUR	MIN	TEMP (°C)	dt (min)	dt,acc (min)	dt (sec)	dt,acc (sec)	Reading (psi)	Head (cm)	Gradient	Permeability (cm/sec)
06/15/06	38883	10	50	21.5	0	0	0	0	1.37	96.37	12.75	9.9E-08
06/15/06	38883	10	55	21.5	5	5	300	300	1.37	96.37	12.75	9.9E-08
06/15/06	38883	11	0	21.5	5	10	300	600	1.37	96.37	12.75	9.9E-08
06/15/06	38883	11	5	21.5	5	15	300	900	1.37	96.37	12.75	9.9E-08 *
06/15/06	38883	11	10	21.5	5	20	300	1200	1.37	96.37	12.75	9.9E-08 *
06/15/06	38883	11	15	21.5	5	25	300	1500	1.37	96.37	12.75	9.9E-08 *
06/15/06	38883	11	20	21.5	5	30	300	1800	1.37	96.37	12.75	9.9E-08 *

*TRANSCRIBED FROM ORIGINAL DATA SHEETS

PERMEABILITY REPORTED AS ** 9.9E-08 cm/sec **

DATE	6/15/2006
CHECK	
REVIEW	

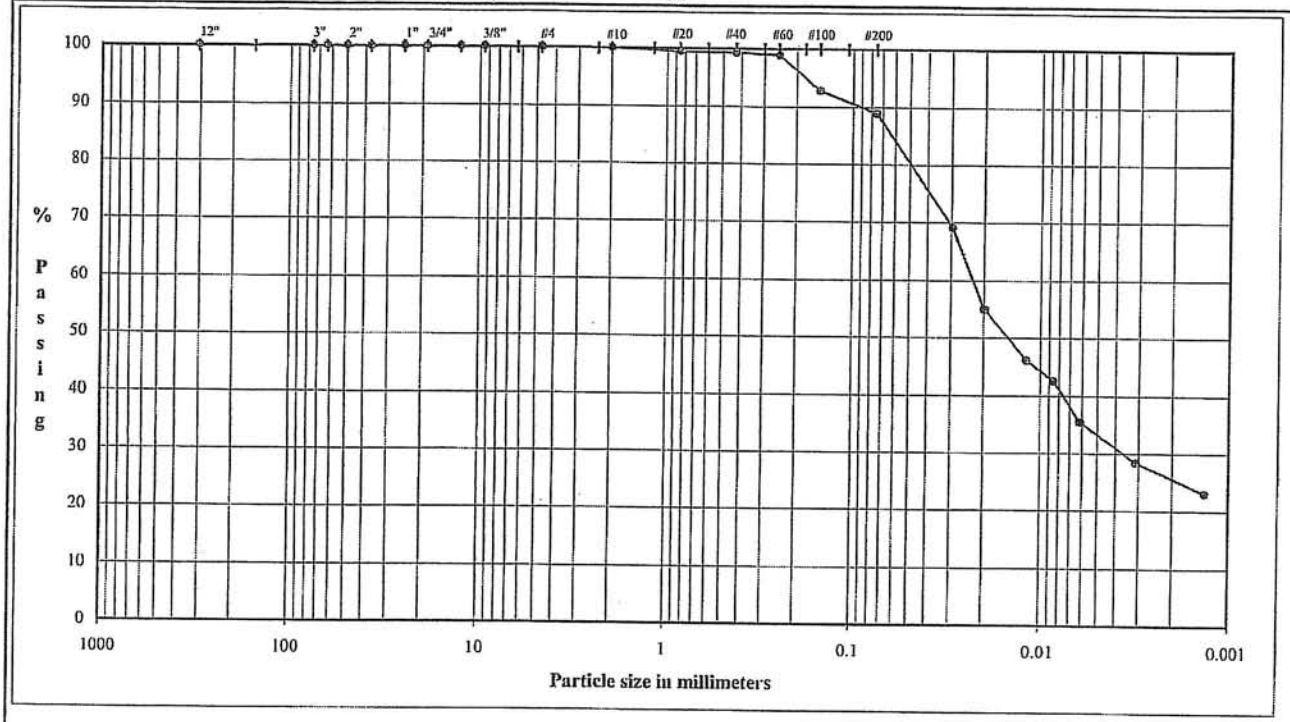
JUNE 2006

063-6507

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: REPUBLIC/PHASE 6 PERMIT APP/NC
SAMPLE ID: PZ-117B Depth: 22.0 - 24.0'
TYPE: UD



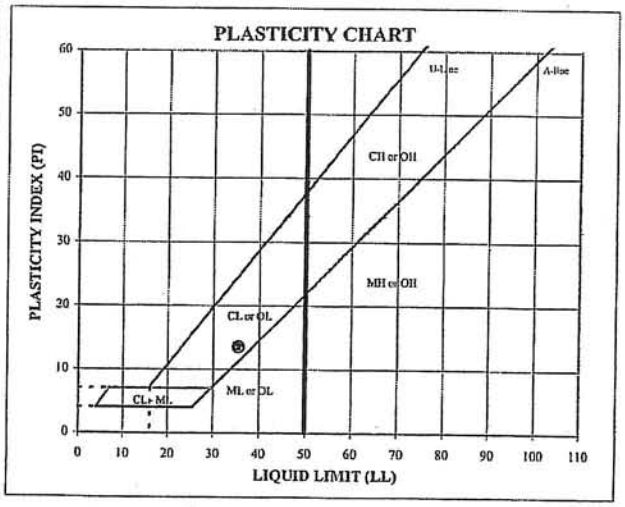
COBBLES	GRAVEL		SAND			FINES
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	ASTM Classification	Wentworth Classification
12.0"	304.8	100.0	Cobbles 0.0%	Gravel 0%
3.0"	75.0	100.0		
2.5"	63.5	100.0	Coarse Gravel 0.0%	
2.0"	50.0	100.0		
1.5"	37.5	100.0		
1.0"	25.0	100.0		
0.75"	19.0	100.0		
0.50"	12.7	100.0	Fine Gravel 0.0%	
0.375"	9.5	100.0		
#4	4.8	100.0		
#10	2.00	100.0	Coarse Sand	Sand 14%
#20	0.85	99.4	Medium Sand 0.7%	
#40	0.43	99.3		
#60	0.25	98.9		
#100	0.15	92.8	Fine Sand 10.4%	
#200	0.075	88.9		

Hydrometer Analysis

(mm)	%Finer		
0.030	69.1	Fines Silt or Clay 88.9%	Silt 56%
0.020	54.9		
0.012	46.1		
0.0086	42.5		
0.0062	35.4		
0.0031	28.3		Mud 30%
0.0013	23.0		



ATTERBERG LIMITS
Method -B (Dry preparation)

M_c	LL	PL	PI	LI
62.2	35	22	13	2.99

LL (oven-dried) / < 0.75 = ORGANIC (OL/OH)

DESCRIPTION: Gray and Yellow, SILTY CLAY, little fine sand.

USCS: CL
USDA: Silty Loam

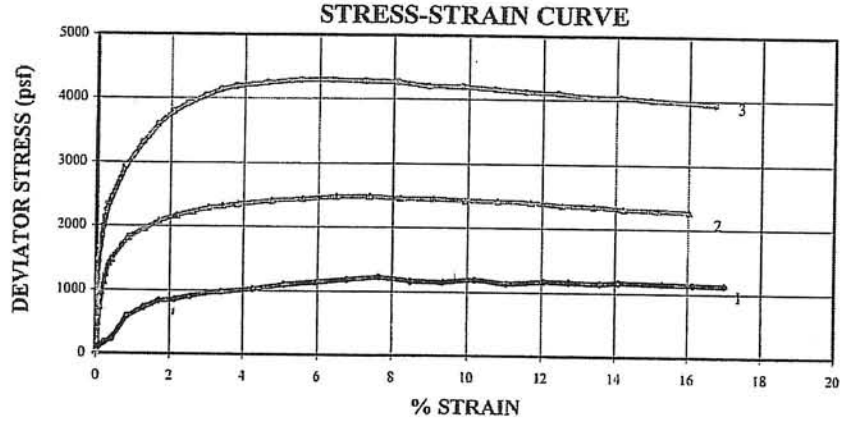
TECH	TJ/TPC
DATE	06/07/06
CHECK	
REVIEW	

Golder Associates Inc.

TRIAXIAL COMPRESSION TEST - CONSOLIDATED UNDRAINED WITH PORE PRESSURE
ASTM D 4767

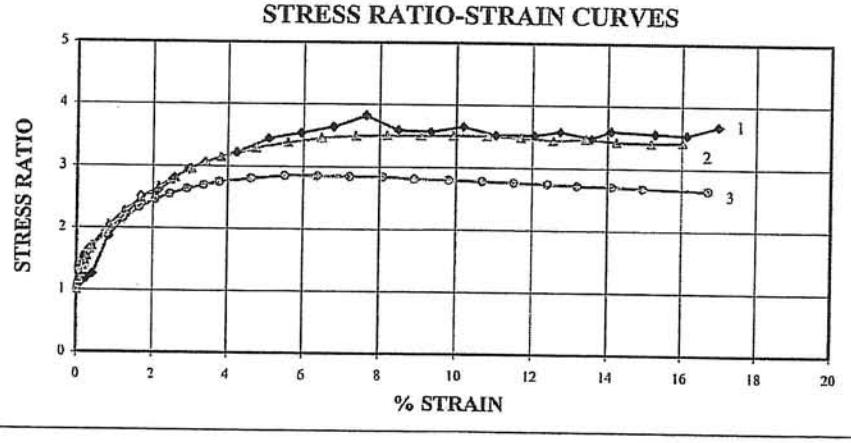
PROJECT NAME: REPUBLIC/PHASE 6 PERMIT APP/NC
PROJECT NUMBER: 063-6507
SAMPLE ID: PZ - 117B DEPTH: 22.0 - 24.0' Sample Type: UD

STRESS-STRAIN CURVE

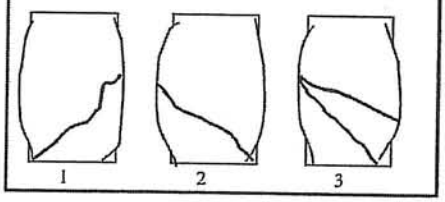


Specimen	Effective Confining Pressure (psf)	Initial Dry Density (pcf)	Initial Moisture Content (%)
1	1008	69.1	65.2
2	3024	77.0	50.5
3	5040	91.3	30.7
	Average	79.1	48.8

STRESS RATIO-STRAIN CURVES

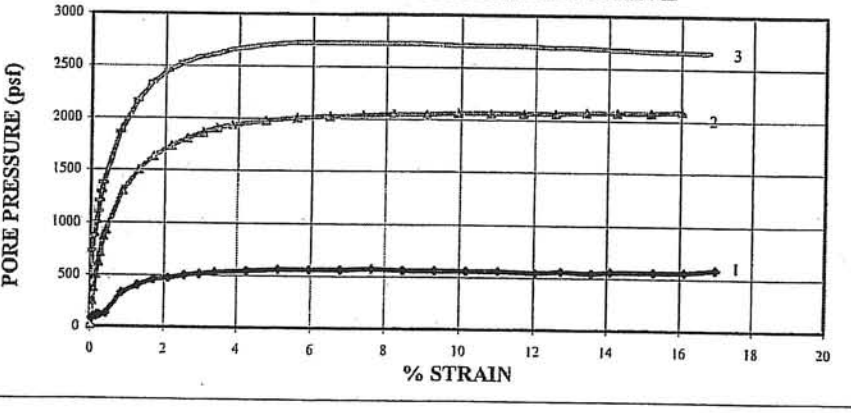


FAILURE SKETCH



1= Top of tube - Dark Gray very wet material
2 = Middle of tube - Dark Gray very wet material
3 = Bottom of tube - Dark Gray and Yellowish Brown not a wet as cut 1 & 2.

PORE PRESSURE-STRAIN CURVE



Soil Description

Dark Gray, SILTY CLAY, little fine sand,
Yellowish Brown, SILTY CLAY, trace fine sand.

USCS: - USDA: -

LL	PL	PI
-	-	-

Comments

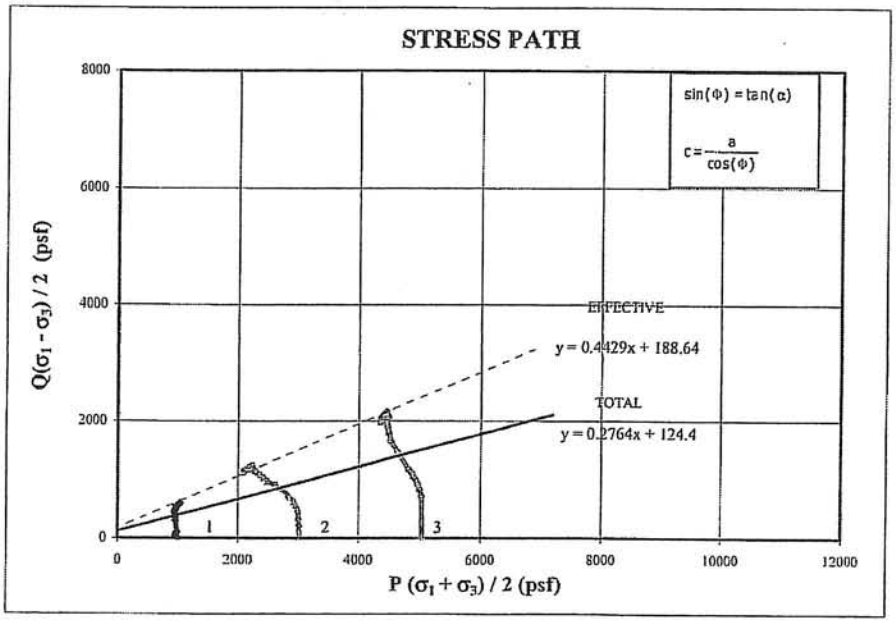
NOTE: Not sure what is happening with initial and final Saturation .

* Failure based on effective stress ratio or 15% strain.

CHECK
REVIEW

TRIAXIAL COMPRESSION TEST - CONSOLIDATED UNDRAINED WITH PORE PRESSURE
ASTM D 4767

PROJECT NAME: REPUBLIC/PHASE 6 PERMIT APP/NC
PROJECT NUMBER: 063-6507
SAMPLE ID: PZ - 117B DEPTH: 22.0 - 24.0' Sample Type: UD

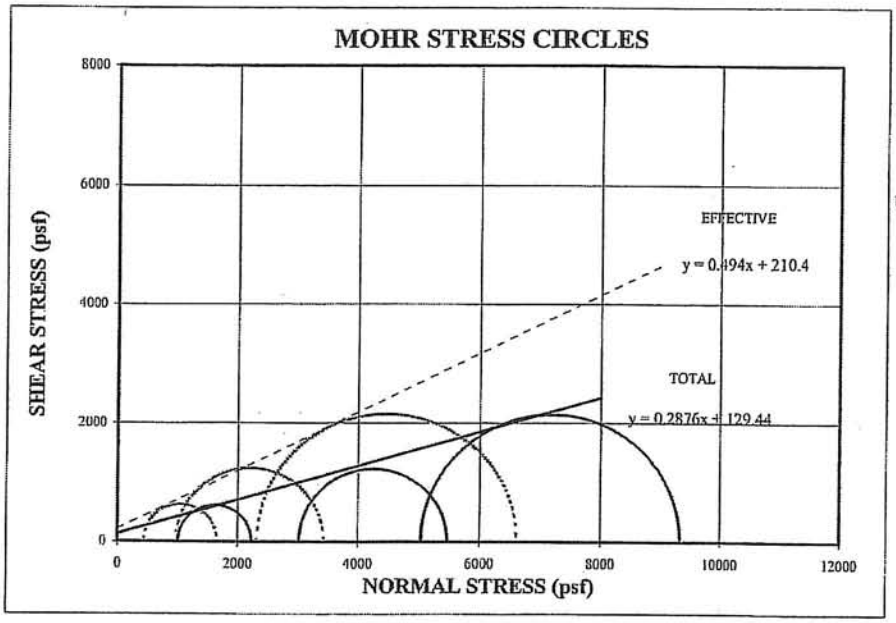


Specimen	Effective Confining Pressure (psf)	Initial Dry Density (pcf)	Initial Moisture Content (%)
1	1008	69.1	65.2
2	3024	77.0	50.5
3	5040	91.3	30.7

Specimen	Strain Rate (%)	Initial Saturation (%)	Saturation Before Shearing (%)
1	0.014	123.5	135.3
2	0.017	115.5	116.7
3	0.017	97.1	98.9

STRESS PATH			MOHR CIRCLES		
*TOTAL STRESS PARAMETER			*TOTAL STRENGTH PARAMETER		
α	=	15.5 °	ϕ	=	16.0 °
a	=	124.4 psf	c	=	129.4 psf
* EFFECTIVE STRESS PARAMETER			*EFFECTIVE STRENGTH PARAMETER		
α'	=	23.9 °	ϕ'	=	26.3 °
a'	=	188.6 psf	c'	=	210.4 psf

1= Top of tube - Dark Gray very wet material
2 = Middle of tube - Dark Gray very wet material
3 = Bottom of tube - Dark Gray and Yellowish Brown not a wet as cut 1 & 2.



Soil Description

Dark Gray, SILTY CLAY, little fine sand,
Yellowish Brown, SILTY CLAY, trace fine sand.

USCS - USDA Silty Loam

LL	PL	PI
-	-	-

Comments

NOTE: Not sure what is happening with initial and final Saturation .

*** Failure based on effective stress ratio or 15% strain.**

CHECK
REVIEW

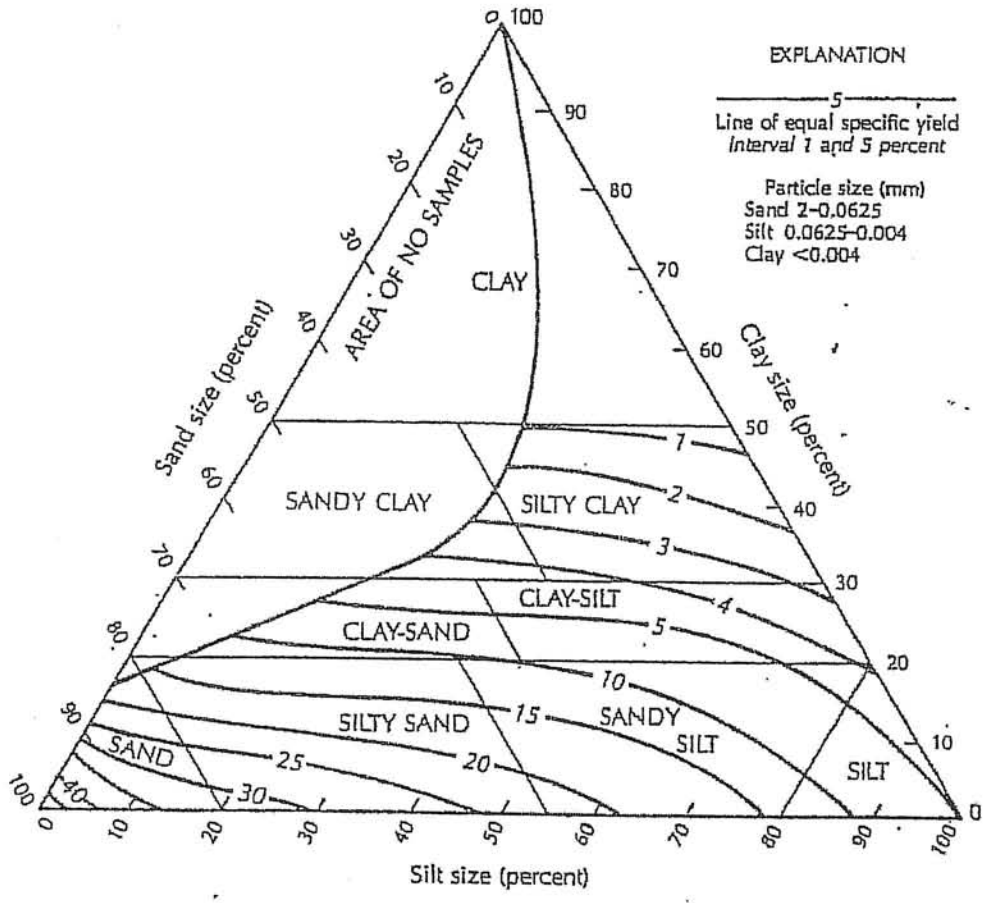


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A.I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.

APPENDIX D

SINGLE WELL AQUIFER (SLUG) TEST RESULTS

Data Set: C:\Documents and Settings\dreedy\My Documents\Phase 5 Application for Permit to Construct\Phase 5
Date: 12/03/06
Time: 12:26:20

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Date: 10/31/06
Test Well: PZ-119 Falling

AQUIFER DATA

Saturated Thickness: 14.8 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PZ-109A

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 0.679 ft
Static Water Column Height: 12.61 ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft
Well Skin Radius: 0.3438 ft
Screen Length: 10. ft
Total Well Penetration Depth: 20. ft

No. of Observations: 84

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.25	0.036	17.88	0.046
0.51	0.036	18.96	0.044
0.75	0.032	20.1	0.048
1.	0.036	21.3	0.041
1.599	0.039	22.56	0.019
1.802	0.037	23.88	0.043
2.004	0.033	25.32	0.036
2.208	0.046	26.82	0.037
2.579	0.037	28.38	0.036
2.792	0.052	30.06	0.035
3.006	0.039	31.86	0.035
3.224	0.118	33.72	0.037
3.438	0.577	35.76	0.036
4.017	0.635	37.86	0.035
4.22	0.679	40.08	0.035
4.423	0.64	42.48	0.029
4.811	0.61	45.	0.034
5.026	0.596	47.64	0.034
5.237	0.553	50.46	0.033
5.439	0.477	53.46	0.033
5.642	0.409	56.64	0.031
5.845	0.408	60.	0.031
6.048	0.445	63.6	0.033
6.26	0.415	67.2	0.033
6.465	0.402	71.4	0.028
6.72	0.354	75.6	0.032
7.14	0.359	79.8	0.028
7.56	0.381	84.6	0.029
7.98	0.368	90.	0.031
8.46	0.218	94.81	0.031
9.	0.107	100.8	0.028

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
9.48	0.125	106.8	0.027
10.08	0.123	112.8	0.029
10.68	0.103	119.4	0.027
11.28	0.078	126.6	0.031
11.94	0.063	134.4	0.032
12.66	0.062	142.2	0.032
13.44	0.06	150.6	0.029
14.22	0.056	159.6	0.031
15.06	0.054	169.2	0.029
15.96	0.057	178.8	0.029
16.92	0.049	189.6	0.031

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 4.139

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.0001875	cm/sec
y0	0.05186	ft

T = T*b = 0.08457 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
K	0.001183	0.0004248	+/- 0.0008449	2.785	cm/sec
y0	0.2984	0.04335	+/- 0.08623	6.883	ft

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = T*b = 0.5336 cm²/sec

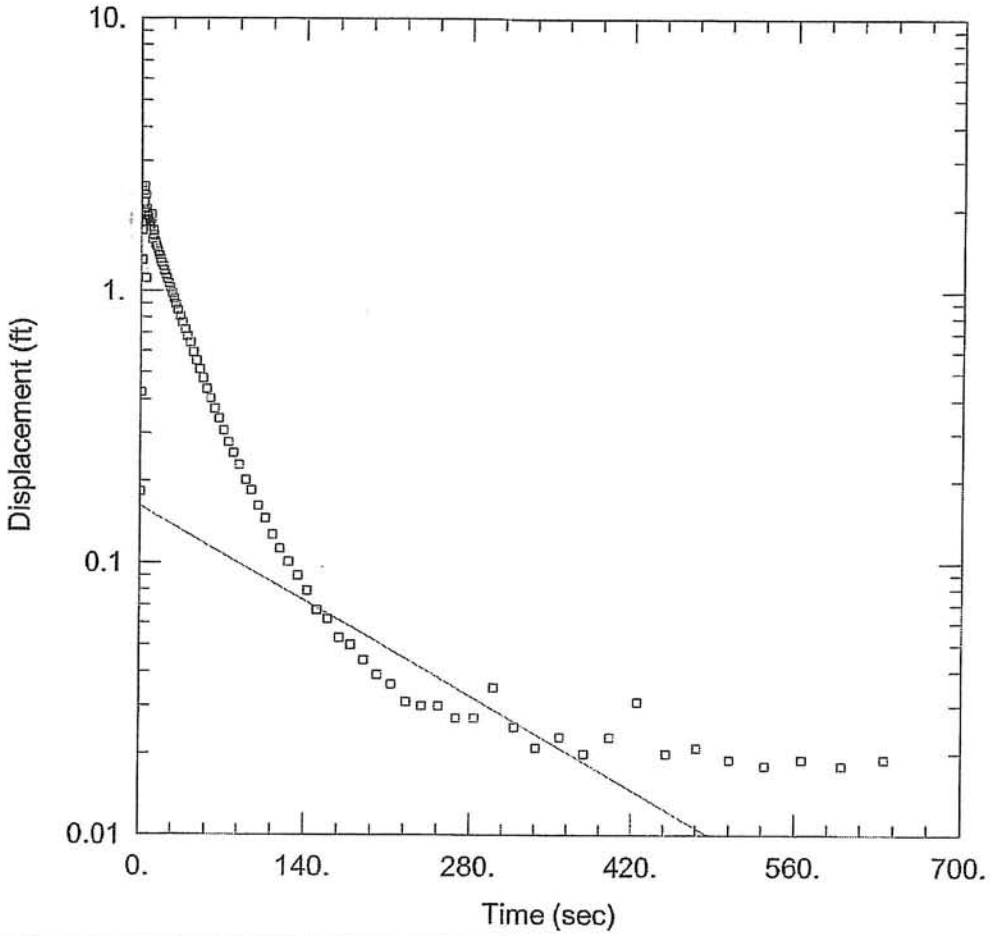
Parameter Correlations

	K	y0
K	1.00	0.70
y0	0.70	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 2.108 ft^2
Variance . . . . . 0.0257 ft^2
Std. Deviation . . . . . 0.1603 ft
Mean . . . . . 0.002606 ft
No. of Residuals 84
No. of Estimates 2



WELL TEST ANALYSIS

Data Set: C:\...\PZ-109B Falling.aqt
Date: 12/03/06 Time: 12:26:52

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Well: PZ-109B Falling
Test Date: 10/31/06

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PZ-109B)

Initial Displacement: 2.419 ft
Total Well Penetration Depth: 52. ft
Casing Radius: 0.083 ft
Static Water Column Height: 9.09 ft
Screen Length: 5. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.0003309 cm/sec
y0 = 0.1614 ft

Data Set: C:\Documents and Settings\dreedy\My Documents\Phase 5 Application for Permit to Construct\Phase 5
Date: 12/03/06
Time: 12:26:58

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Date: 10/31/06
Test Well: PZ-109B Falling

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PZ-109B

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.419 ft
Static Water Column Height: 9.09 ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft
Well Skin Radius: 0.3438 ft
Screen Length: 5. ft
Total Well Penetration Depth: 52. ft

No. of Observations: 105

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.25	0.	33.72	0.806
0.5	0.182	35.76	0.764
0.898	0.425	37.86	0.72
1.103	1.306	40.08	0.678
1.306	1.68	42.48	0.644
1.518	1.301	45.	0.593
1.75	1.773	47.64	0.553
2.141	2.109	50.46	0.514
2.344	2.327	53.46	0.477
2.56	2.26	56.64	0.437
2.77	1.944	60.	0.404
3.	2.419	63.6	0.369
3.25	2.133	67.2	0.34
3.5	1.805	71.4	0.307
3.75	1.966	75.6	0.278
4.	2.254	79.8	0.254
4.25	1.116	84.6	0.229
4.5	1.83	90.	0.202
4.75	1.999	94.8	0.185
5.	1.887	100.8	0.162
5.25	1.904	106.8	0.146
5.5	1.898	112.8	0.127
5.75	1.873	119.4	0.113
6.	1.866	126.6	0.101
6.36	1.843	134.4	0.09
6.72	1.819	142.2	0.079
7.14	1.807	150.6	0.067
7.56	1.73	159.6	0.062
7.98	1.749	169.2	0.053
8.46	1.782	178.8	0.05
9.	1.914	189.6	0.044

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
9.48	1.764	201.	0.039
10.08	1.555	213.	0.036
10.68	1.679	225.6	0.031
11.28	1.609	238.8	0.03
11.94	1.525	253.2	0.03
12.66	1.501	268.2	0.027
13.44	1.464	283.8	0.027
14.22	1.429	300.6	0.035
15.06	1.39	318.6	0.025
15.96	1.353	337.2	0.021
16.92	1.314	357.6	0.023
17.88	1.277	378.6	0.02
18.96	1.235	400.8	0.023
20.1	1.193	424.8	0.031
21.3	1.153	450.	0.02
22.57	1.11	476.4	0.021
23.88	1.068	504.6	0.019
25.32	1.026	534.6	0.018
26.82	0.983	566.4	0.019
28.38	0.938	600.	0.018
30.06	0.893	636.	0.019
31.86	0.847		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 4.534

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.0003309	cm/sec
y0	0.1614	ft

T = T*b = 0.5043 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
K	0.001258	0.0001425	+/- 0.0002825	8.83	cm/sec
y0	1.853	0.07036	+/- 0.1395	26.34	ft

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = T*b = 1.917 cm²/sec

Parameter Correlations

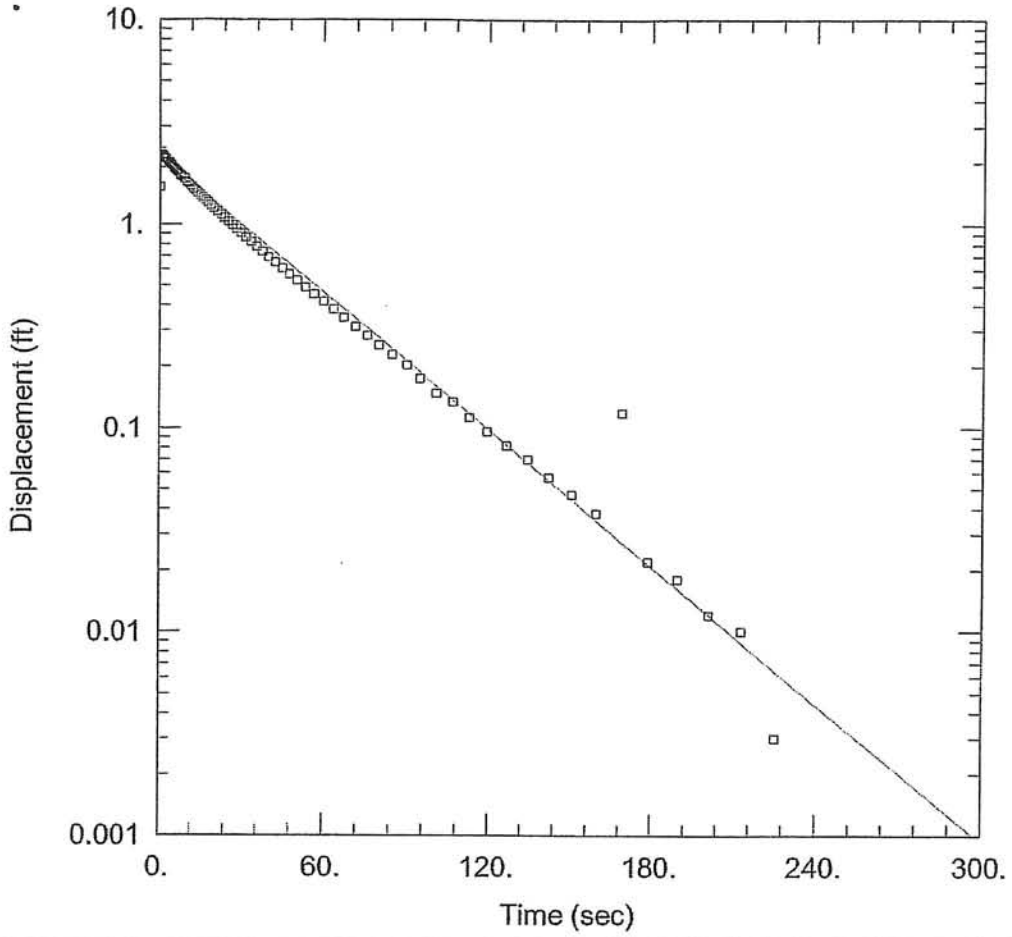
	K	y0
K	1.00	0.63
y0	0.63	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 11.85 ft^2
Variance . . . . . 0.1151 ft^2
Std. Deviation . . . . . 0.3392 ft

Mean . . . . . -0.002003 ft
No. of Residuals 105
No. of Estimates 2



WELL TEST ANALYSIS

Data Set: C:\...\PZ-109B Rising.aqt
Date: 12/03/06 Time: 12:27:10

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Well: PZ-109B Rising
Test Date: 10/31/06

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PZ-109B)

Initial Displacement: 2.261 ft
Total Well Penetration Depth: 99. ft
Casing Radius: 0.083 ft
Static Water Column Height: 9.09 ft
Screen Length: 52. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.000183 cm/sec
y0 = 2.172 ft

Data Set: C:\Documents and Settings\dreedy\My Documents\Phase 5 Application for Permit to Construct\Phase
Date: 12/03/06
Time: 12:27:15

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Date: 10/31/06
Test Well: PZ-109B Rising

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PZ-109B

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.261 ft
Static Water Column Height: 9.09 ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft
Well Skin Radius: 0.3438 ft
Screen Length: 52. ft
Total Well Penetration Depth: 99. ft

No. of Observations: 88

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.25	1.525	20.1	1.2
0.526	1.984	21.3	1.157
0.75	2.261	22.56	1.118
1.	2.192	23.88	1.078
1.491	2.172	25.32	1.033
1.695	2.154	26.82	0.992
1.9	2.133	28.38	0.951
2.106	2.123	30.06	0.907
2.317	2.098	31.86	0.864
2.53	2.087	33.72	0.822
2.75	2.074	35.76	0.777
3.	2.027	37.86	0.734
3.474	2.014	40.08	0.69
3.679	2.	42.48	0.652
3.884	1.989	45.	0.607
4.095	1.973	47.64	0.568
4.305	1.956	50.46	0.529
4.508	1.946	53.46	0.488
4.75	1.93	56.64	0.453
5.	1.91	60.	0.415
5.25	1.883	63.6	0.38
5.5	1.88	67.2	0.347
5.75	1.863	71.4	0.312
6.	1.845	75.6	0.283
6.36	1.824	79.8	0.253
6.72	1.802	84.6	0.228
7.14	1.778	90.	0.202
7.56	1.754	94.8	0.175
7.98	1.729	100.8	0.149
8.46	1.704	106.8	0.135
9.	1.674	112.8	0.113

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
9.48	1.669	119.4	0.096
10.08	1.615	126.6	0.082
10.68	1.588	134.4	0.07
11.28	1.557	142.2	0.057
11.94	1.528	150.6	0.047
12.66	1.495	159.6	0.038
13.44	1.462	169.2	0.119
14.22	1.426	178.8	0.022
15.06	1.389	189.6	0.018
15.96	1.354	201.	0.012
16.92	1.316	213.	0.01
17.88	1.279	225.6	0.003
18.96	1.239	238.8	0.

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 5.769

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.000183	cm/sec
y0	2.172	ft

T = T*b = 0.2789 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
K	0.0002007	4.629E-6	+/- 9.203E-6	43.35	cm/sec
y0	2.172	0.01781	+/- 0.03541	122.	ft

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = T*b = 0.3058 cm²/sec

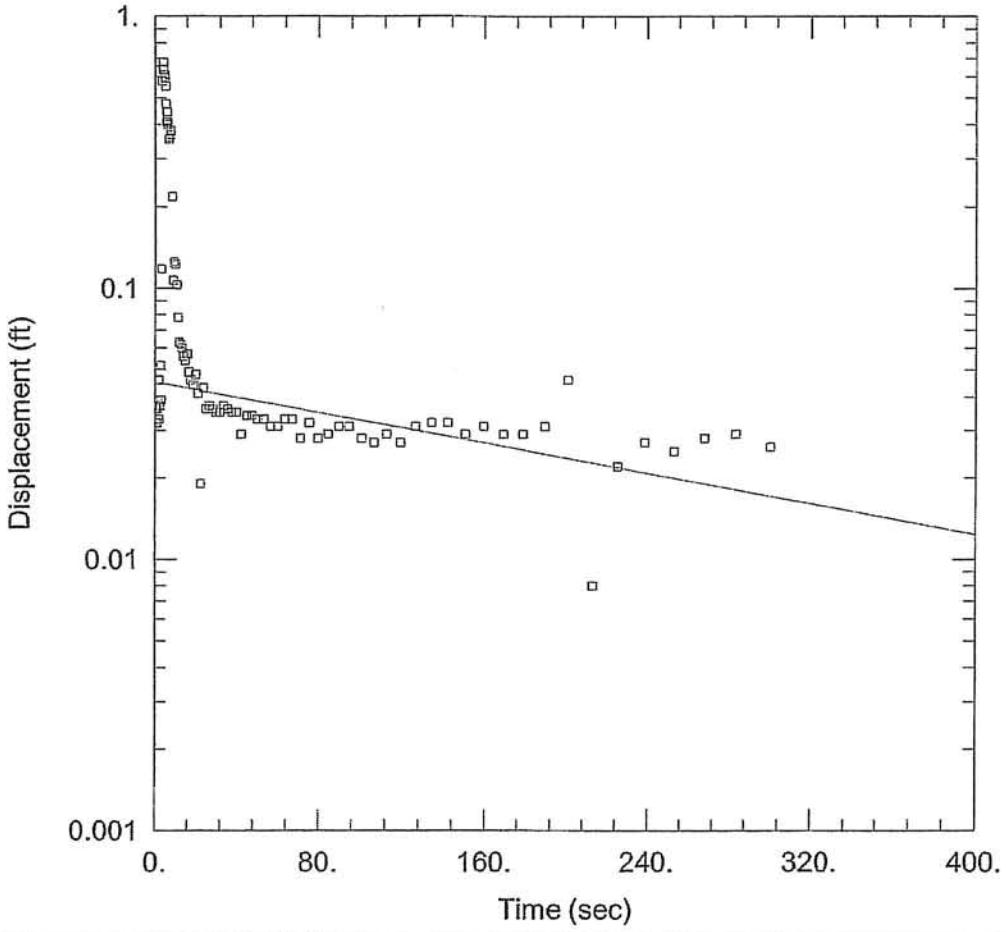
Parameter Correlations

	K	y0
K	1.00	0.65
y0	0.65	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.5355 ft^2
Variance . . . . . 0.006227 ft^2
Std. Deviation . . . . . 0.07891 ft
Mean . . . . . 0.004506 ft
No. of Residuals 88
No. of Estimates 2



WELL TEST ANALYSIS

Data Set: C:\...\PZ-110 Falling.aqt
Date: 12/03/06 Time: 12:27:26

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Well: PZ-110 Falling
Test Date: 10/31/06

AQUIFER DATA

Saturated Thickness: 22. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PZ-110)

Initial Displacement: 0.679 ft
Total Well Penetration Depth: 28. ft
Casing Radius: 0.083 ft
Static Water Column Height: 20.81 ft
Screen Length: 15. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 6.137E-5 cm/sec
y0 = 0.04517 ft

Data Set: C:\Documents and Settings\dreedy\My Documents\Phase 5 Application for Permit to Construct\Phase 5
Date: 12/03/06
Time: 12:27:30

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Date: 10/31/06
Test Well: PZ-110 Falling

AQUIFER DATA

Saturated Thickness: 22. ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PZ-110

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 0.679 ft
Static Water Column Height: 20.81 ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft
Well Skin Radius: 0.3438 ft
Screen Length: 15. ft
Total Well Penetration Depth: 28. ft

No. of Observations: 92

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.25	0.036	22.56	0.019
0.51	0.036	23.88	0.043
0.75	0.032	25.32	0.036
1.	0.036	26.82	0.037
1.599	0.039	28.38	0.036
1.802	0.037	30.06	0.035
2.004	0.033	31.86	0.035
2.208	0.046	33.72	0.037
2.579	0.037	35.76	0.036
2.792	0.052	37.86	0.035
3.006	0.039	40.08	0.035
3.224	0.118	42.48	0.029
3.438	0.577	45.	0.034
4.017	0.635	47.64	0.034
4.22	0.679	50.46	0.033
4.423	0.64	53.46	0.033
4.811	0.61	56.64	0.031
5.026	0.596	60.	0.031
5.237	0.553	63.6	0.033
5.439	0.477	67.2	0.033
5.642	0.409	71.4	0.028
5.845	0.408	75.6	0.032
6.048	0.445	79.8	0.028
6.26	0.415	84.6	0.029
6.465	0.402	90.	0.031
6.72	0.354	94.81	0.031
7.14	0.359	100.8	0.028
7.56	0.381	106.8	0.027
7.98	0.368	112.8	0.029
8.46	0.218	119.4	0.027
9.	0.107	126.6	0.031

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
9.48	0.125	134.4	0.032
10.08	0.123	142.2	0.032
10.68	0.103	150.6	0.029
11.28	0.078	159.6	0.031
11.94	0.063	169.2	0.029
12.66	0.062	178.8	0.029
13.44	0.06	189.6	0.031
14.22	0.056	201.	0.046
15.06	0.054	213.	0.008
15.96	0.057	225.6	0.022
16.92	0.049	238.8	0.027
17.88	0.046	253.2	0.025
18.96	0.044	268.2	0.028
20.1	0.048	283.8	0.029
21.3	0.041	300.6	0.026

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 4.447

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	6.137E-5	cm/sec
y0	0.04517	ft

T = T*b = 0.04115 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
K	0.0008471	0.0002928	+/- 0.0005818	2.893	cm/sec
y0	0.2984	0.04152	+/- 0.08251	7.187	ft

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = T*b = 0.568 cm²/sec

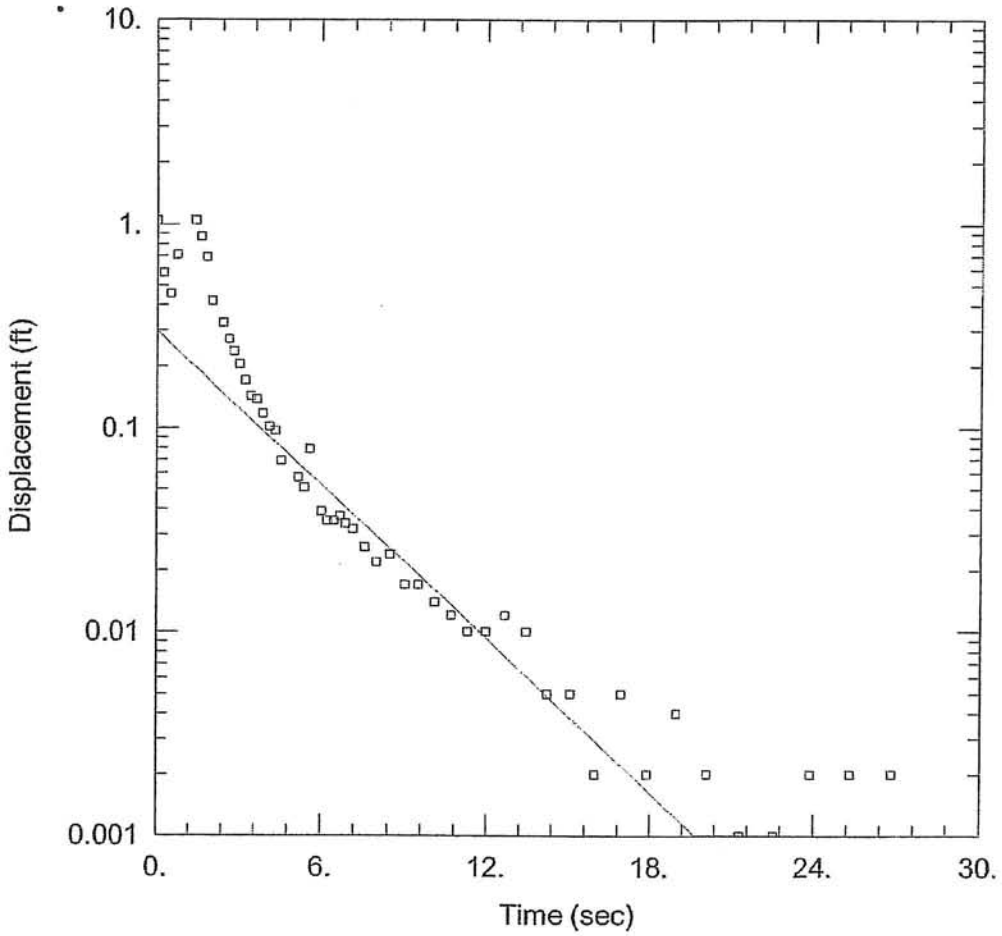
Parameter Correlations

	K	y0
K	1.00	0.70
y0	0.70	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 2.114 ft^2
Variance . . . . . 0.02349 ft^2
Std. Deviation . . . . . 0.1533 ft
Mean . . . . . 0.004649 ft
No. of Residuals 92
No. of Estimates 2



WELL TEST ANALYSIS

Data Set: C:\...\PZ-110 Rising.aqt
Date: 12/03/06 Time: 12:27:41

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Well: PZ-110 Rising
Test Date: 10/31/06

AQUIFER DATA

Saturated Thickness: 22. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PZ-110)

Initial Displacement: 1.043 ft
Total Well Penetration Depth: 28. ft
Casing Radius: 0.083 ft
Static Water Column Height: 20.81 ft
Screen Length: 15. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.005478 cm/sec
y0 = 0.2976 ft

Data Set: C:\Documents and Settings\dreedy\My Documents\Phase 5 Application for Permit to Construct\Phase
Date: 12/03/06
Time: 12:27:46

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Date: 10/31/06
Test Well: PZ-110 Rising

AQUIFER DATA

Saturated Thickness: 22. ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PZ-110

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.043 ft
Static Water Column Height: 20.81 ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft
Well Skin Radius: 0.3438 ft
Screen Length: 15. ft
Total Well Penetration Depth: 28. ft

No. of Observations: 51

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.25	0.578	7.14	0.032
0.5	0.455	7.56	0.026
0.75	0.707	7.98	0.022
1.416	1.043	8.46	0.024
1.62	0.872	9.	0.017
1.823	0.69	9.48	0.017
2.03	0.419	10.08	0.014
2.433	0.326	10.68	0.012
2.636	0.272	11.28	0.01
2.839	0.237	11.96	0.01
3.044	0.205	12.66	0.012
3.25	0.172	13.44	0.01
3.458	0.144	14.22	0.005
3.672	0.139	15.06	0.005
3.886	0.118	15.96	0.002
4.128	0.102	16.92	0.005
4.338	0.097	17.88	0.002
4.551	0.069	18.96	0.004
5.185	0.057	20.1	0.002
5.389	0.051	21.3	0.001
5.592	0.079	22.56	0.001
6.019	0.039	23.88	0.002
6.223	0.035	25.32	0.002
6.462	0.035	26.82	0.002
6.667	0.037	28.38	0.
6.872	0.034		

SOLUTION

Slug Test
Aquifer Model: Confined

Solution Method: Bouwer-Rice
ln(Re/rw): 4.447

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.005478	cm/sec
y0	0.2976	ft

T = T*b = 3.674 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
K	0.007414	0.0009721	+/- 0.001954	7.627	cm/sec
y0	0.8987	0.08986	+/- 0.1806	10.	ft

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = T*b = 4.971 cm²/sec

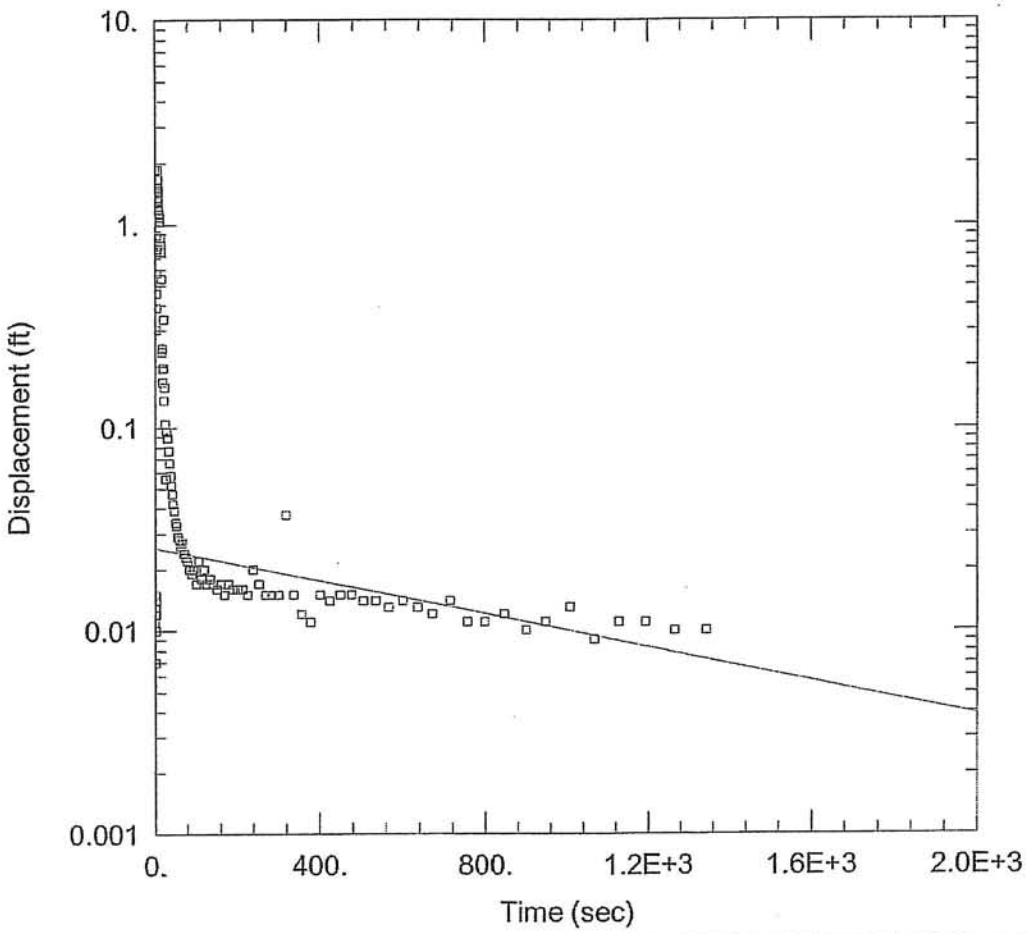
Parameter Correlations

	K	y0
K	1.00	0.75
y0	0.75	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.7043 ft^2
Variance . . . . . 0.01437 ft^2
Std. Deviation . . . . . 0.1199 ft
Mean . . . . . -0.008007 ft
No. of Residuals 51
No. of Estimates 2



WELL TEST ANALYSIS

Data Set: C:\...\PZ-115A Falling.aqt
Date: 12/03/06 Time: 12:27:56

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Well: PZ-115A Falling
Test Date: 11/3/06

AQUIFER DATA

Saturated Thickness: 9.8 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PZ-115A)

Initial Displacement: 1.862 ft
Total Well Penetration Depth: 17. ft
Casing Radius: 0.083 ft
Static Water Column Height: 9.05 ft
Screen Length: 5. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 4.669E-5 cm/sec
y0 = 0.02548 ft

AQTESOLV for Windows

Data Set: C:\Documents and Settings\dreedy\My Documents\Phase 5 Application for Permit to Construct\Phase 5
Date: 12/03/06
Time: 12:28:01

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Date: 11/3/06
Test Well: PZ-115A Falling

AQUIFER DATA

Saturated Thickness: 9.8 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PZ-115A

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.862 ft
Static Water Column Height: 9.05 ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft
Well Skin Radius: 0.3438 ft
Screen Length: 5. ft
Total Well Penetration Depth: 17. ft

No. of Observations: 118

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.251	0.013	47.64	0.039
0.5	0.011	50.46	0.034
0.78	0.013	53.46	0.033
1.	0.012	56.66	0.029
1.25	0.007	60.	0.028
1.935	0.015	63.6	0.026
2.138	0.007	67.2	0.027
2.341	0.01	71.4	0.024
2.544	0.013	75.6	0.023
3.126	0.012	79.8	0.022
3.329	0.014	84.6	0.02
3.533	0.303	90.	0.019
3.847	0.389	94.8	0.02
4.101	0.716	100.8	0.017
4.334	0.459	106.8	0.022
4.537	0.576	112.8	0.018
4.742	0.501	119.4	0.02
4.959	0.743	126.6	0.017
5.173	0.889	134.4	0.018
5.38	0.759	142.2	0.017
5.993	1.283	150.6	0.016
6.197	1.472	159.6	0.017
6.399	1.511	169.2	0.015
6.602	1.862	178.8	0.017
7.164	1.675	189.6	0.016
7.369	1.381	201.	0.016
7.573	1.428	213.	0.016
7.885	1.524	225.6	0.015
8.136	1.354	239.2	0.02
8.46	1.472	253.2	0.017
9.	1.316	268.2	0.015

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
9.48	1.185	283.8	0.015
10.1	1.459	300.6	0.015
10.68	1.124	318.6	0.037
11.28	1.045	337.2	0.015
11.94	1.092	357.6	0.012
12.66	1.035	378.6	0.011
13.44	0.869	400.8	0.015
14.22	0.794	424.8	0.014
15.06	0.742	450.	0.015
15.96	0.541	476.4	0.015
16.92	0.235	504.6	0.014
17.88	0.245	534.6	0.014
18.96	0.168	566.4	0.013
20.11	0.196	600.	0.014
21.3	0.341	636.	0.013
22.56	0.137	672.	0.012
23.88	0.159	714.	0.014
25.32	0.105	756.	0.011
26.82	0.056	798.	0.011
28.38	0.096	846.	0.012
30.06	0.09	900.	0.01
31.86	0.089	948.	0.011
33.72	0.077	1008.	0.013
35.76	0.067	1068.	0.009
37.86	0.058	1128.	0.011
40.08	0.052	1194.	0.011
42.48	0.047	1266.	0.01
45.	0.042	1344.	0.01

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 3.899

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	4.669E-5	cm/sec
y0	0.02548	ft

T = T*b = 0.01395 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
K	0.001286	0.0004178	+/- 0.0008277	3.078	cm/sec
y0	0.7696	0.08806	+/- 0.1745	8.739	ft

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = T*b = 0.3841 cm²/sec

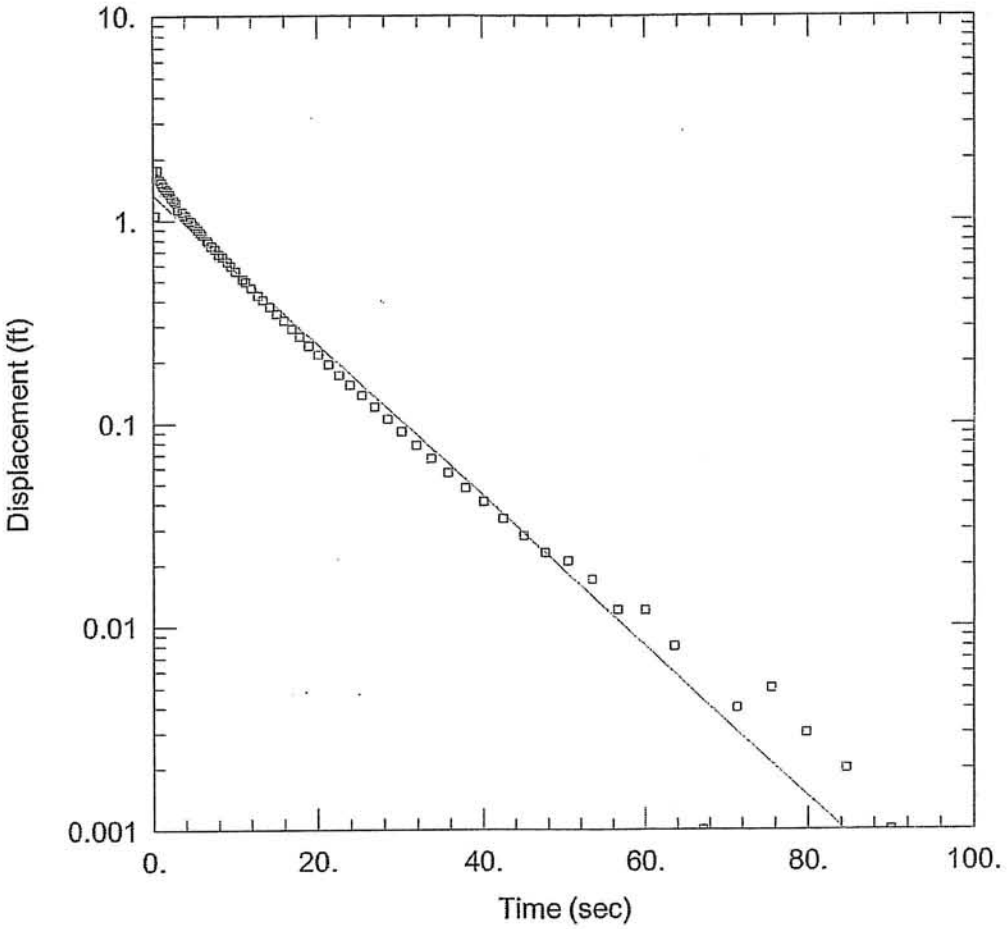
Parameter Correlations

	K	y0
K	1.00	0.65
y0	0.65	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 17.96 ft^2
Variance . . . . . 0.1548 ft^2
Std. Deviation . . . . . 0.3935 ft
Mean . . . . . -0.006673 ft
No. of Residuals 118
No. of Estimates 2



WELL TEST ANALYSIS

Data Set: C:\...\PZ-115A Rising.aqt
Date: 12/03/06 Time: 12:28:13

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Well: PZ-115A Rising
Test Date: 11/3/06

AQUIFER DATA

Saturated Thickness: 9.8 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PZ-115A)

Initial Displacement: 1.762 ft
Total Well Penetration Depth: 17. ft
Casing Radius: 0.083 ft
Static Water Column Height: 9.05 ft
Screen Length: 5. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.004238 cm/sec
y0 = 1.331 ft

Data Set: C:\Documents and Settings\dreedy\My Documents\Phase 5 Application for Permit to Construct\Phase 5
Date: 12/03/06
Time: 12:28:18

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Date: 11/3/06
Test Well: PZ-115A Rising

AQUIFER DATA

Saturated Thickness: 9.8 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PZ-115A

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.762 ft
Static Water Column Height: 9.05 ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft
Well Skin Radius: 0.3438 ft
Screen Length: 5. ft
Total Well Penetration Depth: 17. ft

No. of Observations: 72

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.25	1.059	12.84	0.425
0.5	1.762	13.44	0.405
0.777	1.59	14.22	0.374
1.	1.534	15.06	0.346
1.25	1.478	15.96	0.319
1.5	1.429	16.92	0.291
1.75	1.388	17.88	0.266
2.	1.347	18.96	0.24
2.25	1.295	20.1	0.217
2.5	1.258	21.3	0.194
2.75	1.223	22.56	0.173
3.	1.127	23.88	0.155
3.618	1.099	25.32	0.138
3.821	1.069	26.82	0.121
4.025	1.052	28.38	0.105
4.227	1.023	30.06	0.091
4.431	0.999	31.86	0.078
4.634	0.987	33.72	0.067
4.837	0.961	35.76	0.057
5.04	0.946	37.86	0.048
5.25	0.922	40.08	0.041
5.5	0.899	42.48	0.034
5.75	0.875	45.	0.028
6.	0.853	47.64	0.023
6.602	0.798	50.46	0.021
6.808	0.781	53.46	0.017
7.14	0.75	56.64	0.012
7.56	0.723	60.	0.012
8.003	0.682	63.6	0.008
8.461	0.66	67.2	0.001
9.	0.626	71.4	0.004

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
9.48	0.596	75.6	0.005
10.08	0.561	79.8	0.003
10.95	0.512	84.6	0.002
11.28	0.497	90.	0.001
11.99	0.463	94.8	0.

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 3.899

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.004238	cm/sec
y0	1.331	ft

T = T*b = 1.266 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
K	0.005095	0.0001659	+/- 0.0003307	30.72	cm/sec
y0	1.6	0.02658	+/- 0.05301	60.18	ft

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = T*b = 1.522 cm²/sec

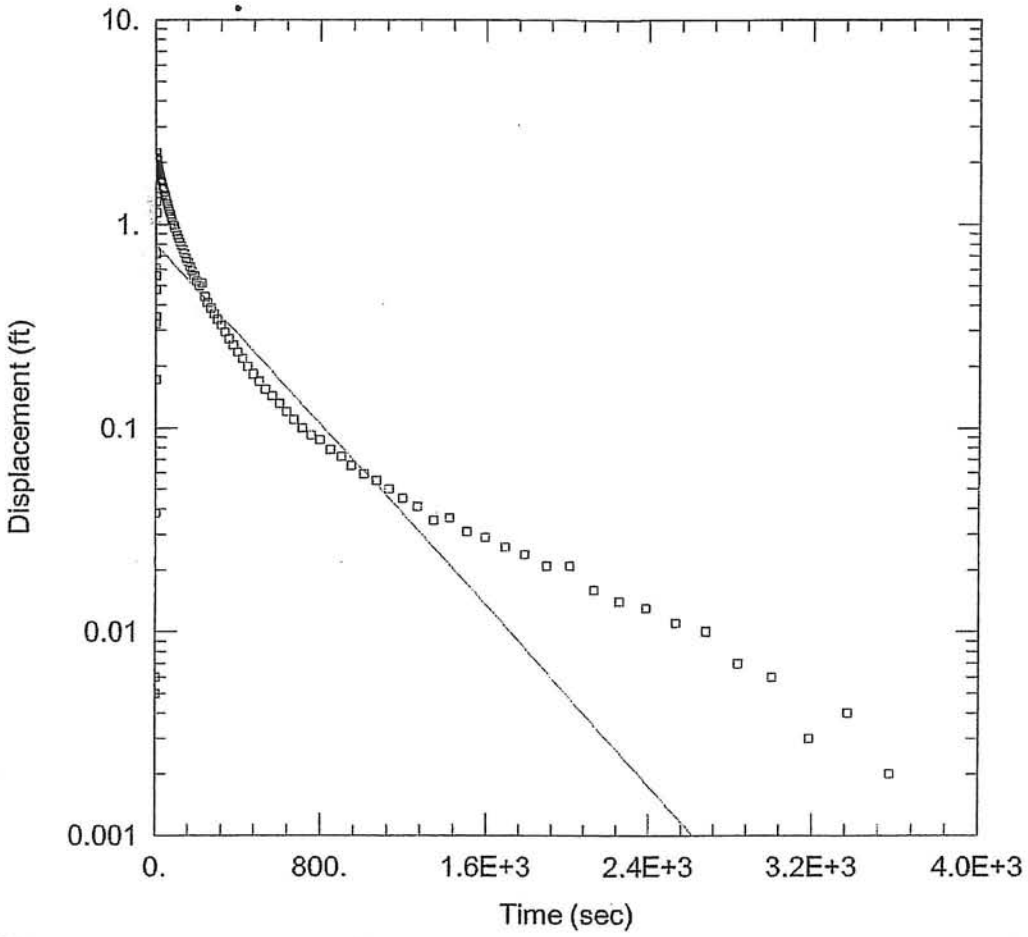
Parameter Correlations

	K	y0
K	1.00	0.74
y0	0.74	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 0.3546 ft^2
Variance . . . . . 0.005066 ft^2
Std. Deviation . . . . . 0.07117 ft
Mean . . . . . 0.003204 ft
No. of Residuals 72
No. of Estimates 2



WELL TEST ANALYSIS

Data Set: C:\...\PZ-115B Rising.aqt
Date: 12/03/06 Time: 12:29:00

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Well: PZ-115B Rising
Test Date: 10/31/06

AQUIFER DATA

Saturated Thickness: 50. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PZ-115B)

Initial Displacement: 2.24 ft
Total Well Penetration Depth: 50. ft
Casing Radius: 0.083 ft
Static Water Column Height: 3.7 ft
Screen Length: 20. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice
K = 3.995E-5 cm/sec y0 = 0.7967 ft

Data Set: C:\Documents and Settings\dreedy\My Documents\Phase 5 Application for Permit to Construct\Phase 5
Date: 12/03/06
Time: 12:28:39

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Date: 10/31/06
Test Well: PZ-115B Falling

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PZ-115B

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.657 ft
Static Water Column Height: 3.7 ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft
Well Skin Radius: 0.3438 ft
Screen Length: 20. ft
Total Well Penetration Depth: 50. ft

No. of Observations: 156

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.251	0.008	142.2	0.724
0.501	0.023	150.6	0.695
1.123	0.0736	159.6	0.661
1.327	1.305	169.2	0.631
1.53	1.67	178.8	0.601
2.045	1.217	189.6	0.568
2.248	1.619	201.	0.539
2.451	1.756	213.	0.512
2.662	1.745	225.6	0.483
2.882	1.685	238.8	0.455
3.092	2.614	253.2	0.43
3.736	2.084	268.2	0.405
3.939	2.033	283.8	0.382
4.142	2.184	300.6	0.366
4.345	2.06	318.6	0.343
4.819	1.957	337.2	0.322
5.022	1.874	357.6	0.303
5.226	1.889	378.6	0.282
5.442	1.948	400.8	0.265
5.657	2.107	424.8	0.248
5.866	1.995	450.	0.231
6.071	2.194	476.4	0.216
6.286	2.367	504.6	0.203
6.501	1.916	534.6	0.188
6.709	1.838	566.4	0.175
6.914	2.168	600.	0.162
7.14	2.657	636.	0.153
7.56	1.881	672.	0.143
7.98	1.495	714.	0.132
8.46	2.163	756.	0.126
9.	1.843	798.	0.119

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
9.48	1.946	846.	0.112
10.08	1.954	900.	0.103
10.68	1.995	948.	0.1
11.28	1.921	1008.	0.092
11.94	1.845	1068.	0.088
12.66	1.871	1128.	0.082
13.44	1.847	1194.	0.079
14.22	1.828	1266.	0.075
15.06	1.814	1344.	0.07
15.96	1.796	1422.	0.066
16.92	1.778	1506.	0.065
17.88	1.757	1596.	0.062
18.96	1.738	1692.	0.059
20.1	1.717	1788.	0.057
21.3	1.7	1896.	0.055
22.56	1.678	2010.	0.054
23.88	1.657	2130.	0.049
25.39	1.633	2256.	0.047
26.82	1.61	2388.	0.048
28.38	1.588	2532.	0.046
30.06	1.562	2682.	0.043
31.86	1.537	2838.	0.04
33.91	1.507	3006.	0.041
35.76	1.484	3186.	0.041
37.86	1.458	3372.	0.039
40.25	1.429	3576.	0.038
42.57	1.4	3786.	0.037
45.	1.373	4008.	0.036
47.64	1.344	4248.	0.036
50.46	1.313	4500.	0.036
53.46	1.282	4764.	0.035
56.64	1.249	5046.	0.035
60.	1.221	5346.	0.035
63.6	1.187	5646.	0.033
67.2	1.157	5946.	0.033
71.4	1.122	6246.	0.031
75.6	1.088	6546.	0.033
79.8	1.058	6846.	0.033
84.6	1.025	7146.	0.033
90.	0.989	7446.	0.031
94.8	0.957	7746.	0.032
100.8	0.923	8046.	0.033
106.8	0.891	8346.	0.031
112.8	0.857	8646.	0.031
119.4	0.825	8946.	0.033
126.6	0.791	9246.	0.031
134.4	0.696	9546.	0.033

SOLUTION

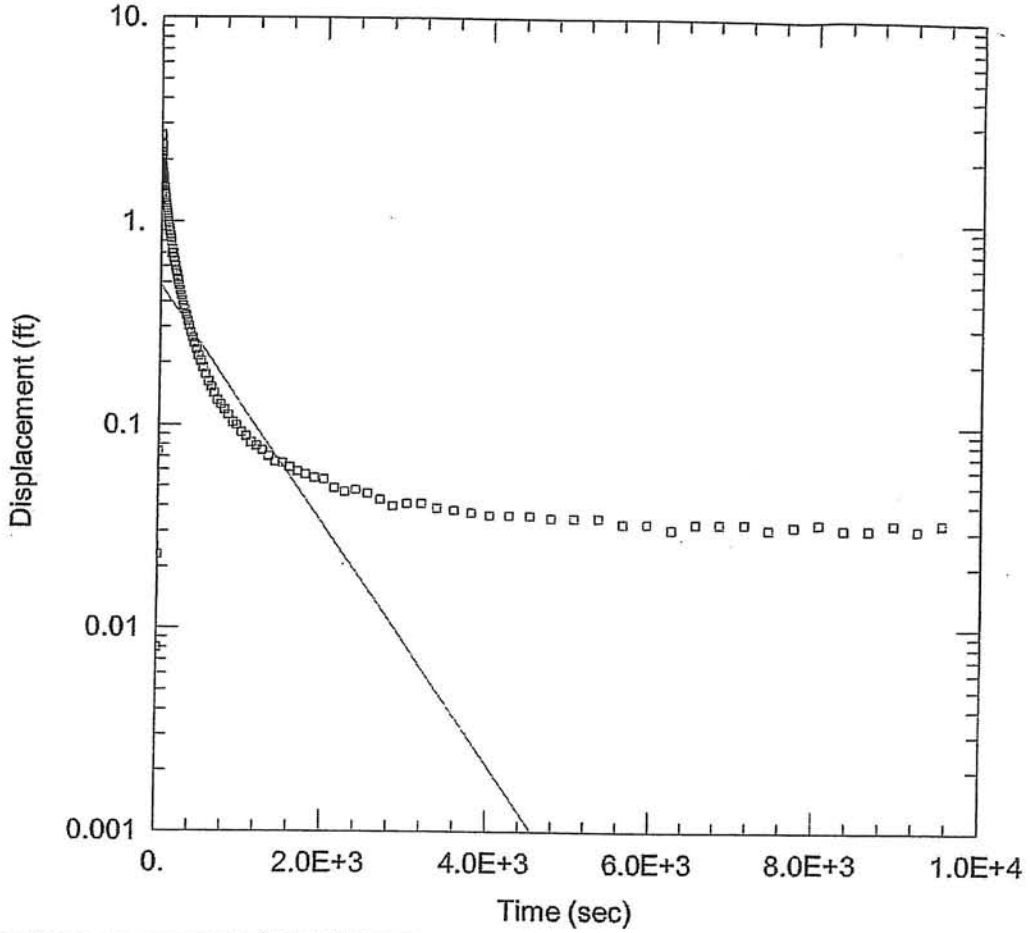
Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 4.908

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	2.126E-5	cm/sec
y0	0.4878	ft

T = T*b = 0.03239 cm²/sec



WELL TEST ANALYSIS

Data Set: C:\...\PZ-115B Falling.aqt
Date: 12/03/06 Time: 12:28:28

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Well: PZ-115B Falling
Test Date: 10/31/06

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PZ-115B)

Initial Displacement: 2.657 ft
Total Well Penetration Depth: 50. ft
Casing Radius: 0.083 ft
Static Water Column Height: 3.7 ft
Screen Length: 20. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined
K = 2.126E-5 cm/sec
Solution Method: Bouwer-Rice
y0 = 0.4878 ft

Data Set: C:\Documents and Settings\dreedy\My Documents\Phase 5 Application for Permit to Construct\Phase 5
Date: 12/03/06
Time: 12:29:05

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Date: 10/31/06
Test Well: PZ-115B Rising

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PZ-115B

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.24 ft
Static Water Column Height: 3.7 ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft
Well Skin Radius: 0.3438 ft
Screen Length: 20. ft
Total Well Penetration Depth: 50. ft

No. of Observations: 136

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.26	0.006	79.8	1.057
0.5	0.005	84.6	1.025
0.76	0.611	90.	0.987
1.391	0.323	94.8	0.959
1.595	0.174	100.8	0.919
1.798	0.038	106.8	0.887
2.001	0.476	112.8	0.852
2.204	0.718	119.4	0.82
2.407	0.35	126.6	0.786
2.61	0.173	134.4	0.753
2.814	0.557	142.2	0.717
3.017	1.142	150.6	0.682
3.25	1.295	159.6	0.651
3.5	1.498	169.2	0.617
3.75	1.554	178.8	0.588
4.359	2.24	189.6	0.558
4.563	2.196	201.	0.524
4.766	2.138	213.	0.498
4.988	2.131	225.6	0.514
5.248	2.134	238.8	0.439
5.454	2.132	253.2	0.411
5.657	2.106	268.2	0.386
5.86	2.11	283.8	0.361
6.063	2.092	300.6	0.338
6.36	2.083	318.6	0.317
6.72	2.087	337.2	0.294
7.152	2.053	357.6	0.272
7.56	2.047	378.6	0.254
7.98	2.064	400.8	0.234
8.46	2.015	424.8	0.218
9.	1.979	450.	0.199

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
9.48	1.984	476.4	0.184
10.08	1.974	504.6	0.17
10.68	1.957	534.6	0.155
11.28	1.934	566.4	0.144
11.94	1.926	600.	0.132
12.66	1.904	636.	0.12
13.44	1.882	672.	0.11
14.22	1.869	714.	0.1
15.06	1.85	756.	0.092
15.96	1.833	798.	0.087
16.92	1.81	846.	0.078
17.88	1.789	900.	0.072
18.96	1.77	948.	0.065
20.1	1.749	1008.	0.059
21.3	1.728	1068.	0.055
22.56	1.704	1128.	0.05
23.88	1.682	1194.	0.045
25.32	1.657	1266.	0.041
26.82	1.633	1344.	0.035
28.38	1.609	1422.	0.036
30.06	1.587	1506.	0.031
31.86	1.56	1596.	0.029
33.72	1.533	1692.	0.026
35.76	1.505	1788.	0.024
37.86	1.479	1896.	0.021
40.08	1.45	2010.	0.021
42.48	1.421	2130.	0.016
45.	1.391	2256.	0.014
47.64	1.362	2388.	0.013
50.46	1.321	2532.	0.011
53.46	1.286	2682.	0.01
56.64	1.254	2838.	0.007
60.	1.221	3006.	0.006
63.6	1.188	3186.	0.003
67.21	1.159	3372.	0.004
71.4	1.123	3576.	0.002
75.6	1.09	3786.	0.

SOLUTION

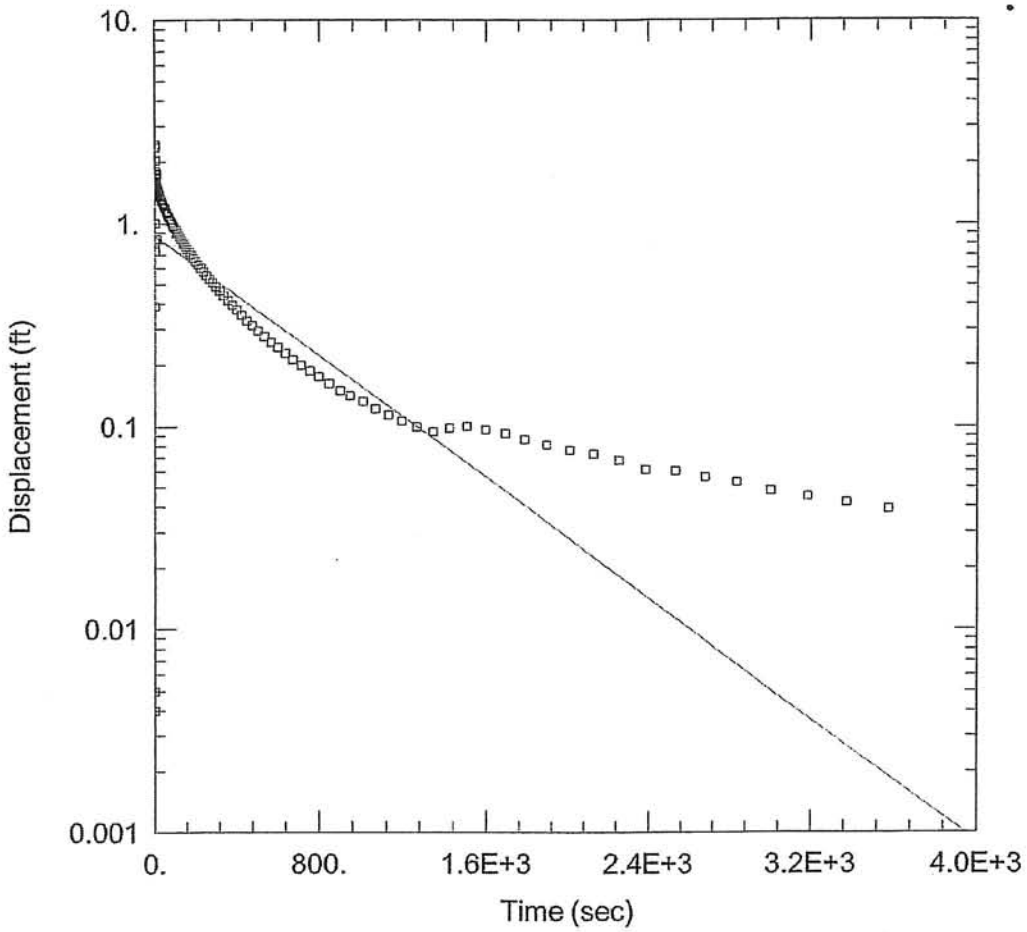
Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 4.908

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	3.995E-5	cm/sec
y0	0.7967	ft

T = T*b = 0.06089 cm²/sec



WELL TEST ANALYSIS

Data Set: C:\...\PZ-117A Falling.aqt
Date: 12/03/06 Time: 12:29:14

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Well: PZ-117A Falling
Test Date: 11/1/06

AQUIFER DATA

Saturated Thickness: 4.2 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PZ-117A)

Initial Displacement: 2.447 ft
Total Well Penetration Depth: 18. ft
Casing Radius: 0.083 ft
Static Water Column Height: 11.33 ft
Screen Length: 5. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 8.61E-5 cm/sec y0 = 0.8706 ft

Data Set: C:\Documents and Settings\dreedy\My Documents\Phase 5 Application for Permit to Construct\Phase 5
Date: 12/03/06
Time: 12:29:19

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Date: 11/1/06
Test Well: PZ-117A Falling

AQUIFER DATA

Saturated Thickness: 4.2 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PZ-117A

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.447 ft
Static Water Column Height: 11.33 ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft
Well Skin Radius: 0.3438 ft
Screen Length: 5. ft
Total Well Penetration Depth: 18. ft

No. of Observations: 135

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.25	0.005	79.8	1.031
0.502	0.004	84.64	1.01
0.75	0.004	90.	0.985
1.392	0.39	94.8	0.966
1.595	0.729	100.8	0.941
1.799	1.006	106.8	0.898
2.002	1.683	112.8	0.894
2.63	0.814	119.4	0.872
2.834	1.702	126.6	0.845
3.037	1.299	134.4	0.822
3.605	2.045	142.2	0.797
3.809	2.447	150.6	0.771
4.013	2.374	159.6	0.748
4.22	1.654	169.2	0.722
4.441	1.816	178.8	0.7
4.665	1.626	189.6	0.674
4.871	1.617	201.	0.65
5.076	1.603	213.	0.626
5.297	1.615	225.6	0.602
5.569	1.5	238.8	0.576
5.79	1.701	253.2	0.554
6.022	1.66	268.2	0.531
6.616	1.646	283.8	0.512
6.819	1.575	300.6	0.486
7.024	1.442	318.6	0.464
7.23	1.661	337.2	0.441
7.877	1.668	357.6	0.415
8.083	1.623	378.6	0.394
8.292	1.586	400.8	0.374
8.891	1.586	424.8	0.352
9.096	1.56	450.	0.329

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
9.498	1.554	476.4	0.312
10.08	1.569	504.6	0.293
10.68	1.358	534.6	0.276
11.28	1.762	566.4	0.258
11.94	0.835	600.	0.243
12.66	1.737	636.	0.228
13.44	1.466	672.	0.212
14.22	1.522	714.	0.199
15.06	1.499	756.	0.187
15.96	1.488	798.	0.175
16.92	1.47	846.	0.162
17.88	1.46	900.	0.15
18.96	1.45	948.	0.142
20.1	1.435	1008.	0.133
21.3	1.426	1068.	0.122
22.56	1.412	1128.	0.114
23.88	1.398	1194.	0.106
25.32	1.387	1266.	0.099
26.82	1.372	1344.	0.094
28.38	1.358	1422.	0.098
30.06	1.344	1506.	0.1
31.86	1.327	1596.	0.096
33.72	1.314	1692.	0.092
35.76	1.298	1788.	0.086
37.86	1.282	1896.	0.081
40.08	1.264	2010.	0.076
42.48	1.247	2130.	0.073
45.	1.229	2256.	0.068
47.64	1.212	2388.	0.061
50.46	1.194	2532.	0.06
53.46	1.186	2682.	0.056
56.64	1.154	2838.	0.053
60.07	1.137	3006.	0.048
63.62	1.116	3186.	0.045
67.22	1.094	3372.	0.042
71.4	1.074	3576.	0.039
75.63	1.052		

SOLUTION

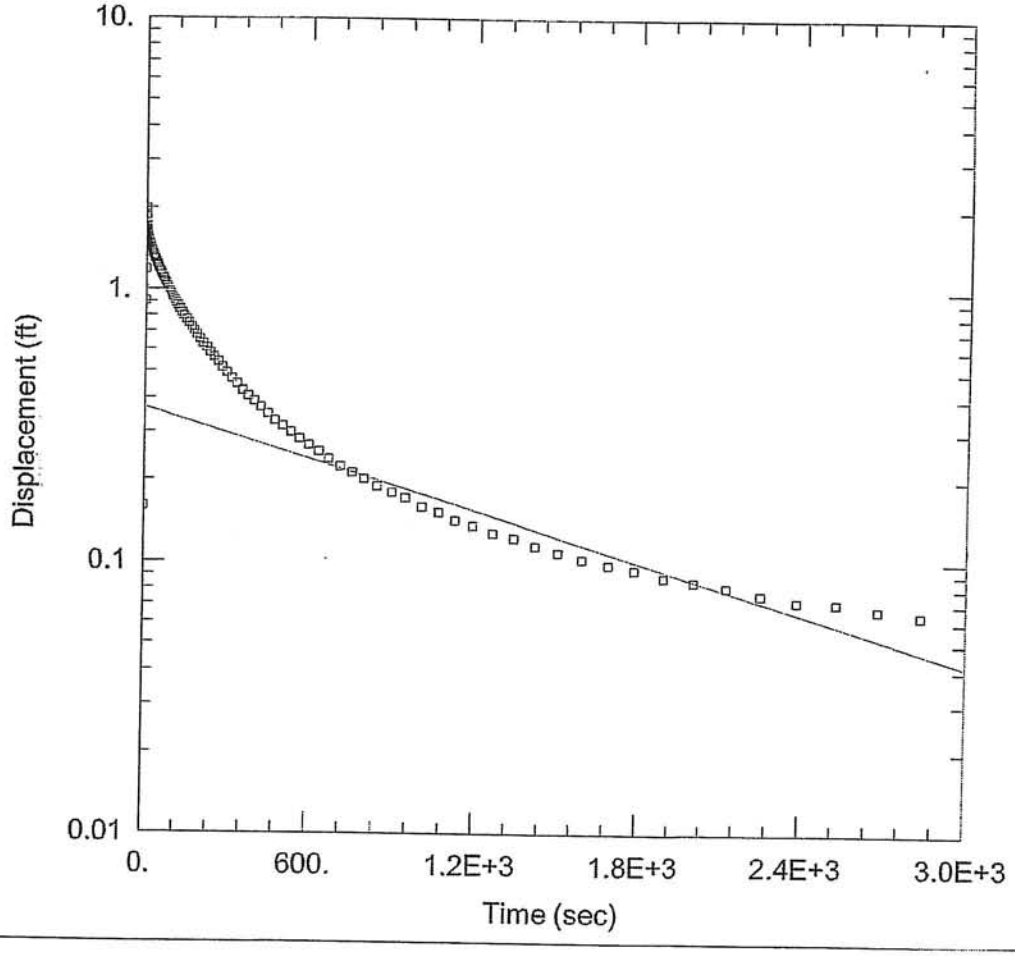
Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 3.933

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	8.61E-5	cm/sec
y0	0.8706	ft

T = T*b = 0.01102 cm²/sec



WELL TEST ANALYSIS

Data Set: C:\...\PZ-117A Rising.aqt
Date: 12/03/06 Time: 12:29:28

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Well: PZ-117A Rising
Test Date: 11/1/06

AQUIFER DATA

Saturated Thickness: 4.2 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PZ-117A)

Initial Displacement: 1.975 ft
Total Well Penetration Depth: 18. ft
Casing Radius: 0.083 ft
Static Water Column Height: 11.36 ft
Screen Length: 5. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined
K = 3.655E-5 cm/sec
Solution Method: Bouwer-Rice
y0 = 0.3693 ft

Data Set: C:\Documents and Settings\dreedy\My Documents\Phase 5 Application for Permit to Construct\Phase
Date: 12/03/06
Time: 12:29:32

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Date: 11/1/06
Test Well: PZ-117A Rising

AQUIFER DATA

Saturated Thickness: 4.2 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PZ-117A

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.975 ft
Static Water Column Height: 11.36 ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft
Well Skin Radius: 0.3438 ft
Screen Length: 5. ft
Total Well Penetration Depth: 18. ft

No. of Observations: 131

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.25	1.184	71.4	1.067
0.5	1.368	75.6	1.046
0.76	0.159	79.8	1.027
1.	0.903	84.6	1.004
1.25	1.641	90.	0.981
1.879	1.975	94.8	0.962
2.082	1.878	100.8	0.938
2.285	1.711	106.8	0.914
2.901	1.688	112.8	0.893
3.105	1.701	119.4	0.87
3.308	1.694	126.6	0.846
3.512	1.667	134.4	0.82
4.122	1.662	142.2	0.799
4.326	1.656	150.6	0.773
4.53	1.644	159.6	0.751
4.849	1.644	169.2	0.726
5.09	1.639	178.8	0.703
5.312	1.632	189.6	0.678
5.552	1.62	201.	0.654
5.777	1.614	213.	0.629
6.411	1.606	225.6	0.608
6.614	1.603	238.8	0.584
6.817	1.602	253.2	0.561
7.473	1.587	268.2	0.539
7.678	1.583	283.8	0.515
7.883	1.579	300.6	0.494
8.088	1.566	318.6	0.471
8.704	1.565	337.2	0.45
8.909	1.559	357.6	0.426
9.117	1.553	378.6	0.407
9.427	1.551	400.8	0.39

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
9.697	1.549	424.8	0.37
10.08	1.543	450.	0.351
10.68	1.533	476.4	0.331
11.28	1.524	504.6	0.316
11.94	1.517	534.6	0.3
12.66	1.506	566.4	0.284
13.44	1.496	600.	0.269
14.22	1.486	636.	0.255
15.06	1.475	672.	0.239
15.96	1.465	714.	0.224
16.92	1.452	756.	0.213
17.88	1.442	798.	0.202
18.96	1.43	846.	0.19
20.1	1.418	900.	0.18
21.3	1.406	948.	0.172
22.56	1.394	1008.	0.159
23.88	1.382	1068.	0.152
25.32	1.368	1128.	0.142
26.82	1.354	1194.	0.136
28.38	1.342	1266.	0.128
30.06	1.327	1344.	0.123
31.86	1.313	1422.	0.115
33.72	1.296	1506.	0.109
35.76	1.282	1596.	0.103
37.86	1.268	1692.	0.098
40.08	1.249	1788.	0.094
42.48	1.234	1896.	0.088
45.	1.218	2010.	0.085
47.64	1.199	2130.	0.081
50.46	1.181	2256.	0.076
53.46	1.165	2388.	0.072
56.64	1.144	2532.	0.071
60.	1.126	2682.	0.067
63.6	1.104	2838.	0.064
67.2	1.089		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 3.933

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	3.655E-5	cm/sec
y0	0.3693	ft

T = T*b = 0.004678 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
K	0.0002008	1.256E-5	+/- 2.485E-5	15.99	cm/sec
y0	1.539	0.02453	+/- 0.04851	62.76	ft

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = T*b = 0.02571 cm²/sec

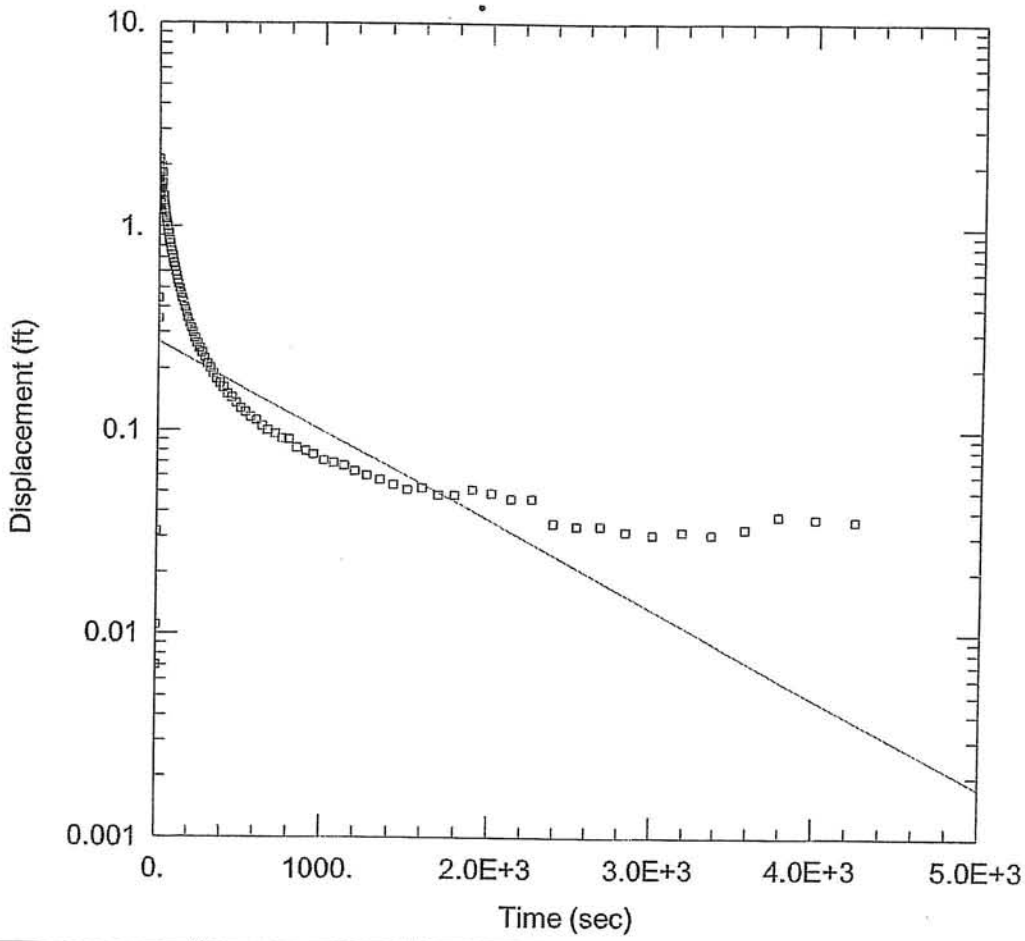
Parameter Correlations

	K	y0
K	1.00	0.51
y0	0.51	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 3.807 ft^2
Variance . . . . . 0.02951 ft^2
Std. Deviation . . . . . 0.1718 ft
Mean . . . . . 0.02416 ft
No. of Residuals 131
No. of Estimates 2



WELL TEST ANALYSIS

Data Set: C:\...\PZ-117B Falling.aqt
Date: 12/03/06 Time: 12:29:41

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Well: PZ-117B Falling
Test Date: 10/31/06

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PZ-117B)

Initial Displacement: 2.152 ft
Total Well Penetration Depth: 50. ft
Casing Radius: 0.083 ft
Static Water Column Height: 4.3 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 3.019E-5 cm/sec
y0 = 0.27 ft

Data Set: C:\Documents and Settings\dreedy\My Documents\Phase 5 Application for Permit to Construct\Phase 5
Date: 12/03/06
Time: 12:29:46

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Date: 10/31/06
Test Well: PZ-117B Falling

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PZ-117B

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.152 ft
Static Water Column Height: 4.3 ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft
Well Skin Radius: 0.3438 ft
Screen Length: 10. ft
Total Well Penetration Depth: 50. ft

No. of Observations: 138

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.251	0.007	84.6	0.691
0.501	0.032	90.	0.658
0.751	0.007	94.8	0.629
1.001	0.011	100.8	0.597
1.251	0.442	106.8	0.57
1.833	1.636	112.8	0.543
2.037	2.152	119.4	0.518
2.24	0.351	126.6	0.492
2.461	1.572	134.4	0.467
2.676	1.188	142.2	0.442
2.889	2.119	150.6	0.421
3.107	2.052	159.6	0.398
3.679	1.749	169.2	0.374
3.883	1.82	178.8	0.353
4.086	1.811	189.6	0.333
4.303	1.841	201.	0.315
4.509	1.73	213.	0.299
4.712	1.735	225.6	0.281
4.915	1.435	238.8	0.266
5.117	1.651	253.2	0.251
5.32	1.67	268.2	0.238
5.534	1.701	283.8	0.225
5.751	1.626	300.6	0.211
6.001	1.552	318.6	0.201
6.361	1.581	337.2	0.189
6.721	1.555	357.6	0.178
7.141	1.514	378.6	0.17
7.561	1.512	400.8	0.162
7.981	1.474	424.8	0.151
8.461	1.459	450.	0.145
9.001	1.462	476.4	0.136

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
9.481	1.312	504.6	0.128
10.08	1.296	534.6	0.123
10.68	1.253	566.4	0.116
11.28	1.237	600.	0.112
11.94	1.205	636.	0.105
12.66	1.182	672.	0.1
13.44	1.161	714.	0.096
14.22	1.529	756.	0.091
15.06	1.948	798.	0.09
15.96	1.558	846.	0.082
16.92	1.823	900.	0.079
17.88	1.632	948.	0.076
18.96	1.613	1008.	0.071
20.1	1.592	1068.	0.069
21.3	1.523	1128.	0.067
22.56	1.336	1194.	0.063
23.88	1.454	1266.	0.06
25.32	1.298	1344.	0.057
26.82	1.394	1422.	0.054
28.38	1.408	1506.	0.051
30.06	1.316	1596.	0.052
31.86	1.282	1692.	0.048
33.72	1.259	1788.	0.048
35.76	1.212	1896.	0.051
37.86	1.181	2010.	0.049
40.08	1.088	2130.	0.046
42.48	1.105	2256.	0.046
45.	1.061	2388.	0.035
47.64	1.033	2532.	0.034
50.46	0.997	2682.	0.034
53.46	0.956	2838.	0.032
56.64	0.929	3006.	0.031
60.	0.85	3186.	0.032
63.6	0.852	3372.	0.031
67.2	0.822	3576.	0.033
71.4	0.786	3786.	0.038
75.6	0.753	4008.	0.037
79.8	0.723	4248.	0.036

SOLUTION

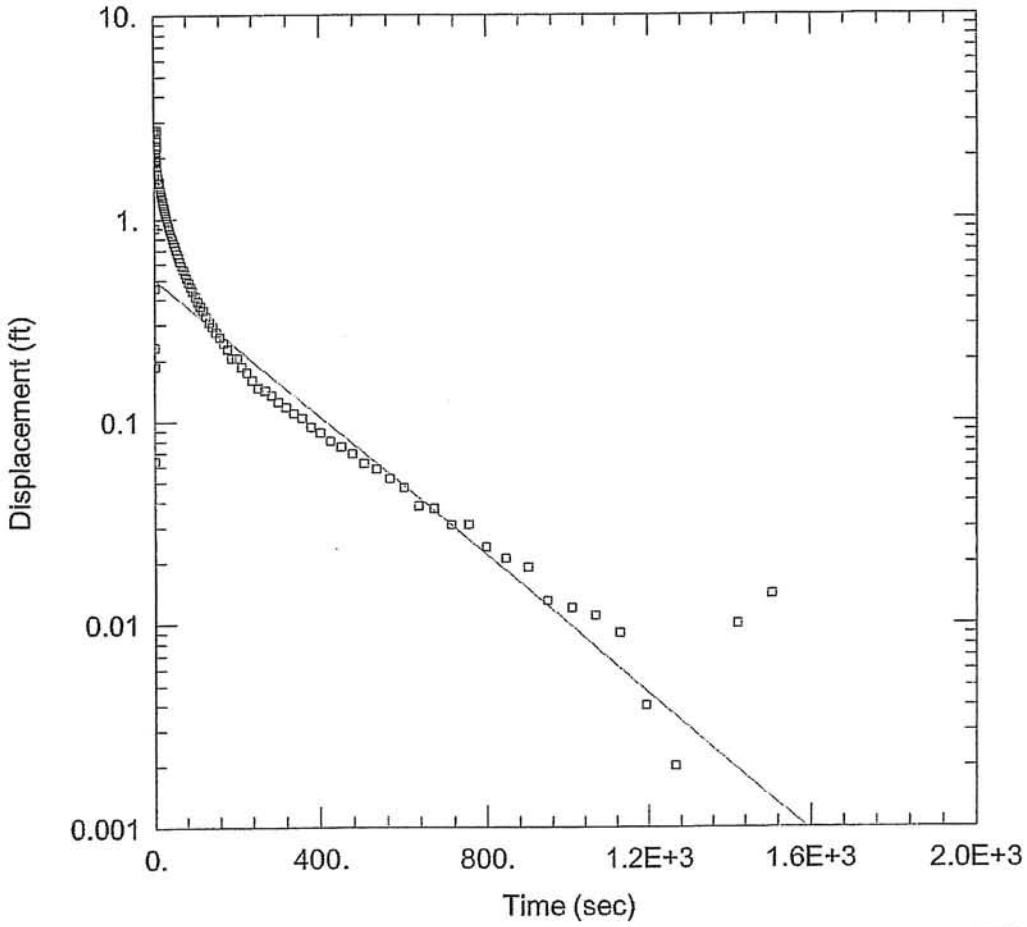
Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 4.697

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	3.019E-5	cm/sec
y0	0.27	ft

$T = T^*b = 0.04601$ cm²/sec



WELL TEST ANALYSIS

Data Set: C:\...\PZ-117B Rising.aqt
Date: 12/03/06 Time: 12:29:58

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Well: PZ-117B Rising
Test Date: 10/31/06

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PZ-117B)

Initial Displacement: 2.744 ft
Total Well Penetration Depth: 50. ft
Casing Radius: 0.083 ft
Static Water Column Height: 4.3 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.0001172 cm/sec
y0 = 0.5005 ft

Data Set: C:\Documents and Settings\dreedy\My Documents\Phase 5 Application for Permit to Construct\Phase 5
Date: 12/03/06
Time: 12:30:03

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Date: 10/31/06
Test Well: PZ-117B Rising

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PZ-117B

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.744 ft
Static Water Column Height: 4.3 ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft
Well Skin Radius: 0.3438 ft
Screen Length: 10. ft
Total Well Penetration Depth: 50. ft

No. of Observations: 120

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.25	0.064	50.46	0.738
0.501	0.232	53.46	0.705
0.75	0.187	56.64	0.675
1.	0.456	60.	0.645
1.25	0.901	63.6	0.616
1.5	1.454	67.2	0.589
1.75	1.563	71.4	0.562
2.	1.68	75.6	0.536
2.25	2.027	79.8	0.51
2.5	2.122	84.6	0.484
3.08	2.014	90.	0.46
3.283	2.02	94.8	0.439
3.486	2.018	100.8	0.412
3.788	1.96	106.8	0.391
4.005	1.977	112.9	0.37
4.21	1.935	119.4	0.351
4.414	1.945	126.6	0.329
4.627	1.901	134.4	0.307
4.839	1.913	142.2	0.292
5.06	1.876	150.6	0.274
5.269	1.9	159.6	0.259
5.844	2.111	169.2	0.242
6.047	2.297	178.8	0.226
6.251	2.514	189.6	0.204
6.455	2.669	201.	0.205
6.733	2.744	213.	0.186
7.158	2.235	225.6	0.174
7.56	1.982	238.8	0.16
7.98	1.808	253.2	0.147
8.46	1.669	268.2	0.143
9.	1.63	283.8	0.135

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
9.48	1.606	300.6	0.125
10.08	1.581	318.6	0.118
10.68	1.56	337.2	0.11
11.28	1.531	357.6	0.104
11.94	1.502	378.6	0.094
12.66	1.51	400.8	0.088
13.44	1.51	424.8	0.08
15.22	1.373	450.	0.075
15.43	1.388	476.4	0.069
15.96	1.376	504.6	0.062
16.92	1.333	534.6	0.058
17.88	1.303	566.4	0.052
18.96	1.272	600.	0.047
20.1	1.241	636.	0.038
21.3	1.21	672.	0.037
22.56	1.178	714.	0.031
23.88	1.146	756.	0.031
25.32	1.111	798.	0.024
26.82	1.082	846.	0.021
28.38	1.051	900.	0.019
30.06	1.018	948.	0.013
31.86	0.985	1008.	0.012
33.72	0.954	1068.	0.011
35.76	0.922	1128.	0.009
37.86	0.889	1194.	0.004
40.08	0.857	1266.	0.002
42.48	0.825	1344.	0.
45.	0.797	1422.	0.01
47.64	0.765	1506.	0.014

SOLUTION

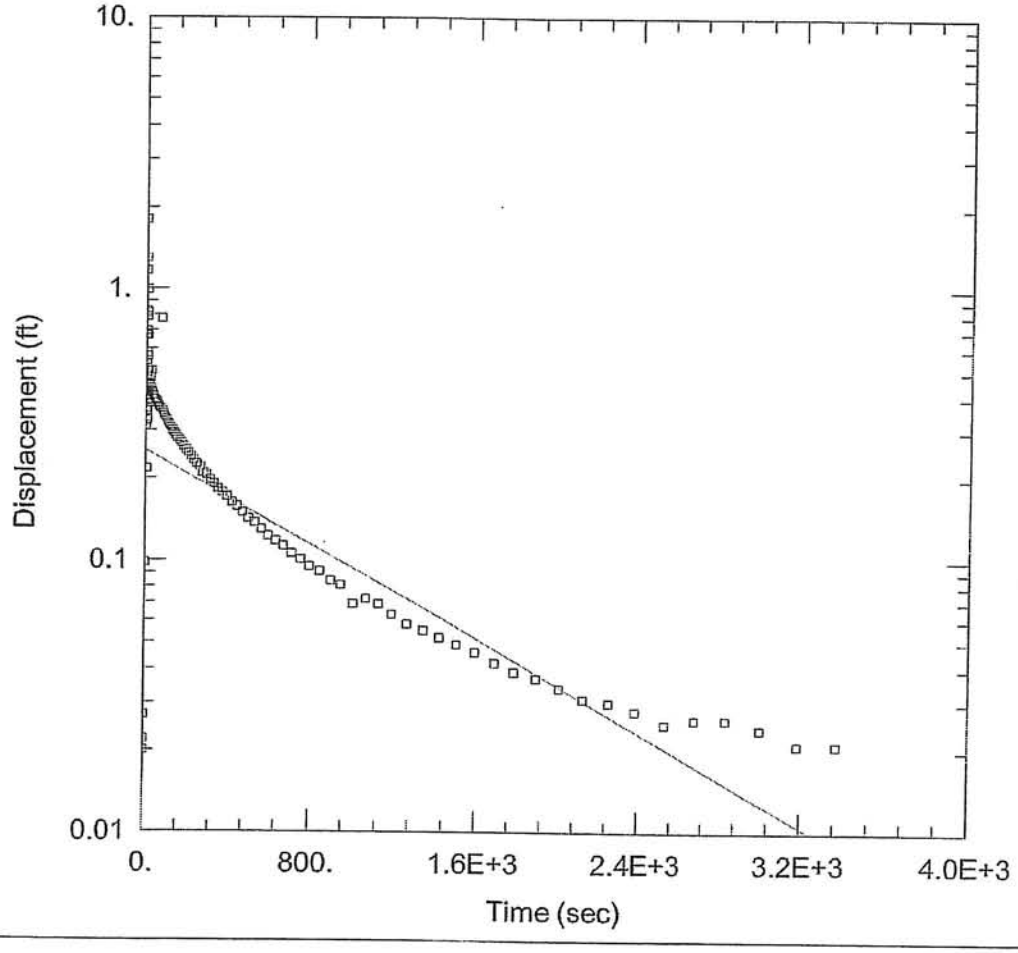
Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 4.697

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.0001172	cm/sec
y0	0.5005	ft

T = T*b = 0.1786 cm²/sec



WELL TEST ANALYSIS

Data Set: C:\...\PZ-118 Falling.aqt
Date: 12/04/06 Time: 11:05:33

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Well: PZ-118 Falling
Test Date: 10/30/06

AQUIFER DATA

Saturated Thickness: 18.8 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (GW-19)

Initial Displacement: 1.798 ft
Total Well Penetration Depth: 21. ft
Casing Radius: 0.083 ft
Static Water Column Height: 8.69 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined
K = 2.65E-5 cm/sec
Solution Method: Bouwer-Rice
y0 = 0.2532 ft

AQTESOLV for Windows

Data Set: C:\Documents and Settings\dreedy\My Documents\Phase 5 Application for Permit to Construct\Phase 5
Date: 12/03/06
Time: 12:30:34

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Date: 10/30/06
Test Well: PZ-118 Falling

AQUIFER DATA

Saturated Thickness: 18.8 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: GW-19

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.798 ft
Static Water Column Height: 8.69 ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft
Well Skin Radius: 0.3438 ft
Screen Length: 10. ft
Total Well Penetration Depth: 21. ft

No. of Observations: 134

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.25	0.02	75.6	0.773
0.504	0.022	79.8	0.361
0.75	0.027	84.6	0.354
1.421	0.671	90.	0.346
1.626	1.798	94.8	0.339
1.83	1.295	100.8	0.333
2.037	1.164	106.8	0.327
2.664	0.098	112.8	0.319
2.868	0.313	119.4	0.314
3.072	0.824	126.6	0.308
3.69	0.477	134.4	0.301
3.893	0.441	142.2	0.294
4.097	0.673	150.7	0.288
4.3	0.54	159.6	0.282
4.837	0.666	169.2	0.276
5.041	0.694	178.8	0.27
5.266	0.578	189.6	0.262
5.504	0.362	201.	0.254
5.754	0.326	213.	0.248
5.983	0.505	225.6	0.241
6.19	0.217	238.8	0.233
6.826	0.576	253.2	0.226
7.03	0.99	268.2	0.221
7.234	0.786	283.8	0.209
7.845	0.669	300.6	0.206
8.05	0.811	318.6	0.197
8.256	0.354	337.2	0.191
8.926	0.563	357.6	0.183
9.132	0.39	378.6	0.177
9.338	0.404	400.8	0.171
9.544	0.472	424.8	0.163

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
10.05	0.668	450.	0.158
10.25	0.329	476.4	0.15
10.68	0.676	504.6	0.143
11.28	0.496	534.6	0.138
11.94	0.432	566.4	0.13
12.66	0.437	600.	0.123
13.44	0.4	636.	0.118
14.22	0.449	672.	0.113
15.06	0.498	714.	0.106
15.96	0.445	756.	0.101
16.92	0.432	798.	0.095
17.88	0.437	846.	0.091
18.96	0.437	900.	0.084
20.1	0.422	948.	0.081
21.3	0.458	1008.	0.069
22.56	0.379	1068.	0.072
23.88	0.471	1128.	0.069
25.32	0.497	1194.	0.063
26.82	0.428	1266.	0.058
28.38	0.421	1344.	0.055
30.06	0.42	1422.	0.052
31.86	0.416	1506.	0.049
33.72	0.413	1596.	0.046
35.76	0.41	1692.	0.042
37.86	0.406	1788.	0.039
40.08	0.403	1896.	0.037
42.48	0.398	2010.	0.034
45.	0.394	2130.	0.031
47.64	0.392	2256.	0.03
50.46	0.387	2388.	0.028
53.46	0.387	2532.	0.025
56.67	0.381	2682.	0.026
60.	0.377	2838.2	0.026
63.6	0.373	3006.	0.024
67.2	0.368	3186.	0.021
71.4	0.364	3372.	0.021

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 4.169

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	2.65E-5	cm/sec
y0	0.2532	ft

T = T*b = 0.01518 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
K	8.774E-5	1.761E-5	+/- 3.484E-5	4.982	cm/sec
y0	0.5291	0.02653	+/- 0.05248	19.94	ft

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = T*b = 0.05027 cm²/sec

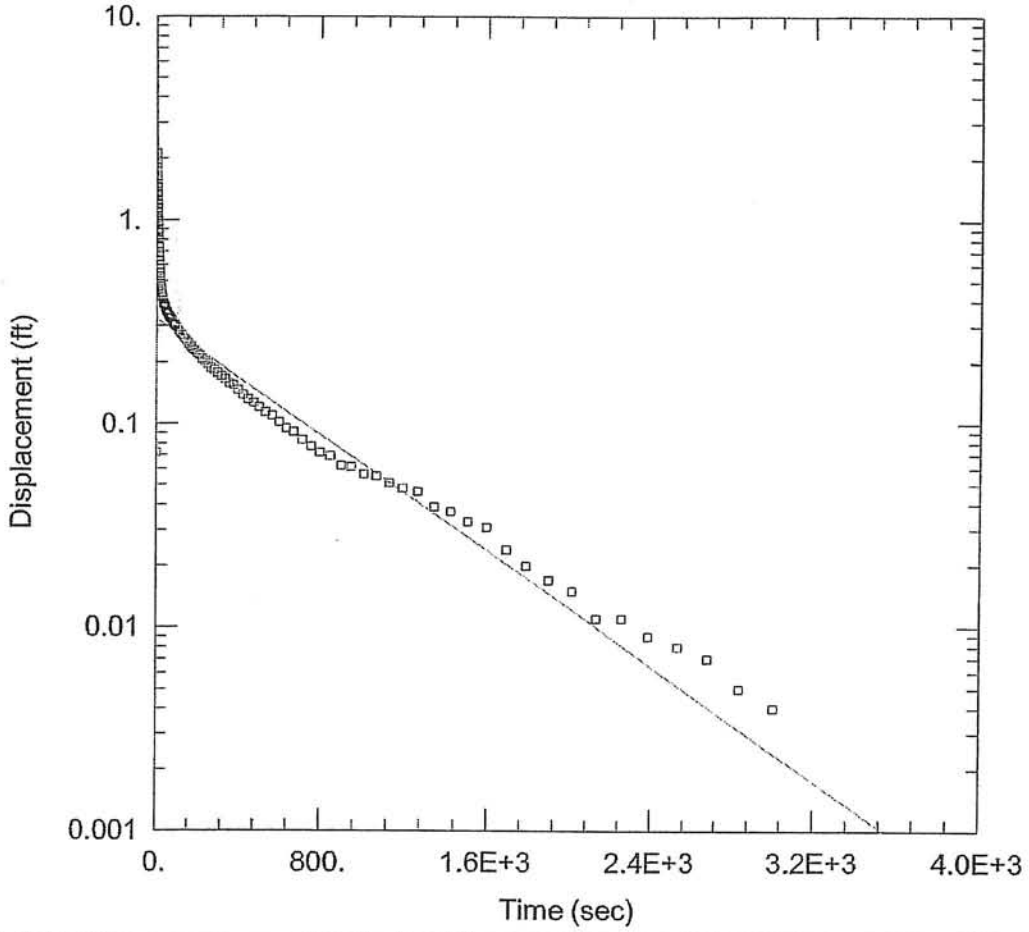
Parameter Correlations

	K	y0
K	1.00	0.50
y0	0.50	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 4.866 ft^2
Variance . . . . . 0.03687 ft^2
Std. Deviation . . . . . 0.192 ft
Mean . . . . . 0.009344 ft
No. of Residuals 134
No. of Estimates 2



WELL TEST ANALYSIS

Data Set: C:\...\PZ-118 Rising.aqt
Date: 12/04/06 Time: 11:05:46

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Well: PZ-118 Rising
Test Date: 10/30/06

AQUIFER DATA

Saturated Thickness: 18.8 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PZ-118)

Initial Displacement: 2.125 ft
Total Well Penetration Depth: 21. ft
Casing Radius: 0.083 ft
Static Water Column Height: 8.69 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 4.343E-5 cm/sec
y0 = 0.3225 ft

AQTESOLV for Windows

Data Set: C:\Documents and Settings\dreedy\My Documents\Phase 5 Application for Permit to Construct\Phase 5
Date: 12/03/06
Time: 12:30:48

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Date: 10/30/06
Test Well: PZ-118 Rising

AQUIFER DATA

Saturated Thickness: 18.8 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: PZ-118

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 2.125 ft
Static Water Column Height: 8.69 ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft
Well Skin Radius: 0.3438 ft
Screen Length: 10. ft
Total Well Penetration Depth: 21. ft

No. of Observations: 132

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.25	0.072	71.4	0.325
0.522	1.648	75.6	0.319
0.75	1.078	79.8	0.314
1.	2.125	84.6	0.308
1.624	1.886	90.	0.304
1.827	1.75	94.8	0.298
2.031	1.801	100.8	0.293
2.676	1.646	106.8	0.285
2.881	1.626	112.8	0.28
3.086	1.584	119.4	0.275
3.29	1.496	126.6	0.269
3.955	1.451	134.4	0.263
4.159	1.437	142.2	0.258
4.361	1.343	150.6	0.252
4.978	1.32	159.6	0.245
5.182	1.298	169.2	0.238
5.386	1.261	178.8	0.232
5.662	1.237	189.6	0.227
5.926	1.201	201.	0.22
6.153	1.191	213.	0.216
6.356	1.146	225.6	0.207
6.597	1.132	238.8	0.202
6.8	1.107	253.2	0.197
7.005	1.086	268.2	0.188
7.213	1.016	283.8	0.184
7.849	0.995	300.6	0.178
8.055	0.975	318.6	0.172
8.262	0.959	337.2	0.166
8.92	0.897	357.6	0.158
9.125	0.884	378.6	0.155
9.33	0.869	400.8	0.147

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
9.993	0.815	424.8	0.139
10.2	0.801	450.	0.132
11.03	0.743	476.4	0.127
11.28	0.729	504.6	0.121
11.95	0.692	534.6	0.114
12.66	0.658	566.4	0.11
13.44	0.625	600.	0.102
14.22	0.597	636.	0.095
15.06	0.57	672.	0.091
15.96	0.548	714.	0.083
16.92	0.528	756.	0.077
17.88	0.509	798.	0.072
18.96	0.494	846.	0.069
20.1	0.479	900.	0.062
21.3	0.468	948.	0.061
22.56	0.453	1008.	0.056
23.88	0.445	1068.	0.055
25.32	0.435	1128.	0.051
26.82	0.424	1194.	0.048
28.38	0.416	1266.	0.046
30.06	0.408	1344.	0.039
31.86	0.402	1422.	0.037
33.72	0.383	1506.	0.033
35.76	0.385	1596.	0.031
37.86	0.382	1692.	0.024
40.08	0.377	1788.	0.02
42.48	0.371	1896.	0.017
45.	0.366	2010.	0.015
47.64	0.359	2130.	0.011
50.46	0.354	2256.	0.011
53.46	0.348	2388.	0.009
56.64	0.343	2532.	0.008
60.	0.34	2682.	0.007
63.6	0.335	2838.	0.005
67.2	0.329	3006.	0.004

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 4.169

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	4.343E-5	cm/sec
y0	0.3225	ft

T = T*b = 0.02489 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio	
K	0.001253	0.0001229	+/- 0.0002431	10.19	cm/sec
y0	1.543	0.06415	+/- 0.1269	24.06	ft

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = T*b = 0.7178 cm²/sec

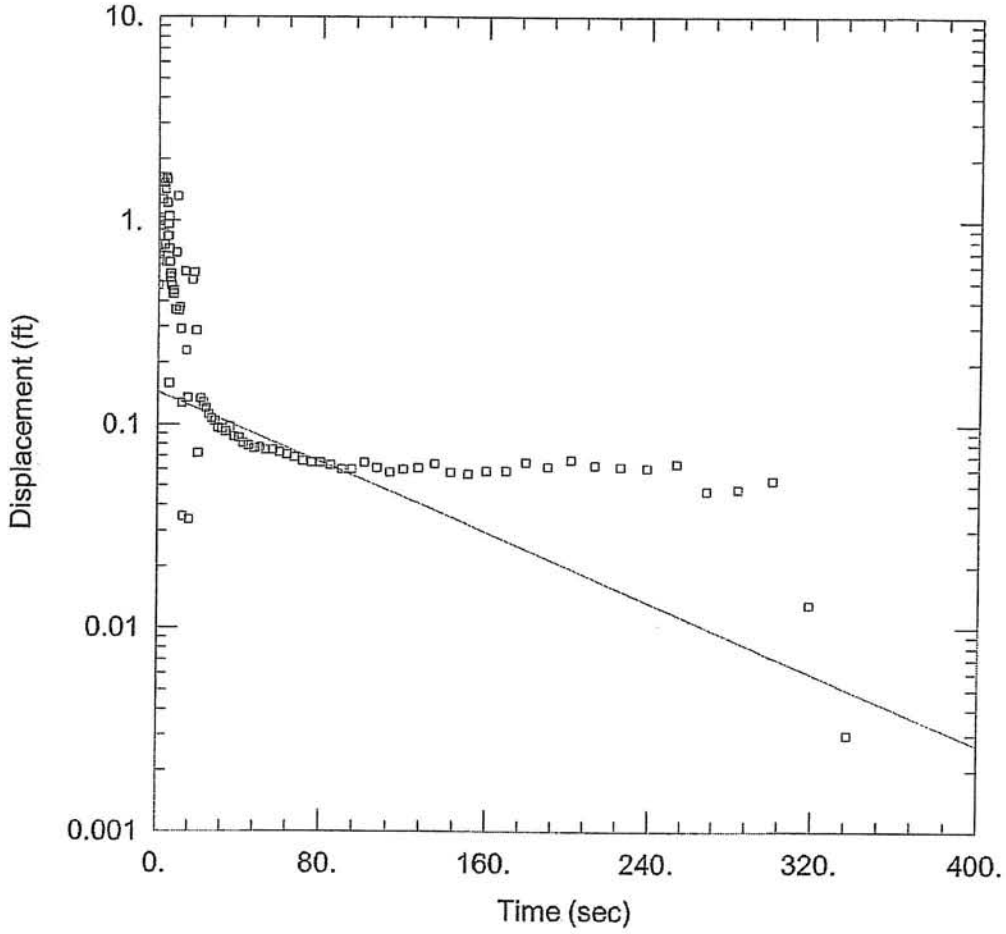
Parameter Correlations

	K	y0
K	1.00	0.72
y0	0.72	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 6.417 ft^2
Variance . . . . . 0.04936 ft^2
Std. Deviation . . . . . 0.2222 ft
Mean . . . . . 0.07691 ft
No. of Residuals 132
No. of Estimates 2



WELL TEST ANALYSIS

Data Set: C:\...\GW-16 Falling.aqt
Date: 12/03/06 Time: 12:23:04

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Well: GW-16 Falling
Test Date: 11/3/06

AQUIFER DATA

Saturated Thickness: 14. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (GW-16)

Initial Displacement: 1.628 ft
Total Well Penetration Depth: 23. ft
Casing Radius: 0.083 ft
Static Water Column Height: 12.32 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.000269 cm/sec
y0 = 0.1443 ft

Data Set: C:\Documents and Settings\dreedy\My Documents\Phase 5 Application for Permit to Construct\Phase 5
Date: 12/04/06
Time: 14:40:43

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Date: 11/3/06
Test Well: GW-16 Falling

AQUIFER DATA

Saturated Thickness: 14. ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: GW-16

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.628 ft
Static Water Column Height: 12.32 ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft
Well Skin Radius: 0.3438 ft
Screen Length: 10. ft
Total Well Penetration Depth: 23. ft

No. of Observations: 94

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.25	0.481	23.88	0.12
0.504	0.639	25.32	0.112
0.75	0.683	26.82	0.107
1.	0.994	28.38	0.104
1.25	1.026	30.06	0.096
1.874	1.625	31.89	0.095
2.077	1.582	33.72	0.092
2.28	1.268	35.76	0.097
2.936	1.523	37.86	0.087
3.139	1.535	40.27	0.086
3.343	0.76	42.48	0.081
3.546	1.419	45.	0.079
3.944	1.628	47.64	0.076
4.148	1.598	50.46	0.077
4.351	1.581	53.46	0.075
4.592	1.221	56.65	0.075
4.795	0.839	60.01	0.073

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
5.001	0.961	63.6	0.071
5.219	1.048	67.25	0.069
5.437	0.726	71.4	0.066
5.647	0.626	75.6	0.065
5.851	0.159	79.8	0.065
6.069	0.528	84.6	0.063
6.304	0.546	90.	0.06
6.515	0.491	94.8	0.06
6.72	0.476	100.8	0.065
7.364	0.452	106.8	0.061
7.571	0.436	112.8	0.058
7.98	0.454	119.4	0.06
8.633	0.364	126.6	0.061
9.	0.696	134.4	0.064
9.48	1.311	142.2	0.058
10.08	0.36	150.6	0.057
10.68	0.374	159.6	0.059
11.28	0.291	169.2	0.059
11.94	0.127	178.8	0.065
12.66	0.035	189.6	0.062
13.44	0.56	201.	0.067
14.22	0.228	213.	0.063
15.06	0.135	225.6	0.062
15.96	0.034	238.8	0.061
16.92	0.511	253.2	0.064
17.88	0.555	268.2	0.047
18.96	0.286	283.8	0.048
20.1	0.072	300.6	0.053
21.3	0.134	318.6	0.013
22.56	0.128	337.2	0.003

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 4.226

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.000269	cm/sec
y0	0.1443	ft

T = T*b = 0.1148 cm²/sec

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	Approx. C.I.	t-Ratio

K	0.002397	0.0003574	+/- 0.0007097	6.708	cm/sec
y0	1.316	0.09896	+/- 0.1965	13.3	ft

C.I. is approximate 95% confidence interval for parameter
t-ratio = estimate/std. error
No estimation window

T = T*b = 1.023 cm²/sec

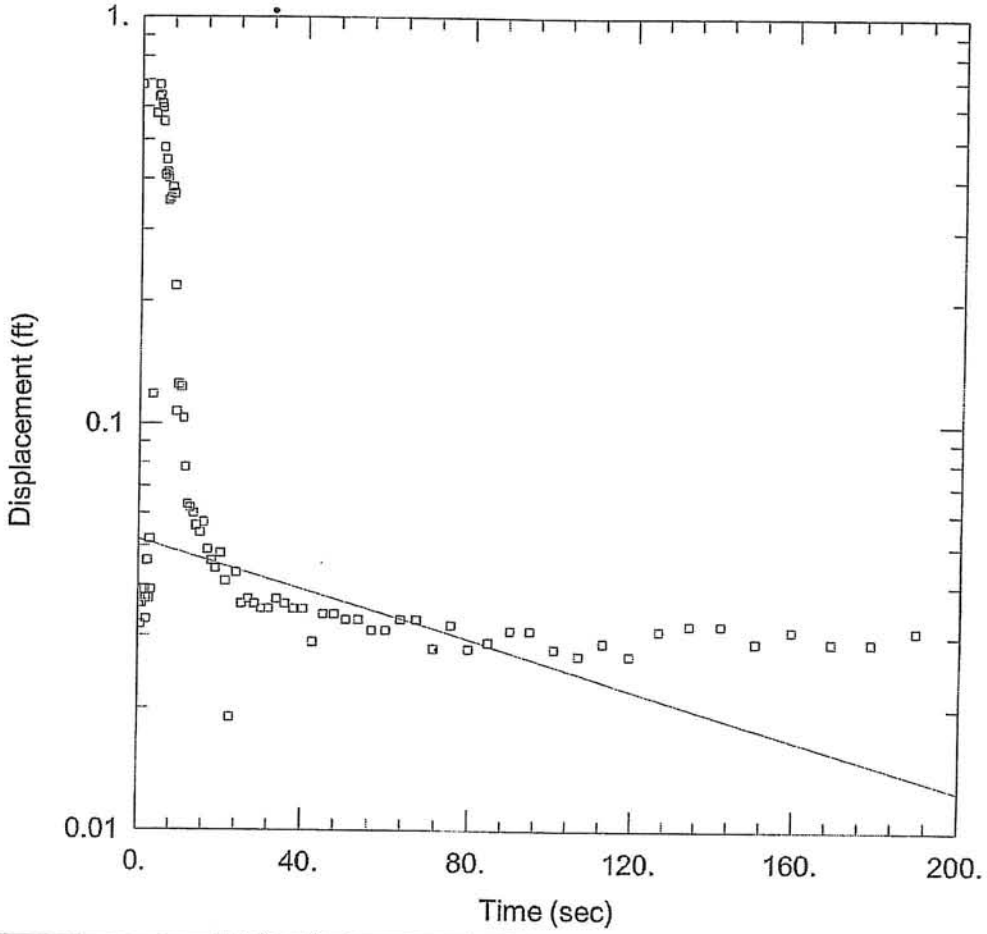
Parameter Correlations

	K	y0
K	1.00	0.75
y0	0.75	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . . . 6.603 ft^2
Variance . . . . . 0.07177 ft^2
Std. Deviation . . . . . 0.2679 ft
Mean . . . . . 0.01951 ft
No. of Residuals 94
No. of Estimates 2



WELL TEST ANALYSIS

Data Set: C:\...\PZ-109A Falling.aqt
Date: 12/03/06 Time: 12:26:13

PROJECT INFORMATION

Company: Golder Associates Inc.
Client: Republic Services,NC
Project: 063-6507.201
Location: East Carolina Landfill
Test Well: PZ-119 Falling
Test Date: 10/31/06

AQUIFER DATA

Saturated Thickness: 14.8 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (PZ-109A)

Initial Displacement: 0.679 ft
Total Well Penetration Depth: 20. ft
Casing Radius: 0.083 ft
Static Water Column Height: 12.61 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.0001875 cm/sec
y0 = 0.05186 ft

APPENDIX E

WATER QUALITY MONITORING PLAN

WATER QUALITY MONITORING PLAN

REPUBLIC SERVICES OF NORTH CAROLINA, LLC
EAST CAROLINA REGIONAL LANDFILL, PERMIT #08-03
BERTIE COUNTY, NORTH CAROLINA

JULY 2007

PREPARED FOR:

REPUBLIC SERVICES OF NORTH CAROLINA, LLC
1922 REPUBLIC ROAD
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PROJECT NO. 063-6507.203

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1.0 INTRODUCTION

This Water Quality Monitoring Plan (WQMP) will serve as a guidance document for collecting and analyzing groundwater samples, evaluating the associated analytical results, and monitoring for any potential releases to the uppermost aquifer from the East Carolina Regional Landfill in Bertie County, North Carolina. The WQMP complies with Rules .1630 through .1637 of the North Carolina Solid Waste Management Rules (NCSWMR), Title 15A, Subchapter 13B. The WQMP also addresses the requirements for surface water monitoring specified in Rule .0602. The pertinent geologic and hydrogeologic characteristics of the site, as described in the *Phase Five Application for Permit to Construct – Design Hydrogeologic Report* for the East Carolina Regional Landfill, prepared by Golder Associates NC, Inc. (Golder), dated December 2006, are summarized below.

1.1 Site Description

The East Carolina Regional Landfill is an active Subtitle D municipal solid waste landfill that began operating in 1993. As of July 2006, cells 3 through 11 have been constructed. The location of the facility is shown on the inlay on Drawing 1. As shown, the East Carolina Regional Landfill is located approximately 7.5 miles northwest of Windsor, North Carolina at the intersection of State Routes 1221 and 1225. The facility is bound to the north and east by undeveloped property and the Connaritsa Swamp, to the west by State Route 1225 and undeveloped and agricultural property, and to the south by State Route 1221, wooded property, and undeveloped bottomlands associated with the easterly flowing Cashie River.

Topographic elevations at the facility range from approximately 30 to 70 feet above mean sea level. Along the northern and eastern portions of the facility, surface drainage from the facility and surrounding areas is routed by drainage channels and storm water control structures to tributaries of the southerly flowing Connaritsa Swamp, a tributary system of the Cashie River. Along the western and southern portions of the facility, surface drainage from the facility and surrounding areas is routed by drainage channels and storm water control structures to tributaries of the southeasterly flowing Cashie River. The Cashie River discharges to the greater Roanoke River south of the Town of Windsor.

1.2 Site Hydrogeology

Geologically, the facility is located within the Carolina Coastal Plain Physiographic Province of North Carolina (NCGS, 1985). The Coastal Plain Province is generally described as being composed of easterly dipping strata that thicken towards the east. Based on hydrogeologic characteristics, these strata are generally classified as aquifer systems separated by aquitard units. The strata underlying the facility include the Tertiary Yorktown Formation and the Cretaceous Black Creek Formation, both of which are classified as aquifers. The Yorktown Formation is confined at this location being overlain by a sandy clay confining unit, and the lower Black Creek Formation, which is separated from the overlying Yorktown Formation by a low permeability unit, is also confined.

The uppermost groundwater beneath the facility is present in the shallow, confined Yorktown Aquifer. Depending on topographic elevation, the depth to water in the Yorktown Formation ranges from 5 feet below grade along the southwestern perimeter of the facility to 25 feet below grade near the central and northeastern portion of the facility. In the lower Black Creek Formation, the top of the aquifer unit ranges from 20 to 60 feet below grade in the monitoring wells screened in this unit.

The hydraulic head level in the uppermost Yorktown aquifer beneath the facility is fairly consistent, with temporal variation from the long–term average limited to approximately 5 feet (plus or minus) in the upgradient well, and somewhat less in the downgradient wells. Similarly, the fluctuation in the Black Creek aquifer is limited to approximately 3 feet (plus or minus). As expected, the range in fluctuation appears to be greater in the upgradient wells, as these wells are more centrally located to the regional groundwater recharge area. The range in fluctuation in the downgradient compliance wells, which are generally located nearer groundwater discharge areas, is less, likely due to the stabilizing affect of hydraulic discharge boundaries.

Static water level measurements obtained on October 31, 2006, were used to prepare the groundwater contours presented on Drawing 1. In the upper Yorktown Formation, groundwater flow across most of the site is toward the south. An apparent groundwater divide is located near the northern cell boundary, and groundwater flow north of the landfill waste boundary is toward the north. This is consistent with previously submitted interpretations for this facility. Previous interpretations of groundwater flow in the Black Creek Formation show an apparent flow direction towards the southeast.

2.0 GROUNDWATER MONITORING SYSTEM

2.1 Monitoring Well Network

The proposed monitoring network as shown on Drawing No. 1 is designed to monitor for potential releases to the uppermost aquifer at the site. The proposed network will consist of wells screened in the uppermost Yorktown Formation (0803-GW-2, 0803-GW-3, 0803-GW-5, 0803-GW-7 through 0803-GW-11, 0803-GW-13, 0803-GW-15, 0803-GW-16, 0803-GW-17, 0803-GW-18, 0803-GW-19, 0803-GW-20, and 0803-GW-21). Wells from the lower Black Creek Formation (0803-GW-1, 0803-GW-4, 0803-GW-6, and 0803-GW-12) will be monitored for water levels only. Monitoring wells 0803-GW-1 and 0803-GW-2 are located upgradient of the landfill, and the remaining wells are located sidegradient or downgradient of the landfill. Monitoring well 0803-GW-2 is the facility's background compliance well and is located hydraulically upgradient of the waste disposal area.

Monitoring well 0803-GW-14 will be abandoned prior to construction activities, as it lies within the Phase 5 footprint. Monitoring wells 0803-GW-18, 0803-GW-19, 0803-GW-20, and 0803-GW-21 are proposed additions to the existing monitoring network, and are designed to monitor water quality from the Phase 5 unit. Wells 0803-GW-18, 0803-GW-19, and 0803-GW-20 were originally installed as piezometers PZ-110, PZ-118, and PZ-122 respectively,

during the Phase 5 Design Hydrogeologic Report investigation. Monitoring well 0803-GW-21 will be installed after the Permit to Construct is issued. Well 0803-GW-17 will be added in 2007 as part of the Phase 4, Cell 12 construction to characterize groundwater quality in the northern footprint. These wells will also be screened in the Yorktown Formation. The well construction details for all existing and proposed wells are presented on Table 1. Well 0803-GW-17 will be constructed as a Type II well with a screened interval in the Yorktown Formation. Actual screen depth may vary depending on conditions encountered during drilling and installation.

The locations for proposed wells 0803-GW-18, 0803-GW-19, 0803-GW-20, and 0803-GW-21 were selected based on groundwater flow directions as determined from the groundwater levels measured on October 31, 2006. A groundwater divide exists near the southern Phase 5 proposed limits of waste, which causes groundwater flow directions around Phase 5 to be variable as seen on Drawing WQMP-1. Groundwater flow in the southern portion of Phase 5 is primarily to the south. Well 0803-GW-18 was installed approximately 110 feet south of the proposed limits of waste and 0803-GW-19 was installed approximately 150 feet south of the proposed limits of waste. North of the groundwater divide the groundwater flow is primarily to the east-northeast. Well 0803-GW-20 was installed approximately 170 feet east of the Phase 5 proposed limits of waste. Well 0803-GW-21 is proposed to be installed approximately 125 feet northeast of the northeastern corner of Phase 5. The Phase 5 monitoring wells will be incorporated into the compliance network once the Permit to Operate for Phase 5 is issued and will not be phased in with individual cell construction within Phase 5.

The existing and proposed well locations are selected to yield groundwater samples representative of the conditions in the uppermost aquifer underlying the facility, and to monitor for potential releases from the landfill unit. Well placement, well construction methods, well development, well maintenance, and well abandonment procedures are discussed in the following sections. Groundwater monitoring wells shall be sampled during the active life of the landfill as well as the post-closure period, in accordance with Rule .1630 of the NCSWMR.

2.2 Changes in Groundwater Elevations

After each sampling event, groundwater surface elevations will be evaluated to determine whether the monitoring system remains adequate, and to determine the rate and direction of groundwater flow.

The direction of groundwater flow will be determined semiannually by comparing the groundwater surface elevations among the monitoring wells, and constructing a groundwater surface contour map. The groundwater flow rate shall be determined using the following modified Darcy equation:

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

where V = the groundwater flow rate (feet/day)
k = the hydraulic conductivity (feet/day)

i = the hydraulic gradient, $\Delta h/\Delta l$ (foot/foot)
n_e = the effective porosity of the host medium (unitless)
Δh= the change in groundwater elevation between two wells or groundwater contours (feet)
Δl = the distance between the same two wells or groundwater contours (feet)

If the evaluation shows that the groundwater monitoring system does not satisfy the requirements of the Rules, the monitoring system will be modified accordingly. These modifications may include a change in the number, location, and/or depth of the monitoring wells.

2.3 Monitoring Well Construction

The well completion details for the existing and proposed groundwater monitoring wells are included in Section 2.1 and Table 1. The completed boring and well construction logs for the new proposed wells are included in Appendix A. Boring logs/well construction records for proposed monitoring wells will be submitted to the Solid Waste Section (SWS) following installation.

Drilling and installation of any new monitoring wells will be performed in accordance with the specifications outlined in 15A NCAC Subchapter 2C, Section .0100. Further guidance is provided in the *Draft North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities; Solid Waste Section, Division of Solid Waste Management; Department of Environment, Health and Natural Resources* (March 1995). A geologist will oversee drilling activities and prepare boring and well construction logs for each newly installed well. New wells will be located by a licensed surveyor to within $\pm$0.1 foot on the horizontal plane and $\pm$0.01 foot vertically in reference to existing survey points. A boring log, well construction log, groundwater monitoring network map, and well installation certification will be submitted to the Solid Waste Section (SWS) upon completion.

2.4 Monitoring Well Development

Newly constructed wells will be developed to remove particulates that are present in the well due to construction activities, and to interconnect the well with the aquifer. Development of new monitoring wells will be performed no sooner than 24 hours after well construction. Wells may be developed with disposable PVC bailers, a mechanical well developer, or other approved method. A surge block may be used as a means of assessing the integrity of the well screen and riser. In the event a pump is employed, the design of the pump will be such that any groundwater that has come into contact with air is not allowed to drain back into the well. Each well will be developed until sediment-free water with stabilized field parameters (i.e., temperature, pH, and specific conductance) is obtained.

Well development equipment (bailers, pumps, surge blocks) and any additional equipment that contacts subsurface formations will be decontaminated prior to on-site use, between consecutive on-site uses, and/or between consecutive well installations.

The purge water will be disposed of on the ground surface at least 10 feet downgradient of the monitoring well being purged, unless field characteristics suggest the water will need to be disposed of otherwise. If field characteristics suggest, the purge water will be containerized and disposed of in the facility's leachate collection system, or by other approved disposal means.

Samples withdrawn from the facility's monitoring wells should be clay- and silt-free; therefore, existing wells may require redevelopment from time to time based upon observed turbidity levels during sampling activities. If redevelopment of an existing monitoring well is required, it will be performed in a manner similar to that used for a new well.

2.5 Maintenance and Recordkeeping

The existing monitoring wells will be used and maintained in accordance with design specifications throughout the life of the monitoring program. Routine well maintenance will include inspection and correction/repair of, as necessary, identification labels, concrete aprons, locking caps and locks, and access to the wells. Should it be determined that background or compliance monitoring wells no longer provide samples representative of the quality of groundwater passing the relevant point of compliance, the SWS will be notified. The owner will re-evaluate the monitoring network, and provide recommendations to the SWS for modifying, rehabilitating, abandoning, or installing replacement or additional monitoring wells, as appropriate.

Laboratory analytical results will be submitted to the SWS semiannually, along with sample collection field logs, statistical analyses, groundwater flow rate and direction calculations, and groundwater contour map(s) as described in the following sections. Analytical data, calculations, and other relevant groundwater monitoring records will be kept throughout the active life of the facility and the post-closure care period, including notices and reports of any NC 2L exceedances, resampling notifications, and resampling results.

2.6 Monitoring Well Abandonment

Piezometers and wells installed within the proposed landfill footprint will be properly abandoned in accordance with the procedures for permanent abandonment, as described in 15A NCAC 2C Rule .0113(b). The piezometers and wells will be progressively abandoned as necessary to complete construction activities. The piezometers and wells that are within the proposed footprint will be overdrilled to remove well construction materials, and then grouted with a cement-bentonite grout. Other piezometers and wells that will potentially interfere with clearing and construction activities will be grouted in place without overdrilling by grouting the well in place with a cement-bentonite grout and removing all surface features, such as concrete aprons, protective casings, and stickups. In each case, the bentonite content of the cement-bentonite grout shall be approximately 5%, and a tremie pipe will be used to ensure that grout is continuously placed from the bottom of the borehole/monitoring well upward.

If a monitoring well becomes unusable during the monitoring period of the landfill, the well will be abandoned in accordance with the procedures described above. Approval from the SWS will be obtained prior to abandoning any monitoring well.

For each monitoring well abandoned, the following information will be provided to the SWS in a report sealed by a licensed geologist in accordance with Rule .1623 of the NCSWMR: the monitoring well name, a description of the procedure by which the monitoring well was abandoned, the date when the monitoring well was considered to be taken out of service, and the date when the monitoring well was abandoned.

3.0 DETECTION MONITORING

Groundwater samples will be obtained and analyzed semiannually for the Appendix I list of constituents, as defined in the Detection Monitoring Program, during the life of the facility and the post-closure care period. Refer to Appendix B of this report for a list of the required constituents, analytical methods, and reporting limits. These lists were updated in a memo dated October 27, 2006, from the SWS (a copy of which is included in Appendix B). The results of the statistical analyses of the groundwater data will be submitted to the SWS semiannually. Reports will be submitted on a cd-rom with analytical data submitted in the required format, and be accompanied by the required Environmental Monitoring Form, which will be signed and sealed by a licensed geologist in the State of North Carolina. A copy of this form is also included in Appendix B for reference.

3.1 Sampling Frequency

Groundwater samples will be collected semiannually and analyzed for NC Appendix I Detection Monitoring constituents plus required field parameters, including but not limited to, pH, conductivity, and temperature. If the facility's groundwater monitoring program must progress to Assessment Monitoring, notification and sampling will be conducted according to the schedule specified in Rule .1634.

3.2 Establishment of Background Data

During future phases of facility development, a minimum of four independent pre-waste groundwater samples will be collected from the newly installed monitoring wells as specified in the Permit to Construct, once issued. Samples collected from these wells will be analyzed for the NC Appendix I constituents. The intent of background sampling is to collect data to more accurately reflect the natural fluctuations that may occur with these constituents. The data will be submitted to the SWS after completing the fourth background sampling event.

3.3 Evaluation of Detection Monitoring Data

During the Detection Monitoring Program, the reported constituent concentrations from downgradient compliance wells will be statistically compared to the site-specific background

values using approved statistical procedures to determine if a release has occurred. If a statistically significant increase over a site-specific background value is confirmed for one or more of the NC Appendix I constituents at any downgradient compliance well, the following procedures will be followed:

(1) Notify SWS within 14 days of determining the statistically significant increase, and place a notice in the site operating record indicating which constituents have shown statistically significant changes relative to background levels.

(2) Within 90 days, establish an Assessment Monitoring Program meeting the requirements of Rule .1634, except as discussed below.

The data may be re-evaluated within 90 days following the statistical analysis, and wells may be resampled if appropriate, to determine if the concentration resulted from an error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality; or a source other than the facility [Rule .1633(c)(3)]. If it can be demonstrated that one of these factors occurred, a report (Alternate Source Demonstration) certified by a licensed geologist will be submitted to the SWS within 90 days of identifying the suspect statistical increase. A copy of this report will be placed in the operating record. If the SWS approves the demonstration, the Detection Monitoring Program will be resumed with the required semiannual sampling and analysis. If the SWS does not accept the demonstration within 90 days, the Assessment Monitoring Program will be initiated.

4.0 ASSESSMENT MONITORING

Assessment Monitoring is required whenever one or more NC Appendix I constituents are detected at statistically significant concentrations over background, or whenever a violation of the groundwater quality standards (15A NCAC 2L, .0202) has occurred, and no source of error, alternate source, or naturally occurring condition can be identified. If a false positive result cannot be demonstrated, an Assessment Monitoring Program meeting the requirements of Rule .1634 will be established within 90 days, as described below.

Within 90 days of triggering the Assessment Monitoring Program, and annually thereafter, groundwater will be sampled for analysis of the NC Appendix II list of constituents. A minimum of one groundwater sample will be collected from each well and submitted for analysis during each Assessment Monitoring sampling event. However, the NCSWMR allow for petitions to the SWS for an appropriate subset of wells or a reduction in the NC Appendix II sampling list.

If any NC Appendix II constituents are detected in groundwater from the downgradient wells, a minimum of four independent samples will be collected from each background and downgradient well to establish background concentrations for the detected Appendix II constituents.

Within 14 days after receipt of the initial or subsequent sampling analytical data, a report identifying the detected NC Appendix II constituents will be submitted to the SWS, and a notice

will be placed in the operating record. Background concentrations of any detected NC Appendix II constituents will be established and reported to the SWS.

Within 90 days, and on at least a semiannual basis thereafter, the wells will be sampled and analyzed for the NC Appendix I list plus any additional detected Appendix II constituents. An analytical results report of each sampling event will be submitted to the SWS and placed in the facility operational record.

The SWS will determine whether Groundwater Protection Standards must be established for the facility, and may specify a more appropriate alternate sampling frequency for repeated sampling and analysis for the full set of NC Appendix II constituents. Groundwater monitoring will continue in one of three ways, based on the results of the Assessment Monitoring statistical analyses:

(1) If the NC Appendix II constituents are at or less than background values using approved statistical procedures for two consecutive sampling events, the facility may resume Detection Monitoring with the approval of SWS.

(2) If the concentrations of any NC Appendix II constituents exceed the background concentrations, but all concentrations are below the approved Groundwater Protection Standards, the facility will continue Assessment Monitoring.

(3) If one or more NC Appendix II constituents are detected at statistically significant concentrations in excess of the approved Groundwater Protection Standards, and no source of error can be identified, within 14 days the SWS will be notified, a notice will be placed in the operating record, and appropriate local government officials will be notified. The facility operator will proceed to characterize the nature and extent of the release (Rule .1634(g)(1)). Next, the operator will initiate an assessment of corrective measures and corrective action plan, and proceed according to Rules .1635 through .1637. If the facility proceeds to corrective action, a revised WQMP will be submitted to the SWS with the Corrective Action Plan.

Refer to Appendix B of this report for a list of the required constituents, analytical methods, and reporting limits. These lists were updated in a memo dated October 27, 2006, from the Solid Waste Section. The results of the statistical analyses of the groundwater data will be submitted to the SWS semiannually. Reports will be submitted on a cd-rom with analytical data submitted in the required format, and be accompanied by the required Environmental Monitoring Form, which will be signed and sealed by a licensed geologist in the State of North Carolina. A copy of this form is also included in Appendix B.

5.0 GROUNDWATER SAMPLING METHODOLOGY

Groundwater samples will be collected in accordance with Solid Waste Management Rules 15A NCAC 13B .1632 and guidance provided in the *Draft North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities; Solid Waste Section, Division of Solid Waste Management; Department of Environment, Health and Natural Resources* (March

1995). Procedures for well purging, sample withdrawal, and decontamination methods as well as chain-of-custody procedures are outlined below. Field parameter measurements will be submitted electronically to the SWS in a format consistent with that required in the October 27, 2006, memorandum.

5.1 Sample Collection

The procedures for collecting groundwater samples are presented below. The background well 0803-GW-2 will be sampled first, followed by the downgradient compliance wells. The downgradient wells will be sampled so that the most contaminated well, if one is identified from the previous sampling event, is sampled last. One sample will also be collected from the on-site water supply well, which will be sampled from the well-head spigot after running for approximately 5 minutes.

5.1.1 Sampling Frequency

The above-mentioned samples will be collected on a semiannual basis during the Detection and/or Assessment Monitoring programs.

5.1.2 Static Water Elevations

The static water and total well depth will be measured with an electronic water level indicator, to the nearest 0.01 foot, in each well prior to sampling. Static water elevations will be calculated from water depth measurements and top of casing elevations. A reference point will be marked on the top of casing of each well to ensure the same measuring point is used each time static water levels are measured.

If a monitoring well contains a dedicated pump, the depth to water shall be measured without removing the pump. Depth to bottom measurements should be taken from the well construction data and updated when pumps are removed for maintenance.

5.1.3 Well Evacuation

The preferred well evacuation and sampling procedure for the site is a low-flow purge (micropurge) and sample methodology. However, in the event of a pump malfunction or other field condition that will not allow this type of purging, standard evacuation procedures are presented below.

5.1.3 (a) Standard Evacuation Procedures

In the event that low-flow purging and sampling cannot be employed, monitoring wells will be evacuated with a submersible pump or a disposable bailer. If the pump is used for multiple wells, it and any other non-dedicated equipment will be decontaminated before use and between each well.

A low-yield well (one that yields less than 0.5 gallon per minute) will be purged so that water is removed from the bottom of the screened interval. Low-yield wells will be evacuated to dryness once. However, at no time will a well be evacuated to dryness if the recharge rate causes the formation water to vigorously cascade down the sides of the screen and cause an accelerated loss of volatiles. Upon recharging of the well and no longer than a time period of 24 hours, the first sample will be field-tested for pH, temperature, and specific conductivity. Samples will then be collected and containerized in the order of the volatilization sensitivity of the target constituents.

A high-yield well (one that yields 0.5 gallon per minute or more) will be purged so that water is drawn down from above the screen in the uppermost part of the water column to ensure that fresh water from the formation will move upward in the screen. If a pump is used for purging, a high-yield well should be purged at less than 4 gallons per minute to prevent further well development.

A minimum of three casing volumes will be evacuated from each well prior to sampling. An alternative purge will be considered complete if the monitoring well goes dry before removing the calculated minimum purge volume. The well casing volume for a 2-inch well will be calculated using the following formula:

$$V_c \text{ (gallons)} = 0.163 \times h_w$$

where:
V_c = volume in the well casing = $(d_c^2/4) \times 3.14 \times h_w \times 7.48$ gallons/cubic foot
d_c = casing diameter in feet ($d_c = 0.167$)
h_w = height of the water column (i.e., well depth minus depth to water)

The purge water will be disposed of on the ground surface at least 10 feet downgradient of the monitoring well being purged, unless field characteristics suggest the water will need to be disposed of otherwise. If field characteristics suggest, the purged water will be containerized and disposed of in the facility's leachate collection system, or by other approved disposal means.

The monitoring wells will be sampled using disposable bailers within 24 hours of completing the purge. The bailers will be equipped with a check valve and bottom-emptying device. The bailer will be lowered gently into the well to minimize the possibility of degassing the water.

Field measurements of temperature, pH, specific conductance, and turbidity will be made before and after sample collection as a check on the stability of the groundwater sampled over time. The direct-reading equipment used at each well will be calibrated in the field according to the manufacturer's specifications prior to each day's use. Calibration information should be documented in the instrument's calibration logbook and the field book.

5.1.3 (b) Low-Flow Procedures

Under normal conditions, monitoring wells will be purged and sampled using the low-flow sampling method in accordance with the United States Environmental Protection Agency's

(EPA) *Low-Flow (Minimal Drawdown) Sampling Procedures* (April, 1996), as allowed under the NCSWMR. A summary of these procedures is listed below, and a copy of the procedures is presented in Appendix C.

Depth-to-water measurements will be obtained using an electronic water level indicator capable of recording the depth to an accuracy of 0.01 foot. A determination of whether or not the water table is located within the screened interval of the well will be made. If the water table is not within the screened interval, the amount of drawdown that can be achieved before the screen is intersected will be calculated. If the water table is within the screened interval, total drawdown should not exceed 1 foot so as to minimize the amount of aeration and turbidity. If the water table is above the top of the screened interval, the amount of drawdown should be minimized to keep the screen from being exposed.

If the purging equipment is non-dedicated, the equipment will be lowered into the well, taking care to minimize the disturbance to the water column. If conditions (i.e., water column height and well yield) allow, the pump will be placed in the uppermost portion of the water column (minimum of 18 inches of pump submergence is recommended).

The minimum volume/time period for obtaining independent Water Quality Parameter Measurements (WQPM) will be determined. The minimum volume/time period is determined based on the stabilized flow rate and the amount of volume in the pump and the discharge tubing (alternatively, the volume of the flow cell can be used, provided it is greater than the volume of the pump and discharge tubing). Volume of the bladder pump should be obtained from the manufacturer. Volume of the discharge tubing is as follows:

3/8-inch inside diameter tubing:	20 milliliters per foot
1/4-inch inside diameter tubing:	10 milliliters per foot
3/16-inch inside diameter tubing:	5 milliliters per foot

Once the volume of the flow-cell or the pump and the discharge tubing has been calculated, the well purge will begin. The flow rate should be based on historical data for that well (if available) and should not exceed 500 milliliters per minute. The initial round of WQPM should be recorded and the flow rate adjusted until drawdown in the well stabilizes. Water levels should be measured periodically to maintain a stabilized water level. The water level should not fall within 1 foot of the top of the well screen. If the purge rate has been reduced to 100 milliliters or less and the head level in the well continues to decline, the required water samples should be collected following stabilization of the WQPM, based on the criteria presented below.

If neither the head level nor the WQPM stabilize, a passive sample should be collected. Passive sampling is defined as sampling before WQMP have stabilized if the well yield is low enough that the well will purge dry at the lowest possible purge rate (generally 100 milliliters per minute or less).

WQPM stabilization is defined as follows: pH (+/- 0.2 S.U.), conductance (+/- 10% of reading), temperature (+/- 10% of reading or 0.2°C), and dissolved oxygen [+/- 10% of reading or 0.2 mg/L (whichever is greater)]. Oxidation reduction potential will also be measured and

ideally should also fall within +/- 10% of reading; however, this is not a required parameter. At a minimum, turbidity measurements should also be recorded at the beginning of purging, following the stabilization of the WQPM, and following the collection of the samples. The optimal turbidity range for micropurging is 25 NTU or less. Turbidity measurements above 25 NTU are generally indicative of an excessive purge rate or natural conditions related to excessive fines in the aquifer matrix.

Stabilization of the WQPM should occur in most wells within five to six rounds of measurements. If stabilization does not occur following the removal of a purge volume equal to three well volumes, a passive sample will be collected.

The direct-reading equipment used at each well will be calibrated in the field according to the manufacturer's specifications prior to each day's use and checked at a minimum at the end of each sampling day. Calibration information should be documented in the instrument's calibration logbook and the field book.

Each well is to be sampled immediately following stabilization of the WQPM. The sampling flow rate must be maintained at a rate that is less than or equal to the purging rate. For volatile organic compounds, lower sampling rates (100 - 200 milliliters/minute) should be used. Final field parameter readings should be recorded prior to and after sampling.

5.1.4 Collection

Samples will be collected and containerized in the order described below.

- Volatile Organic Compounds (SW- 846 Method 8260);
- Semi-Volatile Organic Compounds (SW- 846 Method 8270);
- Herbicides (SW-846 Method 8151);
- Pesticides (SW- 846 Method 8080);
- Polychlorinated Biphenyls (PCBs; SW-846 Method 8082);
- Cyanide and Sulfide; and
- Total Metals.

Total metals samples may be collected out of sequence if the turbidity increases during sample collection. Samples will be transferred directly from field sampling equipment into pre-preserved, laboratory-supplied containers. Containers for volatile organic analyses will be filled in such a manner that no headspace remains after filling.

5.1.5 Decontamination

Non-dedicated field equipment that is used for purging or sample collection shall be cleaned with a phosphate-free detergent, and triple-rinsed with distilled water. Any disposable polyethylene tubing used with non-dedicated pumps should be discarded after use at each well. Clean, chemical-resistant nitrile gloves will be worn by sampling personnel during well evacuation and sample collection. Measures will be taken to prevent surface soils, which could introduce

contaminants into the well being sampled, from coming in contact with the purging and sampling equipment.

5.2 Sample Preservation and Handling

Upon containerizing groundwater samples, the samples will be packed into pre-chilled, ice-filled coolers and either hand-delivered or shipped overnight by a commercial carrier to the laboratory for analysis. Sample preservation methods will be used to retard biological action and hydrolysis, as well as to reduce sorption effects. These methods will include chemical preservation, cooling/refrigeration at 4° C, and protection from light. The sample container, minimum volume, chemical preservative, and holding times for each analysis type are provided in Table 2.

5.3 Chain-of-Custody Program

The chain-of-custody program will allow for tracing sample possession and handling from the time of field collection through laboratory analysis. The chain-of-custody program includes sample labels, sample seal, field logbook, and chain-of-custody record.

5.3.1 Sample Labels

Legible labels sufficiently durable to remain legible when wet will contain the following information:

- Site and sample identification number;
- Monitoring well number or other location;
- Date and time of collection;
- Name of collector;
- Parameters to be analyzed; and
- Preservative, if applicable.

5.3.2 Sample Seal

The shipping container will be sealed to ensure that the samples have not been disturbed during transport to the laboratory. The tape is labeled with instructions to notify the shipper if the seal is broken prior to receipt at the laboratory.

5.3.3 Field Logbook

The field logbook will contain sheets documenting the following information:

- Identification of the well;
- Well depth;

- Field meter calibration information;
- Static water level depth and measurement technique;
- Purge volume (given in gallons);
- Time well was purged;
- Date and time of collection;
- Well sampling sequence;
- Types of sample containers used and sample identification numbers;
- Preservative used;
- Field analysis data and methods;
- Field observations on sampling event;
- Name of collector(s); and
- Climatic conditions including air temperatures and precipitation.

5.3.4 Chain-of-Custody Record

The chain-of-custody record is required for tracing sample possession from time of collection to time of receipt at the laboratory. A chain-of-custody record will accompany each individual shipment. The record will contain the following information:

- Sample destination and transporter;
- Sample identification numbers;
- Signature of collector;
- Date and time of collection;
- Sample type;
- Identification of well;
- Number of sample containers in shipping container;
- Parameters requested for analysis;
- Signature of person(s) involved in the chain of possession;
- Inclusive dates of possession; and
- Internal temperature of shipping container upon opening in laboratory (noted by the laboratory).

A copy of the completed chain-of-custody form will accompany the shipment and will be returned to the shipper after the shipping container reaches its destination. The chain-of-custody record will also be used as the analysis request sheet.

5.4 Analytical Procedures

A laboratory certified by the North Carolina Department of Environment and Natural Resources will be utilized for analysis of groundwater and surface water samples from the facility. Analyses will be performed in accordance with U.S. EPA SW-846 methods in accordance with the EPA guidance document (EPA, 1997). For Detection Monitoring, method numbers and reporting limits to be used will be those listed in the October 27, 2006, SWS memorandum. The memorandum, titled *New Guidelines for Electronic Submittal of Environmental Monitoring Data*, is included in Appendix B of this WQMP. The monitoring parameters are also included in

Appendix B, along with the proposed analytical methods and reporting limits. Alternate SW-846 methods may be used if they have the same or lower reporting limit. The laboratory must report any detection of any constituent even if it is detected below the solid waste reporting limit (as revised in the October 27, 2006, memorandum).

The laboratory certificates-of-analyses shall, at a minimum, include the following information:

- Narrative: Must include a brief description of the sample group (number and type of samples, field and associated lab sample identification numbers, preparation and analytical methods used). The data reviewer shall also include a statement that all holding times and Quality Control (QC) criteria were met, samples were received intact and properly preserved, with a brief discussion of any deviations potentially affecting data usability. This includes, but is not limited to, test method deviation(s), holding time violations, out-of-control incidents occurring during the processing of QC or field samples and corrective actions taken, and repeated analyses and reasons for the reanalyses (including, for example, contamination, failing surrogate recoveries, matrix effects, or dilutions). The narrative shall be signed by the laboratory director or authorized laboratory representative, signifying that all statements are true to the best of the reviewer's knowledge, and that the data meet the data quality objectives as described in this plan (except as noted). One narrative is required for each sample group.

- Original Chain-of Custody Form

- Target Analyte List (TAL)/Target Compound List (TCL): The laboratory shall list all compounds for which the samples were analyzed. The TAL/TCL is typically included as part of the analytical reporting forms.

- Dilution factors with a narrative of the sample results, including the reasons for the dilution (if any).

- Blank Data: For organic analyses, the laboratory shall report the results of any method blanks, reagent blanks, trip blanks, field blanks, and any other blanks associated with the sample group. For inorganic analyses, the laboratory shall provide the results of any preparation or initial calibration blanks associated with the sample group.

- QC Summary: The laboratory will provide summary forms detailing laboratory QC sample results, which include individual recoveries and relative percent differences (if appropriate) for the following Quality Assurance (QA)/QC criteria: surrogates, MS analyses, MSD analyses, LCS, and sample duplicate analyses. QC control limits shall also be reported; if any QC limits are exceeded, a flag or footnote shall be placed to indicate the affected samples.

Additional QA data and/or other pertinent data may be reported as requested by the owner/operator of the facility.

5.5 Quality Assurance and Quality Control Program

Trip and field blanks will be collected and analyzed during each monitoring event to verify that the sample collection and handling process has not affected the quality of the samples. The trip blank will be prepared in the laboratory each time a group of bottles is prepared for use in the field. The appropriate number of bottles for VOA analysis will be filled with Type II reagent grade water, transported to the site, handled like the samples, and shipped to the laboratory for analysis. The field blank will be prepared in the field and exposed to the sampling environment. As with all other samples, the time of the blank exposure will be recorded so that the sampling sequence is documented. The field blank will be analyzed for the same list of constituents as the groundwater samples. The trip blank will be analyzed for volatile organic compounds only.

The assessment of blank analysis results will be in general accordance with EPA guidance documents (EPA, 1993 and 1994). No positive sample results will be relied upon unless the concentration of the compound in the sample exceeds 10 times the amount in any blank for common laboratory contaminants (see next paragraph), or five times the amount for other compounds. If necessary, resampling will be performed as necessary to confirm or refute suspect data; such resampling will occur within the individual compliance monitoring period.

Concentrations of any contaminants found in the blanks will be used to qualify the groundwater data. Any compound (other than those listed below) detected in the sample, which was also detected in any associated blank, will be qualified "B" when the sample concentration is less than five times the blank concentration. For common laboratory contaminants (methylene chloride, acetone, 2-butanone, and common phthalate esters), the results will be qualified "B" when the reported sample concentration is less than 10 times the blank concentration. The "B" qualifier designates that the reported detection is considered to represent cross-contamination and that the reported constituent is not considered to be present in the sample at the reported concentration.

6.0 STATISTICAL METHODS

Groundwater monitoring data for landfill compliance wells screened in the uppermost aquifer will be evaluated using statistical procedures, as discussed below. The statistical test used to evaluate the groundwater monitoring data will be the prediction interval procedure unless the test is inappropriate with the data collected. Statistical evaluation of groundwater monitoring data will be performed in compliance with Rule .1632 (g), (h), and (i) and the USEPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Interim Final Guidance* (April 1989) and the *Addendum to Interim Final Guidance* (July 1992).

7.0 SURFACE WATER MONITORING (RULE .0602)

In accordance with Rule .0602 of the NCSWMR, several surface water monitoring locations have been established for the facility to monitor water quality surrounding the proposed waste footprint. One upgradient monitoring point (0803-SW-1) and three downgradient monitoring points (0803-SW-2, 0803-SW-3 and 0803-SW-4) are currently sampled as part of the monitoring network for this facility, as shown on Drawing WQMP-1. The downgradient locations coincide with the locations of discharge from the proposed perimeter surface water management basins.

These points will be sampled semiannually for analysis of the NC Appendix I list of constituents and required water quality parameters (pH, specific conductivity, temperature, and turbidity). The results of the analysis of the surface water data will be submitted to the SWS semiannually in conjunction with the groundwater data.

8.0 REFERENCES

The references cited below were used in the preparation of this report, and may or may not be referenced in the text.

BLE (Bunnell-Lammons Engineering, Inc.), 2004. *Report of Ground Water Quality Results & Statistical Analysis, Second Semi-Annual Sampling Event of 2004 (N27) East Carolina Regional MSW Landfill, Bertie County, North Carolina.* December. 5 pp.

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Law Engineering, 1996. Design Hydrogeologic Report Phase II (Cells 7 and 8). August. 15 pp.

NCGS (North Carolina Geologic Survey), 1985. Geologic Map of North Carolina. Scale 1:500,000.

North Carolina Dept. Environment, Health, and Natural Resources (NCDEHNR). 1995. N.C. *Water Quality Monitoring Guidance Document for Solid Waste Facilities.*

North Carolina Dept. Environment, Health, and Natural Resources (NCDEHNR). 2006. N.C. *New Guidelines for Electronic Submittal of Environmental Monitoring Data.*

RCRA *Ground Water Monitoring Technical Enforcement Guidance Document* (TEGD). 1986.

USEPA. 1996. *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures.* Puls, Robert W. and Barcelona, Michael J.

USEPA. 1993. Region III Modifications to Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses, EPA 540/R-01-008. April.

USEPA, 1994. Region III Modifications to National Functional Guidelines for Organic Data Review Multi-Media, Multi-Concentration (OLMO1.0-OLMO0.9), EPA 540/R-99-008. September.

USEPA. June 1997. *SW-846 Methods for Evaluating Solid Waste, Physical/Chemical Methods, Final Update III.*

USEPA. 1992. *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities - Addendum to Interim Final Guidance.* Office of Solid Waste. Washington, D.C.

USEPA. 1989. *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities - Interim Final Guidance.* EPA/530-SW-89-026. Office of Solid Waste. Washington, D.C.

TABLES

TABLE 1

SUMMARY OF WELL CONSTRUCTION INFORMATION
EAST CAROLINA REGIONAL LANDFILL, PERMIT NO. 08-03
BERTIE COUNTY, NORTH CAROLINA

Well Identification	Construction Date	Ground Surface Elevation (ft AMSL)	Measuring Point Elevation (ft AMSL)	Well Depth (feet)	Well Diameter (inches)	Screened Interval (ft AMSL)	Screened Geologic Formation
0803-GW-1	1993	63.7	65.87	62	2	11.7 to 1.7	Black Creek Formation
0803-GW-2	1993	64.0	66.36	26	2	48.0 to 38.0	Yorktown Formation
0803-GW-3	1993	63.7	66.23	26	2	47.7 to 37.7	Yorktown Formation
0803-GW-4	1993	60.7	62.53	59	2	11.7 to 1.7	Black Creek Formation
0803-GW-5	1993	60.9	62.60	24	2	46.9 to 36.9	Yorktown Formation
0803-GW-6	1993	57.5	58.95	63	2	4.5 to -5.5	Black Creek Formation
0803-GW-7	1993	57.4	58.79	18	2	49.4 to 39.4	Yorktown Formation
0803-GW-8	1993	58.6	60.04	18	2	50.6 to 40.6	Yorktown Formation
0803-GW-9	1993	50.1	51.94	13	2	47.1 to 37.1	Yorktown Formation
0803-GW-10	1996	50.4	53.22	22	2	38.4 to 28.4	Yorktown Formation
0803-GW-11	1997	68.6	72.42	28	2	55.6 to 40.6	Yorktown Formation
0803-GW-12	1993	63.7	66.13	54	2	19.7 to 9.7	Black Creek Formation
0803-GW-13	2001	72.2	74.76	41.3	2	45.9 to 30.9	Yorktown Formation
0803-GW-14	2003	76.7	78.74	47.8	2	38.9 to 28.9	Yorktown Formation
0803-GW-15	2005	75.23	78.23	42.6	2	24.2 to 39.2	Yorktown Formation
0803-GW-16	2006	60.99	62.91	23.0	2	23.0 to 13.0	Yorktown Formation
0803-GW-17	*2008*	*76.00*	*78.50*	*54.8*	*2*	*44.8 to 54.8*	*Yorktown Formation*
0803-GW-18	2006	61.01	62.87	32.0	2	28.0 to 13.0	Yorktown Formation
0803-GW-19	2006	64.83	67.36	24.0	2	21.0 to 11.0	Yorktown Formation
0803-GW-20	2006	59.77	62.25	26.0	2	45.8 to 35.8	Yorktown Formation
0803-GW-21	*2008*	*59.50*	*62.00*	*25.0*	*2*	*44.5 to 34.5*	*Yorktown Formation*

Notes: ft AMSL = feet above mean sea level

Wells GW-17 and GW-21 are proposed to be installed at a later date and well construction information details are estimated.

TABLE 2

SAMPLING AND PRESERVATION PROCEDURES
EAST CAROLINA REGIONAL LANDFILL, PERMIT NO. 08-03
BERTIE COUNTY, NORTH CAROLINA

Parameter	Container & Volume	Preservative	Maximum Holding Time
Cyanide	P,G; 500 mL	4°C, NaOH to pH>12, 0.6 g Ascorbic Acid	14 days
Sulfide	P,G; 500 mL	4°C, add Zinc Acetate	7 days
Mercury (total)	P; 300 mL	HNO_3 to pH<2	28 days
Metals (total) except mercury	P; 1000 mL	HNO_3 to pH<2	6 months
Acrolein and acrylonitrile	2-40 ml VOA w/G, Teflon-lined septum	4°C, 0.008% $Na_2S_2O_3$, adjust pH to 4 to 5	14 days
Benzidines	G, Teflon-lined cap 1000 mL	4°C, 0.008% $Na_2S_2O_3$, adjust pH to 4 to 5	7 days to extraction, 40 days after extraction
Haloethers	G, Teflon-lined cap 1000 mL	4°C, 0.008% $Na_2S_2O_3$	7 days to extraction, 40 days after extraction
Phthalate esters	G 1000 mL	4°C	7 days to extraction, 40 days after extraction
Nitrosamines	G, Teflon-lined cap 1000 mL	4°C, store in dark, 0.008% $Na_2S_2O_3$	7 days to extraction, 40 days after extraction
Nitroaromatics and cyclic ketones	G, Teflon-lined cap 1000 mL	4°C, store in dark, 0.008% $Na_2S_2O_3$	7 days to extraction, 40 days after extraction
PCBs	G, Teflon-lined cap 1000 mL	4°C	7 days to extraction, 40 days after extraction
Phenols	G, Teflon-lined cap 1000 mL	4°C, 0.008% $Na_2S_2O_3$	7 days to extraction, 40 days after extraction
Purgeable Aromatic Hydrocarbons	2-40 ml VOA w/G, Teflon-lined septum	4°C, 0.008% $Na_2S_2O_3$, HCl to pH 2	14 days
Purgeable halocarbons	2-40 ml VOA w/G, Teflon-lined septum	4°C, 0.008% $Na_2S_2O_3$	14 days
Polynuclear aromatic hydrocarbons	G, Teflon-lined cap 1000 mL	4°C, store in dark, 0.008% $Na_2S_2O_3$	7 days to extraction, 40 days after extraction
Chlorinated hydrocarbons	G, Teflon-lined cap 1000 mL	4°C	7 days to extraction, 40 days after extraction
Pesticides	G, Teflon-lined cap 1000 mL	4°C, pH 5 to 9	7 days to extraction, 40 days after extraction

Notes: P - Plastic, G - Glass, T - Fluorocarbon Resin (PTFE, TeflonÒ, FEP, etc.)

No headspace should be allowed in the volatile organic compound containers.

DRAWING

LEGEND

- EXISTING TOPOGRAPHIC CONTOUR
- PROPERTY BOUNDARY
- LIMITS OF WASTE
- PROPOSED LIMITS OF WASTE
- GROUNDWATER SURFACE CONTOURS — 48
- APPROXIMATE GROUNDWATER FLOW SEGMENT USED TO CALCULATE GRADIENT
- GROUNDWATER MONITORING WELL — GW-2
- SURFACE WATER MONITORING POINT — SW-2
- PRIVATE WATER SUPPLY WELL — PW-1

NOTES:

1. TOPOGRAPHIC CONTOUR INTERVAL = 2 FEET.
2. GROUNDWATER SURFACE CONTOUR INTERVAL = 2 FEET.
3. GROUNDWATER ELEVATIONS MEASURED ON OCTOBER 31, 2006.
4. GROUNDWATER CONTOURS ARE BASED ON LINEAR INTERPOLATION BETWEEN AND EXTRAPOLATION FROM KNOWN DATA, TOPOGRAPHIC CONTOURS, AND KNOWN FIELD CONDITIONS. THEREFORE, GROUNDWATER CONTOURS MAY NOT REFLECT ACTUAL GROUNDWATER CONDITIONS.
5. GROUNDWATER CONTOUR LINES SHOW THE WATER TABLE SHAPE AND ELEVATION. THESE CONTOURS ARE INFERRED LINES FOLLOWING THE GROUNDWATER SURFACE AT A CONSTANT ELEVATION ABOVE SEA LEVEL. THE GROUNDWATER FLOW DIRECTION IS GENERALLY PERPENDICULAR TO THE GROUNDWATER SURFACE CONTOURS, SIMILAR TO THE RELATIONSHIP BETWEEN SURFACE WATER FLOW AND TOPOGRAPHIC CONTOURS.
6. MONITORING WELLS AND PIEZOMETERS WITHOUT GROUNDWATER ELEVATIONS ARE SCREENED IN THE LOWER BLACK CREEK FORMATION AND GROUNDWATER ELEVATION DATA WERE NOT USED IN THE CONSTRUCTION OF CONTOURS.
7. THE LOCATION OF PW-1 IS APPROXIMATE.
8. MONITORING WELL GW-14 WILL BE DECOMMISSIONED IN ORDER TO CONSTRUCT THE PHASE 5 EXPANSION.
9. POTENTIOMETRIC SURFACE TAKEN FROM DRAWING 1 OF THE PHASE 5 DESIGN HYDROGEOLOGIC REPORT.
10. SURFACE WATER POINTS SW-3 AND SW-4 ARE OUTSIDE OF THE LIMITS OF MAPPING.
11. MONITORING WELLS GW-18, GW-19 AND GW-20 WERE INSTALLED AS PIEZOMETERS PZ-110, PZ-118 AND PZ-122, ARE RESPECTIVELY.
12. MONITORING WELL GW-17 AND GW-21 IS CURRENTLY NOT INSTALLED

GW-20 PROPOSED COMPLIANCE WELL
GW-21 PROPOSED COMPLIANCE WELL
GW-19 PROPOSED COMPLIANCE WELL
GW-18 PROPOSED COMPLIANCE WELL
GW-14 TO BE DECOMMISSIONED
GW-16 COMPLIANCE WELL
GW-17 PROPOSED COMPLIANCE WELL
GW-3 COMPLIANCE WELL
GW-12 COMPLIANCE WELL
GW-5 COMPLIANCE WELL
GW-4 COMPLIANCE WELL
GW-7 COMPLIANCE WELL
GW-8 COMPLIANCE WELL
GW-9 COMPLIANCE WELL
GW-6 COMPLIANCE WELL
GW-10 COMPLIANCE WELL
GW-11 COMPLIANCE WELL
GW-13 COMPLIANCE WELL
GW-15 COMPLIANCE WELL
GW-2 COMPLIANCE WELL
GW-1 COMPLIANCE WELL
PW-1
SW-1
SW-2
SW-3 (~1500 ft South)
SW-4 (~600 ft South)

PROPOSED PHASE 5
FUTURE
EXISTING CELL NO. 11
EXISTING CELL NO. 10
EXISTING CELL NO. 9
EXISTING CELL NO. 8
EXISTING CELL NO. 7
EXISTING CELL NO. 6
EXISTING CELL NO. 5
EXISTING CELL NO. 4
EXISTING CELL NO. 3
EXISTING LEACHATE STORAGE TANK
EXISTING SCALES AND SCALE HOUSE
ACCESS GATE
ACCESS ROAD
BORROW AREA NO. 8 (CLOSED)
BORROW AREA NO. 5
NC 1225 - REPUBLICAN ROAD

48 50 52 54 54 52 50 48

N

200 0 200 400
SCALE FEET

Golder Associates
GOLDER ASSOCIATES INC., INC

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT
EAST CAROLINA REGIONAL MSW LANDFILL
REPUBLIC SERVICES OF NORTH CAROLINA, LLC
BERTIE COUNTY, NORTH CAROLINA

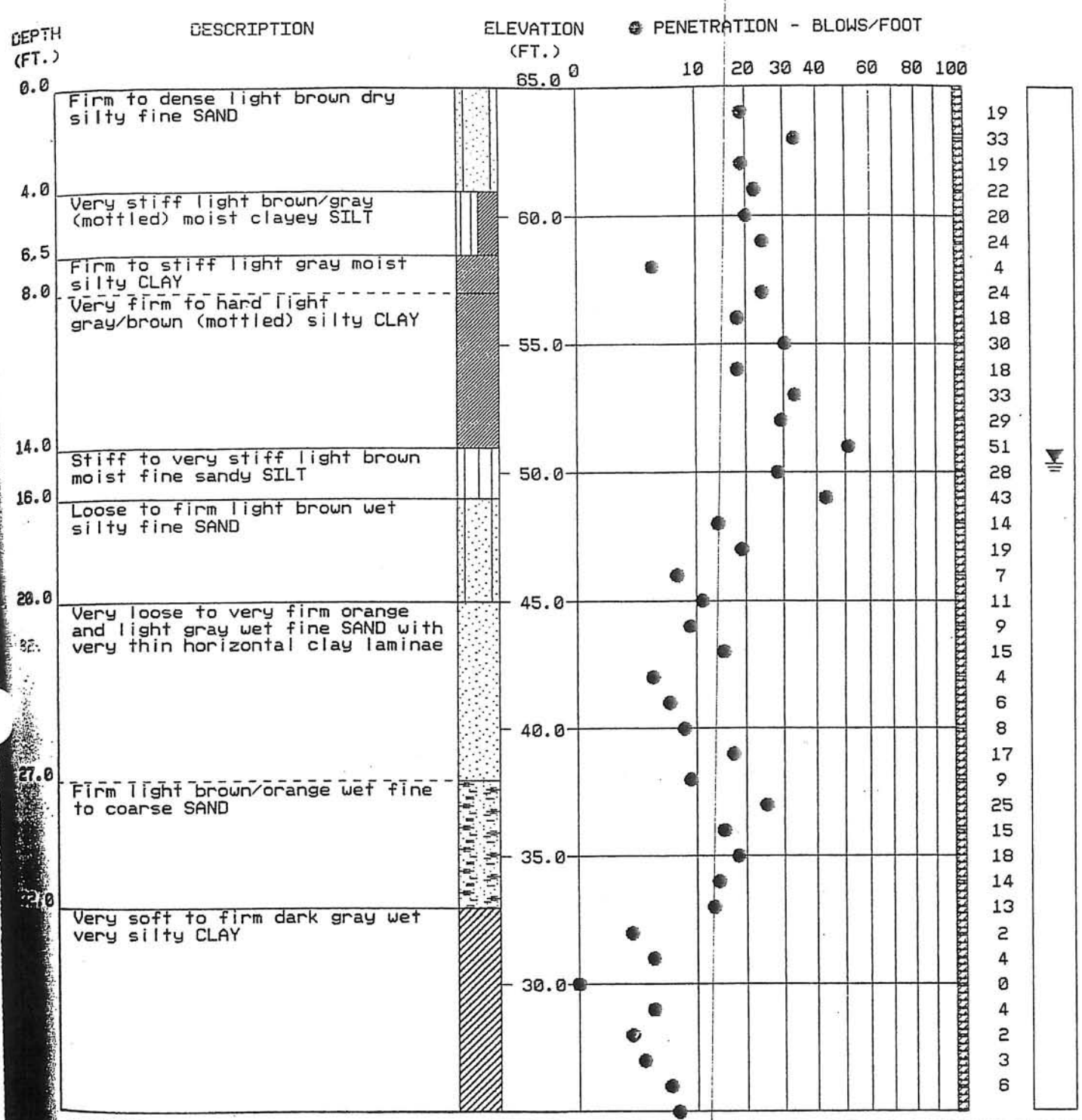
TITLE
WATER QUALITY MONITORING PLAN WITH THE YORKTOWN FORMATION POTENTIOMETRIC SURFACE

PROJECT No.		063-6507
FILE No.		
REV. 0	SCALE	AS SHOWN
DESIGN	DYR	07/16/07
CADD	LKB	07/16/07
CHECK		
REVIEW		

WQMP-1

APPENDIX A

BORING LOGS/WELL CONSTRUCTION RECORDS



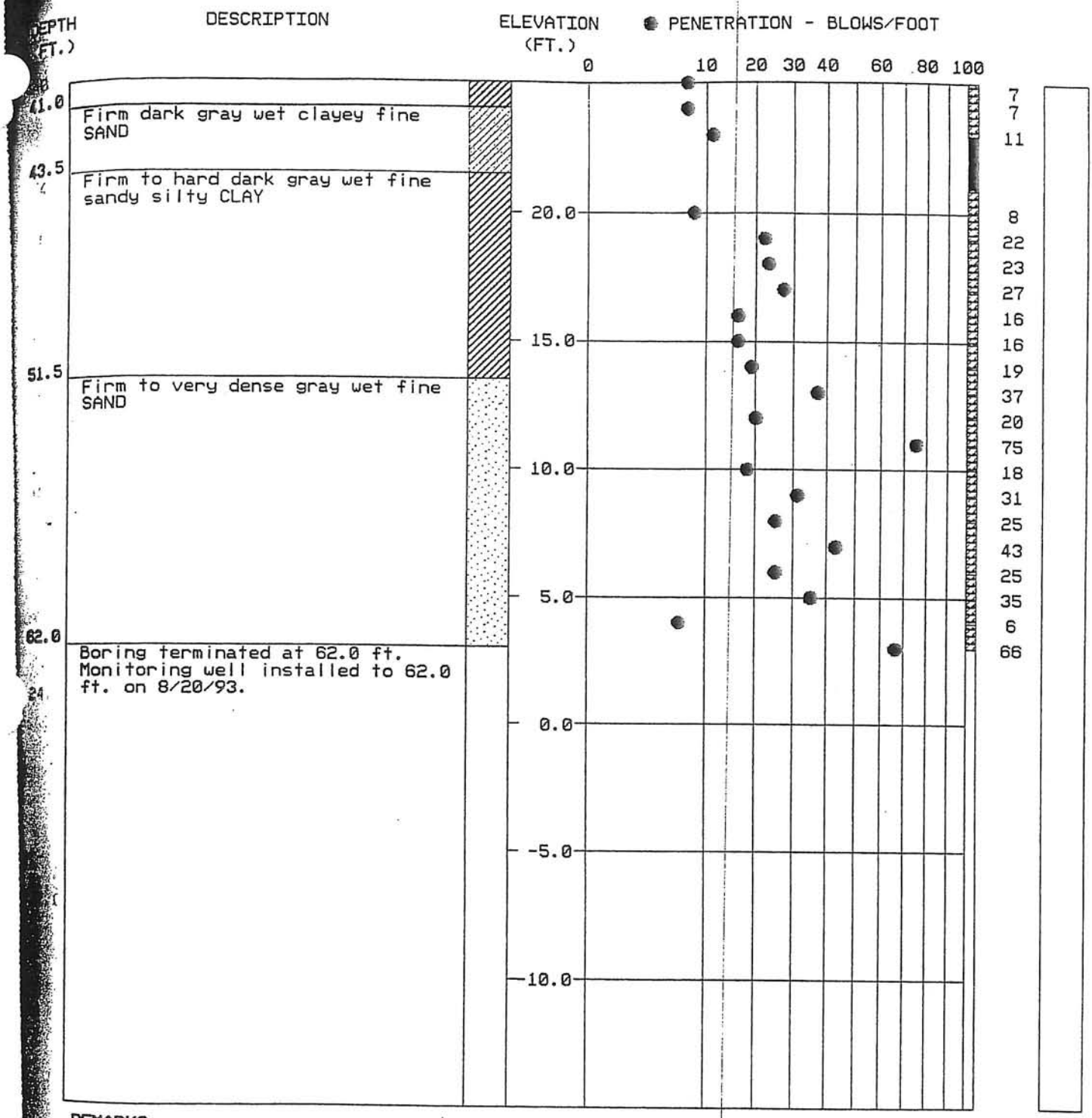
REMARKS:
UD sample analyzed for porosity.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GW-1
DATE DRILLED	August 19, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 1 OF 2	

LAW ENGINEERING



REMARKS:

UD sample analyzed for porosity.

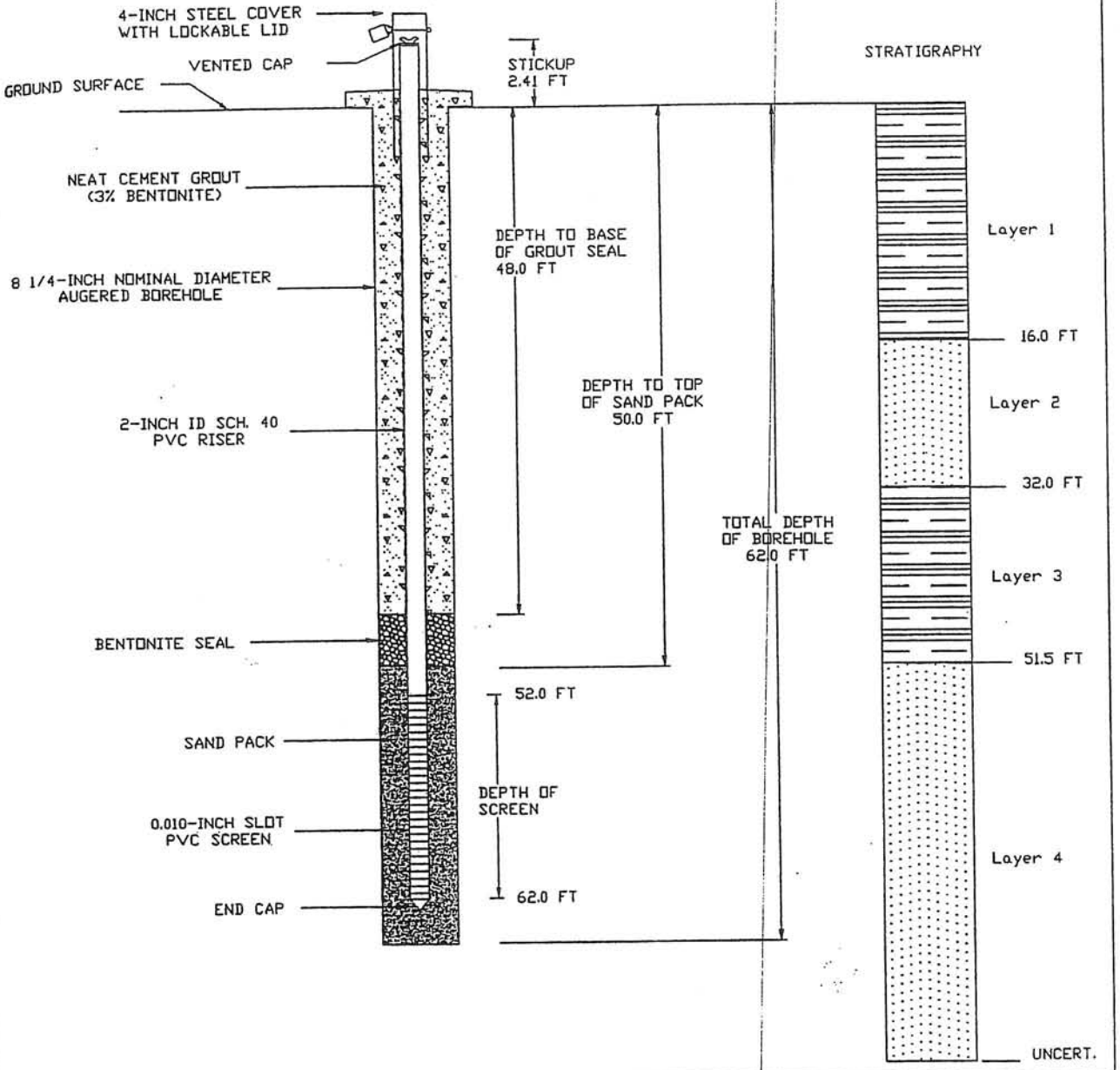
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GW-1
DATE DRILLED	August 19, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 2 OF 2	

LAW ENGINEERING

MONITORING WELL GW–1
CONSTRUCTION DIAGRAM



INSTALLATION DATE: 8/20/93

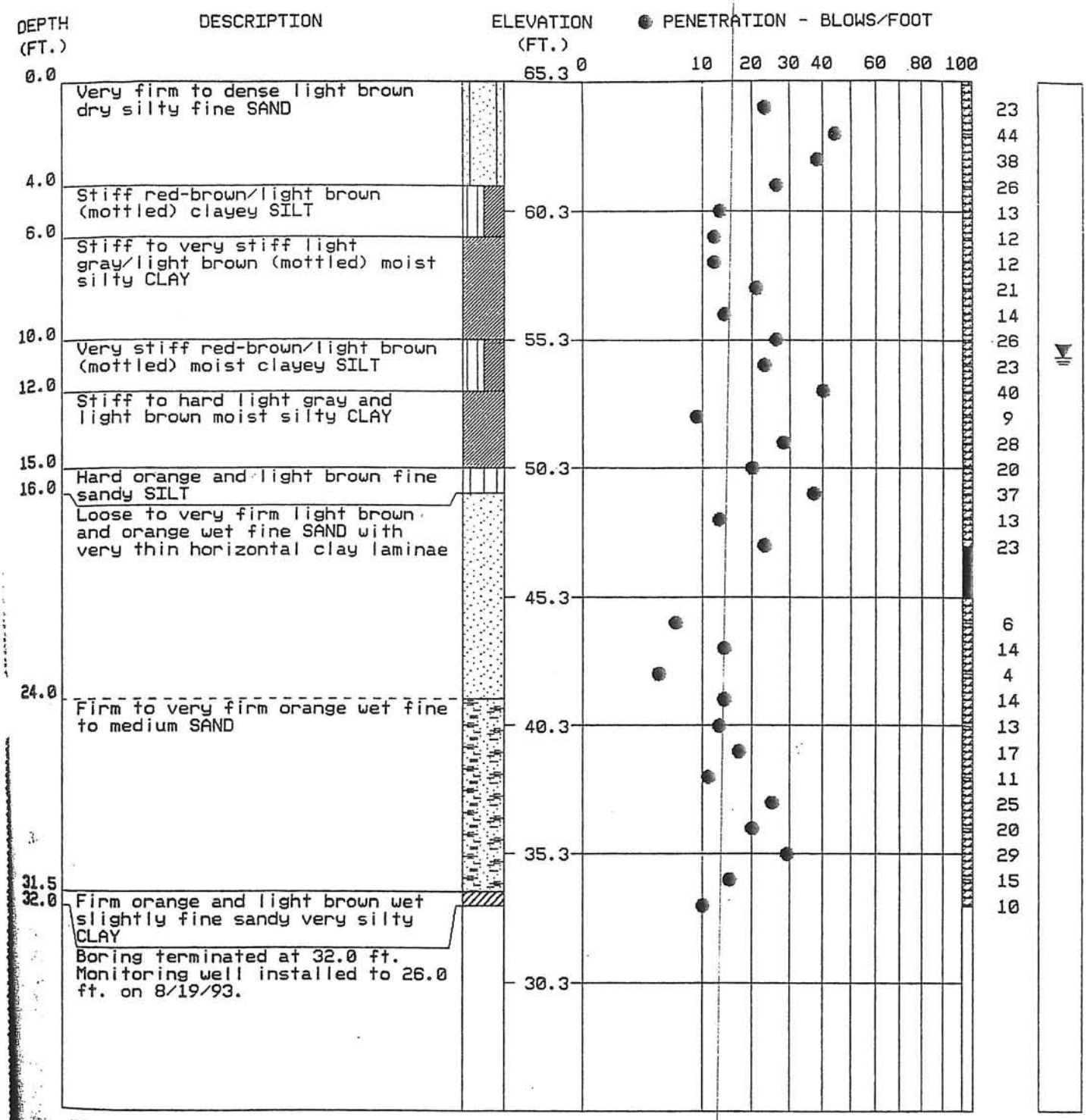
GROUND SURFACE EV. 64.96 FT MSL
MEASURING POINT EV. 67.37 FT MSL
SITE NORTHING: 13454.24 FT
SITE EASTING: 5518.52 FT

NOT TO SCALE

LAW ENGINEERING
GREENVILLE, SOUTH CAROLINA

GW–1 CONSTRUCTION DIAGRAM
EASTERN CAROLINA LANDFILL
BERTIE COUNTY, NORTH CAROLINA

JOB NO:2490472612



REMARKS:

UD sample analyzed for porosity.

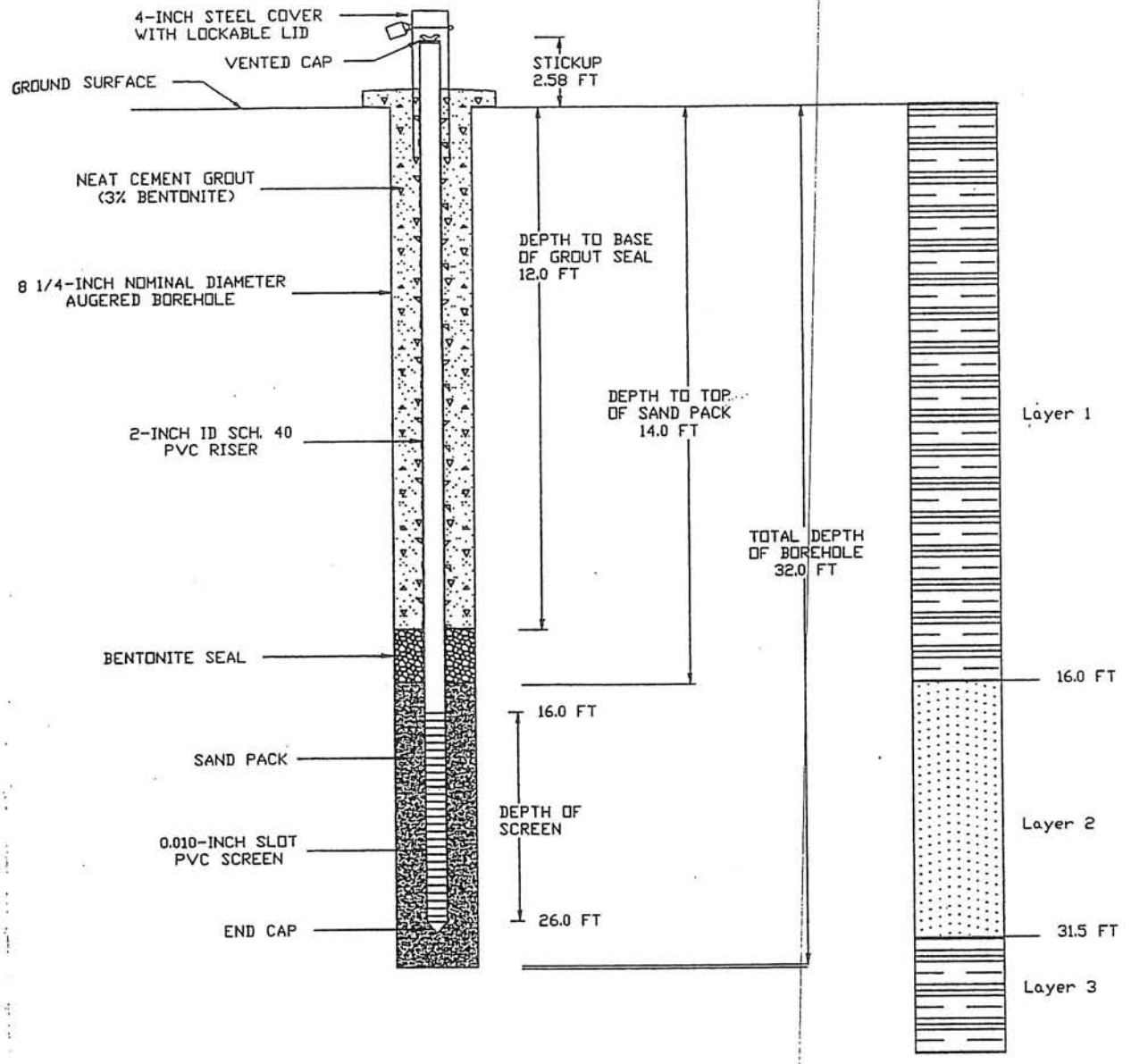
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

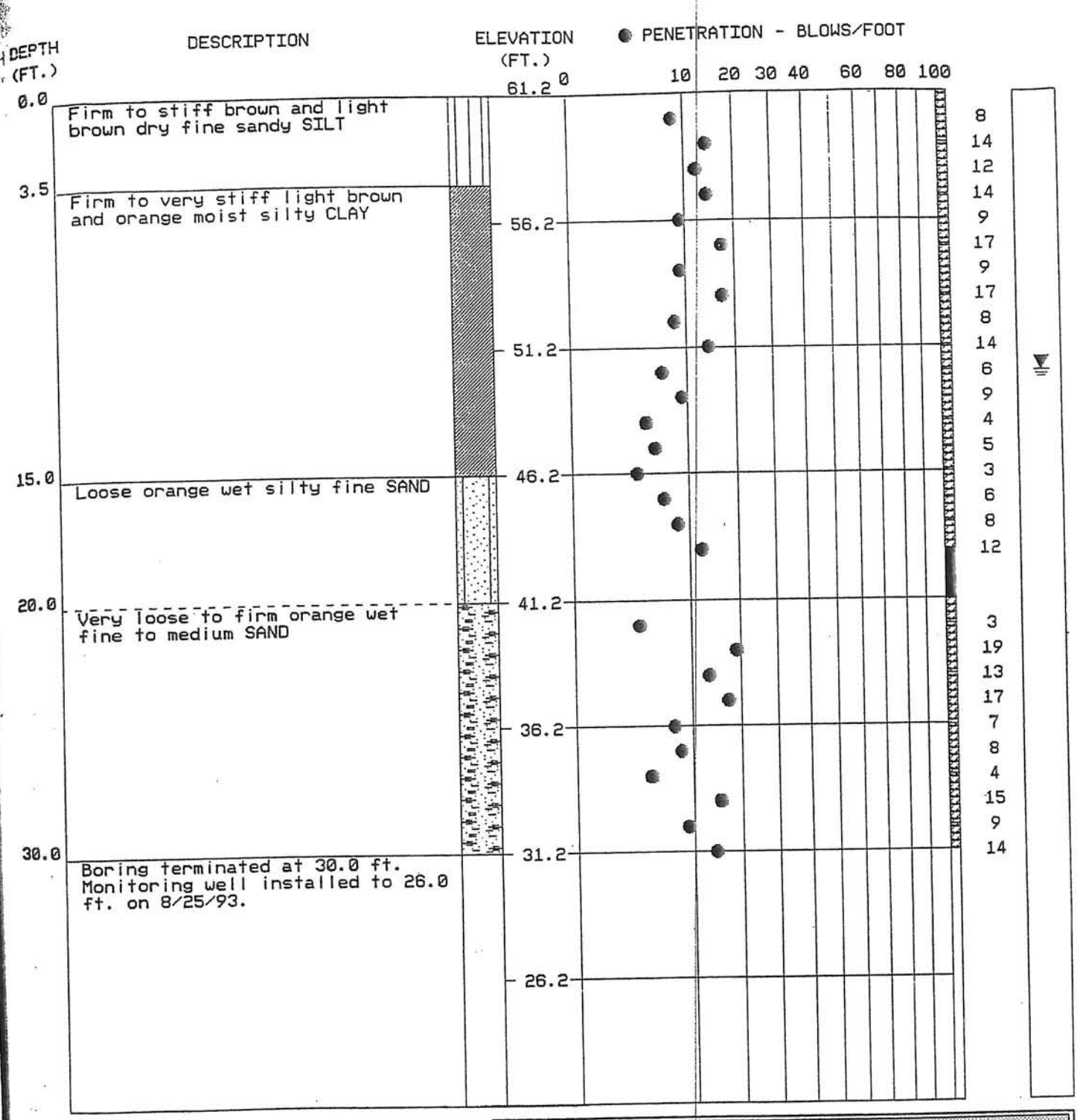
BORING NUMBER	GW-2
DATE DRILLED	August 19, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 1 OF 1	

LAW ENGINEERING

MONITORING WELL GW-2
CONSTRUCTION DIAGRAM



INSTALLATION DATE: 8/19/93 GROUND SURFACE EV. 65.29 FT MSL MEASURING POINT EV. 67.87 FT MSL SITE NORTHING: 13457.23 FT SITE EASTING: 5544.03 FT NOT TO SCALE	LAW ENGINEERING GREENVILLE, SOUTH CAROLINA	GW-2 CONSTRUCTION DIAGRAM EASTERN CAROLINA LANDFILL BERTIE COUNTY, NORTH CAROLINA JOB NO:2490472612



REMARKS:
UD sample analyzed for porosity.

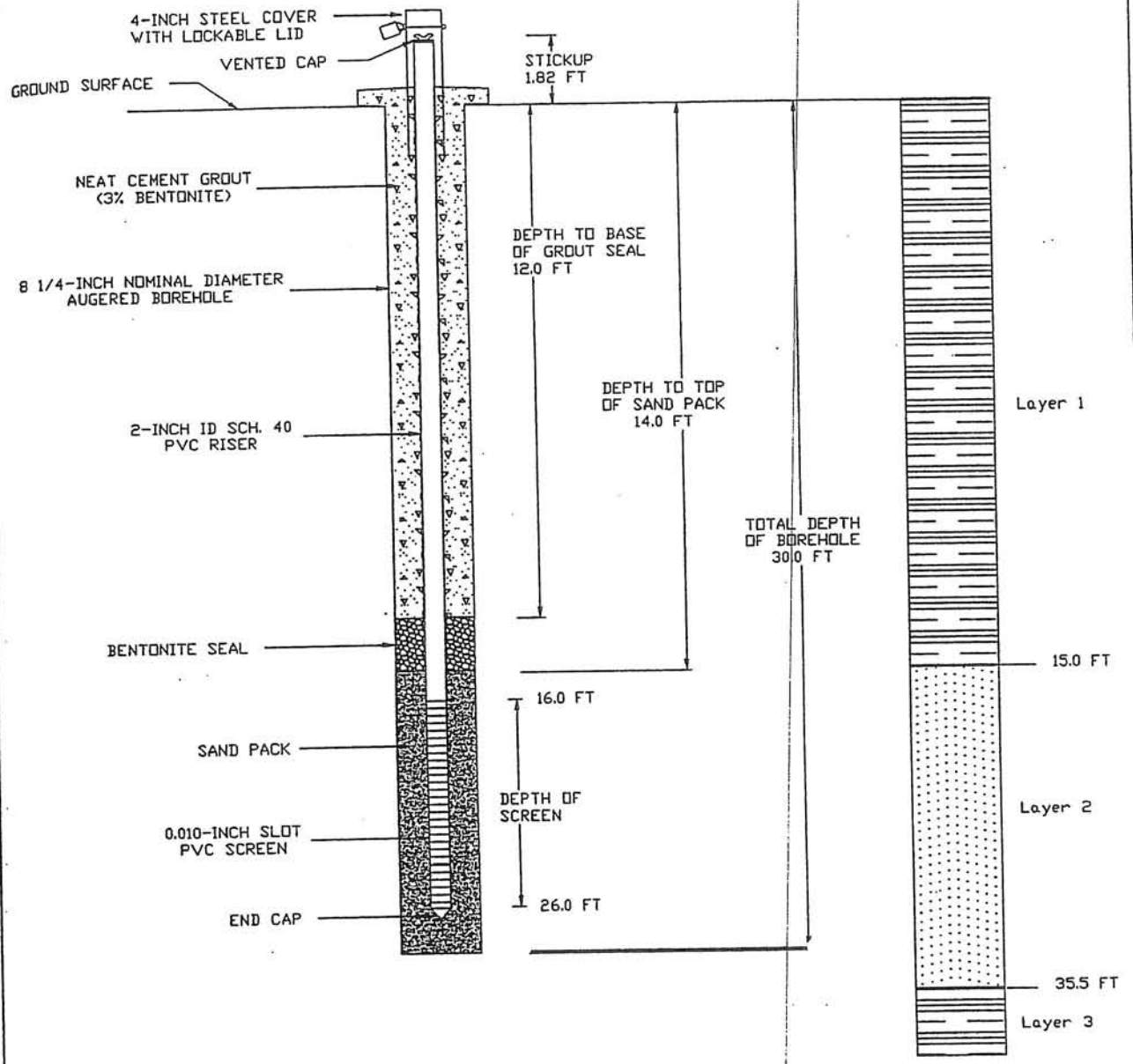
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GW-3
DATE DRILLED	August 25, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 1 OF 1	

LAW ENGINEERING

MONITORING WELL GW–3
CONSTRUCTION DIAGRAM



INSTALLATION DATE: 8/25/93

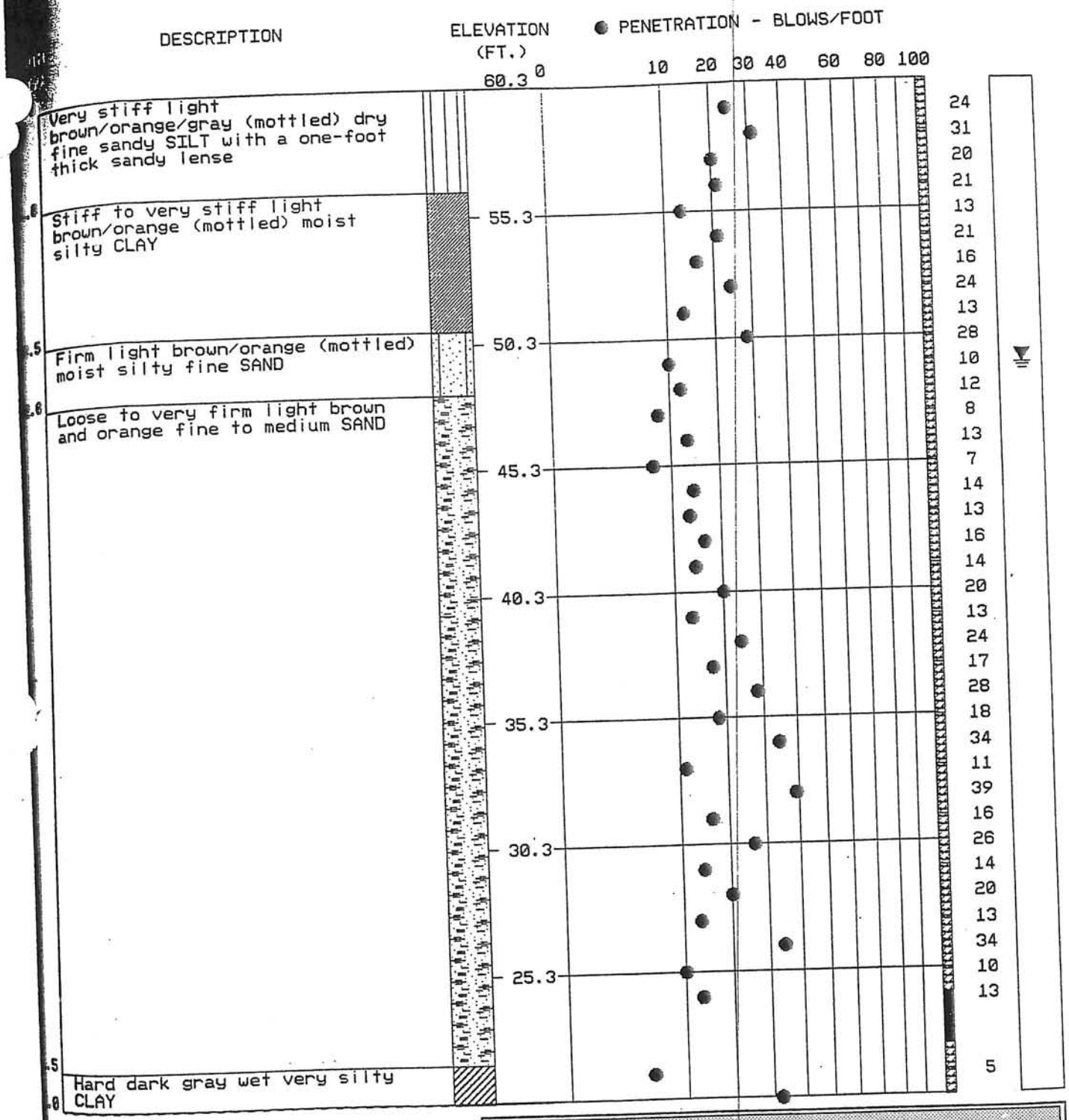
GROUND SURFACE EV. 61.19 FT MSL
MEASURING POINT EV. 63.01 FT MSL
SITE NORTHING: 11356.88 FT
SITE EASTING: 7340.78 FT

NOT TO SCALE

LAW ENGINEERING
GREENVILLE, SOUTH CAROLINA

GW–3 CONSTRUCTION DIAGRAM
EASTERN CAROLINA LANDFILL
BERTIE COUNTY, NORTH CAROLINA

JOB NO:2490472612



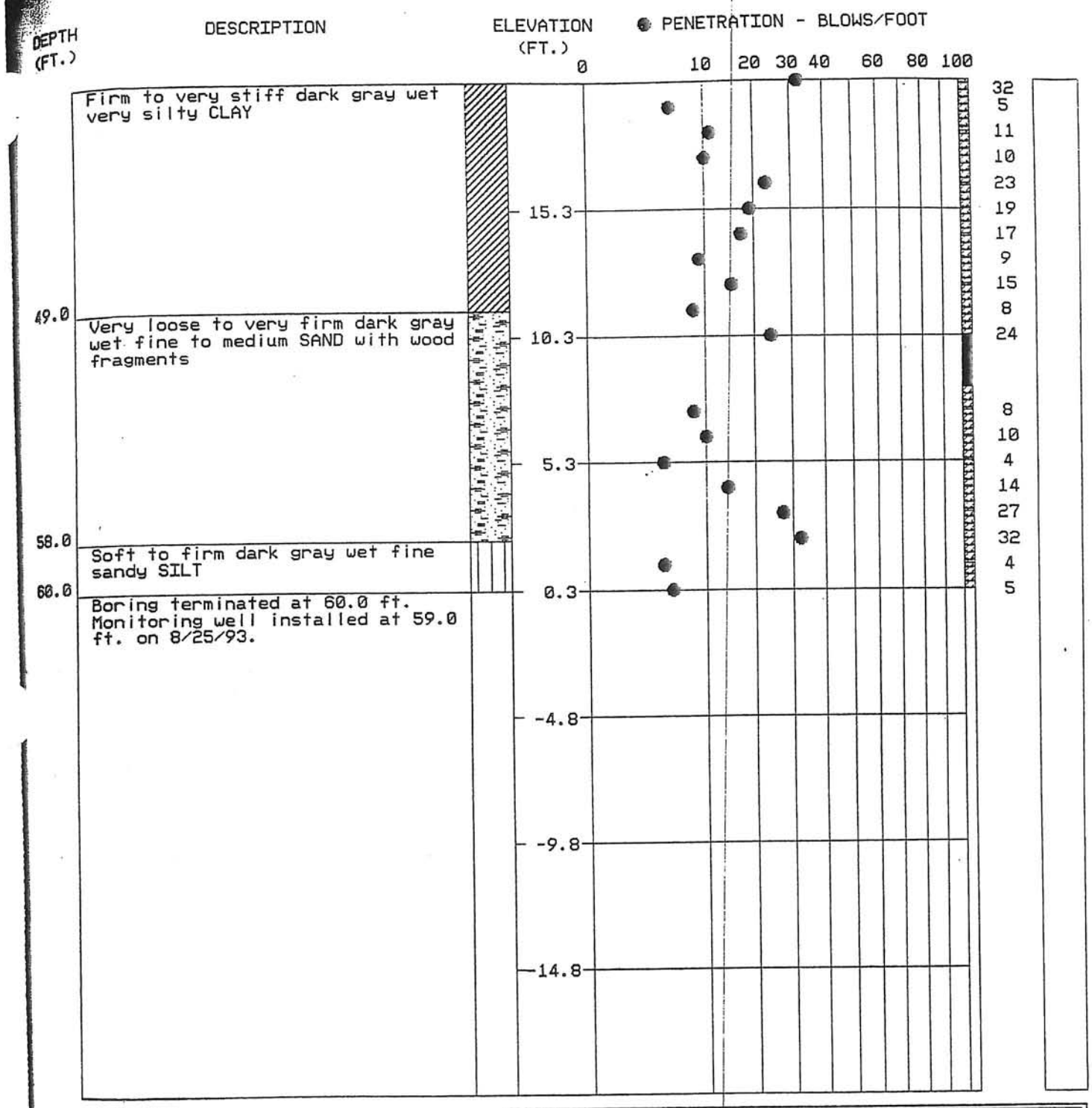
REMARKS:
UD sample analyzed for porosity.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GW-4
DATE DRILLED	August 24, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 1 OF 2	

LAW ENGINEERING



REMARKS:
UD sample analyzed for porosity.

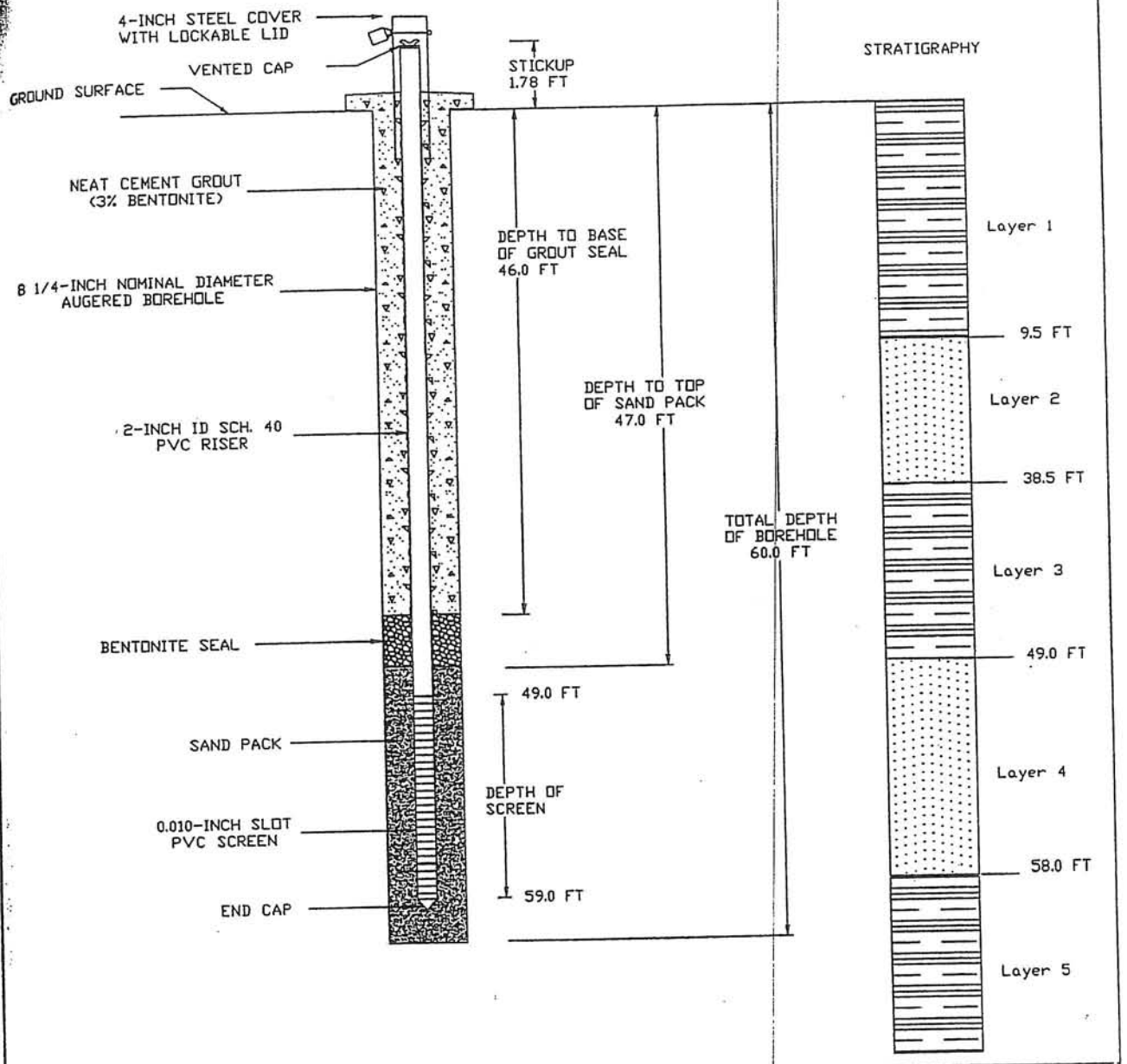
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GW-4
DATE DRILLED	August 24, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 2 OF 2	

LAW ENGINEERING

MONITORING WELL GW-4
CONSTRUCTION DIAGRAM



INSTALLATION DATE: 8/25/93

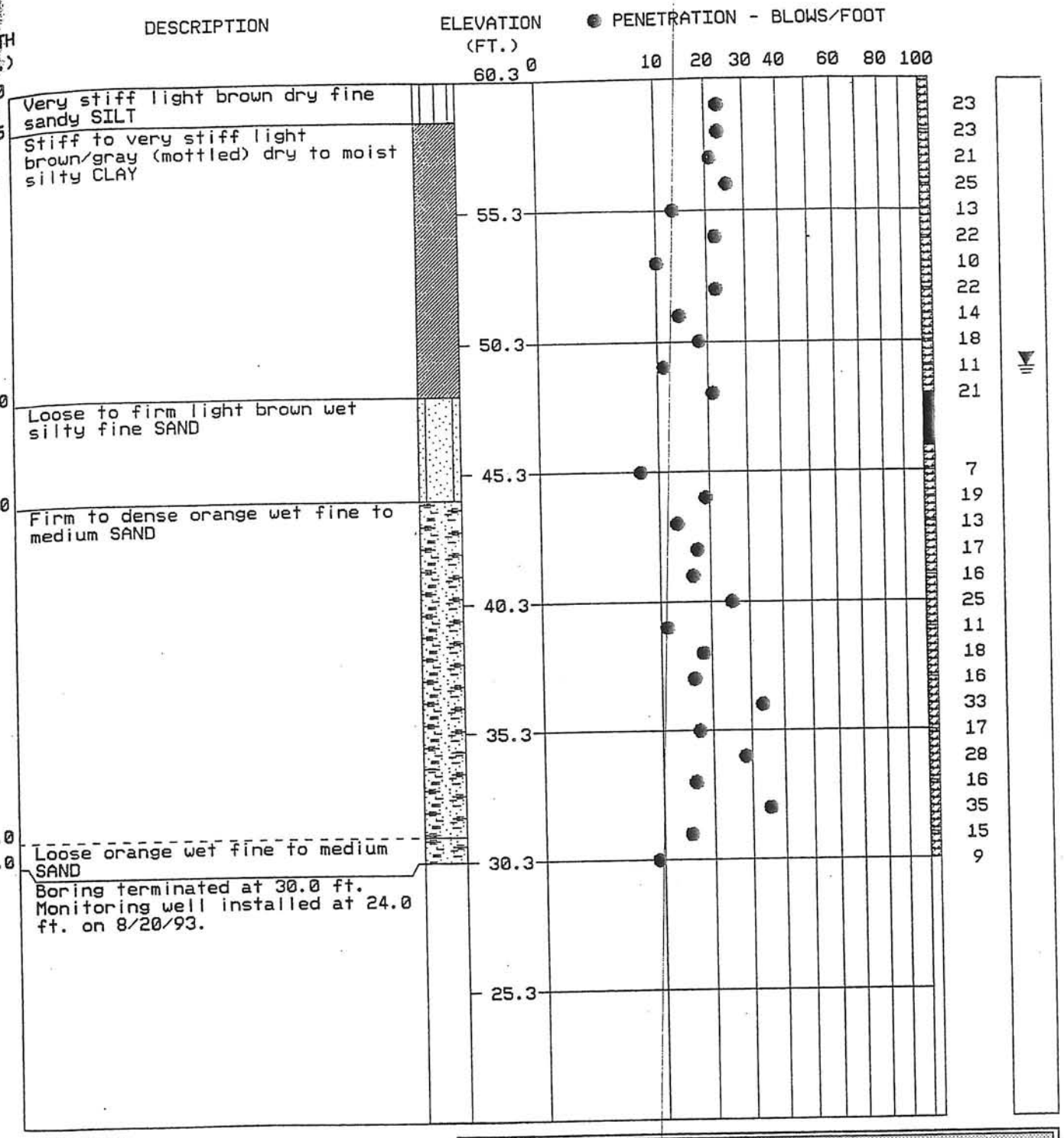
GROUND SURFACE EV. 60.25 FT MSL
MEASURING POINT EV. 62.03 FT MSL
SITE NORTHING: 10476.16 FT
SITE EASTING: 7048.20 FT

NOT TO SCALE

LAW ENGINEERING
GREENVILLE, SOUTH CAROLINA

GW-4 CONSTRUCTION DIAGRAM
EASTERN CAROLINA LANDFILL
BERTIE COUNTY, NORTH CAROLINA

JOB NO:2490472607



REMARKS:

UD sample analyzed for porosity.

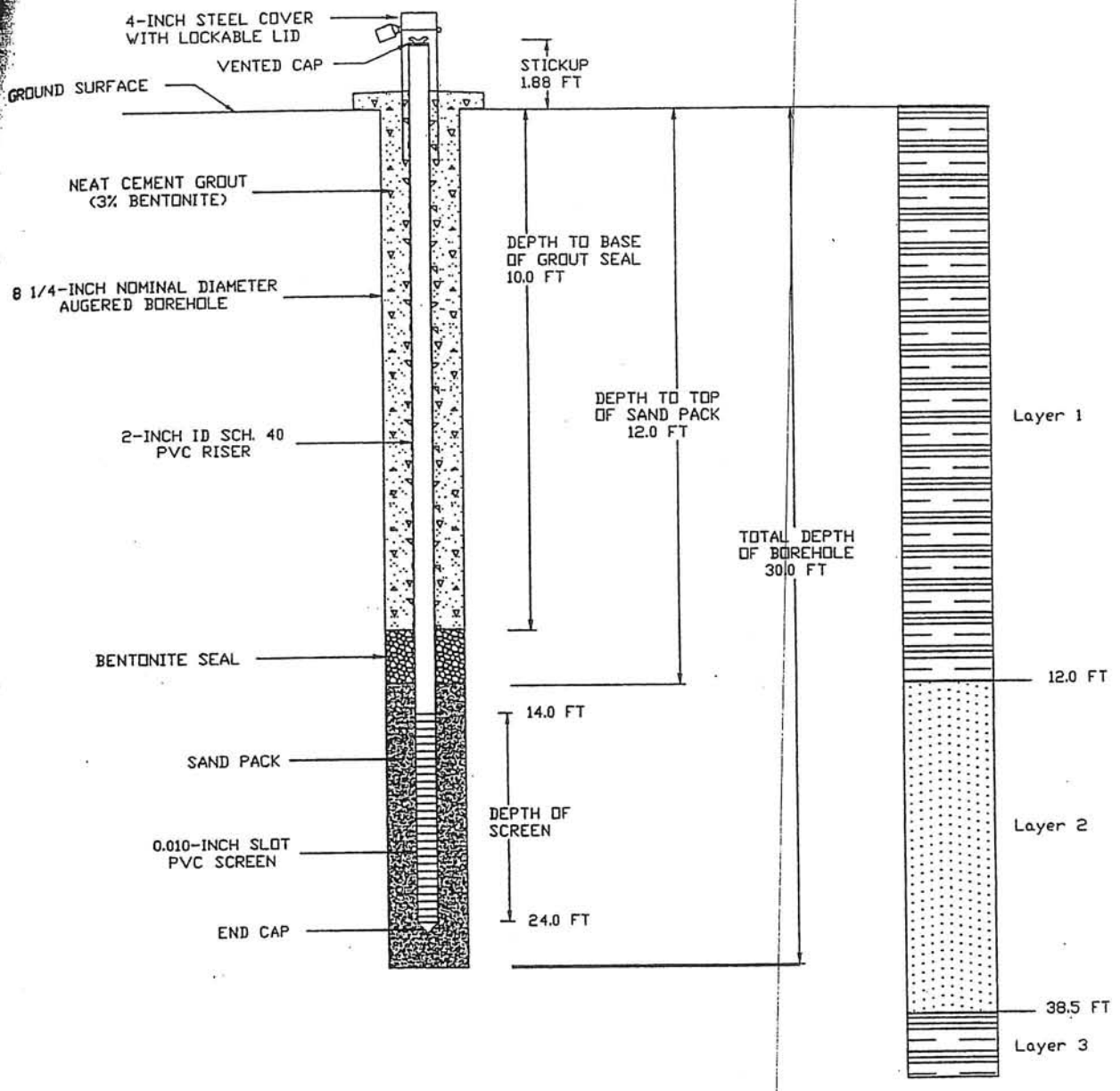
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

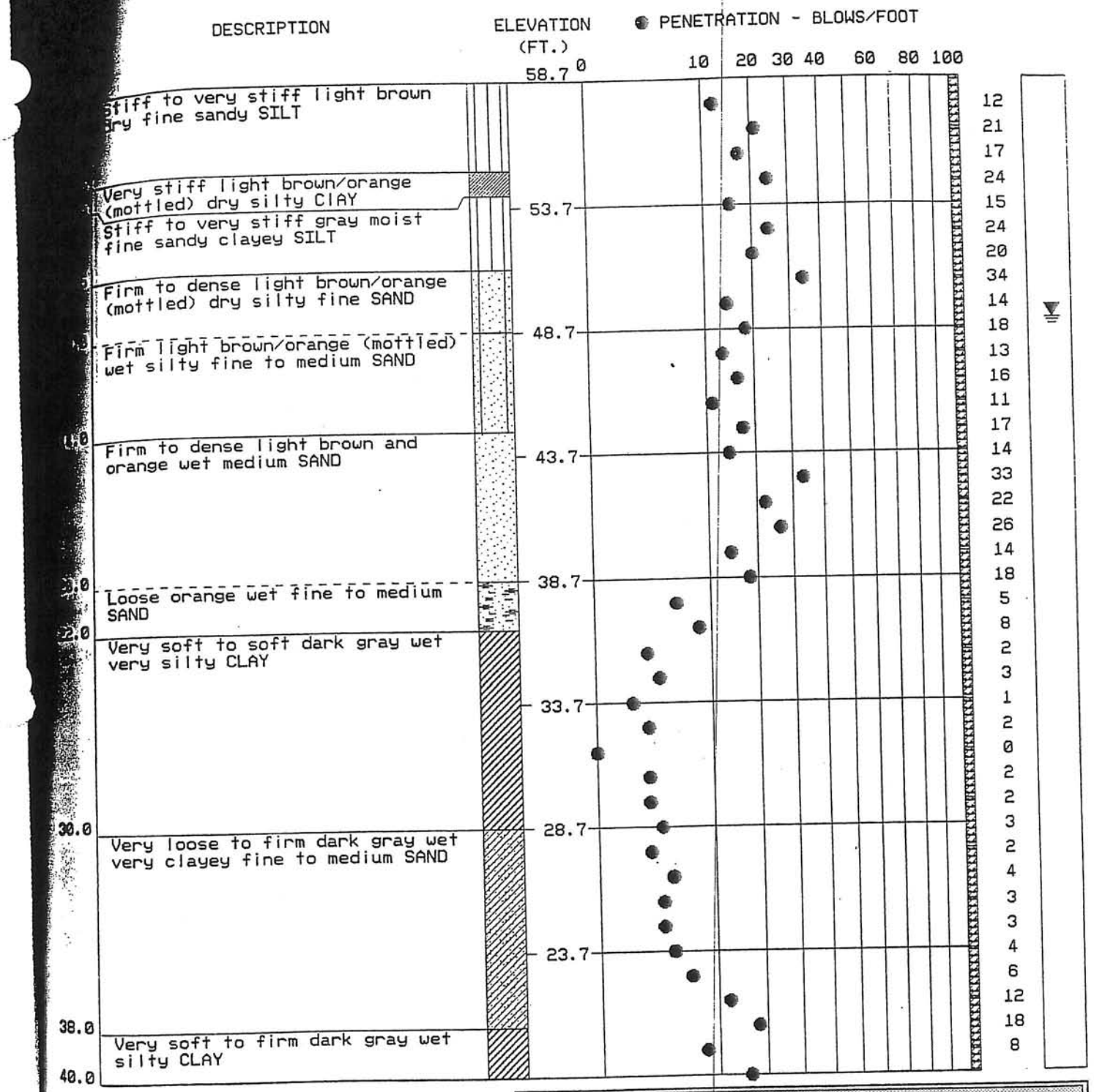
BORING NUMBER	GW-5
DATE DRILLED	August 20, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 1 OF 1	

LAW ENGINEERING

MONITORING WELL GW-5
CONSTRUCTION DIAGRAM



INSTALLATION DATE: 8/22/93 GROUND SURFACE EV. 60.28 FT MSL MEASURING POINT EV. 62.16 FT MSL SITE NORTHING: 10475.73 FT SITE EASTING: 7060.51 FT NOT TO SCALE	LAW ENGINEERING GREENVILLE, SOUTH CAROLINA	GW-5 CONSTRUCTION DIAGRAM EASTERN CAROLINA LANDFILL BERTIE COUNTY, NORTH CAROLINA JOB NO:2490472612



REMARKS:

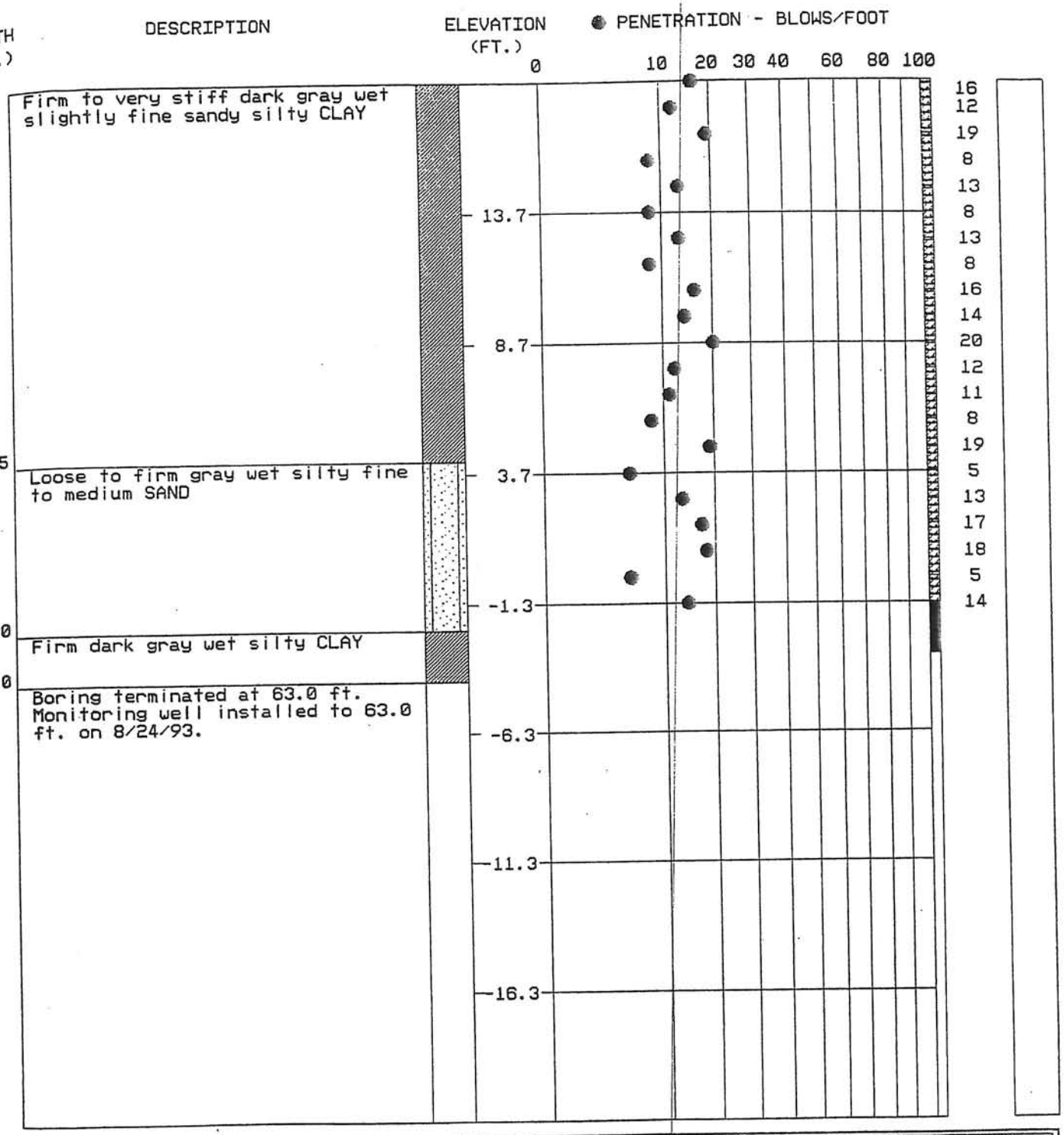
UD sample analyzed for porosity.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GW-6
DATE DRILLED	August 23, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 1 OF 2	

LAW ENGINEERING



REMARKS:

UD sample analyzed for porosity.

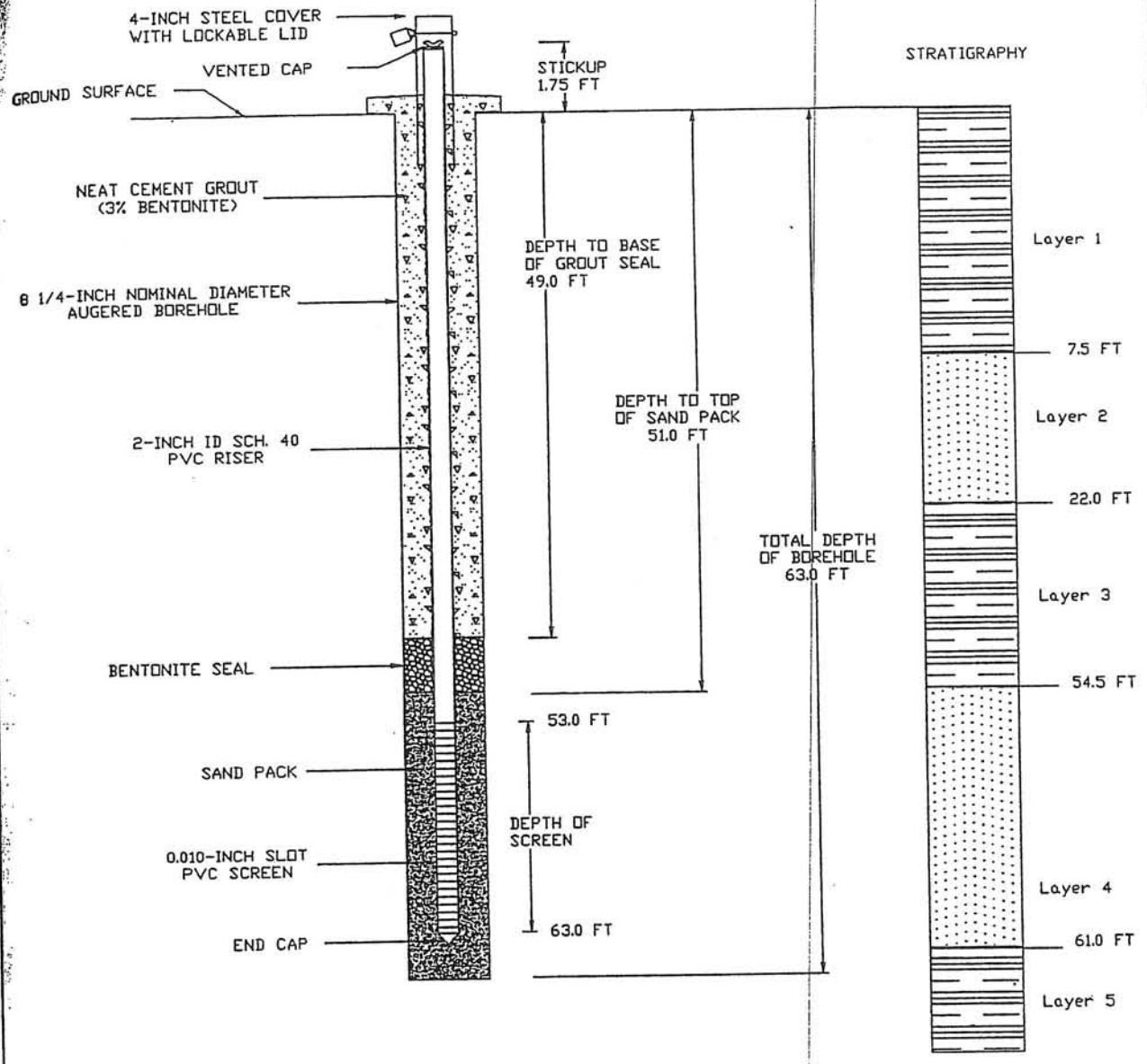
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GW-6
DATE DRILLED	August 23, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 2 OF 2	

LAW ENGINEERING

MONITORING WELL GW-6
CONSTRUCTION DIAGRAM



INSTALLATION DATE: 8/24/93

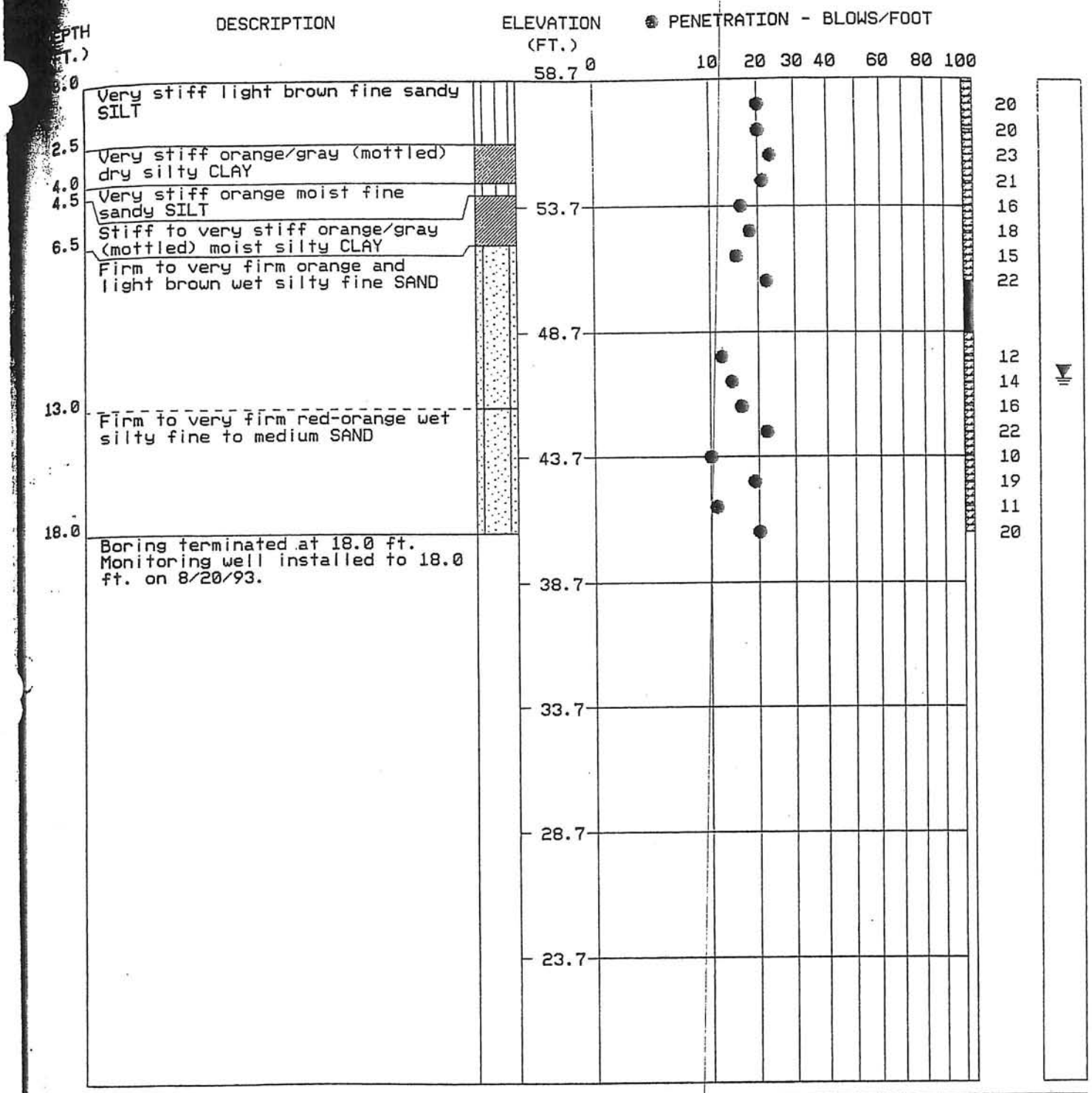
GROUND SURFACE EV. 58.69 FT MSL
MEASURING POINT EV. 60.44 FT MSL
SITE NORTHING: 10566.97 FT
SITE EASTING: 6636.89 FT

NOT TO SCALE

LAW ENGINEERING
GREENVILLE, SOUTH CAROLINA

GW-6 CONSTRUCTION DIAGRAM
EASTERN CAROLINA LANDFILL
BERTIE COUNTY, NORTH CAROLINA

JOB NO:2490472607



REMARKS:
UD sample analyzed for porosity.

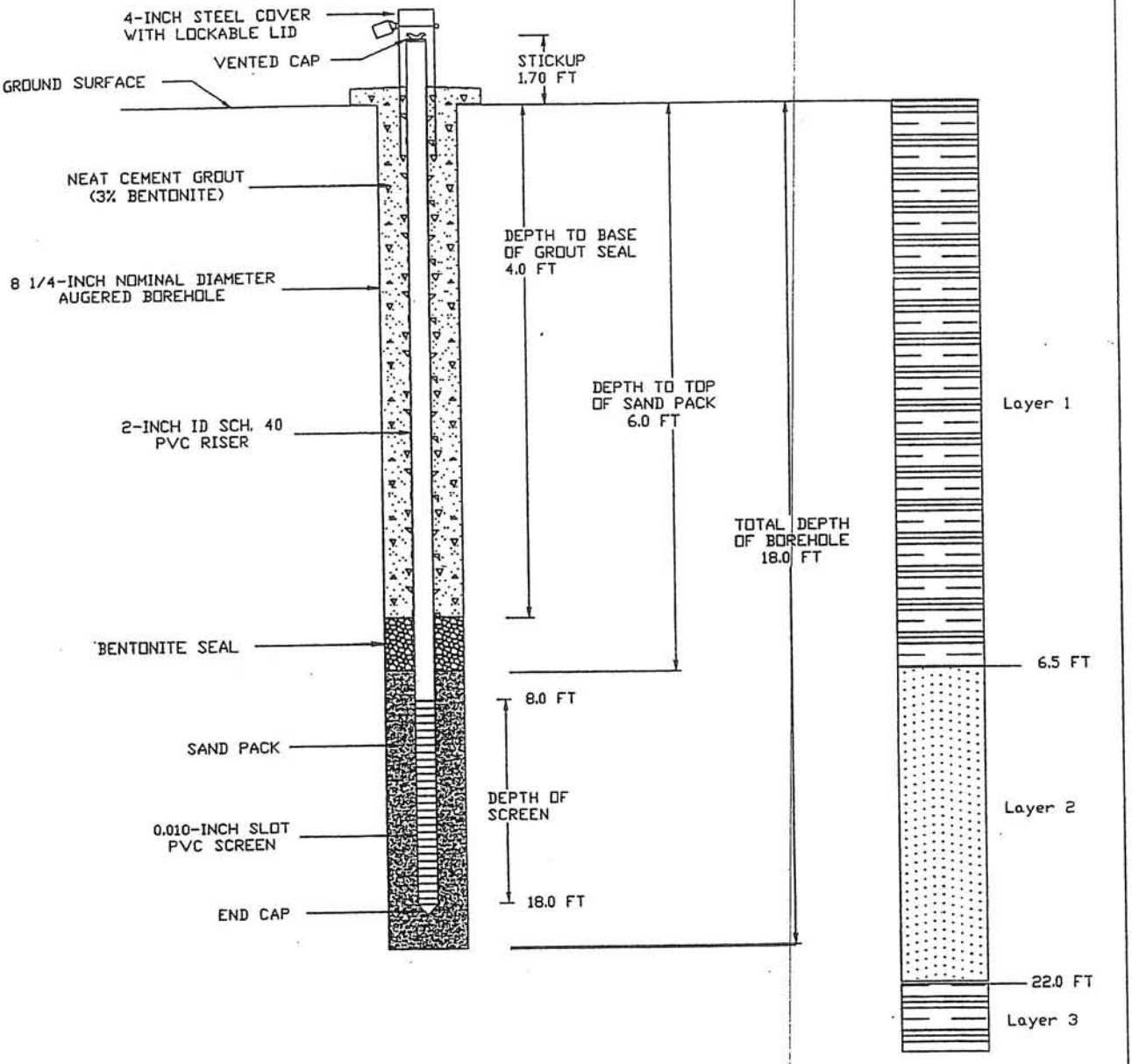
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

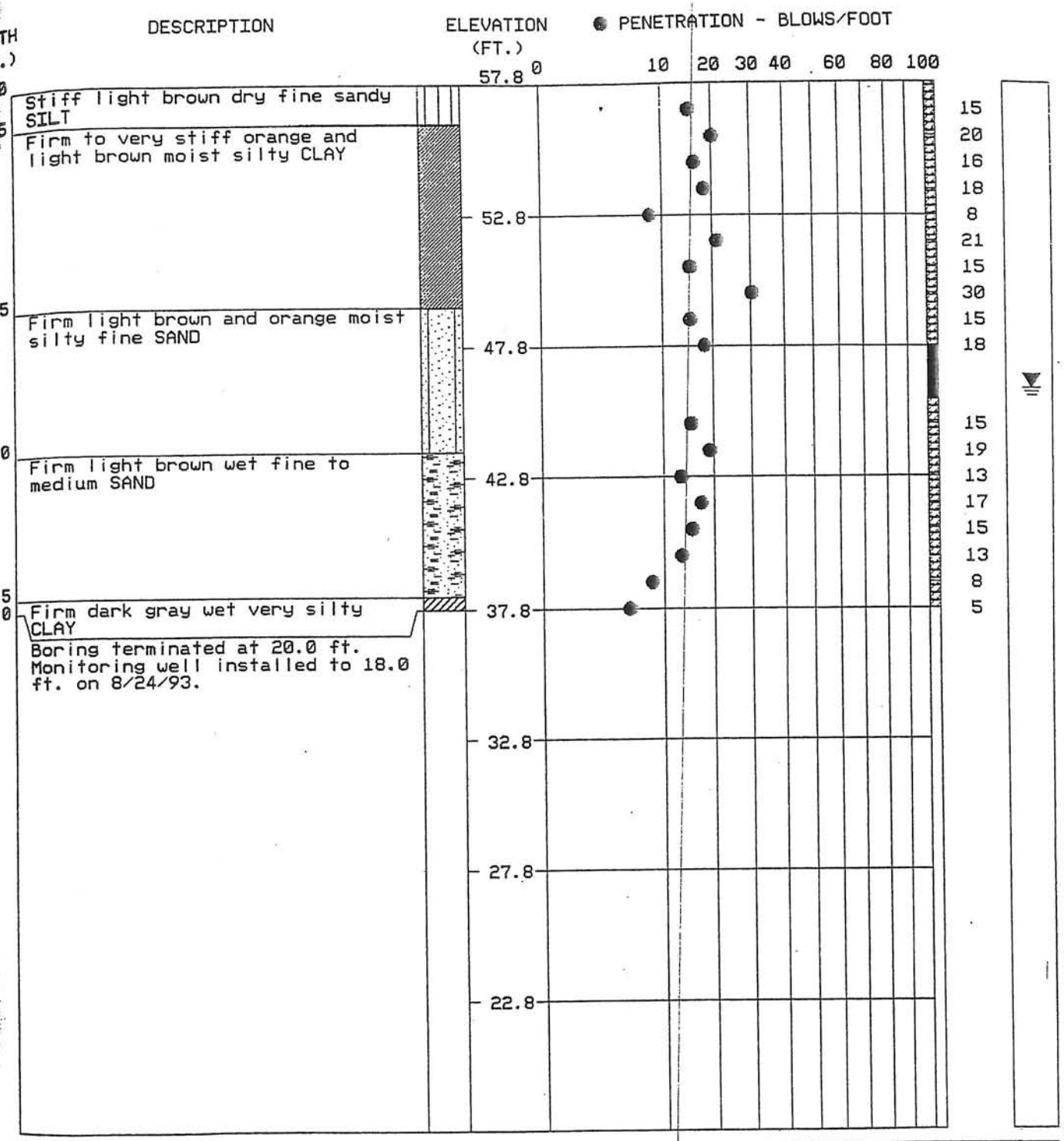
BORING NUMBER	GW-7
DATE DRILLED	August 20, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 1 OF 1	

LAW ENGINEERING

MONITORING WELL GW-7
CONSTRUCTION DIAGRAM



INSTALLATION DATE: 8/20/93 GROUND SURFACE EV. 58.71 FT MSL MEASURING POINT EV. 60.41 FT MSL SITE NORTHING: 10556.15 FT SITE EASTING: 6643.44 FT NOT TO SCALE	LAW ENGINEERING GREENVILLE, SOUTH CAROLINA	GW-7 CONSTRUCTION DIAGRAM EASTERN CAROLINA LANDFILL BERTIE COUNTY, NORTH CAROLINA JOB NO:2490472612



REMARKS:
UD sample analyzed for porosity.

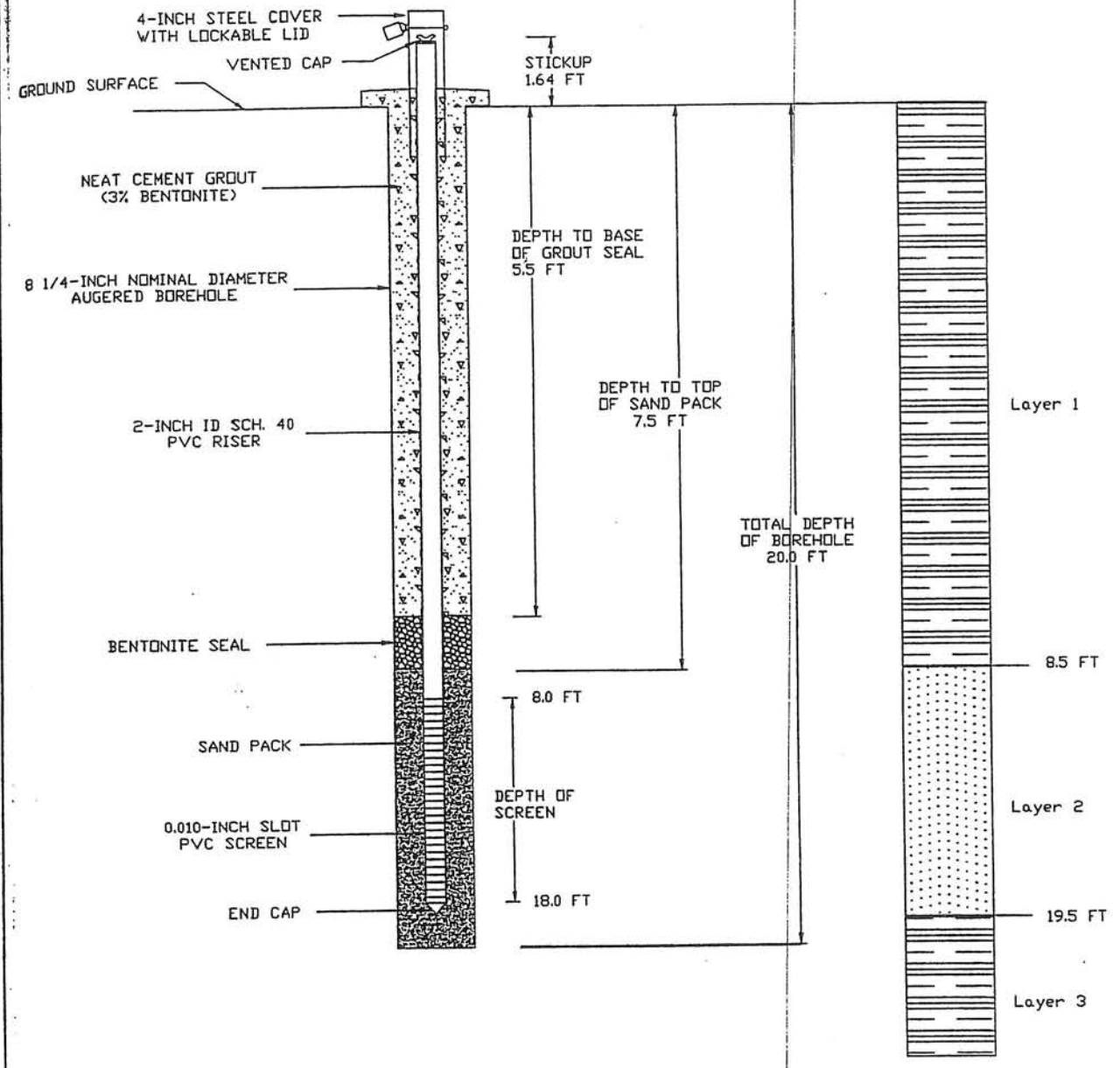
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GW-8
DATE DRILLED	August 24, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 1 OF 1	

LAW ENGINEERING

MONITORING WELL GW-8
CONSTRUCTION DIAGRAM



INSTALLATION DATE: 8/24/93

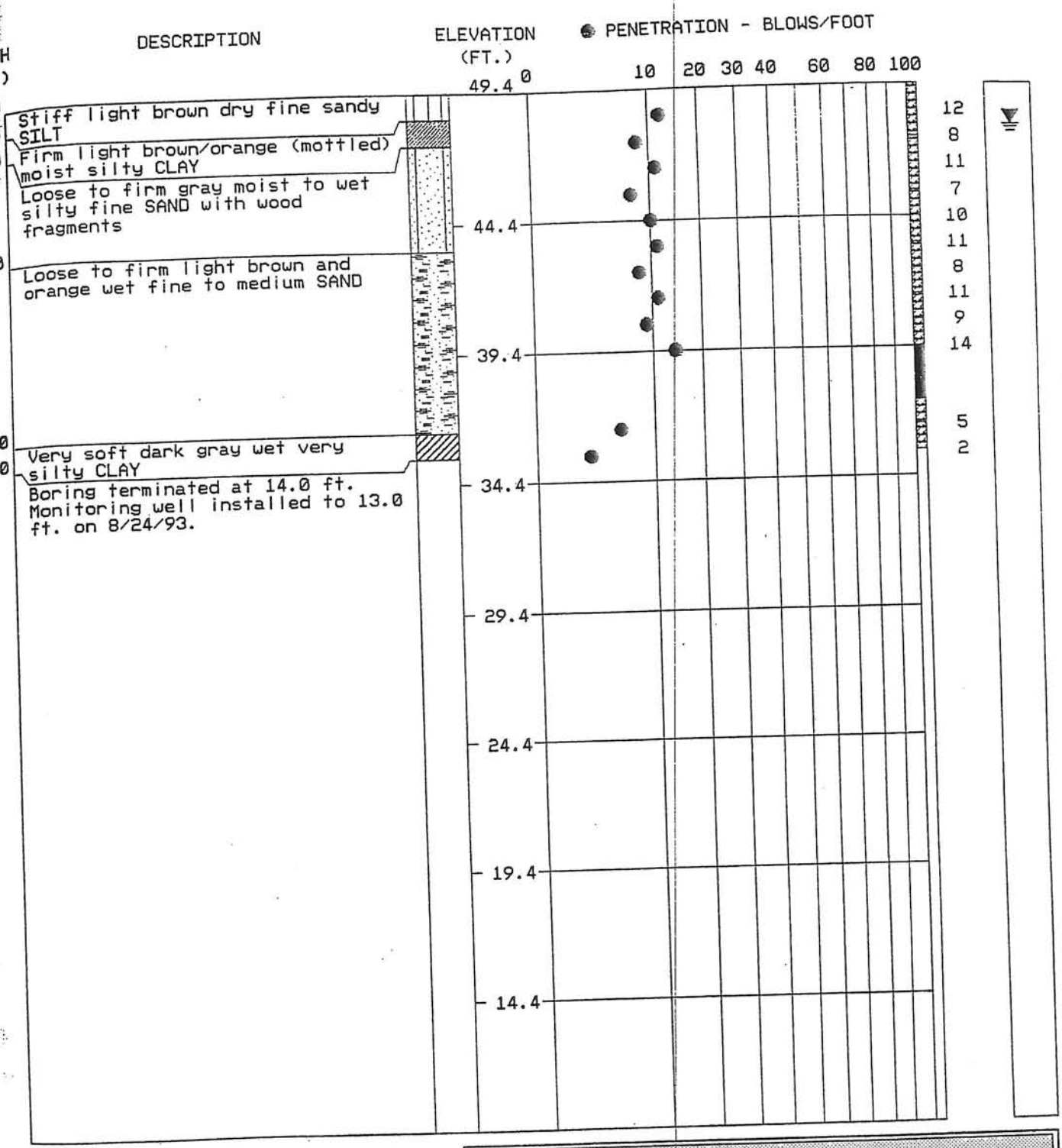
GROUND SURFACE EV. 57.84 FT MSL
MEASURING POINT EV. 59.48 FT MSL
SITE NORTHING: 10789.46 FT
SITE EASTING: 6302.08 FT

NOT TO SCALE

LAW ENGINEERING
GREENVILLE, SOUTH CAROLINA

GW-8 CONSTRUCTION DIAGRAM
EASTERN CAROLINA LANDFILL
BERTIE COUNTY, NORTH CAROLINA

JOB NO:2490472612



REMARKS:
UD sample analyzed for porosity.

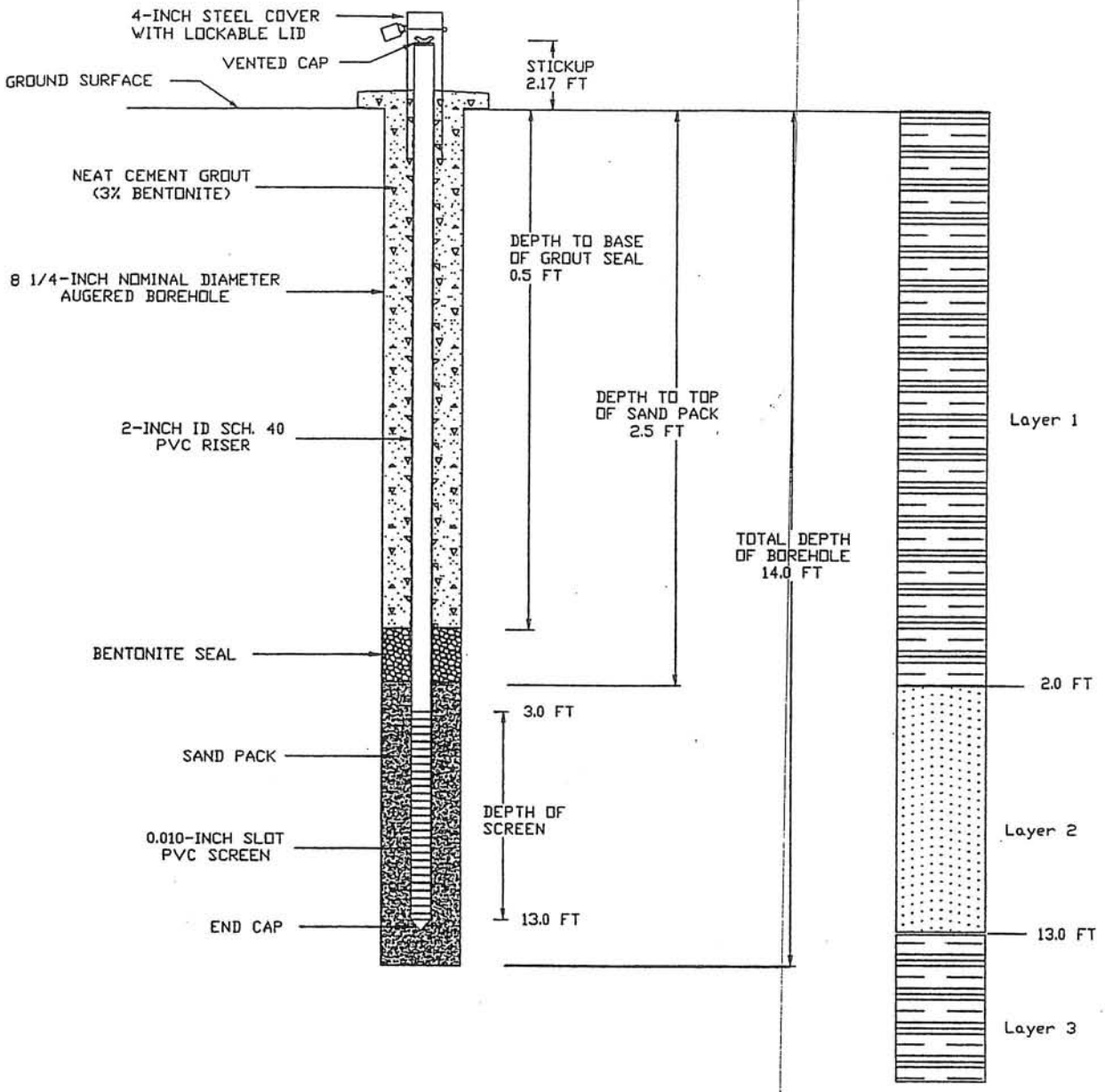
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GW-9
DATE DRILLED	August 24, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 1 OF 1	

LAW ENGINEERING

MONITORING WELL GW-9
CONSTRUCTION DIAGRAM



INSTALLATION DATE: 8/24/93 GROUND SURFACE EV. 49.36 FT MSL MEASURING POINT EV. 51.53 FT MSL SITE NORTHING: 11105.24 FT SITE EASTING: 6304.67 FT NOT TO SCALE	LAW ENGINEERING GREENVILLE, SOUTH CAROLINA	GW-9 CONSTRUCTION DIAGRAM EASTERN CAROLINA LANDFILL BERTIE COUNTY, NORTH CAROLINA JOB NO:2490472612

GROUND WATER MONITORING WELL NO. GW-11

BLE INC.

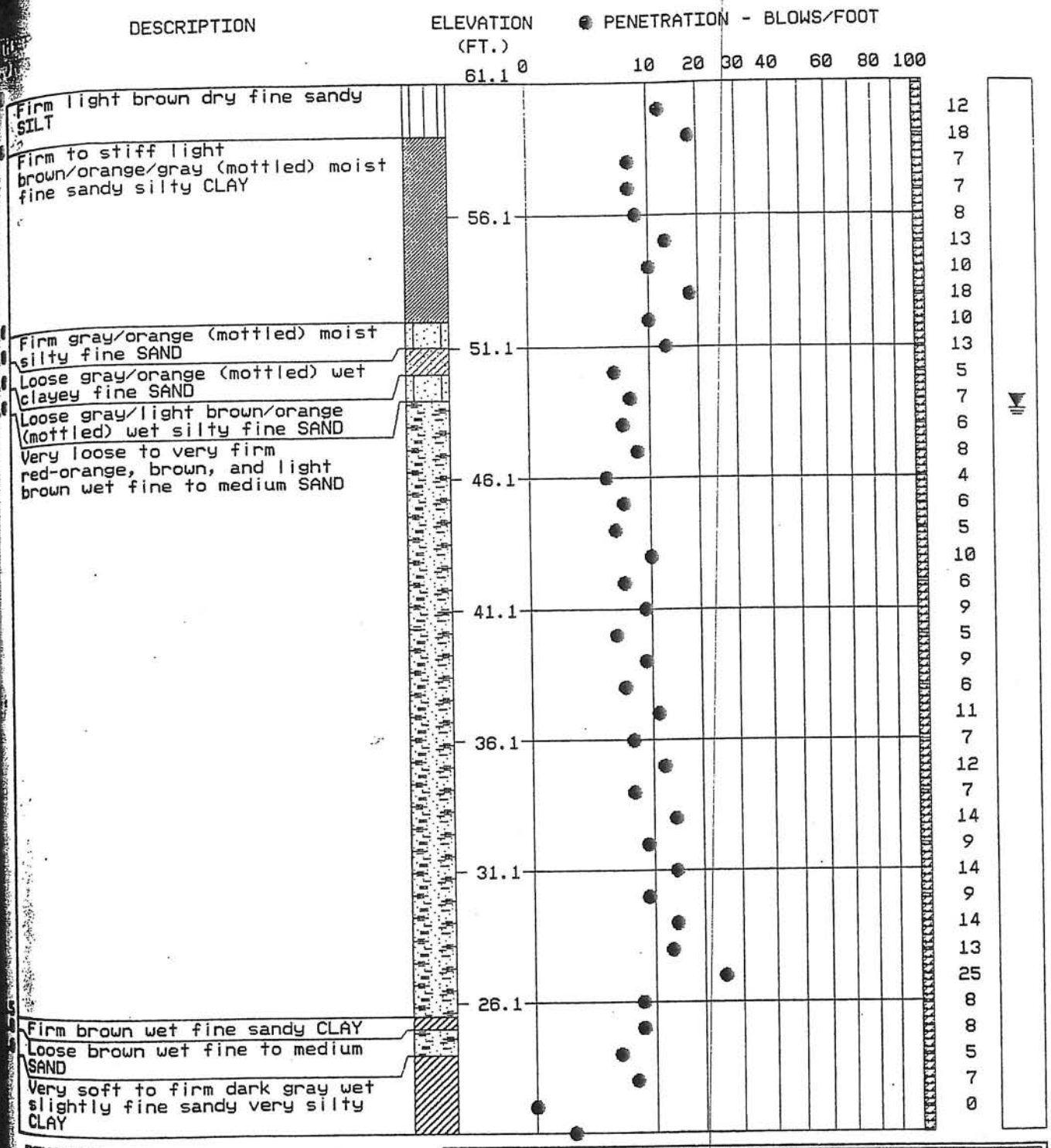
BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PROJECT: ECLF-Monitoring Well Installation
PROJECT NO.: J97-1001.11
CLIENT: HHNT
DATE START: 4/13/97 END: 4/13/97
LOCATION: See Boring Plan
ELEVATION: 68.6 feet
DRILLER: Metro Drilling, Inc. - C. Gordon
LOGGED BY: M. Preddy
DRILLING METHOD: 8.25-inch OD Hollow Stem Auger
DEPTH TO - WATER> INITIAL: ▽ 17.85 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
0	Firm brown slightly moist clayey fine sandy SILT- Fill		6		Well stickup 3.8 feet 4-inch steel locking protective surface casing 3' x 3' concrete pad at ground surface Neat Cement, 0 to 11 feet
10	Very firm brown moist to wet silty fine to medium SAND-Fill		24		2-inch ID, sch. 40 PVC casing
	Very stiff moist gray fine sandy silty CLAY-Fill		17		Bentonite Seal, 11 to 15.8 feet
15	▽ Stiff gray/brown (mottled) moist fine sandy silty CLAY - Layer I		15		Filter Pack, sand 15.8 to 30 feet Foster-Dixiana FX-50 sand
20	Firm gray/brown moist silty fine to medium SAND - Layer II		14		Well Screen, 19 to 29 feet
25	As above, wet		16		2 inch ID, sch. 40 PVC, 0.01 inch machine slotted
30	Base of boring 30'				Well total depth, 29.3 feet
35					

This information pertains only to this boring at the time of drilling and should not be interpreted as being indictive of the site or of this location with the passage of time.

GEOT_WELL - ECLFGW.GPJ 4/15/97



REMARKS:

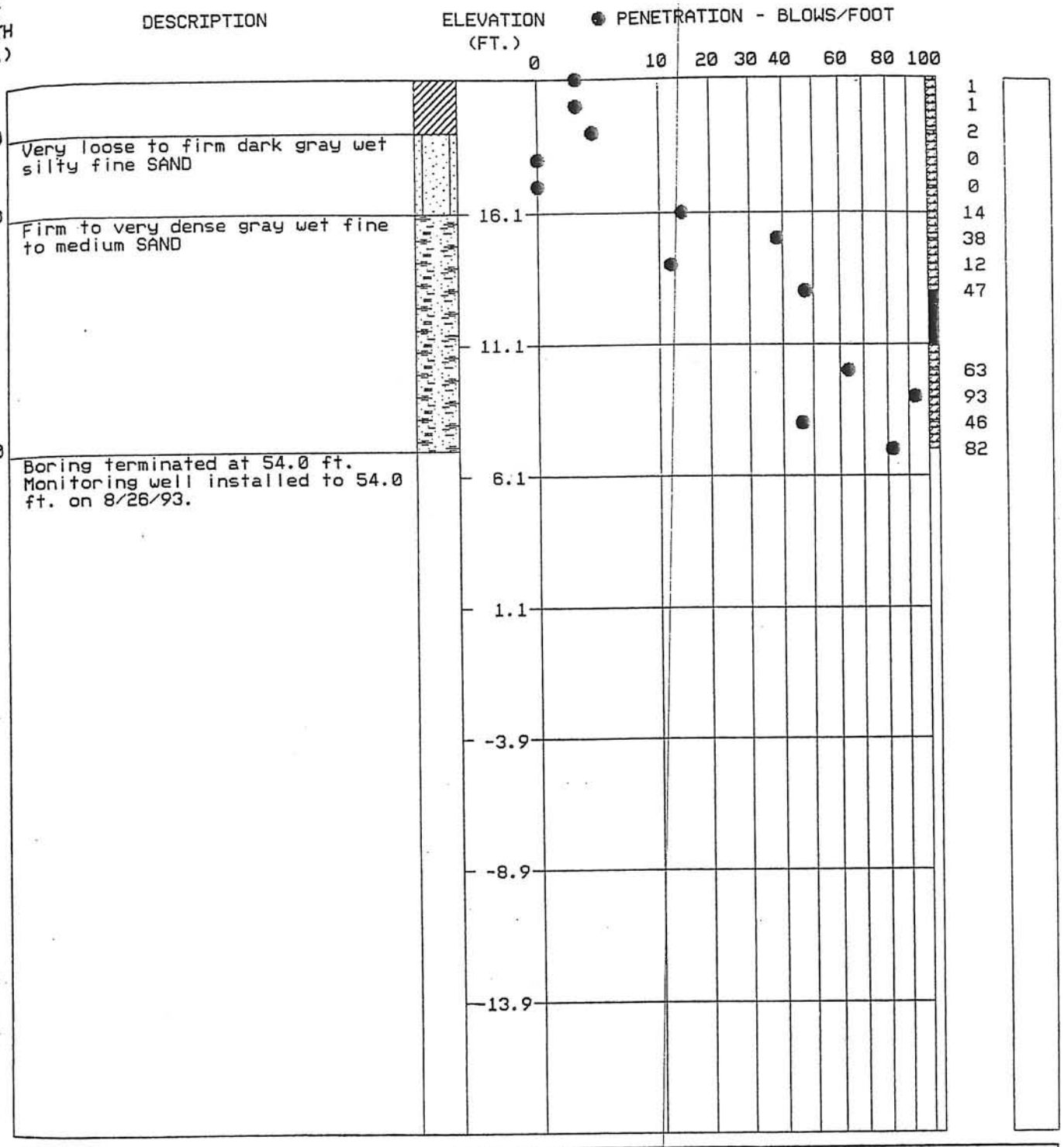
UD encountered very dense sand and was unable to obtain a sample.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GW-12
DATE DRILLED	August 26, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 1 OF 2	

LAW ENGINEERING



REMARKS:

UD encountered very dense sand and was unable to obtain a sample.

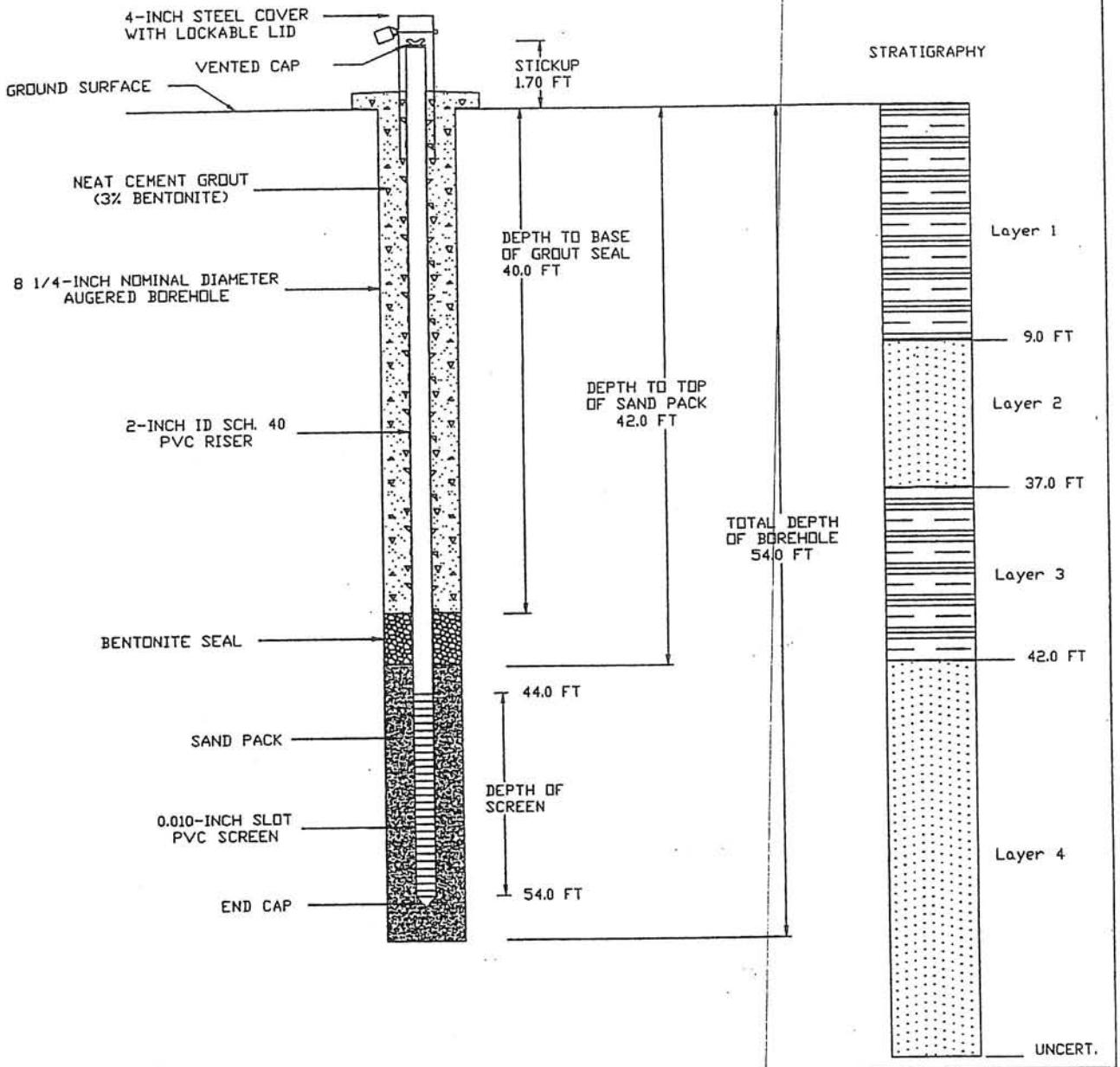
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GW-12
DATE DRILLED	August 26, 1993
PROJECT NUMBER	2490472612
PROJECT	East Carolina Landfill
PAGE 2 OF 2	

LAW ENGINEERING

MONITORING WELL GW-12
CONSTRUCTION DIAGRAM



INSTALLATION DATE: 8/27/93

GROUND SURFACE EV. 61.12 FT MSL
MEASURING POINT EV. 62.82 FT MSL
SITE NORTHING: 11362.87 FT
SITE EASTING: 7336.30 FT

NOT TO SCALE

LAW ENGINEERING
GREENVILLE, SOUTH CAROLINA

GW-12 CONSTRUCTION DIAGRAM
EASTERN CAROLINA LANDFILL
BERTIE COUNTY, NORTH CAROLINA

JOB NO:2490472612

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUND WATER MONITORING WELL NO. GW-13

PROJECT: East Carolina Regional MSW Landfill
PROJECT NO.: J00-1001-32
CLIENT: HHNT
DATE START: 10-26-00 END: 10-26-00
LOCATION: Bertie County, North Carolina
ELEVATION: 72.16
DRILLER: SDI, B. Fletcher (CWD #2526)
LOGGED BY: M. Preddy
DRILLING METHOD: Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 23.9 AFTER 24 HOURS: ▼ 24.54 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)
70 – 2	Loose, brown, moist, clayey, silty, fine SAND - (fill)			8
4				
6				6
8				
10	TOPSOIL			
60 – 12	Firm to stiff, gray and brown, moist, fine sandy, silty CLAY - Layer I			6
14				
16				13
18				
20				
50 – 22	Loose, orange-brown, wet, silty, fine SAND - Layer II			8
24 ▽				
26				
28	Loose, light brown, wet, silty, fine to medium SAND			10
30				
40 – 32				10
34				
36				
38	Firm, orange-brown, wet, silty, fine to medium SAND			11
40				
30 – 42				
44	Firm, orange-brown, wet, very silty CLAY - Layer III			5
46	Boring terminated at 45 feet. Monitoring well Installed to 41.6 feet.			
48				
50				
20 – 52				
54				

MONITOR WELL INSTALLATION DETAILS

SURFACE COMPLETION
Stand-up locking steel cover with a 4' x 4' concrete pad at the base

Neat cement, 0 to 20 feet

Bentonite seal, 20 to 23.5 feet

Filter pack, sand 23.5 to 41.6 feet

.010-inch slotted Schedule 40 PVC well screen, 26.3 to 41.3 feet

Pipe cap

Total well depth, 41.6 feet

Borehole diameter = 8.25-inches

Concrete Pad Elevation = 72.16 feet MSL
Top of PVC Elevation = 74.76 feet MSL
Northing = 12,693.52 feet
Easting = 5,719.85 feet

EOT_WELL_1001-32.GPJ

GROUND WATER MONITORING WELL NO. GW-13
Sheet 1 of 1

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUND WATER MONITORING WELL NO. GW-14

PROJECT: East Carolina Regional MSW Landfill — PROJECT NO.: J03-1001-45
CLIENT: HHNT/Republic — START: 8-26-03 END: 8-26-03
LOCATION: Bertie County, North Carolina — ELEVATION: 76.72
DRILLER: Terracon, B. Fletcher — LOGGED BY: M. Preddy
DRILLING METHOD: CME 550 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 23.10 AFTER 24 HOURS: ▼ 22.82 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
75 / 2	Very loose, yellowish-brown, very slightly moist, slightly clayey, silty, fine SAND - (fill)				**SURFACE COMPLETION** 4" x 4" stand-up locking steel protective cover with 3' x 3' concrete pad with survey pin at the base
4				4	Gound Surface Elev. = 76.72 ft MSL
70 / 6					Top of PVC Casing Elev. = 78.74 ft MSL
8	Stiff, gray, very slightly moist, fine sandy, silty CLAY and firm, yellowish-brown, very slightly moist, slightly clayey, silty, fine SAND - (fill)				Northing = 13,200.13 feet
10				12	Easting = 7,507.13 feet
65 / 12	Very stiff, reddish-brown and yellowish-brown, moist, fine sandy, silty CLAY - (fill)				
14				17	
60 / 16					Grout, 0 to 33.5 feet
18					
20	Stiff, gray, moist, silty CLAY - Layer 1			12	
55 / 22	Very stiff to stiff, gray, moist, slightly fine sandy, silty CLAY with some wood pieces				
24				18	
50 / 26					
28				7	
30					
45 / 32	Stiff, yellowish-brown, moist, clayey, fine sandy SILT and gray, moist, fine sandy, silty CLAY				
34				13	
40 / 36					Bentonite seal, 33.5 to 35.5 feet
38	Very loose, light brown, wet, fine to medium SAND - Layer 2				Filter pack, sand 35.5 to 50 feet
				1	

OLD GEOT_WELL 10... ...GPJ 5/26/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUND WATER MONITORING WELL NO. GW-14

PROJECT: East Carolina Regional MSW Landfill
PROJECT NO.: J03-1001-45
CLIENT: HHNT/Republic
START: 8-26-03 END: 8-26-03
LOCATION: Bertie County, North Carolina
ELEVATION: 76.72
DRILLER: Terracon, B. Fletcher
LOGGED BY: M. Preddy
DRILLING METHOD: CME 550 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 23.10 AFTER 24 HOURS: ▼ 22.82 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
35 / 42	Very loose, light brown, wet, fine to medium SAND - Layer 2				Filter pack, sand 35.5 to 50 feet
44	Very firm, dark reddish-brown and light brown, wet, slightly clayey, silty, fine SAND			21	2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 37.78 to 47.78 feet
30 / 46					
48					Pipe cap
50	Very soft, dark gray, wet, very clayey SILT - Layer 3			1	Total well depth, 48.18 feet
25 / 52	Boring terminated at 50 feet. Ground water encountered at 23.10 feet at time of drilling and at 22.82 feet after 24 hours.				PVC diameter = 2.0-inches
					Borehole diameter = 8.25-Inches
54					
20 / 56					
58					
60					
15 / 62					
64					
66					
10 / 68					
70					
5 / 72					
74					
76					
0 / 78					

OLD GEOT_WELL 100... .GPJ 5/26/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUND WATER MONITORING WELL NO. GW-15

PROJECT: East Carolina Regional MSW Landfill — PROJECT NO.: J05-1001-53
CLIENT: HHNT/Republic — DATE START: 12-2-05 END: 1-9-06
LOCATION: Bertie County, North Carolina — ELEVATION: 75.25
DRILLER: BLE, K. Thomas — LOGGED BY: M. Preddy
DRILLING METHOD: 6620 DT Geoprobe, 8-1/4 inch hollow stem augers
DEPTH TO - WATER> INITIAL: ▽ 25.1 ON 1/12/06 ▼ 21.85 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	MONITOR WELL INSTALLATION DETAILS
75 / 0	Tan, gray and reddish-yellow, fine sandy, silty CLAY - (fill)		SURFACE COMPLETION 4" x 4" stand-up locking steel protective cover with a 3' x 3' concrete pad at the base 1/4-inch weep and vent holes installed in the steel cover and well casing, respectively Ground elev. = 75.25 feet MSL Pad elev. = 75.38 feet MSL PVC elev. =78.23 feet MSL Northing = 13,149.24 feet Easting = 5,688.85 feet
60 / 16	Gray and tan, slightly sandy, silty CLAY - Layer I		Neat cement grout, 0 to 19.3 feet Bentonite seal, 19.3 to 21.9 feet Filter pack, sand 21.9 to 40 feet
50 / 26	Yellowish-red, slightly clayey, silty, fine to medium SAND - Layer II		
45 / 30	Gray and tan (mottled), fine to medium SAND - Layer II		2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 24.22 to 39.22 feet
40 / 36	Reddish-yellow and tan, slightly silty, fine to medium SAND - Layer II		
35 / 40	Boring terminated at 40 feet. Ground water encountered at 25.1 feet at time of drilling and at 21.85 feet on 1-12-06.		Pipe cap Total well depth, 39.47 feet bgs Total well depth, 42.62 feet btoc Borehole diameter, 8.25-inches

GEOTWELLNB_DATE 1001-53.GPJ 2/3/06

RECORD OF BOREHOLE 0803-GW-16

SHEET 1 of 1

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 24.0 ft
LOCATION: Aulander, NC

DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/24/06
DATE COMPLETED: 5/24/06

NORTHING: 869,514.6
EASTING: 2,572,042.8
GS ELEVATION: 61.0 ft
TOC ELEVATION: 63.0 ft

DEPTH W.L.: 11.3 ft
ELEVATION W.L.: 51.8 ft
DATE W.L.: 5/30/06
TIME W.L.: 11:36 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC
0	60	0.0 - 0.5 SILTY SAND - black fine grained silty sand with abundant organics	SM		60.5 / 0.5		SPT	2-1-2-3	3	50.0 / 2.0
		0.5 - 9.5 LEAN CLAY - tan fine grained sandy clay Orange and gray fine grained sandy clay at 2 ft, moist					SPT	3-4-7-12	11	50.0 / 2.0
5	55	Orange and gray silty clay at 6 ft, moist	CL				SPT	2-4-7-9	11	90.0 / 2.0
							SPT	4-6-7-12	13	100.0 / 2.0
					51.5		SPT	5-4-5-8	9	100.0 / 2.0
10	50	9.5 - 10.0 CLAYEY SAND - fine grained clayey sand	SC		51.0 / 10.0		SPT	3-3-2-4	5	80.0 / 2.0
		10.0 - 19.0 SILTY SAND - orange and gray mottled fine grained silty sand, saturated Orange fine grained silty sand, saturated at 12 ft					SPT	2-2-3-2	5	90.0 / 2.0
15	45	Tan fine graine silty sand, saturated at 14 ft	SM				SPT	2-1-2-3	3	90.0 / 2.0
							SPT	2-2-2-4	4	100.0 / 2.0
					42.0		SPT	3-5-8-12	13	100.0 / 2.0
20	40	19.0 - 19.3 CLAYEY SAND - fine grained clayey sand	SC / SM		41.1					
		19.3 - 19.9 SILTY SAND - orange medium grained silty sand	SP		19.9		SPT	3-4-7-10	11	100.0 / 2.0
		19.9 - 23.0 POORLY GRADED SAND - white and brown medium grained well sorted sand with organics, saturated			38.0		SPT	1-2-1-2	3	100.0 / 2.0
		Augers terminated at 23 ft	CL / CH		37.5 / 37.0					
25	35	23.0 - 23.5 LEAN CLAY - orange silty clay 23.5 - 24.0 FAT CLAY - blue gray fat clay Boring completed at 24.0 ft								
30	30									
35	25									
40										

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES: Grout; Bentonite; #2 Sand; Screen; Collapsed Material

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: -2.03-13 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 13-23 ft
Material: PVC
Diameter: 2-inch
Slot Size: 0.010
End Cap: Threaded

FILTER PACK
Interval: 11-23 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 7.5-11 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-7.5 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: 3x3x0.5 ft concrete
Protective Casing: 4-inch Aluminum

DRILLING METHODS
Type: 4.25-inch ID Hollow Stem Augers

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 11/30/06

RECORD OF BOREHOLE PZ-110/0803-GW-18

SHEET 1 of 1

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 32.0 ft
LOCATION: Aulander, NC

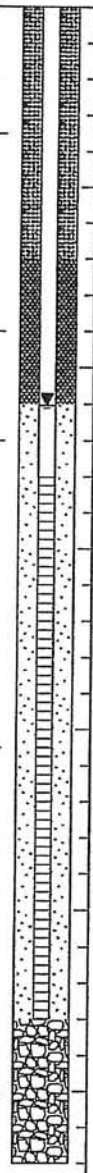
DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/17/06
DATE COMPLETED: 5/18/06

NORTHING: 867,828.0
EASTING: 2,572,575.0
GS ELEVATION: 61.0 ft
TOC ELEVATION: 63.0 ft

DEPTH W.L.: 11.0 ft
ELEVATION W.L.: 51.9 ft
DATE W.L.: 5/19/06
TIME W.L.: 7:42 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC
0	60	0.0 - 0.5 SILTY SAND - black fine grained silty sand	SM		60.5					
		0.5 - 7.8 LEAN CLAY - gray fine grained sandy clay Orange and gray mottled fine grained sandy clay at 2 ft, moist	CL		0.5		SPT	1-0-1-4	1	100.0 / 2.0
							SPT	4-4-8-11	12	100.0 / 2.0
5	55						SPT	4-5-8-11	13	100.0 / 2.0
							SPT	10-10-11-14	21	100.0 / 2.0
					53.3					
		7.8 - 8.0 CLAYEY SILT - light gray clayey silt	ML							
		8.0 - 9.8 LEAN CLAY - light gray fine grained sandy clay with abundant sand	CL		8.0 / 51.3		SPT	4-2-3-7	5	100.0 / 2.0
10	50	9.8 - 15.9 SILTY SAND - medium grained silty sand Light gray and orange medium grained silty sand at 10 ft, saturated Orange medium grained silty sand with some layering at 12.75 ft, wet	SM		9.8		SPT	5-4-5-5	9	100.0 / 2.0
							SPT	4-5-8-7	13	90.0 / 2.0
15	45						SPT	3-6-6-7	12	90.0 / 2.0
					45.1					
		15.9 - 25.9 WELL GRADED SAND - pink, tan, and orange poorly sorted medium grained sand, saturated Layering at 18 ft	SW		15.9		SPT	4-7-7-10	14	80.0 / 2.0
							SPT	6-8-8-14	16	100.0 / 2.0
20	40	No layering visible at 20 ft					SPT	3-4-5-8	9	80.0 / 2.0
							SPT	8-8-10-13	18	90.0 / 2.0
25	35						SPT	3-3-5-6	8	100.0 / 2.0
					35.1					
		25.9 - 26.3 LEAN CLAY - tan sandy clay with coarse grained sand	CL							
			SW		26.3 / 33.8		SPT	4-5-5-12	10	100.0 / 2.0
		26.3 - 27.3 WELL GRADED SAND - tan poorly sorted medium grained sand	CL		33.3					
		27.3 - 27.8 LEAN CLAY - light gray fine grained sandy clay	SM		27.8 / 31.0		SPT	4-6-5-5	11	100.0 / 2.0
30	30	27.8 - 30.0 SILTY SAND - gray fine grained silty sand with layering Augers terminated at 28 ft Medium grained sandy clay layers from 29 to 29.25 ft and 29.75 to 29.9 ft	SW		30.0 / 29.3		SPT	3-2-2-2	4	100.0 / 2.0
			CH							
		30.0 - 31.8 WELL GRADED SAND - orange poorly sorted sand								
35	25	31.8 - 32.0 FAT CLAY - blue gray fat clay								
		Boring completed at 32.0 ft								
40										

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: -1.96-13 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 13-28 ft
Material: PVC
Diameter: 2-inch
Slot Size: .010-inch
End Cap: Threaded

FILTER PACK
Interval: 11-28 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 7-11 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-7 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: 3x3x0.5 ft concrete
Protective Casing: 4-inch Aluminum

DRILLING METHODS
Type: 4.25-inch ID Hollow Stem Augers

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 11/30/06

RECORD OF BOREHOLE PZ-118/0803-GW-19

SHEET 1 of 1

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 24.0 ft
LOCATION: Aulander, NC

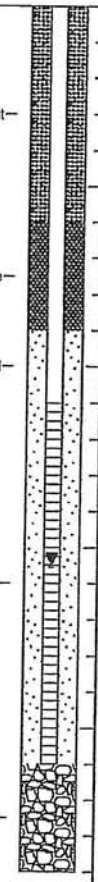
DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/16/06
DATE COMPLETED: 5/16/06

NORTHING: 867,878.6
EASTING: 2,572,947.1
GS ELEVATION: 64.8 ft
TOC ELEVATION: 67.4 ft

DEPTH W.L.: 15.5 ft
ELEVATION W.L.: 51.9 ft
DATE W.L.: 5/17/06
TIME W.L.: 8:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC
0		0.0 - 0.5 LEAN CLAY - orange and brown fine grained sandy clay, dry	CL		64.3		SPT	3-4-4-4	8	100.0 / 2.0
		0.5 - 1.5 SILTY SAND - tan fine grained silty sand	SM		0.5 / 63.3		SPT	7-7-13-17	20	100.0 / 2.0
		1.5 - 5.0 LEAN CLAY - orange fine grained sandy clay; Orange and gray mottled fine grained sandy clay at 4 ft	CL		1.5 / 59.8		SPT	3-6-8-12	14	100.0 / 2.0
5	60	5.0 - 11.5 SILTY SAND - orange and tan mottled silty sand, moist; Orange fine grained silty sand with some clay at 6 ft; Orange and tan mottled fine grained silty sand at 8 ft; Saturated by 10 ft	SM		5.0 / 53.3		SPT	7-8-8-11	16	100.0 / 2.0
							SPT	5-7-8-10	15	100.0 / 2.0
10	55						SPT	6-6-9-7	15	100.0 / 2.0
		11.5 - 13.0 LEAN CLAY - gray and orange fine grained sandy clay; Gray and red sandy clay at 12 ft	CL		11.5 / 51.8		SPT	4-5-6-9	11	100.0 / 2.0
		13.0 - 14.0 CLAYEY SAND - gray and orange thinly bedded clayey sand	SC		13.0 / 50.8		SPT	3-5-6-11	11	100.0 / 2.0
15	50	14.0 - 16.0 SANDY SILT - gray and orange fine grained sandy silt, saturated from 14 ft to 15 ft; Becomes sandy silt with clay at 15 ft	SM		14.0 / 48.8		SPT	4-4-4-9	8	100.0 / 2.0
		16.0 - 20.8 LEAN CLAY - gray thinly bedded sandy clay with organics; Alternating thinly bedded gray sandy clay and sandy silt with organics at 18 ft; Orange and gray mottled sandy clay at 20 ft	CL		16.0 / 44.1		SPT	4-5-6-11	11	100.0 / 2.0
20	45						SPT	3-5-6-9	11	100.0 / 2.0
		20.8 - 21.3 CLAYEY SAND - fine grained clayey sand, saturated; Augers terminated at 21 ft	SC		43.6 / 21.3		SPT	4-3-4-5	7	100.0 / 2.0
		21.3 - 23.8 LEAN CLAY - gray sandy clay	CL		41.1					
25	40	23.8 - 24.0 FAT CLAY - blue gray fat clay; Boring completed at 24.0 ft	CH							
30	35									
35	30									
40	25									

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 2.58-11 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 11-21 ft
Material: PVC
Diameter: 2-inch
Slot Size: .010-inch
End Cap: Threaded

FILTER PACK
Interval: 9-21 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 6-9 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-6 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: 3x3x0.5 ft concrete
Protective Casing: 4-inch Aluminum

DRILLING METHODS
Type: 4.25-inch ID Hollow Stem Augers

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 11/30/06

RECORD OF BOREHOLE PZ-122/0803-GW-20

SHEET 1 of 1

PROJECT: East Carolina Environmental
PROJECT NUMBER: 063-6507.201
DRILLED DEPTH: 26.0 ft
LOCATION: Aulander, NC

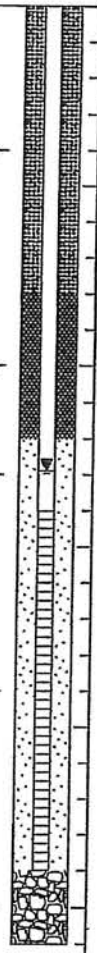
DRILL RIG: Deidrich D-50 Turbo
DATE STARTED: 5/18/06
DATE COMPLETED: 5/22/06

NORTHING: 868,650.4
EASTING: 2,573,246.2
GS ELEVATION: 59.8 ft
TOC ELEVATION: 62.3 ft

DEPTH W.L.: 12.9 ft
ELEVATION W.L.: 49.4 ft
DATE W.L.: 5/23/06
TIME W.L.: 12:48 pm

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC
0		0.0 - 4.0 LEAN CLAY - gray and orange silty clay	CL		55.8		SPT	1-0-0-2	0	0.0 / 2.0
							SPT	2-1-2-4	3	80.0 / 2.0
		4.0 - 4.8 ORGANIC SILT - black organic silt	OL		55.0					
5	55	4.8 - 11.9 LEAN CLAY - tan silty clay, saturated Orange and gray mottled silty clay at 6 ft	CL		4.8		SPT	0-2-3-3	5	100.0 / 2.0
							SPT	2-2-6-8	8	100.0 / 2.0
		Gray fine grained sandy clay at 8 ft Saturated from 8.5 ft to 9.5 ft					SPT	5-7-10-13	17	100.0 / 2.0
10	50	Gray and orange mottled fine grained sandy clay at 10 ft					SPT	8-11-13-16	24	100.0 / 2.0
					47.9					
		11.9 - 16.8 SILTY SAND - orange and tan fine grained silty sand Orange and tan layered fine grained silty sand at 12 ft No visible layering at 14 ft, saturated	SM		11.9		SPT	7-7-10-14	17	100.0 / 2.0
15	45						SPT	4-5-10-14	15	100.0 / 2.0
					43.0					
		16.8 - 17.3 LEAN CLAY - dark gray sandy clay	CL		42.5		SPT	6-7-10-15	17	100.0 / 2.0
		17.3 - 18.5 SILTY SAND - orange fine grained silty sand	SM		17.3					
		18.5 - 18.8 LEAN CLAY - dark gray sandy clay	CL		41.3		SPT	5-6-7-9	13	100.0 / 2.0
20	40	18.8 - 21.9 SILTY SAND - tan and orange fine grained silty sand with layering and some organics	SM		18.8		SPT	6-6-10-19	16	100.0 / 2.0
					37.9					
		21.9 - 23.3 WELL GRADED SAND - poorly sorted coarse grained sand, saturated	SW		21.9		SPT	7-5-3-4	8	100.0 / 2.0
					36.5					
		23.3 - 25.0 LEAN CLAY - orange, gray, and brown sandy clay with layering Orange sandy clay at 24 ft Augers terminated at 24 ft	CL		23.3					
25	35				34.8		SPT	2-1-1-2	2	2.0
			CH		25.0					
		25.0 - 26.0 FAT CLAY - blue gray fat clay			33.8					
		Boring completed at 26.0 ft								
30	30									
35	25									
40	20									

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: -2.48-14 ft
Material: PVC
Diameter: 2-inch
Joint Type: Threaded

WELL SCREEN
Interval: 14-24 ft
Material: PVC
Diameter: 2-inch
Slot Size: .010-inch
End Cap: Threaded

FILTER PACK
Interval: 12-24 ft
Type: #2 Sand

FILTER PACK SEAL
Interval: 8-12 ft
Type: 3/8 Bentonite chip

ANNULUS SEAL
Interval: 0-8 ft
Type: Portland/Bentonite mix

WELL COMPLETION
Pad: None
Protective Casing: None

DRILLING METHODS
Type: 4.25-inch ID Hollow Stem Augers

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Geologic Exploration
DRILLER: Mike McConahey

GA INSPECTOR: David Reedy, P.G.
CHECKED BY: Rachel P. Kirkman, P.G.
DATE: 11/10/06

Golder Associates

BOREHOLE RECORD 0633507.201.GPJ GOLDER NJ-PA.GDT 11/30/06

APPENDIX B

ANALYTICAL REQUIREMENTS

NCDENR
North Carolina Department of Environment and Natural Resources
Dexter R. Matthews, Director Division of Waste Management Michael F. Easley, Governor
William G. Ross Jr., Secretary

October 27, 2006

To: SW Director/County Manager/Consultant/Laboratory

From: NC DENR-DWM, Solid Waste Section

Re: New Guidelines for Electronic Submittal of Environmental Monitoring Data

The Solid Waste Section receives and reviews a wide variety of environmental monitoring data from permitted solid waste management facilities, including the results from groundwater and surface water analyses, leachate samples, methane gas readings, potentiometric measurements, and corrective action data. We are in the process of developing a database to capture the large volume of data submitted by facilities.

To maintain the integrity of the database, it is critical that facilities, consultants, and laboratories work with the Solid Waste Section to ensure that environmental samples are collected and analyzed properly with the resulting data transferred to the Solid Waste Section in an accurate manner.

In order to better serve the public and to expedite our review process, the Solid Waste Section is requesting specific formatting for environmental monitoring data submittals for all solid waste management facilities.

Effective, December 1, 2006, please submit a Solid Waste Environmental Monitoring Data Form in addition to your environmental monitoring data report. This form will be sent in lieu of your current cover letter to the Solid Waste Section. The Solid Waste Environmental Monitoring Data Form must be filled out completely, signed, and stamped with a Board Certified North Carolina Geologist License Seal.

The solid waste environmental monitoring data form will include the following:

1. Contact Information
2. Facility Name
3. Facility Permit Number
4. Facility Address
5. Monitoring Event Date (MM/DD/YYYY)
6. Water Quality Status: Monitoring, Detection Monitoring, or Assessment Monitoring
7. Type of Data Submitted: Groundwater Monitoring Wells, Groundwater Potable Wells, Leachate, Methane Gas, or Corrective Action Data
8. Notification of Exceedance of Groundwater, Surface Water, or Methane Gas (in table form)
9. Signature
10. North Carolina Geologist Seal

1646 Mail Service Center, Raleigh, North Carolina 27699-1646
Phone: 919-508-8400 \ FAX: 919-733-4810 \ Internet http://wastenotnc.org
An Equal Opportunity / Affirmative Action Employer – Printed on Dual Purpose Recycled Paper

Most of these criteria are already being included or can be added with little effort. The Solid Waste Environmental Monitoring Data Form can be downloaded from our website: http://www.wastenotnc.org/swhome/enviro_monitoring.asp.

The Solid Waste Section is also requesting a new format for monitoring wells, potable wells, surface water sampling locations, and methane probes. This format is essential in the development and maintenance of the database. The Solid Waste Section is requesting that each sampling location at all North Carolina solid waste management facilities have its own unique identification number. We are simply asking for the permit number to be placed directly in front of the sampling location number (example: 9901-MW1 = Permit Number 99-01 and Monitoring Well MW-1). No changes will need to be made to the well tags, etc. This unique identification system will enable us to accurately report data not only to NCDENR, but to the public as well. We understand that this new identification system will take some time to implement, but we feel that this will be beneficial to everyone involved in the long term.

Additionally, effective December 1, 2006, the Practical Quantitation Limits (PQLs) established in 1994 will change. The Solid Waste Section is requiring that all solid waste management facilities use the new Solid Waste Reporting Limits (SWRL) for all groundwater analyses by a North Carolina Certified Laboratory. Laboratories must also report any detection of a constituent even it is detected below the new SWRL (e.g., J values where the constituent was detected above the detection limit, but below the quantitation limit).

PQLs are technology-based analytical levels that are considered achievable using the referenced analytical method. The PQL is considered the lowest concentration of a contaminant that the lab can accurately detect and quantify. PQLs provided consistency and available numbers that were achievable by the given analytical method. However, PQLs are not health-based, and analytical instruments have improved over the years resulting in lower achievable PQLs for many of the constituents. As a result, the Solid Waste Section has established the SWRLs as the new reporting limits eliminating the use of the PQLs.

We would also like to take this opportunity to encourage electronic submittal of the reports. This option is intended to save resources for both the public and private sectors. The Solid Waste Section will accept the entire report including narrative text, figures, tables, and maps on CD-ROM. The CD-ROM submittal shall contain a CD-ROM case and both CD-ROM and the case shall be labeled with the site name, site address, permit number, and the monitoring event date (MM/DD/YYYY). The files may be a .pdf, .txt, .csv, .xls, or .doc type. Also, analytical lab data should be reported in an .xls file. We have a template for analytical lab data available on the web at the address listed above.

If you have any questions or concerns, please call (919) 508-8400. Thank you for your anticipated cooperation in this matter.

North Carolina Department of Environment and Natural Resources

Dexter R. Matthews, Director | **Division of Waste Management** | Michael F. Easley, Governor
William G. Ross Jr., Secretary

February 23, 2007

MEMORANDUM

To: Solid Waste Directors, Landfill Operators, North Carolina Certified Laboratories, and Consultants

From: North Carolina Division of Waste Management, Solid Waste Section

Re: Addendum to October 27, 2006, North Carolina Solid Waste Section Memorandum Regarding New Guidelines for Electronic Submittal of Environmental Data.

The purpose of this addendum memorandum is to provide further clarification to the October 27, 2006, North Carolina Solid Waste Section memo titled, "New Guidelines for Electronic Submittal of Environmental Data."

The updated guidelines is in large part due to questions and concerns from laboratories, consultants, and the regulated community regarding the detection of constituents in groundwater at levels below the previous practical quantitation limits (PQLs). The North Carolina Solid Waste Section solicited feedback from the regulated community, and, in conjunction with the regulated community, developed new limits. The primary purpose of these changes was to improve the protection of public health and the environment. The North Carolina Solid Waste Section is concerned about analytical data at these low levels because the earliest possible detection of toxic or potentially carcinogenic chemicals in the environment is paramount in the North Carolina Solid Waste Section's mission to protect human health and the environment. Low level analytical data are critical for making the correct choices when designing site remediation strategies, alerting the public to health threats, and protecting the environment from toxic contaminants. The revised limits were updated based on readily available laboratory analytical methodology and current health-based groundwater protection standards.

Definitions

Many definitions relating to detection limits and quantitation limits are used in the literature and by government agencies, and commonly accepted procedures for calculating these limits exist. Except for the Solid Waste Section Limit and the North Carolina 2L Standards, the definitions listed below are referenced from the Environmental Protection Agency (EPA). The definitions are also an attempt to clarify the meaning of these terms as used by the North Carolina Solid Waste Section.

Method Detection Limit (MDL) is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero.

Method Reporting Limit or Method Quantitation Limit (MRL or MQL) is the minimum concentration of a target analyte that can be accurately determined by the referenced method.

Practical Quantitation Limit (PQL) is a quantitation limit that represents a practical and routinely achievable quantitation limit with a high degree of certainty (>99.9% confidence) in the results. Per EPA Publication Number SW-846, the PQL is the lowest concentration that can be reliably measured within specified limits of precision and accuracy for a specific laboratory analytical method during routine laboratory operating conditions in accordance with "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods. The PQL appears in older NCDENR literature; however, it is no longer being used by the North Carolina Solid Waste Section.

Solid Waste Section Limit (SWSL) is the lowest amount of analyte in a sample that can be quantitatively determined with suitable precision and accuracy. The SWSL is the concentration below which reported analytical results must be qualified as estimated. *The SWSL is the updated version of the PQL that appears in older North Carolina Solid Waste Section literature. The SWSL is the limit established by the laboratory survey conducted by the North Carolina Solid Waste Section. The nomenclature of the SWRL described in the October 27, 2006, memorandum has changed to the SWSL.*

North Carolina 2L Standards (2L) are water quality standards for the protection of groundwaters of North Carolina as specified in 15A NCAC 2L .0200, Classifications and Water Quality Standards Applicable to the Groundwaters of North Carolina.

Method Detection Limits (MDLs)

Clarification of detection limits referenced in the October 27, 2006, memorandum needed to be addressed because of concerns raised by the regulated community. The North Carolina Solid Waste Section is now requiring laboratories to report to the method detection limit.

Method detection limits are statistically determined values that define the concentration at which measurements of a substance by a specific analytical protocol can be distinguished from measurements of a blank (background noise). Method detection limits are matrix-specific and require a well defined analytical method. In the course of routine operations, laboratories generally report the highest method detection limit for all the instruments used for a specific method.

In many instances, the North Carolina Solid Waste Section gathers data from many sources prior to evaluating the data or making a compliance decision. Standardization in data reporting significantly enhances the ability to interpret and review data because the reporting formats are comparable. Reporting a method detection limit alerts data users of the known uncertainties and limitations associated with using the data. Data users must understand these limitations in order to minimize the risk of making poor environmental decisions. Censoring data below unspecified or non-statistical reporting limits severely biases data sets and restricts their usefulness.

Solid Waste Section Limits (SWSLs)

Due to comments from the regulated community, the North Carolina Solid Waste Section has changed the nomenclature of the new limits referenced on Page 2 of the October 27, 2006, memorandum, from the North Carolina Solid Waste Reporting Limits (SWRL) to the Solid Waste Section Limits (SWSL). Data must be reported to the laboratory specific method detection limits and must be quantifiable at or below the SWSL. The SWSLs must be used for both groundwater and surface water data reported to the North Carolina Solid Waste Section. The PQLs will no longer be used.

The North Carolina Solid Waste Section has considered further feedback from laboratories and the regulated community and has made some additional changes to the values of the SWSLs. These changes may be viewed on our webpage:
http://www.wastenotnc.org/sw/swenvmonitoringlist.asp

Analytical Data Reporting Requirements

The strategy for implementing the new analytical data reporting requirements involves reporting the actual laboratory method detection limit with all analytical laboratory results along with the following requirements:

1) Any analyte detected at a concentration greater than the MDL but less than the SWSL is known to be present, but the uncertainty in the value is higher than a value reported above the SWSL. As a result, the actual concentration is estimated. The estimated concentration is reported along with a qualifier ("J" flag) to alert data users that the result is between the MDL and the SWSL. Any analytical data below quantifiable levels should be examined closely to evaluate whether the analytical data should be included in any statistical analysis. A statistician should make this determination. If an analyte is detected below the North Carolina 2L Standards, even if it is a quantifiable concentration, compliance action may not be taken unless it is statistically significant increase over background.

These analytical results may require additional confirmation.

2) Any analyte detected at a concentration greater than the SWSL is present, and the quantitated value can be reported with a high degree of confidence. These analytes are reported without estimated qualification. The laboratory's MDL and SWSL must be included in the analytical laboratory report. Any reported concentration of an organic or inorganic constituent at or above the North Carolina 2L Standards will be used for compliance purposes, unless the inorganic constituent is not statistically significant). Exceedance of the North Carolina 2L Standards or a statistically significant increase over background concentrations define when a violation has occurred. Any reported concentration of an organic or inorganic constituent at or above the SWSL that is not above an North Carolina 2L Standard will be used as a tool to assess the integrity of the landfill system and predict the possibility that a constituent concentration may exceed the North Carolina 2L Standards in the future.

These analytical results may be used for compliance without further confirmation.

Failure to comply with the requirements described in the October 27, 2006, memorandum and this addendum to the October 27, 2006, memorandum will constitute a violation of 15A NCAC 13B .0601, .0602, or .1632(b), and the analytical data will be returned and deemed unacceptable. Submittal of unacceptable data may lead to enforcement action.

Electronic Data Deliverable (EDD) Submittal

The North Carolina Solid Waste Section would also like to take this opportunity to encourage electronic submittal of the reports in addition to the analytical laboratory data. This option is intended to save resources for both the public and private sectors.

The North Carolina Solid Waste Section will accept the entire report including narrative text, figures, tables, and maps on CD-ROM. Please separate the figures and tables from the report when saving in order to keep the

size of the files smaller. The CD-ROM submittal shall contain a CD-ROM case and both CD-ROM and the case shall be labeled with the site name, site address, permit number, and the monitoring event date (MM/DD/YYYY). The reporting files may be submitted as a .pdf, .txt, .csv, .xls,. or .doc type.

Also, analytical lab data and field data should be reported in .xls files. The North Carolina Solid Waste Section has a template for analytical lab data and field data. This template is available on our webpage: http://www.wastenotnc.org/swhome/enviro_monitoring.asp. Methane monitoring data may also be submitted electronically in this format.

Pursuant to the October 27, 2006, memorandum, please remember to submit a Solid Waste Section Environmental Monitoring Reporting Form in addition to your environmental monitoring data report. This form should be sealed by a geologist or engineer licensed in North Carolina if hydrogeologic or geologic calculations, maps, or interpretations are included with the report. Otherwise, any representative that the facility owner chooses may sign and submit the form. Also, if the concentration of methane generated by the facility exceeds 100% of the lower explosive limits (LEL) at the property boundary or exceeds 25% of the LEL in facility structures (excluding gas control or recovery system components), include the exceedance(s) on the North Carolina Solid Waste Section Environmental Monitoring Reporting Form.

If you have any questions or concerns, please feel free to contact Jaclynne Drummond (919-508-8500) or Ervin Lane (919-508-8520).

Thank you for your continued cooperation with this matter.

DENR USE ONLY: ☐ Paper Report ☐ Electronic Data - Email CD (data loaded: Yes / No) Doc/Event #:

NC DENR
Division of Waste Management - Solid Waste

Environmental Monitoring Reporting Form

Notice: This form and any information attached to it are "Public Records" as defined in NC General Statute 132-1. As such, these documents are available for inspection and examination by any person upon request (NC General Statute 132-6).

Instructions:

- **Prepare one form for each individually monitored unit.**
- **Please type or print legibly.**
- Attach a notification table with values that attain or exceed NC 2L groundwater standards or NC 2B surface water standards. The notification must include a preliminary analysis of the cause and significance of each value. (e.g. naturally occurring, off-site source, pre-existing condition, etc.).
- Attach a notification table of any groundwater or surface water values that equal or exceed the reporting limits.
- Attach a notification table of any methane gas values that attain or exceed explosive gas levels. This includes any structures on or nearby the facility (NCAC 13B .1629 (4)(a)(i).
- In Accordance with NC General Statutes Chapter 89C and 89E and NC Solid Waste Management Rules 15A NCAC 13B, be sure to affix a seal to the bottom of this page, when applicable.
- Send the original signed and sealed form, any tables, and Electronic Data Deliverable to: Compliance Unit, NCDENR-DWM, Solid Waste Section, 1646 Mail Service Center, Raleigh, NC 27699-1646.

Solid Waste Monitoring Data Submittal Information

Name of entity submitting data (laboratory, consultant, facility owner):

Contact for questions about data formatting. Include data preparer's name, telephone number and E-mail address:

Name: _____ Phone: _____

E-mail: _____

Facility name:	Facility Address:	Facility Permit #	NC Landfill Rule: (.0500 or .1600)	Actual sampling dates (e.g., October 20-24, 2006)

Environmental Status: (Check all that apply)

☐ Initial/Background Monitoring ☐ Detection Monitoring ☐ Assessment Monitoring ☐ Corrective Action

Type of data submitted: (Check all that apply)

☐ Groundwater monitoring data from monitoring wells
☐ Groundwater monitoring data from private water supply wells
☐ Leachate monitoring data
☐ Surface water monitoring data
☐ Methane gas monitoring data
☐ Corrective action data (specify) _____
☐ Other(specify)

Notification attached?

☐ No. No groundwater or surface water standards or explosive methane gas limits were exceeded.
☐ Yes, a notification of values exceeding a groundwater or surface water standard is attached. It includes a list of groundwater and surface water monitoring points, dates, analytical values, NC 2L groundwater standard, NC 2B surface water standard or NC Solid Waste GWPS and preliminary analysis of the cause and significance of any concentration.
☐ Yes, a notification of values exceeding an explosive methane gas limit is attached. It includes the methane monitoring points, dates, sample values and explosive methane gas limits.

Certification

To the best of my knowledge, the information reported and statements made on this data submittal and attachments are true and correct. Furthermore, I have attached complete notification of any sampling values meeting or exceeding groundwater standards or explosive gas levels, and a preliminary analysis of the cause and significance of concentrations exceeding groundwater standards. I am aware that there are significant penalties for making any false statement, representation, or certification including the possibility of a fine and imprisonment.

Facility Representative Name (Print) Title (Area Code) Telephone Number

Signature Date

Affix NC Licensed/ Professional Geologist/Engineer Seal here:

Revised 10/2006

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* GWP = Groundwater Protection
** SWSL = Solid Waste Section Limit

CAS Number	Name	Other Names	2L Std.	GWP* Std.	SWSL**	SW ID	App I
630-20-6	1,1,1,2-Tetrachloroethane	Ethane, 1,1,1,2-tetrachloro-	NE	1.3	5	190	I
71-55-6	1,1,1-Trichloroethane; Methylchloroform	Ethane, 1,1,1-trichloro-	200	--	1	200	I
79-34-5	1,1,2,2-Tetrachloroethane	Ethane, 1,1,2,2-tetrachloro-	NE	0.18	3	191	I
79-00-5	1,1,2-Trichloroethane	Ethane, 1,1,2-trichloro-	NE	0.6	1	202	I
75-34-3	1,1-Dichloroethane; Ethyldidene chloride	Ethane, 1,1-dichloro-	70	--	5	75	I
75-35-4	1,1-Dichloroethylene; 1,1-Dichloroethene;	Ethene, 1,1-dichloro-	7	--	5	77	I
563-58-6	1,1-Dichloropropene	1-Propene, 1,1-dichloro-	NE	NE	5	85	II
96-18-4	1,2,3-Trichloropropane	Propane, 1,2,3-trichloro-	0.005	--	1	206	I
95-94-3	1,2,4,5-Tetrachlorobenzene	Benzene, 1,2,4,5-tetrachloro-	NE	NE	10	189	II
120-82-1	1,2,4-Trichlorobenzene	Benzene, 1,2,4-trichloro-	NE	70	10	199	II
96-12-8	1,2-Dibromo-3-chloropropane; DBCP	Propane, 1,2-dibromo-3-chloro-	0.025	--	13	67	I
106-93-4	1,2-Dibromoethane; Ethylene dibromide; EDB	Ethane, 1,2-dibromo-	0.0004	--	1	68	I
107-06-2	1,2-Dichloroethane; Ethylene dichloride	Ethane, 1,2-dichloro-	0.38	--	1	76	I
78-87-5	1,2-Dichloropropane	Propane, 1,2-dichloro-	0.51	--	1	82	I
142-28-9	1,3-Dichloropropane; Trimethylene dichloride	Propane, 1,3-dichloro-	NE	NE	1	83	II
130-15-4	1,4-Naphthoquinone	1,4-Naphthalenedione	NE	NE	10	149	II
134-32-7	1-Naphthylamine	1-Naphthalenamine	NE	NE	10	150	II
594-20-7	2,2-Dichloropropane; Isopropylidene chloride	Propane, 2,2-dichloro-	NE	NE	15	84	II
58-90-2	2,3,4,6-Tetrachlorophenol	Phenol, 2,3,4,6-tetrachloro-	210	--	10	193	II
93-76-5	2,4,5-T; 2,4,5-Trichlorophenoxyacetic acid	Acetic acid, (2,4,5-trichlorophenoxy)-	NE	NE	2	188	II
95-95-4	2,4,5-Trichlorophenol	Phenol, 2,4,5-trichloro-	NE	700	10	204	II
88-06-2	2,4,6-Trichlorophenol	Phenol, 2,4,6-trichloro-	NE	NE	10	205	II
94-75-7	2,4-D; 2,4-Dichlorophenoxyacetic acid	Acetic acid, (2,4-dichlorophenoxy)-	70	--	2	59	II
120-83-2	2,4-Dichlorophenol	Phenol, 2,4-dichloro-	NE	NE	10	80	II
105-67-9	2,4-Dimethylphenol; m-Xylenol	Phenol, 2,4-dimethyl-	140	--	10	95	II
51-28-5	2,4-Dinitrophenol	Phenol, 2,4-dinitro-	NE	NE	50	99	II
121-14-2	2,4-Dinitrotoluene	Benzene, 1-methyl-2,4-dinitro-	NE	NE	10	100	II
87-65-0	2,6-Dichlorophenol	Phenol, 2,6-dichloro-	NE	NE	10	81	II
606-20-2	2,6-Dinitrotoluene	Benzene, 2-methyl-1,3-dinitro-	NE	NE	10	101	II
53-96-3	2-Acetylaminofluorene; 2-AAF	Acetamide, N-9H-fluoren-2-yl-	NE	NE	20	6	II
91-58-7	2-Chloronaphthalene	Naphthalene, 2-chloro-	NE	NE	10	47	II
95-57-8	2-Chlorophenol	Phenol, 2-chloro-	0.36	--	10	48	II
591-78-6	2-Hexanone; Methyl butyl ketone	2-Hexanone	NE	280	50	124	I
91-57-6	2-Methylnaphthalene	Naphthalene, 2-methyl-	14	--	10	145	II
91-59-8	2-Naphthylamine	2-Naphthalenamine	NE	NE	10	151	II
91-94-1	3,3'-Dichlorobenzidine	[1,1'-Biphenyl]-4,4'-diamine,3,3'-dichloro-	NE	NE	20	72	II
119-93-7	3,3'-Dimethylbenzidine	[1,1'-Biphenyl]-4,4'-diamine,3,3'-dimethyl-	NE	NE	10	94	II
56-49-5	3-Methylcholanthrene	Benz[j]aceanthrylene,1,2-dihydro-3-methyl-	NE	NE	10	138	II
72-54-8	4,4'-DDD	Benzene 1,1'-(2,2-dichloroethylidene)bis[4-chloro-	0.14	--	0.1	60	II
72-55-9	4,4'-DDE	Benzene, 1,1'-(dichloroethenylidene)bis[4-chloro-	NE	NE	0.1	61	II
50-29-3	4,4'-DDT	Benzene, 1,1'-(2,2,2-trichloroethylidene)bis[4-chloro-	0.1	--	0.1	62	II
534-52-1	4,6-Dinitro-o-cresol; 4,6-Dinitro-2-methylphenol	Phenol, 2-methyl-4,6-dinitro-	NE	NE	50	98	II
92-67-1	4-Aminobiphenyl	[1,1'-Biphenyl]-4-amine	NE	NE	20	11	II
101-55-3	4-Bromophenyl phenyl ether	Benzene, 1-bromo-4-phenoxy-	NE	NE	10	31	II
7005-72-3	4-Chlorophenyl phenyl ether	Benzene, 1-chloro-4-phenoxy-	NE	NE	10	49	II
108-10-1	4-Methyl-2-pentanone; Methyl isobutyl ketone	2-Pentanone, 4-methyl-	NE	560	100	147	I
99-55-8	5-Nitro-o-toluidine	Benzenamine, 2-methyl-5-nitro-	NE	NE	10	157	II
57-97-6	7,12-Dimethylbenz[a]anthracene	Benz[a]anthracene, 7,12-dimethyl-	NE	NE	10	93	II
83-32-9	Acenaphthene	Acenaphthylene, 1,2-dihydro-	80	--	10	1	II
208-96-8	Acenaphthylene	Acenaphthylene	210	--	10	2	II
67-64-1	Acetone	2-Propanone	700	--	100	3	I
75-05-8	Acetonitrile; Methyl cyanide	Acetonitrile	NE	42	55	4	I
98-86-2	Acetophenone	Ethanone, 1-phenyl-	NE	700	10	5	II
107-02-8	Acrolein	2-Propenal	NE	3.5	53	7	II
107-13-1	Acrylonitrile	2-Propenenitrile	NE	NE	200	8	II

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CAS Number	Name	Other Names	2L Std.	GWP* Std.	SWSL**	SW ID	App I
309-00-2	Aldrin	1,4:5,8-Dimethanonaphthalene,1,2,3,4,10,10 - hexachloro-1,4,4a,5,8,8a-hexahydro-(1,4,4a,5,8,8a)-	NE	NE	0.05	9	II
107-05-1	Allyl chloride	1-Propene, 3-chloro-	NE	NE	10	10	II
319-84-6	alpha-BHC	Cyclohexane,1,2,3,4,5,6-hexachloro-,(1a,2a,3β,4a,5□,6□)-	NE	0.006	0.05	24	II
120-12-7	Anthracene	Anthracene	2100	--	10	12	II
7440-36-0	Antimony	Antimony	NE	1.4	6	13	I
7440-38-2	Arsenic	Arsenic	50	--	10	14	I
7440-39-3	Barium	Barium	2000	--	100	15	I
71-43-2	Benzene	Benzene	1	--	1	16	I
56-55-3	Benzo[a]anthracene; Benzanthracene	Benz[a]anthracene	0.0479	--	10	17	II
50-32-8	Benzo[a]pyrene	Benzo[a]pyrene	0.00479	--	10	21	II
205-99-2	Benzo[b]fluoranthene	Benz[e]acephenanthrylene	0.0479	--	10	18	II
191-24-2	Benzo[ghi]perylene	Benzo[ghi]perylene	210	--	10	20	II
207-08-9	Benzo[k]fluoranthene	Benzo[k]fluoranthene	0.479	--	10	19	II
100-51-6	Benzyl alcohol	Benzenemethanol	NE	3500	20	22	II
7440-41-7	Beryllium	Beryllium	NE	4	1	23	I
319-85-7	beta-BHC	Cyclohexane,1,2,3,4,5,6-hexachloro-,(1a,2□,3a,4□,5a,6□)-	NE	0.019	0.05	25	II
SW316	Biological Oxygen Demand	BOD	NE	NE	NE	316	
108-60-1	Bis(2-chloro-1-methylethyl) ether; 2,2'-Dichlorodiisopropyl ether; DCIP, See footnote 4	Propane, 2,2'-oxybis[1-chloro-	NE	NE	10	46	II
111-91-1	Bis(2-chloroethoxy)methane	Ethane, 1,1'-[methylenebis(oxy)]bis [2-chloro	NE	NE	10	42	II
111-44-4	Bis(2-chloroethyl)ether; Dichloroethyl ether	Ethane, 1,1'-oxybis[2-chloro-	NE	0.031	10	43	II
117-81-7	Bis(2-ethylhexyl) phthalate	1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl)ester	NE	NE	15	111	II
74-97-5	Bromochloromethane; Chlorobromethane	Methane, bromochloro-	NE	0.6	3	28	I
75-27-4	Bromodichloromethane; Dichlorobromomethane	Methane, bromodichloro-	0.56	--	1	29	I
75-25-2	Bromoform; Tribromomethane	Methane, tribromo-	4.43	--	3	30	I
85-68-7	Butyl benzyl phthalate; Benzyl butyl phthalate	1,2-Benzenedicarboxylicacid, butyl phenylmethyl ester	100	--	10	32	II
7440-43-9	Cadmium	Cadmium	1.75	--	1	34	I
75-15-0	Carbon disulfide	Carbon disulfide	700	--	100	35	I
56-23-5	Carbon tetrachloride	Methane, tetrachloro-	0.269	--	1	36	I
SW317	Chemical Oxygen Demand	COD	NE	NE	NE	317	
57-74-9	Chlordane	4,7-Methano-1H-indene,1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-	0.1	--	0.5	339	II
108-90-7	Chlorobenzene	Benzene, chloro-	50	--	3	39	I
510-15-6	Chlorobenzilate	Benzeneacetic acid, 4-chloro-(4-chlorophenyl)--hydroxy-, ethyl ester	NE	NE	10	40	II
75-00-3	Chloroethane; Ethyl chloride	Ethane, chloro-	2800	--	10	41	I
67-66-3	Chloroform; Trichloromethane	Methane, trichloro-	70	--	5	44	I
126-99-8	Chloroprene	1,3-Butadiene, 2-chloro-	NE	NE	20	50	II
7440-47-3	Chromium	Chromium	50	--	10	51	I
218-01-9	Chrysene	Chrysene	4.79	--	10	52	II
156-59-2	cis-1,2-Dichloroethylene; cis-1,2-Dichloroethene	Ethene, 1,2-dichloro-,(Z)-	70	--	5	78	I
10061-01-5	cis-1,3-Dichloropropene	1-Propene, 1,3-dichloro-, (Z)-	0.19	--	1	86	I
7440-48-4	Cobalt	Cobalt	NE	70	10	53	I
7440-50-8	Copper	Copper	1000	--	10	54	I
57-12-5	Cyanide	Cyanide	70	--	10	58	II
319-86-8	delta-BHC	Cyclohexane,1,2,3,4,5,6-hexachloro-,(1a,2a,3a,4□,5a,6□)-	NE	0.019	0.05	26	II
2303-16-4	Diallate	Carbamothioic acid,bis(1-methylethyl)-, S-(2,3-dichloro-2-propenyl) ester	NE	NE	10	63	II
53-70-3	Dibenz[a,h]anthracene	Dibenz[a,h]anthracene	0.0047	--	10	64	II
132-64-9	Dibenzofuran	Dibenzofuran	NE	28	10	65	II

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124-48-1	Dibromochloromethane; Chlorodibromomethane	Methane, dibromochloro-	NE	0.41	3	66	I
75-71-8	Dichlorodifluoromethane; CFC 12	Methane,dichlorodifluoro-	1400	--	5	74	II
60-57-1	Dieldrin	2,7:3,6-Dimethanonaphth[2,3-b]oxirene,3,4,5,6,9,9-hexachloro - 1a,2,2a,3,6,6a,7,7a-octahydro-, (1aa,2□,2aa,3□,6□,6aa,7□,7aa)-	0.0022	--	0.075	88	II
84-66-2	Diethyl phthalate	1,2-Benzenedicarboxylicacid, diethyl ester	5000	--	10	90	II
60-51-5	Dimethoate	Phosphorodithioic acid,O,O-dimethyl S-[2-(methylamino)-2-oxoethyl] ester	NE	NE	20	91	II
131-11-3	Dimethyl phthalate	1,2-Benzenedicarboxylicacid, dimethyl ester	NE	NE	10	96	II
84-74-2	Di-n-butyl phthalate	1,2-Benzenedicarboxylic acid, dibutyl ester	700	--	10	33	II
117-84-0	Di-n-octyl phthalate	1,2-Benzenedicarboxylicacid, dioctyl ester	140	--	10	168	II
88-85-7	Dinoseb; DNBP; 2-sec-Butyl-4,6-dinitrophenol	Phenol, 2-(1-methylpropyl)-4,6-dinitro-	NE	7	1	102	II
122-39-4	Diphenylamine	Benzenamine, N-phenyl-	NE	NE	10	103	II
298-04-4	Disulfoton	Phosphorodithioic acid,O,O-diethyl S-[2-(ethylthio)ethyl]ester	0.28	--	10	104	II
959-98-8	Endosulfan I	6,9-Methano-2,4,3-benzodiox-athiepin,6,7,8,9,10,10 -hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide,	NE	NE	0.1	105	II
33213-65-9	Endosulfan II	6,9-Methano-2,4,3-benzodioxathiepin,6,7,8,9,10,10 -hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide,(3a,5aa,6□,9□,9aa)-	42	--	0.1	106	II
1031-07-8	Endosulfan sulfate	6,9-Methano-2,4,3-benzodioxathiepin,6,7,8,9,10,10 -hexachloro-1,5,5a,6,9,9a-hexahydro-, 3,3-dioxide	NE	NE	0.1	107	II
72-20-8	Endrin	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aa,2□,2a□,3a,6a,6a□,7□,7aa)	2	--	0.1	108	II
7421-93-4	Endrin aldehyde	1,2,4-Methenocyclo-penta[cd]pentalene-5-carboxaldehyde,2,2a,3,3,4,7 - hexachlorodecahydro-(1a,2□,2a□,4□,4a□,5□,6a□,6b□,7R*)-	2.1	--	0.1	109	II
97-63-2	Ethyl methacrylate	2-Propenoic acid, 2-methyl-, ethyl ester	NE	NE	10	112	II
62-50-0	Ethyl methanesulfonate	Methanesulfonic acid,ethyl ester	NE	NE	20	113	II
100-41-4	Ethylbenzene	Benzene, ethyl-	550	--	1	110	I
52-85-7	Famphur	Phosphorothioic acid, O-[4-[(dimethylamino)sulfonyl]phenyl]-O, O-dimethyl ester	NE	NE	20	114	II
206-44-0	Fluoranthene	Fluoranthene	280	--	10	115	II
86-73-7	Fluorene	9H-Fluorene	280	--	10	116	II
58-89-9	gamma-BHC; Lindane	Cyclohexane,1,2,3,4,5,6-hexachloro-,(1a,2a,3□,4a,5a,6□)-	0.2	--	0.05	27	II
76-44-8	Heptachlor	4,7-Methano-1H-indene,1,4,5,6,7,8,8-heptachloro- 3a,4,7,7a-tetrahydro-	0.0078	--	0.05	117	II
1024-57-3	Heptachlor epoxide	2,5-Methano-2H-indeno[1,2-b]oxirene,2,3,4,5,6,7,7 -heptachloro-1a,1b,5,5a,6,6a, -hexahydro-,(1aa,1b□,2a,5a,5a□,6□,6aa)	0.0038	--	0.075	118	II
118-74-1	Hexachlorobenzene	Benzene, hexachloro-	0.02	--	10	119	II
87-68-3	Hexachlorobutadiene	1,3-Butadiene,1,1,2,3,4,4-hexachloro-	NE	0.44	10	120	II
77-47-4	Hexachlorocyclopentadiene	1,3-Cyclopentadiene,1,2,3,4,5,5-hexachloro-	NE	50	10	121	II
67-72-1	Hexachloroethane	Ethane, hexachloro-	NE	2.5	10	122	II
1888-71-7	Hexachloropropene	1-Propene, 1,1,2,3,3,3-hexachloro-	NE	NE	10	123	II
193-39-5	Indeno(1,2,3-cd)pyrene	Indeno[1,2,3-cd]pyrene	0.0479	--	10	125	II

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78-83-1	Isobutyl alcohol	1-Propanol, 2-methyl-	NE	NE	100	126	II
465-73-6	Isodrin	1,4,5,8-Dimethanonaphthalene,1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a hexahydro-(1a,4a,4a□,5□,8□,8a□)-	NE	NE	20	127	II
78-59-1	Isophorone	2-Cyclohexen-1-one,3,5,5-trimethyl-	36.8	--	10	128	II
120-58-1	Isosafrole	1,3-Benzodioxole, 5-(1-propenyl)-	NE	NE	10	129	II
143-50-0	Kepone	1,3,4-Metheno-2H-cyclobuta-[cd]pentalen-2-one, 1,1a,3,3a,4,5,5,5a,5b,6-decachlorooctahydro-	NE	NE	20	130	II
7439-92-1	Lead	Lead	15	--	10	131	I
108-39-4	m-Cresol; 3-Methylphenol	Phenol, 3-methyl-	35	--	10	345	II
541-73-1	m-Dichlorobenzene; 1,3-Dichlorobenzene	Benzene, 1,3-dichloro-	170	--	5	70	II
99-65-0	m-Dinitrobenzene	Benzene, 1,3-dinitro-	NE	NE	20	97	II
7439-97-6	Mercury	Mercury	1.05	--	0.2	132	II
126-98-7	Methacrylonitrile	2-Propenenitrile, 2-methyl-	NE	NE	100	133	II
91-80-5	Methapyrilene	1,2,Ethanediamine, N,N-dimethyl-N'-2-pyridinyl-N'-(2-thienylmethyl)-	NE	NE	100	134	II
72-43-5	Methoxychlor	Benzene, 1,1'-(2,2,2,trichloroethylidene)bis [4-methoxy-	35	--	1	135	II
74-83-9	Methyl bromide; Bromomethane	Methane, bromo-	NE	NE	10	136	I
74-87-3	Methyl chloride; Chloromethane	Methane, chloro-	2.6	--	1	137	I
78-93-3	Methyl ethyl ketone; MEK; 2-Butanone	2-Butanone	4200	--	100	141	I
74-88-4	Methyl iodide; Iodomethane	Methane, iodo-	NE	NE	10	142	I
80-62-6	Methyl methacrylate	2-Propenoic acid, 2-methyl-, methyl ester	NE	NE	30	143	II
66-27-3	Methyl methanesulfonate	Methanesulfonic acid,methyl ester	NE	NE	10	144	II
298-00-0	Methyl parathion; Parathion methyl	Phosphorothioic acid,O,O-dimethyl	NE	NE	10	146	II
74-95-3	Methylene bromide; Dibromomethane	Methane, dibromo-	NE	NE	10	139	I
75-09-2	Methylene chloride; Dichloromethane	Methane, dichloro-	4.6	--	1	140	I
99-09-2	m-Nitroaniline; 3-Nitroaniline	Benzenamine, 3-nitro-	NE	NE	50	153	II
91-20-3	Naphthalene	Naphthalene	21	--	10	148	II
7440-02-0	Nickel	Nickel	100	--	50	152	I
SW303	Nitrate (as N)		10000	--	10000	303	
98-95-3	Nitrobenzene	Benzene, nitro-	NE	NE	10	156	II
55-18-5	N-Nitrosodiethylamine	Ethanamine, N-ethyl-N-nitroso-	NE	NE	20	160	II
62-75-9	N-Nitrosodimethylamine	Methanamine, N-methyl-N-nitroso-	0.0007	--	10	161	II
924-16-3	N-Nitrosodi-n-butylamine	1-Butanamine, N-butyl-N-nitroso-	NE	NE	10	162	II
86-30-6	N-Nitrosodiphenylamine	Benzenamine, N-nitroso-N-phenyl-	NE	NE	10	163	II
621-64-7	N-Nitrosodipropylamine; N-Nitroso-N-dipropylamine; Di-n-propylnitrosamine	1-Propanamine, N-nitroso-N-propyl-	NE	NE	10	164	II
10595-95-6	N-Nitrosomethylethalamine	Ethanamine, N-methyl-N-nitroso-	NE	NE	10	165	II
100-75-4	N-Nitrosopiperidine	Piperidine, 1-nitroso-	NE	NE	20	166	II
930-55-2	N-Nitrosopyrrolidine	Pyrrolidine, 1-nitroso-	NE	NE	10	167	II
126-68-1	O,O,O-Triethyl phosphorothioate	Phosphorothioic acid,O,O,O-triethyl ester	NE	NE	10	207	II
297-97-2	O,O-Diethyl O-2-pyrazinyl phosphorothioate; Thionazin	Phosphorothioic acid,O,O-diethyl O-pyrazinyl ester	NE	NE	20	89	II
95-48-7	o-Cresol; 2-Methylphenol	Phenol, 2-methyl-	NE	35	10	56	II
95-50-1	o-Dichlorobenzene; 1,2-Dichlorobenzene	Benzene, 1,2-dichloro-	24	--	5	69	I
88-74-4	o-Nitroaniline; 2-Nitroaniline	Benzenamine, 2-nitro-	NE	NE	50	154	II
88-75-5	o-Nitrophenol; 2-Nitrophenol	Phenol, 2-nitro-	NE	NE	10	158	II
95-53-4	o-Toluidine	Benzenamine, 2-methyl-	NE	NE	10	197	II
60-11-7	p-(Dimethylamino)azobenzene	Benzenamine, N,N-dimethyl-4-(phenylazo)-	NE	NE	10	92	II
56-38-2	Parathion	Phosphorothioic acid,O,O-diethyl-O-(4-nitrophenyl) ester	NE	NE	10	169	II
106-47-8	p-Chloroaniline	Benzenamine, 4-chloro-	NE	NE	20	38	II
59-50-7	p-Chloro-m-cresol; 4-Chloro-3-methylphenol	Phenol, 4-chloro-3-methyl-	NE	NE	20	45	II
106-44-5	p-Cresol; 4-Methylphenol	Phenol, 4-methyl-	3.5	NE--	10	344	II
106-46-7	p-Dichlorobenzene; 1,4-Dichlorobenzene	Benzene, 1,4-dichloro-	1.4	--	1	71	I
608-93-5	Pentachlorobenzene	Benzene, pentachloro-	NE	NE	10	171	II
82-68-8	Pentachloronitrobenzene	Benzene,pentachloronitro-	NE	NE	20	172	II
87-86-5	Pentachlorophenol	Phenol, pentachloro-	0.29	--	25	173	II
62-44-2	Phenacetin	Acetamide, N-(4-ethoxyphenyl)	NE	NE	20	174	II
85-01-8	Phenanthrene	Phenanthrene	210	--	10	175	II

All units are in (ug/L) unless noted.
NE = Not Established
CAS numbers that begin with "SW" are not real CAS numbers, instead this represents the Solid Waste Section's ID number

* GWP = Groundwater Protection
** SWSL = Solid Waste Section Limit

CAS Number	Name	Other Names	2L Std.	GWP* Std.	SWSL**	SW ID	App I
108-95-2	Phenol	Phenol	300	--	10	177	II
298-02-2	Phorate	Phosphorodithioic acid,O,O-diethyl S-[(ethylthio)methyl]ester	1.4	--	10	178	II
SW412	Total Phosphorus	Total Phosphorus	NE	NE	NE	412	
100-01-6	p-Nitroaniline; 4-Nitroaniline	Benzenamine, 4-nitro-	NE	NE	20	155	II
100-02-7	p-Nitrophenol; 4-Nitrophenol	Phenol, 4-nitro-	NE	NE	50	159	II
1336-36-3	Polychlorinated biphenyls; PCBs 1016/1242	1,1'-Biphenyl,chloro derivatives Method 1016/1242	NE	0.5	2	434	II
106-50-3	p-Phenylenediamine	1,4-Benzenediamine	NE	NE	10	176	II
23950-58-5	Pronamide	Benzamide, 3,5-dichloro-N-(1,1-dimethyl-2-propynyl)-	NE	NE	10	179	II
107-12-0	Propionitrile; Ethyl cyanide	Propanenitrile	NE	NE	150	180	II
129-00-0	Pyrene	Pyrene	210	--	10	181	II
94-59-7	Safrole	1,3-Benzodioxole, 5-(2-propenyl)-	NE	NE	10	182	II
7782-49-2	Selenium	Selenium	50	--	10	183	I
7440-22-4	Silver	Silver	17.5	--	10	184	I
93-72-1	Silvex; 2,4,5-TP	Propanoic acid, 2-(2,4,5-trichlorophenoxy)-	50	--	2	185	II
100-42-5	Styrene	Benzene, ethenyl-	100	--	1	186	I
14808-79-8	Sulfate		250000	--	250000	315	
18496-25-8	Sulfide	Sulfide	NE	NE	1000	187	II
99-35-4	sym-Trinitrobenzene	Benzene, 1,3,5-trinitro-	NE	NE	10	208	II
127-18-4	Tetrachloroethylene; Tetrachloroethene; Perchloroethylene	Ethene, tetrachloro-	0.7	--	1	192	I
7440-28-0	Thallium	Thallium	NE	0.28	5.5	194	I
7440-31-5	Tin	Tin	NE	NE	100	195	II
108-88-3	Toluene	Benzene, methyl-	1000	--	1	196	I
8001-35-2	Toxaphene	Toxaphene	0.031	--	1.5	198	II
156-60-5	trans-1,2-Dichloroethylene; trans-1,2-Dichloroethene	Ethene, 1,2-dichloro-,(E)-	100	--	5	79	I
10061-02-6	trans-1,3-Dichloropropene	1-Propene, 1,3-dichloro-, (E)-	0.19	--	1	87	I
110-57-6	trans-1,4-Dichloro-2-butene	2-Butene, 1,4-dichloro-, (E)-	NE	NE	100	73	I
79-01-6	Trichloroethylene; Trichloroethene	Ethene, trichloro-	2.8	--	1	201	I
75-69-4	Trichlorofluoromethane; CFC-11	Methane,trichlorofluoro-	2100	--	1	203	I
7440-62-2	Vanadium	Vanadium	NE	3.5	25	209	I
108-05-4	Vinyl acetate	Acetic acid, ethenylester	NE	7000	50	210	I
75-01-4	Vinyl chloride; Chloroethene	Ethene, chloro-	0.015	--	1	211	I
1330-20-7	Xylene (total)	Benzene, dimethyl-	530	--	5	346	I
7440-66-6	Zinc	Zinc	1050	--	10	213	I

APPENDIX C

LOW-FLOW GROUNDWATER PURGING AND SAMPLING GUIDANCE

United States Environmental Protection Agency | Office of Research and Development | Office of Solid Waste and Emergency Response | EPA/540/S-95/50 April 1996

EPA Ground Water Issue

LOW-FLOW (MINIMAL DRAWDOWN) GROUND-WATER SAMPLING PROCEDURES

by Robert W. Puls[1] and Michael J. Barcelona[2]

Background

The Regional Superfund Ground Water Forum is a group of ground-water scientists, representing EPA's Regional Superfund Offices, organized to exchange information related to ground-water remediation at Superfund sites. One of the major concerns of the Forum is the sampling of ground water to support site assessment and remedial performance monitoring objectives. This paper is intended to provide background information on the development of low-flow sampling procedures and its application under a variety of hydrogeologic settings. It is hoped that the paper will support the production of standard operating procedures for use by EPA Regional personnel and other environmental professionals engaged in ground-water sampling.

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I. Introduction

The methods and objectives of ground-water sampling to assess water quality have evolved over time. Initially the emphasis was on the assessment of water quality of aquifers as sources of drinking water. Large water-bearing units were identified and sampled in keeping with that objective. These were highly productive aquifers that supplied drinking water via private wells or through public water supply systems. Gradually, with the increasing aware ness of subsurface pollution of these water resources, the understanding of complex hydrogeochemical processes which govern the fate and transport of contaminants in the subsurface increased. This increase in understanding was also due to advances in a number of scientific disciplines ar improvements in tools used for site characterization and ground-water sampling. Ground-water quality investigations where pollution was detected initially borrowed ideas, methods, and materials for site characterization from the water supply field and water analysis from public health practices. This included the materials and manner in which monitoring wells were installed and the way in which water was brought to the surface, treated, preserved and analyze The prevailing conceptual ideas included convenient gener zations of ground-water resources in terms of large and relatively homogeneous hydrologic *units*. With time it becar apparent that conventional water supply generalizations of *homogeneity* did not adequately represent field data regard ing pollution of these subsurface resources. The important role of *heterogeneity* became increasingly clear not only in geologic terms, but also in terms of complex physical,

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chemical and biological subsurface processes. With greater appreciation of the role of heterogeneity, it became evident that subsurface pollution was ubiquitous and encompassed the unsaturated zone to the deep subsurface and included unconsolidated sediments, fractured rock, and *aquitards* or low-yielding or impermeable formations. Small-scale processes and heterogeneities were shown to be important in identifying contaminant distributions and in controlling water and contaminant flow paths.

It is beyond the scope of this paper to summarize all the advances in the field of ground-water quality investigations and remediation, but two particular issues have bearing on ground-water sampling today: aquifer heterogeneity and colloidal transport. Aquifer heterogeneities affect contaminant flow paths and include variations in geology, geochemistry, hydrology and microbiology. As methods and the tools available for subsurface investigations have become increasingly sophisticated and understanding of the subsurface environment has advanced, there is an awareness that in most cases a primary concern for site investigations is characterization of contaminant flow paths rather than entire aquifers. In fact, in many cases, plume thickness can be less than well screen lengths (e.g., 3-6 m) typically installed at hazardous waste sites to detect and monitor plume movement over time. Small-scale differences have increasingly been shown to be important and there is a general trend toward smaller diameter wells and shorter screens.

The hydrogeochemical significance of colloidal-size particles in subsurface systems has been realized during the past several years (Gschwend and Reynolds, 1987; McCarthy and Zachara, 1989; Puls, 1990; Ryan and Gschwend, 1990). This realization resulted from both field and laboratory studies that showed faster contaminant migration over greater distances and at higher concentrations than flow and transport model predictions would suggest (Buddemeier and Hunt, 1988; Enfield and Bengtsson, 1988; Penrose et al., 1990). Such models typically account for interaction between the mobile aqueous and immobile solid phases, but do not allow for a mobile, reactive solid phase. It is recognition of this third *phase* as a possible means of contaminant transport that has brought increasing attention to the manner in which samples are collected and processed for analysis (Puls et al., 1990; McCarthy and Degueldre, 1993; Backhus et al., 1993; U. S. EPA, 1995). If such a phase is present in sufficient mass, possesses high sorption reactivity, large surface area, and remains stable in suspension, it can serve as an important mechanism to facilitate contaminant transport in many types of subsurface systems.

Colloids are particles that are sufficiently small so that the surface free energy of the particle dominates the bulk free energy. Typically, in ground water, this includes particles with diameters between 1 and 1000 nm. The most commonly observed mobile particles include: secondary clay minerals; hydrous iron, aluminum, and manganese oxides; dissolved and particulate organic materials, and viruses and bacteria. These reactive particles have been shown to be mobile unde a variety of conditions in both field studies and laboratory column experiments, and as such need to be included in monitoring programs where identification of the *total* mobile contaminant loading (dissolved + naturally suspended particles) at a site is an objective. To that end, sampling methodologies must be used which do not artificially bias *naturally* suspended particle concentrations.

Currently the most common ground-water purging and sampling methodology is to purge a well using bailers or high speed pumps to remove 3 to 5 casing volumes followed by sample collection. This method can cause adverse impact on sample quality through collection of samples with high levels of turbidity. This results in the inclusion of otherwise immobile artifactual particles which produce an overestimation of certain analytes of interest (e.g., metals or hydrophobi organic compounds). Numerous documented problems associated with filtration (Danielsson, 1982; Laxen and Chandler, 1982; Horowitz et al., 1992) make this an undesirable method of rectifying the turbidity problem, and include the removal of potentially mobile (contaminant-associated) particles during filtration, thus artificially biasing contaminant concentrations low. Sampling-induced turbidity problems car often be mitigated by using low-flow purging and sampling techniques.

Current subsurface conceptual models have undergone considerable refinement due to the recent development and increased use of field screening tools. So-called hydraulic *push* technologies (e.g., cone penetrometer, Geoprobe®, QED HydroPunch®) enable relatively fast screening site characterization which can then be used to design and install a monitoring well network. Indeed, alternatives to conventional monitoring wells are now being considered for some hydrogeologic settings. The ultimate design of any monitoring system should however be based upon adequate site characterization and be consistent with established monitoring objectives.

If the sampling program objectives include accurate assessment of the magnitude and extent of subsurface contamination over time and/or accurate assessment of subsequent remedial performance, then some information regarding plume delineation in three-dimensional space is necessary prior to monitoring well network design and installation. This can be accomplished with a variety of different tools and equipment ranging from hand-operated augers to screening tools mentioned above and large drilling rigs. Detailed information on ground-water flow velocity, direction, and horizontal and vertical variability are essential baseline data requirements. Detailed soil and geologic data are required prior to and during the installation of sampling points. This includes historical as well as detailed soil and geologic logs which accumulate during the site investigation. The use of borehole geophysical techniques is also recommended. With this information (together with other site characterization data) and a clear understanding of sampling

objectives, then appropriate location, screen length, well diameter, slot size, etc. for the monitoring well network can be decided. This is especially critical for new in situ remedial approaches or natural attenuation assessments at hazardous waste sites.

In general, the overall goal of any ground-water sampling program is to collect water samples with no alteration in water chemistry; analytical data thus obtained may be used for a variety of specific monitoring programs depending on the regulatory requirements. The sampling methodology described in this paper assumes that the monitoring goal is to sample monitoring wells for the presence of contaminants and it is applicable whether mobile colloids are a concern or not and whether the analytes of concern are metals (and metalloids) or organic compounds.

II. Monitoring Objectives and Design Considerations

The following issues are important to consider prior to the design and implementation of any ground-water monitoring program, including those which anticipate using low-flow purging and sampling procedures.

A. Data Quality Objectives (DQOs)

Monitoring objectives include four main types: detection, assessment, corrective-action evaluation and resource evaluation, along with *hybrid* variations such as site-assessments for property transfers and water availability investigations. Monitoring objectives may change as contamination or water quality problems are discovered. However, there are a number of common components of monitoring programs which should be recognized as important regardless of initial objectives. These components include:

1) Development of a conceptual model that incorporates elements of the regional geology to the local geologic framework. The conceptual model development also includes initial site characterization efforts to identify hydrostratigraphic units and likely flow-paths using a minimum number of borings and well completions;

2) Cost-effective and well documented collection of high quality data utilizing simple, accurate, and reproducible techniques; and

3) Refinement of the conceptual model based on supplementary data collection and analysis.

These fundamental components serve many types of monitoring programs and provide a basis for future efforts that evolve in complexity and level of spatial detail as purposes and objectives expand. High quality, reproducible data collection is a common goal regardless of program objectives.

High quality data collection implies data of sufficien accuracy, precision, and completeness (i.e., ratio of valid analytical results to the minimum sample number called for t the program design) to meet the program objectives. Accuracy depends on the correct choice of monitoring tools and procedures to minimize sample and subsurface disturbance from collection to analysis. Precision depends on the repeatability of sampling and analytical protocols. It can be assured or improved by replication of sample analyses including blanks, field/lab standards and reference standard:

B. Sample Representativeness

An important goal of any monitoring program is collection of data that is truly representative of conditions at the site. The term *representativeness* applies to chemical an hydrogeologic data collected via wells, borings, piezometers geophysical and soil gas measurements, lysimeters, and temporary sampling points. It involves a recognition of the statistical variability of individual subsurface physical properties, and contaminant or major ion concentration levels, whil explaining extreme values. Subsurface temporal and spatia variability are facts. Good professional practice seeks to maximize representativeness by using proven accurate and reproducible techniques to define limits on the distribution of measurements collected at a site. However, measures of representativeness are dynamic and are controlled by evolving site characterization and monitoring objectives. An evolutionary site characterization model, as shown in Figure 1, provides a systematic approach to the goal of consistent data collection.

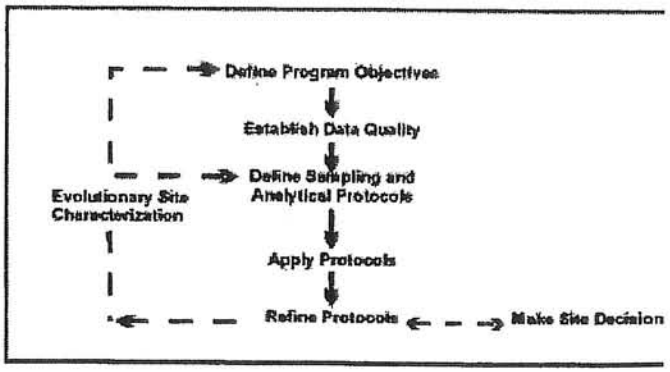

Figure 1. Evolutionary Site Characterization Model

The model emphasizes a recognition of the causes of the variability (e.g., use of inappropriate technology such as usir bailers to purge wells; imprecise or operator-dependent methods) and the need to control avoidable errors.

1) Questions of Scale

A sampling plan designed to collect representative samples must take into account the potential scale of changes in site conditions through space and time as well as the chemical associations and behavior of the parameters that are targeted for investigation. In subsurface systems, physical (i.e., aquifer) and chemical properties over time or space are not statistically independent. In fact, samples taken in close proximity (i.e., within distances of a few meters) or within short time periods (i.e., more frequently than monthly) are highly auto-correlated. This means that designs employing high-sampling frequency (e.g., monthly) or dense spatial monitoring designs run the risk of redundant data collection and misleading inferences regarding trends in values that aren't statistically valid. In practice, contaminant detection and assessment monitoring programs rarely suffer these *over-sampling* concerns. In corrective-action evaluation programs, it is also possible that too little data may be collected over space or time. In these cases, false interpretation of the spatial extent of contamination or underestimation of temporal concentration variability may result.

2) Target Parameters

Parameter selection in monitoring program design is most often dictated by the regulatory status of the site. However, background water quality constituents, purging indicator parameters, and contaminants, all represent targets for data collection programs. The tools and procedures used in these programs should be equally rigorous and applicable to all categories of data, since all may be needed to determine or support regulatory action.

C. Sampling Point Design and Construction

Detailed site characterization is central to all decision-making purposes and the basis for this characterization resides in identification of the geologic framework and major hydro-stratigraphic units. Fundamental data for sample point location include: subsurface lithology, head-differences and background geochemical conditions. Each sampling point has a proper use or uses which should be documented at a level which is appropriate for the program's data quality objectives. Individual sampling points may not always be able to fulfill multiple monitoring objectives (e.g., detection, assessment, corrective action).

1) Compatibility with Monitoring Program and Data Quality Objectives

Specifics of sampling point location and design will be dictated by the complexity of subsurface lithology and variability in contaminant and/or geochemical conditions. It should be noted that, regardless of the ground-water sampling approach, few sampling points (e.g., wells, drive-points, screened augers) have zones of influence in excess of a few feet. Therefore, the spatial frequency of sampling points should be carefully selected and designed.

2) Flexibility of Sampling Point Design

In most cases *well-point* diameters in excess of 1 7/i inches will permit the use of most types of submersible pumping devices for low-flow (minimal drawdown) sampling. It is suggested that *short* (e.g., less than 1.6 m) screens be incorporated into the monitoring design where possible so that comparable results from one device to another might be expected. *Short*, of course, is relative to the degree of vertic water quality variability expected at a site.

3) Equilibration of Sampling Point

Time should be allowed for equilibration of the well or sampling point with the formation after installation. Placement of well or sampling points in the subsurface produces some disturbance of ambient conditions. Drilling techniques (e.g., auger, rotary, etc.) are generally considered to cause more disturbance than *direct-push* technologies. In either case, there may be a period (i.e., days to months) during which water quality near the point may be distinctly different from that in the formation. Proper development of the sampling point and adjacent formation to remove fines created during emplacement will shorten this water quality *recovery* period.

III. Definition of Low-Flow Purging and Sampling

It is generally accepted that water in the well casing is non-representative of the formation water and needs to be purged prior to collection of ground-water samples. Howeve the water in the screened interval may indeed be representative of the formation, depending upon well construction and site hydrogeology. Wells are purged to some extent for the following reasons: the presence of the air interface at the top of the water column resulting in an oxygen concentration gradient with depth, loss of volatiles up the water column, leaching from or sorption to the casing or filter pack, chemica changes due to clay seals or backfill, and surface infiltration.

Low-flow purging, whether using portable or dedicated systems, should be done using pump-intake located in the middle or slightly above the middle of the screened interval. Placement of the pump too close to the bottom of th well will cause increased entrainment of solids which have collected in the well over time. These particles are present a a result of well development, prior purging and sampling events, and natural colloidal transport and deposition. Therefore, placement of the pump in the middle or toward th top of the screened interval is suggested. Placement of the pump at the top of the water column for sampling is only recommended in unconfined aquifers, screened across the water table, where this is the desired sampling point. Low-

flow purging has the advantage of minimizing mixing between the overlying stagnant casing water and water within the screened interval.

A. Low-Flow Purging and Sampling

Low-flow refers to the velocity with which water enters the pump intake and that is imparted to the formation pore water in the immediate vicinity of the well screen. It does not necessarily refer to the flow rate of water discharged at the surface which can be affected by flow regulators or restrictions. Water level drawdown provides the best indication of the stress imparted by a given flow-rate for a given hydrological situation. The objective is to pump in a manner that minimizes stress (drawdown) to the system to the extent practical taking into account established site sampling objectives. Typically, flow rates on the order of 0.1 - 0.5 L/min are used, however this is dependent on site-specific hydrogeology. Some extremely coarse-textured formations have been successfully sampled in this manner at flow rates to 1 L/min. The effectiveness of using low-flow purging is intimately linked with proper screen location, screen length, and well construction and development techniques. The reestablishment of natural flow paths in both the vertical and horizontal directions is important for correct interpretation of the data. For high resolution sampling needs, screens less than 1 m should be used. Most of the need for purging has been found to be due to passing the sampling device through the overlying casing water which causes mixing of these stagnant waters and the dynamic waters within the screened interval. Additionally, there is disturbance to suspended sediment collected in the bottom of the casing and the displacement of water out into the formation immediately adjacent to the well screen. These disturbances and impacts can be avoided using dedicated sampling equipment, which precludes the need to insert the sampling device prior to purging and sampling.

Isolation of the screened interval water from the overlying stagnant casing water may be accomplished using low-flow minimal drawdown techniques. If the pump intake is located within the screened interval, most of the water pumped will be drawn in directly from the formation with little mixing of casing water or disturbance to the sampling zone. However, if the wells are not constructed and developed properly, zones other than those intended may be sampled. At some sites where geologic heterogeneities are sufficiently different within the screened interval, higher conductivity zones may be preferentially sampled. This is another reason to use shorter screened intervals, especially where high spatial resolution is a sampling objective.

B. Water Quality Indicator Parameters

It is recommended that water quality indicator parameters be used to determine purging needs prior to sample collection in each well. Stabilization of parameters such as pH, specific conductance, dissolved oxygen, oxidation-reduction potential, temperature and turbidity should be used to determine when formation water is accessed during purging. In general, the order of stabilization is pH, temperature, and specific conductance, followed by oxidation-reduction potential, dissolved oxygen and turbidity. Temperature and pH, while commonly used as purging indicators, are actually quite insensitive in distinguishing between formation water and stagnant casing water; nevertheless, these are important parameters for data interpretation purposes and should also be measured. Performance criteria for determination of stabilization should be based on water-level drawdown, pumping rate and equipment specifications for measuring indicator parameters. Instruments are available which utilize in-line flow cells to continuously measure the above parameters.

It is important to establish specific well stabilization criteria and then consistently follow the same methods thereafter, particularly with respect to drawdown, flow rate and sampling device. Generally, the time or purge volume required for parameter stabilization is independent of well depth or well volumes. Dependent variables are well diameter, sampling device, hydrogeochemistry, pump flow rate, and whether the devices are used in a portable or dedicated manner. If the sampling device is already in place (i.e., dedicated sampling systems), then the time and purge volume needed for stabilization is much shorter. Other advantages of dedicated equipment include less purge water for waste disposal, much less decontamination of equipment, less time spent in preparation of sampling as well as time in the field, and more consistency in the sampling approach which probably will translate into less variability in sampling results. The use of dedicated equipment is strongly recommended at wells which will undergo routine sampling over time.

If parameter stabilization criteria are too stringent, then minor oscillations in indicator parameters may cause purging operations to become unnecessarily protracted. It should also be noted that turbidity is a very conservative parameter in terms of stabilization. Turbidity is always the last parameter to stabilize. Excessive purge times are invariably related to the establishment of too stringent turbidity stabilization criteria. It should be noted that natural turbidity levels in ground water may exceed 10 nephelometric turbidity units (NTU).

C. Advantages and Disadvantages of Low-Flow (Minimum Drawdown) Purging

In general, the advantages of low-flow purging include:

- samples which are representative of the *mobile* load o contaminants present (dissolved and colloid-associated);
- minimal disturbance of the sampling point thereby minimizing sampling artifacts;
- less operator variability, greater operator control;

- reduced stress on the formation (minimal drawdown);
- less mixing of stagnant casing water with formation water;
- reduced need for filtration and, therefore, less time required for sampling;
- smaller purging volume which decreases waste disposal costs and sampling time;
- better sample consistency; reduced artificial sample variability.

Some disadvantages of low-flow purging are:

- higher initial capital costs,
- greater set-up time in the field,
- need to transport additional equipment to and from the site,
- increased training needs,
- resistance to change on the part of sampling practitioners,
- concern that new data will indicate a *change in conditions* and trigger an *action*.

IV. Low-Flow (Minimal Drawdown) Sampling Protocols

The following ground-water sampling procedure has evolved over many years of experience in ground-water sampling for organic and inorganic compound determinations and as such summarizes the authors' (and others) experiences to date (Barcelona et al., 1984, 1994; Barcelona and Helfrich, 1986; Puls and Barcelona, 1989; Puls et. al. 1990, 1992; Puls and Powell, 1992; Puls and Paul, 1995). High-quality chemical data collection is essential in ground-water monitoring and site characterization. The primary limitations to the collection of *representative* ground-water samples include: mixing of the stagnant casing and *fresh* screen waters during insertion of the sampling device or ground-water level measurement device; disturbance and resuspension of settled solids at the bottom of the well when using high pumping rates or raising and lowering a pump or bailer; introduction of atmospheric gases or degassing from the water during sample handling and transfer, or inappropriate use of vacuum sampling device, etc.

A. Sampling Recommendations

Water samples should not be taken immediately following well development. Sufficient time should be allowed for the ground-water flow regime in the vicinity of the monitoring well to stabilize and to approach chemical equilibrium with the well construction materials. This lag time will depend on site conditions and methods of installation but often exceeds one week.

Well purging is nearly always necessary to obtain samples of water flowing through the geologic formations in the screened interval. Rather than using a general but arbitrary guideline of purging three casing volumes prior to sampling, it is recommended that an in-line water quality measurement device (e.g., flow-through cell) be used to establish the stabilization time for several parameters (e.g., pH, specific conductance, redox, dissolved oxygen, turbidity) on a well-specific basis. Data on pumping rate, drawdown, and volume required for parameter stabilization can be used as a guide for conducting subsequent sampling activities.

The following are recommendations to be considered before, during and after sampling:

- use low-flow rates (<0.5 L/min), during both purging and sampling to maintain minimal drawdown in the well;
- maximize tubing wall thickness, minimize tubing length;
- place the sampling device intake at the desired sampling point;
- minimize disturbances of the stagnant water column above the screened interval during water level measurement and sampling device insertion;
- make proper adjustments to stabilize the flow rate as soon as possible;
- monitor water quality indicators during purging;
- collect unfiltered samples to estimate contaminant loading and transport potential in the subsurface system.

B. Equipment Calibration

Prior to sampling, all sampling device and monitoring equipment should be calibrated according to manufacturer's recommendations and the site Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP). Calibration of pH should be performed with at least two buffers which bracket the expected range. Dissolved oxygen calibration must be corrected for local barometric pressure readings and elevation.

C. Water Level Measurement and Monitoring

It is recommended that a device be used which will least disturb the water surface in the casing. Well depth should be obtained from the well logs. Measuring to the bottom of the well casing will only cause resuspension of settled solids from the formation and require longer purging times for turbidity equilibration. Measure well depth after sampling is completed. The water level measurement should be taken from a permanent reference point which is surveyed relative to ground elevation.

D. Pump Type

The use of low-flow (e.g., 0.1-0.5 L/min) pumps is suggested for purging and sampling all types of analytes. All pumps have some limitation and these should be investigated with respect to application at a particular site. Bailers are inappropriate devices for low-flow sampling.

1) General Considerations

There are no unusual requirements for ground-water sampling devices when using low-flow, minimal drawdown techniques. The major concern is that the device give consistent results and minimal disturbance of the sample across a range of *low* flow rates (i.e., < 0.5 L/min). Clearly, pumping rates that cause minimal to no drawdown in one well could easily cause *significant* drawdown in another well finished in a less transmissive formation. In this sense, the pump should not cause undue pressure or temperature changes or physical disturbance on the water sample over a reasonable sampling range. Consistency in operation is critical to meet accuracy and precision goals.

2) Advantages and Disadvantages of Sampling Devices

A variety of sampling devices are available for low-flow (minimal drawdown) purging and sampling and include peristaltic pumps, bladder pumps, electrical submersible pumps, and gas-driven pumps. Devices which lend themselves to both dedication and consistent operation at definable low-flow rates are preferred. It is desirable that the pump be easily adjustable and operate reliably at these lower flow rates. The peristaltic pump is limited to shallow applications and can cause degassing resulting in alteration of pH, alkalinity, and some volatiles loss. Gas-driven pumps should be of a type that does not allow the gas to be in direct contact with the sampled fluid.

Clearly, bailers and other *grab* type samplers are ill-suited for low-flow sampling since they will cause repeated disturbance and mixing of *stagnant* water in the casing and the *dynamic* water in the screened interval. Similarly, the use of inertial lift foot-valve type samplers may cause too much disturbance at the point of sampling. Use of these devices also tends to introduce uncontrolled and unacceptable operator variability.

Summaries of advantages and disadvantages of various sampling devices are listed in Herzog et al. (1991), U. S. EPA (1992), Parker (1994) and Thurnblad (1994).

E. Pump Installation

Dedicated sampling devices (left in the well) capable of pumping and sampling are preferred over <u>any</u> other type of device. Any portable sampling device should be slowly and carefully lowered to the middle of the screened interval or slightly above the middle (e.g., 1-1.5 m below the top of a 3 m screen). This is to minimize excessive mixing of the stagnant water in the casing above the screen with the screened interval zone water, and to minimize resuspension of solids which will have collected at the bottom of the well. These two disturbance effects have been shown to directly affect the time required for purging. There also appears to be a direct correlation between size of portable sampling devices relative to the well bore and resulting purge volumes and times. The key is to minimize disturbance of water and solids in the well casing.

F. Filtration

Decisions to filter samples should be dictated by sampling objectives rather than as a *fix* for poor sampling practices, and field-filtering of certain constituents should not be the default. Consideration should be given as to what the application of field-filtration is trying to accomplish. For assessment of truly dissolved (as opposed to operationally *dissolved* [i.e., samples filtered with 0.45 µm filters]) concentrations of major ions and trace metals, 0.1 µm filters are recommended although 0.45 µm filters are normally used for most regulatory programs. Alkalinity samples must also be filtered if significant particulate calcium carbonate is suspected, since this material is likely to impact alkalinity titration results (although filtration itself may alter the CO_2 composition of the sample and, therefore, affect the results).

Although filtration may be appropriate, filtration of a sample may cause a number of unintended changes to occur (e.g. oxidation, aeration) possibly leading to filtration-induced artifacts during sample analysis and uncertainty in the results. Some of these unintended changes may be unavoidable but the factors leading to them must be recognized. Deleterious effects can be minimized by consistent application of certain filtration guidelines. Guidelines should address selection of filter type, media, pore size, etc. in order to identify and minimize potential sources of uncertainty when filtering samples.

In-line filtration is recommended because it provides better consistency through less sample handling, and minimizes sample exposure to the atmosphere. In-line filters are available in both disposable (barrel filters) and non-disposable (in-line filter holder, flat membrane filters) formats and various filter pore sizes (0.1-5.0 µm). Disposable filter cartridges have the advantage of greater sediment handling capacity when compared to traditional membrane filters. Filters must be pre-rinsed following manufacturer's recommendations. If there are no recommendations for rinsing, pass through a minimum of 1 L of ground water following purging and prior to sampling. Once filtration has begun, a filter cake may develop as particles larger than the pore size accumulate on the filter membrane. The result is that the effective pore diameter of the membrane is reduced and particles smaller than the stated pore size are excluded from the filtrate. Possible corrective measures include prefiltering (with larger pore size filters), minimizing particle loads to begin with, and reducing sample volume.

G. Monitoring of Water Level and Water Quality Indicator Parameters

Check water level periodically to monitor drawdown in the well as a guide to flow rate adjustment. The goal is minimal drawdown (<0.1 m) during purging. This goal may b difficult to achieve under some circumstances due to geologi heterogeneities within the screened interval, and may require adjustment based on site-specific conditions and personal experience. In-line water quality indicator parameters should be continuously monitored during purging. The water quality

indicator parameters monitored can include pH, redox potential, conductivity, dissolved oxygen (DO) and turbidity. The last three parameters are often most sensitive. Pumping rate, drawdown, and the time or volume required to obtain stabilization of parameter readings can be used as a future guide to purge the well. Measurements should be taken every three to five minutes if the above suggested rates are used. Stabilization is achieved after all parameters have stabilized for three successive readings. In lieu of measuring all five parameters, a minimum subset would include pH, conductivity, and turbidity or DO. Three successive readings should be within ± 0.1 for pH, ± 3% for conductivity, ± 10 mv for redox potential, and ± 10% for turbidity and DO. Stabilized purge indicator parameter trends are generally obvious and follow either an exponential or asymptotic change to stable values during purging. Dissolved oxygen and turbidity usually require the longest time for stabilization. The above stabilization guidelines are provided for rough estimates based on experience.

H. Sampling, Sample Containers, Preservation and Decontamination

Upon parameter stabilization, sampling can be initiated. If an in-line device is used to monitor water quality parameters, it should be disconnected or bypassed during sample collection. Sampling flow rate may remain at established purge rate or may be adjusted slightly to minimize aeration, bubble formation, turbulent filling of sample bottles, or loss of volatiles due to extended residence time in tubing. Typically, flow rates less than 0.5 L/min are appropriate. The same device should be used for sampling as was used for purging. Sampling should occur in a progression from least to most contaminated well, if this is known. Generally, volatile (e.g., solvents and fuel constituents) and gas sensitive (e.g., Fe^{2+}, CH_4, H_2S/HS^-, alkalinity) parameters should be sampled first. The sequence in which samples for most inorganic parameters are collected is immaterial unless filtered (dissolved) samples are desired. Filtering should be done last and in-line filters should be used as discussed above. During both well purging and sampling, proper protective clothing and equipment must be used based upon the type and level of contaminants present.

The appropriate sample container will be prepared in advance of actual sample collection for the analytes of interest and include sample preservative where necessary. Water samples should be collected directly into this container from the pump tubing.

Immediately after a sample bottle has been filled, it must be preserved as specified in the site (QAPP). Sample preservation requirements are based on the analyses being performed (use site QAPP, FSP, RCRA guidance document [U. S. EPA, 1992] or EPA SW-846 [U. S. EPA, 1982]). It may be advisable to add preservatives to sample bottles in a controlled setting prior to entering the field in order to reduce the chances of improperly preserving sample bottles or introducing field contaminants into a sample bottle while adding the preservatives.

The preservatives should be transferred from the chemical bottle to the sample container using a disposable polyethylene pipet and the disposable pipet should be used only once and then discarded.

After a sample container has been filled with ground water, a Teflon™ (or tin)-lined cap is screwed on tightly to prevent the container from leaking. A sample label is filled out as specified in the FSP. The samples should be stored inverted at 4°C.

Specific decontamination protocols for sampling devices are dependent to some extent on the type of device used and the type of contaminants encountered. Refer to the site QAPP and FSP for specific requirements.

I. Blanks

The following blanks should be collected:

(1) field blank: one field blank should be collected from each source water (distilled/deionized water) used for sampling equipment decontamination or for assisting well development procedures.

(2) equipment blank: one equipment blank should be taken prior to the commencement of field work, from each set of sampling equipment to be used for that day. Refer to site QAPP or FSP for specific requirements.

(3) trip blank: a trip blank is required to accompany each volatile sample shipment. These blanks are prepared in the laboratory by filling a 40-mL volatile organic analysis (VOA) bottle with distilled/deionized water.

V. Low-Permeability Formations and Fractured Rock

The overall sampling program goals or sampling objectives will drive how the sampling points are located, installed, and choice of sampling device. Likewise, site-specific hydrogeologic factors will affect these decisions. Sites with very low permeability formations or fractures causing discrete flow channels may require a unique monitoring approach. Unlike water supply wells, wells installed for ground-water quality assessment and restoration programs are often installed in low water-yielding settings (e.g., clays, silts). Alternative types of sampling points and sampling methods are often needed in these types of environments, because low-permeability settings may require extremely low flow purging (<0.1 L/min) and may be technology-limited. Where devices are not readily available to pump at such low flow rates, the primary consideration is to avoid dewatering o

the well screen. This may require repeated recovery of the water during purging while leaving the pump in place within the well screen.

Use of low-flow techniques may be impractical in these settings, depending upon the water recharge rates. The sampler and the end-user of data collected from such wells need to understand the limitations of the data collected; i.e., a strong potential for underestimation of actual contaminant concentrations for volatile organics, potential false negatives for filtered metals and potential false positives for unfiltered metals. It is suggested that comparisons be made between samples recovered using low-flow purging techniques and samples recovered using passive sampling techniques (i.e., two sets of samples). Passive sample collection would essentially entail acquisition of the sample with no or very little purging using a dedicated sampling system installed within the screened interval or a passive sample collection device.

A. Low-Permeability Formations (<0.1 L/min recharge)

1. Low-Flow Purging and Sampling with Pumps

   a. "portable or non-dedicated mode" - Lower the pump (one capable of pumping at <0.1 L/min) to mid-screen or slightly above and set in place for minimum of 48 hours (to lessen purge volume requirements). After 48 hours, use procedures listed in Part IV above regarding monitoring water quality parameters for stabilization, etc., but do not dewater the screen. If excessive drawdown and slow recovery is a problem, then alternate approaches such as those listed below may be better.

   b. "dedicated mode" - Set the pump as above at least a week prior to sampling; that is, operate in a dedicated pump mode. With this approach significant reductions in purge volume should be realized. Water quality parameters should stabilize quite rapidly due to less disturbance of the sampling zone.

2. Passive Sample Collection

Passive sampling collection requires insertion of the device into the screened interval for a sufficient time period to allow flow and sample equilibration before extraction for analysis. Conceptually, the extraction of water from low yielding formations seems more akin to the collection of water from the unsaturated zone and passive sampling techniques may be more appropriate in terms of obtaining "representative" samples. Satisfying usual sample volume requirements is typically a problem with this approach and some latitude will be needed on the part of regulatory entities to achieve sampling objectives.

B. Fractured Rock

In fractured rock formations, a low-flow to zero purging approach using pumps in conjunction with packers to isolate the sampling zone in the borehole is suggested. Passive multi-layer sampling devices may also provide the most "representative" samples. It is imperative in these settings to identify flow paths or water-producing fractures prior to sampling using tools such as borehole flowmeters and/or other geophysical tools.

After identification of water-bearing fractures, install packer(s) and pump assembly for sample collection using low-flow sampling in "dedicated mode" or use a passive sampling device which can isolate the identified water-bearing fractures.

VI. Documentation

The usual practices for documenting the sampling event should be used for low-flow purging and sampling techniques. This should include, at a minimum: information on the conduct of purging operations (flow-rate, drawdown, water-quality parameter values, volumes extracted and times for measurements), field instrument calibration data, water sampling forms and chain of custody forms. See Figures 2 and 3 and "Ground Water Sampling Workshop -- A Workshop Summary" (U. S. EPA, 1995) for example forms and other documentation suggestions and information. This information coupled with laboratory analytical data and validation data are needed to judge the "useability" of the sampling data.

VII. Notice

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VIII. References

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