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FINAL LEAKING UNDERGROUND STORAGE TANK COMPREHENSIVE SITE ASSESSMENT

BUILDING 1613, USTs 1613 1-4

MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

MAY 17,1996

VOLUME II

Contract No. N62470-93-D-4020
Richard Catlin & Associates, Inc. Job No. 94127-F

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SEAL
1409
GEOLOGIST
TERESA M. PIVER
5/20/96

Prepared by:
Richard Catlin & Associates, Inc.
Wilmington, North Carolina

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LEAKING UNDERGROUND STORAGE TANK
SITE ASSESSMENT WORKPLAN

BUILDING 1613, USTs 1613 1-4
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

Issued: March 10, 1995
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Prepared by:
Richard Catlin & Associates, Inc.
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MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

RC&A PROJECT NO. 94127-F

March 10, 1995

1.0 INTRODUCTION

1.1 Purpose and Scope of Investigation

The purpose of this Leaking Underground Storage Tank (LUST) Site Assessment Workplan (Workplan) is to serve as a guidance document and procedural manual for performing tasks to aid in determining the magnitude and extent of soil and ground water contamination; identifying possible free product accumulation; and assessing potential exposure to possible subsurface petroleum-related contaminants around Building 1613 and underground storage tanks (USTs) 1613 1-4 aboard Marine Corps Base (MCB), Camp Lejeune, North Carolina, shown in Figure 1.

This Workplan was prepared in accordance with the Scope of Work (SOW) developed by the Naval Facilities Engineering Command (NAVFACENGCOM) and requirements listed as Elements 1 through 12 for Comprehensive Site Assessments at LUST Sites of the document entitled *Groundwater Section Guidelines for the Investigation and Remediation of Soils and Groundwater* prepared by the Groundwater Section of the North Carolina Department of Environment, Health and Natural Resources (NCDEHNR), March 1993. The objective of the Comprehensive Site Assessment (CSA) is to provide sufficient data to satisfy the requirements of Section 280.65 of 40 CFR Part 280, *Federal Technical Standards for Underground Storage Tanks* and Section .0706 of The North Carolina Administration Code Title 15A, Chapter 2, Subchapter 2N (NCAC T15A:02N), *North Carolina Criteria and Standards Applicable to Underground Storage Tanks.*

The project will be conducted in two phases. The first phase involves the advancement of 15 Hydropunch penetrometers (Hydropunches) and collection of shallow ground water samples for on-site laboratory analysis. The on-site laboratory results will be available within 24 to 72 hours to provide data to assist in determining the location of subsequently installed boreholes. The Hydropunches will be located predominantly downgradient of the source, with respect to shallow ground water flow, which is unknown. Previously established information will be used to assist in the placement of the Hydropunches. At least three of the Hydropunches will be used to perimeter the crossgradient and upgradient boundaries of the suspected plume.

The second phase of the investigation will involve the advancement of 16 soil borings, into which 12 Type II and three Type III monitoring wells, and one pumping test well will be installed. Samples will be collected from the soil borings (soil) and monitoring wells (ground water) for both on-site and off-site analysis. Slug tests will be conducted on three of the monitoring wells to evaluate the hydraulic conductivity of the shallow aquifer system. An eight hour pumping test will be performed on the pumping test well to determine aquifer parameters.

2.0 PREVIOUS INVESTIGATIONS, REMEDIATION AND/ OR CLOSURES

Past documents revealed that USTs 1613 1-4 contained various grades of gasoline that supplied Building 1613, the PCX Service Station in the Hadnot Point area. Tank installation dates are assumed by MCB personnel to be during the 1950s. A VacuTect™ leak detection test report was written on July 18, 1994 for USTs 1613-1 and 1613-2. No leakage from the USTs was detected. UST 1613-3 and all pressure lines were not tested due to mechanical problems.

During the RC&A site reconnaissance on January 13, 1995, USTs 1613 1-4 were being excavated by Omega Environmental. Tank 1613-1 was a 10,000 gallon UST containing super unleaded premium gasoline. Tank 1613-2 was also a 10,000 gallon UST that contained non-leaded premium gasoline. Tank 1613-3 was a 30,000 gallon UST that contained regular unleaded gasoline. The tank contents and capacity of UST 1613-4 was unknown by RC&A and MCB personnel. An active free product recovery system was recognized on-site. The UST Closure Report was not available at the time of preparation of this document.

3.0 SITE DESCRIPTION

The site description involves the collection of information regarding the history and physical characteristics of the site to identify and evaluate known and/or potential source(s) of contamination and conditions which will assist in determining sample locations. Potential contaminant migration pathways which may influence subsurface contaminant migration characteristics and limit intrusive subsurface investigation will also be identified. These typically include the presence of surface or near surface features, such as asphalt pavement, surface water impoundments, and buried utilities.

3.1 Area of Investigation

The site is located in the Hadnot Point area of the MCB, Camp Lejeune, North Carolina, approximately 1,000 feet south of the Beaver Dam Creek (see Figure 1). The subject site is located at Building 1613, the PCX Service Station on West Road. The former USTs were located to the northeast of Building 1613 in an area surrounded by a fence.

3.2 Site History and Operation

The focus of this investigation is the former USTs, that were removed on January 13, 1995 from Building 1613. A site assessment was requested as a part of the on-going UST investigations within the Hadnot Point area. Release incident information is unknown.

3.3 Contaminant Source Inventory

A visual survey of the facility revealed the potential for subsurface impact by at least six sources, which include: 1) the former UST basin for 1613 1-4 located northeast of Building 1613, near the West Road and Fir Street intersection; 2) Building 1700, a steam generating plant which houses a 5,000 gallon fuel oil AST; 3) two ASTs and a large coal storage facility on the east side of Building 1700; 4) Building 1612, a vehicle repair and virgin fuel storage facility located near the Fir Street and West Road intersection; 5) a waste oil AST located adjacent to and south of Building 1612; and 6) Building 1610, a tire and electric repair shop. This site houses hydraulic fluid for car lifts and is located south of the former UST basin near the West Road and Fir Street intersection. Additional potential sources may exist, but were not observed during the initial site reconnaissance. Any releases that may have occurred from these potential sources may be encountered during this investigation.

3.4 Water Well Inventory/Water Supply

Two water-supply wells were identified in the area. One well is located within a 1,500 foot radius of the project site, approximately 1,000 feet north-northeast. The other well is located approximately 2,375 feet north-northeast from the site. The wells reportedly access water from the Castle Hayne aquifer.

3.5 Utility Survey

A site reconnaissance of the area of investigation revealed overhead telephone and electric lines. It is also reported that underground water, sanitary sewer, steam lines, telephone, and electric lines exist in the subsurface beneath the site. Caution will be exercised during subsurface investigations to prevent breaching any encountered utilities.

4.0 SITE CHARACTERIZATION

The site characterization involves the collection of information to characterize the physical setting of the project area. Information regarding the geology/hydrogeology, topography, and other physical characteristics of the site and vicinity will be evaluated to identify conditions that could potentially affect the migration of petroleum contaminants. The information available at this time has revealed the following:

4.1 Regional Geology/Hydrogeology

The following information regarding regional geology/hydrogeology contained in this section is taken directly from the report entitled Leaking Underground Storage Tank Site Assessment Workplan,Tank 1115, Marine Corps Base, Camp Lejeune, North Carolina prepared by RC&A, dated October 21, 1993.

4.1.1 Regional Geology

The Coastal Plain consists of a layered sequence of unconsolidated sand, gravel, silt, and clay deposits of Miocene to Holocene age. These deposits in formations of Lower Cretaceous age, which overlie bedrock of Precambrian age, thicken and dip eastward with a thickness of 1,500 feet in the west to 6,000 feet in the east. The geologic units in the area are divided into six formations: the Castle Hayne Formation of the Eocene series; the River Bend Formation of the Oligocene series; the Pungo River of the Miocene series; the Yorktown Formation of the Pliocene series; and the James City and Flanner Beach Formations of the Pleistocene series. The Castle Hayne Formation is composed of interbedded sands, clays, and limestones. The Castle Hayne Formation is overlain by the River Bend Formation. The Pungo River is composed of interbedded phosphatic sands, silts and clays, diatomaceous clays, phosphatic and non-phosphatic limestones and silty claystones. The Yorktown Formation is defined as a medium to coarse-grained, poorly sorted, shelly sand. In the Camp Lejeune area, the Yorktown Formation is characterized by fine-to-medium grain quartz sand. The basal unit consists of contiguous clays. The James City Formation, which unconformably overlies the Yorktown Formation, consists primarily of unconsolidated, calcareous, sandy clays and argillaceous sands.

The Flanner Beach Formation, which immediately underlies the site, is composed of fine, well-sorted sand to silty sand.

4.1.2 Regional Hydrogeology

In the eastern part of the North Carolina Coastal Plain, ground water is obtained from the surficial, Yorktown, and Castle Hayne aquifers. The depth to ground water typically ranges from three to 12 feet below the surface. The surficial unconfined aquifer extends to depths ranging from 50 to 100 feet. This unit is not used as a source of water on the MCB. The Castle Hayne aquifer, the principle source of water for the MCB, consists of thick limestone, sand, and clay sequences. The general ground water flow is in the direction of lower hydraulic head to a discharge area like the New River or its tributaries or the ocean.

4.2 Site Geology/Hydrogeology and Soils

No wells have been installed at the subject site; therefore, ground water flow characteristics and geology are not known.

4.3 Site Topography and Other Surface Characteristics

The project area is dominated by relatively flat topography. The nearest bodied surface water is the Beaver Dam Creek, located approximately 1,500 feet south of Building 1613.

5.0 POTENTIAL RECEPTORS

The information collected in sections 2.0, 3.0, and 4.0 will be evaluated to provide a preliminary listing of potential receptors that could be affected by the known/suspected release of petroleum. Potential receptors of contamination, as defined by the NCDEHNR, include but are not limited to surface water bodies, ground water supply wells, and subsurface building structures.

6.0 SUBSURFACE INVESTIGATION METHODOLOGY

The major objectives of the subsurface investigation are to: (1) define the approximate lateral and vertical extent of free product accumulation (if any) and dissolved-phase ground water contamination resulting from possible discharge of petroleum fuels at the site; and (2) determine the approximate direction and rate of migration of ground water contaminant constituents at the project site including the identification of preferential pathways of contaminant migration. To accomplish this, 16 borings will be advanced to install 12 Type II and three

Type III monitoring wells, and one pumping test well. Fifteen Hydropunch penetrometers will be advanced at the beginning of the project to provide preliminary information to delineate the extent of contamination in order to assist in the location of the wells. Field activities will be performed in adherence to procedures and guidelines contained in the project Health and Safety Plan (Appendix I). The specific methods to accomplish these objectives are as follows:

6.1 Hydropunch Penetrometer Advancement and Soil Test Borings

6.1.1 Hydropunch Penetrometer Advancement

The proposed Hydropunch penetrometer locations are shown on Figure 2. As specified in the Delivery Order, 15 Hydropunch penetrometers will be advanced to the shallow water table interface for sample collection. The locations of these sample points were selected based on known/suspected contaminant source locations, and previous subsurface investigative results. The Hydropunch sample locations are intended to provide preliminary information to delineate the spatial extent of the dissolved and free-phase plume(s). The actual sample locations may change slightly based upon data obtained during the field investigation.

The Hydropunch penetrometers will be advanced by a trailer-mounted drill rig. Depending upon the subsurface conditions at each sample location, the penetrometer will be advanced by hammer blows or by a hydraulic press. If fill material, hard/dense soils, or a deep ground water table (greater than ten feet deep) is encountered, a shallow pilot boring will be advanced until a more suitable sampling interval is encountered to avoid damage to the probe.

6.1.2 Soil Test Borings

Sixteen soil borings will be advanced on the site by a trailer-mounted drill rig to install 12 Type II and three Type III monitoring wells, and one pumping test well. Hollow-stem augers will be used to advance the soil borings utilizing a split spoon sampling device for soil sample collection at five foot intervals as described in Section 7.2.

An on-site geologist/engineer will examine the soils from the borings to obtain lithological conditions and continuously monitor soils for evidence of contamination using physical observation and field screening with a flame ionization detector (FID) or photoionization detector (PID). Special emphasis will be placed on physical evaluation of soils by field personnel for evidence of contamination since the presence of heavier hydrocarbons characteristically cannot be entirely detected by a FID or PID. All data will be recorded in a project specific field book.

The soil borings for the Type II monitoring wells will be advanced to a depth of approximately 25 feet BLS, or approximately five feet below the shallow ground water table, whichever is encountered first. The soil borings for the Type III wells will be advanced to approximately 50 feet deep. The pumping test well will be advanced to a maximum depth of 40 feet. Boring depths may be modified slightly based on actual hydrogeological characteristics. The final locations of the borings will be subject to subsurface utility clearance.

6.2 Monitoring Well Design, Installation, and Development

A total of 16 wells will be installed on the site which include 12 Type II wells, three Type III (deep) wells, and one pumping test well. The information will be used to obtain data necessary to further define the lithology beneath the project site; develop a water table contour map and determine the direction of ground water flow across the project site; ascertain the lateral extent and approximate thickness of the free product plume, if present; establish the approximate geometric dimensions (vertical and lateral) of the dissolved-phase contaminant plume(s), if present; and provide for reproducible sampling points in the upper and lower portions of the surficial aquifer. Information will also be obtained to evaluate the hydraulic parameters of the shallow aquifer.

The assigned well identification numbers for this site are as follows:

1613-1 through 1613-16

6.2.1 Monitoring Well Locations

The locations of the monitoring wells will be based on the Hydropunch sampling results; the information obtained from previous subsurface investigations, geologic and hydrologic information, site topography, and visual assessment of the site. At least one Type II well will be located upgradient and two Type II wells located cross-gradient of the suspected/known source of contamination. The remaining Type II wells will be located at downgradient positions to delineate the horizontal extent of contamination. The Type III wells will be paired with selected Type II wells to ascertain vertical components of flow gradient and delineate the vertical extent of contamination. The final locations of the wells will be determined by the information obtained while drilling and installing successive monitoring wells.

6.2.2 Monitoring Well Design and Construction

The Type II monitoring wells will be constructed of two inch diameter PVC, machine slotted well screens and two inch diameter, Schedule 40 PVC riser pipe, except in traffic areas, where Schedule 80 PVC pipe will be utilized. Piping will be flush jointed and threaded, and wells will be constructed without the use of glue. Screen slot widths will be 0.010 or 0.020 inches. Sand packs will be constructed of washed silica Torpedo sand (ASTM C190).

The Type III wells will be constructed using six inch diameter PVC casing and two inch diameter well screen and riser. All well drilling will be performed by a trailer-mounted rig fully equipped for dry auger drilling.

The pumping test well will be constructed in a manner similar to the Type II wells except six inch diameter PVC well material will be used.

All wells will be installed by a qualified driller registered in the State of North Carolina and well installation will be supervised in the field by an experienced staff or project level geologist or engineer specializing in subsurface investigation. No petroleum lubricants will be used on drill pipe joints. However, Teflon® tape, vegetable oil, or phosphate-free laboratory detergent such as Liquinox® will be used for lubrication, if required.

6.2.3 Detailed Monitoring Well Installation Procedures

The PVC screen and riser pipe used in well construction will be pre-cleaned and packaged by the manufacturer. All well casings and screens will be transported and stored at the site in original packaging. Personnel handling these items will not handle tools or drilling equipment while installing the well. Clean, new disposable latex rubber gloves will be worn when handling well screens or casings. Personnel who are handling the drilling equipment will not be allowed to handle the well screens or casings until a new "clean" pair of gloves are worn.

The Type II monitoring wells will be installed as follows:

- Boreholes will typically be advanced with 4.25 inch inner diameter (ID) hollow stem augers to a depth of approximately 20 to 25 feet BLS to intersect the shallow water table, collect soil samples, and install the well. If heaving or flowing sands are encountered, a 2.5 inch auger may initially be advanced to collect split spoon soil samples followed by the 4.25 inch I.D. hollow stem auger with a bottom plug.

- Soil samples for chemical analysis will be collected via split spoon sampling in accordance with procedures outlined in Section 7.2 of this Workplan.

- At three well locations, a soil sample will be collected and analyzed for grain size distribution to obtain additional information regarding the hydraulic and physical properties of the aquifer material.

- The desired sections of two inch well screen and riser pipe will be assembled and lowered to the bottom of the augers.

- The lengths of all screen and riser casing sections and bottom plugs will be measured and recorded.

- Washed silica filter sand will be poured into the augers to construct a continuous filter pack within the augers which will extend from approximately one foot below the bottom of the well screen to a maximum of two feet above the slotted section. The depth to the sand pack will be frequently measured through the augers using a decontaminated weighted fiberglass measuring tape while pulling the augers without rotation to maintain the sand inside the augers as the filter pack is constructed.

- A two foot thick bentonite seal will be emplaced above the sand filter pack by pouring bentonite pellets into the augers in the manner described above. Distilled water will be added to the annular space at ten-minute intervals to aid in the hydration of the bentonite seal. The bentonite seal will be allowed to hydrate in accordance with manufacturer's recommendations.

- The annular space above the bentonite seal will be tremie grouted from the bottom to within approximately three feet of land surface with neat cement grout.

- After allowing the grout to set, the concrete pad and well head cover will be installed to complete the installation.

- A concrete apron constructed of 3,000 psi concrete and measuring 5.0 feet by 5.0 feet by 0.5 foot will be constructed around each well located in non-traffic areas. In non-traffic areas, each well head will be protected with three Schedule 40, protective steel pipes, three inch I.D., imbedded in a minimum of 2.5 feet of 3,000 psi concrete. A security pipe with a hinged locking cap, having an embedment depth of 2.5 feet into the concrete, will be installed over the well casing. The security pipes will extend 3.0 feet above the ground surface and will be filled with concrete and painted day-glow yellow or an equivalent color. All wells will be secured with a brass Master Lock padlock.

- In traffic areas, a flush manhole cover will be built into a three foot square, concrete collar, which will be nine inches thick. If the well is installed through a paved surface, the annular space between the casing and the borehole will be grouted to a depth of at least 2.5 feet and finished with a concrete collar. If the well is not installed through a paved or concrete surface, then a concrete apron, measuring 5.0 feet by 5.0 feet by 0.5 foot will be constructed around each well. The collar and pad will be constructed of 3,000 psi concrete and will be crowned to meet the finished grade of surrounding pavement as required. All wells will be secured with a brass Master Lock padlock. Upon completion, North Carolina Well Construction Records and as-built well diagrams will be prepared to provide site specific well construction information (refer to Appendix II).

The Type III monitoring wells will be installed in two phases, as follows:

- Boreholes will be advanced with hollow stem auger drilling techniques to a depth of approximately 40 feet BLS.

- The desired sections of six inch PVC pipe will be assembled and lowered to the bottom of the borehole.

- The six inch casing will be grouted into place and allowed to set for a minimum of 48 hours prior to installation of the two inch diameter well.

- Utilizing roller cone/dragbit drilling techniques, a five and 7/8 inch hole will be drilled through the grout in the six inch outer casing to a terminal depth of 50 feet BLS.

- A five foot length of two inch PVC screen will be installed to a depth of 50 feet BLS with two inch PVC riser to the surface.

- The lengths of all screen, riser sections and bottom plugs will be measured and recorded.

- Washed silica filter sand will be poured into the augers to construct a continuous filter pack which will extend from below the bottom of the well screen to a maximum of two feet above the slotted section. The depth to the sand pack will be frequently measured using a decontaminated, weighted fiberglass measuring tape.

- A two foot thick bentonite seal will be emplaced above the sand filter pack by pouring bentonite pellets into the borehole in the manner described above.

- The annular space above the bentonite seal will be tremie grouted from the bottom to within approximately three feet of land surface with neat cement grout.

- After allowing the grout to set, the concrete pad and well head cover will be constructed to complete the installation. The well head will be completed in accordance with the specifications for the Type II wells.

- Upon completion, North Carolina Well Construction Records and as-built well details will be prepared to provide site specific well construction information (refer to Appendix II).

The six inch diameter pumping test well will be of similar construction to the Type II monitoring wells except 20 feet of screen (instead of 15 feet) with riser to the surface will be utilized.

6.2.4 Monitoring Well Development

Well development will be performed no sooner than 24 hours after grouting is completed for Type II wells, or 48 hours for Type III wells and the pumping test well. Wells will be developed by continuous low yield pumping or bailing. As the wells are developed, ground water turbidity will be monitored as an indicator parameter and be noted visually and recorded. Well development will continue until the turbidity stabilizes. Water generated during the well development activities will be handled according to the procedures specified in Section 6.3.

6.2.5 Ground Water Level and Free Product Thickness Measurement

Measurements will be taken in all monitoring wells at the site no sooner than 48 hours after completion of well development activities. All monitoring wells will be measured on the same day. These measurements will be used to calculate hydraulic gradients, determine direction of ground water flow at the site, and estimate thickness of free product (if present) in the subsurface beneath the site.

Water level and free product thickness measurements will be performed using an electronic interface probe or steel tape with water/product finding pastes. The liquid levels will be measured by slowly lowering the instrument or tape into the well. When the probe reaches the water or free product surface, the circuit is completed and a buzzer is activated. A constant buzzing indicates free product while an intermittent buzzing indicates water. When the tape is inserted into the well, the liquid-specific pastes react with different fluids. The distance from the surveyed marker on the top of the well casing to the free product and/or water level is then measured and recorded. If free product is present, the thickness will be measured to the nearest 0.01 foot. Depth to water will also be measured to the nearest 0.01 foot. The measuring device will be decontaminated between wells by detergent wash and distilled water rinse. A complete set of water level measurements taken on the same day will be tabulated as shown in Table 1.

6.3 Disposal of Borehole Cuttings and Wastewater

Borehole cuttings will be containerized in drums and/or a roll-off box at or near the project site and covered to prevent entry of rainwater and exposure to windblown particles. Ultimate disposal of the material at a permitted facility will be based on analytical results and/or regulatory consultation. Development and purge water will also be containerized and removed to an off-site permitted facility. All soil and ground water shall be placed in DOT-approved containers and properly labeled prior to any shipment. Manifests will be prepared for all wastes shipped from the site. Wastes generated as part of this investigation will be removed within 48 hours of obtaining the necessary clearances.

6.4 Surveying

Horizontal and vertical locations of all top of casings, soil borings, and Hydropunch sampling points will be surveyed in reference to mean sea level. Surveys will be supervised by a registered land surveyor.

7.0 SAMPLE COLLECTION METHODOLOGY

The following sections describe the methods that will be utilized to collect soil and ground water samples for this project. All samples will be collected by personnel who are trained and experienced in sample collection procedures.

7.1 Hydropunch Ground Water Sample Collection

Collection of the shallow ground water samples (less than ten feet deep) will be accomplished by driving the Hydropunch through the unsaturated zone into the water-bearing zone as described in Section 6.1.1. The Hydropunch will then be opened by pulling back on the body of the tool to allow ground water to enter into the screened portion of the sample chamber. Samples will then be collected by lowering a small-diameter, decontaminated Teflon® bailer into the sample chamber.

One water sample will be collected at every Hydropunch location. All ground water samples collected will be immediately placed on ice and submitted to the on-site laboratory as described in Section 7.5. Ground water will be collected and placed in containers in accordance with the type of analyses scheduled for that sample as follows:

Analytical Method	Bottle Type and Size	Total Number of Bottles per Sample, On-Site Lab	Preservative
EPA 601	Glass Vial/40 ml	2	H_2SO_4
EPA 602	Glass Vial/40 ml	2	HCl

See Section 8.0 for the specific type and quantity of analyses that will be conducted for this project.

7.2 Test Boring Soil Sample Collection and Field Screening Methodology

Field screening will be conducted during drilling of the monitoring well borings to determine if organic vapors are present in the unsaturated zone and to identify areas of suspected near-surface releases. Soil samples for general site characterization will be obtained from the borings at regular intervals starting at 0.0 to 1.5 feet. The soil samples will be obtained using a split spoon sampler driven in accordance with ASTM D-1586. Soil samples will be described in the field by an engineer or geologist trained in using visual/manual techniques as described in ASTM D-2487 and D-2488. The soils will be classified in accordance with the Unified Soils Classification System (USCS) and a boring record of each borehole will be produced. A sample boring log used for final presentation is provided in Appendix II.

Each sample will be removed from the split spoon, divided, and placed in two pre-labeled, airtight, plastic bags. One bag will be immediately placed on ice pending selection of the appropriate laboratory sample depth. The second bag will be left undisturbed for several minutes to allow the organic vapors to reach equilibrium. The gas contained in the headspace of the bag will be tested with a PID or an OVA. The first laboratory sample will be taken from two to five feet deep, and the second from within five feet of the water table. All soil samples will be sent to the off-site laboratory. No change in screening or instrumentation will occur during the site investigation in order to enhance consistency of results unless the equipment is damaged and/or needs replacement.

All soil samples collected for laboratory analyses will be immediately placed on ice. Soil will be collected and placed into containers in accordance with the type of analyses scheduled for that sample as follows:

Analytical Method	Bottle Type and Size	Total Number of Bottles per Sample, Off-Site Lab	Preservative
TPH 5030/3550	Glass Separate Jar Amber Glass Wide Mouth/2 oz.	2 2	<4°C <4°C
Grain Size	Glass Wide Mouth/32 oz.	32 oz. total	NR
Flash Point EPA 1010	Amber Glass Wide Mouth/8 oz.	1	<4°C
Total Lead	Clear Glass Wide Mouth/8 oz.	1	<4°C
pH EPA 9045	Glass or Plastic/8 oz.	1	<4°C

NR = Not Required.

See Section 8.0 for the specific type and quantity of analyses that will be conducted for this project.

7.3 Monitoring Well Ground Water Sample Collection

The ground water sampling program has been developed to determine the magnitude and extent of contamination that may be present as a result of a petroleum fuel release at the project site. The sampling program will consist of purging the monitoring wells, and then collecting one ground water sample from each of the newly-constructed wells. Purging and sampling will proceed from the least contaminated areas to the highest contaminated areas based on observations made during the well installations, measurement of free phase product, and distance from the known source of contamination. The sampling program will include collection of samples for both on-site and off-site laboratory analysis; static ground water level measurements, and product thickness measurements.

The RC&A Well Sampling Worksheet will be used to record all measurements made during well purging and sampling (see Appendix II). This form was designed to be used as a checklist and as documentation for all ground water sampling activities for each individual well.

Each well will be purged prior to sample collection to draw new water into the well in an effort to collect samples that are representative of the surrounding aquifer. Three standing well volumes of water will be removed from each well. Wells that can be purged to dryness while purging less than three well volumes will be sampled as soon as the well has recovered to yield sufficient water volume for a sample. All purge water removed from the wells will be disposed in accordance with procedures for disposal of development water as described in Section 6.3 of this Workplan.

Well purging will be accomplished using pre-cleaned, disposable, Teflon® bailers. New nylon rope will be used at each monitoring well location. Care will be taken to prevent contact between the rope and the ground during well purging and sample collection. Purging techniques will be performed in accordance with recommended practices described in the North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities (Solid Waste Section, 1987). The volume of water to be purged is calculated using the following equation:

$$V = \pi r^2 h$$

where:

$\pi = 3.14159$
r = Radius of well casing
h = Height of water column in well (total well depth - depth to ground water prior to purging)
V = Volume of water in well (standing well volume)

Minimum purge volume = $V \times 3$

Samples will be collected immediately upon purging of the well in accordance with the following procedures:

- Chemical preservatives, if applicable, will be added to sample bottles by the laboratory.
- Sample bottles will be labeled prior to sample collection.
- Sample bottles will be filled directly from the Teflon® bailer or Hydropunch.
- Caps will be secured on bottles.
- Sample containers will be placed in plastic bags and the bags sealed.

All monitoring well ground water samples collected for laboratory analyses will be immediately placed on ice. Ground water will be collected and placed into containers in the following order based upon the type of laboratory analyses scheduled for that sample:

Analytical Method	Bottle Type and Size	Total Number of Bottles per Sample On-Site/ Off-Site Lab	Preservative
EPA 602	Clear Glass Vial/40 ml	2/2	HCl
EPA 601	Clear Glass Vial/40 ml	2/2	H_2SO_4
EPA 625	Amber Glass Jar/1 liter	NA/1	<4°C

NA = Not Applicable. Analysis not scheduled for off-site (EPA Method 610) or on-site (EPA Method 625) Laboratories.

See Section 8.0 for the specific type and quantity of analyses that will be conducted for this project.

7.4 Sample Identification

Prior to collecting each soil and ground water sample, sample bottles will be labeled with the following information:

- Date and time of sample collection;
- Project identification number;
- Sample location number;
- Initials of person collecting sample;
- Type of preservative added to sample; and
- Parameter(s) or parameter group to be analyzed.

Additional specific information, such as sampling interval, may be added. The sample location number on the label will correspond to the sample location numbers assigned on the field site map.

7.5 Chain of Custody and Transportation Procedures

Chain of Custody (COC) procedures will be followed to establish documentation of sample possession from the time of collection until completion of analysis for both the on-site and off-site laboratories. As few people as possible will handle the sample(s). The sampler will be responsible for the care and custody of the samples until they are delivered to the on-site laboratory or dispatched for shipment to the off-site laboratory. An accurate record of sample collection, transport, and analysis will be maintained and documented. A sample COC record is provided in Appendix II.

The COC Record will be used by personnel responsible for ensuring the integrity of samples from the time of collection to shipment to both the on-site and off-site laboratories. The laboratory will not proceed with sample analysis without a correctly prepared COC Record and Analytical Request Form. The laboratory will be responsible for maintaining COC of the sample(s) from time of receipt to disposal. COC procedures will be instituted and followed throughout the investigation.

The COC Record will be signed by each individual who has maintained custody of the samples. General preparation of the COC Record for samples to be delivered to the on-site and off-site laboratories will be as follows:

- Samples will be accompanied by a COC Record at all times.
- The COC Record will be initiated in the field by the person collecting the samples. Every sample will be assigned a unique identification number as described in Section 7.4 that is entered on the COC Record.
- The Record will be completed in the field identifying the project, sampler, RC&A assigned project number, etc.
- If the person collecting the sample does not transport the samples to the laboratory or deliver the sample containers for shipment, the first block for "Relinquished By ________________" will be signed by the sampler.
- The person transporting the samples to the laboratory or delivering them for shipment will sign the Record as "Relinquished By ____________".

7.5.1 Off-Site Laboratory

Collected soil and ground water samples will be transported on a daily basis by courier to GeoChem, Inc. in Morrisville, North Carolina. Prior to the start of the field investigation, necessary arrangements will be made with the laboratory to assure proper and prompt delivery and log in of the collected samples. Shipment and COC procedures are as follows:

- Samples will be packed properly for shipment so that bottles will not dislodge and/or break. The samples will be kept cool using either ice packs or ice in zip-lock bags.

- Samples will be transported each day via a GeoChem, Inc. courier.

- The COC record will be sealed in a watertight container and placed in the shipping container.

- The courier will double check the contents of the shipping container to assure that the samples are properly packed and the COC inventory is correct.

7.5.2 On-Site Laboratory

An on-site mobile laboratory will provide expedient analytical data to assist in determining the placement of additional sample locations. The mobile laboratory will be set up at a location central to other projects concurrently being conducted in the area. Relocation of the laboratory will be avoided once it is set up since it will involve a recalibration of instrumentation and set-up logistics which may delay the project schedule. Base personnel will pre-approve the proposed location of the mobile laboratory. Shipment and COC procedures are as follows:

- The samples will be packed properly for transport so that bottles will not dislodge/and or break. The samples will be kept cool using either ice packs or ice in zip-lock bags.

- Once the samples are properly packed, the container will be adequately secured for transport to the laboratory.

- The COC Record will be maintained as described in Section 7.5.

7.6 Equipment Decontamination

Equipment decontamination sites will be established by the MCB Environmental personnel prior to the initiation of drilling activities.

7.6.1 Drill Rig

The drill rig will be cleaned in accordance with the following guidelines:

- Drill rigs and all support equipment will be cleaned of excess grease, oils and caked-on soil prior to arrival at the site. Equipment which leaks fuel, coolant, or lubricants will not be used on site.
- Equipment such as pumps and pump lines will be flushed thoroughly with potable water prior to use.

7.6.2 Soil and Ground Water Sample Collection Equipment

Disposable Teflon® bailers used for ground water sampling will be disposed of after the sampling of each well.

Split spoons, Hydropunch sample probes, submersible well development pump equipment, and other sample collection equipment will be decontaminated between sample events as follows:

- Tap water rinse.
- Wash with phosphate-free detergent and tap water using a brush to remove any particulate matter or surface film.
- Tap water rinse.
- Rinse thoroughly with distilled water.
- Rinse with isopropanol.
- Allow to air dry or rinse with distilled water.
- Wrap completely with aluminum foil and seal in airtight plastic bags or place on clean plastic if planned for immediate reuse.

Hollow stem augers, rods, and other drilling equipment will be decontaminated between borings as follows:

- High temperature and pressure water rinse .
- If any noticeable petroleum hydrocarbon film is present, wash with phosphate-free detergent and tap water using a brush.
- High temperature and pressure tap water rinse.
- Allow to air dry.
- Place on and cover with clean plastic until next use.

7.6.3 Rinsate Sample Collection Methodology

Rinsate water samples will be collected for QA/QC purposes. Water from the same brand or batch of distilled water that is used in the decontamination process outlined above will be used to pour over previously decontaminated sampling equipment. The rinsate water will be collected in the sample bottles. The collected samples will be analyzed in accordance with the parameters listed in Section 8.0 to confirm that equipment decontamination is being conducted adequately and that no cross contamination is occurring between sample locations. If the rinsate samples detect any *contamination, a sample of the source rinsate water will be* collected and analyzed for the same laboratory parameters.

8.0 SAMPLE ANALYSIS

A majority of the samples collected during the investigation will be analyzed by the on-site mobile laboratory. The analytical methods for this project are outlined below and summarized in Tables 2 and 3 for both the off-site and on-site laboratories.

8.1 Off-Site Laboratory

Samples will be analyzed at GeoChem, Inc. in Morrisville, North Carolina. Analytical methods for soils include grain size analysis, TPH (EPA Methods 3550 and/or 5030), total lead, flash point, and pH. Ground water samples will be analyzed for purgeable aromatics (EPA Method 602), purgeable halocarbons (EPA Method 601), and base/neutrals (EPA Method 625). The number and type of samples to be analyzed and the types of analyses to be conducted are summarized in Table 2.

8.2 On-Site Laboratory

Samples submitted to the on-site laboratory will be analyzed for purgeable aromatics (EPA Method 602) and purgeable halocarbons (EPA Method 601). The number and type of samples to be analyzed and the types of analysis to be conducted are summarized in Table 3.

9.0 COLLECTION AND ANALYSIS OF AQUIFER CHARACTERISTICS DATA

9.1 Slug Tests

Subsequent to development and sampling of the shallow monitoring wells, three standard slug tests will be conducted on three Type II wells which do not contain free product. To perform the test, the static head of ground water will first be measured. A slug will be introduced into the monitoring well and allowed to equilibrate. Measurements of the water level will be taken at pre-determined time intervals and recorded. The recovery data will be analyzed by methods presented by Hvorslev (1951). The hydraulic conductivity (K) value will be calculated as follows:

$$K = \frac{r^2 \ln(L/R)}{2LT_0}$$

where: K = Hydraulic conductivity (ft/day)
r = Well radius (ft)
L = Sandpack length (ft)
R = Borehole radius (ft)
T_0 = Time required (time lag) for the recovering water level to be within 37 percent of the static water level.

9.2 Eight Hour Pumping Test

An eight hour pumping test will be conducted on the six inch diameter pumping well to determine the performance characteristics of the well and the hydraulic parameters of the aquifer. Yield and drawdown will be recorded so that the specific capacity of the well can be calculated. These data give a measure of the productive capacity of the well and provides information needed during the corrective action phase of the project. The pumping test will also provide data to determine the transmissivity and storage coefficient of the surrounding aquifer in order to predict time-related capture zones around pumping wells.

9.2.1 Pumping Test Procedures

Prior to the actual pumping test, the well will be pumped to determine the approximate well yield. This pre-test data is necessary to select the proper pump and establish the pumping rate to be used during the test. During the eight hour pumping test, a constant yield will be maintained, the drawdown in the surrounding monitoring wells will be accurately recorded at appropriate time intervals, and, after shutting down the pump, recovery data will be collected for comparative purposes. The eight hour pumping test water will be containerized and transported off-site to an approved treatment and disposal facility.

9.2.2 Pumping Well Sampling and Analysis

A water sample will be collected from the pumping test well and analyzed for purgeable aromatics (EPA Method 602) and purgeable halocarbons (EPA Method 601). This analytical data will be used to determine the ultimate disposition of the pumping test water.

9.2.3 Aquifer Parameter Determinations

The data collected during the pumping test will be used to calculate the storativity and transmissivity of the surrounding aquifer. These determinations will be made using the modified non-equilibrium equations by Cooper and Jacob after Theis where:

$$S = \frac{0.3\ T\ t_0}{r^2}$$

where:

- S = Storativity (dimensionless)
- T = Transmissivity, in gallons per day per foot
- t_0 = intercept of the straight line at zero drawdown, in days
- r = distance, in feet, from the pumping well to the observation point (monitoring well)

and: $$T = \frac{264\,Q}{\Delta s}$$

where:
- T = Transmissivity in gallons per day per foot
- Q = pumping rate, in gallons per day
- Δs = drawdown difference per log cycle of t

Hydraulic conductivity (K) will also be calculated from the pumping test data utilizing the most appropriate method.

10.0 EVALUATION OF ASSESSMENT DATA

An evaluation of the assessment monitoring data will be performed to establish and map the spatial boundaries of contaminant plume(s). Accomplishment of this objective will aid in: (1) identifying contaminant source area(s), migration pathways, and potential receptors; and, if necessary, (2) establishing a basis for corrective action strategies.

The initial step in the evaluation process involves data reduction. Analytical results will be reviewed and mapped to their respective sample locations. The following data will be presented in tabular form:

- Sampling point identification number (or quality control designation).
- Sampling date.
- Practical quantitation limit.
- Reported concentration.
- Reported approximate concentration, if below practical quantitation limit.

A quantitative ranking of constituent concentration/sampling point combination will be performed to identify likely source areas, delineate the approximate boundaries of the contamination plume, and establish concentration gradients of detected contaminants within the plume. Based on these results, horizontal and vertical limits of the plume area(s) and contaminant isopleth contours will be calculated for the project area.

11.0 ESTIMATION OF THE RATE OF CONSTITUENT MIGRATION

Ground water travel time or average linear ground water flow velocity will serve as the basis for estimating the rate of contaminant migration at the facility. Ground water flow rates should represent the maximum rate of contaminant migration with variations among contaminants due to geohydrochemical processes including molecular diffusion, mechanical mixing, sorption-desorption, ion-exchange, hydrolysis and biodegradation. However, due to the difficulties in estimating the effects of many of the processes on contaminant migration rates and the desire to produce relatively conservative (higher) estimates, only sorption processes will be incorporated into rate calculations.

Ground water flow velocities will be calculated using the following modification of Darcy's Law:

$$V = K/n_e(dh/dl)$$

where: K = Hydraulic conductivity (ft/day)
n_e = Effective porosity (unitless)
dh/dl = Hydraulic gradient (ft/ft)

Estimates of hydraulic conductivity will be determined from results of grain size distribution analyses of soil samples, slug tests, and pumping test calculations. Hydraulic gradients will be calculated from water level measurements obtained as described in Section 6.2.5.

Estimates of bulk density and porosity will be determined from results of visual/manual classification of soils and standard penetration resistance tests as described in Section 6.1.2. Average velocities of contaminant constituents will then be calculated in accordance with the following equation (USEPA, 1985):

$$v_c = v/R$$

where: v_c = Average velocity of contaminant constituent (ft/day)
v = Average linear ground water flow velocity (ft/day)
R = Retardation factor (unitless)

12.0 PROJECT SCHEDULE

A schedule for implementation of the Comprehensive Site Assessment Workplan, along with appropriate milestones, is exhibited in Appendix III. Where possible, one drill rig and Site Manager will be dedicated to the site throughout all of its phases of investigation.

13.0 REFERENCES

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Solid Waste Section, North Carolina Department of Environmental, Health and Natural Resources, North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities, Document No. SW-1001-87, 1987.

United States Environmental Protection Agency (USEPA), 1985. Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Groundwater - Parts I & II, Environmental Research Laboratory, Office of Research and Development, Athens, Georgia.

United States Environmental Protection Agency, 1986. Test Methods for Evaluating Solid Wastes (SW-846), 3rd Edition, Vol. II, Office of Solid Waste, Washington, DC.

TABLES

TABLE 1 WATER TABLE ELEVATIONS SUMMARY					
DATA POINT	TOP OF CASING ELEVATION	DEPTH TO WATER	FREE PRODUCT THICKNESS	SPECIFIC GRAVITY ADJUSTMENT	WATER TABLE ELEVATION

N/A = Not Applicable
NMT = No Measurable Thickness

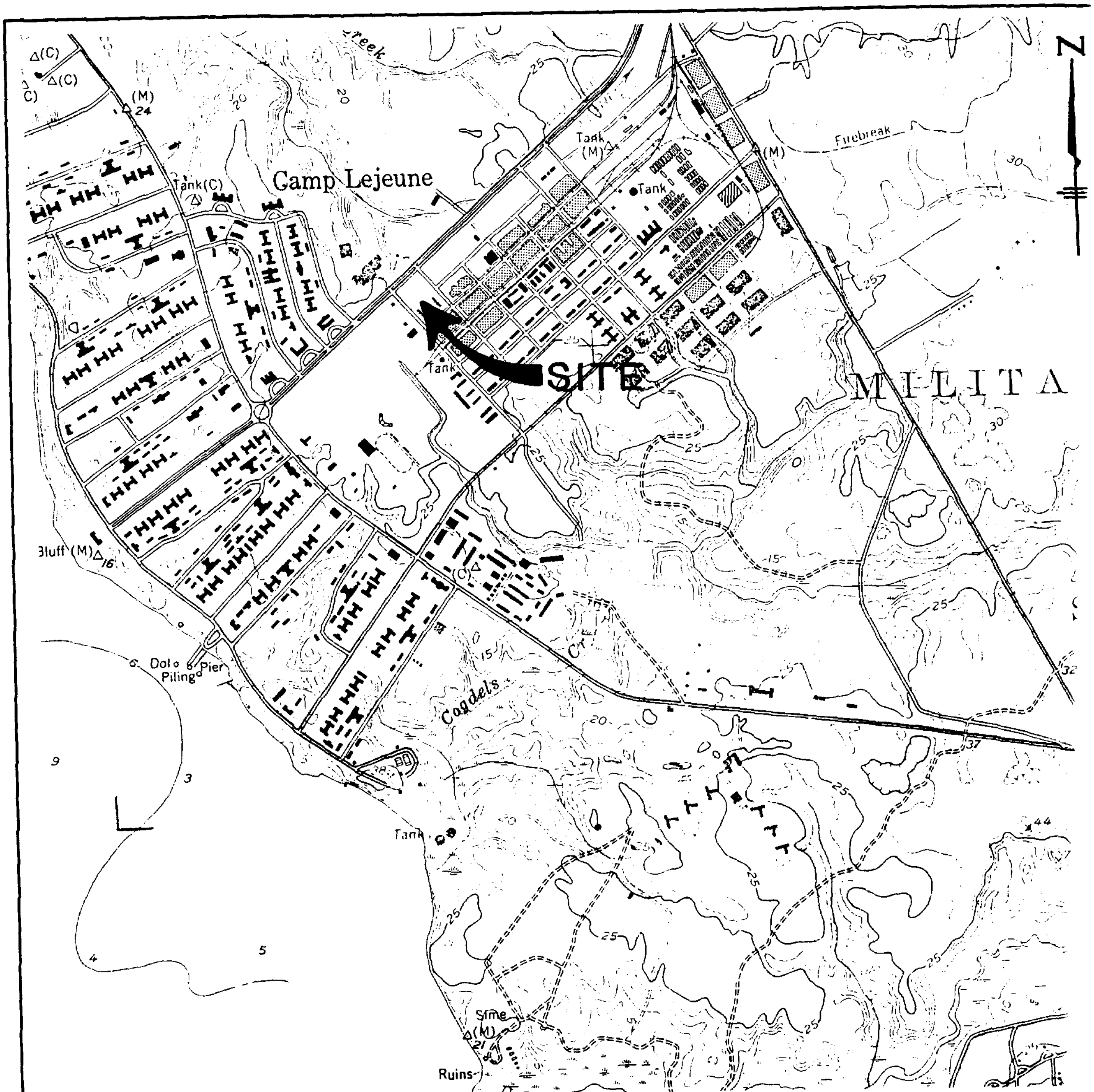
TABLE 2
SAMPLE ANALYSES SUMMARY TABLE
OFF-SITE LABORATORY

DATA POINT	NUMBER OF SAMPLE LOCATIONS	TOTAL ANALYSIS QUANTITY											
		SOIL							WATER				
		TPH 3550 / 5030	TPH 9071	8021	TOTAL LEAD	FLASH POINT	PH	GRAIN SIZE	601	602	610	625	8 RCRA METALS
Hydropunch Penetrometers	0	--	--	--	--	--	--	--	--	--	--	--	--
Pumping Well	1	2	--	--	1	--	--	1	1	1	--	--	--
Type II Wells/Borings	12	24	--	--	3	2	2	2	12	12	--	3	--
Type III Wells/Borings	3	6	--	--	--	--	--	--	3	3	--	--	--
Duplicate	2	2	--	--	--	--	--	--	1	1	--	--	--
Trip Blank	1	--	--	--	--	--	--	--	1	1	--	--	--
Waste Soil	1	1	--	--	1	1	1	--	--	--	--	--	--
Waste Water	1	--	--	--	--	--	--	--	1	1	--	1	--
TOTAL SAMPLES		35	--	--	5	3	3	3	19	19	--	4	--

TABLE 3
SAMPLE ANALYSES SUMMARY TABLE
ON-SITE LABORATORY

DATA POINT	NUMBER OF SAMPLE LOCATIONS	TOTAL ANALYSIS QUANTITY											
		SOIL							WATER				
		TPH 3550 / 5030	TPH 9071	TPH 8021	TOTAL LEAD	FLASH POINT	PH	GRAIN SIZE	601	602	610	625	8 RCRA METALS
Hydropunch Penetrometers	15	--	--	--	--	--	--	--	15	15	--	--	--
Pumping Well	0	--	--	--	--	--	--	--	--	--	--	--	--
Type II Wells/Borings	0	--	--	--	--	--	--	--	--	--	--	--	--
Type III Wells/Borings	0	--	--	--	--	--	--	--	--	--	--	--	--
Duplicate	2	--	--	--	--	--	--	--	2	2	--	--	--
Trip Blank	0	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL SAMPLES		--	--	--	--	--	--	--	17	17	--	--	--

FIGURES



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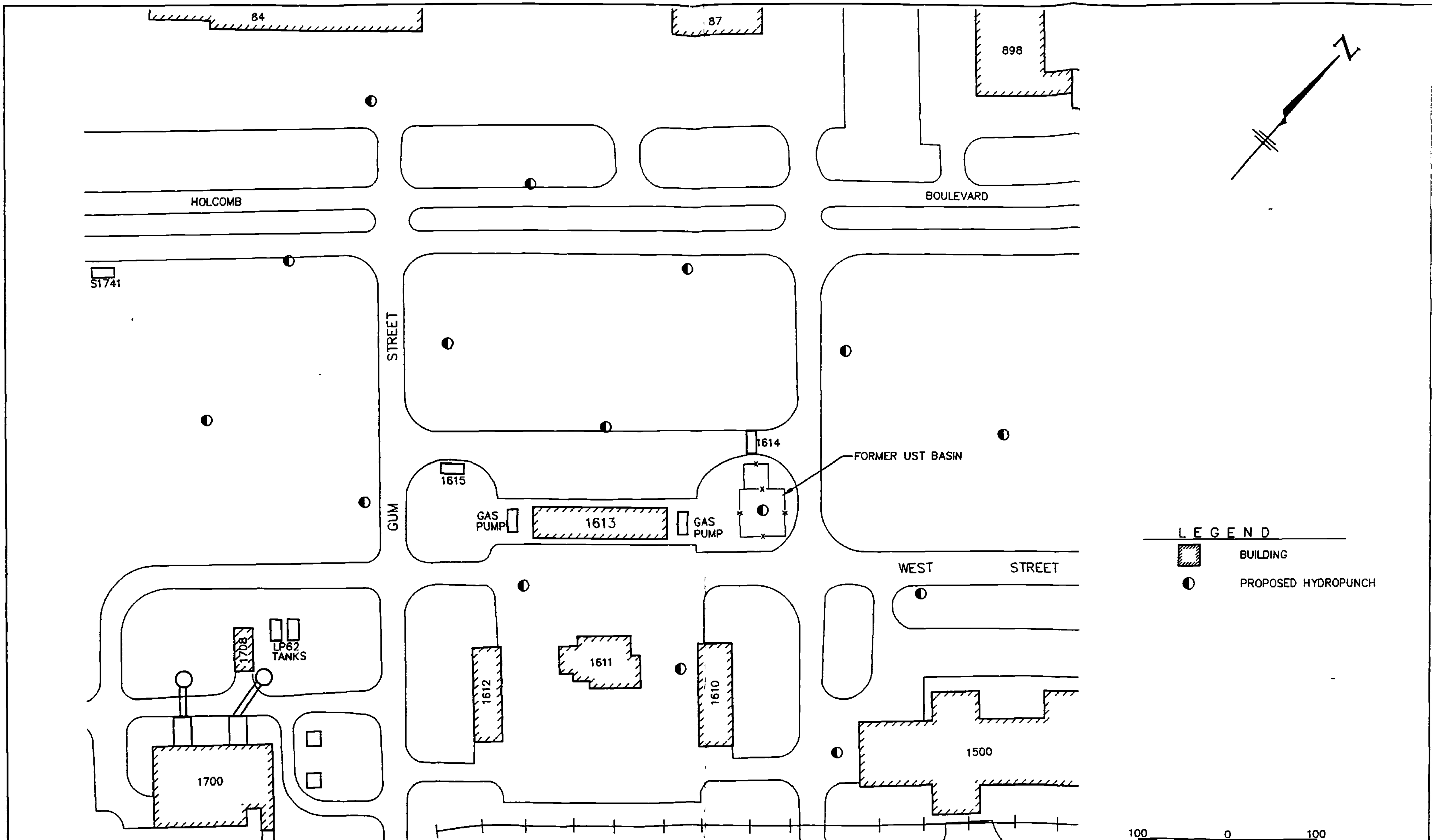
Richard Catlin & Associates, Inc. RC&A ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS WILMINGTON, NC CHARLESTON, SC ATLANTA, GA MOORESVILLE, NC	PROJECT BLDG 1613 1-4 LANTDIV NAVFACENGCOM CAMP LEJEUNE, NC	TITLE GENERAL LOCATION USGS TOPOGRAPHIC QUADRANGLE
	JOB NO: 94127 DATE: MAR 1995	SCALE: AS SHOWN DRAWN BY: WHW CHECKED BY: JC



Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS RC&A WILMINGTON, NC CHARLESTON, SC ATLANTA, GA MOORESVILLE, NC	PROJECT BUILDING 1613 1-4 LANTDIV NAVFACENGCOM CAMP LEJEUNE, N.C.	TITLE SITE MAP WITH PROPOSED HYDROPUNCH LOCATIONS	FIGURE 2
	JOB NO. 94127-NS DATE: MAR 1995	SCALE: 1"=100 DRAWN BY: WHW CHECKED BY: JC	

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APPENDICES

APPENDIX I
SITE SPECIFIC HEALTH & SAFETY PLAN

PETROLEUM HYDROCARBON
SITE SPECIFIC HEALTH & SAFETY PLAN

PREPARED FOR:
BUILDING 1613, USTs 1613 1-4
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

PREPARED BY:
RICHARD CATLIN & ASSOCIATES, INC.

PREPARATION DATE:
MARCH 8, 1995
RC&A JOB NO.: 94127-F

COPIES TO: ______________________________ DATE: ______________
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COPIES TO: ______________________________ DATE: ______________

The undersigned have read the Site Specific Health and Safety Plan and are familiar with its provisions:

Signature	Date	Signature	Date

AMENDMENTS/REVISIONS MUST BE APPROVED BY PLAN AUTHOR PRIOR TO IMPLEMENTATION OF EACH AMENDMENT.

AMENDMENT NUMBER	EFFECTIVE DATE	SUBJECT

APPROVED: Teri M. Piver DATE: 03/08/95
Health & Safety Manager

PLAN AUTHOR: Teri M. Piver DATE: 03/08/95

PETROLEUM HYDROCARBON
SITE SPECIFIC HEALTH & SAFETY PLAN

BUILDING 1613, USTs 1613 1-4
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA
MARCH 8, 1995

1.0 INTRODUCTION

This section of the Site Health and Safety Plan (HASP) document defines general applicability and general responsibilities with respect to compliance with Health and Safety programs.

1.1 Scope and Applicability of the Site Health & Safety Plan

The purpose of this Site Health and Safety Plan is to define the requirements and designate protocols to be followed at the Site during investigation and remediation activities. Applicability extends to all employees, contractors, and subcontractors.

All personnel on site, contractors and subcontractors included, shall be informed of the emergency response procedures and any potential fire, explosion, health, or safety hazards of the operation. This HASP summarizes these hazards and defines protective measures planned for the site.

This plan must be reviewed and an agreement to comply with the requirements must be signed by all personnel prior to entering the exclusion zone or contamination reduction zone.

During development of this plan consideration was given to current safety standards as defined by Environmental Protection Agency/Occupational Safety and Health Administration/National Institute of Occupational Safety and Health (EPA/OSHA/NIOSH), health effects and standards for known contaminants, and procedures designed to account for the potential for exposure to unknown substances. Specifically, the following reference sources have been consulted:

- OSHA 29 CFR 1910.120 and EPA 40 CFR 311
- U.S. EPA, Office of Emergency and Remedial Response, Environmental Response Team (OERR ERT) Standard Operating Safety Guidelines
- NIOSH/OSHA/USCG/EPA Occ. Health and Safety Guidelines
- American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values
- U. S. EPA OERR ERT, Health and Safety Plan (HASP), version 3.0

2.0 PROJECT ORGANIZATION/ KEY PERSONNEL:

The following personnel are designated to carry out the stated job functions. (Note: One person may carry out more than one job function.)

RC&A Project Manager: Rick Catlin
RC&A Safety Manager: Teri Piver
RC&A Field Team Leader: Tom Landis/Steve Hudson
RC&A Field Team Members: Rick Catlin, Tommy Chalmers, Don Cummings, Ira Hines, Steve Hudson, Tom Landis, Tim Lupo, Mike Mason, Alan Melton, Bill Miller, Amy Myers, Teri Piver, and Israel West.

RC&A Public Information Manager: Rick Catlin
Security Officer: Not applicable
Subcontractors: Not applicable

3.0 SITE CHARACTERIZATION:

3.1 Location:

(Refer to Figure 1)

Building 1613 is located in the Hadnot Point Industrial area of the MCB, Camp Lejeune, North Carolina.

3.2 Type/Description of Site:

(Refer to Figure 2)

Active retail fuel dispensing facility. Closure of underground storage tanks (USTs) containing various species of petroleum were removed in January 1995. Information regarding number of USTs removed, sizes, and contents was not available at the time of health and safety plan preparation.

3.3 Activities Performed on Site Prior to Investigation/Cleanup:

Permanent closure of the USTS was performed January 1995.

3.4 Unusual Features (Containers, Buildings, Dikes, Power Lines, Terrain, Bodies of Water, etc.):

Above and below ground utilities may be present; vehicular traffic.

3.5 Results of Previous Surveys:

The UST closure report and closure data were not available at the time of health and safety plan preparation.

3.6 Waste Types (Liquid, Solid, Gas Vapor):

Potential for petroleum impacted soil, ground water, and/or vapors. Free product has been identified at the site.

3.7 Characteristics:

Toxic _X_ Flammable/Volatile _X_ Reactive ____
Radioactive ____ Corrosive ____ Ignitable ____
Biological Agent ____ Combustible ____

3.8 Hazard Evaluation:

3.8.1 Chemicals (known or suspected):
(Refer to Appendix I)

CHEMICAL	PEL	STEL	IDLH
Diesel	NE	NE	NE
Gasoline	300 ppm	500 ppm	NE

Notes:

PEL- Permissible Exposure Limit
STEL- Short Term Exposure Limit
IDLH- Immediately Dangerous to Life and Health
NE- No Evidence that an Exposure Limit has been Established

3.8.2 Task Specific Physical Hazards

Hazards at the site may be associated with several job tasks detailed in the site workplan. Listed below are summaries for the hazards associated with each of the tasks.

Task Site Reconnaissance/Surveying

Chemical

- Ingestion of contaminated material from hand to mouth contact.

Physical/Environmental

- Slips/trips/falls-sloped, uneven terrain.
- Skin irritation from contact with insects and vegetation.
- Interaction with native and potentially hostile animal life.
- Thermal stress.
- Vehicular traffic.

Task Soil Boring/Hypdropunch/Monitoring Well Installation

Chemical
- Potentially-contaminated mud, etc. in eyes and on skin.
- Contact with potentially contaminated material.
- Ingestion of potentially contaminated material from hand to mouth contact.
- Inhalation of volatile or semivolatile contaminants.
- Inhalation of fumes (carbon monoxide) from drill rig.

Physical/Environmental
- Heavy objects landing on foot/toe or head.
- Elevated noise levels from heavy equipment operation.
- Slips/trips/falls-sloped, uneven terrain.
- Skin irritation from contact with insects and vegetation.
- Overhead hazards, moving parts, and high pressure hydraulic lines from drill rig operations.
- Underground/above ground utilities.
- Lifting hazards.
- Thermal stress.
- Vehicular traffic.

Task Hydropunch/Monitoring Well Sampling/Monitoring

Chemical
- Skin contact with potentially contaminated water.
- Eye contact from splashing water.
- Ingestion of potentially contaminated materials from hand to mouth contact.
- Inhalation of volatile compounds emitting from the well opening.

Physical/Environmental
- Skin irritation from contact with insects and vegetation.
- Lifting hazards (bailers, pumps, generators).
- Cuts from using knives to cut bailer rope.
- Slips/trips/falls-sloped, uneven terrain.
- Thermal stress.
- Vehicular Traffic.
- Electrical hazards associated with use of electrical equipment around water or wet surfaces.

3.8.3 General Physical Hazards

Confined Space Entry

It is not anticipated that there will be a need for a confined space entry procedure during the site activities. However, confined space entry procedures may have to be implemented if a "permit required confined space" (as defined by OSHA) has the following characteristics:

- Contains or has known potential to contain a hazardous atmosphere.
- Has limited or restricted means of entry.
- Is large enough that an employee can bodily enter and perform work,
- Contains material with potential for engulfment.
- Contains any other recognized serious safety or health hazard.

Before any operation is to be performed in a confined space, the Safety Manager must be contacted. Procedures are detailed in Appendix III.

Thermal Stress/Cold Stress

Provisions for monitoring heat stress and/or cold stress are detailed in Appendix III.

Explosion and Fire

In general, the following items present potential physical hazards and will be monitored closely.

- Explosion and fire resulting from:
  - Heavy equipment malfunction
  - Penetration into underground utilities
  - Ignition of trapped flammable vapors
  - Vehicular accidents

Noise

Excessive noise levels may be produced during equipment operation and by aircraft. Depending on the length and duration of these activities, hearing protective devices may be required.

Radiation Hazards

Radiation hazards are not anticipated during site activities; therefore, radiation monitoring is not required.

Hazardous Flora

Contact by individuals with poisonous/thorny plants is possible. Bare skin should be covered as much as is practical when working in forested areas. Rashes and other injuries should be reported to the Safety Manager as soon as they are known.

Hazardous Fauna

All animal life should be treated with respect. Without proper training, individuals may not be able to differentiate between dangerous and nondangerous species.

Insects such as mosquitoes and gnats pose a nuisance and physical hazard to field personnel. As a nuisance, they distract workers, leading to accidents. Perfumes and scented deodorants should be avoided. Donning light colored clothing is preferable.

There is potential to come into contact with other dangerous insects, such as, fire ants, chiggers, bees, wasps, hornets, mites, fleas, spiders, and ticks. All personnel should perform checks, periodically during and at the end of each work shift, to inspect for the presence of insects or insect bites.

Poisonous snakes such as copperheads, rattlesnakes, and water moccasin (pit vipers), are common to the southeast United States. When encountering a snake, avoid quick/jerky motions, loud noises, and retreat slowly. Do not provoke the snake.

4.0 SITE ORGANIZATION AND CONTROL: Refer to Appendix II

4.1 Work Zones

Work Areas Identified
(Refer to Figure 2)

Areas identified in and around the former USTs. Figure 2 illustrates the proposed Hydropunch locations. Investigative perimeters will be established during initial site walk-over, prior to commencement of field activities.

Decontamination Areas Identified

Temporary decontamination area to be established prior to initiation of field activities. The decontamination area will be set up in an area mutually agreed upon by RC&A and MCB personnel.

Support Areas Established

Support areas will be located upwind from the work zone.

4.2 Site Access

Access areas will be established following the initial site walk-over, but prior to commencement of field activities.

4.3 Site Conditions

Anticipated weather conditions include moderate temperatures and rain.

5.0 JOB ACTIVITIES/ WORK PLANS:

Types of Activities to be Performed:

Install 15 Hydropunches, 12 Type II wells, three Type III wells, and one pumping well, develop monitoring wells, collect soil and ground water samples, perform aquifer tests, and survey.

6.0 EDUCATION AND TRAINING:

Training Requirements:

40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) and 8-hour HAZWOPER refresher in accordance with 29 CFR 1910.120 where required.

7.0 MEDICAL SURVEILLANCE:

Medical Monitoring Requirements:

RC&A medical monitoring program in accordance with 29 CFR 1910.120.

Avoid frequent or prolonged skin contact with petrochemicals. Monitor skin and eyes for dermatitis, allergic reaction, and eye irritation. If these or other symptoms develop, seek qualified medical attention. Workers with histories of liver, kidney, or nervous system disorders should be advised as to possible increased risk.

Symptoms of Acute Exposure to Volatile Organics: High vapor levels can cause irritation of the respiratory tract, headaches, nausea and mental confusion. Loss of consciousness occurs with very high concentrations. Liquid contact with skin may cause defatting, drying and irritation. Both vapor and liquid phases are irritating to the eyes.

Heat stress will be monitored in accordance with the contingency plan provided in Appendix III.

8.0 AMBIENT FIELD MONITORING:

8.1 Field Monitoring Equipment Needed for this Site:
Photoionization detector (PID) or flame ionization detector (FID).

8.2 Monitoring Protocol:

Breathing Zone: Ambient air monitoring for the presence of volatile organic compounds (VOCs) will be performed using a PID or FID. Testing will be conducted initially (at the start of job task) and periodically (when site conditions or set-up changes warrant). The following guidelines should be consulted to determine protection levels.

- Background to 1 ppm above background = Level D
- > 1 ppm to 5 ppm above background for greater than five continuous minutes = Level C
- > 5 ppm above background for up to 15 continuous minutes = Stop work and consult the Safety Manager
- Instantaneous peak concentrations > 50 ppm = Stop work and consult the Safety Manager

9.0 CLOTHING AND PROTECTIVE GEAR

In general, most work will be performed in Level D protective gear unless conditions warrant more protective attire. Level D is the minimum protection clothing as established by OSHA. Typically Level D consists of steel-toe protective work boots, protective eyewear (goggles or glasses), hard hats, nitrile outer gloves, vinyl or latex inner gloves, and hearing protection. Should conditions warrant, full face respirators with proper cartridges, chemical-resistant coveralls (tyvek), and splash suits shall be available.

- *Job Activity:* Site reconnaissance/Surveying

  Level: D

  Monitoring Protocol: None required

  List of PPE: Steel toe impermeable safety boots, safety goggles, gloves, hard hat, and hearing protection.

- *Job Activity:* Drilling/Well Installation/Hydropunch

  Level: D unless conditions warrant, then Level C

  Monitoring Protocol: Monitor breathing zone with PID/FID

  List of PPE: Steel toe impermeable safety boots, hard hat with face shield or safety goggles, hearing protection, splash suit, outer gloves, inner gloves, tyvek coveralls, hearing protection, full face respirator with proper cartridges.

- *Job Activity:* Monitoring Well Development/Sampling/Monitoring

  Level: D unless conditions warrant, then Level C.

  Monitoring Protocol: Monitor breathing zone with PID/FID

  List of PPE: Steel toe impermeable safety boots, hearing protection, hard hat with face shield or safety goggles, splash suit (optional), outer gloves, inner gloves, tyvek coveralls, hearing protection. Tyveks may be optional depending on the potential for skin contact with free product and/or contaminated soil, full-face respirator with proper cartridges.

10.0 SAFETY EQUIPMENT LIST:

First Aid: Small - medium industrial First Aid Kit

Fire Fighting: "No Smoking" signs, ABC type Fire Extinguisher

Communications (Radios/Signs): Barricade tape/traffic cones to keep people out of work area, if necessary.

Personal Protective Equipment: MSHA/NIOSH approved full face air purifying respirator with organic vapor cartridges, hard hats, face shields or safety goggles gloves, hearing protection, steel toe impermeable boots, hearing protection, splash suit (optional), tyvek (optional).

Decontamination Equipment: Potable water, non-phosphate soap, alcohol rinse, steam cleaner.

11.0 DECONTAMINATION PROCEDURES:

- *Work Activities:* Drilling/Hydropunch equipment

  Level of Protection: D (tyvek and/or splash suit)

  Decontamination Solutions: Steam cleaner or high pressure wash

  Procedures (By Station): Steam wash or pressure wash off dirt and product residue from equipment. May require soapy water wash.

- *Work Activities:* Personal Decontamination

  Level of Protection: D

Decontamination Solutions: Non-phosphate soap, potable water

Procedures (By Station): Wash boots and outer gloves; change product contaminated clothing immediately. Wash contaminated skin surfaces.

12.0 CONTINGENCY PLANS:

(Refer to Appendix III)

12.1 Local Sources of Assistance:

FACILITY	PHONE NUMBER	CONTACT
Police	911 or (910) 451-4555	MCB Police
Fire	911	MCB Fire Department
Ambulance (On-Base)	911	Naval Regional Medical Center
Ambulance (Off-Base)	(910) 455-9119	Onslow Memorial Hospital
Hospital (On-Base)	911 or (910) 451-4551	Naval Regional Medical Center
Hospital (Off-Base)	(910) 577-2240	Onslow Memorial Hospital
Emergency	911	MCB Dispatch
MCB EMD	(910) 451-5063	N. Neal Paul
RC&A	1-800-346-7360 (910) 452-5861	Rick Catlin

12.2 Special First Aid or Evacuation Procedures:

Provide basic first aid procedures as required and note time and circumstances of injuries. In the event of serious injury or emergency, the Naval Regional Medical Center, Brewster Boulevard, will be used (see Figure 1). Minor injuries and non-emergency cases should be treated off-base at Onslow Memorial Hospital, 317 Western Boulevard in Jacksonville, North Carolina (see Figure 1).

In the event of potential or actual fire or explosion, evacuate the area immediately. Notify the fire department. DO NOT attempt to fight the fire. Notify project manager and Mr. N. Neal Paul immediately.

EMERGENCY PROCEDURES (Petroleum Products):

Skin-	Wash with soap and water, rinse well
Inhalation-	Move to fresh air at least 50 feet upwind from vapor source. Seek qualified medical attention
Eyes-	Flush for a minimum of ten minutes with clean water while holding eye open. Seek qualified medical attention.
Ingestion-	Do not induce vomiting. If conscious, give water or milk to drink. Seek qualified medical attention.

12.3 National or Regional Sources of Assistance:

• *Richard Catlin & Associates, Inc.*	1-910-452-5861 1-800-346-7360
• *EPA RCRA/Superfund Hotline*	1-800-424-9346
• *Chemtrec (24 Hours)*	1-800-424-9300
• *Bureau of Explosives (24 Hours)* (Association of American Railroads)	1-202-293-4048
• *Communicative Disease Center* (Biological Agents)	1-404-633-5313
• *National Response Center, NRC* (Oil/Hazardous Substances)	1-800-424-8802
• *US DOT, Office of Hazardous Operations* US DOT, (Regulatory Matters)	1-202-426-0656 1-202-426-9280
• *US Coast Guard (Major Incidents)*	1-800-424-8802
• *Poison Control Center*	1-800-672-1697
• *National Agricultural Chemical Association*	1-513-961-4300

13.0 AMENDMENTS TO SITE SPECIFIC HEALTH & SAFETY PLAN

13.1 This Site Specific Health & Safety Plan is based on information available at the time of preparation. Unexpected conditions may arise. It is important that personnel protective measures be thoroughly assessed by the RC&A Field Team Leader prior to and during the planned activities. Unplanned activities and/or changes in the hazard status should initiate a review of and may initiate changes in this plan.

13.2 Changes in the hazard status or unplanned activities are to be submitted on "Amendments to Site Specific Health and Safety Plan" which is included.

13.3 Amendments must be approved by the Safety Manager prior to implementation of amendment.

AMENDMENTS TO SITE SPECIFIC HEALTH AND SAFETY PLAN

Changes in field activities of hazards:

Proposed Amendment:

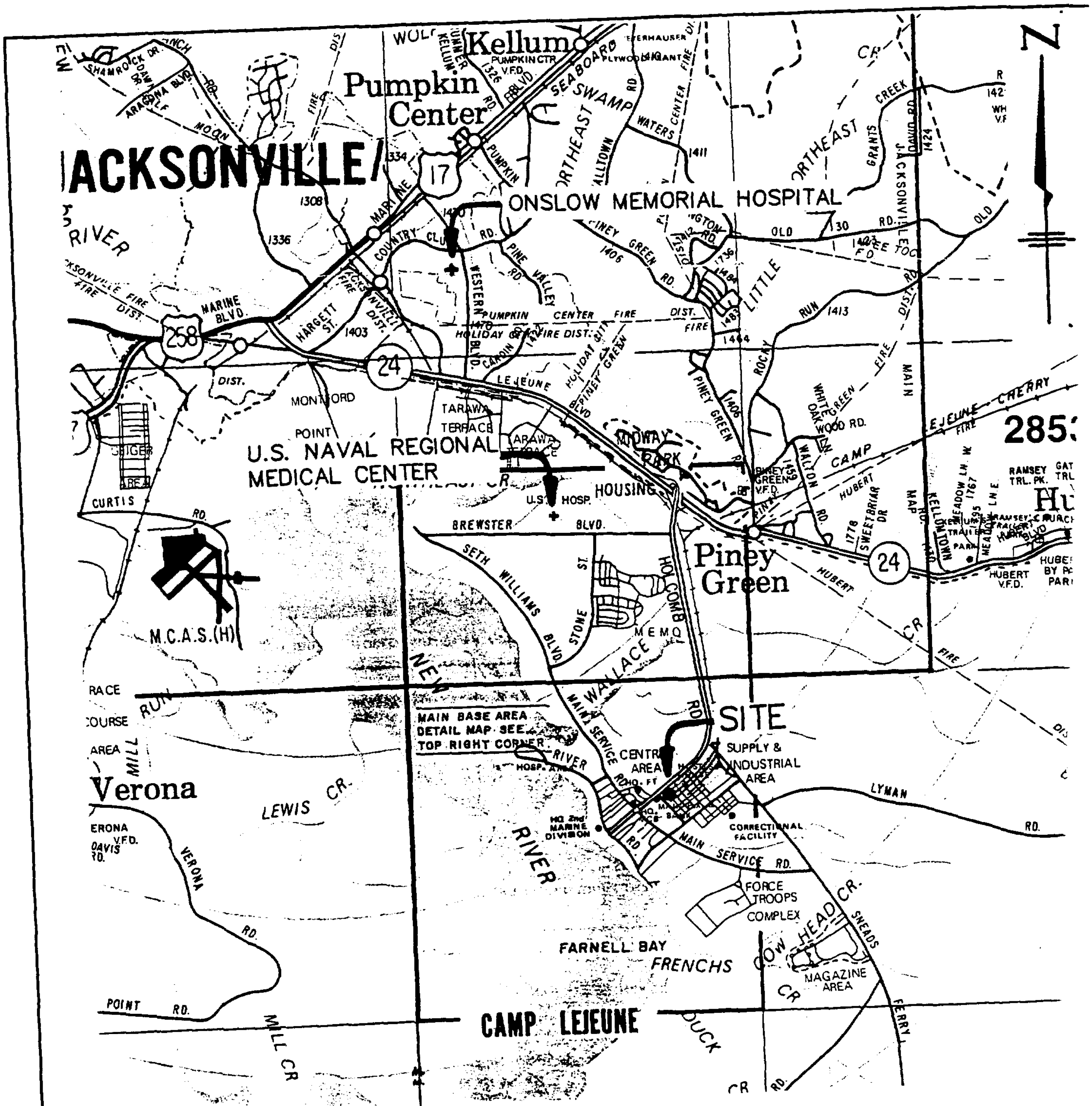
Proposed By:
Date:

Approved By:

Accepted:
Declined:

Amendment Effective Date:

FIGURES



Published 1989

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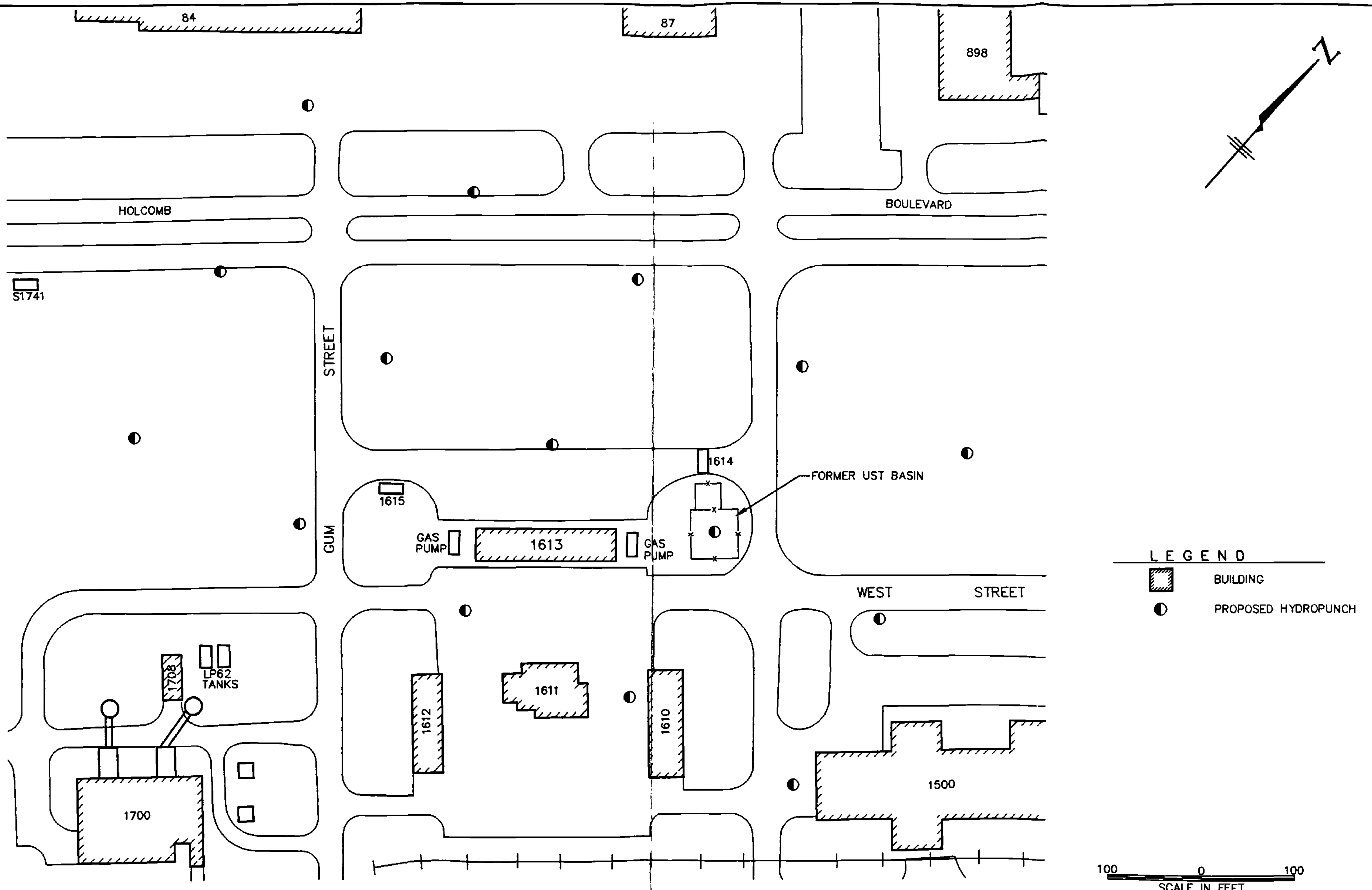
Approximate SCALES OF MILES

ONSLOW COUNTY

Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS RC&A CHARLESTON, SC ATLANTA, GA MOORESVILLE, NC	PROJECT BLDG 1613 1-4 LANTDIV NAVFACENGCOM CAMP LEJEUNE, NC	TITLE HOSPITAL AND EVACUATION ROUTES
	JOB NO: 94127 DATE: MAR 1995	SCALE: AS SHOWN DRAWN BY: WHW CHECKED BY: JC



Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS RC&A WILMINGTON, NC CHARLESTON, SC ATLANTA, GA MOORESVILLE, NC	PROJECT BUILDING 1613 1-4 LANTDIV NAVFACENGCOM CAMP LEJEUNE, N.C.	TITLE SITE MAP WITH PROPOSED HYDROPUNCH LOCATIONS	FIGURE 2
	JOB NO. 94127-NS DATE: MAR 1995	SCALE: 1"=100 DRAWN BY: WHW CHECKED BY: JC	

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APPENDIX I

PETROLEUM SUBSTANCES
SUBSTANCE INFORMATION FORMS
MATERIAL SAFETY DATA SHEETS

PETROLEUM SUBSTANCES

INTRODUCTION

During work involving petroleum products, workers may be exposed to petroleum hydrocarbon liquids, vapors or wastes. Petroleum substances in liquid or vapor form are a highly complex mixture of hydrocarbons and additives in varying concentrations. Gasoline for instance, is comprised of over 200 components. Due to the complexity of gasoline and diesel fuel, no firm standards for recommended occupational health and safety have been established. Never the less, health precautions should be taken to minimize exposure to the various petroleum forms.

TOXICITY CONSIDERATIONS

Tests have shown that prolonged or repeated exposures to petroleum substances, in liquid or vapor form, may cause serious illness including cancer in laboratory test animals. High concentrations of inhaled petroleum product components may cause a variety of symptoms including dizziness, intoxication, excitement or unconsciousness (API, 1987). Some petroleum product components may be toxic and care should be exercised to minimize exposure to these substances. When working with or around petroleum substances the ambient air quality should be monitored in the breathing zone by means of an organic vapor detector, oxygen meter, explosimeter and/or colorimetric tubes. However, other aromatic hydrocarbons may become contaminated with benzene during the distillation process and benzene-related health effects should be considered when exposure to any of these agents is suspected (NIOSH, 1985).

The following general health precautions are recommended:

1. Minimize skin contact and breathing of vapors;

2. Keep petroleum projects away from eyes, skin and mouth; and

3. Keep work areas well ventilated.

New Jersey Department of Health
HAZARDOUS SUBSTANCE FACT SHEET

Common Name: **GASOLINE**

CAS Number: 8006-61-9
DOT Number: UN 1203

RTK Substance number: 0957
Date: July 1986

HAZARD SUMMARY

* Gasoline can affect you when breathed in and by passing through your skin.
* Gasoline should be handled as a carcinogen--with extreme caution.
* High exposures during pregnancy may damage the developing fetus.
* It can cause you to feel dizzy, and irritate the nose and throat. Higher levels can cause irregular heartbeat, seizures, and even death.
* *Exposure may damage the kidneys.
* Exposure to Gasoline can expose you to toxic additives (such as *Benzene*, *Tetraethyl Lead* and *Ethylene Dibromide*).
* Gasoline is a HIGHLY FLAMMABLE LIQUID and a DANGEROUS FIRE HAZARD.

IDENTIFICATION

Gasoline is a clear liquid with a characteristic odor. It is used as a fuel for internal combustion engines, (cars, and planes), and as a solvent.

REASON FOR CITATION

* Gasoline is on the Hazardous Substance List because it is cited by ACGIH, NFPA, and DOT.
* This chemical is on the Special Health Hazard Substance List because it is FLAMMABLE.
* Definitions are provided on page 5.

HOW TO DETERMINE IF YOU ARE BEING EXPOSED

* Exposure to hazardous substances should be routinely evaluated. This may include collecting air samples. Under OSHA 1910.20, you have a legal right to obtain copies of sampling results from your employer. If you think you are experiencing any work-related health problems, see a doctor trained to recognize occupational diseases. Take this Fact Sheet with you.
* Gasoline causes eye and throat irritation at 160-270 ppm. This irritation only serves as a warning of exposure. Not experiencing it does not mean you are not being exposed.

WORKPLACE EXPOSURE LIMITS

ACGIH: The recommended airborne exposure limit is 300 ppm averaged over an 8-hour workshift and 500 ppm as a STEL (short term exposure limit).

* The above exposure limits are for air levels only. When skin contact also occurs, you may be overexposed, even though air levels are less than the limits listed above.
* Gasoline may be a CARCINOGEN in humans. There may be no safe level of exposure to a carcinogen, so all contact should be reduced to the lowest possible level.

WAYS OF REDUCING EXPOSURE

* Where possible, enclose operations and use local exhaust ventilation at the site of chemical release. If local exhaust ventilation or enclosure is not used, respirators should be worn.
* Wear protective work clothing.
* Post hazard and warning information in the work area. In addition, as part of an ongoing education and training effort, communicate all information on the health and safety hazards of Gasoline to potentially exposed workers.

This Fact Sheet is a summary source of information of all potential and most severe health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

HEALTH HAZARD INFORMATION

Acute Health Effects

The following acute (short-term) health effects may occur immediately or shortly after exposure to **Gasoline**:

* Exposure can cause irritation of the nose and throat. Higher levels cause headaches, nausea, and poor coordination. Very high levels can cause seizures, coma, and even death.
* Contact can cause eye and skin irritation.

Chronic Health Effects

The following chronic (long-term) health effects can occur at some time after exposure to **Gasoline** and can last for months or years:

Cancer Hazard

* There is limited evidence that **Gasoline** causes cancer in animals. It may cause cancer of the kidney.

Reproductive Hazard

* High exposure during pregnancy may damage the developing fetus.

Other Long-Term Effects

* Repeated exposure may cause poor appetite, weakness, muscle weakness, cramps, and possible brain damage.
* Repeated high exposure may damage the lungs.
* Prolonged contact can cause a rash with drying and cracking of the skin. **Gasoline** may cause a skin allergy. If allergy develops, very low future exposures can cause itching and a skin rash.
* Exposure may damage the kidneys.
* Repeated exposure may cause permanent eye damage.
* Since **Gasoline** often contains *Lead* and *Benzene*, these can also cause toxic effects. *CONSULT THE FACT SHEETS ON TETRAETHYL LEAD, BENZENE* and *ETHYLENE DIBROMIDE.*

MEDICAL

Medical Testing

If symptoms develop or overexposure has occurred, the following may be useful:

* Urinary *Lead* level.
* Evaluation by a qualified allergist, including careful exposure history and special testing, may help diagnose skin allergy.
* Liver function tests.

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are not a substitute for controlling exposure.

Request copies of your medical testing. You have a legal right to this information under OSHA 1910.20.

WORKPLACE CONTROLS AND PRACTICES

Unless a less toxic chemical can be substituted for a hazardous substance, **ENGINEERING CONTROLS** are the most effective way of reducing exposure. The best protection is to enclose operations and/or provide local exhaust ventilation at the site of chemical release. Isolating operations can also reduce exposure. Using respirators or protective equipment is less effective than the controls mentioned above, but is sometimes necessary.

In evaluating the controls present in your workplace, consider: (1) how hazardous the substance is, (2) how much of the substance is released into the workplace and (3) whether harmful skin or eye contact could occur. Special controls should be in place for highly toxic chemicals or when significant skin, eye, or breathing exposures are possible.

In addition, the following control is recommended:

* Where possible, automatically pump liquid **Gasoline** from drums, barrels, or other storage containers to process containers.

Good WORK PRACTICES can help to reduce hazardous exposures. The following work practices are recommended:

Workers whose clothing has been contaminated by **Gasoline** should change into clean clothing promptly.
* Do not take contaminated work clothes home. Family members could be exposed.
* Contaminated work clothes should be laundered by individuals who have been informed of the hazards of exposure to **Gasoline**.
* Wash any areas of the body that may have contacted **Gasoline** at the end of each work day, whether or not known skin contact has occurred.
* Do not eat, smoke, or drink where **Gasoline** is handled, processed, or stored, since the chemical can be swallowed. Wash hands carefully before eating or smoking.

PERSONAL PROTECTIVE EQUIPMENT

WORKPLACE CONTROLS ARE BETTER THAN PERSONAL PROTECTIVE EQUIPMENT. However, for some jobs (such as outside work, confined space entry, jobs done only once in a while, or jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

The following recommendations are only guidelines and may not apply to every situation.

Clothing
* Avoid skin contact with **Gasoline**. Protective "barrier" creams are available to help lower skin absorption. Wear protective gloves and clothing. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation.
* All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.

Eye Protection
* Wear splash-proof chemical goggles when working with liquid, unless full facepiece respiratory protection is worn.

Respiratory Protection
IMPROPER USE OF RESPIRATORS IS DANGEROUS. Such equipment should only be used if the employer has a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing and medical exams, as described in OSHA 1910.134.

* Where the potential exists for exposures over 300 ppm, use a MSHA/NIOSH approved respirator with an organic vapor cartridge/canister. More protection is provided by a full facepiece respirator than by a half-mask respirator, and even greater protection is provided by a powered-air purifying respirator.
* If while wearing a filter, cartridge or canister respirator, you can smell, taste, or otherwise detect **Gasoline**, or in the case of a full facepiece respirator you experience eye irritation, leave the area immediately. Check to make sure the respirator-to-face seal is still good. If it is, replace the filter, cartridge, or canister. If the seal is no longer good, you may need a new respirator.
* Be sure to consider all potential exposures in your workplace. You may need a combination of filters, prefilters, cartridges, or canisters, to protect against different forms of a chemical (such as vapor and mist) or against a mixture of chemicals.
* Where the potential for high exposures exists, use a MSHA/NIOSH approved supplied-air respirator with a full facepiece operated in the positive pressure mode or with a full facepiece, hood, or helmet in the continuous flow mode, or use a MSHA/NIOSH approved self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

HANDLING AND STORAGE

* Prior to working with **Gasoline** you should be trained on its proper handling and storage.
* Sources of ignition such as smoking and open flames are prohibited where **Gasoline** is handled, used, or stored.
* Metal containers involving the transfer of 5 gallons or more of **Gasoline** should be grounded and bonded. Drums must be

equipped with self-closing valves, pressure vacuum bungs, and flame arresters.

* Use only non-sparking tools and equipment, especially when opening and closing containers of **Gasoline**.
* Wherever **Gasoline** is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings.

QUESTIONS AND ANSWERS

Q: If I have acute health effects, will I later get chronic health effects?
A: Not always. Most chronic (long-term) effects result from repeated exposures to a chemical.

Q: Can I get long-term effects without ever having short-term effects?
A: Yes, because long-term effects can occur from repeated exposures to a chemical at levels not high enough to make you immediately sick.

Q: What are my chances of getting sick when I have been exposed to chemicals?
A: The likelihood of becoming sick from chemicals is increased as the amount of exposure increases. This is determined by the length of time and the amount of material to which someone is exposed.

Q: When are higher exposures more likely?
A: Conditions which increase risk of exposure include <u>dust releasing operations</u> (grinding, mixing, blasting, dumping, etc.), <u>other physical and mechanical processes</u> (heating, pouring, spraying, spills and evaporation from large surface areas such as open containers), and <u>"confined space" exposures</u> (working inside vats, reactors, boilers, small rooms, etc.).

Q: Is the risk of getting sick higher for workers than for community residents?
A: Yes. Exposures in the community, except possibly in cases of fires or spills, are usually much lower than those found in the workplace. However, people in the community may be exposed to contaminated water as well as to chemicals in the air over long periods. Because of this, and because of exposure of children or people who are already ill, community exposures may cause health problems.

Q: Don't all chemicals cause cancer?
A: No. Most chemicals tested by scientists are not cancer-causing.

Q: Should I be concerned if a chemical causes cancer in animals?
A: Yes. Most scientists agree that a chemical that causes cancer in animals should be treated as a suspected human carcinogen unless proven otherwise.

Q: But don't they test animals using much higher levels of a chemical than people usually are exposed to?
A: Yes. That's so effects can be seen more clearly using fewer animals. But high doses alone do not cause cancer unless it is a cancer agent. In fact, a chemical that causes cancer in animals at high doses could cause cancer in humans exposed to low doses.

Q: Who is at the greatest risk from reproductive hazards?
A: Pregnant women are at greatest risk from chemicals which harm the developing fetus. However, chemicals may affect the <u>ability</u> to have children, so both men and women of child-bearing age are at high risk.

The New Jersey State Department of Health, Occupational Health Service offers multiple services in occupational health. These include: Right to Know Information Resources, Public Presentations, General References, Industrial Hygiene Information, Surveys and Investigations, and Medical Evaluation. Consult another Fact Sheet for a more detailed description of these services or call (609) 984-1863.

DEFINITIONS

ACGIH is the American Conference of Governmental Industrial Hygienists. It recommends upper limits (called TLVs) for exposure to workplace chemicals.

A **carcinogen** is a substance that causes cancer.

The **CAS number** is assigned by the Chemical Abstracts Service to identify a specific chemical.

A **combustible** substance is a solid, liquid or gas that will burn.

A **corrosive** substance is a gas, liquid or solid that causes irreversible damage to human tissue or containers.

DEPE is the New Jersey Department of Environmental Protection and Energy.

DOT is the Department of Transportation, the federal agency that regulates the transportation of chemicals.

EPA is the Environmental Protection Agency, the federal agency responsible for regulating environmental hazards.

A **fetus** is an unborn human or animal.

A **flammable** substance is a solid, liquid, vapor or gas that will ignite easily and burn rapidly.

The **flash point** is the temperature at which a liquid or solid gives off vapor that can form a flammable mixture with air.

HHAG is the Human Health Assessment Group of the federal EPA.

IARC is the International Agency for Research on Cancer, a scientific group that classifies chemicals according to their cancer-causing potential.

A **miscible** substance is a liquid or gas that will evenly dissolve in another.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of concentration (weight/volume).

MSHA is the Mine Safety and Health Adminis tration, the federal agency that regulate mining. It also evaluates and approve respirators.

A **mutagen** is a substance that causes muta tions. A **mutation** is a change in the ge netic material in a body cell. Mutation can lead to birth defects, miscarriages, o cancer.

NCI is the National Cancer Institute, a federal agency that determines the cancer-causing potential of chemicals.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for Occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

NTP is the National Toxicology Program which tests chemicals and reviews evidence for cancer.

OSHA is the Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

ppm means parts of a substance per million parts of air. It is a measure of concentration by volume in air.

A **reactive** substance is a solid, liquid or gas that can cause an explosion under certain conditions or on contact with other specific substances.

A **teratogen** is a substance that causes birth defects by damaging the fetus.

TLV is the Threshold Limit Value, the workplace exposure limit recommended by ACGIH.

The **vapor pressure** is a measure of how readily a liquid or a solid mixes with air at its surface. A higher vapor pressure indicates a higher concentration of the substance in air and therefore increases the likelihood of breathing it in.

>>>>>>>>>>>>>>>>>> E M E R G E N C Y I N F O R M A T I O N <<<<<<<<<<<<<<<<<

Common Name: **GASOLINE**
DOT Number: UN 1203
DOT Emergency Guide code:
Number: 8006-61-9

Hazard rating	NJ DOH	NFPA
FLAMMABILITY		3
REACTIVITY		0
FLAMMABLE LIQUID		
CONTAINERS MAY EXPLODE IN FIRE		
POISONOUS GAS IS PRODUCED IN FIRE		

Hazard Rating Key: 0=minimal; 1=slight; 2=moderate; 3=serious; 4=severe

FIRE HAZARDS

* Gasoline is a FLAMMABLE LIQUID.
* CONTAINERS MAY EXPLODE IN FIRE.
* POISONOUS GAS IS PRODUCED IN FIRE.
* Use dry chemical, CO_2, or foam extinguishers.
* If employees are expected to fight fires, they must be trained and equipped as stated in OSHA 1910.156.

SPILLS AND EMERGENCIES

I Gasoline is spilled or leaked, take the f lowing steps:

* Restrict persons not wearing protective equipment from area of spill or leak until clean-up is complete.
* Remove all ignition sources.
* Ventilate area of spill or leak.
* Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers.
* It may be necessary to contain and dispose of Gasoline as a HAZARDOUS WASTE. Contact your Department of Environmental Protection (DEP) or your regional office of the federal Environmental Protection Agency (EPA) for specific recommendations.

FOR LARGE SPILLS AND FIRES immediately call your fire department. You can request emergency information from the following:

CHEMTREC: (800) 424-9300
NJDEPE HOTLINE: (609) 292-7172

HANDLING AND STORAGE (See page 3)

FIRST AID

In NJ, POISON INFORMATION 1-800-962-1253

Eye Contact
* Immediately flush with large amounts of water for at least 15 minutes, occasionally lifting upper and lower lids.

Skin Contact
* Quickly remove contaminated clothing. Immediately wash contaminated skin with large amounts of soap and water.

Breathing
* Remove the person from exposure.
* Begin rescue breathing if breathing has stopped and CPR if heart action has stopped.
* Transfer promptly to a medical facility.

PHYSICAL DATA

Flash Point: -50°F
Water Solubility: Insoluble

OTHER COMMONLY USED NAMES

Chemical Name:
Gasoline
Other Names and Formulations:
Petrol

NEW JERSEY DEPARTMENT OF HEALTH
Right to Know Program
CN 368, Trenton, NJ 08625-0368
(609) 984-2202

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 470
Diesel Fuel Oil No. 2-D

Issued: 10/81 Revision: A, 11/90

Section 1. Material Identification

33

Diesel Fuel Oil No. 2-D Description: Diesel fuel is obtained from the middle distillate in petroleum separation; a distillate oil of low sulfur content. It is composed chiefly of unbranched paraffins. Diesel fuel is available in various grades, one of which is synonymous with fuel oil No. 2-D. This diesel fuel oil requires a minimum Cetane No. (efficiency rating for diesel fuel comparable to octane number ratings for gasoline) of 40 (ASTM D613). Used as a fuel for trucks, ships, and other automotive engines; as mosquito control (coating on breeding waters); and for drilling muds.

Other Designations: CAS No. 68334-30-5, diesel fuel.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[(73)] for a suppliers list.

Cautions: Diesel fuel oil No. 2-D is a skin irritant and central nervous depressant with high mist concentrations. It is an environmental hazard and moderate fire risk.

R 1
I -
S 2
K 2

NFPA: 2, 0, 0, -

HMIS
H 0
F 2
R 0
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Diesel fuel oil No. 2-D*

1989 OSHA PEL	1990-91 ACGIH TLV	1988 NIOSH REL	1985-86 Toxicity Data‡
None established	Mineral Oil Mist TWA: 5 mg/m^3† STEL: 10 mg/m^3	None established	Rat, oral, LD_{50}: 9 g/kg produces gastrointestinal (hypermotility, diarrhea) effects

* Diesel fuel No. 2-D tends to be low in aromatics and high in paraffinics. This fuel oil is complex mixture of: 1) >95% paraffinic, olefinic, naphthenic, and aromatic hydrocarbons, 2) sulfur (<0.5%), and 3) benzene (<100 ppm). [A low benzene level reduces carcinogenic risk. Fuel oils can be exempted under the benzene standard (29 CFR 1910.1028)]. Although low in the fuel itself, benzene concentrations are likely to be much higher in processing areas.

† As sampled by nonvapor-collecting method.

‡ Monitor NIOSH, *RTECS* (HZ1800000), for future toxicity data.

Section 3. Physical Data

Boiling Point Range: 340 to 675 °F (171 to 358 °C)
Viscosity: 1.9 to 4.1 centistoke at 104 °F (40 °C)
Specific Gravity: <0.86
Water Solubility: Insoluble

Appearance and Odor: Brown, slightly viscous liquid.

Section 4. Fire and Explosion Data

Flash Point: 125 °F (52 °C) min.	Autoignition Temperature: >500 °F (932 °C)	LEL: 0.6% v/v	UEL: 7.5% v/v

Extinguishing Media: Use dry chemical, carbon dioxide, or foam to fight fire. Use a water spray to cool fire exposed containers. Do not use a forced water spray directly on burning oil since this will scatter the fire. Use a smothering technique for extinguishing fire.

Unusual Fire or Explosion Hazards: Diesel fuel oil No. 2-D is a OSHA Class II combustible liquid. Its volatility is similar to that of gas oil. Vapors may travel to a source of ignition and flash back.

Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective clothing. If feasible, remove containers from fire. Be aware of runoff from fire control methods. Do not release to sewers or waterways due to pollution and fire or explosion hazard.

Section 5. Reactivity Data

Stability/Polymerization: Diesel fuel oil No. 2-D is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: It is incompatible with strong oxidizing agents; heating greatly increases the fire hazard.

Conditions to Avoid: Avoid heat and ignition sources.

Hazardous Products of Decomposition: Thermal oxidative decomposition of diesel fuel oil No. 2-D can produce various hydrocarbons and hydrocarbon derivatives, and other partial oxidation products such as carbon dioxide, carbon monoxide, and sulfur dioxide.

Section 6. Health Hazard Data

Carcinogenicity: Although the IARC has not assigned an overall evaluation to diesel fuels as a group, it has evaluated occupational exposures in pe--leum refining as an IARC probable human carcinogen (Group 2A). It has evaluated distillate (light) diesel oils as not classifiable as human ...gens (Group 3).
...ary of **Risks:** Although diesel fuel's toxicologic effects should resemble kerosine's, they are somewhat more pronounced due to additives ...ch as sulfurized esters. Excessive inhalation of aerosol or mist can cause respiratory tract irritation, headache, dizziness, nausea, vomiting, and loss of coordination, depending on concentration and exposure time. When removed from exposure area, affected persons usually recover completely. If vomiting occurs after ingestion and if oil is aspirated into the lungs, hemorrhaging and pulmonary edema, progressing to renal involvement and chemical pneumonitis, may result. A comparative ratio of oral to aspirated lethal doses may be 1 pt vs. 5 ml. Aspiration may also result in transient CNS depression or excitement. Secondary effects may include hypoxia (insufficient oxygen in body cells), infection, pneumatocele formation, and chronic lung dysfunction. Inhalation may result in euphoria, cardiac dysrhythmias, respiratory arrest, and CNS toxicity. Prolonged or repeated skin contact may irritate hair follicles and block sebaceous glands, producing a rash of acne pimples and spots, usually on arms and legs.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Target Organs: Central nervous system, skin, and mucous membranes.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects: Systemic effects from ingestion include gastrointestinal irritation, vomiting, diarrhea, and in severe cases central nervous system depression, progressing to coma or death. Inhalation of aerosols or mists may result in increased rate of respiration, tachycardia (excessively rapid heart beat), and cyanosis (dark purplish discoloration of the skin and mucous membranes caused by deficient blood oxygenation).
Chronic Effects: Repeated contact with the skin causes dermatitis.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. If large areas of the body have been exposed or if irritation persists, get medical help immediately. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* due to aspiration hazard. Contact a physician immediately. Position to avoid aspiration.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Gastric lavage is contraindicated due to aspiration hazard. Preferred antidotes are charcoal and milk. In cases of severe aspiration pneumonitis, consider monitoring arterial blood gases to ensure adequate ventilation. Observe the patient for 6 hr. If vital signs become abnormal or symptoms develop, obtain a chest x-ray.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate area for large spills, remove all heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and liquid contact. Clean up spills promptly to reduce fire or vapor hazards. Use a noncombustible absorbent material to pick up small spills or residues. For large spills, dike far ahead to contain. Pick up liquid for reclamation or disposal. Do not release to sewers or waterways due to health and fire and/or explosion hazard. Follow applicable OSHA regulations (29 CFR 1910.120). Diesel fuel oil No. 2-D spills may be environmental hazards. Report large spills.
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
...Designations
...Hazardous Waste (40 CFR 261.21): Ignitable waste
...CLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed
OSHA Designations
Air Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, use a NIOSH-approved respirator with a mist filter and organic vapor cartridge. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations that promote worker safety and productivity. Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Use and storage conditions should be suitable for a OSHA Class II combustible liquid. Store in closed containers in a well-ventilated area away from heat and ignition sources and strong oxidizing agents. Protect containers from physical damage. To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations. Use nonsparking tools and explosion-proof electrical equipment. No smoking in storage or use areas.
Engineering Controls: Avoid vapor or mist inhalation and prolonged skin contact. Wear protective rubber gloves and chemical safety glasses where contact with liquid or high mist concentration may occur. Additional suitable protective clothing may be required depending on working conditions. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal hygiene and housekeeping procedures. Do not wear oil contaminated clothing. At least weekly laundering of work clothes is recommended. Do not put oily rags in pockets. When working with this material, wear gloves or use barrier cream.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Fuel oil

DOT Hazard Class: Combustible liquid

ID No.: NA1993

Label: None

Packaging Exceptions: 173.118a

DOT Packaging Requirements: None

MSDS Collection References: 1, 6, 7, 12, 73, 84, 101, 103, 126, 127, 132, 133, 136, 143, 146
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** AC Darlington, MD; **Edited by:** JR Stuart, MS

APPENDIX II

SITE ORGANIZATION AND CONTROL

SITE ORGANIZATION AND CONTROL

- SITE CONTROL MEASURES

  The following section defines measures and procedures for maintaining site control. Site control is an essential component in the implementation of the site health and safety program.

  - General
    Prior to any site work the following items will be addressed:

    - Site reconnaissance
    - Obtain drawings of site and/or existing private utilities for the site.
    - Contact utility locating services (U-L-O-C-O) and/or local utility companies and request a site inspection.
    - Check for physical restraints/obstructions such as overhead utilities, signs, canopies, etc.
    - Determine work areas (decontamination, staging, etc...).
    - Barricade work areas, as necessary, to isolate from pedestrians and vehicles.

  - Site Communications Plan

    Successful communications between field teams and contact with personnel in the support zone is essential. The following communications systems should be available during activities at the Site.

- *Noise Makers (horns, whistles, sirens)*

SIGNAL	DEFINITION
One long blast	Evacuate area to nearest emergency exit.
Two short blasts	Localized problem. Not dangerous to workers.
Two long blasts	All clear. Resume activities.

- *Hand Signals*

SIGNAL	DEFINITION
Hands clutching throat	Out of air/cannot breath
Hands on top of head	Need assistance
Thumbs up	OK/I am all right/I understand
Thumbs down	No/negative
Arms waving upright	Send back up support
Grip partner's wrist	Exit area immediately

- *Buddy System (where necessary):*

This system is used in situations where partners provide each other with assistance and observe his or her partner for signs of chemical exposure or for medical emergencies.

Safe Work Practices:

Standing orders have been developed to maintain a strong safety awareness and to enforce safe procedures at the Site.

- Work Area

No smoking, eating or drinking;
No horse play;
No matches or lighters;
Implement the communications system; and
Wear the appropriate level of protection as defined in this plan.

Excavations/trenching:

Hazards encountered during soil and test pit excavation or trenching include both chemical and physical agents, and are as follows:

- Exposure to airborne contaminants released during intrusive activities. Flammable atmospheres may also be encountered.

- Excavation cave in.

- Falling during access/egress, while monitoring, or stumbling into excavation.

- Overhead hazard may result from material, tools, rock and/or soil falling into the excavation.

- Congested work area due to too many workers in small area.

Hazard prevention includes:

- Monitor for airborne contaminants. Allow test pits/excavations to purge and/or use PPE.

- Provide adequate shoring and sloping of sides of the excavation. Regularly inspect trenches for changing conditions.

  Solid rock, cemented sand or gravel = 90 degrees
  Compact angular gravel = 63 degrees 26 feet deep
  Compacted sharp sand = 33 degrees 41 feet deep
  Rounded loose sand = 26 degrees 34 feet deep

- Provide ramps or ladders to trenches to allow safe access and egress.

- Provide an adequate barrier around open pits (barricades, barricade tape, etc...)

- Maintain ample work room between workers.

Confined Space Entry Procedures (CSEP)

A confined space provides the potential for unusually high concentrations of contaminants, explosive atmospheres, limited visibility, and restricted movements.

General provisions include:

- When possible, confined spaces should be identified with a posted sign which reads: Caution - Confined Space.

- Only personnel trained and knowledgeable of the requirements of the Confined Space Entry Procedures will be authorized to enter a confined space or be a confined space observer.

- Natural ventilation shall be provided for the confined space prior to initial entry and for the duration of the CSEP. Positive/forced mechanical ventilation may be required. However, care should be taken to not spread contamination outside of the enclosed area.

- If flammable liquids may be contained within the confined space, explosion proof equipment will be used. All equipment shall be positively grounded.

- The contents of any confined space shall, where necessary, be removed prior to entry. All sources of ignition must be removed prior to entry.

- Hand tools used in confined spaces shall be in good repair explosion proof and spark proof, and selected according to intended use. Where possible, pneumatic power tools are to be used.

- Hand-held lights and other illumination utilized in confined spaces shall be equipped with guards to prevent contact with the bulb and must be explosion proof.

- Compressed gas cylinders, except cylinders used for a self-contained breathing apparatus, shall not be taken into confined spaces. Gas hoses shall be removed from the space and the supply turned off at the cylinder valve when personnel exit from the confined space.

- If a confined space requires respiratory equipment or where rescue may be difficult, safety belts, body harnesses, and lifelines will be used. The outside observer shall be provided with the same equipment as those working within the confined space.

- A ladder is required in all confined spaces deeper than the employee's shoulders. The ladder shall be secured and not removed until all employees have exited the space.

- Only self-contained breathing apparatus or NIOSH approved airline respirators equipped with a 5-minute emergency air supply (egress bottle) shall be used in untested confined spaces or in any confined space with conditions determined immediately dangerous to life and health.

- Where air-moving equipment is used to provide ventilation, chemicals shall be removed from the vicinity to prevent introduction into the confined space.

- Vehicles shall not be left running near confined space work or near air-moving equipment being used for confined space ventilation.

- Smoking in confined spaces will be prohibited at all times.

- Any deviation from these Confined Space Entry Procedures requires the prior permission of the Safety Manager.

APPENDIX III

CONTINGENCY PLAN

CONTINGENCY PLAN

This section describes contingencies and emergency planning procedures to be implemented at the Site. This plan is compatible with local, state and federal disaster and emergency management plans as appropriate.

Pre-Emergency Plan

During the periodic site briefings, all employees will be trained in and reminded of provisions of the emergency response plan, communications systems, and evacuation routes. The HASP identifies the hazardous conditions associated with specific site activities. The plan will be reviewed on a regular basis and revised, if necessary, by the Safety Manager. This will ensure that the plan is adequate and consistent with prevailing site conditions.

Personnel Roles and Lines of Authority

The Site Supervisor has primary responsibility for responding to and correcting emergency situations. This includes taking appropriate measures to ensure the safety of site personnel and the public. Possible actions may involve evacuation of personnel from the site area, and/or evacuation of adjacent residents. He/she is additionally responsible for ensuring that corrective measures have been implemented, appropriate authorities notified, and follow-up reports completed. The Safety Manager may be called upon to act on the behalf of the site supervisor, and may direct responses to any medical emergency. The individual contractor organizations are responsible for assisting the project manager in his/her mission within the parameters of their scope of work.

The Project Supervisor(s):	Rick Catlin, RC&A, (910) 452-5861, or (800) 346-7360;
The Safety Manager:	Teri M. Piver, RC&A, (910) 452-5861, or (800) 346-7360

Evacuation Routes/Procedures

In the event of an emergency which necessitates an evacuation of the site, the following alarm procedures will be implemented:

Evacuation alarm notification should be made using one long blast on the air horn. All personnel should evacuate upwind of any activities. Insure that a predetermined location is identified off-site in case of an emergency, so that all personnel can be accounted for.

Personnel will be expected to proceed to the closest exit with your buddy, and mobilize to the safe distance area associated with the evacuation route. Personnel will remain at that area until the re-entry alarm is sounded or an authorized individual provides further instructions.

Emergency Medical Treatment Procedures

Any person who becomes ill or injured in the Exclusion Zone must be decontaminated to the maximum extent possible. If the injury or illness is minor, full decontamination should be completed and first aid administered prior to transport. If the patient's condition is serious, at least partial decontamination should be completed (i.e., complete disrobing of the victim and redressing in clean coveralls or wrapping in a blanket). First aid should be administered while awaiting an ambulance or paramedics. All injuries and illnesses must immediately be reported to the project manager.

Any person being transported to a clinic or hospital for treatment should take with them information on the chemical they have been exposed to at the site.

Any vehicle used to transport contaminated personnel will be treated and cleaned as necessary.

Heat Stress

One or more of the following measures will be used to help control heat stress:

- Provision of adequate liquids to replace body fluids. Workers must replace water and salt lost from sweating. Employees must be encouraged to drink more than the amount required to satisfy thirst. Thirst satisfaction is not an accurate indicator of adequate salt and fluid replacement.

- Replacement fluids can be commercial mixes, such as Gatorade, or a combination of these with fresh water. Replacement fluids should be cool (50-60° F) but not chilled (40° F).

- Establishment of a work regiment that will provide adequate rest periods for cooling down . This may require additional shifts of workers.

- During the hot season, workers should frequently drink small amounts (i.e. one cup every 15 - 20 minutes).

- Cooling devices such as cooling vests may be worn beneath protective garments.

- All breaks are to be taken in a cool area (77° F is best).

- Employees shall remove impermeable protective garments during rest periods.

- Workers shall not be assigned other tasks during rest periods.

- All employees shall be informed of the importance of adequate rest, acclimation and proper diet in the prevention of heat stress.

- A copy of the "American Red Cross Standard First Aid" will be available on-site.

Heat Stress Monitoring

- For workers wearing permeable clothing, refer to the "American Conference of Government Industrial Hygienists' (ACGIH) Threshold Limit Values for Heat Stress".

- For workers wearing semipermeable or impermeable ensembles the ACGIH standard cannot be used. For these situations, workers should be monitored when the temperature in the work area is above 70° F. Therefore, the following measures should be employed.

  - Heart rate. Count the radial pulse during a 30-second period as early as possible in the rest period.

    If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one third and keep the rest period the same. If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one-third.

  - Oral temperature. Use a clinical thermometer (3 minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking replacement fluids).

    If the oral temperature exceeds 99.6° F shorten the next work cycle by one-third without changing the rest period. If the oral temperature still exceeds 99.6° F at the beginning of the next rest period, shorten the following work cycle by one-third.

    Do not permit a worker to wear a semipermeable or impermeable garment when his/her oral temperature exceeds 100.6° F.

- Body water loss. If possible, measure weight at the beginning of each work day to see if enough fluids are being taken to prevent dehydration. The body water loss should not exceed 1.5 percent of the total body weight loss in a work day.

Cold Stress

The potential exists for cold stress (frostbite or hypothermia) to occur when conducting work activities in an environment where air temperatures may fall below freezing. Following is a brief description identifying exposure symptoms:

Hypothermia- a condition in which the body loses heat faster than it is produced. Vasodilators (alcohol and drugs) allow the body to lose heat faster which accelerate hypothermia. The five stages of hypothermia are: (1) shivering; (2) apathy; (3) unconsciousness; (4) freezing; and (5) death.

Frostbite- a condition in which there is a freezing of partial freezing of some part of the body. individuals previously exposed to frostbite are ,ore susceptible to contracting it again. Vasoconstrictors (tobacco products), constrict the blood vessels, and accelerate frostbite. The three stages of frostbite are: (1) frostnip-the beginnings of frostbite whereby the skin begins to turn white; (2) superficial-similar to frostnip except the skin begins to turn numb; and (3) deep- the affected area is frozen to the bone, cold, numb, and very hard.

To prevent conditions from occurring, the following is recommended:

- Dress in a minimum of three layers(a skin layer to absorb moisture and keep skin dry, an insulating layer, and an outer chemical-protective layer).
- Avoid touching cold surfaces (especially metal) with bare skin, minimize exposed skin surfaces.
- Keep active, use shelter areas during rest cycles.
- Maintain body fluids.
- Use wind breaks whenever possible.

Fire or Explosion

In the event of a fire or explosion, the local fire department should be summoned immediately. Upon their arrival, the project manager or designated alternate will advise the fire commander of the location, nature, and identification of the hazardous materials onsite.

If it is safe to do so, site personnel may:

- Remove or isolate flammable or other hazardous materials which may contribute to the fire.

Spill or Leaks

In the event of a spill or a leak, site personnel will:

- Inform their supervisor immediately;
- Locate the source of the spillage and stop the flow if it can be done safely; and
- Begin containment and recovery of the spilled materials.

APPENDIX II
BORING LOG
AS-BUILT WELL DETAILS
NC WELL CONSTRUCTION RECORD
WELL SAMPLING WORKSHEET
CHAIN OF CUSTODY RECORD
IN-SITU PERMEABILITY (SLUG) TEST

BORING LOG

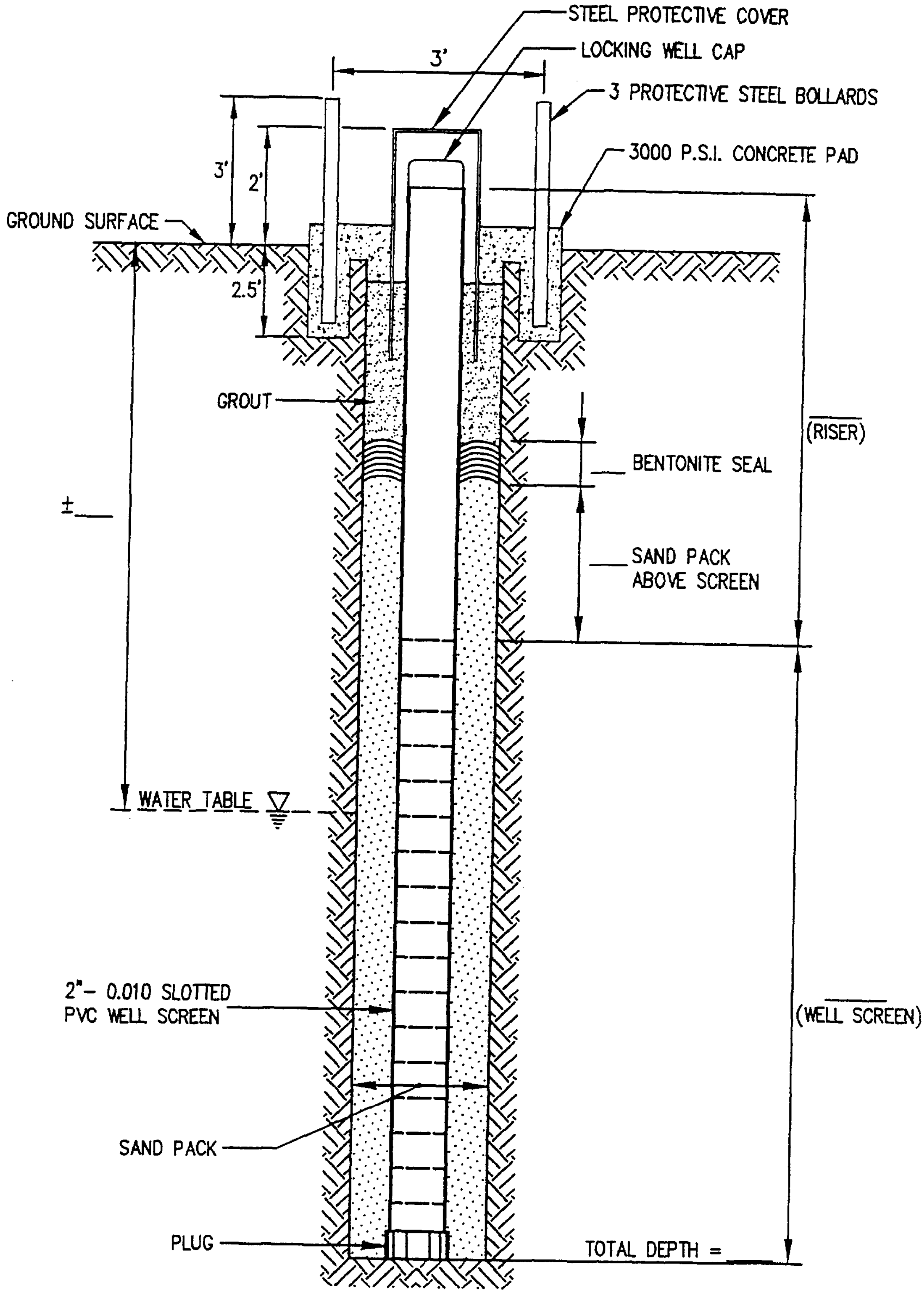
BORING NUMBER________ SITE LOCATION__________________ DRILLED BY______________

TOTAL DEPTH___________ ______________________________ LOGGED BY______________

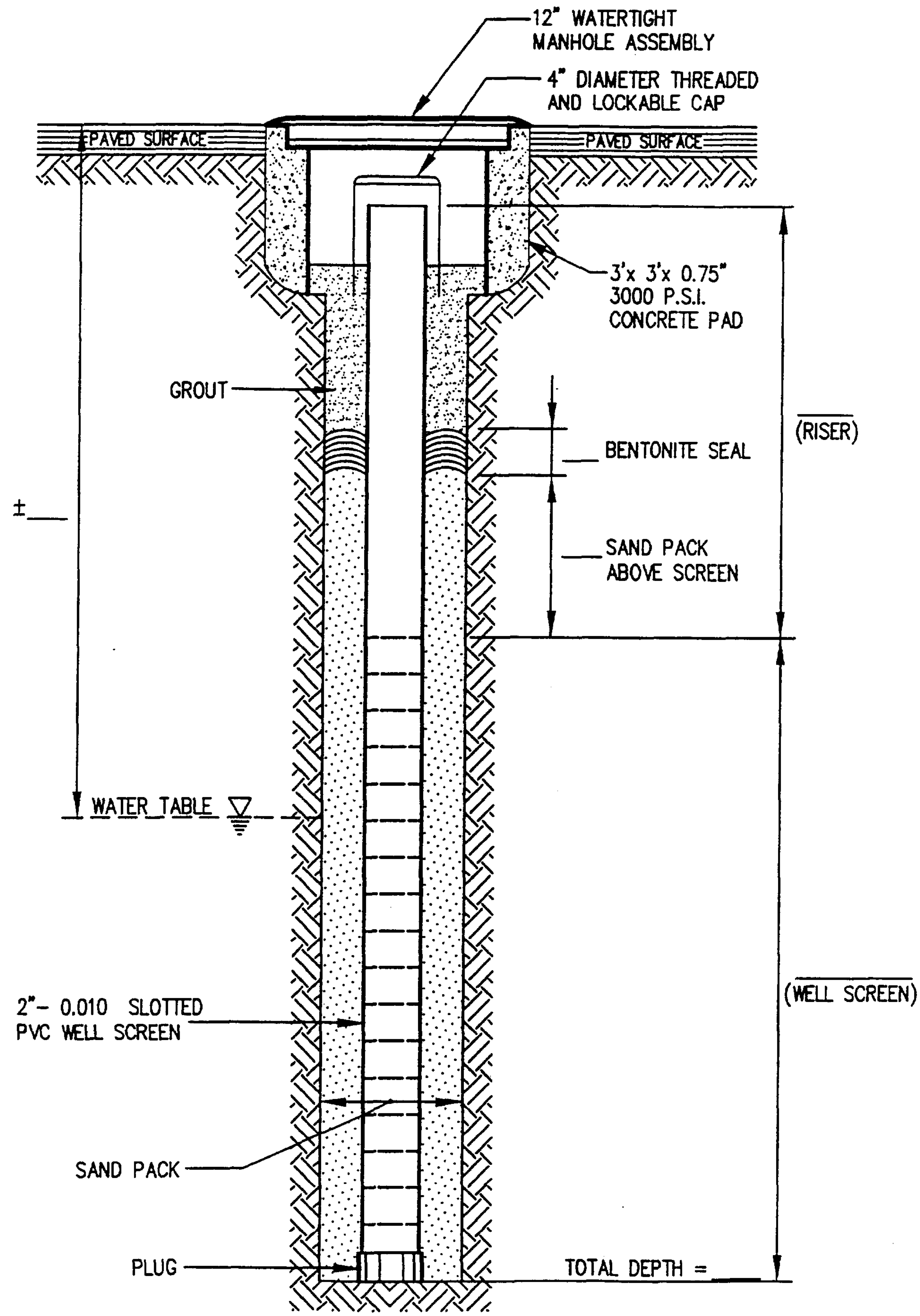
DRILLING DATE___________

SAMPLE DEPTH (FT.)		SAMPLE DESCRIPTION	USCS	WATER CONTENT	HC ODOR	PID/ FID PPM	BLOW COUNT

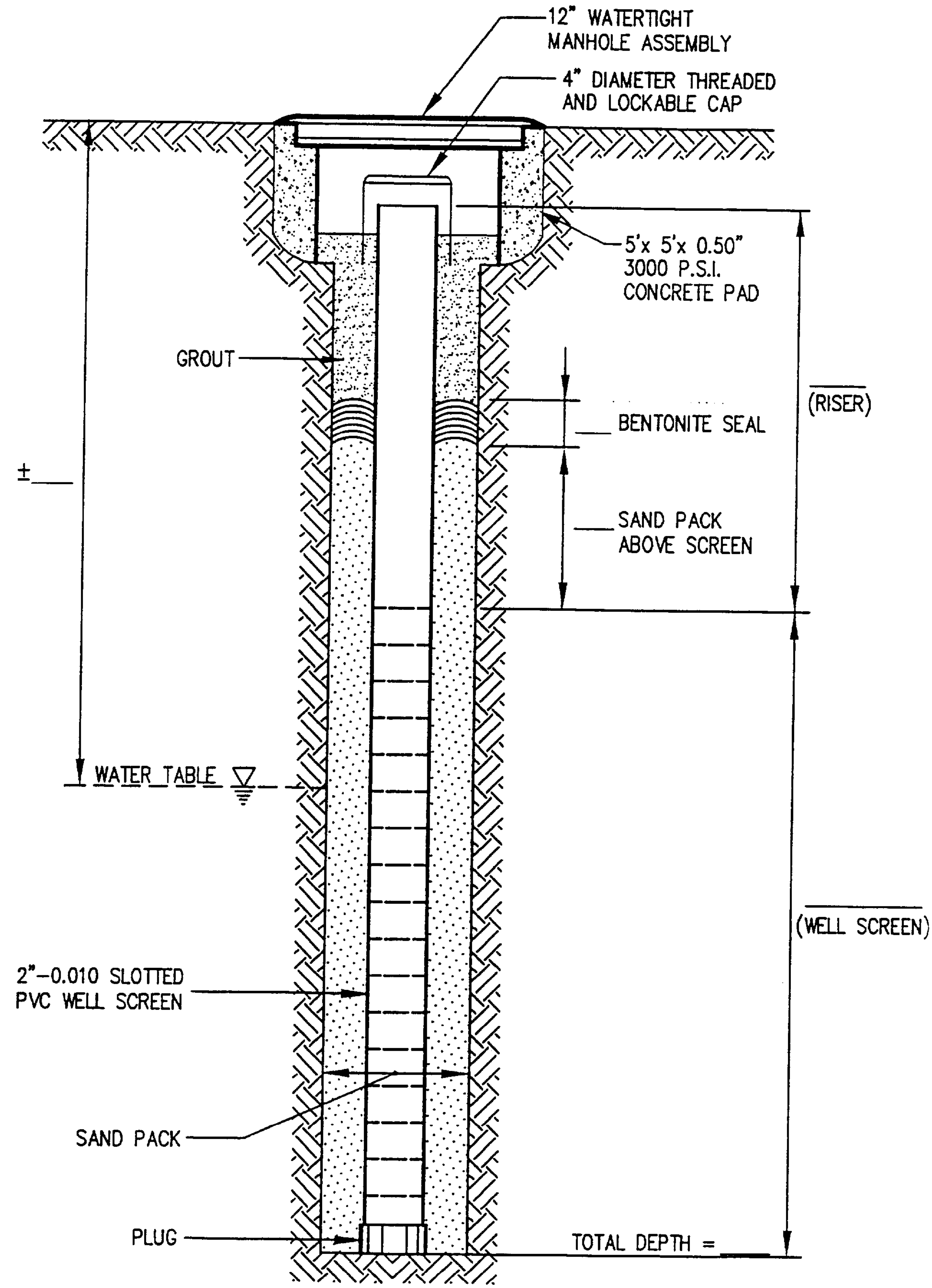
REMARKS____ PAGE___OF___



Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS RC&A WILMINGTON, NC CHARLESTON, SC ATLANTA, GA WINSTON-SALEM, NC	PROJECT		TITLE ABOVE GROUND TYPE II MONITORING WELL DETAIL		FIGURE
	JOB NO:	DATE:	SCALE: NTS	DRAWN BY: WHW	CHECKED BY: JC



Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS RC&A WILMINGTON, NC CHARLESTON, SC ATLANTA, GA WINSTON-SALEM, NC	PROJECT	TITLE PAVED SURFACE TYPE II MONITORING WELL DETAIL	FIGURE
	JOB NO: DATE:	SCALE: NTS DRAWN BY: WHW CHECKED BY: JC	



Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS RC&A WILMINGTON, NC CHARLESTON, SC ATLANTA, GA WINSTON-SALEM, NC	PROJECT	TITLE UNPAVED SURFACE TYPE II MONITORING WELL DETAIL	FIGURE
	JOB NO: DATE:	SCALE: NTS DRAWN BY: WHW CHECKED BY: JC	

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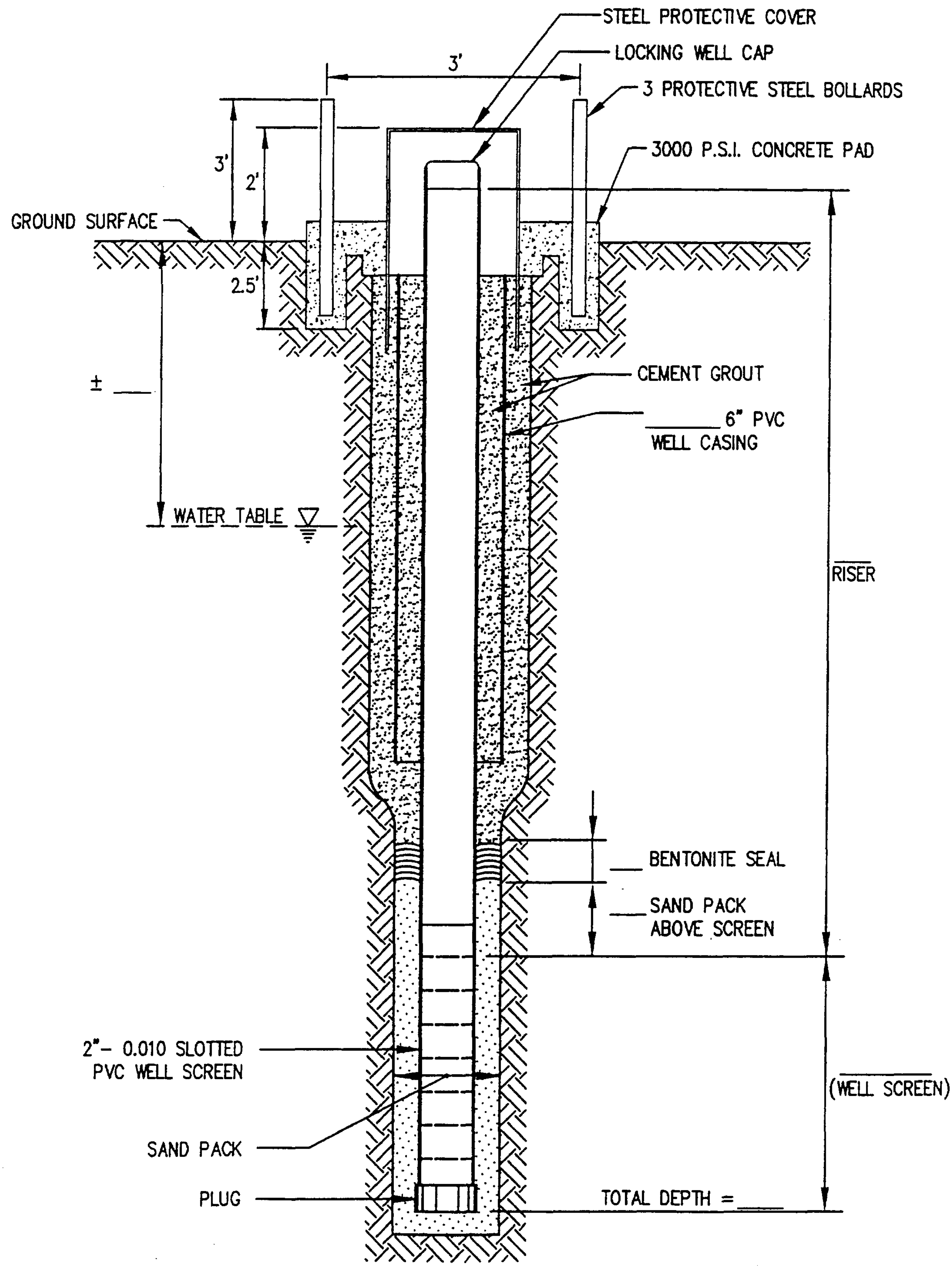

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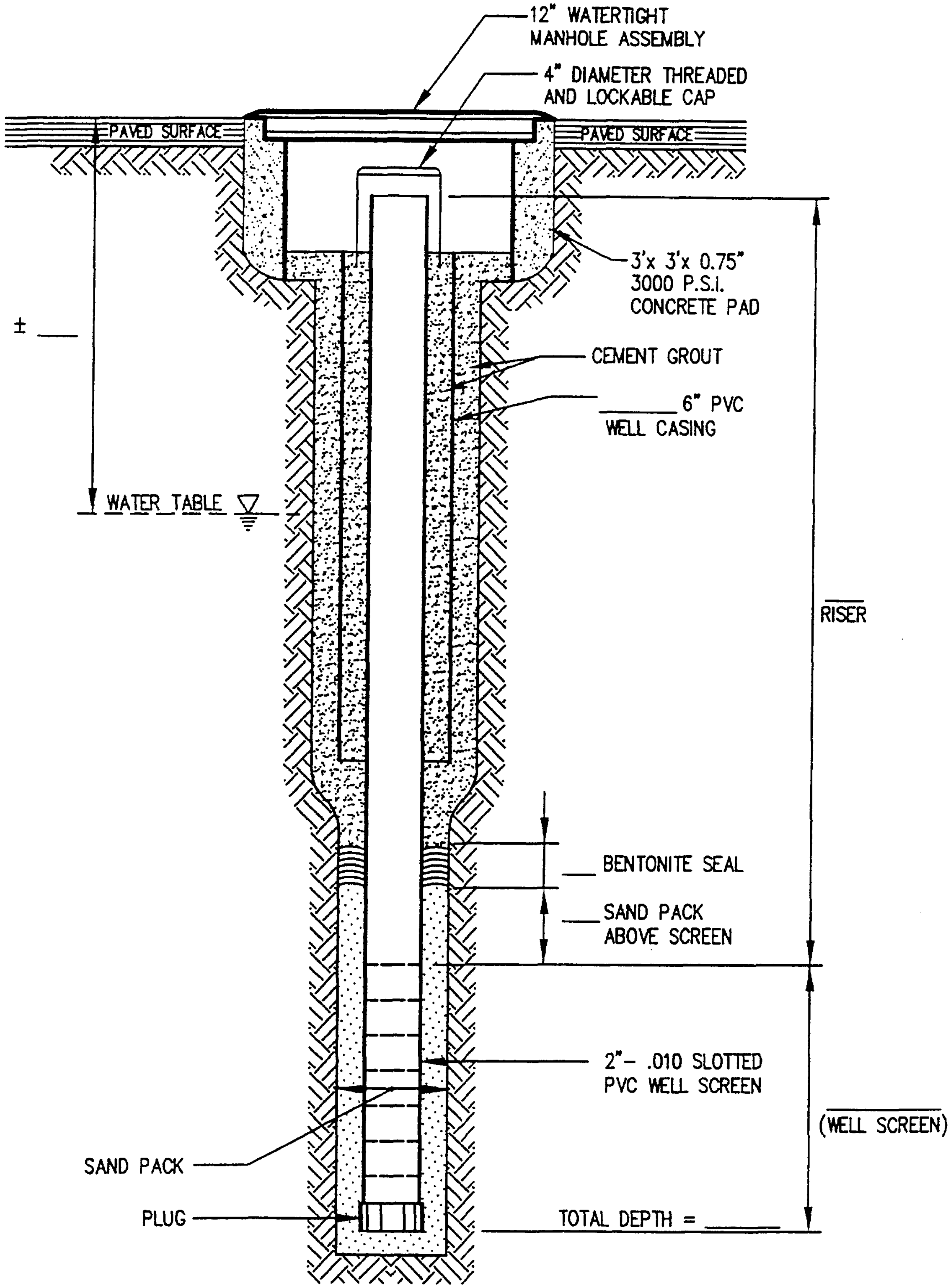
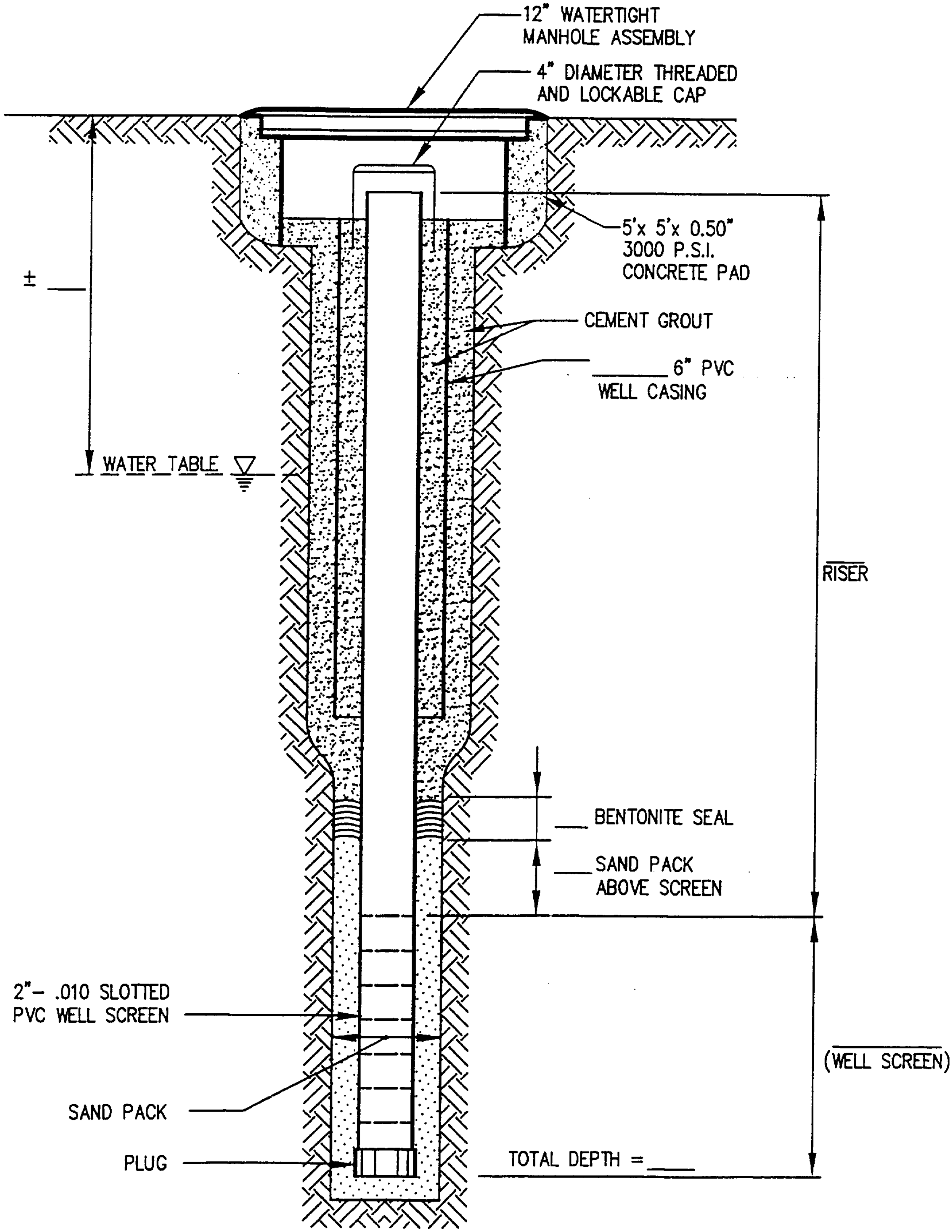


Richard Catlin & Associates, Inc. RC&A ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS WILMINGTON, NC CHARLESTON, SC ATLANTA, GA WINSTON-SALEM, NC	PROJECT	TITLE PAVED SURFACE TYPE III MONITORING WELL DETAIL	FIGURE
	JOB NO: DATE:	SCALE: NTS DRAWN BY: WHW CHECKED BY: JC	



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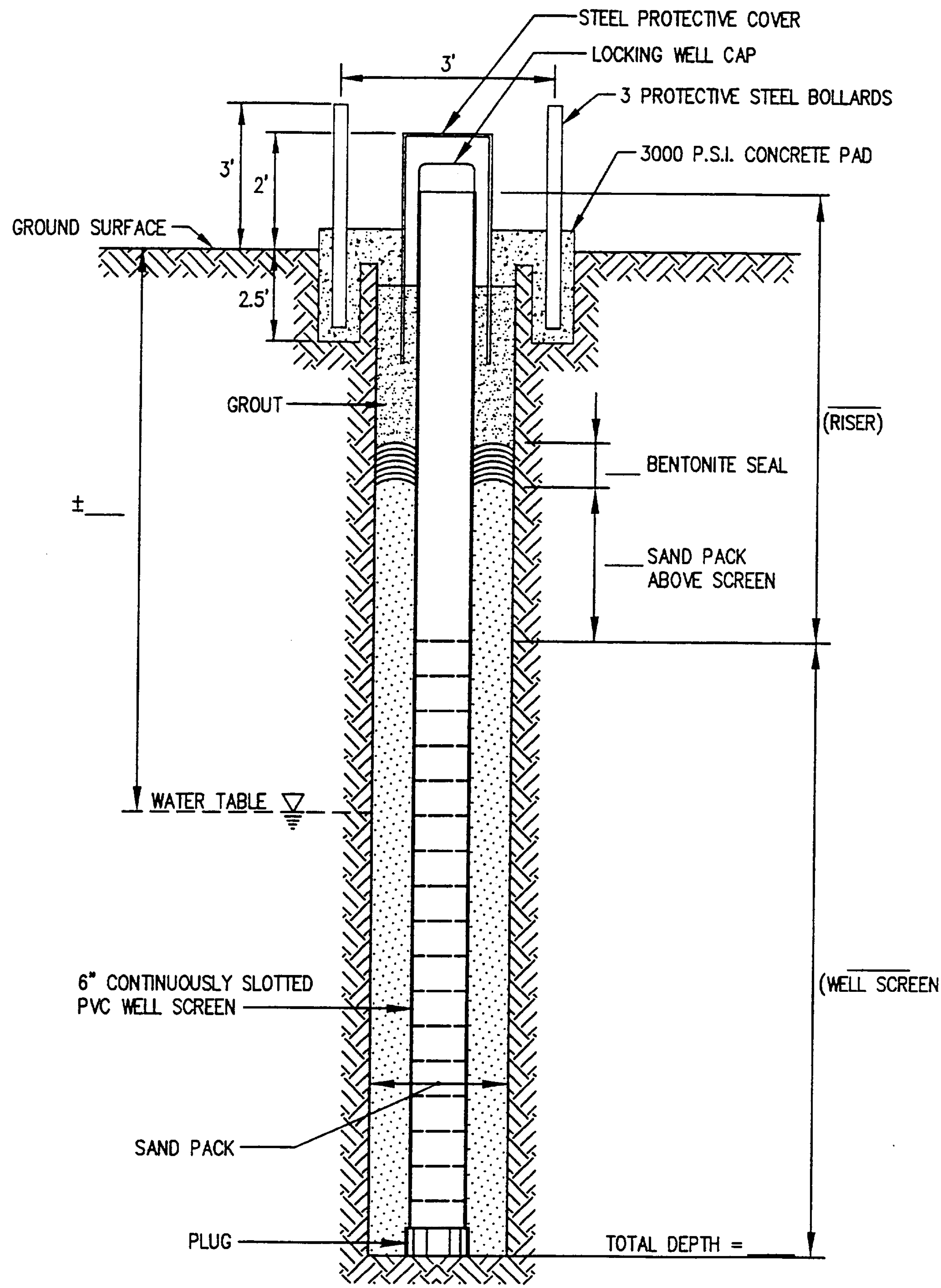


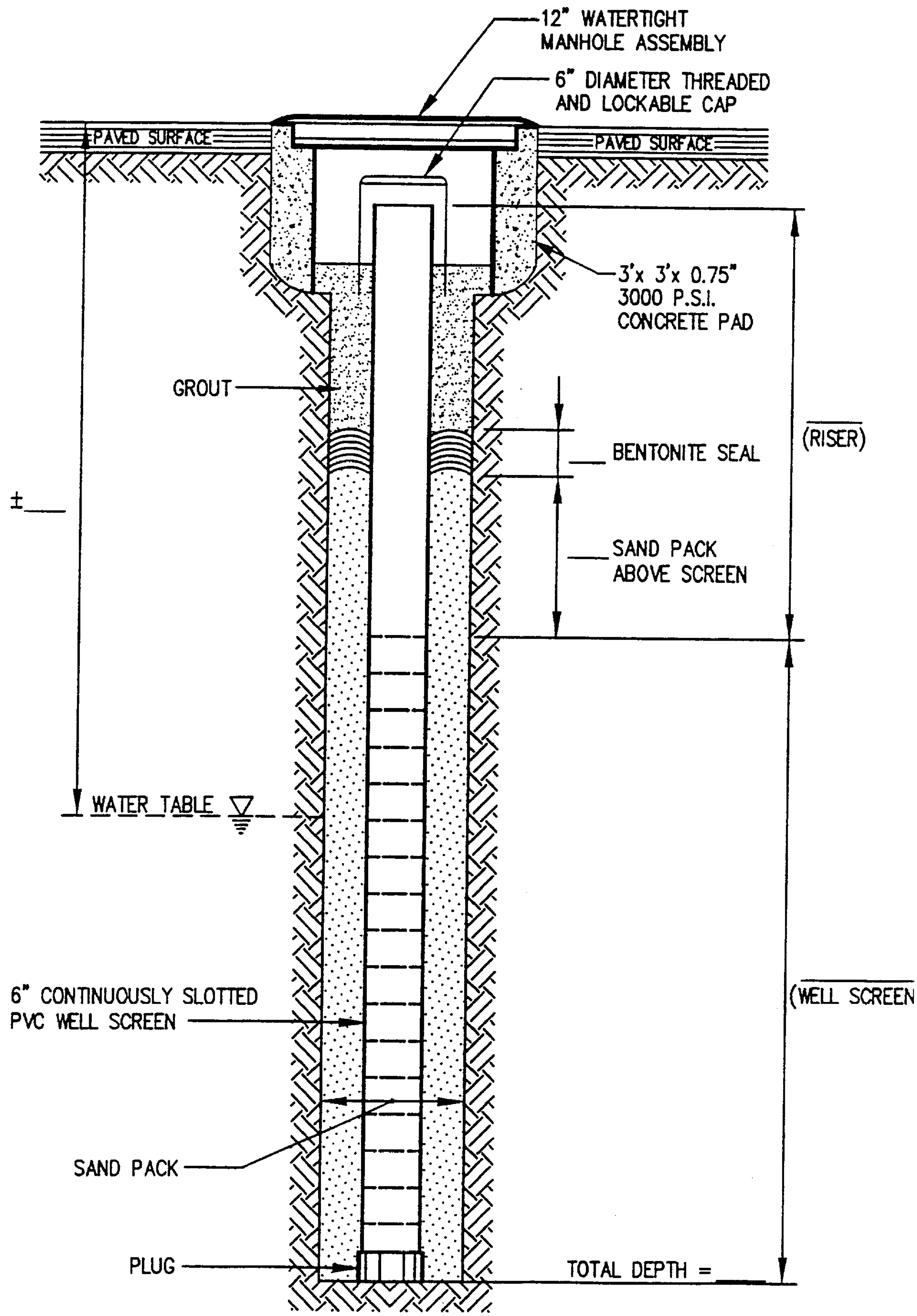
Richard Catlin & Associates, Inc.
ENVIRONMENTAL ENGINEERS
AND HYDROGEOLOGISTS
RC&A
WILMINGTON, NC CHARLESTON, SC ATLANTA, GA WINSTON-SALEM, NC

PROJECT

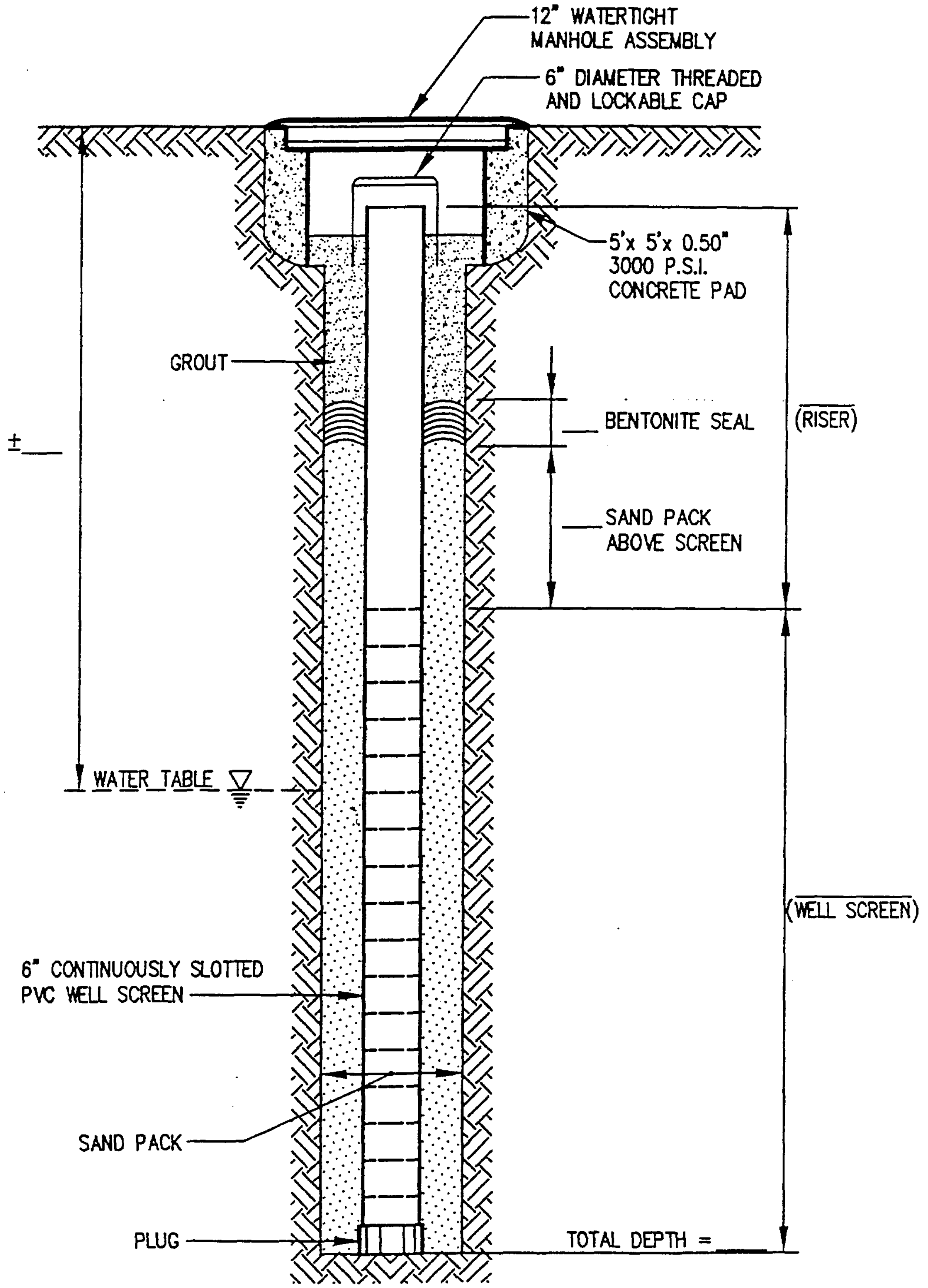
TITLE
ABOVE GROUND
PUMPING WELL DETAIL

FIGURE

JOB NO:
DATE:
SCALE: NTS
DRAWN BY: WHW
CHECKED BY: JC



Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS RC&A WILMINGTON, NC CHARLESTON, SC ATLANTA, GA WINSTON-SALEM, NC	PROJECT	TITLE PAVED SURFACE PUMPING WELL DETAIL	FIGURE
	JOB NO: DATE:	SCALE: NTS DRAWN BY: WHW CHECKED BY: JC	



Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS RC&A	PROJECT		TITLE UNPAVED SURFACE PUMPING WELL DETAIL			FIGURE
WILMINGTON, NC CHARLESTON, SC ATLANTA, GA WINSTON-SALEM, NC	JOB NO:	DATE:	SCALE: NTS	DRAWN BY: WHW	CHECKED BY: JC	

ACAD FILE: STD DETAILS 5

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, NC 27611-7687
PHONE: (910) 733-3221

FOR OFFICE USE ONLY

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

WELL CONSTRUCTION RECORD FOR

DRILLING CONTRACTOR Richard Catlin & Associates, Inc.

DRILLER REGISTRATION NUMBER 1142

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below) County: ________
   Nearest Town: ________

   ____
   (Road, Community, or Subdivision and Lot No.)
2. OWNER ________

   ADDRESS ________
   (Street or Route No.)

   ____
   City or Town State Zip Code
3. DATE DRILLED ___ USE OF WELL Monitoring
4. TOTAL DEPTH ' CUTTINGS COLLECTED X YES ___ NO
5. DOES WELL REPLACE EXISTING WELL? ___ YES X NO
6. STATIC WATER LEVEL:± ___ FT. ___ ABOVE/BELOW TOP OF CASING.
7. YIELD (gpm): N/A METHOD OF TEST N/A
8. WATER ZONES (depth): Surficial Aquifer
9. CHLORINATION: Type: N/A Amount N/A
10. CASING:

Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	To	Ft.	2 in.	SCH40	PVC
From	To	Ft.	in.		

11. GROUT:

Depth			Material	Method
From	To	Ft.	CEMENT	TREMIE
From	To	Ft.	BENTONITE	CHIPS

12. SCREEN:

Depth			Diameter	Slot Size	Material
From	To	Ft.	2 in.	.010 in.	PVC

13. GRAVEL PACK:

Depth			Size	Material
From	To	Ft.	TORPEDO	SAND

14. REMARKS: ________

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

Depth From	To	DRILLING LOG Formation Description

SEE ATTACHED

If additional space is needed use back of form.

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

SEE ATTACHED

____
SIGNATURE OF CONTRACTOR OR AGENT DATE
Submit original to Division of Environmental Management and copy to well owner.

GW-1 REVISED 2/90

WELL SAMPLING WORKSHEET

PROJECT______________________________ DATE____________________

PROJECT NO.______________________________ SAMPLED BY____________________

WELL NO.

TIME

WELL DIAMETER

WELL DEPTH - A ____________________

DEPTH TO WATER - B ____________________

(A-B) FT H_20 IN WELL - C ____________________

GALLONS/FT - D ____________________

(C x D) ONE VOLUME - E ____________________

(E x 3) THREE VOLUMES - F ____________________

VOLUME OF BAILER - G ____________________

(F-G) NO. BAILS REQUIRED - H ____________________

NO. BAILS TAKEN - I ____________________

FIELD TESTS:

pH ____________________

CONDUCTIVITY ____________________

OTHERS ____________________

VOLUMES:

3' x 1.5" BAILER = 0.24 GAL/BAIL

4' x 1.5" BAILER = 0.37 GAL/BAIL

1-1/4" WELL = 0.064 GAL/FT

2" WELL = 0.163 GAL/FT

4" WELL = 0.653 GAL/FT

Report To:

GeoChem, Incorporated

Environmental Laboratories

2500 Gate Way Centre Blvd., Suite 300
Morrisville, NC 27560

Bill To:

Chain of Custody Record

Page 1 of ______

PROJECT SITE NUMBER	PO#	NO. OF CONTAINERS PER LOCATION	ANALYSES	GEOCHEM PROJECT #
SITE NAME				DATE DUE
COLLECTED BY *(Signature)*				VERBAL/FAX/HARDCOPY

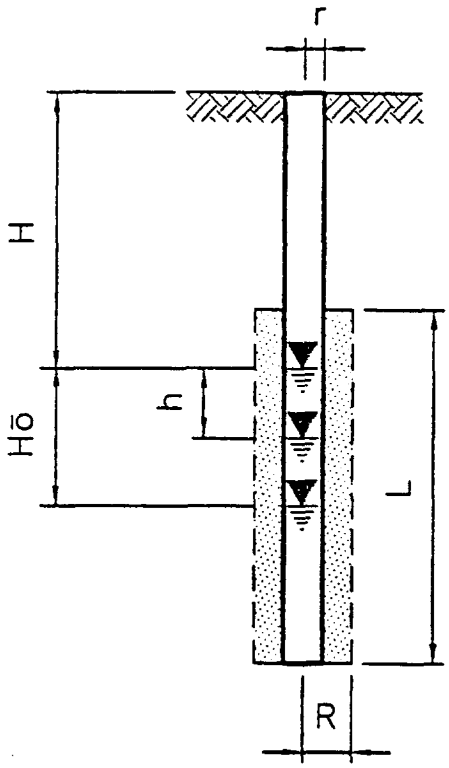
FIELD SAMPLE ID	TURNAROUND IN DAYS	SAMPLE MATRIX	DATE AND TIME COLLECTED												REMARKS	LAB ID NO. (for lab use only)

REMARKS	RELINQUISHED BY:	DATE	TIME

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME

IN-SITU PERMEABILITY (SLUG) TEST

(HVORSLEV, 1951)



STATIC LEVEL (H): ____________ INITIAL DROP (H_o): ____________

PIPE RADIUS (r): ____________ SAND PACK LENGTH (L): ____________

BORE HOLE RADIUS (R): ________ LEVEL DURING RECOVERY (h): ________

TIME REQUIRED FOR h/H_o TO EQUAL 0.37 (T_o): __________

- HYDRAULIC CONDUCTIVITY: $K = \frac{r^2 \ln(L/R)}{2LT_o}$

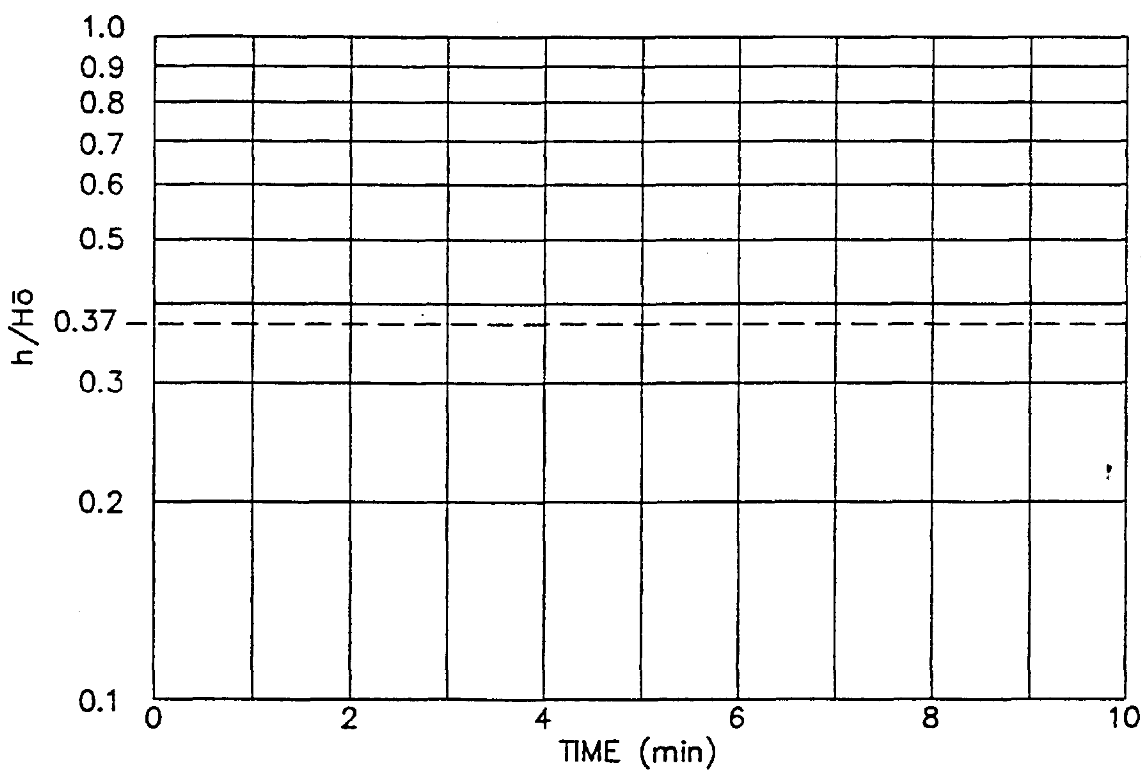
K= ________________

HYDRAULIC GRADIENT (dh/dL): __________

EFFECTIVE PORORSITY (Ne): __________

- GROUND WATER VELOCITY: $V_x = \frac{K(dh/dL)}{(Ne)}$

Vx= ________________



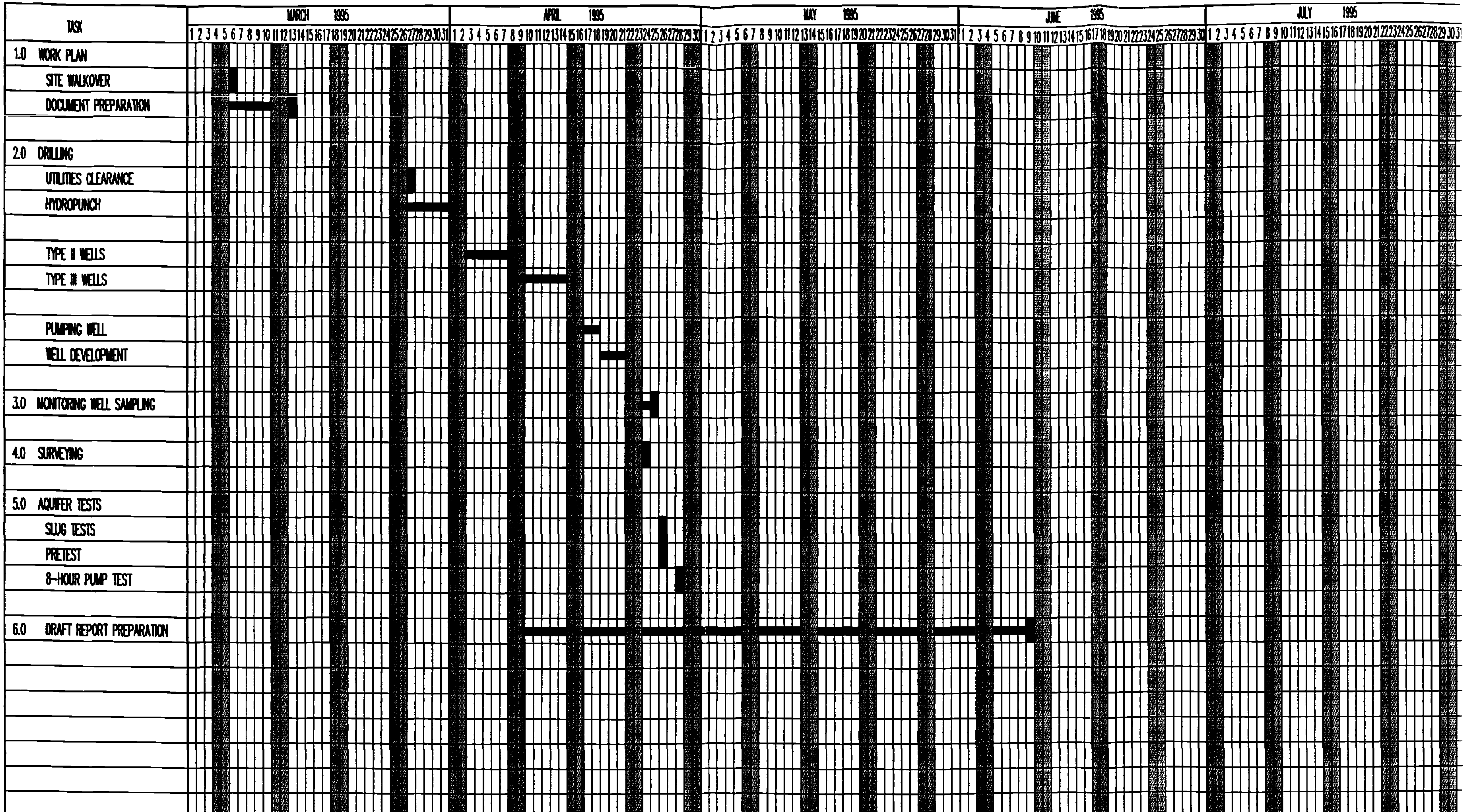
________ SCREEN INTERSECTS WATER TABLE LOCATION ____________

________ REMOVING A SLUG WELL NO. ____________

CALCULATED BY: ____________	PROJECT NAME: ____________
CHECKED BY: ____________	PROJECT NO. ____________ DATE: ____________

FORM NO. S. -2 NOV 93

APPENDIX III
PROJECT SCHEDULE



DENOTES ACTUAL DAYS EVENT WILL OCCUR

DENOTES TIME FRAME WHICH EVENT WILL OCCUR

00090D032

Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS RC&A WILMINGTON, NC CHARLESTON, SC ATLANTA, GA MOORESVILLE, NC	PROJECT BLDG 1613 1-4 LANTDIV NAVFACENGCOM CAMP LEJEUNE, N.C. JOB NO. 94127SCH DATE MAR 1995	TITLE SCHEDULE OF EVENTS 1 MAR 95 TO 31 JULY 95 SCALE NTS DRAWN BY WHW CHECKED BY JC	FIGURE 1 SHEET 1 OF 1

CAD FILE: \DWG\LANTDIV\94127SC

APPENDIX B

SOIL TEST BORING RECORDS

BORING LOG

BORING NUMBER: 1613-1
TOTAL DEPTH: 20'

BUILDING 1613, USTs 1613 1-4
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

DRILLED BY: D. STACK
LOGGED BY: S. HUDSON

DRILLING DATE: 4/10/95

SAMPLE DEPTH (FT.)		SAMPLE DESCRIPTION	USCS	WATER CONTENT	HC ODOR	PID/ FID PPM	BLOW COUNT
2.0	4.0	Light tan/brown, SAND with minor silt, fine grained, moderately sorted.	SP	Dry	No	0.0	Grab
5.0	7.0	Light tan/brown, SAND with minor silt, fine grained, moderately sorted.	SP	Damp	No	1.4	HP-HP-HP-HP
10.0	12.0	Light gray/orange and brown/tan mottled, SAND with minor silt, fined grained, moderately sorted.	SP	Moist	No	1.0	9-18-9-12
15.0	17.0	Dark brown, SANDY CLAY, fine grained, soft, moderate plasticity, many root fragments.	SC	Wet	No	3.6	HP-HP-HP-HP
20.0	22.0	Light gray/white and orange/brown, SAND with minor silts, fine to medium grained, moderately sorted.	SP	Wet	No	1.4	4-6-6-5

REMARKS: Grab = Grab Sample, HP = Hydraulic Push

BORING LOG

BORING NUMBER: 1613-2
TOTAL DEPTH: 20'

BUILDING 1613, USTs 1613 1-4
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

DRILLED BY: D. STACK
LOGGED BY: S. HUDSON

DRILLING DATE: 4/10/95

SAMPLE DEPTH (FT.)		SAMPLE DESCRIPTION	USCS	WATER CONTENT	HC ODOR	PID/ FID PPM	BLOW COUNT
2.0	4.0	Light tan/gray, SAND, fine grained, well sorted, high permeability.	SP	Dry	No	2.6	Grab
5.0	7.0	Light tan/gray and orange/brown mottled, SAND with minor silts, very fine to fine grained, moderately sorted.	SP	Damp	No	1.2	HP-HP-HP-HP
10.0	12.0	(10-11.5) Light tan/gray and orange brown mottled, SAND with minor silts, very fine to fine grained, moderately sorted.	SM	Moist	No	0.0	5-5-5-8
		(11.5-12) Gray, SILTY SAND, very fine to fine grained, moderately poor sorting.					
15.0	17.0	Gray, CLAYEY SAND, very fine to fine grained, moderately poor sorting, semi-cohesive.	SC	Wet	No	150	HP-HP-HP-HP
20.0	22.0	Gray, CLAYEY SAND with interbedded peat layers, very fine to fine grained, large root fragments, moderately poor sorting, semi-cohesive.	SC	Wet	No	420	HP-HP-HP-HP

REMARKS: Grab = Grab Sample, HP = Hydraulic Push

BORING LOG

BORING NUMBER: 1613-3
TOTAL DEPTH: 15'

BUILDING 1613, USTs 1613 1-4
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

DRILLED BY: D. STACK
LOGGED BY: S. HUDSON

DRILLING DATE: 4/11/95

SAMPLE DEPTH (FT.)		SAMPLE DESCRIPTION	USCS	WATER CONTENT	HC ODOR	PID/ FID PPM	BLOW COUNT
2.0	4.0	Yellowish orange, SAND with minor silts, very fine to fine grained, moderately well sorted, moderate to moderately low permeability.	SP	Dry	No	1.2	Grab
5.0	7.0	Yellowish orange/red and orange/light gray mottled, SAND with minor silts, very fine to fine grained, moderately well sorted, moderate to moderately low permeability.	SP	Dry	No	2.6	3-5-3-6
10.0	12.0	Light gray and gray, SANDY CLAY, with interbedded coarse grained SILTY SANDS, soft cohesive, high plasticity.	SC	Wet	No	5.8	HP-HP-HP-HP
15.0	17.0	Light gray, SAND, very fine to medium grained, poorly sorted, minor silts, firm to loose.	SP	Wet	No	3.0	HP-HP-HP-HP

REMARKS: Grab = Grab Sample, HP = Hydraulic Push

BORING LOG

BORING NUMBER: 1613-4
TOTAL DEPTH: 15'

BUILDING 1613, USTs 1613 1-4
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

DRILLED BY: D. STACK
LOGGED BY: S. HUDSON

DRILLING DATE: 4/11/95

SAMPLE DEPTH (FT.)		SAMPLE DESCRIPTION	USCS	WATER CONTENT	HC ODOR	PID/ FID PPM	BLOW COUNT
2.0	4.0	Dark brown, SILTY SAND, very fine to medium grained, poorly sorted, semi-cohesive.	SM	Damp	No	11	Grab
5.0	7.0	Dark brown, SILTY CLAY, soft, high plasticity, root fragments.	SC	Moist	No	6.2	HP-HP-HP-HP
10.0	12.0	(10-11) Light gray, SANDY CLAY, very soft, poorly sorted. (11-12) Gray, SILTY CLAY, medium grained, stiff, very cohesive, high plasticity.	SC	Wet	No	3.4	HP-HP-HP-HP
15.0	17.0	Light milky gray, alternating layers (3-4") of SANDS (medium grained, moderately sorted) and SILTY SANDS, (medium grained, poorly sorted), loose to tight.	SM	Wet	No	8.4	HP-HP-HP-HP

REMARKS: Grab = Grab Sample, HP = Hydraulic Push

BORING LOG

BORING NUMBER: 1613-5
TOTAL DEPTH: 15'

BUILDING 1613, USTs 1613 1-4
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

DRILLED BY: D. STACK
LOGGED BY: S. HUDSON

DRILLING DATE: 4/11/95

SAMPLE DEPTH (FT.)		SAMPLE DESCRIPTION	USCS	WATER CONTENT	HC ODOR	PID/ FID PPM	BLOW COUNT
2.0	4.0	Yellowish orange, SILTY SAND, very fine to fine grained, moderately sorted.	SM	Dry	No	2.2	Grab
5.0	7.0	Dark gray to black, SILTY SAND, very fine to medium grained, moderately poor sorting, root fragments.	SM	Wet	No	12	HP-HP-HP-HP
10.0	12.0	Light gray, SILTY CLAY with minor medium grained sands, medium stiff, high plasticity.	CL	Wet	No	3.6	HP-HP-HP-HP
15.0	17.0	Gray, alternating layers of SILTY CLAY and SANDY CLAY, very fine to medium grained, medium stiff, moderate plasticity.	CL	Wet	No	4.4	HP-HP-HP-HP

REMARKS: Grab = Grab Sample, HP = Hydraulic Push

BORING LOG

BORING NUMBER: 1613-6
TOTAL DEPTH:15'

BUILDING 1613, USTs 1613 1-4
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

DRILLED BY: D. STACK
LOGGED BY: S. HUDSON

DRILLING DATE: 4/11/95

SAMPLE DEPTH (FT.)		SAMPLE DESCRIPTION	USCS	WATER CONTENT	HC ODOR	PID/ FID PPM	BLOW COUNT
2.0	4.0	Brown, SILTY SAND, very fine to fine grained, moderately well sorted, root fragments.	SM	Dry	No	1.0	Grab
5.0	7.0	Brown, and orange/brown mottled, SAND with minor silts, fine to medium grained, moderately well sorted.	SP	Damp	No	1.2	HP-HP-HP-HP
10.0	12.0	Light gray/white, SAND, fine grained, well sorted, high permeability, clean sands.	SP	Moist	No	1.0	4-6-10-11
15.0	17.0	Light gray/white, SAND, fine grained, well sorted, high permeability, clean sands.	SP	Wet	No	3.4	HP-13-15-10

REMARKS: Grab = Grab Sample, HP = Hydraulic Push

BORING LOG

ORING NUMBER: 1613-7
TOTAL DEPTH: 18.5'

BUILDING 1613, USTs 1613 1-4
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

DRILLED BY: D. STACK
LOGGED BY: S. HUDSON

DRILLING DATE: 4/12/95

SAMPLE DEPTH (FT.)		SAMPLE DESCRIPTION	USCS	WATER CONTENT	HC ODOR	PID/ FID PPM	BLOW COUNT
2.0	4.0	Tan/brown, SAND, fine grained, moderately well sorted, minor silts, root fragments.	SP	Dry	No	5.6	Grab
5.0	7.0	Tan/brown, SILTY SAND, fine grained, moderately well sorted, minor silts, root fragments.	SM	Dry	No	6.2	HP-HP-HP-HP
10.0	12.0	Tan/brown, SILTY SAND, fine grained, moderately well sorted, minor silts, root fragments.	SM	Moist	No	1.0	HP-HP-HP-HP
15.0	17.0	Gray, SILTY SAND, very fine to medium grained, moderately sorted.	SM	Wet	No	0.8	HP-HP-HP-HP

REMARKS: Grab = Grab Sample, HP = Hydraulic Push

BORING LOG

BORING NUMBER: 1613-8
TOTAL DEPTH: 18'

BUILDING 1613, USTs 1613 1-4
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

DRILLED BY: D. STACK
LOGGED BY: S. HUDSON

DRILLING DATE: 4/12/95

SAMPLE DEPTH (FT.)		SAMPLE DESCRIPTION	USCS	WATER CONTENT	HC ODOR	PID/ FID PPM	BLOW COUNT
2.0	4.0	Brown to orange/brown, SILTY SAND, very fine to fine grained, poorly sorted, semi-cohesive.	SM	Damp	No	2.6	Grab
5.0	7.0	Tan/brown, SANDY CLAY with interbedded sand layers, very fine to medium grained, moderately sorted, slick, firm cohesive.	SC	Wet	No	1.4	HP-HP-HP-HP
10.0	12.0	Gray, CLAY with minor fine grained sand, well sorted, slick, soft, cohesive, high plasticity.	CL	Wet	No	0.8	HP-HP-HP-HP
15.0	17.0	Gray, CLAY with a 1/2" SAND layer at 15.5', well sorted, slick, soft, cohesive, high plasticity.	CL	Wet	No	0.8	HP-HP-HP-HP

REMARKS: Grab = Grab Sample, HP = Hydraulic Push

BORING LOG

BORING NUMBER: 1613-9
TOTAL DEPTH:15'

BUILDING 1613, USTs 1613 1-4
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

DRILLED BY: D. STACK
LOGGED BY: S. HUDSON

DRILLING DATE: 4/13/95

SAMPLE DEPTH (FT.)		SAMPLE DESCRIPTION	USCS	WATER CONTENT	HC ODOR	PID/ FID PPM	BLOW COUNT
2.0	4.0	Dark brown, CLAYEY SAND, very fine to fine grained, poorly sorted, soft, moderate plasticity.	SC	Moist	No	1.6	Grab
5.0	7.0	Tan brown, SANDY SILT, very loose, very fine to fine grained, poorly sorted, soft.	SM	Wet	No	2.0	HP-HP-HP-HP
10.0	12.0	Light gray (milky), SILTY SAND with interbedded medium grained, well sorted SAND, very fine to medium grained, moderately sorted, medium stiff.	SM	Wet	No	1.2	HP-HP-HP-HP
15.0	17.0	(15-16) Gray, SANDY SILT, very fine to fine grained, moderately sorted, medium stiff, high plasticity, moderate dilatency.	SM	Wet	No	12	HP-HP-HP-HP
		(16-27) Gray, SILTY CLAY, moderately sorted, soft, high plasticity, slick cohesive, moderately high dilatency.	SC				

REMARKS: Grab = Grab Sample, HP = Hydraulic Push

BORING LOG

BORING NUMBER: 1613-10
TOTAL DEPTH: 18'

BUILDING 1613, USTs 1613 1-4
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

DRILLED BY: D. STACK
LOGGED BY: S. HUDSON

DRILLING DATE: 4/18/95

SAMPLE DEPTH (FT.)		SAMPLE DESCRIPTION	USCS	WATER CONTENT	HC ODOR	PID/ FID PPM	BLOW COUNT
0.0	2.0	Light to dark brown, SAND, loose, loamy, very fine to fine grained, well rounded.	SP	Low	No	18	Grab
2.0	4.0	Dark brown, SAND, loose, loamy, fine grained, well rounded.	SP	Low	Slight	16	Grab
5.0	7.0	Light gray to light brown, SILTY SAND, very fine grained, minor clay present, loose to medium dense.	SM	Low	Slight	40	HP-8-8-16
10.0	12.0	Yellowish orange, SILTY, CLAYEY SAND, very fine grained, soft.	SC	Moderate	Moderate	560	HP-HP-HP-HP
15.0	17.0	Light brown, SILTY SAND, very fine grained, medium dense.	SM	Moderate	Strong	750	HP-HP-HP-HP

REMARKS: Grab = Grab Sample, HP = Hydraulic Push

BORING LOG

BORING NUMBER: 1613-11
TOTAL DEPTH: 20'

BUILDING 1613, USTs 1613 1-4
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

DRILLED BY: D. STACK
LOGGED BY: S. HUDSON

DRILLING DATE: 4/18/95

SAMPLE DEPTH (FT.)		SAMPLE DESCRIPTION	USCS	WATER CONTENT	HC ODOR	PID/ FID PPM	BLOW COUNT
2.0	4.0	Light and dark gray mottled, SAND, fine grained, loamy, loose.	SP	Low	No	8.4	Grab
5.0	7.0	Light gray and light brown mottled, SANDY CLAY, fine grained, medium stiff to stiff.	SC	Low	No	3.2	HP-HP-HP-HP
10.0	12.0	Light brown and light gray mottled, SILTY CLAY, very fine grained, stiff.	CL	Low	No	14	HP-HP-HP-HP
15.0	17.0	Light gray, SILTY, SANDY CLAY, very fine to fine grained, soft to medium stiff.	SC	Moderate	No	16	HP-HP-HP-HP
20.0	22.0	Yellowish orange, CLAYEY SAND, very fine to fine grained, minor shell fragments.	SC	High	No	12	HP-HP-HP-HP

REMARKS: Grab = Grab Sample, HP = Hydraulic Push

BORING LOG

.ORING NUMBER: 1613-12
TOTAL DEPTH: 20'

BUILDING 1613, USTs 1613 1-4
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

DRILLED BY: D. STACK
LOGGED BY: S. HUDSON

DRILLING DATE: 4/18/95

SAMPLE DEPTH (FT.)		SAMPLE DESCRIPTION	USCS	WATER CONTENT	HC ODOR	PID/ FID PPM	BLOW COUNT
0.0	2.0	Dark gray, SAND, very fine to fine grained, loamy, loose, poorly sorted.	SP	Low	No	4.6	Grab
5.0	7.0	Light and dark gray mottled, SILTY SAND, very fine grained, loose to medium dense.	SM	Low	No	7.8	HP-HP-HP-HP
10.0	12.0	Light and greenish gray mottled, SILTY SAND, very fine grained, minor clay present, loose to medium dense.	SM	Low	No	0.6	HP-HP-HP-HP
15.0	17.0	Light gray, SILTY SAND, very fine to fine grained, medium dense.	SM	Moderate	No	0.8	HP-HP-HP-HP
20.0	22.0	Light gray, CLAYEY SAND, very fine to fine grained, medium dense.	SC	High	No	1.0	HP-HP-HP-HP

REMARKS: Grab = Grab Sample, HP = Hydraulic Push

BORING LOG

ɔORING NUMBER: 1613-13
TOTAL DEPTH: 50'

BUILDING 1613, USTs 1613 1-4
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

DRILLED BY: D. STACK
LOGGED BY: S. HUDSON

DRILLING DATE: 4/13/95

SAMPLE DEPTH (FT.)		SAMPLE DESCRIPTION	USCS	WATER CONTENT	HC ODOR	PID/ FID PPM	BLOW COUNT
0.0	2.5	Light brown, SILTY SAND, very fine to fine grained, moderately sorted.	SM	Damp	No	0.8	Grab
2.5	5.0	Tan/brown, SAND, fine grained, moderately well sorted, minor silts.	SP	Damp	No	0.8	Grab
5.0	7.5	Tan/brown, SILTY SAND, fine grained, moderate;y well sorted, minor silts.	SM	Dry	No	4.4	HP-HP-HP-HP-HP
7.5	10.0	Tan/brown, SILTY SAND, fine grained, moderately well sorted, minor silts.	SM	Damp	No	3.4	HP-HP-HP-HP-HP
10.0	12.5	Tan/brown, SILTY SAND, fine grained, moderately well sorted, minor silts.	SM	Moist	No	1.0	HP-HP-HP-HP-HP
12.5	15.0	Tan/brown and gray mottled, SILTY SAND, very fine to medium grained, moderately poor sorting.	SM	Wet	No	6.8	HP-HP-HP-HP-HP
15.0	17.5	Gray, SILTY SAND, very fine to fine grained, moderately sorted.	SM	Wet	No	1.8	HP-HP-HP-HP-HP
17.5	20.0	(17.5-18.5) Gray, SILTY SAND, very fine to fine grained, moderately sorted.	SM	Wet	No	9.2	HP-HP-6-12-19
		(18.5-19.5) Gray, CLAY with minor silts and fine grained sands, stiff, moderate plasticity, very cohesive, low to no dilatency.	CL				
		(19.5-20) Light gray, SAND, medium to fine grained, moderately well sorted, clean, tight.					
20.0	22.5	(20-22) Light gray, SAND, medium to fine grained, moderately well sorted, clean, tight.	SP	Wet	No	18	HP-HP-HP-HP-HP
		(22-22.5) Orange/brown and light gray mottled, SILTY SAND, very fine to fine grained, moderately sorted.					
22.5	25.0	Orange/brown, SAND, fine grained, moderately well sorted, loose.	SP	Wet	No	8.8	HP-HP-HP-HP-HP

REMARKS: Grab = Grab Sample, HP = Hydraulic Push

BORING LOG

BORING NUMBER: 1613-13
TOTAL DEPTH: 50'

BUILDING 1613, USTs 1613 1-4
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

DRILLED BY: D. STACK
LOGGED BY: S. HUDSON

DRILLING DATE: 4/13/95

SAMPLE DEPTH (FT.)		SAMPLE DESCRIPTION	USCS	WATER CONTENT	HC ODOR	PID/ FID PPM	BLOW COUNT
25.0	27.5	(25-25.5) Orange/brown, SAND, fine grained, moderately well sorted, loose.	SP	Wet	No	15	HP-HP-HP-HP-HP
		(25.5-26) Gray, CLAY, firm, low dilatency.	CL				
		(26-27) Light gray, GRAVELY SAND, fine to gravel sized, well rounded, moderately sorted, loose.	GP				
		(27-27.5) Orange/brown, SILTY SAND, very fine to medium grained, moderately sorted.	SM				
27.5	30.0	Orange/brown, SILTY SAND, very fine to medium grained, moderately sorted.	SM	Wet	No	1.6	HP-HP-HP-HP-HP
30.0	32.5	Orange/brown, SILTY SAND, very fine to medium grained, moderately sorted.	SM	Wet	No	1.2	WR-WR-WR-WR-WR
32.5	35.0	Tan/brown, SAND, fine grained, moderately well sorted.	SP	Wet	No	3.0	WR-WR-WR-WR-WR
35.0	37.5	Tan/brown, SAND with limestone fragments, fine grained, moderately well sorted.	SP	Wet	No	0.6	HP-7-7-9-10
37.5	40.0	Tan/brown, SANDY LIMESTONE, fine to coarse grained, plecapod mold.	LM	Wet	No	0.8	6-9-9-14-12
40.0	42.0	Tan/brown with gray sands, very SANDY LIMESTONE, poorly sorted, fragmented, moderately poor consolidation.	LM	Wet	No		10-10-13-7
45.0	47.0	Gray with black speckles, SAND with limestone fragments, very fine to fine grained, poorly sorted, beach deposit.	LM	Wet	No		6-6-5-9
50.0	52.0	Tan/brown to gray, LIMESTONE, moderately well consolidated, SAND and SILT matrix, ecinoderm spines and plecapod molds.	LM	Wet	No		15-12-10-18

REMARKS: Grab = Grab Sample, HP = Hydraulic Push, WR = Weight of Rod

BORING LOG

BORING NUMBER: 1613-14
TOTAL DEPTH: 50'

BUILDING 1613, USTs 1613 1-4
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

DRILLED BY: D. STACK
LOGGED BY: S. HUDSON

DRILLING DATE: 4/17/95

SAMPLE DEPTH (FT.)		SAMPLE DESCRIPTION	USCS	WATER CONTENT	HC ODOR	PID/ FID PPM	BLOW COUNT
0.0	2.5	Dark brown,, SILTY SAND, very fine to fine grained, loose.	SM	Low	NO	8.0	Grab
2.5	5.0	Light gray, SILTY SAND, loamy, very fine grained, very well rounded.	SM	Low	No	4.4	HP-HP-HP-HP-HP
5.0	7.5	Light gray, SAND, very fine grained, medium dense.	SP	Low	No	26	HP-HP-HP-HP-HP
7.5	10.0	Yellowish orange and light gray mottled, SILTY SAND, very fine grained, minor clay present, medium dense.	SM	Low	No	13	HP-HP-HP-HP-HP
10.0	12.5	Yellowish orange and light gray, slightly mottled, SAND, very fine to fine grained, medium dense.	SP	Low	No	20	HP-HP-HP-HP-HP
12.5	15.0	(12.5-14) Yellowish orange, SAND, very fine grained, medium dense.	SP	High	No	20	HP-HP-HP-HP-HP
		(14-15) Dark gray, SILTY SAND, very fine to fine grained, medium dense.	SM				
15.0	17.5	Olive gray to light brown, SILTY SAND, very fine grained, minor clay present.	SM	Low	No	16	HP-HP-HP-HP-HP
17.5	20.0	Light gray and light brown mottled, SILTY SAND, very fine to fine grained, medium dense.	SM	Moderate	Slight	38	9-10-10-15-8
20.0	22.5	Light gray, SAND, fine to medium grained, medium dense, well rounded.	SP	Moderate	Moderate	88	HP-HP-HP-10-12
22.5	25.0	Light gray, SAND, very fine to fine grained, medium dense, minor clay present.	SP	Moderate	Slight	140	HP-HP-HP-HP-HP

REMARKS: Grab = Grab Sample, HP = Hydraulic Push

BORING LOG

BORING NUMBER: 1613-14
TOTAL DEPTH: 50'

BUILDING 1613, USTs 1613 1-4
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

DRILLED BY: D. STACK
LOGGED BY: S. HUDSON

DRILLING DATE: 4/17/95

SAMPLE DEPTH (FT.)		SAMPLE DESCRIPTION	USCS	WATER CONTENT	HC ODOR	PID/ FID PPM	BLOW COUNT
25.0	27.5	Yellowish orange and light gray mottled, SILTY, CLAYEY SAND, medium dense, very soft, very fine to fine grained.	SC	Moderate	Slight	70	HP-HP-HP-HP-HP
27.5	30.0	Light greenish gray, SILTY SAND, very fine to medium grained, medium dense.	SM	High	Slight	64	HP-HP-HP-HP-HP
30.0	32.5	Light gray to beige, SILTY SAND, fine grained, medium dense.	SM	High	Slight	38	HP-HP-HP-HP-HP
32.5	35.0	Light gray, SILTY SAND, fine to medium grained, medium dense, shell fragments.	SM	Moderate	Slight	14	WR-WR-HP-HP-HP
35.0	37.5	Light olive gray, SAND, fine to medium grained, medium dense, shell fragments.	SP	Moderate	No	20	WR-WR-HP-HP-HP
37.5	40.0	Light greenish gray, SILTY SAND, fine grained, shell fragments.	SM	Moderate	No	10	WR-WR-HP-HP-HP
40.0	42.0	Light brown/tan, SANDY LIMESTONE, poorly consolidated.	LM	Wet	No	24	16-12-19-23
45.0	47.0	Gray with black specks, SAND with limestone fragments, poorly sorted, very fine to fine grained.	SP	Wet	No	0.0	HP-HP-HP-HP
50.0	52.0	Gray with black specks, SAND with limestone fragments, poorly sorted, very fine to fine grained.	SP	Wet	No	3.2	7-12-9-8

REMARKS: Grab = Grab Sample, HP = Hydraulic Push, WR = Weight of Rod

BORING LOG

BORING NUMBER: 1613-15
TOTAL DEPTH: 41'

BUILDING 1613, USTs 1613 1-4
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

DRILLED BY: T. CHALMERS
LOGGED BY: S. HUDSON

DRILLING DATE: 4/17/95

SAMPLE DEPTH (FT.)		SAMPLE DESCRIPTION	USCS	WATER CONTENT	HC ODOR	PID/ FID PPM	BLOW COUNT
0.0	2.5	Brown, SILTY SAND, very fine to fine grained, moderately sorted.	SM	Dry	No	3.2	Grab
2.5	5.0	Brown to tan/ brown mottled, SILTY SAND, very fine to fine grained, poorly sorted, semi-cohesive.	SM	Dry	No	1.0	Grab
5.0	7.5	Tan/brown, SANDY CLAY with interbedded medium grained SANDS, very fine to medium grained, moderately sorted, firm, slick, cohesive.	SC	Wet	No	1.8	HP-HP-HP-HP
7.5	10.0	Tan/brown, SANDY CLAY with interbedded medium grained SANDS, very fine to medium grained, moderately sorted, firm, slick, cohesive.	SC	Wet	No	2.0	HP-HP-HP-HP-HP
10.0	12.5	Gray, CLAY with minor fine grained sands, moderately well sorted, soft, slick, moderately high plasticity, high dilatency.	CL	Wet	No	9.2	HP-HP-HP-HP-HP
12.5	15.0	Gray, CLAY with minor fine grained sands, moderately well sorted, soft, slick, moderately high plasticity, high dilatency	CL	Wet	No	8.0	HP-HP-HP-HP-HP
15.0	17.5	Gray, CLAY with minor fine grained sands, 1/2" sand layer at 15.5', moderately well sorted, soft, slick, moderately high plasticity, high dilatency	CL	Wet	No	4.2	HP-HP-HP-HP-HP
17.5	20.0	Gray, CLAY with minor silts, firm, cohesive, high plasticity, low dilatency.	CL	Wet	No	1.5	HP-HP-HP-HP-HP
20.0	22.5	(20-20'4") Gray, CLAY with minor silts, firm, cohesive, high plasticity, low dilatency.	GP	Wet	Possible	0.8	HP-50 for 5"
		(20'4"-20'6") Orange brown, SANDY GRAVEL, very fine to pebble sized grains, poorly sorted, well rounded.					
		(20'6"-20'11") Light gray, SANDY LIMESTONE, shell fragments with calcareous mud matrix, moderately consolidated.					

REMARKS: Grab = Grab Sample, HP = Hydraulic Push

BORING LOG

BORING NUMBER: 1613-15
TOTAL DEPTH:41'

BUILDING 1613, USTs 1613 1-4
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

DRILLED BY: T. CHALMERS
LOGGED BY: S. HUDSON

DRILLING DATE: 4/17/95

SAMPLE DEPTH (FT.)		SAMPLE DESCRIPTION	USCS	WATER CONTENT	HC ODOR	PID/ FID PPM	BLOW COUNT
22.5	25.0	Light brown/gray, SANDY LIMESTONE, fine grained matrix, well consolidated, minor shell fragments, numerous casts and molds.	LM	Wet	No	0.8	36-22-16-12-13
25.0	27.5	Light tan/brown, consolidated sands, LIMESTONE, SANDS, very fine to medium grained, all are imbedded in 2" to 4" beds. Sands are fine to medium grained, poorly sorted. Consolidated sands are fine grained, calcareous cement, moderately well consolidated. Limestone, shell fragments with calcareous mud matrix, moderately consolidated.	LM	Wet	Minor	1.8	18-27-22-26-12
27.5	30.0	Gray, LIMESTONE, well consolidated, fine grained sand matrix, calcareous worm tubes, minor shell fragments, plecapod molds and casts, very fine to fine grained sands.	LM	Wet	Moderate	6.2	18-50-35-22-36
,0.0	32.5	Gray, LIMESTONE with consolidated SANDS, very fine to coarse grained, moderately sorted, moderate consolidation.	LM	Wet	Moderate	4.4	11-16-12-18-15
32.5	35.0	Gray, LIMESTONE with consolidated SANDS, very fine to coarse grained, moderately sorted, poorly consolidated.	LM	Wet	Possible	3.2	12-15-16-21-14
35.0	37.5	Gray, LIMESTONE with consolidated SANDS, very fine to coarse grained, moderately sorted, poorly consolidated.	LM	Wet	No	5.2	28-27-27-23-21
37.5	40.0	Gray, SANDY LIMESTONE, medium grained sands, moderately well consolidated, no shell fragments, very fine grained sand matrix.	LM	Wet	No	3.8	21-24-19-14-14

REMARKS:

BORING LOG

BORING NUMBER: 1613-16
TOTAL DEPTH: 37'

BUILDING 1613, USTs 1613 1-4
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

DRILLED BY: D. STACK
LOGGED BY: S. HUDSON

DRILLING DATE: 4/18/95

SAMPLE DEPTH (FT.)		SAMPLE DESCRIPTION	USCS	WATER CONTENT	HC ODOR	PID/ FID PPM	BLOW COUNT
2.0	4.0	Light to dark brown, SILTY SAND, very fine to fine grained, moderately sorted.	SM	Dry	Mild	18	Grab
5.0	7.0	Light brown, SILTY SAND, very fine to fine grained, moderate poor sorting, minor clays.	SM	Dry	Mild	12	HP-HP-HP-HP
10.0	12.0	Yellowish orange, SILTY SAND with moderate clays, soft, poorly sorted, very fine to fine grained.	SM	Moist	Moderate	>1000	HP-HP-HP-HP
15.0	17.0	Yellowish orange, SILTY SAND with moderate clays, moderate firm poorly sorted, very fine to fine grained.	SM	Wet	Strong	>1000	HP-HP-HP-HP
20.0	22.0	Light gray/brown, SAND with minor silts, very fine to fine grained, moderately sorted.	SM	Wet	Strong	>1000	HP-HP-HP-HP
25.0	27.0	Yellowish orange, CLAYEY SAND with minor silts, poorly sorted, high plasticity, moderate dilatency.	SC	Wet	Moderate	400	HP-HP-HP-HP
30.0	32.0	Light tan, SILTY SAND, very fine to fine grained, moderately sorted.	SM	Wet	Mild	64	HP-HP-HP-HP
35.0	37.0	Light green/gray, SAND with numerous shell fragments (coarse, poorly sorted), fine to medium grained.	SW	Wet	Mild	22	HP-HP-HP-HP
40.0	42.0	Light green/gray, SAND with numerous shell fragments (coarse, poorly sorted), fine to medium grained.	SW	Wet	Mild	10	HP-7-7-4

REMARKS: Grab = Grab Sample, HP = Hydraulic Push

APPENDIX C

GRAIN SIZE DISTRIBUTION, RISING HEAD TEST DATA-HYDRAULIC CONDUCTIVITY CALCULATIONS, AND SITE SENSITIVITY EVALUATION (SSE)

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AQTESOLV RESULTS
Version 2.01

Developed by Glenn M. Duffield
(c) 1988-1995 Geraghty & Miller, Inc.

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TEST DESCRIPTION

Data set........... 1613-1.DAT
Output file........ 1613-1.OUT
Data set title..... CAMP LEJEUNE - BUILDING 1613
Company............ RICHARD CATLIN & ASSOCIATES
Project............ 94127
Client............. LANTDIV
Location........... BLDG 1613
Test date.......... MAY 5, 1995
Obs. well.......... 1613-1

Units of Measurement
Length.......... ft
Time............ min

Test Well Data
Initial displacement in well..... 2.07
Radius of well casing............ 0.083
Radius of wellbore............... 0.333
Aquifer saturated thickness...... 50
Well screen length............... 15
Static height of water in well... 6.54
Gravel pack porosity............. 0.25
Effective well casing radius..... 0.1814
Effective wellbore radius........ 0.333
Log(Re/Rw)....................... 2.061
Constants A, B and C............. 2.919 , 0.472, 0.000
No. of observations.............. 180

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ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

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RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

	Estimate	Std. Error
K =	1.1447E-003 +/-	5.6240E-005 ft/min
y0 =	1.9431E+000 +/-	2.1146E-002 ft

ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
weighted residual = residual * weight

Weighted Residual Statistics:
Number of residuals............... 180
Number of estimated parameters.... 2
Degrees of freedom................ 178
Residual mean..................... 0.005376
Residual standard deviation....... 0.168
Residual variance................. 0.02824

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.0033	0.589	1.9399	-1.3509	1
0.0066	0.794	1.9366	-1.1426	1
0.01	1.049	1.9333	-0.8843	1
0.0133	1.276	1.9301	-0.65408	1
0.0166	1.635	1.9269	-0.29185	1
0.02	1.922	1.9235	-0.001534	1
0.0233	1.953	1.9203	0.03268	1
0.0266	2.045	1.9171	0.12789	1
0.03	2.073	1.9138	0.15919	1
0.0333	2.048	1.9106	0.13738	1
0.0366	2.041	1.9074	0.13358	1
0.04	2.026	1.9041	0.12186	1
0.0433	2.023	1.901	0.12204	1
0.0466	2.01	1.8978	0.11222	1
0.05	2.016	1.8945	0.12148	1
0.0533	1.997	1.8914	0.10565	1
0.0566	1.997	1.8882	0.10881	1
0.06	2.01	1.8849	0.12506	1
0.0633	1.988	1.8818	0.10621	1
0.0666	1.985	1.8786	0.10635	1
0.07	1.975	1.8754	0.099585	1
0.0733	1.972	1.8723	0.099718	1
0.0766	1.966	1.8692	0.096846	1
0.08	1.96	1.8659	0.094063	1
0.0833	1.783	1.8628	-0.07982	1
0.0866	1.956	1.8597	0.096293	1
0.09	1.937	1.8565	0.080494	1
0.0933	1.937	1.8534	0.083595	1
0.0966	1.947	1.8503	0.096692	1
0.1	1.941	1.8471	0.093876	1
0.1033	1.925	1.844	0.080962	1
0.1066	1.915	1.841	0.074043	1

0.11	1.919	1.8378	0.081212	1
0.1133	1.915	1.8347	0.080282	1
0.1166	1.909	1.8317	0.077347	1
0.12	1.865	1.8285	0.0365	1
0.1233	1.893	1.8254	0.067555	1
0.1266	1.9	1.8224	0.077604	1
0.13	1.897	1.8193	0.077741	1
0.1333	1.878	1.8162	0.06178	1
0.1366	1.884	1.8132	0.070815	1
0.14	1.884	1.8101	0.073936	1
0.1433	1.871	1.807	0.06396	1
0.1466	1.893	1.804	0.088979	1
0.15	1.874	1.8009	0.073084	1
0.1533	1.865	1.7979	0.067092	1
0.1566	1.856	1.7949	0.061096	1
0.16	1.859	1.7918	0.067186	1
0.1633	1.846	1.7888	0.057179	1
0.1666	1.862	1.7858	0.076168	1
0.17	1.837	1.7828	0.054241	1
0.1733	1.83	1.7798	0.05022	1
0.1766	1.83	1.7768	0.053193	1
0.18	1.818	1.7737	0.044251	1
0.1833	1.83	1.7708	0.059215	1
0.1866	1.815	1.7678	0.047173	1
0.19	1.811	1.7648	0.046216	1
0.1933	1.808	1.7618	0.046164	1
0.1966	1.811	1.7589	0.052108	1
0.2	1.793	1.7559	0.037135	1
0.2033	1.802	1.7529	0.049069	1
0.2066	1.793	1.75	0.042997	1
0.21	1.789	1.747	0.042009	1
0.2133	1.783	1.7441	0.038928	1
0.2166	1.783	1.7412	0.041842	1
0.22	1.78	1.7382	0.041839	1
0.2233	1.777	1.7353	0.041742	1
0.2266	1.771	1.7324	0.038641	1
0.23	1.767	1.7294	0.037623	1
0.2333	1.764	1.7265	0.037512	1
0.2366	1.758	1.7236	0.034397	1
0.24	1.755	1.7206	0.034364	1
0.2433	1.755	1.7178	0.037238	1
0.2466	1.748	1.7149	0.033108	1
0.25	1.745	1.7119	0.03306	1
0.2533	1.742	1.7091	0.03292	1
0.2566	1.739	1.7062	0.032775	1
0.26	1.733	1.7033	0.029712	1
0.2633	1.733	1.7004	0.032557	1
0.2666	1.726	1.6976	0.028398	1
0.27	1.723	1.6947	0.02832	1
0.2733	1.72	1.6918	0.028151	1
0.2766	1.714	1.689	0.024978	1
0.28	1.711	1.6861	0.024885	1
0.2833	1.708	1.6833	0.024702	1
0.2866	1.708	1.6805	0.027514	1
0.29	1.701	1.6776	0.023407	1
0.2933	1.698	1.6748	0.023209	1

0.2966	1.695	1.672	0.023007	1
0.3	1.692	1.6691	0.022885	1
0.3033	1.689	1.6663	0.022674	1
0.3066	1.685	1.6635	0.021458	1
0.31	1.682	1.6607	0.021321	1
0.3133	1.679	1.6579	0.021095	1
0.3166	1.673	1.6551	0.017865	1
0.32	1.67	1.6523	0.017714	1
0.3233	1.67	1.6495	0.020474	1
0.3266	1.663	1.6468	0.01623	1
0.33	1.663	1.6439	0.019065	1
0.3333	1.657	1.6412	0.015811	1
0.35	1.641	1.6274	0.01364	1
0.3666	1.622	1.6137	0.0082698	1
0.3833	1.604	1.6001	0.0038669	1
0.4	1.588	1.5867	0.0013494	1
0.4166	1.572	1.5734	-0.0013614	1
0.4333	1.556	1.5601	-0.0041044	1
0.45	1.541	1.547	-0.0059592	1
0.4666	1.525	1.534	-0.0090024	1
0.4833	1.509	1.5211	-0.012077	1
0.5	1.493	1.5083	-0.015261	1
0.5166	1.481	1.4956	-0.014628	1
0.5333	1.465	1.483	-0.018026	1
0.55	1.449	1.4705	-0.02153	1
0.5666	1.437	1.4582	-0.021214	1
0.5833	1.424	1.4459	-0.021927	1
0.6	1.408	1.4337	-0.025744	1
0.6166	1.396	1.4217	-0.025735	1
0.6333	1.383	1.4098	-0.026756	1
0.65	1.37	1.3979	-0.027877	1
0.6666	1.358	1.3862	-0.028169	1
0.6833	1.345	1.3745	-0.02949	1
0.7	1.333	1.3629	-0.029908	1
0.7166	1.317	1.3515	-0.034493	1
0.7333	1.307	1.3401	-0.033106	1
0.75	1.295	1.3288	-0.033814	1
0.7666	1.282	1.3177	-0.035684	1
0.7833	1.27	1.3066	-0.036582	1
0.8	1.26	1.2956	-0.035573	1
0.8166	1.248	1.2847	-0.036721	1
0.8333	1.235	1.2739	-0.038896	1
0.85	1.225	1.2632	-0.038163	1
0.8666	1.213	1.2526	-0.039583	1
0.8833	1.203	1.242	-0.039029	1
0.9	1.191	1.2316	-0.040564	1
0.9166	1.181	1.2212	-0.040249	1
0.9333	1.172	1.211	-0.038958	1
0.95	1.159	1.2008	-0.041755	1
0.9666	1.15	1.1907	-0.040698	1
0.9833	1.14	1.1807	-0.040665	1
1	1.131	1.1707	-0.039717	1
1.2	0.995	1.0579	-0.062894	1
1.4	0.898	0.95594	-0.057944	1
1.6	0.81	0.86382	-0.053819	1
1.8	0.731	0.78057	-0.049572	1

2	0.661	0.70535	-0.044347	1
2.2	0.598	0.63737	-0.039372	1
2.4	0.542	0.57595	-0.033948	1
2.6	0.491	0.52044	-0.029444	1
2.8	0.444	0.47029	-0.026288	1
3	0.403	0.42497	-0.021966	1
3.2	0.365	0.38401	-0.019012	1
3.4	0.334	0.347	-0.013004	1
3.6	0.299	0.31356	-0.014563	1
3.8	0.271	0.28334	-0.012345	1
4	0.245	0.25604	-0.011039	1
4.2	0.22	0.23136	-0.011364	1
4.4	0.201	0.20907	-0.0080671	1
4.6	0.185	0.18892	-0.0039192	1
4.8	0.173	0.17071	0.0022871	1
5	0.163	0.15426	0.0087389	1
5.2	0.157	0.13939	0.017605	1
5.4	0.151	0.12596	0.025039	1
5.6	0.145	0.11382	0.031178	1
5.8	0.141	0.10285	0.038147	1
6	0.141	0.092941	0.048059	1
6.2	0.135	0.083984	0.051016	1
6.4	0.132	0.075891	0.056109	1
6.6	0.132	0.068577	0.063423	1
6.8	0.132	0.061968	0.070032	1
7	0.129	0.055996	0.073004	1
7.2	0.126	0.0506	0.0754	1
7.4	0.126	0.045723	0.080277	1
7.6	0.122	0.041317	0.080683	1
7.8	0.119	0.037335	0.081665	1
8	0.119	0.033737	0.085263	1
8.2	0.116	0.030486	0.085514	1
8.4	0.113	0.027548	0.085452	1
8.6	0.113	0.024893	0.088107	1
8.8	0.113	0.022494	0.090506	1
9	0.113	0.020326	0.092674	1

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RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

Estimate
K = 1.1447E-003 ft/min
y0 = 1.9431E+000 ft

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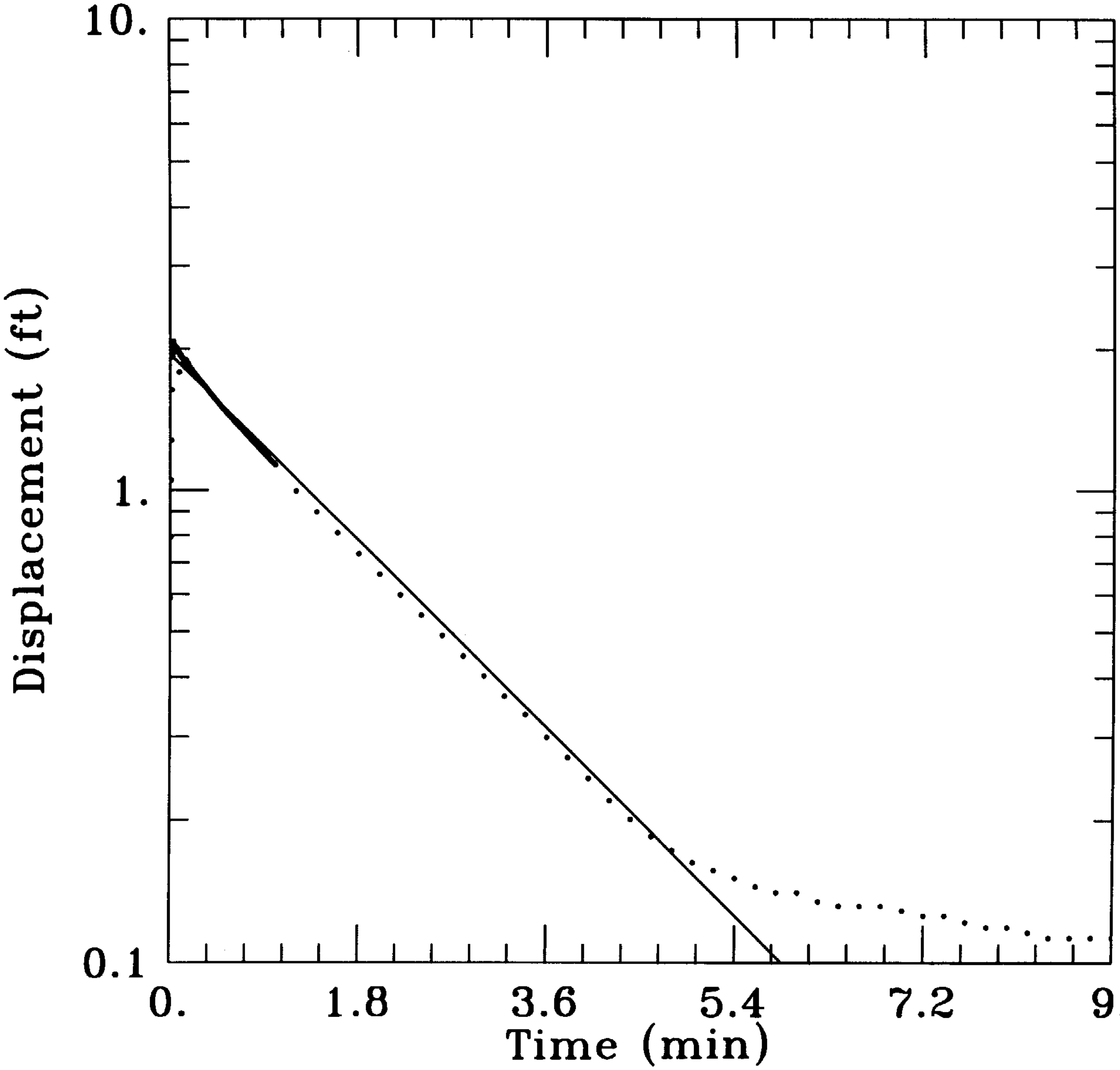

DATA SET:
1613-1.DAT
05/09/95

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

PROJECT DATA:
test date: MAY 5, 1995
obs. well: 1613-1

TEST DATA:
H0 = 2.07 ft
rc = 0.083 ft
rw = 0.333 ft
L = 15. ft
b = 50. ft
H = 6.54 ft

PARAMETER ESTIMATES:
K = 0.001145 ft/min
y0 = 1.943 ft

$K = 0.001145 \frac{ft}{min} \cdot 1440 \frac{min}{day}$

$K = 1.6$ ft/day

AQTESOLV

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AQTESOLV RESULTS
Version 2.01

Developed by Glenn M. Duffield
(c) 1988-1995 Geraghty & Miller, Inc.

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TEST DESCRIPTION

Data set........... 1613-2.DAT
Output file........ 1613-2.OUT
Data set title..... CAMP LEJEUNE - BUILDING 1613
Company............ RICHARD CATLIN & ASSOCIATES
Project............ 94127
Client............. LANTDIV
Location........... BLDG 1613
Test date.......... MAY 5, 1995
Obs. well.......... 1613-2

Units of Measurement
Length.......... ft
Time............ min

Test Well Data
Initial displacement in well..... 2.74
Radius of well casing............ 0.083
Radius of wellbore............... 0.333
Aquifer saturated thickness...... 50
Well screen length............... 15
Static height of water in well... 10.63
Gravel pack porosity............. 0.25
Effective well casing radius..... 0.1814
Effective wellbore radius........ 0.333
Log(Re/Rw)....................... 2.313
Constants A, B and C............. 2.919 , 0.472, 0.000
No. of observations.............. 130

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ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

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RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

Estimate Std. Error
K = 2.9169E-003 +/- 2.2192E-004 ft/min
y0 = 1.9262E+000 +/- 4.8260E-002 ft

ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
weighted residual = residual * weight

Weighted Residual Statistics:
Number of residuals............... 130
Number of estimated parameters.... 2
Degrees of freedom................ 128
Residual mean..................... 0.00505
Residual standard deviation....... 0.2492
Residual variance................. 0.06209

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.0366	2.739	1.8467	0.89225	1
0.04	1.01	1.8395	-0.82954	1
0.0433	0.565	1.8326	-1.2676	1
0.0466	1.559	1.8256	-0.26662	1
0.05	1.613	1.8185	-0.20549	1
0.0533	1.717	1.8116	-0.094603	1
0.0566	1.685	1.8047	-0.11974	1
0.06	1.739	1.7977	-0.058692	1
0.0633	1.849	1.7909	0.05812	1
0.0666	1.9	1.7841	0.11591	1
0.07	2.032	1.7771	0.25487	1
0.0733	2.187	1.7704	0.41661	1
0.0766	2.19	1.7637	0.42631	1
0.08	2.272	1.7568	0.5152	1
0.0833	2.209	1.7501	0.45886	1
0.0866	2.171	1.7435	0.42749	1
0.09	2.171	1.7367	0.4343	1
0.0933	2.111	1.7301	0.38088	1
0.0966	2.105	1.7236	0.38143	1
0.1	2.073	1.7168	0.35616	1
0.1033	2.038	1.7103	0.32767	1
0.1066	2.023	1.7039	0.31915	1
0.11	1.991	1.6972	0.2938	1
0.1133	1.969	1.6908	0.27823	1
0.1166	1.944	1.6844	0.25964	1
0.12	1.915	1.6778	0.23721	1
0.1233	1.893	1.6714	0.22157	1
0.1266	1.871	1.6651	0.2059	1
0.13	1.843	1.6586	0.18441	1
0.1333	1.824	1.6523	0.17169	1
0.1366	1.799	1.646	0.15295	1
0.14	1.78	1.6396	0.14038	1

0.1433	1.751	1.6334	0.11759	1
0.1466	1.729	1.6272	0.10178	1
0.15	1.71	1.6209	0.089133	1
0.1533	1.688	1.6147	0.073275	1
0.1566	1.666	1.6086	0.057394	1
0.16	1.647	1.6023	0.044674	1
0.1633	1.628	1.5963	0.031746	1
0.1666	1.609	1.5902	0.018794	1
0.17	1.594	1.584	0.010002	1
0.1733	1.575	1.578	-0.0029953	1
0.1766	1.553	1.572	-0.019016	1
0.18	1.543	1.5659	-0.022879	1
0.1833	1.515	1.5599	-0.044945	1
0.1866	1.508	1.554	-0.046034	1
0.19	1.489	1.548	-0.058967	1
0.1933	1.467	1.5421	-0.075101	1
0.1966	1.458	1.5363	-0.078257	1
0.2	1.445	1.5303	-0.08526	1
0.2033	1.43	1.5245	-0.094461	1
0.2066	1.411	1.5187	-0.10768	1
0.21	1.401	1.5128	-0.11176	1
0.2133	1.388	1.507	-0.11902	1
0.2166	1.376	1.5013	-0.12531	1
0.22	1.36	1.4955	-0.13545	1
0.2233	1.354	1.4898	-0.13578	1
0.2266	1.344	1.4841	-0.14014	1
0.23	1.329	1.4783	-0.14935	1
0.2333	1.316	1.4727	-0.15674	1
0.2366	1.313	1.4672	-0.15416	1
0.24	1.297	1.4614	-0.16443	1
0.2433	1.291	1.4559	-0.1649	1
0.2466	1.278	1.4504	-0.17238	1
0.25	1.272	1.4447	-0.17272	1
0.2533	1.253	1.4392	-0.18624	1
0.2566	1.25	1.4338	-0.18379	1
0.26	1.246	1.4282	-0.18219	1
0.2633	1.24	1.4228	-0.18278	1
0.2666	1.228	1.4174	-0.18939	1
0.27	1.224	1.4119	-0.18786	1
0.2733	1.218	1.4065	-0.18851	1
0.2766	1.209	1.4012	-0.19218	1
0.28	1.202	1.3957	-0.19371	1
0.2833	1.19	1.3904	-0.20042	1
0.2866	1.19	1.3851	-0.19515	1
0.29	1.193	1.3797	-0.18674	1
0.2933	1.177	1.3745	-0.19751	1
0.2966	1.164	1.3693	-0.2053	1
0.3	1.164	1.364	-0.19996	1
0.3033	1.158	1.3588	-0.20079	1
0.3066	1.155	1.3536	-0.19864	1
0.31	1.152	1.3484	-0.19636	1
0.3133	1.145	1.3432	-0.19825	1
0.3166	1.139	1.3382	-0.19916	1
0.32	1.136	1.3329	-0.19693	1
0.3233	1.133	1.3279	-0.19488	1
0.3266	1.127	1.3228	-0.19585	1

0.33	1.123	1.3177	-0.19468	1
0.3333	1.12	1.3127	-0.19269	1
0.35	1.111	1.2877	-0.17671	1
0.3666	1.086	1.2634	-0.17735	1
0.3833	1.073	1.2393	-0.16631	1
0.4	1.057	1.2157	-0.15873	1
0.4166	1.048	1.1927	-0.14473	1
0.4333	1.038	1.17	-0.13203	1
0.45	1.032	1.1478	-0.11577	1
0.4666	1.019	1.1261	-0.10706	1
0.4833	1.013	1.1046	-0.091628	1
0.5	1.003	1.0836	-0.080608	1
0.5166	1	1.0631	-0.063109	1
0.5333	0.994	1.0429	-0.048879	1
0.55	0.988	1.023	-0.035034	1
0.5666	0.981	1.0037	-0.022681	1
0.5833	0.978	0.98458	-0.0065817	1
0.6	0.975	0.96585	0.0091544	1
0.6166	0.966	0.94758	0.018425	1
0.6333	0.966	0.92954	0.036457	1
0.65	0.959	0.91185	0.047146	1
0.6666	0.956	0.89461	0.061395	1
0.6833	0.956	0.87758	0.078419	1
0.7	0.95	0.86088	0.089119	1
0.7166	0.947	0.8446	0.1024	1
0.7333	0.943	0.82852	0.11448	1
0.75	0.94	0.81276	0.12724	1
0.7666	0.934	0.79738	0.13662	1
0.7833	0.931	0.78221	0.14879	1
0.8	0.931	0.76732	0.16368	1
0.8166	0.928	0.75281	0.17519	1
0.8333	0.925	0.73848	0.18652	1
0.85	0.925	0.72443	0.20057	1
0.8666	0.918	0.71073	0.20727	1
0.8833	0.918	0.6972	0.2208	1
0.9	0.915	0.68393	0.23107	1
0.9166	0.912	0.671	0.241	1
0.9333	0.909	0.65823	0.25077	1
0.95	0.906	0.6457	0.2603	1
0.9666	0.902	0.63349	0.26851	1
0.9833	0.902	0.62143	0.28057	1
1	0.902	0.60961	0.29239	1

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RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

Estimate
K = 9.2894E-003 ft/min
y0 = 2.9927E+000 ft

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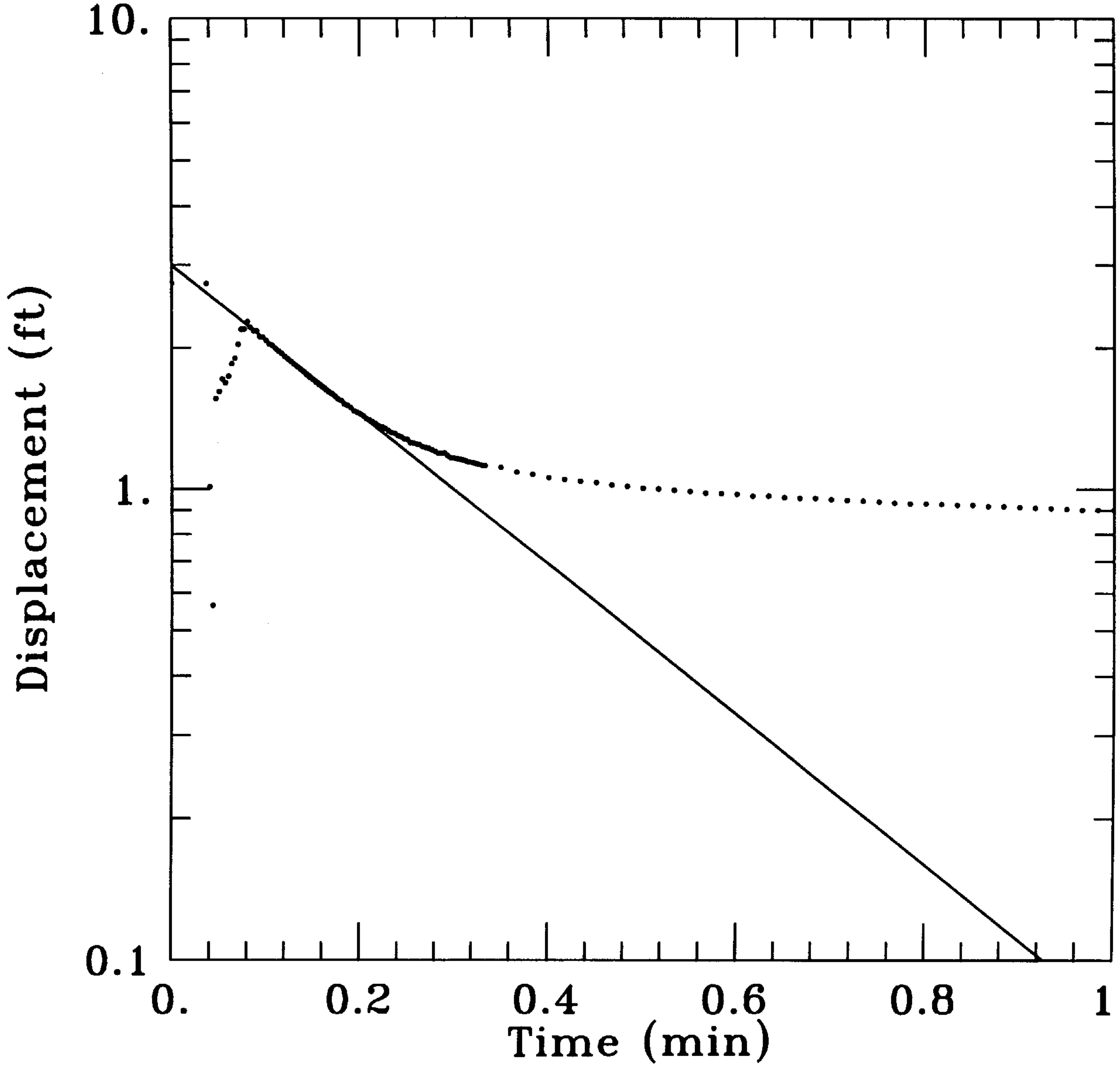

DATA SET:
1613-2.DAT
05/09/95

AQUIFE MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

PROJECT DATA:
test date: MAY 5, 1995
obs. well: 1613-2

TEST DATA:
H0 = 2.74 ft
rc = 0.083 ft
rw = 0.333 ft
L = 15. ft
b = 50. ft
H = 10.63 ft

PARAMETER ESTIMATES:
K = 0.009289 ft/min
y0 = 2.993 ft

$K = 0.009289 \frac{ft}{min} \cdot \frac{1440\ min}{day}$

$K = 13.4$ ft/day

AQTESOLV

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A Q T E S O L V   R E S U L T S
Version 2.01

Developed by Glenn M. Duffield
(c) 1988-1995 Geraghty & Miller, Inc.

05/09/95 11:20:21

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TEST DESCRIPTION

Data set........... 1613-8.DAT
Output file........ 1613-8.OUT
Data set title..... CAMP LEJEUNE - BUILDING 1613
Company............ RICHARD CATLIN & ASSOCIATES
Project............ 94127
Client............ LANTDIV
Location........... BLDG 1613
Test date.......... MAY 5, 1995
Obs. well.......... 1613-8

Units of Measurement
Length.......... ft
Time........... min

Test Well Data
Initial displacement in well..... 2.57
Radius of well casing............ 0.083
Radius of wellbore............... 0.333
Aquifer saturated thickness...... 50
Well screen length............... 10
Static height of water in well... 12.3
Gravel pack porosity............. 1
Effective well casing radius..... 0.333
Effective wellbore radius........ 0.333
Log(Re/Rw)....................... 2.228
Constants A, B and C............. 2.445 , 0.398, 0.000
No. of observations.............. 149

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ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

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RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

	Estimate	Std. Error
K =	1.5653E-002 +/-	2.4557E-004 ft/min
y0 =	2.7429E+000 +/-	1.5578E-002 ft

ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
weighted residual = residual * weight

Weighted Residual Statistics:
Number of residuals............... 149
Number of estimated parameters.... 2
Degrees of freedom................ 147
Residual mean..................... 0.01164
Residual standard deviation....... 0.07892
Residual variance................. 0.006228

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.04	2.558	2.6074	-0.049382	1
0.0433	1.901	2.5965	-0.6955	1
0.0466	2.567	2.5857	-0.01867	1
0.05	2.57	2.5746	-0.004555	1
0.0533	2.495	2.5638	-0.068813	1
0.0566	2.678	2.5531	0.12488	1
0.06	2.482	2.5421	-0.060141	1
0.0633	2.637	2.5315	0.10547	1
0.0666	2.501	2.521	-0.019972	1
0.07	2.596	2.5101	0.085865	1
0.0733	2.492	2.4997	-0.0076618	1
0.0766	2.526	2.4892	0.036768	1
0.08	2.507	2.4785	0.028468	1
0.0833	2.495	2.4682	0.026809	1
0.0866	2.473	2.4579	0.015108	1
0.09	2.473	2.4473	0.025673	1
0.0933	2.466	2.4371	0.028884	1
0.0966	2.432	2.4269	0.0050528	1
0.1	2.438	2.4165	0.021485	1
0.1033	2.425	2.4064	0.018568	1
0.1066	2.413	2.3964	0.016608	1
0.11	2.391	2.3861	0.0049095	1
0.1133	2.384	2.3761	0.0078652	1
0.1166	2.387	2.3662	0.020779	1
0.12	2.359	2.356	0.0029507	1
0.1233	2.362	2.3462	0.015781	1
0.1266	2.346	2.3364	0.0095705	1
0.13	2.337	2.3264	0.010614	1
0.1333	2.324	2.3167	0.0073203	1
0.1366	2.299	2.307	-0.0080136	1
0.14	2.315	2.2971	0.017903	1
0.1433	2.289	2.2875	0.0014877	1

0.1466	2.267	2.278	-0.010968	1
0.15	2.274	2.2682	0.0058241	1
0.1533	2.267	2.2587	0.0082878	1
0.1566	2.248	2.2493	-0.001288	1
0.16	2.23	2.2396	-0.0096193	1
0.1633	2.242	2.2303	0.011725	1
0.1666	2.226	2.221	0.0050309	1
0.17	2.211	2.2114	-0.00042212	1
0.1733	2.201	2.2022	-0.0011952	1
0.1766	2.204	2.193	0.010993	1
0.18	2.192	2.1836	0.00842	1
0.1833	2.195	2.1745	0.020531	1
0.1866	2.17	2.1654	0.0046035	1
0.19	2.176	2.1561	0.019912	1
0.1933	2.163	2.1471	0.015908	1
0.1966	2.138	2.1381	-0.00013381	1
0.2	2.147	2.1289	0.018057	1
0.2033	2.128	2.1201	0.0079399	1
0.2066	2.119	2.1112	0.0077856	1
0.21	2.084	2.1021	-0.018139	1
0.2133	2.113	2.0934	0.019632	1
0.2166	2.097	2.0846	0.012366	1
0.22	2.075	2.0757	-0.00067296	1
0.2233	2.081	2.067	0.013988	1
0.2266	2.072	2.0584	0.013612	1
0.23	2.059	2.0495	0.0094601	1
0.2333	2.046	2.041	0.0050116	1
0.2366	2.037	2.0325	0.0045274	1
0.24	2.043	2.0237	0.019264	1
0.2433	2.024	2.0153	0.0087079	1
0.2466	2.012	2.0069	0.0051165	1
0.25	2.012	1.9983	0.013743	1
0.2533	2.009	1.9899	0.019081	1
0.2566	1.996	1.9816	0.014383	1
0.26	1.983	1.9731	0.0099016	1
0.2633	1.98	1.9649	0.015134	1
0.2666	1.98	1.9567	0.023332	1
0.27	1.958	1.9483	0.0097432	1
0.2733	1.945	1.9401	0.0048721	1
0.2766	1.955	1.932	0.022967	1
0.28	1.952	1.9237	0.028272	1
0.2833	1.933	1.9157	0.017299	1
0.2866	1.93	1.9077	0.022292	1
0.29	1.93	1.8995	0.030492	1
0.2933	1.917	1.8916	0.025418	1
0.2966	1.898	1.8837	0.01431	1
0.3	1.895	1.8756	0.019407	1
0.3033	1.892	1.8678	0.024233	1
0.3066	1.866	1.86	0.0060259	1
0.31	1.86	1.852	0.0080211	1
0.3133	1.854	1.8443	0.0097483	1
0.3166	1.86	1.8366	0.023443	1
0.32	1.841	1.8287	0.012338	1
0.3233	1.832	1.821	0.010968	1
0.3266	1.835	1.8134	0.021566	1
0.33	1.835	1.8056	0.029361	1

0.3333	1.819	1.7981	0.020895	1
0.35	1.778	1.7605	0.017541	1
0.3666	1.734	1.7238	0.010181	1
0.3833	1.699	1.6877	0.011272	1
0.4	1.664	1.6524	0.011608	1
0.4166	1.633	1.618	0.014999	1
0.4333	1.598	1.5841	0.013874	1
0.45	1.563	1.551	0.012041	1
0.4666	1.529	1.5187	0.01032	1
0.4833	1.491	1.4869	0.0041165	1
0.5	1.456	1.4558	0.00024699	1
0.5166	1.421	1.4255	-0.0044549	1
0.5333	1.39	1.3956	-0.0056105	1
0.55	1.361	1.3664	-0.0053909	1
0.5666	1.336	1.338	-0.0019527	1
0.5833	1.311	1.3099	0.0010597	1
0.6	1.279	1.2825	-0.0035144	1
0.6166	1.251	1.2558	-0.0048218	1
0.6333	1.219	1.2295	-0.010529	1
0.65	1.191	1.2038	-0.012787	1
0.6666	1.162	1.1787	-0.016733	1
0.6833	1.137	1.1541	-0.017054	1
0.7	1.112	1.1299	-0.017892	1
0.7166	1.09	1.1064	-0.016376	1
0.7333	1.067	1.0832	-0.016212	1
0.75	1.039	1.0605	-0.021533	1
0.7666	1.014	1.0385	-0.02446	1
0.7833	0.988	1.0167	-0.028718	1
0.8	0.966	0.99543	-0.029431	1
0.8166	0.944	0.97471	-0.030714	1
0.8333	0.928	0.95431	-0.026307	1
0.85	0.906	0.93433	-0.028326	1
0.8666	0.887	0.91488	-0.027881	1
0.8833	0.862	0.89573	-0.033726	1
0.9	0.84	0.87697	-0.036972	1
0.9166	0.821	0.85872	-0.03772	1
0.9333	0.802	0.84074	-0.038741	1
0.95	0.789	0.82314	-0.034139	1
0.9666	0.77	0.80601	-0.036007	1
0.9833	0.748	0.78913	-0.041132	1
1	0.726	0.77261	-0.04661	1
1.2	0.515	0.59967	-0.084666	1
1.4	0.382	0.46543	-0.083435	1
1.6	0.312	0.36125	-0.04925	1
1.8	0.262	0.28039	-0.018386	1
2	0.227	0.21762	0.0093763	1
2.2	0.218	0.16891	0.04909	1
2.4	0.199	0.1311	0.0679	1
2.6	0.202	0.10175	0.10025	1
2.8	0.195	0.078977	0.11602	1
3	0.186	0.061299	0.1247	1
3.2	0.195	0.047577	0.14742	1
3.4	0.183	0.036928	0.14607	1
3.6	0.192	0.028662	0.16334	1
3.8	0.183	0.022246	0.16075	1
4	0.192	0.017266	0.17473	1

4.2	0.18	0.013401	0.1666	1
4.4	0.189	0.010401	0.1786	1
4.6	0.186	0.0080732	0.17793	1
4.8	0.183	0.006266	0.17673	1
5	0.186	0.0048634	0.18114	1

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RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

Estimate
K = 1.5653E-002 ft/min
y0 = 2.7429E+000 ft

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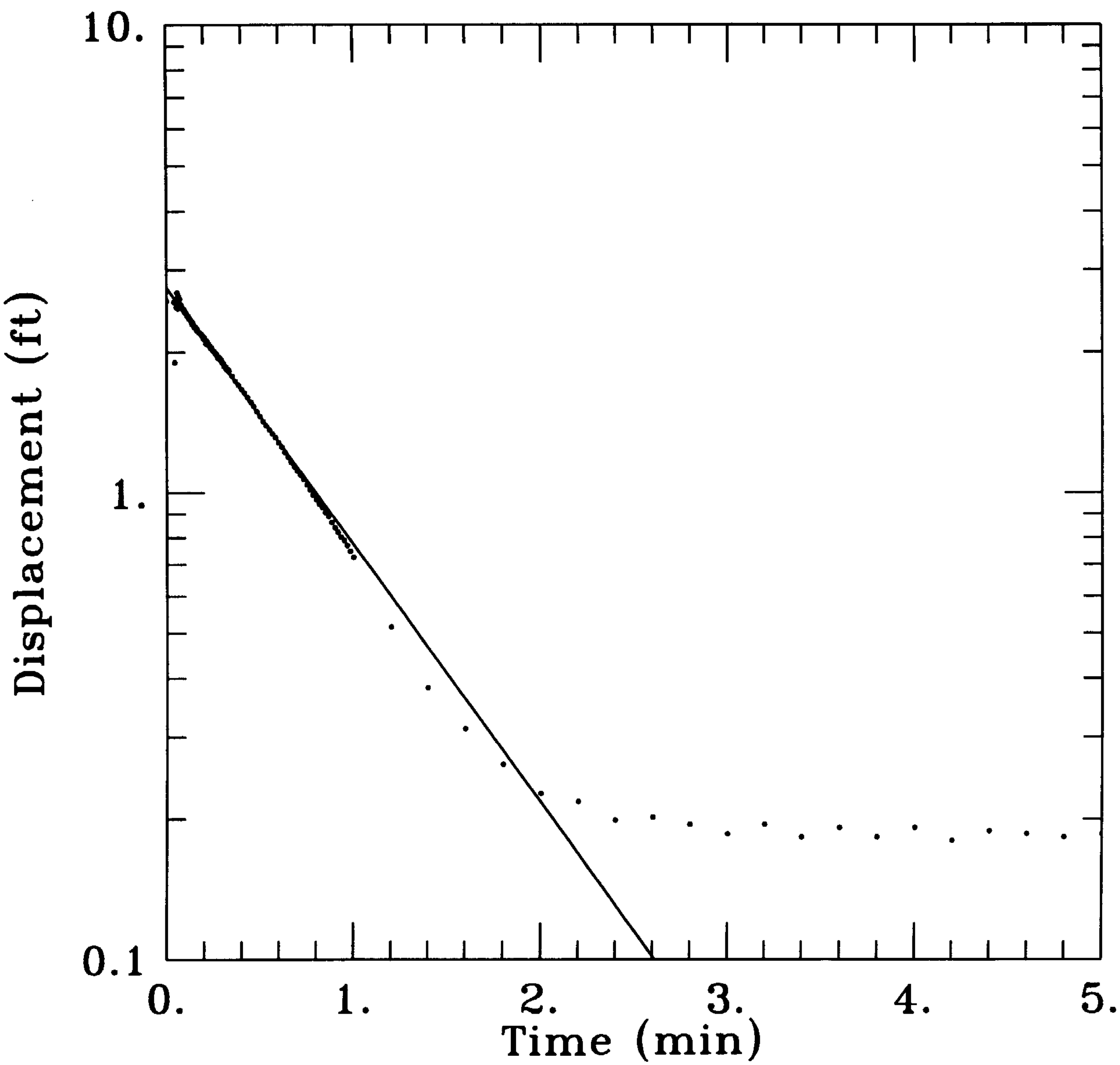


DATA SET:
1613-8.DAT
05/09/95

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

PROJECT DATA:
test date: MAY 5, 1995
obs. well: 1613-8

TEST DATA:
H0 = 2.57 ft
rc = 0.083 ft
rw = 0.333 ft
L = 10. ft
b = 50. ft
H = 12.3 ft

PARAMETER ESTIMATES:
K = 0.01565 ft/min
y0 = 2.743 ft

$K = 0.01565 \frac{ft}{min} \cdot 1440 \frac{min}{day}$

$K = 22.5$ ft/day

AQTESOLV

Richard Catlin & Associates, Inc.
ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS
RC&A

May 31, 1995

Ms. Teri Piver
Richard Catlin & Associates, Inc.
P.O. Box 10279
Wilmington, NC 28405-3755

RE: Sieve Analysis of Soil Samples
Bldg. 1613-7, Bldg. 1613-8, Bldg. 1613-16
Camp Lejeune, NC
RC&A #94127

Dear Ms. Piver:

In accordance with your authorization, Richard Catlin and Associates Geotechnical Laboratories has completed laboratory determination of the requested grain size analysis on the soil samples submitted for analysis.

On May 22, 1995, three soil samples containerized in glass jars were received for determination of grain size analysis. ASTM D422 (Sieve Analysis) and ASTM D1140 (Wash 200) were used in the determination of the grain size analysis. Results of each analysis is presented in the attached tables and graphs.

If I can be of further assistance to you on this project, please contact me at your convenience.

Very truly yours,

John T. Jones

John T. Jones, P.E.
Laboratory Manager

JTJ/klm

Enclosures

GRAIN SIZE ANALYSIS-MECHANICAL

Project Building 1613-7 Job No. 94127

Location of Project Camp Lejeune, N.C. Boring No. ______ Sample No. 1613-7

Description of Soil Light Grey Silt Clay Depth of Sample 15.0' - 17.0'

Tested By John T. Jones Date of Testing 5/24/95

Soil Sample Size (ASTM D422-63)

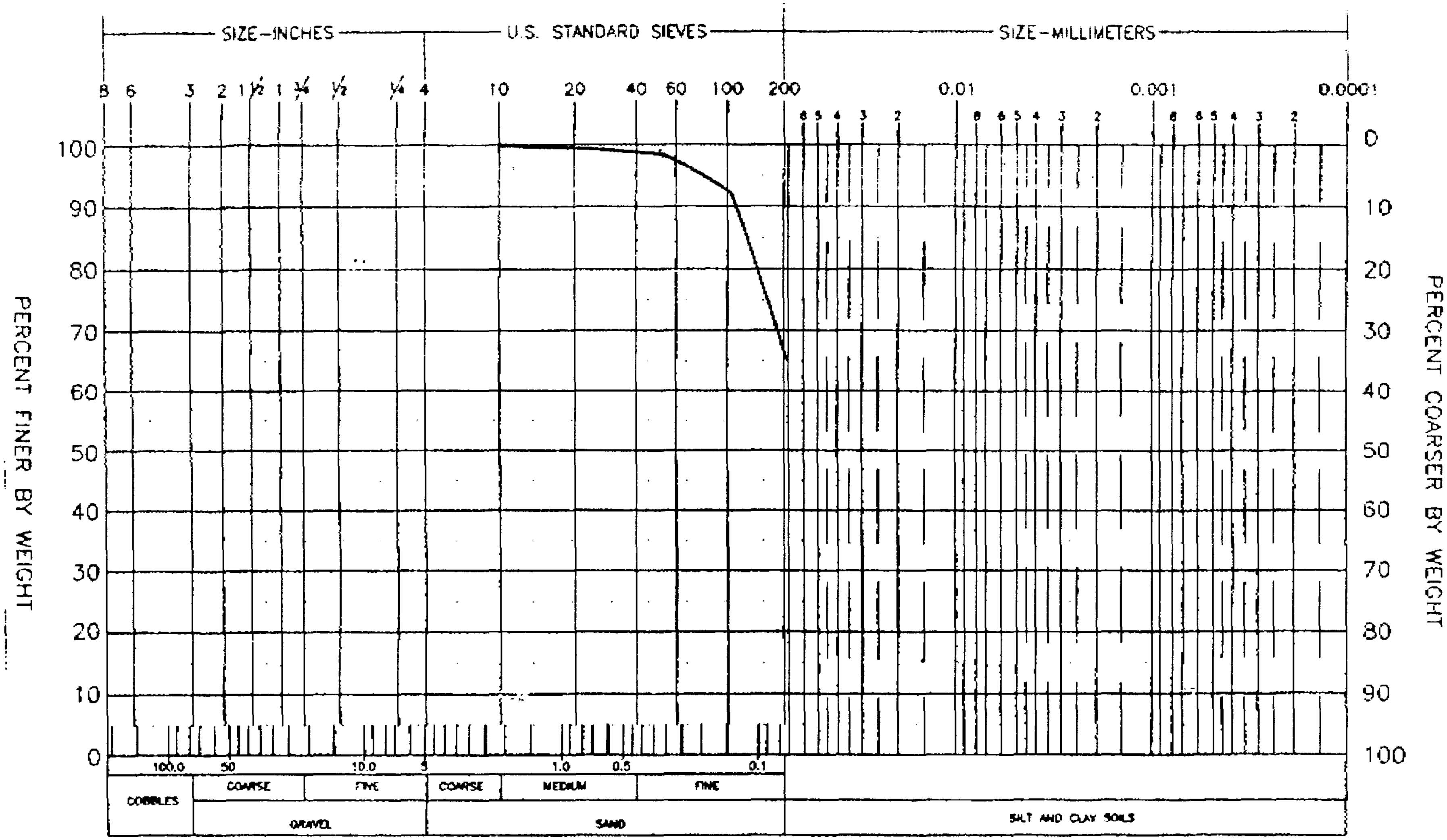
Nominal diameter of largest particle	Approximate minimum Wt. of sample, g
No. 10 sieve	200
No. 4 sieve	500
3/4 in.	1500

Wt. of dry sample + container, W_{sc}	274.60 g
Wt. of container, W_c	13.88 g
Wt. of dry sample, $W_s = W_{sc} - W_c$	260.72 g

Sieve analysis and grain shape

Sieve no.	Diam. (mm)	Wt. retained	% retained	Σ % retained	% passing
#10	2.00	0.00 g	0.00	0.00	100.00
#16	1.18	0.00 g	0.00	0.00	100.00
#30	0.60	0.40 g	0.20	0.20	99.80
#50	0.30	0.62 g	0.20	0.40	99.60
#100	0.15	18.28 g	7.00	7.40	92.60
#200	0.075	66.50 g	25.50	32.90	67.10

% retained = (Wt. retained/W_s) · 100 % passing = 100 - Σ % retained.



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	Remarks	Project Name: Bldg. 1613-7
1613-7	15' - 17'	OH	37.71%					Project Location: Camp Lejeune
								RC&A Project #: 94127
								Boring No. 1613-7
								Date: 5/25/95

GRADATION CURVES

P.04

GRAIN SIZE ANALYSIS-MECHANICAL

Project Bldg. 1613-8 Job No. 94127

Location of Project Camp Lejeune, NC Boring No. ________ Sample No. 1613-8

Description of Soil Light Grey Silty Clay Depth of Sample 15' - 17'

Tested By John T. Jones Date of Testing 5/25/95

Soil Sample Size (ASTM D422-63)

Nominal diameter of largest particle	Approximate minimum Wt. of sample, g
No. 10 sieve	200
No. 4 sieve	500
3/4 in.	1500

Wt. of dry sample + container, W_{cs}	479.70 g
Wt. of container, W_c	220.48 g
Wt. of dry sample, $W_s = W_{cs} - W_c$	259.22 g

Sieve analysis and grain shape

Sieve no.	Diam. (mm)	Wt. retained	% retained	Σ % retained	% passing
#10	2.00	1.70 g	0.70	0.70	99.30
#16	1.18	3.75 g	1.40	2.10	97.90
#30	0.60	4.76 g	1.80	3.90	96.10
#50	0.30	5.76 g	2.20	6.10	93.90
#80	0.18	13.85 g	5.30	11.40	88.60
#100	0.15	26.91 g	10.40	21.80	78.20
#200	0.075	27.31 g	10.50	32.30	67.70

% retained = $(\text{Wt. retained}/W_s) \cdot 100$

% passing = 100 - Σ % retained.

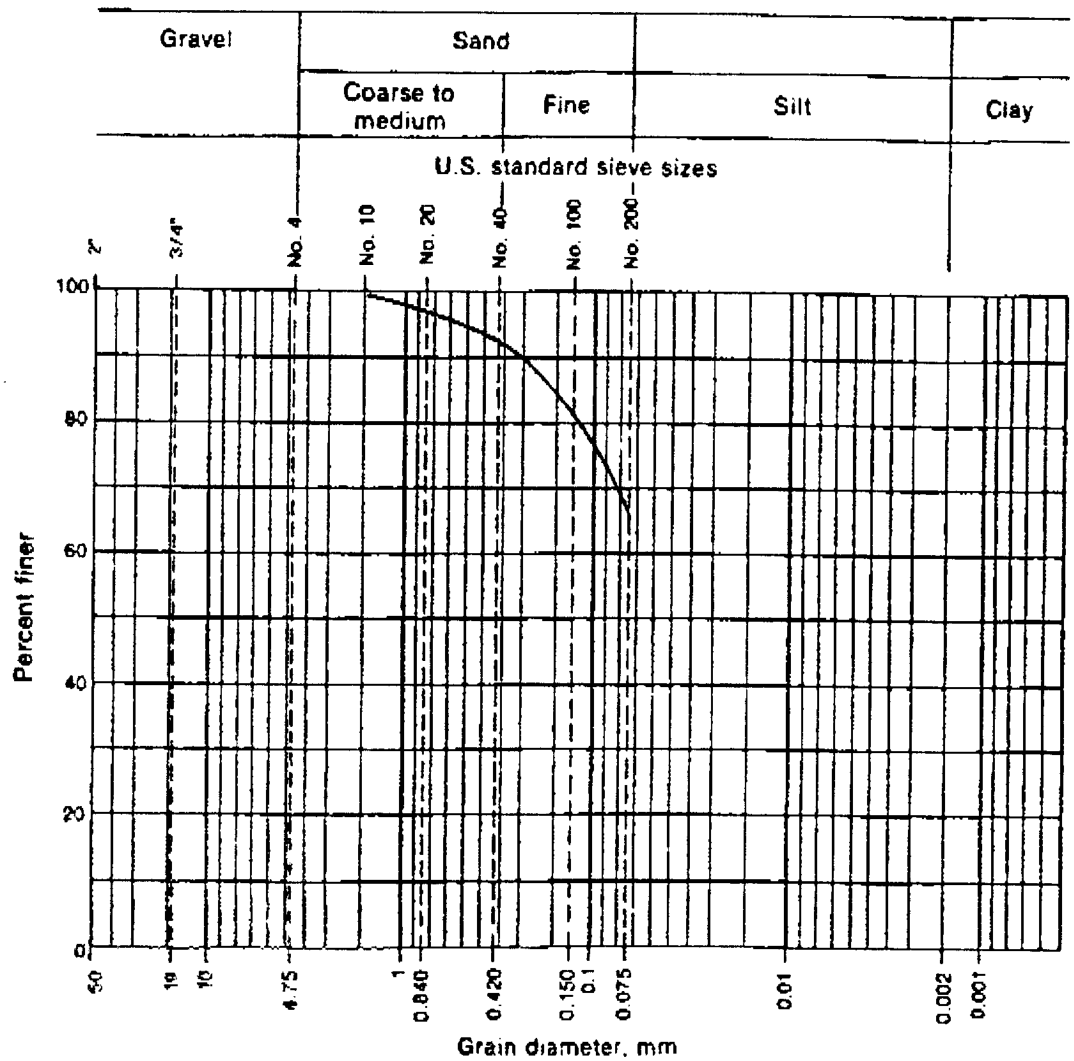
GRAIN SIZE DISTRIBUTION (ASTM D-422 & ASTM D-1140)

Project Bldg. 1613-8 Job No. 94127

Location of Project Camp Lejeune, NC Boring No. ______ Sample No. 1613-8

Description of Soil Light Grey Silty Clay Depth of Sample 15' - 17'

Tested By John T. Jones Date of Testing 5/25/95



Visual soil description Light Grey Silty Clay

Soil classification:

OH System Unified Soil Classification System

Richard Catlin & Associates, Inc.
Geotechnical Laboratories

GRAIN SIZE ANALYSIS-MECHANICAL

Project Building 1613-16 Job No. 94127

Location of Project Camp Lejeune, N.C. Boring No. ______ Sample No. 1613-16

Description of Soil Light Grey Fine Grained Sand Depth of Sample 15.0' - 17.0'

Tested By John T. Jones Date of Testing 5/24/95

Soil Sample Size (ASTM D422-63)

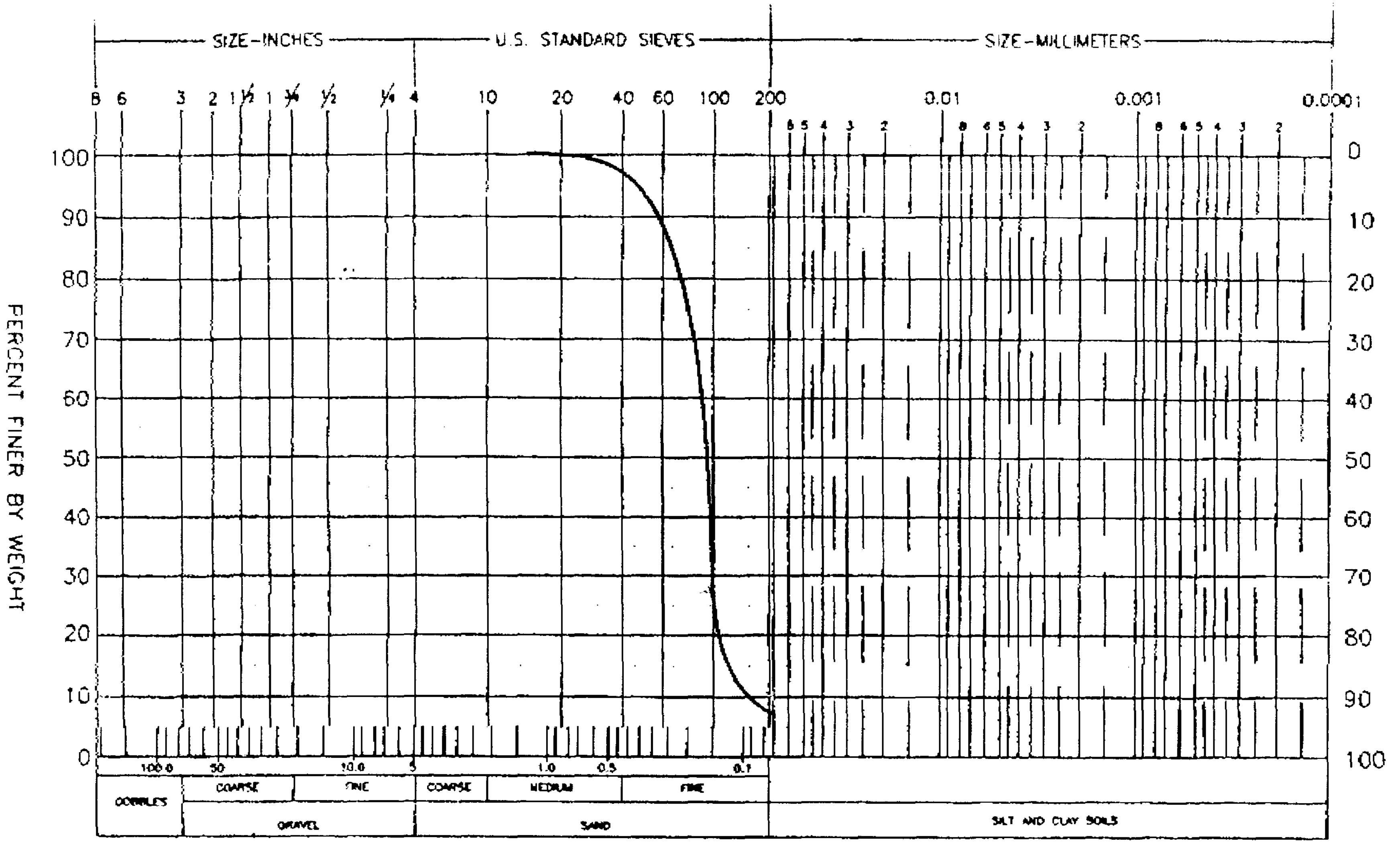
Nominal diameter of largest particle	Approximate minimum Wt. of sample, g
No. 10 sieve	200
No. 4 sieve	500
3/4 in.	1500

Wt. of dry sample + container, W_{ca}	449.70 g
Wt. of container, W_c	218.86 g
Wt. of dry sample, $W_s = W_{ca} - W_c$	230.84 g

Sieve analysis and grain shape

Sieve no.	Diam. (mm)	Wt. retained	% retained	Σ % retained	% passing
#10	2.00	0.00	0.00	0.00	100.00
#16	1.18	0.11 g	0.00	0.00	100.00
#30	0.60	0.93 g	0.40	0.40	99.60
#50	0.30	8.45 g	3.70	4.10	95.90
#100	0.15	176.31 g	76.40	80.50	19.50
#200	0.075	26.37 g	11.40	91.90	8.10

% retained = (Wt. retained/W_s) · 100 % passing = 100 - Σ % retained.



Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	Remarks	
1613-16	15' - 17'	SP - SM	21.43%				d_{10} = 0.095 MM	Project Name: Bldg. 1613-16
								Project Location: Camp Lejeune
								RC&A Project #: 94127
								Boring No. 1613-16
								Date: 5/24/95

GRADATION CURVES

JOB: Ida 1613 COMPUTED BY: TMP DATE: 5/31/95

DESCRIPTION: Grain Size K CHECKED BY: ______ DATE: ______

FROM SAMPLE : 1613-16 (15-17 ft)
Light grey fine grained sand
USCS = SP-SM

HAZEN EQUATION*: $K = C (D_{10})^2$

Where:

K = Hydraulic Conductivity (cm/sec)
C = Empirical Coefficient (1.0)
D_{10} = Effective Grain Size (mm) for which 10% are finer by weight

$$K = (1.0)(0.095)^2$$

$$K = 9.03 \times 10^{-3}\ \text{cm/sec}$$

$$K = 9.03 \times 10^{-3} \frac{\text{cm}}{\text{sec}} \cdot 60 \frac{\text{sec}}{\text{min}} \cdot 1440 \frac{\text{min}}{\text{day}} \cdot \frac{1\ \text{in}}{2.54\ \text{cm}} \cdot \frac{1\ \text{ft}}{12\ \text{in}} =$$

$$K = \frac{13.0\ \text{ft}}{30.48\ \text{day}} = \boxed{0.43\ \text{ft/day}}$$

* From: Maidment, D.R., 1993, <u>Handbook of Hydrology</u>, McGraw-Hill, p. 6.42.

Richard Catlin & Associates, Inc.
CONSULTING ENGINEERS AND HYDROGEOLOGISTS
RC&A

Table 1 Building 1613

Site Sensitivity Evaluation (SSE)

Site Characteristics Evaluation (Step 1)

Characteristic	Condition	Rating	
Grain Size*	Gravel Sand Silt Clay	150 100 50 0	50
Are relict structures, sedimentary structures, and/or textures present in the zone of contamination and underlying "soils"?	Present and intersecting the water table. Present but <u>not</u> intersecting the water table. None present.	10 5 0	0
Distance from location of deepest contaminated soil** to water table.	0 -5 feet (C, D & E sites only) 5 - 10 feet >10 - 40 feet > 40 feet	20 20 10 0	20
Is the top of bedrock or transmissive indurated sediments located above the water table?	Yes No	20 0	0
Artificial conduits present within the zone of contamination.	Present and intersecting the water table. Present but <u>not</u> intersecting the water table. Not present.	10 5 0	5

Total Site Characteristics Score: 75

* **Predominant** grain size based on Unified Soil Classification System or U.S. Dept. of Agriculture's Soil Classification Method.

** (>10 ppm TPFH by Method 5030; >40 ppm TPFH by Method 3550; >250 ppm O&G by Method 9071)

Table 2

Site Sensitivity Evaluation (SSE)

Initial Cleanup Level (Step 2) — Final Cleanup Level (Step 3)

EPA Method 5030 for Low Boiling Point Hydrocarbons such as Gasoline, Aviation Fuels, Gasohol

Total Site Characteristics Score	Initial Cleanup Level TPFH (ppm)
>150	≤10
121-150	20
91-120	40
61-90	60
31-60	80
0-30	100

Select Site Category* →

	Final Cleanup Level
Category A & B (Multiply initial cleanup level by 1)	1 x 60 = 60 ppm
Category C & D (Multiply initial cleanup level by 2)	2 x ____ = ______ ppm
Category E (Multiply initial cleanup level by 3)	3 x ____ = ______ ppm

EPA Method 3550 for High Boiling Point Hydrocarbons such as Kerosene, Diesel, Varsol, Mineral Spirits, Naphtha

Total Site Characteristics Score	Initial Cleanup Level TPFH (ppm)
>150	≤40
121-150	80
91-120	160
61-90	240
31-60	320
0-30	400

Select Site Category* →

	Final Cleanup Level
Category A & B (Multiply initial cleanup level by 1)	1 x 240 = 240 ppm
Category C & D (Multiply initial cleanup level by 2)	2 x ____ = ______ ppm
Category E (Multiply initial cleanup level by 3)	3 x ____ = ______ ppm

EPA Method 9071 for Heavy Fuels - Oil & Grease (O&G) such as Fuel Oil #4, #5, #6, Motor Oil, Hydraulic Fluid

Total Site Characteristics Score	Initial Cleanup Level O&G (ppm)
>150	≤250
121-150	400
91-120	550
61-90	700
31-60	850
0-30	1000

Select Site Category* →

	Final Cleanup Level
Category A & B (Multiply initial cleanup level by 1)	1 x 700 = 700 ppm
Category C & D (Multiply initial cleanup level by 2)	2 x ____ = ______ ppm
Category E (Multiply initial cleanup level by 3)	3 x ____ = ______ ppm

* See Site Category Descriptions, Table 3

TABLE 3

SSE SITE CATEGORY DESCRIPTIONS

<u>**CATEGORY A**</u> (*Site meets any <u>one</u> of the criteria*)

1. Water supply well(s) contaminated and <u>not served</u> by accessible public water supply.

2. Vapors present in confined areas at explosive or health concern levels.

3. Treated surface water supply in violation of the safe drinking water standards.

<u>**CATEGORY B**</u> (*Site meets any <u>one</u> of the criteria*)

1. Water supply well(s) contaminated, but de-activated but served by accessible public water supply.

2. Water supply well(s) within 1500 feet of site, but not contaminated and not served by accessible public water supply.

3. Vapors present in confined areas but not at explosive or health concern levels.

<u>**CATEGORY C**</u> (*Site meets <u>both</u> of the criteria*)

1. No known water supply well(s) contaminated.

2. Water supply well(s) greater than 1500 feet from site but not served by accessible public water supply.

<u>**CATEGORY D**</u> (*Site meets <u>both</u> of the criteria*)

1. No known water supply well(s) contaminated.

2. Water supply well(s) within 1500 feet of site but served by accessible public water supply.

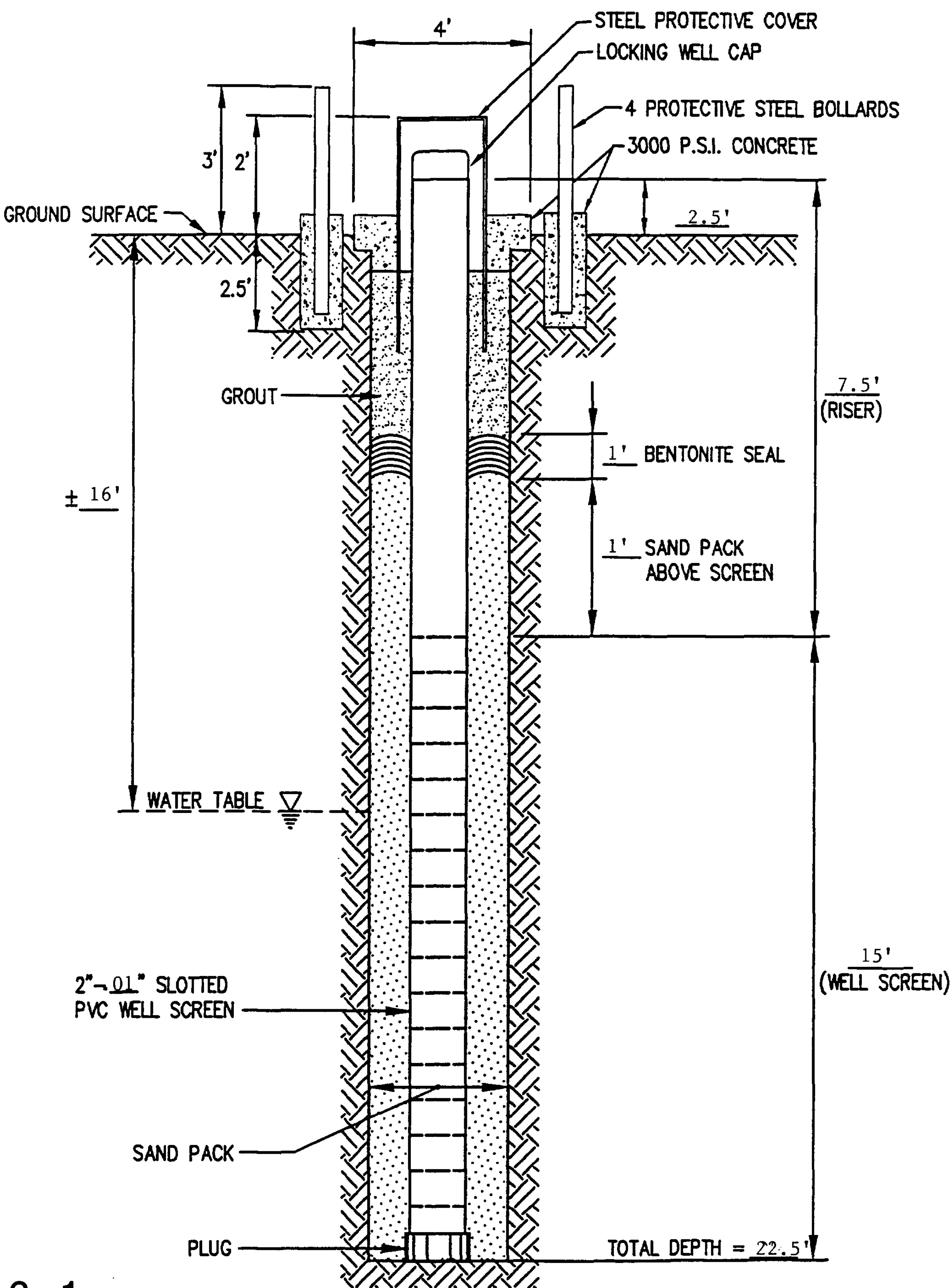
<u>**CATEGORY E**</u> (*Site meets <u>both</u> of the criteria*)

1. No known water supply well(s) contaminated or within 1500 feet of site.

2. Area served by accessible public water supply.

APPENDIX D

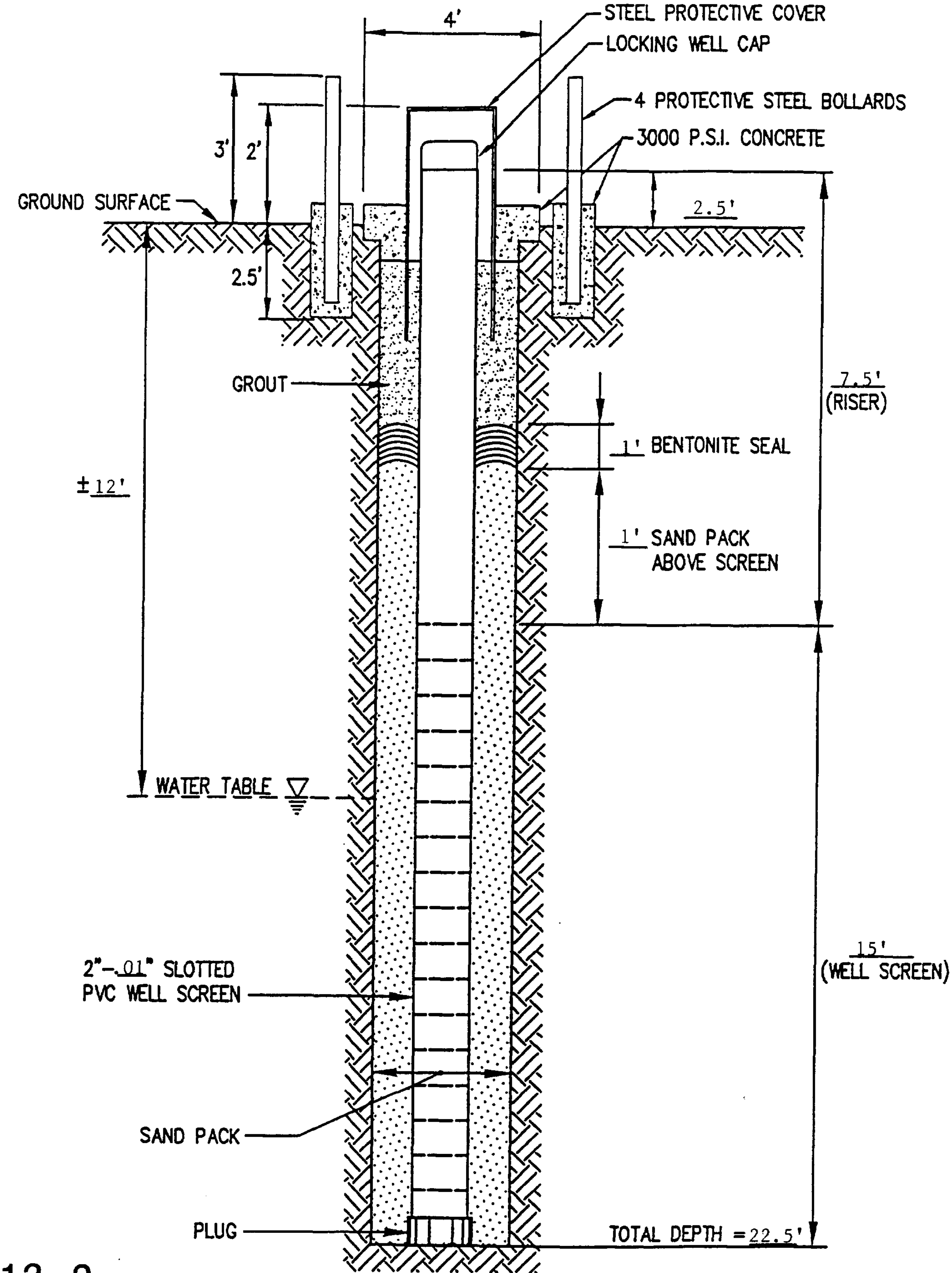
WELL CONSTRUCTION RECORDS AND GROUND WATER MONITORING WELL INSTALLATION DETAILS



1613-1

Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS RC&A	PROJECT UST's 1613 1-4 LANTDIV NAVFACENGCOM CAMP LEJEUNE, NC		TITLE ABOVE GROUND TYPE II MONITORING WELL DETAIL .		FIGURE
WILMINGTON, NC CHARLESTON, SC ATLANTA, GA MOORESVILLE, NC	JOB NO: 94127	DATE: MAY 1995	SCALE: NTS	DRAWN BY: WHW	CHECKED BY: JC

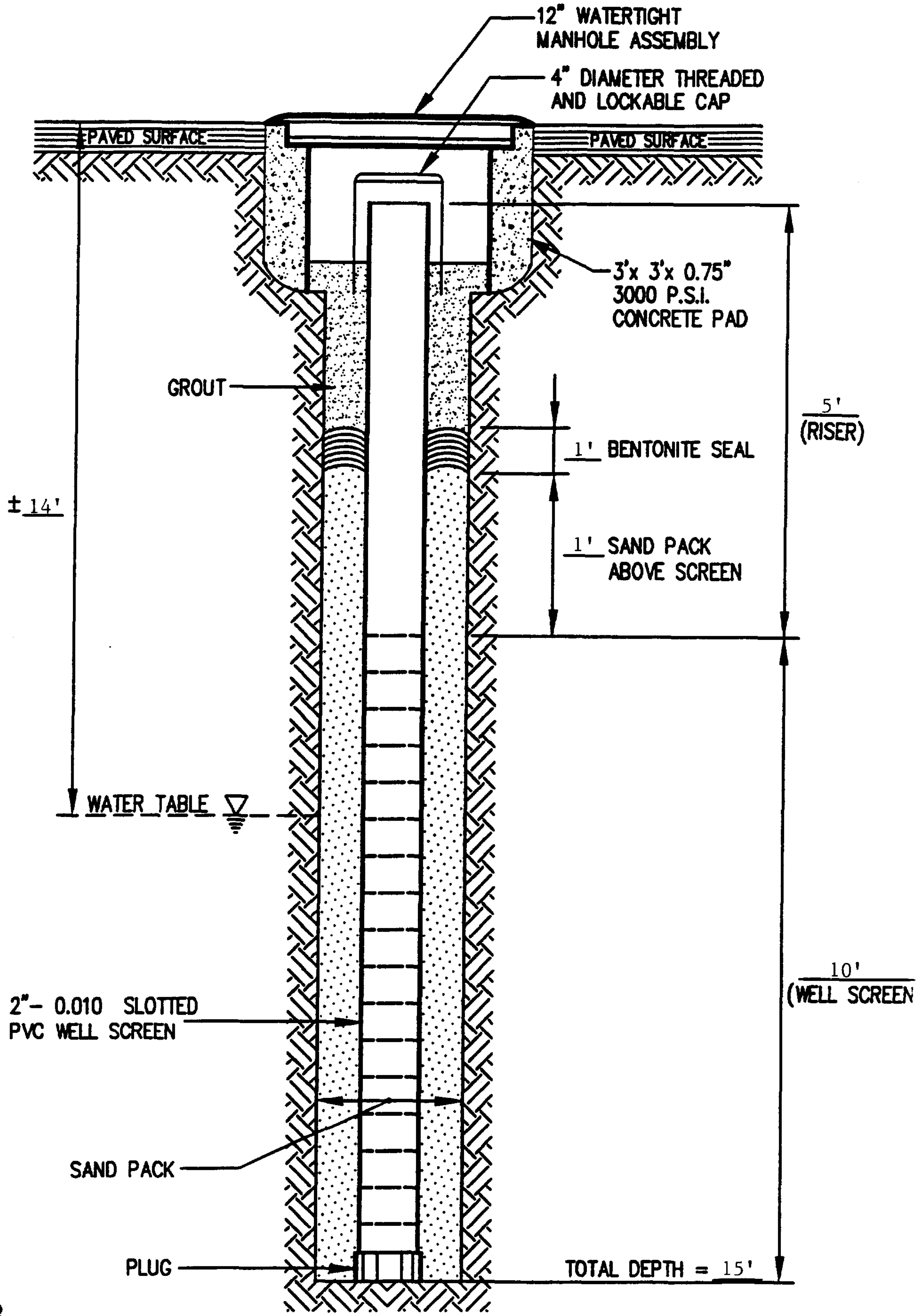
CAMP LEJEUNE ONLY



1613-2

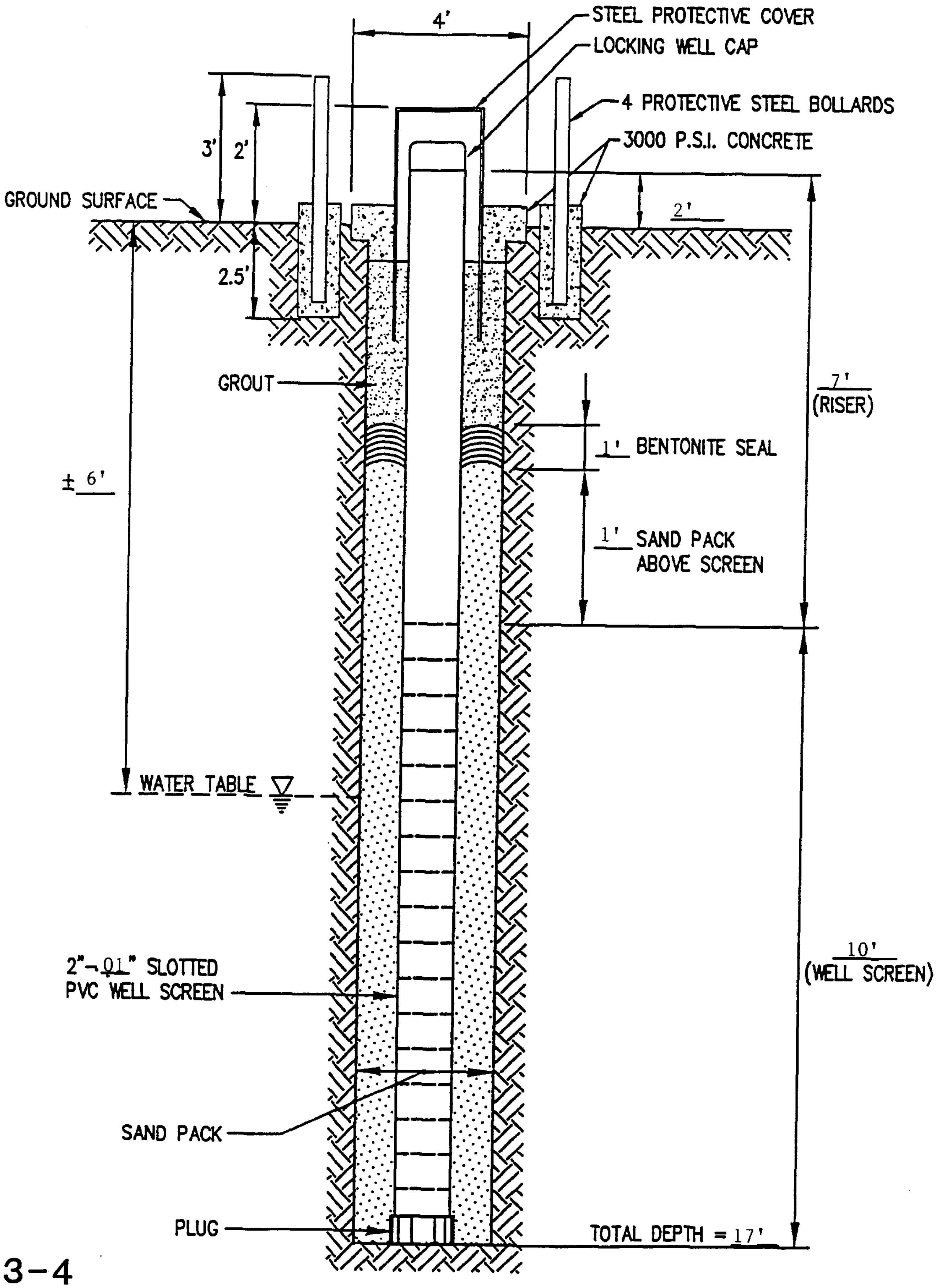
Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS RC&A WILMINGTON, NC CHARLESTON, SC ATLANTA, GA MOORESVILLE, NC	PROJECT UST's 1613 1-4 LANTDIV NAVFACENGCOM CAMP LEJEUNE, NC	TITLE ABOVE GROUND TYPE II MONITORING WELL DETAIL	FIGURE
JOB NO: 94127 DATE: MAY 1995	SCALE: NTS	DRAWN BY: WHW	CHECKED BY: JC

AMP LEJEUNE ONLY



1613-3

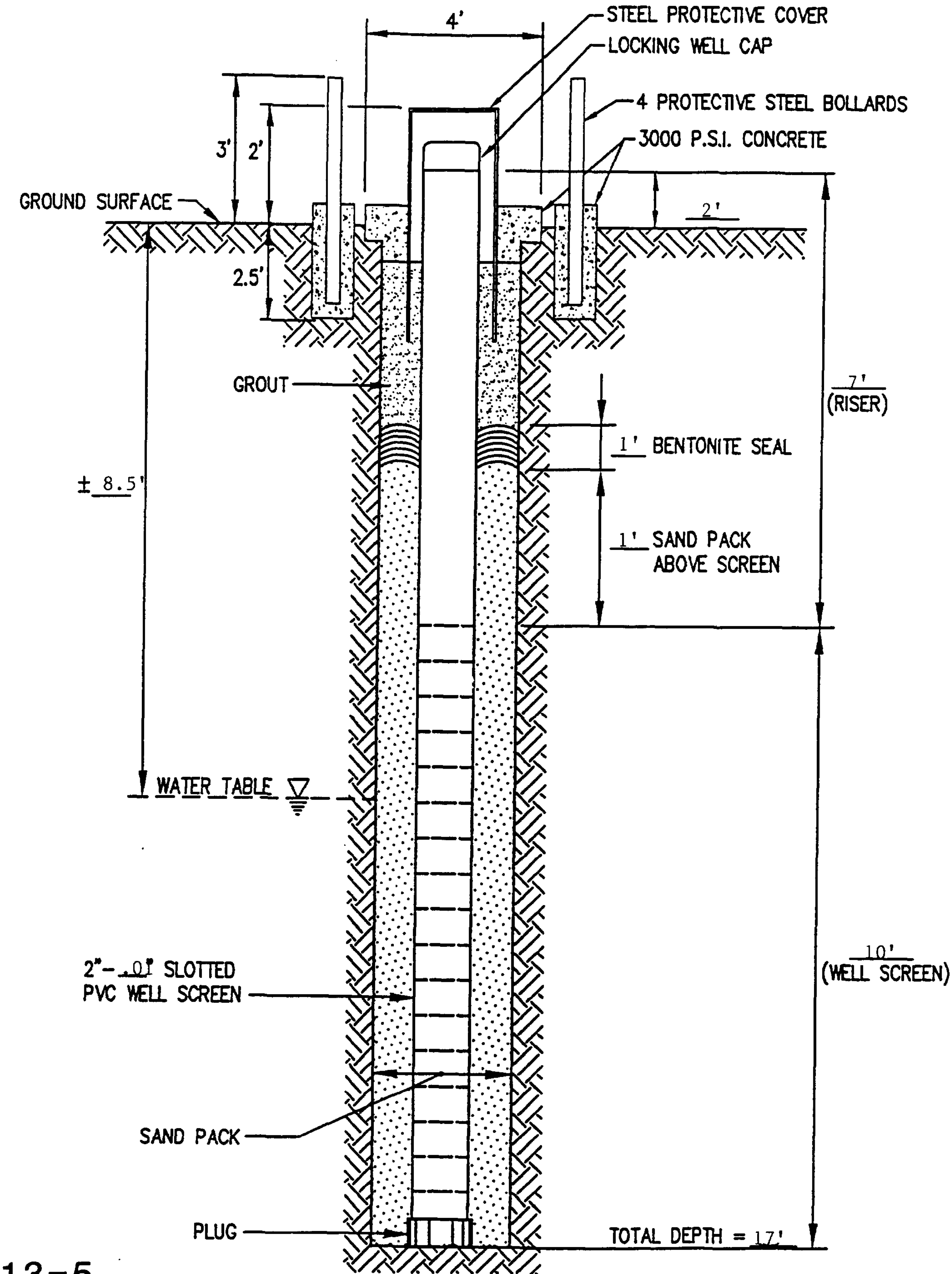
Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS RC&A WILMINGTON, NC CHARLESTON, SC ATLANTA, GA WINSTON-SALEM, NC	PROJECT UST's 1613 1-4 LANTDIV NAVFACENGCOM CAMP LEJEUNE, NC	TITLE PAVED SURFACE TYPE II MONITORING WELL DETAIL	FIGURE
	JOB NO: 94127 DATE: MAY 1995	SCALE: NTS DRAWN BY: WHW CHECKED BY: JC	



1613-4

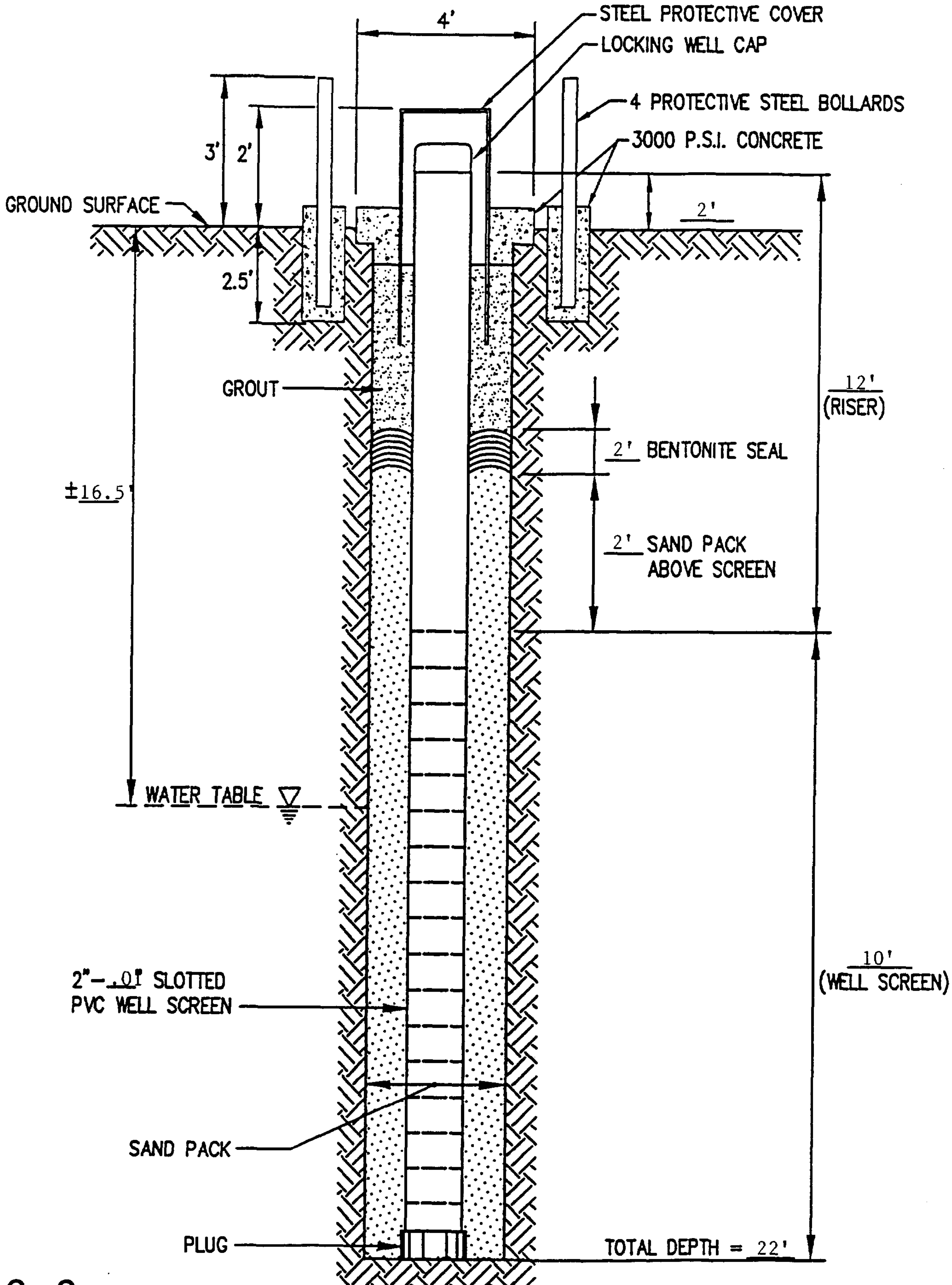
Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS RC&A WILMINGTON, NC CHARLESTON, SC ATLANTA, GA MOORESVILLE, NC	PROJECT UST's 1613 1-4 LANTDIV NAVFACENGCOM CAMP LEJEUNE, NC	TITLE ABOVE GROUND TYPE II MONITORING WELL DETAIL		FIGURE
	JOB NO. 94127 DATE MAY 1995	SCALE: NTS	DRAWN BY: WHW	CHECKED BY: JC

AMP LEJEUNE ONLY



1613-5

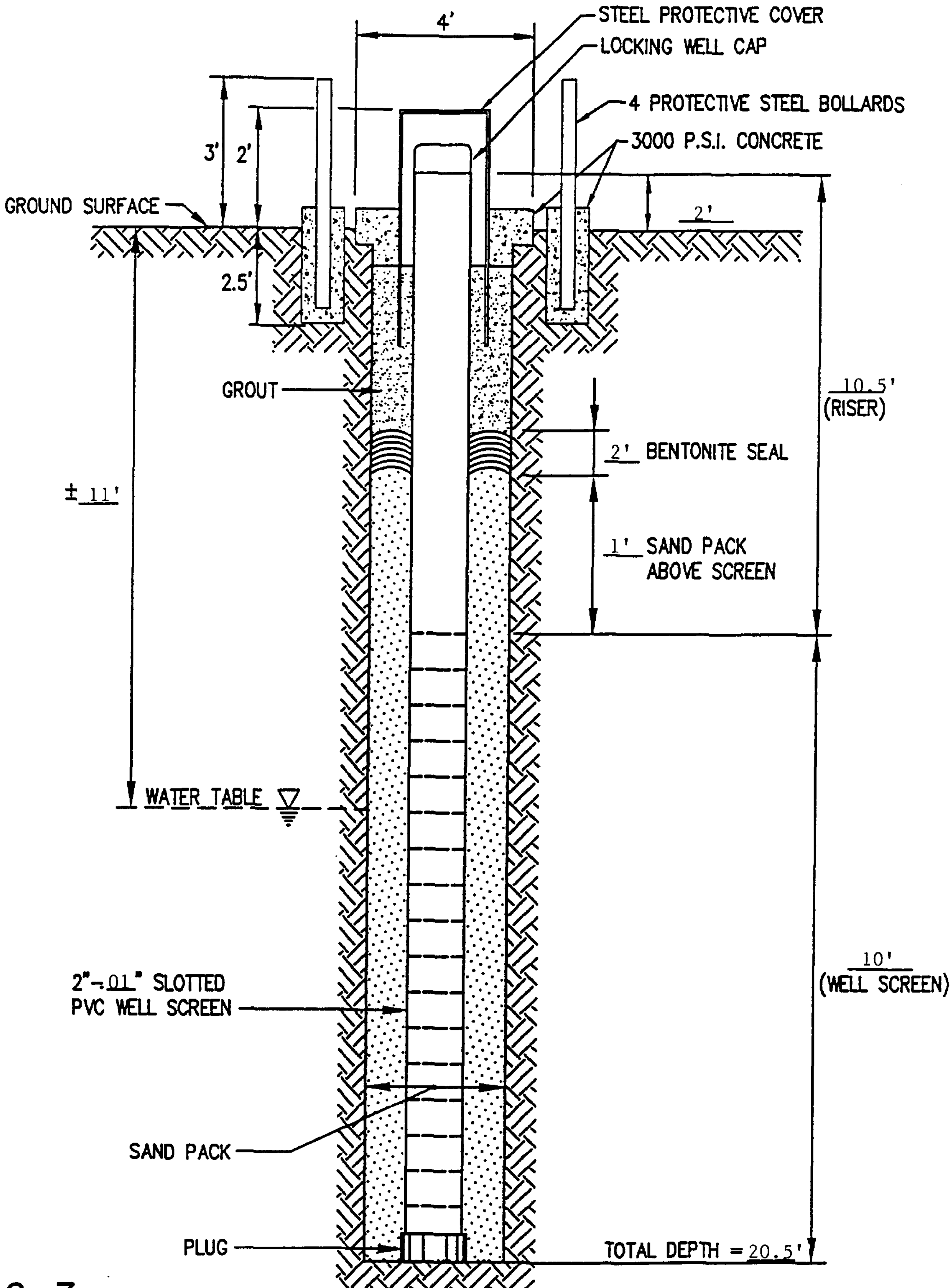
Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS RC&A — WILMINGTON, NC CHARLESTON, SC ATLANTA, GA MOORESVILLE, NC	PROJECT UST's 1613 1-4 LANTDIV NAVFACENGCOM CAMP LEJEUNE, NC	TITLE ABOVE GROUND TYPE II MONITORING WELL DETAIL .	FIGURE
JOB NO. 94127	DATE MAY 1995	SCALE NTS — DRAWN BY: WHW	CHECKED BY: JC



1613-6

Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS RC&A	PROJECT UST's 1613 1-4 LANTDIV NAVFACENGCOM CAMP LEJEUNE, NC		TITLE ABOVE GROUND TYPE II MONITORING WELL DETAIL			FIGURE
WILMINGTON, NC CHARLESTON, SC ATLANTA, GA MOORESVILLE, NC	JOB NO. 94127	DATE MAY 1995	SCALE NTS	DRAWN BY: WHW	CHECKED BY: JC	

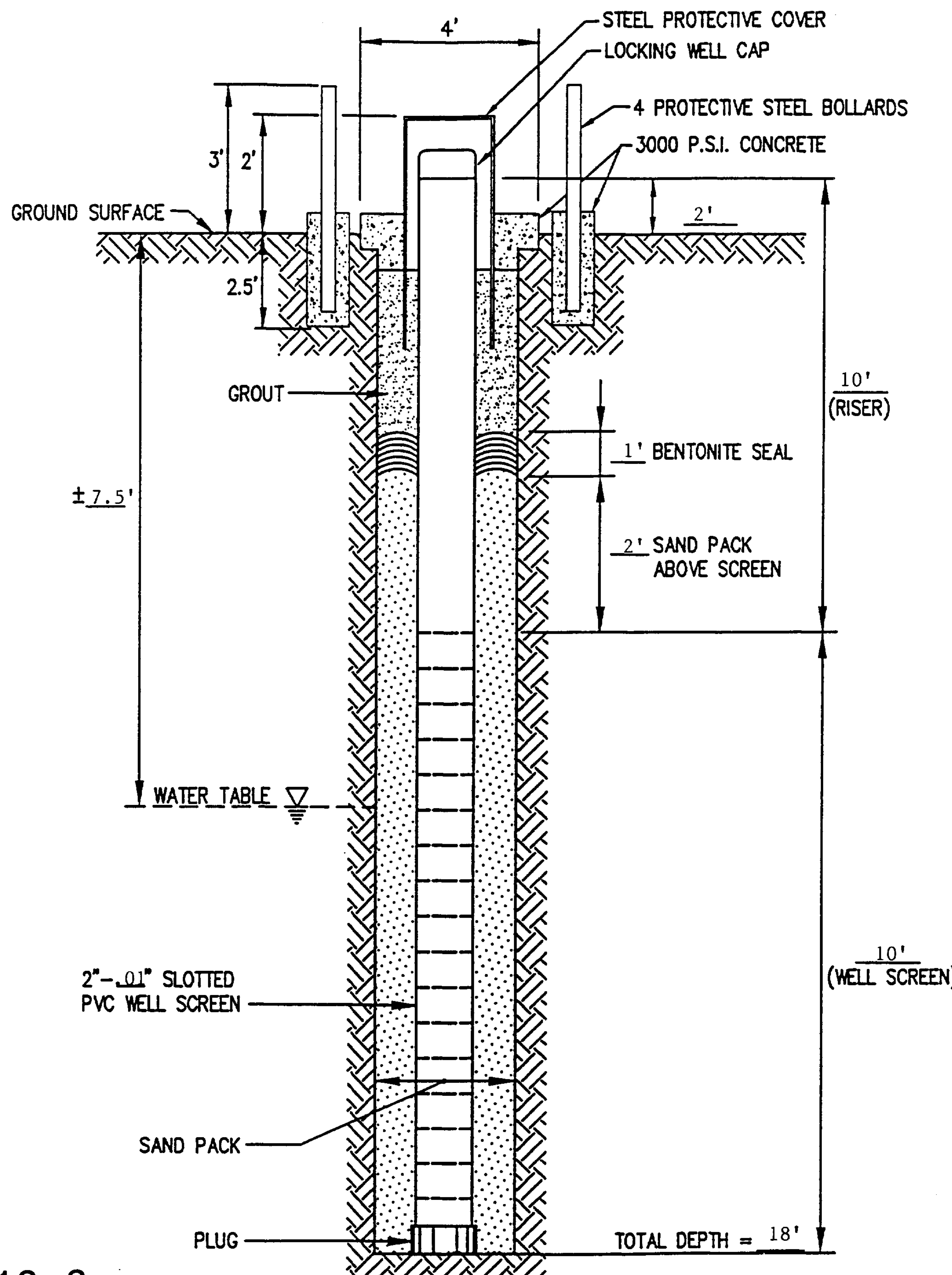
AMP LEJEUNE ONLY



1613-7

Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS RC&A WILMINGTON, NC CHARLESTON, SC ATLANTA, GA MOORESVILLE, NC	PROJECT UST's 1613 1-4 LANTDIV NAVFACENGCOM CAMP LEJEUNE, NC		TITLE ABOVE GROUND TYPE II MONITORING WELL DETAIL		FIGURE
	JOB NO. 94127	DATE MAY 1995	SCALE NTS	DRAWN BY: WHW	CHECKED BY: JC

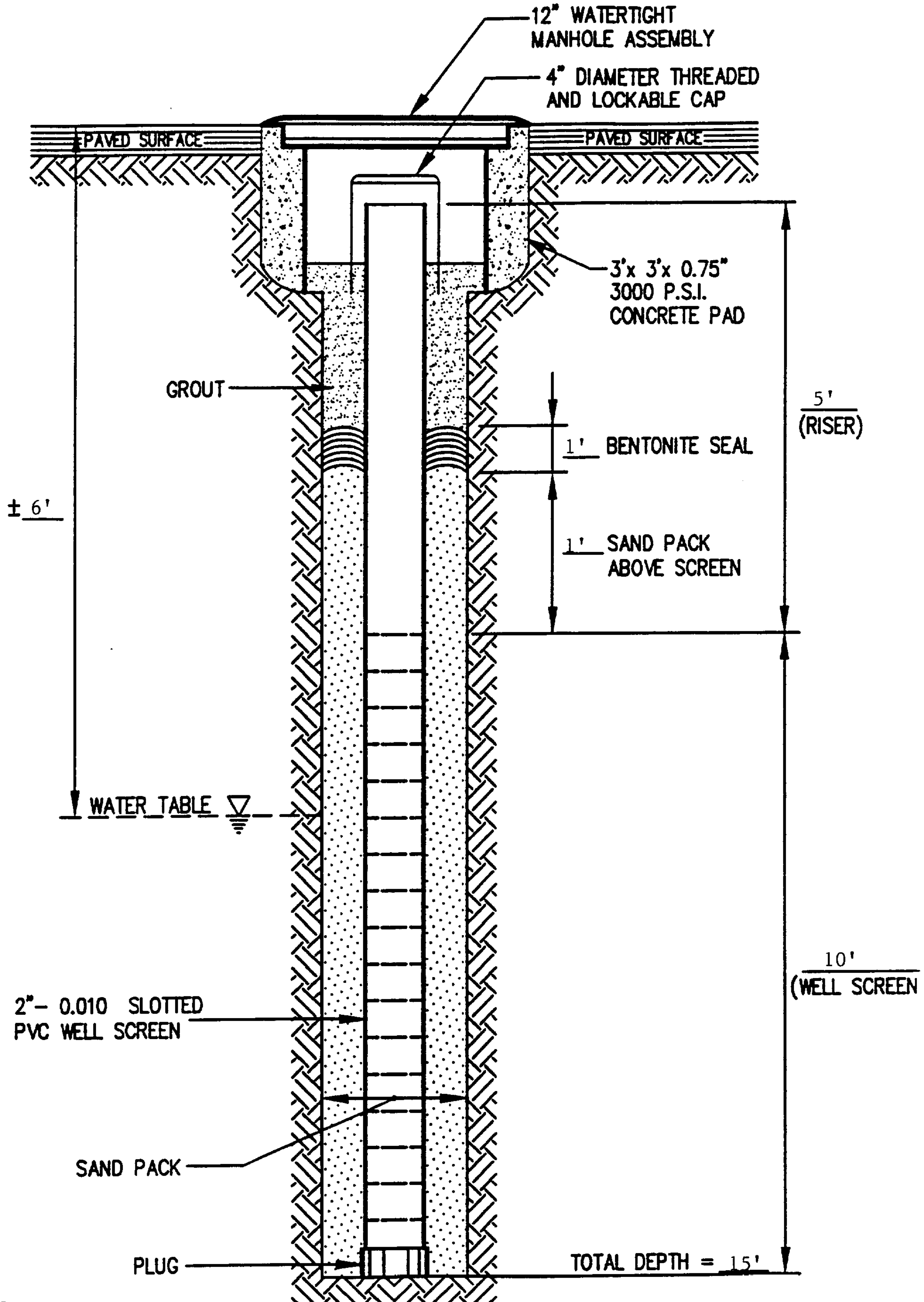
CAMP LEJEUNE ONLY



1613-8

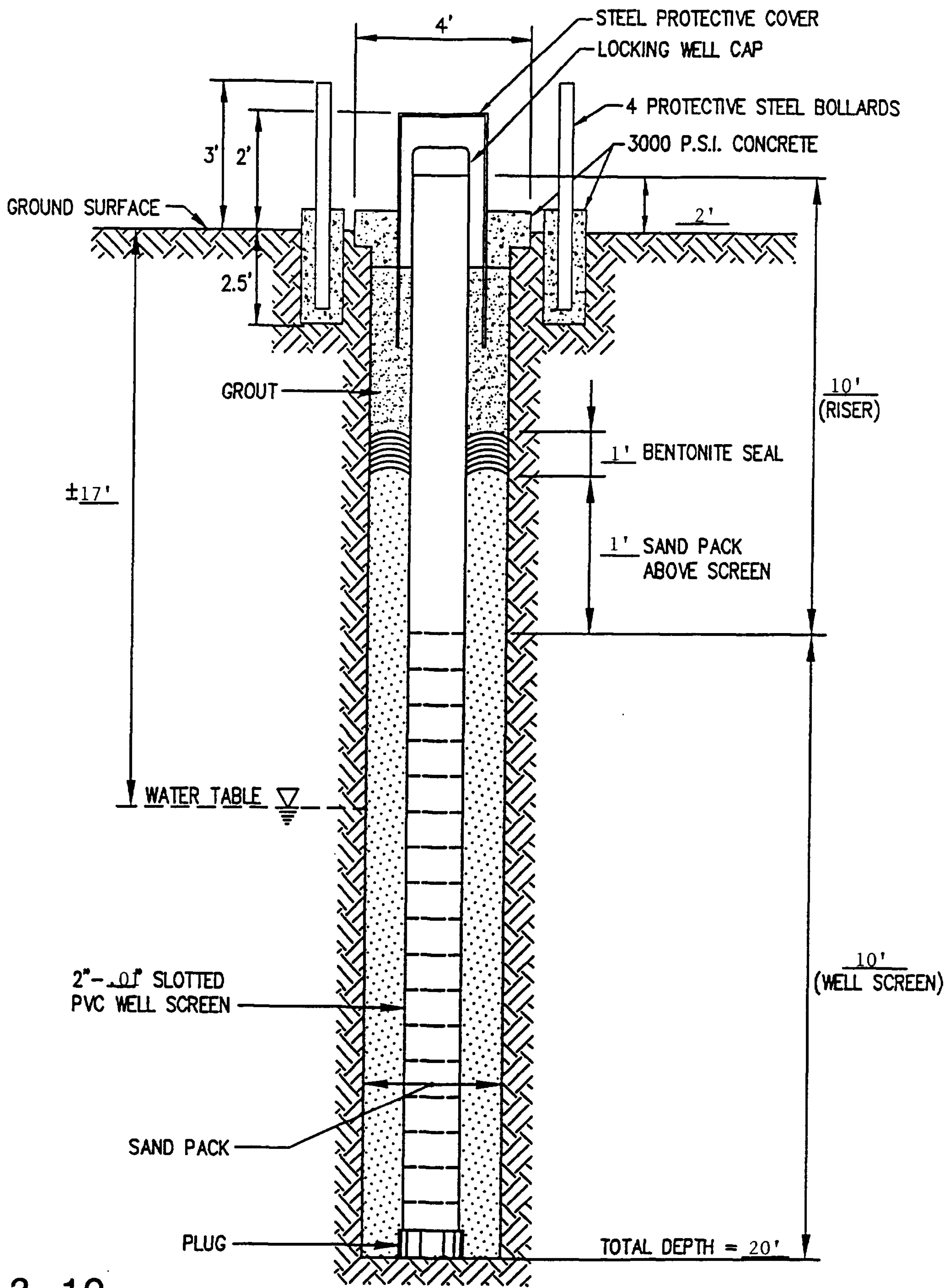
Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS RC&A WILMINGTON, NC CHARLESTON, SC ATLANTA, GA MOORESVILLE, NC	PROJECT UST's 1613 1-4 LANTDIV NAVFACENGCOM CAMP LEJEUNE, NC	TITLE ABOVE GROUND TYPE II MONITORING WELL DETAIL	FIGURE
	JOB NO: 94127 DATE: MAY 1995	SCALE: NTS DRAWN BY: WHW CHECKED BY: JC	

AMP LEJEUNE ONLY



1613-9

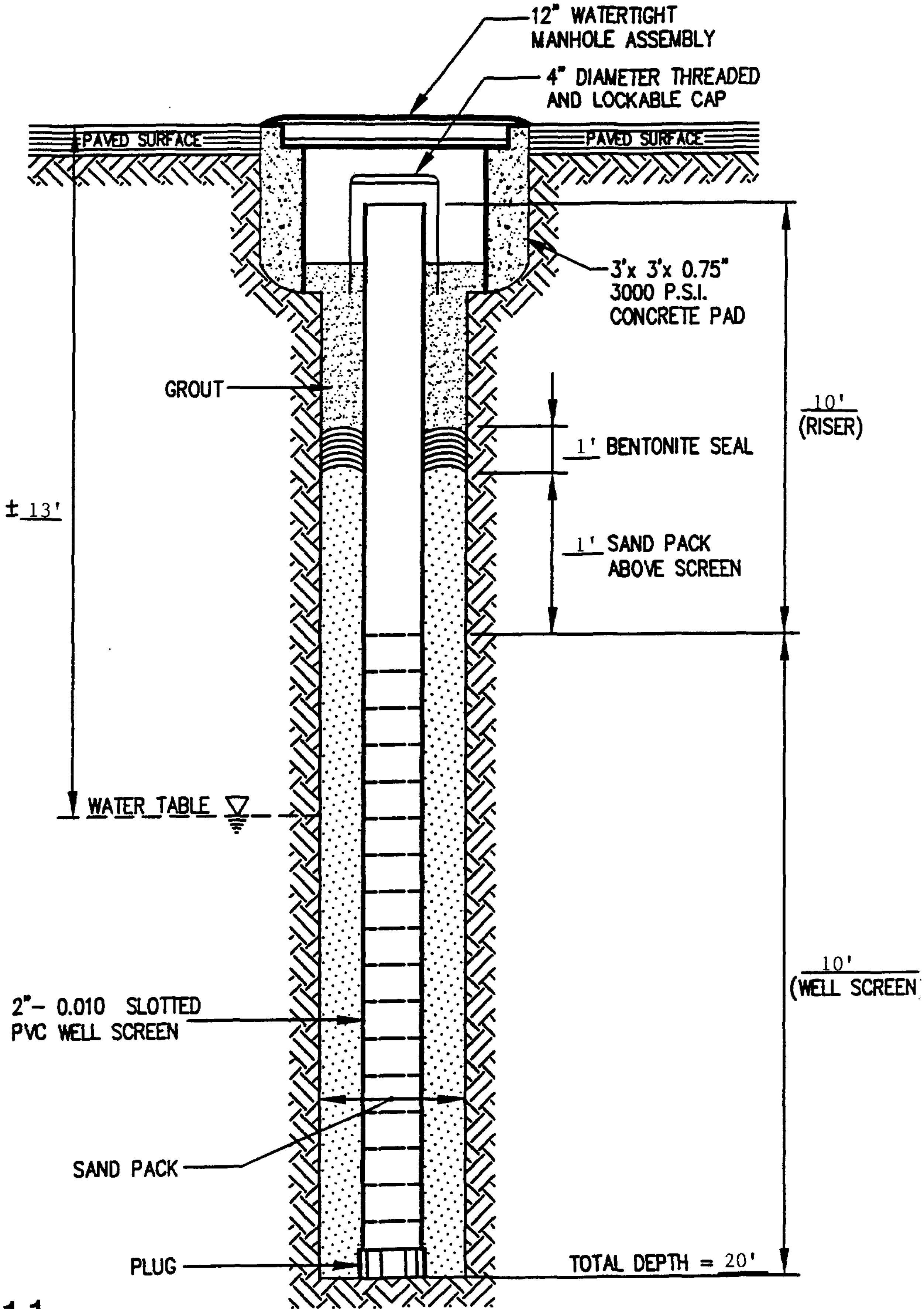
Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS RC&A WILMINGTON, NC CHARLESTON, SC ATLANTA, GA WINSTON-SALEM, NC	PROJECT UST's 1613 1-4 LANTDIV NAVFACENGCOM CAMP LEJEUNE, NC		TITLE PAVED SURFACE TYPE II MONITORING WELL DETAIL		FIGURE
	JOB NO: 94127	DATE: MAY 1995	SCALE: NTS	DRAWN BY: WHW	CHECKED BY: JC



1613-10

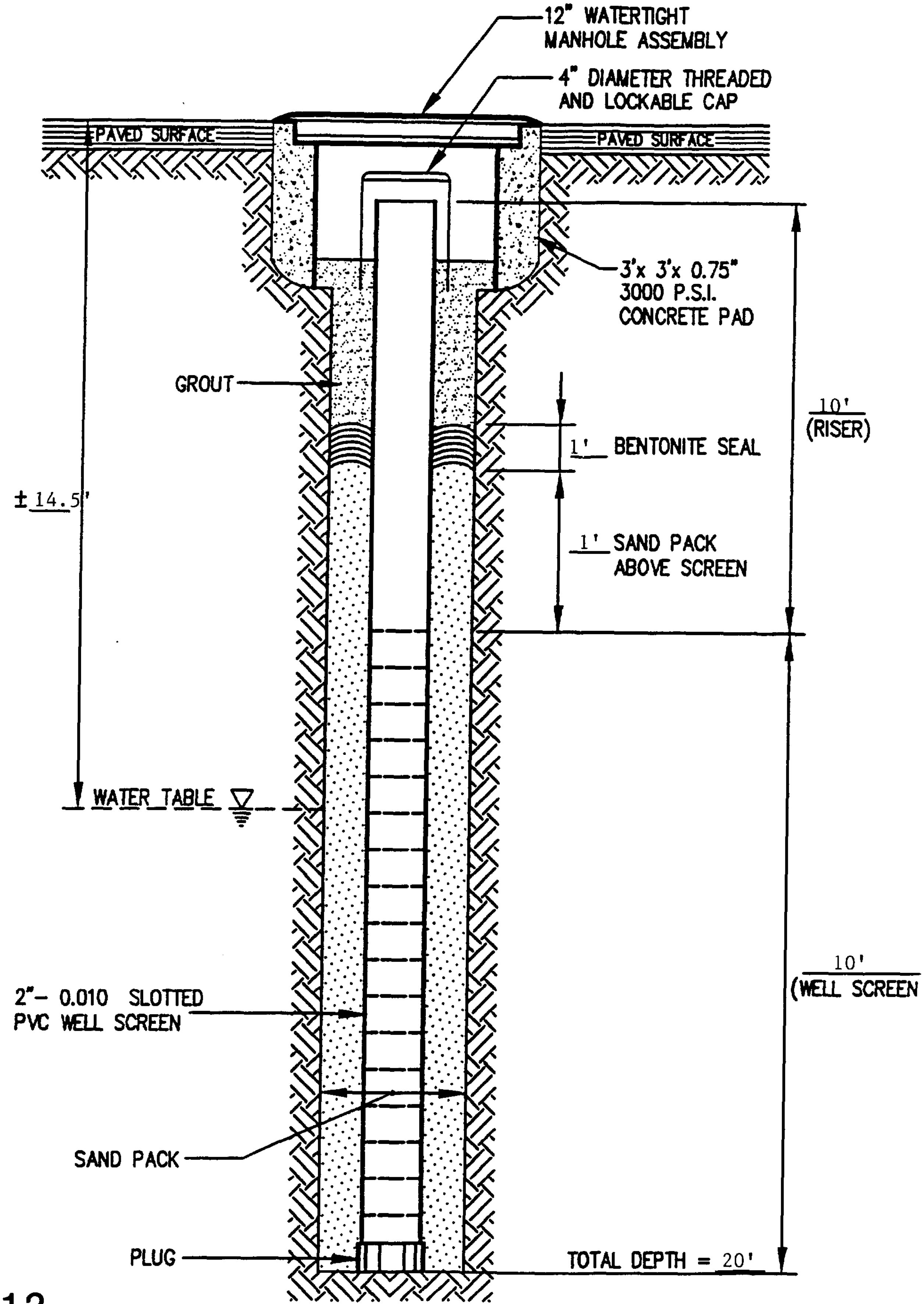
Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS RC&A WILMINGTON, NC CHARLESTON, SC ATLANTA, GA MOORESVILLE, NC	PROJECT UST's 1613 1-4 LANTDIV NAVFACENGCOM CAMP LEJEUNE, NC	TITLE ABOVE GROUND TYPE II MONITORING WELL DETAIL	FIGURE
	JOB NO: 94127 DATE: MAY 1995	SCALE: NTS DRAWN BY: WHW	CHECKED BY: JC

AMP LEJEUNE ONLY



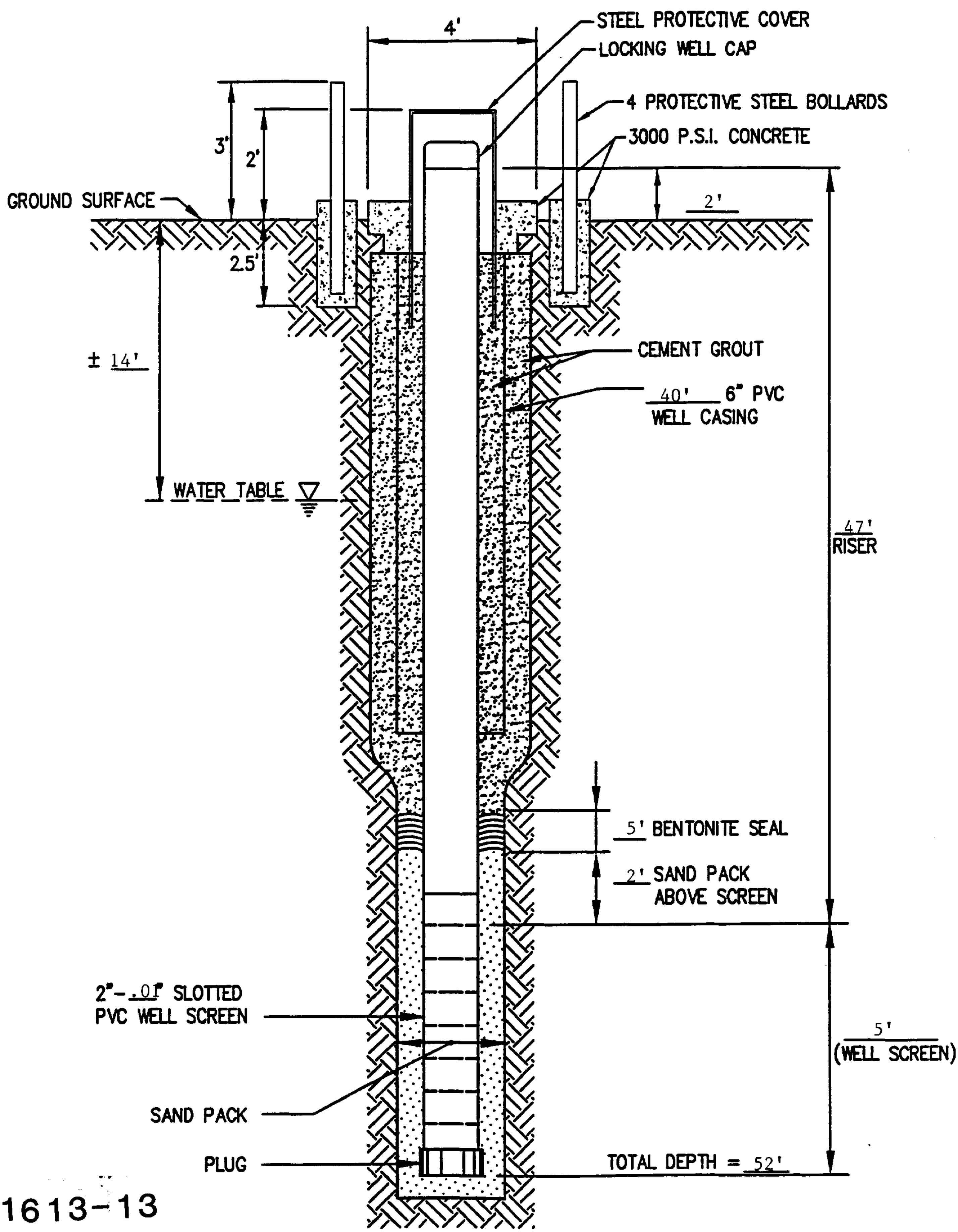
1613-11

Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS RC&A WILMINGTON, NC CHARLESTON, SC ATLANTA, GA WINSTON-SALEM, NC	PROJECT UST's 1613 1-4 LANTDIV NAVFACENGCOM CAMP LEJEUNE, NC	TITLE PAVED SURFACE TYPE II MONITORING WELL DETAIL	FIGURE
	JOB NO. 94127 DATE MAY 1995	SCALE NTS DRAWN BY: WHW CHECKED BY: JC	



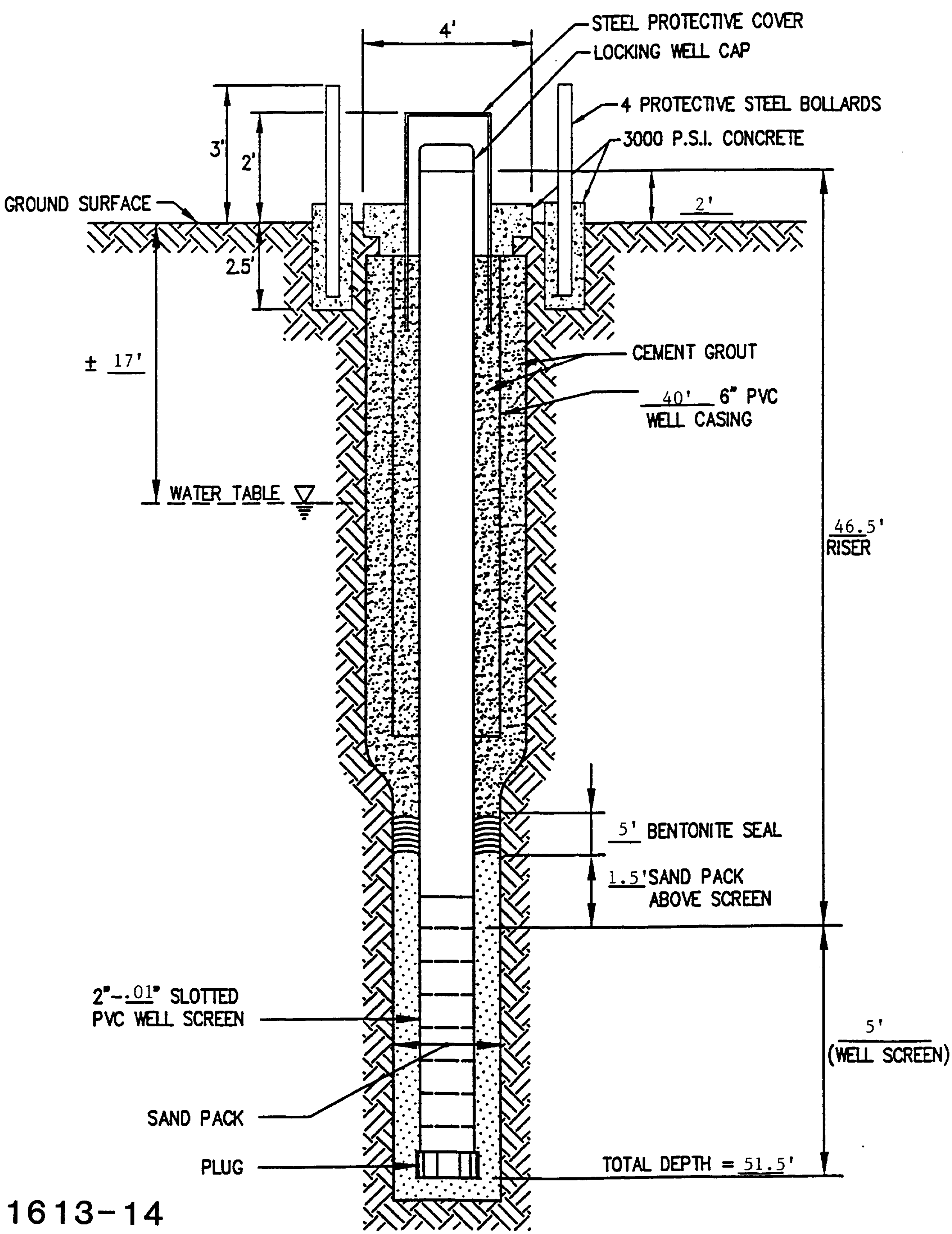
1613-12

Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS (RC&A) WILMINGTON, NC CHARLESTON, SC ATLANTA, GA WINSTON-SALEM, NC	PROJECT UST's 1613 1-4 LANTDIV NAVFACENGCOM CAMP LEJEUNE, NC	TITLE PAVED SURFACE TYPE II MONITORING WELL DETAIL	FIGURE
	JOB NO. 94127 / DATE MAY 1995	SCALE NTS / DRAWN BY: WHW / CHECKED BY: JC	



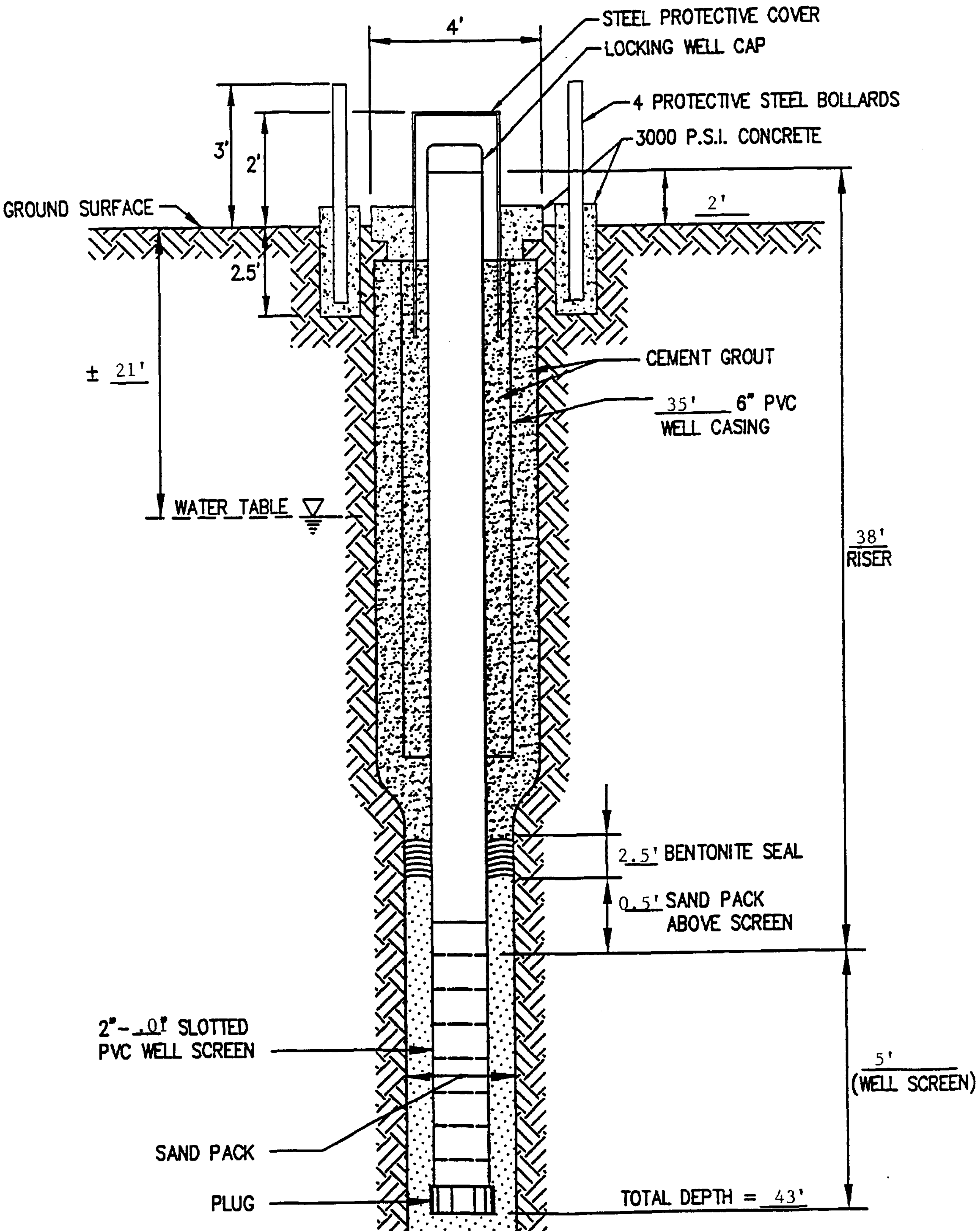
Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS RC&A WILMINGTON, NC CHARLESTON, SC ATLANTA, GA MOORESVILLE, NC	PROJECT UST's 1613 1-4 LANTDIV NAVFACENGCOM CAMP LEJEUNE, NC	TITLE ABOVE GROUND TYPE III MONITORING WELL DETAIL	FIGURE
	JOB NO: 94127 DATE: MAY 1995	SCALE: NTS DRAWN BY: WHW CHECKED BY: JC	

AMP LEJEUNE ONLY



1613-14

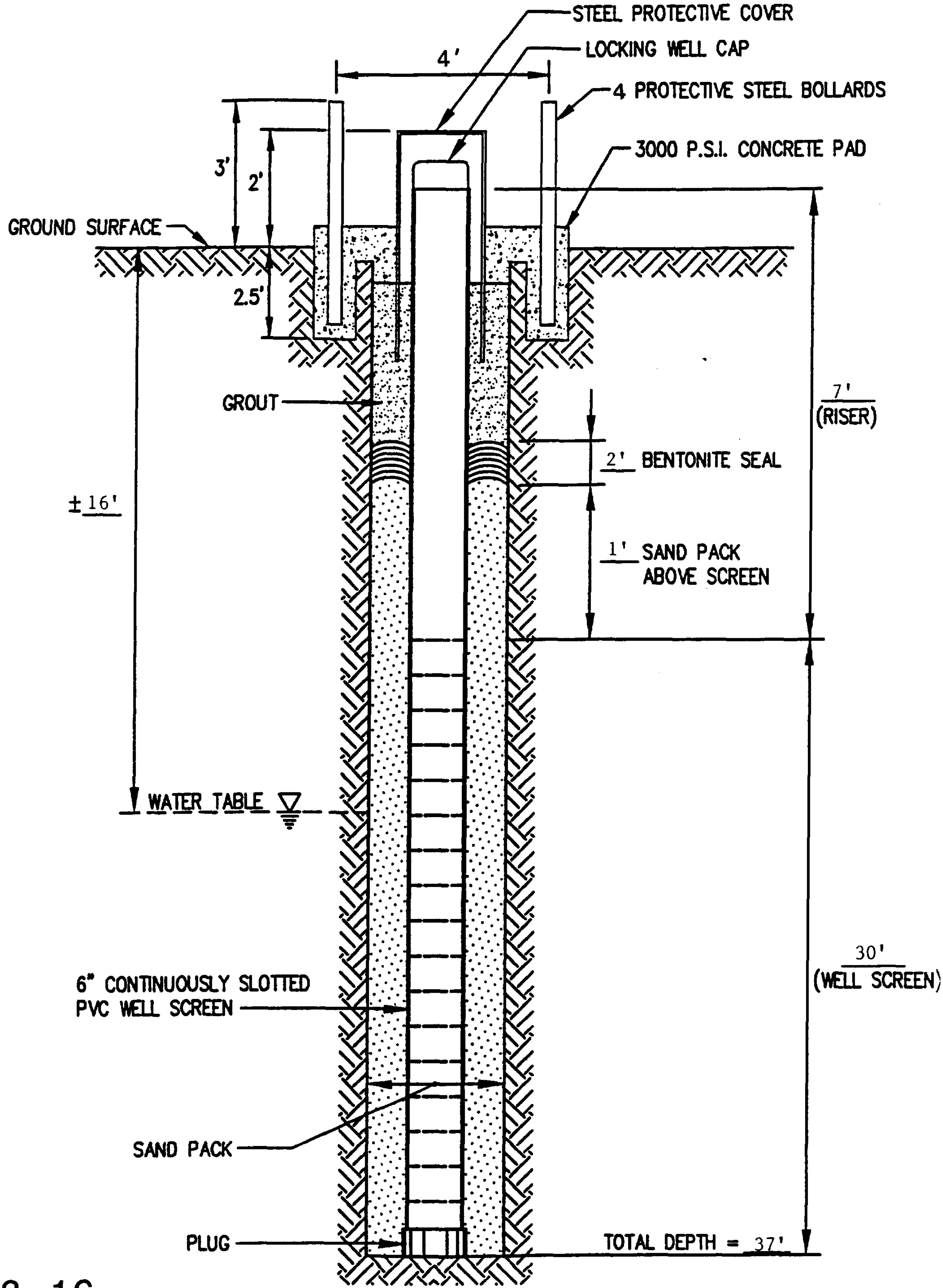
Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS RC&A WILMINGTON, NC CHARLESTON, SC ATLANTA, GA MOORESVILLE, NC	PROJECT UST's 1613 1-4 LANTDIV NAVFACENGCOM CAMP LEJEUNE, NC	TITLE ABOVE GROUND TYPE III MONITORING WELL DETAIL ..	FIGURE
	JOB NO: 94127 DATE: MAY 1995	SCALE: NTS DRAWN BY: WHW CHECKED BY: JC	



1613-15

Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS RC&A WILMINGTON, NC CHARLESTON, SC ATLANTA, GA MOORESVILLE, NC	PROJECT UST's 1613 1-4 LANTDIV NAVFACENGCOM CAMP LEJEUNE, NC	TITLE ABOVE GROUND TYPE III MONITORING WELL DETAIL	FIGURE
	JOB NO. 94127 — DATE MAY 1995	SCALE NTS — DRAWN BY: WHW — CHECKED BY: JC	

MP LEJEUNE ONLY



1613-16

Richard Catlin & Associates, Inc. ENVIRONMENTAL ENGINEERS AND HYDROGEOLOGISTS RC&A WILMINGTON, NC CHARLESTON, SC ATLANTA, GA WINSTON-SALEM, NC	PROJECT UST's 1613 1-4 LANTDIV NAVFACENGCOM CAMP LEJEUNE, NC	TITLE ABOVE GROUND PUMPING WELL DETAIL	FIGURE
	JOB NO: 94127 DATE: MAY 1995	SCALE: NTS DRAWN BY: WHW CHECKED BY: JC	

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, NC 27611-7687
PHONE: (910) 733-3221

FOR OFFICE USE ONLY

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

WELL CONSTRUCTION RECORD FOR 1613-1

DRILLING CONTRACTOR Richard Catlin & Associates, Inc.

DRILLER REGISTRATION NUMBER 1142

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below) County: Onslow
Nearest Town: Camp Lejeune

BUILDING 1613, USTs 1613 1-4
(Road, Community, or Subdivision and Lot No.)

2. OWNER LANTDIV NAVFACENGCOM, Commanding General

ADDRESS AC/S EMD/Marine Corps Base/PSC Box 20004
(Street or Route No.)
Camp Lejeune NC 28542-0004
City or Town State Zip Code

3. DATE DRILLED 4/10/95 USE OF WELL Monitoring

4. TOTAL DEPTH 20' CUTTINGS COLLECTED X YES ____ NO

5. DOES WELL REPLACE EXISTING WELL? ____ YES X NO

6. STATIC WATER LEVEL: ± 16 FT. ____ ABOVE/BELOW TOP OF CASING.

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

8. WATER ZONES (depth): Surficial Aquifer

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

10. CASING:

	Depth				Diameter	Wall Thickness or Weight/Ft.	Material
From	+2.5	To	5	Ft.	2 in.	SCH40	PVC
From		To		Ft.	in.	SCH40	

11. GROUT:

	Depth				Material	Method
From	0	To	3	Ft.	CEMENT	TREMIE
From	3	To	4	Ft.	BENTONITE	CHIPS

12. SCREEN:

	Depth				Diameter	Slot Size	Material
From	5	To	20	Ft.	2 in.	.010 in.	PVC

13. GRAVEL PACK:

	Depth				Size	Material
From	4	To	20	Ft.	TORPEDO	SAND

Depth From	Depth To	DRILLING LOG Formation Description

SEE ATTACHED

If additional space is needed use back of form.

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

SEE ATTACHED

14. REMARKS: Measurements Referenced to Ground Surface

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

Cindy L. Myers 5-29-95
SIGNATURE OF CONTRACTOR OR AGENT DATE
Submit original to Division of Environmental Management and copy to well owner.

GW-1 REVISED 2/90

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, NC 27611-7687
PHONE: (910) 733-3221

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

WELL CONSTRUCTION RECORD FOR 1613-2

DRILLING CONTRACTOR Richard Catlin & Associates, Inc.

DRILLER REGISTRATION NUMBER 1142

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below) County: Onslow
   Nearest Town: Camp Lejeune
   BUILDING 1613, USTs 1613 1-4
   (Road, Community, or Subdivision and Lot No.)
2. OWNER LANTDIV NAVFACENGCOM, Commanding General
   ADDRESS AC/S EMD/Marine Corps Base/PSC Box 20004
   (Street or Route No.)
   Camp Lejeune (City or Town) NC (State) 28542-0004 (Zip Code)
3. DATE DRILLED 4/10/95 USE OF WELL Monitoring
4. TOTAL DEPTH 20' CUTTINGS COLLECTED X YES ___ NO
5. DOES WELL REPLACE EXISTING WELL? ___ YES X NO
6. STATIC WATER LEVEL: ± 12 FT. ___ ABOVE/BELOW TOP OF CASING.
7. YIELD (gpm): N/A METHOD OF TEST N/A
8. WATER ZONES (depth): Surficial Aquifer
9. CHLORINATION: Type: N/A Amount N/A
10. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	+2.5	To 5	Ft.	2 in.	SCH40	PVC
From		To	Ft.	in.	SCH40	

11. GROUT:

	Depth			Material	Method
From	0	To 3	Ft.	CEMENT	TREMIE
From	3	To 4	Ft.	BENTONITE	CHIPS

12. SCREEN:

	Depth			Diameter	Slot Size	Material
From	5	To 20	Ft.	2 in.	.010 in.	PVC

13. GRAVEL PACK:

	Depth			Size	Material
From	4	To 20	Ft.	TORPEDO	SAND

14. REMARKS: Measurements Referenced to Ground Surface

Depth From	To	DRILLING LOG Formation Description

SEE ATTACHED

If additional space is needed use back of form.

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

SEE ATTACHED

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

Amy L. Myers 5-29-95

SIGNATURE OF CONTRACTOR OR AGENT DATE

GW-1 REVISED 2/90

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

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, NC 27611-7687
PHONE: (910) 733-3221

FOR OFFICE USE ONLY

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

WELL CONSTRUCTION RECORD FOR 1613-3

DRILLING CONTRACTOR Richard Catlin & Associates, Inc.

DRILLER REGISTRATION NUMBER 1142

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below) County: Onslow
Nearest Town: Camp Lejeune

BUILDING 1613, USTs 1613 1-4
(Road, Community, or Subdivision and Lot No.)

2. OWNER LANTDIV NAVFACENGCOM, Commanding General

ADDRESS AC/S EMD/Marine Corps Base/PSC Box 20004
(Street or Route No.)
Camp Lejeune NC 28542-0004
City or Town State Zip Code

3. DATE DRILLED 4/11/95 USE OF WELL Monitoring

4. TOTAL DEPTH 15' CUTTINGS COLLECTED X YES ____ NO

5. DOES WELL REPLACE EXISTING WELL? ____ YES X NO

6. STATIC WATER LEVEL: ± 14 FT. ____ ABOVE/BELOW TOP OF CASING.

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

8. WATER ZONES (depth): Surficial Aquifer

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

10. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	0.5	To 5	Ft.	2 in.	SCH40	PVC
From		To	Ft.	in.	SCH40	

11. GROUT:

	Depth			Material	Method
From	0.5	To 3	Ft.	CEMENT	TREMIE
From	3	To 4	Ft.	BENTONITE	CHIPS

12. SCREEN:

	Depth			Diameter	Slot Size	Material
From	5	To 15	Ft.	2 in.	.010 in.	PVC

13. GRAVEL PACK:

	Depth			Size	Material
From	4	To 15	Ft.	TORPEDO	SAND

14. REMARKS:

Depth From	To	DRILLING LOG Formation Description

SEE ATTACHED

If additional space is needed use back of form.

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

SEE ATTACHED

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

Amy L. Myers 5-29-95
SIGNATURE OF CONTRACTOR OR AGENT DATE

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

GW-1 REVISED 2/90

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, NC 27611-7687
PHONE: (910) 733-3221

FOR OFFICE USE ONLY

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

WELL CONSTRUCTION RECORD FOR 1613-4

DRILLING CONTRACTOR Richard Catlin & Associates, Inc.

DRILLER REGISTRATION NUMBER 1142

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below) County: Onslow
Nearest Town: Camp Lejeune

BUILDING 1613, USTs 1613 1-4
(Road, Community, or Subdivision and Lot No.)

2. OWNER LANTDIV NAVFACENGCOM, Commanding General

ADDRESS AC/S EMD/Marine Corps Base/PSC Box 20004
(Street or Route No.)
Camp Lejeune (City or Town) NC (State) 28542-0004 (Zip Code)

3. DATE DRILLED 4/11/95 USE OF WELL Monitoring

4. TOTAL DEPTH 15' CUTTINGS COLLECTED X YES ____ NO

5. DOES WELL REPLACE EXISTING WELL? ____ YES X NO

6. STATIC WATER LEVEL: ± 6 FT. ____ ABOVE/BELOW TOP OF CASING.

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

8. WATER ZONES (depth): Surficial Aquifer

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

10. CASING:

Depth				Diameter	Wall Thickness or Weight/Ft.	Material
From	+2	To 5	Ft.	2 in.	SCH40	PVC
From		To	Ft.	in.	SCH40	

11. GROUT:

Depth				Material	Method
From	0	To 3	Ft.	CEMENT	TREMIE
From	3	To 4	Ft.	BENTONITE	CHIPS

12. SCREEN:

Depth				Diameter	Slot Size	Material
From	5	To 15	Ft.	2 in.	.010 in.	PVC

13. GRAVEL PACK:

Depth				Size	Material
From	4	To 15	Ft.	TORPEDO	SAND

14. REMARKS: Measurements Referenced to Ground Surface

Depth From	To	DRILLING LOG Formation Description

SEE ATTACHED

If additional space is needed use back of form.

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

SEE ATTACHED

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

Amy R. Myers 5-29-95
SIGNATURE OF CONTRACTOR OR AGENT DATE

GW-1 REVISED 2/90

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

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, NC 27611-7687
PHONE: (910) 733-3221

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

WELL CONSTRUCTION RECORD FOR 1613-5

DRILLING CONTRACTOR Richard Catlin & Associates, Inc.

DRILLER REGISTRATION NUMBER 1142

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below) County: Onslow
   Nearest Town: Camp Lejeune

   BUILDING 1613, USTs 1613 1-4
   (Road, Community, or Subdivision and Lot No.)

2. OWNER LANTDIV NAVFACENGCOM, Commanding General

   ADDRESS AC/S EMD/Marine Corps Base/PSC Box 20004
   (Street or Route No.)
   Camp Lejeune (City or Town) NC (State) 28542-0004 (Zip Code)

3. DATE DRILLED 4/11/95 USE OF WELL Monitoring

4. TOTAL DEPTH 15' CUTTINGS COLLECTED X YES ____ NO

5. DOES WELL REPLACE EXISTING WELL? ____ YES X NO

6. STATIC WATER LEVEL: ± 8.5 FT. ____ ABOVE/BELOW TOP OF CASING.

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

8. WATER ZONES (depth): Surficial Aquifer

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

10. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From +2	To 5	Ft.	2 in.	SCH40	PVC
From	To	Ft.	in.	SCH40	

11. GROUT:

	Depth		Material	Method
From 0	To 3	Ft.	CEMENT	TREMIE
From 3	To 4	Ft.	BENTONITE	CHIPS

12. SCREEN:

	Depth		Diameter	Slot Size	Material
From 5	To 15	Ft.	2 in.	.010 in.	PVC

13. GRAVEL PACK:

	Depth		Size	Material
From 4	To 15	Ft.	TORPEDO	SAND

14. REMARKS: Measurements Referenced to Ground Surface

Depth From	To	DRILLING LOG Formation Description

SEE ATTACHED

If additional space is needed use back of form.

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

SEE ATTACHED

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

Amy L. Myers 5-29-95
SIGNATURE OF CONTRACTOR OR AGENT DATE
Submit original to Division of Environmental Management and copy to well owner.

GW-1 REVISED 2/90

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, NC 27611-7687
PHONE: (910) 733-3221

FOR OFFICE USE ONLY

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

WELL CONSTRUCTION RECORD FOR 1613-6

DRILLING CONTRACTOR Richard Catlin & Associates, Inc.

DRILLER REGISTRATION NUMBER 1142

STATE WELL CONSTRUCTION
PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below) County: Onslow
Nearest Town: Camp Lejeune

BUILDING 1613, USTs 1613 1-4
(Road, Community, or Subdivision and Lot No.)

2. OWNER LANTDIV NAVFACENGCOM, Commanding General

ADDRESS AC/S EMD/Marine Corps Base/PSC Box 20004
(Street or Route No.)

City or Town	State	Zip Code
Camp Lejeune	NC	28542-0004

3. DATE DRILLED 4/12/95 USE OF WELL Monitoring

4. TOTAL DEPTH 20' CUTTINGS COLLECTED X YES ___ NO

5. DOES WELL REPLACE EXISTING WELL? ___ YES X NO

6. STATIC WATER LEVEL: ± 16.5 FT. ___ ABOVE/BELOW TOP OF CASING.

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

8. WATER ZONES (depth): Surficial Aquifer

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

10. CASING:

		Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From	+2	To 10	Ft.	2 in.	SCH40	PVC
From		To	Ft.	in.	SCH40	

11. GROUT:

		Depth		Material	Method
From	0	To 6	Ft.	CEMENT	TREMIE
From	6	To 8	Ft.	BENTONITE	CHIPS

12. SCREEN:

		Depth		Diameter	Slot Size	Material
From	10	To 20	Ft.	2 in.	.010 in.	PVC

13. GRAVEL PACK:

		Depth		Size	Material
From	8	To 20	Ft.	TORPEDO	SAND

Depth From	To	DRILLING LOG Formation Description

SEE ATTACHED

If additional space is needed use back of form.

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

SEE ATTACHED

14. REMARKS: Measurements Referenced to Ground Surface

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

Amy L. Myers 5-29-95
SIGNATURE OF CONTRACTOR OR AGENT DATE
Submit original to Division of Environmental Management and copy to well owner.

GW-1 REVISED 2/90

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, NC 27611-7687
PHONE: (910) 733-3221

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

WELL CONSTRUCTION RECORD FOR 1613-7

DRILLING CONTRACTOR Richard Catlin & Associates, Inc.

DRILLER REGISTRATION NUMBER 1142

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below) County: Onslow
Nearest Town: Camp Lejeune

BUILDING 1613, USTs 1613 1-4
(Road, Community, or Subdivision and Lot No.)

2. OWNER LANTDIV NAVFACENGCOM, Commanding General

ADDRESS AC/S EMD/Marine Corps Base/PSC Box 20004
(Street or Route No.)
Camp Lejeune NC 28542-0004
City or Town State Zip Code

3. DATE DRILLED 4/12/95 USE OF WELL Monitoring

4. TOTAL DEPTH 18.5' CUTTINGS COLLECTED X YES ____ NO

5. DOES WELL REPLACE EXISTING WELL? ____ YES X NO

6. STATIC WATER LEVEL: ± 11 FT. ____ ABOVE/BELOW TOP OF CASING.

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

8. WATER ZONES (depth): Surficial Aquifer

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

10. CASING:

		Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From	+2	To	8.5 Ft.	2 in.	SCH40	PVC
From		To	Ft.	in.	SCH40	

11. GROUT:

		Depth		Material	Method
From	0	To	5.5 Ft.	CEMENT	TREMIE
From	5.5	To	7.5 Ft.	BENTONITE	CHIPS

12. SCREEN:

		Depth		Diameter	Slot Size	Material
From	8.5	To	18.5 Ft.	2 in.	.010 in.	PVC

13. GRAVEL PACK:

		Depth		Size	Material
From	7.5	To	18.5 Ft.	TORPEDO	SAND

DRILLING LOG

Depth From	To	Formation Description

SEE ATTACHED

If additional space is needed use back of form.

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

SEE ATTACHED

14. REMARKS: Measurements Referenced to Ground Surface

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

Amy L. Myers 5-31-95
SIGNATURE OF CONTRACTOR OR AGENT DATE

GW-1 REVISED 2/90

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

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, NC 27611-7687
PHONE: (910) 733-3221

FOR OFFICE USE ONLY

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

WELL CONSTRUCTION RECORD FOR 1613-8

DRILLING CONTRACTOR Richard Catlin & Associates, Inc.

DRILLER REGISTRATION NUMBER 1142

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below) County: Onslow
Nearest Town: Camp Lejeune

BUILDING 1613, USTs 1613 1-4
(Road, Community, or Subdivision and Lot No.)

2. OWNER LANTDIV NAVFACENGCOM, Commanding General

ADDRESS AC/S EMD/Marine Corps Base/PSC Box 20004
(Street or Route No.)
Camp Lejeune NC 28542-0004
City or Town State Zip Code

3. DATE DRILLED 4/12/95 USE OF WELL Monitoring

4. TOTAL DEPTH 18' CUTTINGS COLLECTED X YES ____ NO

5. DOES WELL REPLACE EXISTING WELL? ____ YES X NO

6. STATIC WATER LEVEL: ± 7.5 FT. ____ ABOVE/BELOW TOP OF CASING.

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

8. WATER ZONES (depth): Surficial Aquifer

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

10. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	+2	To 8	Ft.	2 in.	SCH40	PVC
From		To	Ft.	in.	SCH40	

11. GROUT:

	Depth			Material	Method
From	0	To 5	Ft.	CEMENT	TREMIE
From	5	To 6	Ft.	BENTONITE	CHIPS

12. SCREEN:

	Depth			Diameter	Slot Size	Material
From	8	To 18	Ft.	2 in.	.010 in.	PVC

13. GRAVEL PACK:

	Depth			Size	Material
From	6	To 18	Ft.	TORPEDO	SAND

14. REMARKS: Measurements Referenced to Ground Syrface

Depth From	To	DRILLING LOG Formation Description

SEE ATTACHED

If additional space is needed use back of form.

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

SEE ATTACHED

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

Amy L. Myers 5-30-95
SIGNATURE OF CONTRACTOR OR AGENT DATE

GW-1 REVISED 2/90

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

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, NC 27611-7687
PHONE: (910) 733-3221

FOR OFFICE USE ONLY

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

WELL CONSTRUCTION RECORD FOR 1613-9

DRILLING CONTRACTOR Richard Catlin & Associates, Inc.

DRILLER REGISTRATION NUMBER 1142

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below) County: Onslow
   Nearest Town: Camp Lejeune

   BUILDING 1613, USTs 1613 1-4
   (Road, Community, or Subdivision and Lot No.)
2. OWNER LANTDIV NAVFACENGCOM, Commanding General

   ADDRESS AC/S EMD/Marine Corps Base/PSC Box 20004
   (Street or Route No.)
   Camp Lejeune (City or Town) NC (State) 28542-0004 (Zip Code)

3. DATE DRILLED 4/13/95 USE OF WELL Monitoring
4. TOTAL DEPTH 15' CUTTINGS COLLECTED X YES ___ NO
5. DOES WELL REPLACE EXISTING WELL? ___ YES X NO
6. STATIC WATER LEVEL: ± 6 FT. ___ ABOVE/BELOW TOP OF CASING.
7. YIELD (gpm): N/A METHOD OF TEST N/A
8. WATER ZONES (depth): Surficial Aquifer
9. CHLORINATION: Type: N/A Amount N/A
10. CASING:

						Diameter	Wall Thickness or Weight/Ft.	Material
	Depth							
From	0.5	To	5	Ft.		2 in.	SCH40	PVC
From		To		Ft.		in.	SCH40	

11. GROUT:

	Depth				Material	Method
From	0.5	To	3	Ft.	CEMENT	TREMIE
From	3	To	4	Ft.	BENTONITE	CHIPS

12. SCREEN:

	Depth				Diameter	Slot Size	Material
From	5	To	15	Ft.	2 in.	.010 in.	PVC

13. GRAVEL PACK:

	Depth				Size	Material
From	4	To	15	Ft.	TORPEDO	SAND

14. REMARKS: ______

Depth From	To	DRILLING LOG Formation Description

SEE ATTACHED

If additional space is needed use back of form.

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

SEE ATTACHED

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

Amy R. Myers 5-29-95
SIGNATURE OF CONTRACTOR OR AGENT DATE

GW-1 REVISED 2/90

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

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, NC 27611-7687
PHONE: (910) 733-3221

FOR OFFICE USE ONLY

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

WELL CONSTRUCTION RECORD FOR 1613-10

DRILLING CONTRACTOR Richard Catlin & Associates, Inc.

DRILLER REGISTRATION NUMBER 1142

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below) County: Onslow
Nearest Town: Camp Lejeune

BUILDING 1613, USTs 1613 1-4
(Road, Community, or Subdivision and Lot No.)

2. OWNER LANTDIV NAVFACENGCOM, Commanding General

ADDRESS AC/S EMD/Marine Corps Base/PSC Box 20004
(Street or Route No.)
Camp Lejeune NC 28542-0004
City or Town State Zip Code

3. DATE DRILLED 4/18/95 USE OF WELL Monitoring

4. TOTAL DEPTH 18' CUTTINGS COLLECTED X YES ____ NO

5. DOES WELL REPLACE EXISTING WELL? ____ YES X NO

6. STATIC WATER LEVEL: ± 17 FT. ____ ABOVE/BELOW TOP OF CASING.

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

8. WATER ZONES (depth): Surficial Aquifer

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

10. CASING:

	Depth				Diameter	Wall Thickness or Weight/Ft.	Material
From	+2	To	8	Ft.	2 in.	SCH40	PVC
From		To		Ft.	in.	SCH40	

11. GROUT:

	Depth				Material	Method
From	0	To	6	Ft.	CEMENT	TREMIE
From	6	To	7	Ft.	BENTONITE	CHIPS

12. SCREEN:

	Depth				Diameter	Slot Size	Material
From	8	To	18	Ft.	2 in.	.010 in.	PVC

13. GRAVEL PACK:

	Depth				Size	Material
From	7	To	18	Ft.	TORPEDO	SAND

Depth From	To	DRILLING LOG Formation Description

SEE ATTACHED

If additional space is needed use back of form.

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

SEE ATTACHED

14. REMARKS: Measurements Referenced to Ground Surface

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

Amy L. Myers 5-29-95
SIGNATURE OF CONTRACTOR OR AGENT DATE
Submit original to Division of Environmental Management and copy to well owner.

GW-1 REVISED 2/90

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, NC 27611-7687
PHONE: (910) 733-3221

FOR OFFICE USE ONLY

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

WELL CONSTRUCTION RECORD FOR 1613-11

DRILLING CONTRACTOR Richard Catlin & Associates, Inc.

DRILLER REGISTRATION NUMBER 1142

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below) County: Onslow
   Nearest Town: Camp Lejeune

   BUILDING 1613, USTs 1613 1-4
   (Road, Community, or Subdivision and Lot No.)
2. OWNER LANTDIV NAVFACENGCOM, Commanding General

   ADDRESS AC/S EMD/Marine Corps Base/PSC Box 20004
   (Street or Route No.)
   Camp Lejeune (City or Town) NC (State) 28542-0004 (Zip Code)

3. DATE DRILLED 4/18/95 USE OF WELL Monitoring
4. TOTAL DEPTH 20' CUTTINGS COLLECTED X YES ___ NO
5. DOES WELL REPLACE EXISTING WELL? ___ YES X NO
6. STATIC WATER LEVEL: ± 13 FT. ___ ABOVE/BELOW TOP OF CASING.
7. YIELD (gpm): N/A METHOD OF TEST N/A
8. WATER ZONES (depth): Surficial Aquifer
9. CHLORINATION: Type: N/A Amount N/A
10. CASING:

	Depth From	To		Diameter	Wall Thickness or Weight/Ft.	Material
From	0.5	To 10	Ft.	2 in.	SCH40	PVC
From		To	Ft.	in.	SCH40	

11. GROUT:

	Depth From	To		Material	Method
From	1	To 8	Ft.	CEMENT	TREMIE
From	8	To 9	Ft.	BENTONITE	CHIPS

12. SCREEN:

	Depth From	To		Diameter	Slot Size	Material
From	10	To 20	Ft.	2 in.	.010 in.	PVC

13. GRAVEL PACK:

	Depth From	To		Size	Material
From	9	To 20	Ft.	TORPEDO	SAND

14. REMARKS: ______

Depth From	To	DRILLING LOG Formation Description

SEE ATTACHED

If additional space is needed use back of form.

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

SEE ATTACHED

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

Amy P. Myers 5-29-95
SIGNATURE OF CONTRACTOR OR AGENT DATE

GW-1 REVISED 2/90
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P.O. BOX 27687 - RALEIGH, NC 27611-7687
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FOR OFFICE USE ONLY

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

WELL CONSTRUCTION RECORD FOR 1613-12

DRILLING CONTRACTOR Richard Catlin & Associates, Inc.

DRILLER REGISTRATION NUMBER 1142

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below) County: Onslow
Nearest Town: Camp Lejeune

BUILDING 1613, USTs 1613 1-4
(Road, Community, or Subdivision and Lot No.)

2. OWNER LANTDIV NAVFACENGCOM, Commanding General

ADDRESS AC/S EMD/Marine Corps Base/PSC Box 20004
(Street or Route No.)
Camp Lejeune NC 28542-0004
City or Town State Zip Code

3. DATE DRILLED 4/18/95 USE OF WELL Monitoring

4. TOTAL DEPTH 20' CUTTINGS COLLECTED X YES ___ NO

5. DOES WELL REPLACE EXISTING WELL? ___ YES X NO

6. STATIC WATER LEVEL: ± 14. 5 FT. ___ ABOVE/BELOW TOP OF CASING.

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

8. WATER ZONES (depth): Surficial Aquifer

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

10. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From 0.5	To 10	Ft.	2 in.	SCH40	PVC
From	To	Ft.	in.	SCH40	

11. GROUT:

	Depth		Material	Method
From 1	To 8	Ft.	CEMENT	TREMIE
From 8	To 9	Ft.	BENTONITE	CHIPS

12. SCREEN:

	Depth		Diameter	Slot Size	Material
From 10	To 20	Ft.	2 in.	.010 in.	PVC

13. GRAVEL PACK:

	Depth		Size	Material
From 9	To 20	Ft.	TORPEDO	SAND

Depth From	To	DRILLING LOG Formation Description

SEE ATTACHED

If additional space is needed use back of form.

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

SEE ATTACHED

14. REMARKS: ______

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

Amy L. Myers 5-29-95

SIGNATURE OF CONTRACTOR OR AGENT DATE

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GW-1 REVISED 2/90

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, NC 27611-7687
PHONE: (910) 733-3221

FOR OFFICE USE ONLY

Quad No. ________ Serial No.________
Lat. ________ Long.________ Pc________
Minor Basin________
Basin Code________
Header Ent. ________ GW-1 Ent. ________

WELL CONSTRUCTION RECORD FOR 1613-13

DRILLING CONTRACTOR Richard Catlin & Associates, Inc.

DRILLER REGISTRATION NUMBER 1142

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below) County: Onslow
Nearest Town: Camp Lejeune

BUILDING 1613, USTs 1613 1-4
(Road, Community, or Subdivision and Lot No.)

2. OWNER LANTDIV NAVFACENGCOM, Commanding General

ADDRESS AC/S EMD/Marine Corps Base/PSC Box 20004
(Street or Route No.)

Camp Lejeune	NC	28542-0004
City or Town	State	Zip Code

3. DATE DRILLED 4/21/95 USE OF WELL Monitoring

4. TOTAL DEPTH 50' CUTTINGS COLLECTED X YES ____ NO

5. DOES WELL REPLACE EXISTING WELL? ________ YES X NO

6. STATIC WATER LEVEL: ± 14 FT. ____ ABOVE/BELOW TOP OF CASING.

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

8. WATER ZONES (depth): Surficial Aquifer

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

10. CASING:

		Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From	+2	To 40	Ft.	6 in.	SCH40	PVC
From	+2	To 45	Ft.	2 in.	SCH40	PVC

11. GROUT:

		Depth		Material	Method
From	0	To 38	Ft.	CEMENT	TREMIE
From	38	To 43	Ft.	BENTONITE	CHIPS

12. SCREEN:

		Depth		Diameter	Slot Size	Material
From	45	To 50	Ft.	2 in.	.010 in.	PVC

13. GRAVEL PACK:

		Depth		Size	Material
From	43	To 50	Ft.	TORPEDO	SAND

Depth From	To	DRILLING LOG Formation Description

SEE ATTACHED

If additional space is needed use back of form.

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

SEE ATTACHED

14. REMARKS: Measurements Referenced to Ground Surface

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

Amy L. Myers 5-29-95

SIGNATURE OF CONTRACTOR OR AGENT DATE

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

GW-1 REVISED 2/90

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DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, NC 27611-7687
PHONE: (910) 733-3221

FOR OFFICE USE ONLY

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

WELL CONSTRUCTION RECORD FOR 1613-14

DRILLING CONTRACTOR Richard Catlin & Associates, Inc.

DRILLER REGISTRATION NUMBER 1142

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below) County: Onslow
Nearest Town: Camp Lejeune

BUILDING 1613, USTs 1613 1-4
(Road, Community, or Subdivision and Lot No.)

2. OWNER LANTDIV NAVFACENGCOM, Commanding General

ADDRESS AC/S EMD/Marine Corps Base/PSC Box 20004
(Street or Route No.)
Camp Lejeune (City or Town) NC (State) 28542-0004 (Zip Code)

3. DATE DRILLED 4/21/95 USE OF WELL Monitoring

4. TOTAL DEPTH 49.5' CUTTINGS COLLECTED X YES ____ NO

5. DOES WELL REPLACE EXISTING WELL? ____ YES X NO

6. STATIC WATER LEVEL: ± 17 FT. ____ ABOVE/BELOW TOP OF CASING.

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

8. WATER ZONES (depth): Surficial Aquifer

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

10. CASING:

		Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From	+2	To 35	Ft.	6 in.	SCH40	PVC
From	+2	To 36	Ft.	2 in.	SCH40	PVC

11. GROUT:

		Depth		Material	Method
From	0	To 33	Ft.	CEMENT	TREMIE
From	33	To 35.5	Ft.	BENTONITE	CHIPS

12. SCREEN:

		Depth		Diameter	Slot Size	Material
From	36	To 41	Ft.	2 in.	.010 in.	PVC

13. GRAVEL PACK:

		Depth		Size	Material
From	35.5	To 43	Ft.	TORPEDO	SAND

14. REMARKS: Measurements Referenced to Ground Surface

Depth From	To	DRILLING LOG Formation Description

SEE ATTACHED

If additional space is needed use back of form.

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

SEE ATTACHED

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

Amy L. Myers 5-29-95
SIGNATURE OF CONTRACTOR OR AGENT DATE

GW-1 REVISED 2/90

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

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DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, NC 27611-7687
PHONE: (910) 733-3221

FOR OFFICE USE ONLY

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

WELL CONSTRUCTION RECORD FOR 1613-15

DRILLING CONTRACTOR Richard Catlin & Associates, Inc.

DRILLER REGISTRATION NUMBER 1142

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below) County: Onslow
Nearest Town: Camp Lejeune

BUILDING 1613, USTs 1613 1-4
(Road, Community, or Subdivision and Lot No.)

2. OWNER LANTDIV NAVFACENGCOM, Commanding General

ADDRESS AC/S EMD/Marine Corps Base/PSC Box 20004
(Street or Route No.)
Camp Lejeune (City or Town) NC (State) 28542-0004 (Zip Code)

3. DATE DRILLED 4/20/95 USE OF WELL Monitoring

4. TOTAL DEPTH 41' CUTTINGS COLLECTED X YES ____ NO

5. DOES WELL REPLACE EXISTING WELL? ____ YES X NO

6. STATIC WATER LEVEL: ± 21 FT. ____ ABOVE/BELOW TOP OF CASING.

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

8. WATER ZONES (depth): Surficial Aquifer

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

10. CASING:

Depth				Diameter	Wall Thickness or Weight/Ft.	Material
From	+2	To 35	Ft.	6 in.	SCH40	PVC
From	+2	To 36	Ft.	2 in.	SCH40	PVC

11. GROUT:

Depth				Material	Method
From	0	To 33	Ft.	CEMENT	TREMIE
From	33	To 35.5	Ft.	BENTONITE	CHIPS

12. SCREEN:

Depth				Diameter	Slot Size	Material
From	36	To 41	Ft.	2 in.	.010 in.	PVC

13. GRAVEL PACK:

Depth				Size	Material
From	33	To 41	Ft.	TORPEDO	SAND

14. REMARKS: Measurements Referenced to Ground Surface

Depth From	To	DRILLING LOG Formation Description

SEE ATTACHED

If additional space is needed use back of form.

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

SEE ATTACHED

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

Amy L. Myers 5-29-95
SIGNATURE OF CONTRACTOR OR AGENT DATE

GW-1 REVISED 2/90

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DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, NC 27611-7687
PHONE: (910) 733-3221

FOR OFFICE USE ONLY

Quad No. ________ Serial No.________
Lat. ________ Long.________ Pc________
Minor Basin________
Basin Code________
Header Ent. ________ GW-1 Ent. ________

WELL CONSTRUCTION RECORD FOR 1613-16

DRILLING CONTRACTOR Richard Catlin & Associates, Inc.

DRILLER REGISTRATION NUMBER 1142

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below) County: Onslow
Nearest Town: Camp Lejeune

BUILDING 1613, USTs 1613 1-4
(Road, Community, or Subdivision and Lot No.)

2. OWNER LANTDIV NAVFACENGCOM, Commanding General

ADDRESS AC/S EMD/Marine Corps Base/PSC Box 20004
(Street or Route No.)
Camp Lejeune (City or Town) NC (State) 28542-0004 (Zip Code)

3. DATE DRILLED 4/20/95 USE OF WELL Monitoring

4. TOTAL DEPTH 37' CUTTINGS COLLECTED X YES ____ NO

5. DOES WELL REPLACE EXISTING WELL? ____ YES X NO

6. STATIC WATER LEVEL: ± 16 FT. ____ ABOVE/BELOW TOP OF CASING.

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

8. WATER ZONES (depth): Surficial Aquifer

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

10. CASING:

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	+2	To 7	Ft.	2 in.	SCH40	PVC
From		To	Ft.	in.	SCH40	PVC

11. GROUT:

	Depth			Material	Method
From	0	To 4	Ft.	CONCRETE	POURED
From	4	To 5	Ft.	BENTONITE	CHIPS

12. SCREEN:

	Depth			Diameter	Slot Size	Material
From	7	To 37	Ft.	2 in.	.010 in.	PVC

13. GRAVEL PACK:

	Depth			Size	Material
From	5	To 37	Ft.	TORPEDO	SAND

14. REMARKS: Measurements Referenced to Ground Surface

Depth From	To	DRILLING LOG Formation Description

SEE ATTACHED

If additional space is needed use back of form.

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

SEE ATTACHED

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

Amy L. Myers 5-29-95
SIGNATURE OF CONTRACTOR OR AGENT DATE

GW-1 REVISED 2/90

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APPENDIX E

MONITORING WELL CASING AND WATER ELEVATION WORKSHEET

APPENDIX E

BUILDING 1613, USTs 1613 1-4
MONITORING WELL CASING AND
WATER ELEVATIONS WORKSHEET

MAY 17, 1995

DATA POINT	TOP OF CASING ELEVATION (in feet)	DEPTH TO WATER (in feet)	FREE PRODUCT THICKNESS (in feet)	SPECIFIC GRAVITY ADJUSTMENT	ADJUSTED DEPTH TO WATER (in feet)	WATER TABLE ELEVATION (in feet)
1613-1	28.21	16.02	NMT	--	--	12.19
1613-2	28.82	12.49	NMT	--	--	16.33
1613-3	25.55	13.66	NMT	--	--	11.89
1613-4	26.21	6.10	NMT	--	--	20.11
1613-5	24.80	8.44	NMT	--	--	16.36
1613-6	27.86	16.23	NMT	--	--	11.63
1613-7	25.37	11.42	NMT	--	--	13.95
1613-8	29.10	7.97	NMT	--	--	21.13
1613-9	25.91	6.14	NMT	--	--	19.77
1613-10	28.67	16.89	NMT	--	--	11.78
1613-11	25.25	13.44	NMT	--	--	11.81
1613-12	26.41	14.14	NMT	--	--	12.27
1613-13	25.63	13.03	NMT	--	--	12.60
1613-14	27.57	15.94	NMT	--	--	11.63
1613-15	29.23	19.24	NMT	--	--	9.99
1613-16	27.03	15.24	NMT	--	--	11.79

NMT = No Measurable Thickness

APPENDIX F

GROUND WATER FLOW DIRECTION AND VELOCITY OF SURFICIAL AQUIFER

JOB: Bldg 1613 COMPUTED BY: JMP DATE: 5/31/9-

DESCRIPTION: Ground Water Velocity CHECKED BY: DATE:

GROUND WATER FLOW VELOCITY CALCULATIONS

$$V = \frac{K\,(dh/dl)}{Ne}$$

Where:

V = Ground Water Flow Velocity (ft/day)

K = Hydraulic Conductivity (ft/day) From Pumping Test Performed on Well 1613-16

dh/dl = Hydraulic Gradient (unitless) Measured Between Wells 1613-4 and 1613-10

Ne = Effective Porosity (unitless) Assumed from Boring Logs

JOB: Bldg 1613 COMPUTED BY: JMP DATE: 5/31/95

DESCRIPTION: CHECKED BY: DATE:

Therefore,

$K = 4.3$ ft/day

$dh = 8.33$ ft

$dl = 265$ ft

$Ne = 0.25$ (assumed)

$$V = \frac{4.3\ \text{ft/day}\ (8.33\ \text{ft}/265\ \text{ft})}{0.25}$$

$V = 0.54$ ft/day to the northeast

APPENDIX G

MONITORING WELL AND SAMPLING FIELD DATA WORKSHEETS

SAMPLING FIELD DATA WORKSHEET

SUBJECT: BUILDING 1613, USTs 1613 1-4
PROJECT NO.: 94127

SAMPLED BY: T. LUPO

WELL NO.	1613-1	1613-2	1613-3	1613-4	1613-5	1613-6	1613-7	1613-8
DATE SAMPLED	5/3/95	5/3/95	5/3/95	5/3/95	5/3/95	5/3/95	5/3/95	5/3/95
WELL DIAMETER	2"	2"	2"	2"	2"	2"	2"	2"
WELL DEPTH - A	20'	20'	15'	15'	15'	20'	18.5'	18'
DEPTH TO WATER - B	15.93'	12.11'	14.22'	6.00'	8.46'	16.64'	11.12'	7.79'
(A-B) FT. H_20 IN WELL - C	4.07	7.89	0.78	9.00	6.54	3.36	7.38	10.21
GALLONS/FT. - D	.163	.163	.163	.163	.163	.163	.163	1.42
(CxD) ONE VOLUME - E	0.66	1.29	0.13	1.47	1.07	0.55	1.20	14.50
(Ex3) THREE VOLUMES - F	1.98	3.87	0.39	4.41	3.21	1.65	3.60	43.50
VOLUME OF BAILER - G	.24	.24	.24	.24	.24	.24	.24	.24
(F/G) NO. BAILS REQUIRED - H	9	17	2	19	14	7	15	182
NO. BAILS TAKEN - I	9	17	2	19	14	7	15	182

VOLUMES:

1-1/4" WELL = 0.064 GAL/FT
2" WELL = 0.163 GAL/FT
4" WELL = 0.653 GAL/FT

6" WELL = 1.42 GAL/FT
3' x 1.5" BAILER = 0.24 GAL/BAIL
4' x 1.5" BAILER = 0.37 GAL/BAIL

SAMPLING FIELD DATA WORKSHEET

SUBJECT: BUILDING 1613, USTs 1613 1-4
PROJECT NO.: 94127

SAMPLED BY: T. LUPO

WELL NO.	1613-9	1613-10	1613-11	1613-12	1613-13	1613-14	1613-15	1613-16
DATE SAMPLED	5/3/95	5/3/95	5/3/95	5/3/95	5/3/95	5/3/95	5/3/95	5/3/95
WELL DIAMETER	2"	2"	2"	2"	2"	2"	2"	6"
WELL DEPTH - A	15'	18'	20'	20'	50'	49.5'	41'	37'
DEPTH TO WATER - B	6.28'	17.13'	13.33'	14.75'	14.33'	16.98'	21.35'	16.12'
(A-B) FT. H_20 IN WELL - C	8.72	0.87	6.67	5.25	35.67	32.52	19.65	20.88
GALLONS/FT. - D	.163	.163	.163	.163	.163	.163	.163	1.42
(CxD) ONE VOLUME - E	1.42	0.14	1.09	0.86	5.81	5.30	3.20	29.65
(Ex3) THREE VOLUMES - F	4.26	0.42	3.27	2.58	17.43	15.90	9.60	88.95
VOLUME OF BAILER - G	.24	.24	.24	.24	.24	.24	.24	.24
(F/G) NO. BAILS REQUIRED - H	18	2	14	11	73	66	40	371
NO. BAILS TAKEN - I	18	2	14	11	73	66	40	371

VOLUMES:

1-1/4" WELL = 0.064 GAL/FT
2" WELL = 0.163 GAL/FT
4" WELL = 0.653 GAL/FT

6" WELL = 1.42 GAL/FT
3' x 1.5" BAILER = 0.24 GAL/BAIL
4' x 1.5" BAILER = 0.37 GAL/BAIL

APPENDIX H

CONTAMINANT VELOCITY CALCULATIONS

JOB: Bldg 1613 COMPUTED BY: TMP DATE: 5.31.95

DESCRIPTION: CHECKED BY: DATE:

CALCULATE CONTAMINANT VELOCITY

$K_{OW} = 8$ for Chloromethane

Determine Contaminant Velocity For:

$$V_c = \frac{V_{MAX}}{R_d}$$

Where: V_{MAX} = Maximum Ground Water Velocity

R_d = Retardation Factor

Calculate Retardation Factor

$$R_d = 1 + \left(K_d \frac{\rho_b}{P}\right)$$

Where: K_d = Distribution Coefficient (ml/g)

ρ_b = Bulk Density (g/cm^3)

P = Porosity (decimal)

JOB: Bldg 1613 COMPUTED BY: TMP DATE: 5.31.95

DESCRIPTION: CHECKED BY: DATE:

$$K_d = K_{oc}\left[0.2(1-f)\,X^s_{oc} + f X^f_{oc}\right]$$

Where: $f = \dfrac{\text{Mass of Silt and Clay}}{\text{Mass of Sand, Silt, and Clay}}$

X^s_{oc} = Organic Fraction of Sand $(0 \leq X^s_{oc} \leq 0.1)$

X^f_{oc} = Organic Fraction of Silt and Clay $(0 \leq X^f_{oc} \leq 0.1)$

$K_{oc} = 0.63\ K_{ow}$ (Organic Carbon Partition Coefficient)

K_{ow} = Octanol Water Partition Coefficient

$K_{ow} = 8$

$K_{oc} = 0.63\ (\ 8\ )$

$K_{oc} = 5.04$

$f = 0.081$ (Grain Size 15-17 feet Well 1613-16)

$\rho_b = 1.55\ g/m^3$ (p. 314, Table VII-2, EPA 'PWQA' Part II)

JOB: Bldg 1613 COMPUTED BY: TMP DATE: 5.31.95

DESCRIPTION: CHECKED BY: DATE:

$P = 0.43$ (Fine Sand p.318, Table VII-4, EPA WQA Part II)

$X_{oc}^{s} = 0.025$ (mean value)

$X_{oc}^{f} = 0.065$ (mean value)

$$K_d = K_{oc}\left[0.2(1-f)X_{oc}^{s} + fX_{oc}^{f}\right]$$

$$K_d = 5.04\left[0.2(1-0.081)0.025 + (0.081)(0.065)\right]$$

$$K_d = 0.05$$

$$R_d = 1 + K_d \frac{\rho_b}{P}$$

$$R_d = 1 + 0.05 \frac{1.55}{0.43} = 1.18$$

$$V_c = \frac{V_{max}}{R_d} = \frac{0.54 \text{ ft/day}}{1.18}$$

$$V_c = \boxed{0.46 \text{ ft/day}}$$

APPENDIX I

LABORATORY ANALYTICAL TEST REPORTS/ CHAIN OF CUSTODY RECORDS

GeoChem, Incorporated

Environmental Laboratories

March 30, 1995

Mr. Steve Hudson/ Ms. Teri Piver
Richard Catlin & Associates
P.O. Box 10279
Wilmington, NC 28405-3755

Reference: **Bld. 1613**
94127-F
GCI# 9503-100

Dear Mr. Steve Hudson/ Ms. Teri Piver:

This is the analytical report for the above referenced project. On March 29, 1995 we received one ground water sample for analysis. The analytical and quality control results are presented in separate tables for your convenience. Brief summaries of analytical methods employed are as follows. GeoChem analytical reports contain information based strictly on the analysis requested on the chain of custody (COC) accompanying this report. All soil values are calculated using dry weights.

EPA method 601

Samples are loaded into a specially designed purging chamber at ambient temperature. Helium is bubbled through the sample. This drives the organics onto a sorbent trap. Once purging has been completed the sorbent column is rapidly heated. This efficiently transfers the organics into the gas chromatograph which separates the components of the sample. The purgeable organics are then detected using a halide specific detector.

2500 Gate Way Centre Blvd., Suite 300 • Morrisville, NC 27560
Telephone: 919-460-8093 • FAX: 919-460-0167

GeoChem, Incorporated
Environmental Laboratories

EPA method 602

Samples are loaded into a specially designed purging chamber at ambient temperature. Helium is bubbled through the sample. This drives the organics onto a sorbent trap. Once purging has been completed the sorbent column is rapidly heated. This efficiently transfers the organics into the gas chromatograph which separates the components of the sample. The purgeable organics are then detected using flame ionization and photo ionization detectors.

If there are any technical questions please feel free to call me at 919-460-8093. Thank you for allowing **GEOCHEM** to serve your analytical needs.

Sincerely,

Dean Gokel
President

2500 Gate Way Centre Blvd., Suite 300 • Morrisville, NC 27560
Telephone: 919-460-8093 • FAX: 919-460-0167

GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9503-100 1 Site Name Bldg. 1613

LAB ID.	1289	LAB BLANK
DATE SAMPLED	03/28/95	**
DATE ANALYZED	03/29/95	03/29/95
FIELD ID.	HP-1	**

METHOD

ANALYTE	ug/l	pql	ug/l	pql
EPA 601				
Dichlorodifluoromethane	BDL	0.5	BDL	0.5
Chloromethane	BDL		0.5	
Vinyl chloride	BDL		BDL	
Bromomethane	BDL		BDL	
Chloroethane	BDL		BDL	
Trichlorofluoromethane	BDL		BDL	
1,1-Dichloroethene	BDL		BDL	
Methylene Chloride	BDL		BDL	
trans-1,2-dichloroethene	BDL		BDL	
1,1-Dichloroethane	BDL		BDL	
Chloroform	BDL		BDL	
1,1,1-Trichloroethane	BDL		BDL	
Carbon tetrachloride	BDL		BDL	
1,2-Dichloroethane	BDL		BDL	
Trichloroethene	BDL		BDL	
2-Chloroethylvinyl Ether	BDL		BDL	
1,2-Dichloropropane	BDL		BDL	
Bromodichloromethane	BDL		BDL	
cis-1,3-Dichloropropene	BDL		BDL	
trans1,3Dichloropropene	BDL		BDL	
1,1,2-Trichloroethane	BDL		BDL	
Tetrachloroethene	BDL		BDL	
Dibromochloromethane	BDL		BDL	
Chlorobenzene	BDL		BDL	
1,1,1,2Tetrachloroethane	BDL		BDL	
Bromoform	BDL		BDL	
1,1,2,2Tetrachloroethane	BDL		BDL	
1,3-Dichlorobenzene	BDL		BDL	
1,4-Dichlorobenzene	BDL		BDL	
1,2-Dichlorobenzene	BDL		BDL	

	soil	water
parts per million =	mg/kg	mg/l
parts per billion =	ug/kg	ug/l

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.
*** Sample has been blank subtracted.*

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GeoChem, Incorporated
Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9503-100 2 Site Name Bld. 1613

LAB ID.	1289	LAB BLANK
DATE SAMPLED	03/28/95	**
DATE ANALYZED	03/29/95	03/29/95
FIELD ID.	HP-1	**

METHOD

ANALYTE	ug/l	pql	ug/l	pql
EPA 602				
Benzene	BDL	0.5	BDL	0.5
Toluene	4.2		BDL	
Chlorobenzene	BDL		BDL	
Ethylbenzene	0.6		BDL	
Xylenes	BDL	1.5	BDL	1.5
1,3 Dichlorobenzene	BDL	0.5	BDL	0.5
1,4 Dichlorobenzene	BDL		BDL	
1,2 Dichlorobenzene	BDL		BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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QUALITY CONTROL RESULTS

METHOD	RECOVERY	METHOD DETECTION LIMIT
601		
Vinyl Chloride	100 %	0.5 ppb
Trichlorofluoromethane	100 %	
trans-1,2-Dichloroethene	101 %	
602		
Benzene	103 %	0.5 ppb
Toluene	94 %	
Chlorobenzene	95 %	
Ethylbenzene	93 %	
Xylenes	93 %	
1,3-Dichlorobenzene	92 %	
1,4-Dichlorobenzene	93 %	
1,2-Dichlorobenzene	93 %	

REVIEWED BY

Dena J. Barrett

REVIEWED BY

Kevin B

Report To: TERI PIVER/STEVE HUDSON
RC & A

GeoChem, Incorporated

Environmental Laboratories

2500 Gate Way Centre Blvd., Suite 300
Morrisville, NC 27560

Bill To: RC & A
WILM NC

Chain of Custody Record

03/29/95

Page 1 of 1

PROJECT SITE NUMBER: 94127-F
PO#: ON-SITE
GEOCHEM PROJECT #: 9503-100
SITE NAME: Bld. 1613
DATE DUE: 03-30-95
COLLECTED BY (Signature): [signature]
VERBAL/FAX/HARDCOPY:

ANALYSES

FIELD SAMPLE ID	TURNAROUND IN DAYS	SAMPLE MATRIX	DATE AND TIME COLLECTED	NO. OF CONTAINERS PER LOCATION	601	602								REMARKS	LAB ID NO. (for lab use only)
HP-1	NORMAL	GROUND H2O	3/28/95 1400	4	✓	✓									1289
	1 day														
														ON SITE	
														LAB	

REMARKS

RELINQUISHED BY:	DATE	TIME
[signature]	3/29/95	0730

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
K Goebel	3-29-95	12:15	[signature]	3-29-95	3:20pm						

This Chain of Custody is considered a written contract to perform the services requested in the analyses section of this document

GeoChem, Incorporated

Environmental Laboratories

March 31, 1995

Mr. Steve Hudson/ Ms. Teri Piver
Richard Catlin & Associates
P.O. Box 10279
Wilmington, NC 28405-3755

Reference: **Bld. 1613**
94127-F
GCI# 9503-107

Dear Mr. Steve Hudson/ Ms. Teri Piver:

This is the analytical report for the above referenced project. On March 30, 1995 we received two water samples for analysis. The analytical and quality control results are presented in separate tables for your convenience. Brief summaries of analytical methods employed are as follows. GeoChem analytical reports contain information based strictly on the analysis requested on the chain of custody (COC) accompanying this report. All soil values are calculated using dry weights.

EPA method 602

Samples are loaded into a specially designed purging chamber at ambient temperature. Helium is bubbled through the sample. This drives the organics onto a sorbent trap. Once purging has been completed the sorbent column is rapidly heated. This efficiently transfers the organics into the gas chromatograph which separates the components of the sample. The purgeable organics are then detected using flame ionization and photo ionization detectors.

GeoChem, Incorporated

Environmental Laboratories

EPA method 601

Samples are loaded into a specially designed purging chamber at ambient temperature. Helium is bubbled through the sample. This drives the organics onto a sorbent trap. Once purging has been completed the sorbent column is rapidly heated. This efficiently transfers the organics into the gas chromatograph which separates the components of the sample. The purgeable organics are then detected using a halide specific detector.

If there are any technical questions please feel free to call me at 919-460-8093. Thank you for allowing **GEOCHEM** to serve your analytical needs.

Sincerely,

Dean Gokel
President

2500 Gate Way Centre Blvd., Suite 300 • Morrisville, NC 27560
Telephone: 919-460-8093 • FAX: 919-460-0167

GeoChem, Incorporated
Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9503-107 1 Site Name Bld. 1613

LAB ID.	1320	1321	LAB BLANK
DATE SAMPLED	03/29/95	03/29/95	**
DATE ANALYZED	03/30/95	03/30/95	03/30/95
FIELD ID.	HP-1D	HP-2	**

METHOD

ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
EPA 602						
Benzene	BDL	0.5	BDL	0.5	BDL	0.5
Toluene	12.9		0.9		BDL	
Chlorobenzene	BDL		BDL		BDL	
Ethylbenzene	0.8		BDL		BDL	
Xylenes	2.0	1.5	2.7	1.5	BDL	1.5
1,3 Dichlorobenzene	BDL	0.5	BDL	0.5	BDL	0.5
1,4 Dichlorobenzene	BDL		BDL		BDL	
1,2 Dichlorobenzene	BDL		BDL		BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9503-107 2 Site Name Bld. 1613

LAB ID.	1320		1321		LAB BLANK	
DATE SAMPLED	03/29/95		03/29/95		**	
DATE ANALYZED	03/30/95		03/30/95		03/30/95	
FIELD ID.	HP-1D		HP-2		**	
METHOD						
ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
EPA 601						
Dichlorodifluoromethane	BDL	0.5	BDL	0.5	BDL	0.5
Chloromethane	BDL		BDL		BDL	
Vinyl chloride	BDL		BDL		BDL	
Bromomethane	BDL		BDL		BDL	
Chloroethane	BDL		BDL		BDL	
Trichlorofluoromethane	1.9		BDL		BDL	
1,1-Dichloroethene	BDL		BDL		BDL	
Methylene Chloride	BDL		BDL		BDL	
trans-1,2-dichloroethene	0.9		BDL		BDL	
1,1-Dichloroethane	BDL		BDL		BDL	
Chloroform	BDL		BDL		BDL	
1,1,1-Trichloroethane	BDL		BDL		BDL	
Carbon tetrachloride	BDL		BDL		BDL	
1,2-Dichloroethane	BDL		BDL		BDL	
Trichloroethene	29.2		BDL		BDL	
2-Chloroethylvinyl Ether	BDL		BDL		BDL	
1,2-Dichloropropane	BDL		BDL		BDL	
Bromodichloromethane	BDL		BDL		BDL	
cis-1,3-Dichloropropene	BDL		BDL		BDL	
trans1,3Dichloropropene	BDL		BDL		BDL	
1,1,2-Trichloroethane	BDL		BDL		BDL	
Tetrachloroethene	BDL		BDL		BDL	
Dibromochloromethane	BDL		BDL		BDL	
Chlorobenzene	BDL		BDL		BDL	
1,1,1,2Tetrachloroethane	BDL		BDL		BDL	
Bromoform	BDL		BDL		BDL	
1,1,2,2Tetrachloroethane	BDL		BDL		BDL	
1,3-Dichlorobenzene	BDL		BDL		BDL	
1,4-Dichlorobenzene	BDL		BDL		BDL	
1,2-Dichlorobenzene	BDL		BDL		BDL	

	soil	*water*
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

QUALITY CONTROL RESULTS

METHOD	RECOVERY	METHOD DETECTION LIMIT
602		
Benzene	103 %	0.5 ppb
Toluene	94 %	
Chlorobenzene	96 %	
Ethylbenzene	93 %	
Xylenes	93 %	
1,3-Dichlorobenzene	93 %	
1,4-Dichlorobenzene	92 %	
1,2-Dichlorobenzene	95 %	
601		
Vinyl Chloride	100 %	0.5 ppb
Trichlorofluoromethane	100 %	
trans-1,2-Dichloroethene	101 %	

REVIEWED BY

Dona J. Barrett

REVIEWED BY

Kevin Bolin

2500 Gate Way Centre Blvd., Suite 300 • Morrisville, NC 27560
Telephone: 919-460-8093 • FAX: 919-460-0167

Report To: Teri Piver / Steve Hudson
RCEA

GeoChem, Incorporated

Environmental Laboratories

2500 Gate Way Centre Blvd., Suite 300
Morrisville, NC 27560

Bill To: RC&A
Wilm NC

Chain of Custody Record

3/30/95

Page 1 of ____

PROJECT SITE NUMBER: 94127-F
PO#: ON SITE
SITE NAME: Bld 1613
COLLECTED BY (Signature): [signature]
GEOCHEM PROJECT #: 9503-107
DATE DUE: 3-31-95
VERBAL/FAX/HARDCOPY:

ANALYSES: 602, 601

FIELD SAMPLE ID	TURNAROUND IN DAYS	SAMPLE MATRIX	DATE AND TIME COLLECTED	NO. OF CONTAINERS PER LOCATION	602	601								REMARKS	LAB ID NO. (for lab use only)
HP-1D	1	H_2O	3/29/95 1200	4	✓	✓									1320
HP-2	1		3/29/95 1400	4	✓	✓								ON SITE LAB	1321

REMARKS

RELINQUISHED BY:	DATE	TIME
[signature]	3/30/95	0900

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
K Gurley	3-30-95	1205				[signature]	3/30/95	2:40pm			

This Chain of Custody is considered a written contract to perform the services requested in the analyses section of this form.

GeoChem, Incorporated

Environmental Laboratories

April 10, 1995

Ms. Teri Piver/Mr. Steve Hudson
Richard Catlin & Assoc.
P.O. Box 10279
Wilmington, NC 28405-3755

Reference: **Building 1613**
94127-F
GCI# 9504-014

Dear Ms Teri Piver/Mr. Steve Hudson:

This is the analytical report for the above referenced project. On April 6, 1995 we received six ground water samples for analysis. The analytical and quality control results are presented in separate tables for your convenience. Brief summaries of analytical methods employed are as follows. GeoChem analytical reports contain information based strictly on the analysis requested on the chain of custody (COC) accompanying this report. All soil values are calculated using dry weights. Non-target compounds are not identified or quantified. Our clients must request such additional documentation in writing.

EPA method 601

Samples are loaded into a specially designed purging chamber at ambient temperature. Helium is bubbled through the sample. This drives the organics onto a sorbent trap. Once purging has been completed the sorbent column is rapidly heated. This efficiently transfers the organics into the gas chromatograph which separates the components of the sample. The purgeable organics are then detected using a halide specific detector.

2500 Gate Way Centre Blvd., Suite 300 • Morrisville, NC 27560
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GeoChem, Incorporated

Environmental Laboratories

EPA method 602

Samples are loaded into a specially designed purging chamber at ambient temperature. Helium is bubbled through the sample. This drives the organics onto a sorbent trap. Once purging has been completed the sorbent column is rapidly heated. This efficiently transfers the organics into the gas chromatograph which separates the components of the sample. The purgeable organics are then detected using flame ionization and photo ionization detectors.

If there are any technical questions please feel free to call me at 919-460-8093. Thank you for allowing **GEOCHEM** to serve your analytical needs.

Sincerely,

Dean Gokel
President

2500 Gate Way Centre Blvd., Suite 300 • Morrisville, NC 27560
Telephone: 919-460-8093 • FAX: 919-460-0167

GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9504-014 1 Site Name Building 1613

LAB ID.	1463	1464	1465
DATE SAMPLED	04/05/95	04/05/95	04/05/95
DATE ANALYZED	04/06/95	04/06/95	04/06/95
FIELD ID.	HP-7	HP-8	HP-9

METHOD

ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
EPA 601						
Dichlorodifluoromethane	BDL	0.5	BQL	5.0	BDL	0.5
Chloromethane	BDL		BQL		BDL	
Vinyl chloride	BDL		BQL		BDL	
Bromomethane	BDL		BQL		BDL	
Chloroethane	BDL		BQL		BDL	
Trichlorofluoromethane	BDL		BQL		BDL	
1,1-Dichloroethene	BDL		BQL		BDL	
Methylene Chloride	BDL		BQL		BDL	
trans-1,2-dichloroethene	BDL		BQL		BDL	
1,1-Dichloroethane	BDL		BQL		BDL	
Chloroform	BDL		BQL		BDL	
1,1,1-Trichloroethane	BDL		BQL		BDL	
Carbon tetrachloride	BDL		BQL		BDL	
1,2-Dichloroethane	BDL		BQL		BDL	
Trichloroethene	BDL		BQL		BDL	
2-Chloroethylvinyl Ether	BDL		BQL		BDL	
1,2-Dichloropropane	BDL		BQL		BDL	
Bromodichloromethane	BDL		BQL		BDL	
cis-1,3-Dichloropropene	BDL		BQL		BDL	
trans1,3Dichloropropene	BDL		BQL		BDL	
1,1,2-Trichloroethane	BDL		BQL		BDL	
Tetrachloroethene	BDL		BQL		BDL	
Dibromochloromethane	BDL		BQL		BDL	
Chlorobenzene	BDL		BQL		BDL	
1,1,1,2Tetrachloroethane	BDL		BQL		BDL	
Bromoform	BDL		BQL		BDL	
1,1,2,2Tetrachloroethane	BDL		BQL		BDL	
1,3-Dichlorobenzene	BDL		BQL		BDL	
1,4-Dichlorobenzene	BDL		BQL		BDL	
1,2-Dichlorobenzene	BDL		BQL		BDL	

	soil	*water*
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9504-014 2 Site Name Building 1613

LAB ID.	1466		1467		1468	
DATE SAMPLED	04/05/95		04/05/95		04/05/95	
DATE ANALYZED	04/06/95		04/06/95		04/06/95	
FIELD ID.	HP-12		HP-15		HP-14	

METHOD

ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
EPA 601						
Dichlorodifluoromethane	BDL	0.5	BDL	0.5	BDL	0.5
Chloromethane	BDL		BDL		BDL	
Vinyl chloride	BDL		BDL		BDL	
Bromomethane	BDL		BDL		BDL	
Chloroethane	BDL		BDL		BDL	
Trichlorofluoromethane	BDL		BDL		BDL	
1,1-Dichloroethene	BDL		BDL		BDL	
Methylene Chloride	BDL		BDL		BDL	
trans-1,2-dichloroethene	BDL		BDL		BDL	
1,1-Dichloroethane	BDL		BDL		BDL	
Chloroform	BDL		BDL		BDL	
1,1,1-Trichloroethane	BDL		BDL		BDL	
Carbon tetrachloride	BDL		BDL		BDL	
1,2-Dichloroethane	BDL		BDL		BDL	
Trichloroethene	BDL		BDL		BDL	
2-Chloroethylvinyl Ether	BDL		BDL		BDL	
1,2-Dichloropropane	BDL		BDL		BDL	
Bromodichloromethane	BDL		BDL		BDL	
cis-1,3-Dichloropropene	BDL		BDL		BDL	
trans1,3Dichloropropene	BDL		BDL		BDL	
1,1,2-Trichloroethane	BDL		BDL		BDL	
Tetrachloroethene	BDL		BDL		BDL	
Dibromochloromethane	BDL		BDL		BDL	
Chlorobenzene	BDL		BDL		BDL	
1,1,1,2Tetrachloroethane	BDL		BDL		BDL	
Bromoform	BDL		BDL		BDL	
1,1,2,2Tetrachloroethane	BDL		BDL		BDL	
1,3-Dichlorobenzene	BDL		BDL		BDL	
1,4-Dichlorobenzene	BDL		BDL		BDL	
1,2-Dichlorobenzene	BDL		BDL		BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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Telephone: 919-460-8093 • FAX: 919-460-0167

GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9504-014 3 Site Name Building 1613

LAB ID.	LAB BLANK
DATE SAMPLED	* *
DATE ANALYZED	04/06/95
FIELD ID.	* *

METHOD

ANALYTE	ug/l	pql
EPA 601		
Dichlorodifluoromethane	BDL	0.5
Chloromethane	BDL	
Vinyl chloride	BDL	
Bromomethane	BDL	
Chloroethane	BDL	
Trichlorofluoromethane	BDL	
1,1-Dichloroethene	BDL	
Methylene Chloride	BDL	
trans-1,2-dichloroethene	BDL	
1,1-Dichloroethane	BDL	
Chloroform	BDL	
1,1,1-Trichloroethane	BDL	
Carbon tetrachloride	BDL	
1,2-Dichloroethane	BDL	
Trichloroethene	BDL	
2-Chloroethylvinyl Ether	BDL	
1,2-Dichloropropane	BDL	
Bromodichloromethane	BDL	
cis-1,3-Dichloropropene	BDL	
trans1,3Dichloropropene	BDL	
1,1,2-Trichloroethane	BDL	
Tetrachloroethene	BDL	
Dibromochloromethane	BDL	
Chlorobenzene	BDL	
1,1,1,2Tetrachloroethane	BDL	
Bromoform	BDL	
1,1,2,2Tetrachloroethane	BDL	
1,3-Dichlorobenzene	BDL	
1,4-Dichlorobenzene	BDL	
1,2-Dichlorobenzene	BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

2500 Gate Way Centre Blvd., Suite 300 • Morrisville, NC 27560
Telephone: 919-460-8093 • FAX: 919-460-0167

GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9504-014 4 Site Name Building 1613

LAB ID.	1463		1464		1465	
DATE SAMPLED	04/05/95		04/05/95		04/05/95	
DATE ANALYZED	04/06/95		04/06/95		04/06/95	
FIELD ID.	HP-7		HP-8		HP-9	
METHOD						
ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
EPA 602						
Benzene	BDL	0.5	17300*	5.0	2.9	0.5
Toluene	12.8		20700*		11.2	
Chlorobenzene	BDL		BQL		BDL	
Ethylbenzene	4.0		2140*		1.1	
Xylenes	149	1.5	10800*	15.0	3.0	1.5
1,3 Dichlorobenzene	BDL	0.5	BQL	5.0	BDL	0.5
1,4 Dichlorobenzene	BDL		BQL		BDL	
1,2 Dichlorobenzene	BDL		BQL		BDL	

LAB ID.	1466		1467		1468	
DATE SAMPLED	04/05/95		04/05/95		04/05/95	
DATE ANALYZED	04/06/95		04/06/95		04/06/95	
FIELD ID.	HP-12		HP-15		HP-14	
METHOD						
ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
EPA 602						
Benzene	BDL	0.5	BDL	0.5	0.6	0.5
Toluene	14.4		44.9		1.6	
Chlorobenzene	BDL		BDL		BDL	
Ethylbenzene	1.4		1.7		BDL	
Xylenes	2.4	1.5	55.1	1.5	BDL	1.5
1,3 Dichlorobenzene	BDL	0.5	BDL	0.5	BDL	0.5
1,4 Dichlorobenzene	BDL		BDL		BDL	
1,2 Dichlorobenzene	BDL		BDL		BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.
** = exceeds calibration curve >20% . Values reported are considered minimum concentrations.*

2500 Gate Way Centre Blvd., Suite 300 • Morrisville, NC 27560
Telephone: 919-460-8093 • FAX: 919-460-0167

GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9504-014 5 Site Name Building 1613

LAB ID.	LAB BLANK
DATE SAMPLED	* *
DATE ANALYZED	04/06/95
FIELD ID.	* *

METHOD

ANALYTE	ug/l	pql
EPA 602		
Benzene	BDL	0.5
Toluene	BDL	
Chlorobenzene	BDL	
Ethylbenzene	BDL	
Xylenes	BDL	1.5
1,3 Dichlorobenzene	BDL	0.5
1,4 Dichlorobenzene	BDL	
1,2 Dichlorobenzene	BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

QUALITY CONTROL RESULTS

METHOD	RECOVERY	METHOD DETECTION LIMIT
601		
Vinyl Chloride	99 %	0.5 ppb
1,1,1-Trichloroethane	108 %	
Chlorobenzene	113 %	
602		
Benzene	101 %	0.5 ppb
Toluene	114 %	
Chlorobenzene	100 %	
Ethylbenzene	100 %	
Xylenes	110 %	
1,3-Dichlorobenzene	101 %	
1,4-Dichlorobenzene	99 %	
1,2-Dichlorobenzene	105 %	

REVIEWED BY

Dena Barrett

REVIEWED BY

Kevin Bel

2500 Gate Way Centre Blvd., Suite 300 • Morrisville, NC 27560
Telephone: 919-460-8093 • FAX: 919-460-0167

Report To: Teri Piver / Steve Hudson
RC & A

GeoChem, Incorporated

Environmental Laboratories

2500 Gate Way Centre Blvd., Suite 300
Morrisville, NC 27560

Bill To: RC & A
Wilm NC

Chain of Custody Record

4-6-95

PROJECT SITE NUMBER: 94127-F
PO#: ON-SITE
SITE NAME: Building 1613
COLLECTED BY (Signature): [signature]

GEOCHEM PROJECT #: 9504-014
DATE DUE: 4-7-95
VERBAL/FAX/HARDCOPY:

FIELD SAMPLE ID	TURNAROUND IN DAYS	SAMPLE MATRIX	DATE AND TIME COLLECTED		NO. OF CONTAINERS PER LOCATION	601	602								REMARKS	LAB ID NO. (for lab use only)
HP-7	1	Ground H_2O	4/5/95	0900	4	✓	✓									1463
HP-8	1	"	"	1100	4	✓	✓									1464
HP-9	1	"	"	1330	4	✓	✓									1465
HP-12	1	"	"	1415	4	✓	✓									1466
HP-15	1	"	"	1530	4	✓	✓									1467
HP-14	1	"	"	1600	4	✓	✓									1468

REMARKS:

RELINQUISHED BY:	DATE	TIME
[signature]	4/6/95	0745

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
D Marsh	4/6/95	12:10 p				[signature] Major	4/6/95	2:40 pm			

This Chain of Custody is considered a written contract to perform the services requested in the analyses section of this document.

GeoChem, Incorporated

Environmental Laboratories

April 11, 1995

Mr. Steve Hudson/Ms. Teri Piver
Richard Catlin & Assoc.
P.O. Box 10279
Wilmington, NC 28405-3755

Reference: **Bld. 1613**
94127-F
GCI# 9504-022

Dear Mr. Steve Hudson/Ms. Teri Piver:

This is the analytical report for the above referenced project. On April 7, 1995 we received five ground water samples for analysis. The analytical and quality control results are presented in separate tables for your convenience. Brief summaries of analytical methods employed are as follows. GeoChem analytical reports contain information based strictly on the analysis requested on the chain of custody (COC) accompanying this report. All soil values are calculated using dry weights. Non-target compounds are not identified or quantified. Our clients must request such additional documentation in writing.

EPA method 601

Samples are loaded into a specially designed purging chamber at ambient temperature. Helium is bubbled through the sample. This drives the organics onto a sorbent trap. Once purging has been completed the sorbent column is rapidly heated. This efficiently transfers the organics into the gas chromatograph which separates the components of the sample. The purgeable organics are then detected using a halide specific detector.

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Telephone: 919-460-8093 • FAX: 919-460-0167

EPA method 602

Samples are loaded into a specially designed purging chamber at ambient temperature. Helium is bubbled through the sample. This drives the organics onto a sorbent trap. Once purging has been completed the sorbent column is rapidly heated. This efficiently transfers the organics into the gas chromatograph which separates the components of the sample. The purgeable organics are then detected using flame ionization and photo ionization detectors.

If there are any technical questions please feel free to call me at 919-460-8093. Thank you for allowing **GEOCHEM** to serve your analytical needs.

Sincerely,

Dean Gokel
President

Geochem (NC # 336/SC # 99008)
Project#9504-022 1 Site Name Bld 1613

LAB ID.	1504	1505	1506
DATE SAMPLED	04/06/95	04/06/95	04/06/95
DATE ANALYZED	04/07/95	04/10/95	04/07/95
FIELD ID.	HP-4	HP-5	HP-10

METHOD

ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
EPA 601						
Dichlorodifluoromethane	BDL	0.5	BDL	0.5	BDL	0.5
Chloromethane	BDL		BDL		BDL	
Vinyl chloride	BDL		BDL		BDL	
Bromomethane	BDL		BDL		BDL	
Chloroethane	BDL		BDL		BDL	
Trichlorofluoromethane	BDL		BDL		1.0	
1,1-Dichloroethene	BDL		BDL		1.1	
Methylene Chloride	BDL		BDL		BDL	
trans-1,2-dichloroethene	BDL		BDL		0.8	
1,1-Dichloroethane	BDL		BDL		BDL	
Chloroform	BDL		BDL		BDL	
1,1,1-Trichloroethane	BDL		BDL		1.0	
Carbon tetrachloride	BDL		BDL		BDL	
1,2-Dichloroethane	BDL		BDL		BDL	
Trichloroethene	BDL		BDL		BDL	
2-Chloroethylvinyl Ether	BDL		BDL		BDL	
1,2-Dichloropropane	BDL		BDL		BDL	
Bromodichloromethane	BDL		BDL		BDL	
cis-1,3-Dichloropropene	BDL		BDL		BDL	
trans1,3Dichloropropene	BDL		BDL		BDL	
1,1,2-Trichloroethane	BDL		BDL		BDL	
Tetrachloroethene	BDL		BDL		BDL	
Dibromochloromethane	BDL		BDL		BDL	
Chlorobenzene	BDL		BDL		BDL	
1,1,1,2Tetrachloroethane	BDL		BDL		BDL	
Bromoform	BDL		BDL		BDL	
1,1,2,2Tetrachloroethane	BDL		BDL		BDL	
1,3-Dichlorobenzene	BDL		BDL		BDL	
1,4-Dichlorobenzene	BDL		BDL		BDL	
1,2-Dichlorobenzene	BDL		BDL		BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9504-022 2 Site Name Bld 1613

LAB ID.	1507		1508		LAB BLANK	
DATE SAMPLED	04/06/95		04/06/95		**	
DATE ANALYZED	04/07/95		04/07/95		04/07/95	
FIELD ID.	HP-13		HP-11		**	

METHOD

ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
EPA 601						
Dichlorodifluoromethane	BDL	0.5	BQL	25.0	BDL	0.5
Chloromethane	BDL		BQL		0.5	
Vinyl chloride	BDL		BQL		BDL	
Bromomethane	BDL		BQL		BDL	
Chloroethane	BDL		BQL		BDL	
Trichlorofluoromethane	BDL		BQL		BDL	
1,1-Dichloroethene	BDL		BQL		BDL	
Methylene Chloride	BDL		BQL		BDL	
trans-1,2-dichloroethene	BDL		BQL		BDL	
1,1-Dichloroethane	BDL		BQL		BDL	
Chloroform	BDL		BQL		BDL	
1,1,1-Trichloroethane	BDL		BQL		BDL	
Carbon tetrachloride	BDL		BQL		BDL	
1,2-Dichloroethane	BDL		BQL		BDL	
Trichloroethene	BDL		BQL		BDL	
2-Chloroethylvinyl Ether	BDL		BQL		BDL	
1,2-Dichloropropane	BDL		BQL		BDL	
Bromodichloromethane	BDL		BQL		BDL	
cis-1,3-Dichloropropene	BDL		BQL		BDL	
trans1,3Dichloropropene	BDL		BQL		BDL	
1,1,2-Trichloroethane	BDL		BQL		BDL	
Tetrachloroethene	BDL		BQL		BDL	
Dibromochloromethane	BDL		BQL		BDL	
Chlorobenzene	BDL		BQL		BDL	
1,1,1,2Tetrachloroethane	BDL		BQL		BDL	
Bromoform	BDL		BQL		BDL	
1,1,2,2Tetrachloroethane	BDL		BQL		BDL	
1,3-Dichlorobenzene	BDL		BQL		BDL	
1,4-Dichlorobenzene	BDL		BQL		BDL	
1,2-Dichlorobenzene	BDL		BQL		BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.
*** = samples have been blank subtracted.*

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9504-022 3 Site Name Bld 1613

LAB ID.	1504		1505		1506	
DATE SAMPLED	04/06/95		04/06/95		04/06/95	
DATE ANALYZED	04/07/95		04/10/95		04/07/95	
FIELD ID.	HP-4		HP-5		HP-10	
METHOD						
ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
EPA 602						
Benzene	BDL	0.5	BDL	0.5	BDL	0.5
Toluene	BDL		10.6		21.6	
Chlorobenzene	BDL		BDL		BDL	
Ethylbenzene	BDL		0.8		1.3	
Xylenes	BDL	1.5	2.1	1.5	BDL	1.5
1,3 Dichlorobenzene	BDL	0.5	BDL	0.5	BDL	0.5
1,4 Dichlorobenzene	BDL		BDL		BDL	
1,2 Dichlorobenzene	BDL		BDL		BDL	

	soil	*water*
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9504-022 4 Site Name Bld 1613

LAB ID.	1507		1508		LAB BLANK	
DATE SAMPLED	04/06/95		04/06/95		**	
DATE ANALYZED	04/07/95		04/07/95		04/07/95	
FIELD ID.	HP-13		HP-11		**	
METHOD						
ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
EPA 602						
Benzene	BDL	0.5	7,700*	25.0	BDL	0.5
Toluene	9.0		10,800*		BDL	
Chlorobenzene	BDL		BQL		BDL	
Ethylbenzene	BDL		1,100		BDL	
Xylenes	BDL	1.5	5,420	75.0	BDL	1.5
1,3 Dichlorobenzene	BDL	0.5	BQL	25.0	BDL	0.5
1,4 Dichlorobenzene	BDL		BQL		BDL	
1,2 Dichlorobenzene	BDL		BQL		BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.
** = exceeds calibration curve >20%. Values reported are considered minimum concentrations.*

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GeoChem, Incorporated

Environmental Laboratories

QUALITY CONTROL RESULTS

METHOD	RECOVERY	METHOD DETECTION LIMIT
601		
Trichlorofluoromethane	98 %	0.5 ppb
1,1-Dichloroethene	96 %	
Vinyl Chloride	102 %	
602		
Benzene	106 %	0.5 ppb
Toluene	106 %	
Chlorobenzene	101 %	
Ethylbenzene	103 %	
Xylenes	99 %	
1,3-Dichlorobenzene	105 %	
1,4-Dichlorobenzene	104 %	
1,2-Dichlorobenzene	106 %	

REVIEWED BY

REVIEWED BY

2500 Gate Way Centre Blvd., Suite 300 • Morrisville, NC 27560
Telephone: 919 460 8093 • FAX: 919 460 0167

Report To: Steve Hudson/Tar River
RCCA

GeoChem, Incorporated

Environmental Laboratories

2500 Gate Way Centre Blvd., Suite 300
Morrisville, NC 27560

Bill To: RC&A
Wilm NC

Chain of Custody Record

0407

Page 1 of 1

PROJECT SITE NUMBER: 94127-F
PO#: ON-SITE
GEOCHEM PROJECT #: 9504-022
SITE NAME: Bld 1613
DATE DUE: ~~4/11/95~~ 4-10-95
COLLECTED BY (Signature): [signature]
VERBAL/FAX/HARDCOPY

ANALYSES: 601, 602

FIELD SAMPLE ID	TURNAROUND IN DAYS	SAMPLE MATRIX	DATE AND TIME COLLECTED	NO. OF CONTAINERS PER LOCATION	601	602								REMARKS	LAB ID NO. (for lab use only)
HP-4	1 DM	Ground H2O	4/6/95 1520	4	✓	✓									1504
HP-5	"	"	" 1430	4	✓	✓									1505
HP-10	"	"	" 1715	4	✓	✓									1506
HP-13	"	"	" 1700	4	✓	✓									1507
HP-11	"	"	" 1000	4	✓	✓									1508

REMARKS

RELINQUISHED BY: [signature] DATE 4/6/95 TIME 0730

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
D Marsh	4/7/95	12:10 p				[signature]	4-7-95	3:49			

This Chain of Custody is considered a written contract to perform the servi[illegible]

GeoChem, Incorporated

Environmental Laboratories

April 18, 1995

Mr. Steve Hudson/ Ms. Teri Piver
Richard Catlin & Associates
P.O. Box 10279
Wilmington, NC 28405-3755

Reference: **Bld 1613**
94127-F
GCI# 9504-039

Dear Mr. Steve Hudson/ Ms. Teri Piver:

This is the analytical report for the above referenced project. On April 13, 1995 we received two ground water samples for analysis. The analytical and quality control results are presented in separate tables for your convenience. Brief summaries of analytical methods employed are as follows. GeoChem analytical reports contain information based strictly on the analysis requested on the chain of custody (COC) accompanying this report. All soil values are calculated using dry weights. Non-target compounds are not identified or quantified.

EPA method 602

Samples are loaded into a specially designed purging chamber at ambient temperature. Helium is bubbled through the sample. This drives the organics onto a sorbent trap. Once purging has been completed the sorbent column is rapidly heated. This efficiently transfers the organics into the gas chromatograph which separates the components of the sample. The purgeable organics are then detected using flame ionization and photo ionization detectors.

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GeoChem, Incorporated

Environmental Laboratories

EPA method 601

Samples are loaded into a specially designed purging chamber at ambient temperature. Helium is bubbled through the sample. This drives the organics onto a sorbent trap. Once purging has been completed the sorbent column is rapidly heated. This efficiently transfers the organics into the gas chromatograph which separates the components of the sample. The purgeable organics are then detected using a halide specific detector.

If there are any technical questions please feel free to call me at 919-460-8093. Thank you for allowing **GeoChem** to serve your analytical needs.

Sincerely,

Dean Gokel
President

2500 Gate Way Centre Blvd., Suite 300 • Morrisville, NC 27560
Telephone: 919-460-8093 • FAX: 919-460-0167

GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9504-039 1 Site Name Bld 1613

LAB ID.	1550		1551		LAB BLANK	
DATE SAMPLED	04/12/95		04/12/95		* *	
DATE ANALYZED	04/13/95		04/13/95		04/13/95	
FIELD ID.	HP-6		HP-3		* *	
METHOD						
ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
EPA 602						
Benzene	BDL	0.5	BDL	0.5	BDL	0.5
Toluene	BDL		BDL		0.6	
Chlorobenzene	BDL		BDL		BDL	
Ethylbenzene	BDL		BDL		BDL	
Xylenes	BDL	1.5	BDL	1.5	BDL	1.5
1,3 Dichlorobenzene	BDL	0.5	BDL	0.5	BDL	0.5
1,4 Dichlorobenzene	BDL		BDL		BDL	
1,2 Dichlorobenzene	BDL		BDL		BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.
** * = samples have been blank subtracted.*

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9504-039 2 Site Name Bld 1613

LAB ID.	1550	1551	LAB BLANK
DATE SAMPLED	04/12/95	04/12/95	* *
DATE ANALYZED	04/13/95	04/13/95	04/13/95
FIELD ID.	HP-6	HP-3	* *

METHOD

ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
EPA 601						
Dichlorodifluoromethane	BDL	0.5	BDL	0.5	BDL	0.5
Chloromethane	BDL		BDL		BDL	
Vinyl chloride	BDL		BDL		BDL	
Bromomethane	BDL		BDL		BDL	
Chloroethane	BDL		BDL		BDL	
Trichlorofluoromethane	BDL		BDL		BDL	
1,1-Dichloroethene	BDL		BDL		BDL	
Methylene Chloride	BDL		BDL		BDL	
trans-1,2-dichloroethene	BDL		BDL		BDL	
1,1-Dichloroethane	BDL		BDL		BDL	
Chloroform	BDL		BDL		BDL	
1,1,1-Trichloroethane	BDL		BDL		BDL	
Carbon tetrachloride	BDL		BDL		BDL	
1,2-Dichloroethane	BDL		BDL		BDL	
Trichloroethene	BDL		BDL		BDL	
2-Chloroethylvinyl Ether	BDL		BDL		BDL	
1,2-Dichloropropane	BDL		BDL		BDL	
Bromodichloromethane	BDL		BDL		BDL	
cis-1,3-Dichloropropene	BDL		BDL		BDL	
trans1,3Dichloropropene	BDL		BDL		BDL	
1,1,2-Trichloroethane	BDL		BDL		BDL	
Tetrachloroethene	BDL		BDL		BDL	
Dibromochloromethane	BDL		BDL		BDL	
Chlorobenzene	BDL		BDL		BDL	
1,1,1,2Tetrachloroethane	BDL		BDL		BDL	
Bromoform	BDL		BDL		BDL	
1,1,2,2Tetrachloroethane	BDL		BDL		BDL	
1,3-Dichlorobenzene	BDL		BDL		BDL	
1,4-Dichlorobenzene	BDL		BDL		BDL	
1,2-Dichlorobenzene	BDL		BDL		BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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Telephone: 919-460-8093 • FAX: 919-460-0167

GeoChem, Incorporated

Environmental Laboratories

QUALITY CONTROL RESULTS

METHOD	RECOVERY	METHOD DETECTION LIMIT
602		
Benzene	107 %	0.5 ppb
Toluene	107 %	
Chlorobenzene	104 %	
Ethylbenzene	105 %	
Xylenes	107 %	
1,3-Dichlorobenzene	105 %	
1,4-Dichlorobenzene	105 %	
1,2-Dichlorobenzene	106 %	
601		
Vinyl Chloride	94 %	0.5 ppb
Trichlorofluoromethane	97 %	
Bromoform	105 %	

REVIEWED BY

Dena J. Barrett

REVIEWED BY

2500 Gate Way Centre Blvd., Suite 300 • Morrisville, NC 27560

GeoChem, Incorporated

Environmental Laboratories

2500 Gate Way Centre Blvd., Suite 300
Morrisville, NC 27560

Report To: Teri Piver / Steve Hudson
RC&A

Bill To: RC&A
Wilm NC

Chain of Custody Record ~~4/18~~ 1 DAY

Page 1 of ____

PROJECT SITE NUMBER: 94127-F

PO#: 950413-4 ON-SITE

GEOCHEM PROJECT #: 9504-039

SITE NAME: Bld 1613

DATE DUE: ~~4-20-95~~ / 4-14-95

COLLECTED BY (Signature): [signature]

VERBAL/FAX/HARDCOPY

FIELD SAMPLE ID	TURNAROUND IN DAYS	SAMPLE MATRIX	DATE AND TIME COLLECTED	NO. OF CONTAINERS PER LOCATION	ANALYSES: 601	602								REMARKS	LAB ID NO. (for lab use only)
HP-6	1	GROUND H_2O	4/12/95 1500	4	✓	✓									1550
HP-3	1	"	4/12/95 1600	4	✓	✓									1551
														ON SITE	

REMARKS

RELINQUISHED BY:	DATE	TIME
[signature]	4/13/95	0700

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
D.F. Gotel	4.13.95	9:30A	Billie G. Waller	4/13/95	9:36						

This Chain of Custody is considered a written contract to perform the services requested in the analyses section of this document.

GeoChem, Incorporated

Environmental Laboratories

April 26, 1995

Mr. Steve Hudson/Ms. Teri Piver
Richard Catlin & Assoc.
P.O. Box 10279
Wilmington, NC 28405-3755

Reference: **Bld. 1613**
94127-F
GCI# 9504-050 (complete)

Dear Mr. Steve Hudson/Ms. Teri Piver:

This is the analytical report for the above referenced project. On April 18, 1995 we received twenty-four soil samples for analysis. The analytical and quality control results are presented in separate tables for your convenience. Brief summaries of analytical methods employed are as follows. GeoChem analytical reports contain information based strictly on the analysis requested on the chain of custody (COC) accompanying this report. All soil values are calculated using dry weights. Non-target compounds are not identified or quantified. Our clients must request such additional documentation in writing.

TPH

Samples are analyzed by following the California U.S.T. manual. This methodology incorporates EPA purge and trap (meth. 5030) techniques for analysis of volatile fuels such as gasoline. Less volatile fuels such as diesel fuel and kerosene must be extracted using solvents prior to analysis (soils are sonicated, meth. 3550). A standard calibration curve is created from the pure fuel of interest. The standards serve two functions; they create a "finger print" pattern for comparisons and they allow the chemist to calculate the concentration of that fuel analyzed for.

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GeoChem, Incorporated

Environmental Laboratories

Metals

Metals testing entails several distinct tests. All ground water samples are collected according to EPA Method 3030. All samples are digested in an acidic solution prior to analysis. There are several different digestion(s) performed depending on which metal(s) is (are) to be analyzed and the matrix of the sample(s). Metals such as lead and arsenic are then analyzed using a graphite furnace A.A. Many metals can be analyzed with a Flame A.A.

pH

The pH is used to determine acidic or basic nature of the sample. The pH meter is calibrated with three NBS standards before each use. The calibration of the meter is checked periodically with one standard.

Flash Point

Sample is loaded into tog closed cup flash point tester. The temperature of the chamber is gradually elevated until sample flashes, corresponding to a rapid temperature rise. The flash point is the initial temperature before rapid temperature increase.

If there are any technical questions please feel free to call me at 919-460-8093. Thank you for allowing **GeoChem** to serve your analytical needs.

Sincerely,

Dean Gokel
President

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Geochem (NC #336/SC #99008)
Project#9504-050 1 Site Name Bld. 1613

LAB ID.	1593	1594	1595
DATE SAMPLED	04/10/95	04/10/95	04/10/95
DATE EXTRACTED	04/19/95	04/19/95	04/19/95
FIELD ID.	1613-1(2-4)	1613-1(10-12)	1613-2(2-4)

METHOD

ANALYTE	mg/kg	pql	mg/kg	pql	mg/kg	pql
TPH/diesel	BDL	5.0	BDL	5.0	BDL	5.0

LAB ID.	1593	1594	1595
DATE SAMPLED	04/10/95	04/10/95	04/10/95
DATE ANALYZED	04/19/95	04/19/95	04/19/95
FIELD ID.	1613-1(2-4)	1613-1(10-12)	1613-2(2-4)

METHOD

ANALYTE	mg/kg	pql	mg/kg	pql	mg/kg	pql
TPH/gas	BDL	1.0	BDL	1.0	BDL	1.0

	soil	*water*
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC #336/SC #99008)
Project#9504-050 2 Site Name Bld. 1613

LAB ID.	1596		1597		1598	
DATE SAMPLED	04/10/95		04/11/95		04/11/95	
DATE EXTRACTED	04/19/95		04/19/95		04/19/95	
FIELD ID.	1613-2(10-12)		1613-3(2-4)		1613-3(10-12)	
METHOD						
ANALYTE	mg/kg	pql	mg/kg	pql	mg/kg	pql
TPH/diesel	BDL	5.0	BDL	5.0	BDL	5.0

LAB ID.	1596		1597		1598	
DATE SAMPLED	04/10/95		04/11/95		04/11/95	
DATE ANALYZED	04/19/95		04/19/95		04/19/95	
FIELD ID.	1613-2(10-12)		1613-3(2-4)		1613-3(10-12)	
METHOD						
ANALYTE	mg/kg	pql	mg/kg	pql	mg/kg	pql
TPH/gas	BDL	1.0	BDL	1.0	BDL	1.0

	soil	water
parts per million	= *mg/kg*	*mg/l*
parts per billion	= *ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC #336/SC #99008)
Project#9504-050 3 Site Name Bld. 1613

LAB ID.	1599	1600	1601
DATE SAMPLED	04/11/95	04/11/95	04/11/95
DATE EXTRACTED	04/19/95	04/19/95	04/19/95
FIELD ID.	1613-4(2-4)	1613-4(10-12)	1613-5(2-4)

METHOD

ANALYTE	mg/kg	pql	mg/kg	pql	mg/kg	pql
TPH/diesel	BDL	5.0	BDL	5.0	BDL	5.0

LAB ID.	1599	1600	1601
DATE SAMPLED	04/11/95	04/11/95	04/11/95
DATE ANALYZED	04/19/95	04/19/95	04/19/95
FIELD ID.	1613-4(2-4)	1613-4(10-12)	1613-5(2-4)

METHOD

ANALYTE	mg/kg	pql	mg/kg	pql	mg/kg	pql
TPH/gas	BDL	1.0	BDL	1.0	BDL	1.0

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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Geochem (NC #336/SC #99008)
Project#9504-050 4 Site Name Bld. 1613

LAB ID.	1602		1603		1604	
DATE SAMPLED	04/11/95		04/11/95		04/11/95	
DATE EXTRACTED	04/19/95		04/19/95		04/19/95	
FIELD ID.	1613-5(10-12)		1613-6(2-4)		1613-6(10-12)	
METHOD						
ANALYTE	mg/kg	pql	mg/kg	pql	mg/kg	pql
TPH/diesel	BDL	5.0	BDL	5.0	BDL	5.0

LAB ID.	1602		1603		1604	
DATE SAMPLED	04/11/95		04/11/95		04/11/95	
DATE ANALYZED	04/19/95		04/19/95		04/19/95	
FIELD ID.	1613-5(10-12)		1613-6(2-4)		1613-6(10-12)	
METHOD						
ANALYTE	mg/kg	pql	mg/kg	pql	mg/kg	pql
TPH/gas	BDL	1.0	BDL	1.0	BDL	1.0

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

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Geochem (NC #336/SC #99008)
Project#9504-050 5 Site Name Bld. 1613

LAB ID.	1605		1606		1607	
DATE SAMPLED	04/12/95		04/12/95		04/12/95	
DATE EXTRACTED	04/19/95		04/19/95		04/19/95	
FIELD ID.	1613-7(2-4)		1613-7(10-12)		1613-8(2-4)	
METHOD						
ANALYTE	mg/kg	pql	mg/kg	pql	mg/kg	pql
TPH/diesel	BDL	5.0	BDL	5.0	BDL	5.0

LAB ID.	1605		1606		1607	
DATE SAMPLED	04/12/95		04/12/95		04/12/95	
DATE ANALYZED	04/20/95		04/20/95		04/20/95	
FIELD ID.	1613-7(2-4)		1613-7(10-12)		1613-8(2-4)	
METHOD						
ANALYTE	mg/kg	pql	mg/kg	pql	mg/kg	pql
TPH/gas	BDL	1.0	BDL	1.0	BQL	1.0

	soil	*water*
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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Geochem (NC #336/SC #99008)
Project#9504-050 6 Site Name Bld. 1613

LAB ID.	1608		1609		1610	
DATE SAMPLED	04/12/95		04/13/95		04/13/95	
DATE EXTRACTED	04/19/95		04/19/95		04/19/95	
FIELD ID.	1613-8(10-12)		1613-9(2-4)		1613-9(10-12)	
METHOD						
ANALYTE	mg/kg	pql	mg/kg	pql	mg/kg	pql
TPH/diesel	BDL	5.0	BDL	5.0	BDL	5.0

LAB ID.	1608		1609		1610	
DATE SAMPLED	04/12/95		04/13/95		04/13/95	
DATE ANALYZED	04/20/95		04/20/95		04/20/95	
FIELD ID.	1613-8(10-12)		1613-9(2-4)		1613-9(10-12)	
METHOD						
ANALYTE	mg/kg	pql	mg/kg	pql	mg/kg	pql
TPH/gas	BDL	1.0	BDL	1.0	BQL	1.0

	soil	*water*
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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Geochem (NC #336/SC #99008)
Project#9504-050 7 Site Name Bld. 1613

LAB ID.	1615	1616	Lab Blank
DATE SAMPLED	04/13/95	04/13/95	* *
DATE EXTRACTED	04/19/95	04/19/95	04/19/95
FIELD ID.	1613-13(2.5-5.0)	1613-13(37.5-40)	* *

METHOD

ANALYTE	mg/kg	pql	mg/kg	pql	mg/kg	pql
TPH/diesel	BDL	5.0	BDL	5.0	BDL	5.0

LAB ID.	1615	1616	Lab Blank
DATE SAMPLED	04/13/95	04/13/95	* *
DATE ANALYZED	04/20/95	04/20/95	04/19/95
FIELD ID.	1613-13(2.5-5.0)	1613-13(37.5-40)	* *

METHOD

ANALYTE	mg/kg	pql	mg/kg	pql	mg/kg	pql
TPH/gas	BDL	1.0	BDL	1.0	BDL	1.0

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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Environmental Laboratories

Geochem(NC #336/SC #99008)
Project#9504-050 8 Site Name Bld. 1613

LAB ID.	1611	1612	1613
DATE SAMPLED	04/10/95	04/10/95	04/11/95
DATE DIGESTED	04/19/95	04/19/95	04/19/95
FIELD ID.	1613-1(5-7)	1613-2(5-7)	1613-3(5-7)

METHOD

ANALYTE	mg/kg	pql	mg/kg	pql	mg/kg	pql
RCRA Metals						
Lead	BQL	9.58	BQL	9.35	13.7	10.7

LAB ID.	1614	LAB BLANK
DATE SAMPLED	04/11/95	* *
DATE DIGESTED	04/19/95	04/19/95
FIELD ID.	1613-4(5-7)	* *

METHOD

ANALYTE	mg/kg	pql	mg/kg	pql
RCRA Metals				
Lead	BQL	11.4	BQL	0.50

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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Environmental Laboratories

Geochem (NC #336/SC #99008)
Project#9504-050 9 Site Name Bld. 1613

LAB ID.	1595
DATE SAMPLED	04/10/95
DATE ANALYZED	04/21/95
FIELD ID.	1613-2(2-4)

METHOD

ANALYTE	pH	pql
pH	6.37	0.01

	soil	*water*
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC #336/SC #99008)
Project#9504-050 10 Site Name Bld. 1613

LAB ID.	1595
DATE SAMPLED	04/10/95
DATE ANALYZED	04/21/95
FIELD ID.	1613-2(2-4)

METHOD

ANALYTE	degree ° C
Flash point	>100

	soil	*water*
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

QUALITY CONTROL RESULTS

METHOD	RECOVERY	METHOD DETECTION LIMIT
TPH/diesel	119 %	5.0 ppm
TPH/gas	95 %	1.0 ppm
Metals (flame)		
Lead	84 %	0.50 ppm

REVIEWED BY

REVIEWED BY

2500 Gate Way Centre Blvd., Suite 300 • Morrisville, NC 27560
Telephone: 919-460-8093 • FAX: 919-460-0167

Report To: Teri Piver / Steve Hudson RC&A

GeoChem, Incorporated

Environmental Laboratories

2500 Gate Way Centre Blvd., Suite 300
Morrisville, NC 27560

Bill To: RC&A Wilm NC

Chain of Custody Record

0420 / 0424

Page 1 of ____

PROJECT SITE NUMBER: 94127-F
PO#: 950418-7
GEOCHEM PROJECT #: 9504-050
SITE NAME: Bld 1613
DATE DUE: 4-24-95 5-1-95
COLLECTED BY (Signature): [signature]
VERBAL/FAX/HARDCOPY

ANALYSES

FIELD SAMPLE ID	TURNAROUND IN DAYS	SAMPLE MATRIX	DATE AND TIME COLLECTED	NO. OF CONTAINERS PER LOCATION	TPH 5030/3550	FP/pH	TOTAL LEAD	REMARKS	LAB ID NO. (for lab use only)
1613-1 (2-4)	NORM	SOIL	4/10/95 0900	1	✓			Change on 16113-1 10-12	1593
1613-1 (10-12)	"	"	4/10/95 0900	1	✓			made By TP.	1594
1613-2 (2-4)	"	"	" 1030	1	✓	✓			1595
1613-2 (10-12)	"	"	" 1030	1	✓				1596
1613-3 (2-4)	"	"	4/11/95 0830	1	✓				1597
1613-3 (10-12)	"	"	" 0830	1	✓				1598
1613-4 (2-4)	"	"	" 1000	1	✓				1599
1613-4 (10-12)	"	"	" 1000	1	✓				1600
1613-5 (2-4)	"	"	" 1100	1	✓				1601
1613-5 (10-12)	"	"	" 1100	1	✓				1602
1613-6 (2-4)	"	"	" 1400	1	✓				1603
1613-6 (10-12)	"	"	" 1400	1	✓				1604

REMARKS:

RELINQUISHED BY: [signature] DATE: 4/17/95 TIME: 0800

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
K Sukel	4-18-95	11:55				[signature]	4-18-95	2:30			

This Chain of Custody is considered a written contract to perform the services requested in the analyses section of this document

Report To: Teri Piver/Steve Hudson
RC&A

GeoChem, Incorporated

Environmental Laboratories

2500 Gate Way Centre Blvd., Suite 300
Morrisville, NC 27560

Bill To: RC&A
Wilm NC

Chain of Custody Record

0420 / 0424

Page 1 of ____

PROJECT SITE NUMBER: 94127-F
PO#: 950418-7
GEOCHEM PROJECT #: 9504-050
SITE NAME: Bld 1613
DATE DUE: 4-24-95 5-1-95
COLLECTED BY (Signature): [signature]
VERBAL/FAX/HARDCOPY

ANALYSES: TPH 5030/3550; FP/pH; Total Lead

FIELD SAMPLE ID	TURNAROUND IN DAYS	SAMPLE MATRIX	DATE AND TIME COLLECTED	NO. OF CONTAINERS PER LOCATION	TPH 5030/3550	FP/pH	TOTAL LEAD	REMARKS	LAB ID NO. (for lab use only)
1613-7 (2-4)	NORM	SOIL	4/12/95 1030	1	✓				1605
1613-7 (10-12)	"	"	" 1030	1	✓				1606
1613-8 (2-4)	"	"	" 930 ~~1145~~	1	✓				1607
1613-8 (10-12)	"	"	" 930 ~~1145~~	1	✓				1608
1613-~~9~~ (2-4)	"	"	4/13/95 1145 ~~0930~~	1	✓			No flashpoint/pH	1609
1613-4 (10-12)	"	"	4/13/95 1145 ~~0930~~	1	✓				1610
1613-1 (5-7)	"	"	4/10/95 0900	1			✓		1611
1613-2 (5-7)	"	"	4/10/95 1030	1			✓		1612
1613-3 (5-7)	"	"	4/11/95 0830	1			✓		1613
1613-4 (5-7)	"	"	4/11/95 1100	1			✓		1614
1613-13 (2.5-5.0)	"	"	4/13/95 1100	1	✓				1615
1613-13 (37.5-40)	"	"	4/13/95 1100	1	✓				1616

REMARKS:

RELINQUISHED BY:	DATE	TIME
[signature]	4/17/95	1450

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
K Gafel	4-18-95	11:55				[signature]	4-18-95	2:30			

This Chain of Custody is considered a written contract to perform ...

GeoChem, Incorporated

Environmental Laboratories

April 26, 1995

Mr. Steve Hudson/Ms. Teri Piver
Richard Catlin & Associates
P.O. Box 10279
Wilmington, NC 28405-3755

Reference: **BLDG-1613 1-4**
94127 F
GCI# 9504-058

Dear Mr. Steve Hudson/Ms. Teri Piver:

This is the analytical report for the above referenced project. On April 19, 1995 we received ten soil samples for analysis. The analytical and quality control results are presented in separate tables for your convenience. Brief summaries of analytical methods employed are as follows. GeoChem analytical reports contain information based strictly on the analysis requested on the chain of custody (COC) accompanying this report. All soil values are calculated using dry weights. Non-target compounds are not identified or quantified.

TPH

Samples are analyzed by following the California U.S.T. manual. This methodology incorporates EPA purge and trap (meth. 5030) techniques for analysis of volatile fuels such as gasoline. Less volatile fuels such as diesel fuel and kerosene must be extracted using solvents prior to analysis (soils are sonicated, meth. 3550). A standard calibration curve is created from the pure fuel of interest. The standards serve two functions; they create a "finger print" pattern for comparisons and they allow the chemist to calculate the concentration of that fuel analyzed for.

If there are any technical questions please feel free to call me at 919-460-8093. Thank you for allowing **GEOCHEM** to serve your analytical needs.

Sincerely,

Dean Gokel
President

2500 Gate Way Centre Blvd., Suite 300 • Morrisville, NC 27560
Telephone: 919-460-8093 • FAX: 919-460-0167

Flash Point

Sample is loaded into tog closed cup flash point tester. The temperature of the chamber is gradually elevated until sample flashes, corresponding to a rapid temperature rise. The flash point is the initial temperature before rapid temperature increase.

pH

The pH is used to determine acidic or basic nature of the sample. The pH meter is calibrated with three NBS standards before each use. The calibration of the meter is checked periodically with one standard.

If there are any technical questions please feel free to call me at 919-460-8093. Thank you for allowing **GEOCHEM** to serve your analytical needs.

Sincerely,

Dean Gokel
President

Geochem (NC #336/SC #99008)
Project#9504-058 1 Site Name BLDG-1613 1-4

LAB ID.	1636	1637	1638
DATE SAMPLED	04/18/95	04/18/95	04/18/95
DATE EXTRACTED	04/26/95	04/26/95	04/25/95
FIELD ID.	1613-12(2-4)	1613-12(10-12)	1613-11(2-4)

METHOD

ANALYTE	mg/kg	pql	mg/kg	pql	mg/kg	pql
TPH/diesel	BDL	5.0	BDL	5.0	BDL	5.0

LAB ID.	1636	1637	1638
DATE SAMPLED	04/18/95	04/18/95	04/18/95
DATE ANALYZED	04/20/95	04/20/95	04/21/95
FIELD ID.	1613-12(2-4)	1613-12(10-12)	1613-11(2-4)

METHOD

ANALYTE	mg/kg	pql	mg/kg	pql	mg/kg	pql
TPH/gas	BDL	1.0	BDL	1.0	BDL	1.0

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

GeoChem, Incorporated

Environmental Laboratories

Geochem (NC #336/SC #99008)
Project#9504-058 2 Site Name BLDG-1613 1-4

LAB ID.	1639		1640		1641	
DATE SAMPLED	04/18/95		04/18/95		04/18/95	
DATE EXTRACTED	04/25/95		04/25/95		04/25/95	
FIELD ID.	1613-11(10-12)		1613-10(2-4)		1613-10(10-12)	
METHOD						
ANALYTE	mg/kg	pql	mg/kg	pql	mg/kg	pql
TPH/diesel	BDL	5.0	BDL	5.0	BDL	5.0

LAB ID.	1639		1640		1641	
DATE SAMPLED	04/18/95		04/18/95		04/18/95	
DATE EXTRACTED	04/21/95		04/21/95		04/21/95	
FIELD ID.	1613-11(10-12)		1613-10(2-4)		1613-10(10-12)	
METHOD						
ANALYTE	mg/kg	pql	mg/kg	pql	mg/kg	pql
TPH/gas	BDL	1.0	BDL	1.0	BDL	1.0

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC #336/SC #99008)
Project#9504-058 3 Site Name BLDG-1613 1-4

LAB ID.	1642		1643		1644	
DATE SAMPLED	04/17/95		04/17/95		04/19/95	
DATE EXTRACTED	04/25/95		04/25/95		04/25/95	
FIELD ID.	1613-14(2-4)		1613-14(37.5-40)		1613-16(2-4)	
METHOD						
ANALYTE	mg/kg	pql	mg/kg	pql	mg/kg	pql
TPH/diesel	20.7	5.0	BDL	5.0	BDL	5.0

LAB ID.	1642		1643		1644	
DATE SAMPLED	04/17/95		04/17/95		04/19/95	
DATE ANALYZED	04/21/95		04/21/95		04/21/95	
FIELD ID.	1613-14(2-4)		1613-14(37.5-40)		1613-16(2-4)	
METHOD						
ANALYTE	mg/kg	pql	mg/kg	pql	mg/kg	pql
TPH/gas	BDL	1.0	BDL	1.0	BDL	1.0

	soil	*water*
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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Environmental Laboratories

Geochem (NC #336/SC #99008)
Project#9504-058 4 Site Name BLDG-1613 1-4

LAB ID.	1645	LAB BLANK
DATE SAMPLED	04/19/95	* *
DATE EXTRACTED	04/25/95	04/25/95
FIELD ID.	1613-16(10-12)	* *

METHOD

ANALYTE	mg/kg	pql	mg/kg	pql
TPH/diesel	BDL	5.0	BDL	5.0

LAB ID.	1645	LAB BLANK
DATE SAMPLED	04/19/95	* *
DATE ANALYZED	04/21/95	04/20/95
FIELD ID.	1613-16(10-12)	* *

METHOD

ANALYTE	mg/kg	pql	mg/kg	pql
TPH/gas	BDL	1.0	BDL	1.0

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC #336/SC #99008)
Project#9504-058 5 Site Name BLDG-1613 1-4

LAB ID.	1644
DATE SAMPLED	04/19/95
DATE ANALYZED	04/21/95
FIELD ID.	1613-16(2-4)

METHOD

ANALYTE	degree ° C
Flash point	>130

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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Environmental Laboratories

Geochem (NC #336/SC #99008)
Project#9504-058 6 Site Name BLDG-1613 1-4

LAB ID.	1644
DATE SAMPLED	04/19/95
DATE ANALYZED	04/21/95
FIELD ID.	1613-16(2-4)

METHOD

ANALYTE	pH	pql
pH	8.43	0.01

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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Environmental Laboratories

QUALITY CONTROL RESULTS

METHOD	RECOVERY	METHOD DETECTION LIMIT
TPH/diesel	84 %	5.0 ppm
TPH/gas	99 %	1.0 ppm

REVIEWED BY

REVIEWED BY

2500 Gate Way Centre Blvd., Suite 300 • Morrisville, NC 27560
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Report To: Steve Hudson / Teri Pivec
R.C.A.

GeoChem, Incorporated

Environmental Laboratories

2500 Gate Way Centre Blvd., Suite 300
Morrisville, NC 27560

Bill To: R.C.A

Chain of Custody Record

0421 / 0425 Page 1 of 1

PROJECT SITE NUMBER: 94127 F
PO#: 950419-1
SITE NAME: Bldg 1613 1-4
COLLECTED BY (Signature): [signature]
GEOCHEM PROJECT #: 9504-058
DATE DUE: 4-25-95 5-2-95
VERBAL/FAX/HARDCOPY:

FIELD SAMPLE ID	TURNAROUND IN DAYS	SAMPLE MATRIX	DATE AND TIME COLLECTED	NO. OF CONTAINERS PER LOCATION	TPH 3550/5030	EP/PH								REMARKS	LAB ID NO. (for lab use only)
1613-12 (2-4)	Std	Soil	04/18/95 3:10	1	✓										1636
1613-12 (10-12)	"	"	04/18/95 3:25	1	✓										1637
1613-11 (2-4)	"	"	04/18/95 12:05	1	✓										1638
1613-11 (10-12)	"	"	04/18/95 12:15	1	✓										1639
1613-10 (2-4)	"	"	4/18/95 9:30	1	✓										1640
1613-10 (10-12)	"	"	4/18/95 9:45	1	✓										1641
1613-14 (2-4)	"	"	4/17/95 1:10	1	✓										1642
1613-14 (37.5-40)	"	"	4/17/95 3:10	1	✓										1643
1613-16 (2-4)	"	"	4/19/95 8:05	1	✓	✓									1644
1613-16 (10-12)	"	"	4/19/95 8:25	1	✓										1645

REMARKS

RELINQUISHED BY: [signature] DATE 4/19 TIME 8:45

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
Fokel	4.19.95	10:50	A Billie G. Waller	4/19/95	10:51 am	[signature]	4-19-95	1:38			

This Chain of Custody ...

GeoChem, Incorporated

Environmental Laboratories

May 1, 1995

Ms. Teri Piver/Mr. Steve Hudson
Richard Catlin & Associates
P.O. Box 10279
Wilmington, NC 28405-3755

Reference: **Bld 1613**
94127-F
GCI# 9504-071 (complete)

Dear Ms. Teri Piver/Mr. Steve Hudson:

This is the analytical report for the above referenced project. On April 24, 1995 we received five soil samples for analysis. The analytical and quality control results are presented in separate tables for your convenience. Brief summaries of analytical methods employed are as follows. GeoChem analytical reports contain information based strictly on the analysis requested on the chain of custody (COC) accompanying this report. All soil values are calculated using dry weights. Non-target compounds are not identified or quantified.

TPH

Samples are analyzed by following the California U.S.T. manual. This methodology incorporates EPA purge and trap (meth. 5030) techniques for analysis of volatile fuels such as gasoline. Less volatile fuels such as diesel fuel and kerosene must be extracted using solvents prior to analysis (soils are sonicated, meth. 3550). A standard calibration curve is created from the pure fuel of interest. The standards serve two functions; they create a "finger print" pattern for comparisons and they allow the chemist to calculate the concentration of that fuel analyzed for.

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Metals

Metals testing entails several distinct tests. All ground water samples are collected according to EPA Method 3030. All samples are digested in an acidic solution prior to analysis. There are several different digestion(s) performed depending on which metal(s) is (are) to be analyzed and the matrix of the sample(s). Metals such as lead and arsenic are then analyzed using a graphite furnace A.A. Many metals can be analyzed with a Flame A.A.

If there are any technical questions please feel free to call me at 919-460-8093. Thank you for allowing **GEOCHEM** to serve your analytical needs.

Sincerely,

Dean Gokel
President

2500 Gate Way Centre Blvd., Suite 300 • Morrisville, NC 27560
Telephone: 919-460-8093 • FAX: 919-460-0167

GeoChem, Incorporated

Environmental Laboratories

Geochem (NC #336/SC #99008)
Project#9504-071 1 Site Name Bld 1613

LAB ID.	1698	1699	LAB BLANK
DATE SAMPLED	04/17/95	04/17/95	* *
DATE EXTRACTED	04/25/95	04/25/95	04/25/95
FIELD ID.	1613-15 2.5-5	1613-15 37.5-40	* *

METHOD

ANALYTE	mg/kg	pql	mg/kg	pql	mg/kg	pql
TPH/diesel	BDL	5.0	BDL	5.0	BDL	5.0

LAB ID.	1698	1699	LAB BLANK
DATE SAMPLED	04/17/95	04/17/95	* *
DATE ANALYZED	04/26/95	04/25/95	04/24/95
FIELD ID.	1613-15 2.5-5	1613-15 37.5-40	* *

METHOD

ANALYTE	mg/kg	pql	mg/kg	pql	mg/kg	pql
TPH/gas	BDL	1.0	BDL	1.0	BDL	1.0

	soil	*water*
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

Geochem(NC #336/SC #99008)
Project#9504-071 2 Site Name Bld 1613

LAB ID.	1695	1696	1697
DATE SAMPLED	04/10/95	04/11/95	04/17/95
DATE DIGESTED	04/25/95	04/25/95	04/25/95
FIELD ID.	1613-1 5-7	1613-4 5-7	1613-16 5-7

METHOD

ANALYTE	mg/kg	pql	mg/kg	pql	mg/kg	pql
Metals						
Lead	BQL	11.1	BQL	9.49	BQL	9.22

LAB ID.	LAB BLANK
DATE SAMPLED	* *
DATE DIGESTED	04/25/95
FIELD ID.	* *

METHOD

ANALYTE	mg/kg	pql
Metals		
Total lead	BDL	0.500

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

QUALITY CONTROL RESULTS

METHOD	RECOVERY	METHOD DETECTION LIMIT
TPH/diesel	84 %	5.0 ppm
TPH/gas	104 %	1.0 ppm
Metals (flame)		
Lead	93 %	0.500 ppm

REVIEWED BY

REVIEWED BY

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Report To: Teri Piver / Steve Hodson
RC&A

GeoChem, Incorporated

Environmental Laboratories

2500 Gate Way Centre Blvd., Suite 300
Morrisville, NC 27560

Bill To: RC&A
Wilm NC

Chain of Custody Record

0426 / 0428

PROJECT SITE NUMBER: 94127-F
PO#: 950424-6
SITE NAME: Bld 1613
COLLECTED BY (Signature): [signature]
GEOCHEM PROJECT #: 9504-041
DATE DUE: 4-28-95 / 5-5-95
VERBAL/FAX/HARDCOPY:

ANALYSES: TPH 5030/3550; TOTAL LEAD

FIELD SAMPLE ID	TURNAROUND IN DAYS	SAMPLE MATRIX	DATE AND TIME COLLECTED	NO. OF CONTAINERS PER LOCATION	TPH 5030/3550	TOTAL LEAD								REMARKS	LAB ID NO. (for lab use only)
1613-1 5-7	NORM	SOIL	4/10/95 0900	1		✓									1695
1613-4 5-7	"	"	4/11/95 1000	1		✓									1696
1613-16 5-7	"	"	4/17/95 1400	1		✓									1697
1613-15 2.5-5	"	"	4/17/95 0900	1	✓										1698
1613-15 37.5-40	"	"	4/17/95 0900	1	✓										1699

REMARKS:

RELINQUISHED BY:	DATE	TIME
[signature]	4/21/95	1700

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
K Gale	4-24-95	12:35				[signature]	4-24-95	3:44			

GeoChem, Incorporated

Environmental Laboratories

May 17, 1995

Ms. Teri Piver
Richard Catlin & Assoc.
P. O. Box 10279
Wilmington, NC 28405-3755

Reference: **BLDG 1613 1-4**
94127-F
GCI# 9505-013 (complete)

Dear Ms. Teri Piver:

This is the analytical report for the above referenced project. On May 4, 1995 we received nine ground water samples for analysis. The analytical and quality control results are presented in separate tables for your convenience. Brief summaries of analytical methods employed are as follows. GeoChem analytical reports contain information based strictly on the analysis requested on the chain of custody (COC) accompanying this report. All soil values are calculated using dry weights. Non-target compounds are not identified or quantified. Our clients must request such additional documentation in writing.

EPA method 601

Samples are loaded into a specially designed purging chamber at ambient temperature. Helium is bubbled through the sample. This drives the organics onto a sorbent trap. Once purging has been completed the sorbent column is rapidly heated. This efficiently transfers the organics into the gas chromatograph which separates the components of the sample. The purgeable organics are then detected using a halide specific detector.

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EPA method 602

Samples are loaded into a specially designed purging chamber at ambient temperature. Helium is bubbled through the sample. This drives the organics onto a sorbent trap. Once purging has been completed the sorbent column is rapidly heated. This efficiently transfers the organics into the gas chromatograph which separates the components of the sample. The purgeable organics are then detected using flame ionization and photo ionization detectors.

Semivolatiles EPA 625

This method is used to determine the concentration of semivolatile organic compounds in extracts prepared from waste water and ground water. The components are separated via gas chromatograph and detected using a mass spectrometer. This method can be used to quantify most neutral, acidic, and basic organic compounds that are soluble in methylene chloride.

If there are any technical questions please feel free to call me at 919-460-8093. Thank you for allowing **GeoChem** to serve your analytical needs.

Sincerely,

Dean Gokel
President

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9505-013 1 Site Name BLDG 1613 1-4

LAB ID.	1790		1791		1792	
DATE SAMPLED	05/03/95		05/03/95		05/03/95	
DATE ANALYZED	05/05/95		05/05/95		05/05/95	
FIELD ID.	1613-1		1613-2		1613-4	

METHOD

ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
EPA 601						
Dichlorodifluoromethane	BDL	0.5	BDL	0.5	BDL	0.5
Chloromethane	BDL		BDL		BDL	
Vinyl chloride	BDL		BDL		BDL	
Bromomethane	BDL		BDL		BDL	
Chloroethane	BDL		BDL		BDL	
Trichlorofluoromethane	BDL		BDL		BDL	
1,1-Dichloroethene	BDL		BDL		BDL	
Methylene Chloride	BDL		BDL		BDL	
trans-1,2-dichloroethene	BDL		BDL		BDL	
1,1-Dichloroethane	BDL		BDL		BDL	
Chloroform	BDL		BDL		BDL	
1,1,1-Trichloroethane	BDL		BDL		BDL	
Carbon tetrachloride	BDL		BDL		BDL	
1,2-Dichloroethane	BDL		BDL		BDL	
Trichloroethene	BDL		BDL		BDL	
2-Chloroethylvinyl Ether	BDL		BDL		BDL	
1,2-Dichloropropane	BDL		BDL		BDL	
Bromodichloromethane	BDL		BDL		BDL	
cis-1,3-Dichloropropene	BDL		BDL		BDL	
trans1,3Dichloropropene	BDL		BDL		BDL	
1,1,2-Trichloroethane	BDL		BDL		BDL	
Tetrachloroethene	BDL		BDL		BDL	
Dibromochloromethane	BDL		BDL		BDL	
Chlorobenzene	BDL		BDL		BDL	
1,1,1,2Tetrachloroethane	BDL		BDL		BDL	
Bromoform	BDL		BDL		BDL	
1,1,2,2Tetrachloroethane	BDL		BDL		BDL	
1,3-Dichlorobenzene	BDL		BDL		BDL	
1,4-Dichlorobenzene	BDL		BDL		BDL	
1,2-Dichlorobenzene	BDL		BDL		BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9505-013 2 Site Name BLDG 1613 1-4

LAB ID.	1793		1794		1795	
DATE SAMPLED	05/03/95		05/03/95		05/03/95	
DATE ANALYZED	05/05/95		05/05/95		05/05/95	
FIELD ID.	1613-5		1613-6		1613-7	

METHOD

ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
EPA 601						
Dichlorodifluoromethane	BDL	0.5	BDL	0.5	BDL	0.5
Chloromethane	BDL		5.3		BDL	
Vinyl chloride	BDL		BDL		BDL	
Bromomethane	BDL		1.4		BDL	
Chloroethane	BDL		BDL		BDL	
Trichlorofluoromethane	BDL		BDL		BDL	
1,1-Dichloroethene	BDL		BDL		BDL	
Methylene Chloride	BDL		BDL		BDL	
trans-1,2-dichloroethene	BDL		BDL		BDL	
1,1-Dichloroethane	BDL		BDL		BDL	
Chloroform	BDL		BDL		BDL	
1,1,1-Trichloroethane	BDL		BDL		BDL	
Carbon tetrachloride	BDL		BDL		BDL	
1,2-Dichloroethane	BDL		BDL		BDL	
Trichloroethene	BDL		BDL		BDL	
2-Chloroethylvinyl Ether	BDL		BDL		BDL	
1,2-Dichloropropane	BDL		BDL		BDL	
Bromodichloromethane	BDL		BDL		BDL	
cis-1,3-Dichloropropene	BDL		BDL		BDL	
trans1,3Dichloropropene	BDL		BDL		BDL	
1,1,2-Trichloroethane	BDL		BDL		BDL	
Tetrachloroethene	BDL		BDL		BDL	
Dibromochloromethane	BDL		BDL		BDL	
Chlorobenzene	BDL		BDL		BDL	
1,1,1,2Tetrachloroethane	BDL		BDL		BDL	
Bromoform	BDL		BDL		BDL	
1,1,2,2Tetrachloroethane	BDL		BDL		BDL	
1,3-Dichlorobenzene	BDL		BDL		BDL	
1,4-Dichlorobenzene	BDL		BDL		BDL	
1,2-Dichlorobenzene	BDL		BDL		BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9505-013 3 Site Name BLDG 1613 1-4

LAB ID.	1796	1797	1798
DATE SAMPLED	05/03/95	05/03/95	05/03/95
DATE ANALYZED	05/05/95	05/05/95	05/05/95
FIELD ID.	1613-8	1613-11	1613-13

METHOD

ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
EPA 601						
Dichlorodifluoromethane	BDL	0.5	BDL	0.5	BDL	0.5
Chloromethane	BDL		BDL		BDL	
Vinyl chloride	BDL		BDL		BDL	
Bromomethane	BDL		BDL		BDL	
Chloroethane	BDL		BDL		BDL	
Trichlorofluoromethane	BDL		BDL		BDL	
1,1-Dichloroethene	BDL		BDL		BDL	
Methylene Chloride	BDL		BDL		BDL	
trans-1,2-dichloroethene	BDL		BDL		1.2	
1,1-Dichloroethane	BDL		BDL		BDL	
Chloroform	BDL		BDL		BDL	
1,1,1-Trichloroethane	BDL		BDL		BDL	
Carbon tetrachloride	BDL		BDL		BDL	
1,2-Dichloroethane	BDL		BDL		BDL	
Trichloroethene	BDL		BDL		36.9	
2-Chloroethylvinyl Ether	BDL		BDL		BDL	
1,2-Dichloropropane	BDL		BDL		BDL	
Bromodichloromethane	BDL		BDL		BDL	
cis-1,3-Dichloropropene	BDL		BDL		BDL	
trans1,3Dichloropropene	BDL		BDL		BDL	
1,1,2-Trichloroethane	BDL		BDL		BDL	
Tetrachloroethene	BDL		BDL		BDL	
Dibromochloromethane	BDL		BDL		BDL	
Chlorobenzene	BDL		BDL		BDL	
1,1,1,2Tetrachloroethane	BDL		BDL		BDL	
Bromoform	BDL		BDL		BDL	
1,1,2,2Tetrachloroethane	BDL		BDL		BDL	
1,3-Dichlorobenzene	BDL		BDL		BDL	
1,4-Dichlorobenzene	BDL		BDL		BDL	
1,2-Dichlorobenzene	BDL		BDL		BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9505-013 4 Site Name BLDG 1613 1-4

LAB ID.	LAB BLANK
DATE SAMPLED	* *
DATE ANALYZED	05/05/95
FIELD ID.	* *

METHOD

ANALYTE	ug/l	pql
EPA 601		
Dichlorodifluoromethane	BDL	0.5
Chloromethane	BDL	
Vinyl chloride	BDL	
Bromomethane	BDL	
Chloroethane	BDL	
Trichlorofluoromethane	BDL	
1,1-Dichloroethene	BDL	
Methylene Chloride	BDL	
trans-1,2-dichloroethene	BDL	
1,1-Dichloroethane	BDL	
Chloroform	BDL	
1,1,1-Trichloroethane	BDL	
Carbon tetrachloride	BDL	
1,2-Dichloroethane	BDL	
Trichloroethene	BDL	
2-Chloroethylvinyl Ether	BDL	
1,2-Dichloropropane	BDL	
Bromodichloromethane	BDL	
cis-1,3-Dichloropropene	BDL	
trans1,3Dichloropropene	BDL	
1,1,2-Trichloroethane	BDL	
Tetrachloroethene	BDL	
Dibromochloromethane	BDL	
Chlorobenzene	BDL	
1,1,1,2Tetrachloroethane	BDL	
Bromoform	BDL	
1,1,2,2Tetrachloroethane	BDL	
1,3-Dichlorobenzene	BDL	
1,4-Dichlorobenzene	BDL	
1,2-Dichlorobenzene	BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9505-013 5 Site Name BLDG 1613 1-4

LAB ID.	1790	1791	1792
DATE SAMPLED	05/03/95	05/03/95	05/03/95
DATE ANALYZED	05/05/95	05/05/95	05/05/95
FIELD ID.	1613-1	1613-2	1613-4

METHOD

ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
EPA 602						
Benzene	BDL	0.5	BDL	0.5	BDL	0.5
Toluene	BDL		BDL		BDL	
Chlorobenzene	BDL		BDL		BDL	
Ethylbenzene	BDL		BDL		BDL	
Xylenes	BDL	1.5	BDL	1.5	BDL	1.5
1,3 Dichlorobenzene	BDL	0.5	BDL	0.5	BDL	0.5
1,4 Dichlorobenzene	BDL		BDL		BDL	
1,2 Dichlorobenzene	BDL		BDL		BDL	

	soil	*water*
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9505-013 6 Site Name BLDG 1613 1-4

LAB ID.	1793	1794	1795
DATE SAMPLED	05/03/95	05/03/95	05/03/95
DATE ANALYZED	05/05/95	05/05/95	05/05/95
FIELD ID.	1613-5	1613-6	1613-7

METHOD

ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
EPA 602						
Benzene	BDL	0.5	BDL	0.5	BDL	0.5
Toluene	BDL		BDL		BDL	
Chlorobenzene	BDL		BDL		BDL	
Ethylbenzene	BDL		BDL		BDL	
Xylenes	BDL	1.5	BDL	1.5	BDL	1.5
1,3 Dichlorobenzene	BDL	0.5	BDL	0.5	BDL	0.5
1,4 Dichlorobenzene	BDL		BDL		BDL	
1,2 Dichlorobenzene	BDL		BDL		BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9505-013 7 Site Name BLDG 1613 1-4

LAB ID.	1796		1797		1798	
DATE SAMPLED	05/03/95		05/03/95		05/03/95	
DATE ANALYZED	05/05/95		05/05/95		05/05/95	
FIELD ID.	1613-8		1613-11		1613-13	

METHOD

ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
EPA 602						
Benzene	BDL	0.5	8.8	0.5	BDL	0.5
Toluene	BDL		4.3		BDL	
Chlorobenzene	BDL		BDL		BDL	
Ethylbenzene	BDL		2.3		BDL	
Xylenes	BDL	1.5	18.9	1.5	BDL	1.5
1,3 Dichlorobenzene	BDL	0.5	BDL	0.5	BDL	0.5
1,4 Dichlorobenzene	BDL		BDL		BDL	
1,2 Dichlorobenzene	BDL		BDL		BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9505-013 8 Site Name BLDG 1613 1-4

LAB ID.	LAB BLANK
DATE SAMPLED	* *
DATE ANALYZED	05/05/95
FIELD ID.	* *

METHOD

ANALYTE	ug/l	pql
EPA 602		
Benzene	BDL	0.5
Toluene	BDL	
Chlorobenzene	BDL	
Ethylbenzene	BDL	
Xylenes	BDL	1.5
1,3 Dichlorobenzene	BDL	0.5
1,4 Dichlorobenzene	BDL	
1,2 Dichlorobenzene	BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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Environmental Laboratories

Geochem (NC #336/SC #99008)
Project#9505-013 9 Site Name BLDG 1613 1-4

LAB ID.	1797	LAB BLANK
DATE SAMPLED	05/03/95	* *
DATE EXTRACTED	05/08/95	05/08/95
FIELD ID.	1613-11	* *

METHOD

ANALYTE	ug/l	pql	ug/l	pql
625 Base/Neutral				
1,2,4-Trichlorobenzene	BDL	10	BDL	10
Bis2Chloroethyl Ether	BDL		BDL	
1,3-Dichlorobenzene	BDL		BDL	
1,4-Dichlorobenzene	BDL		BDL	
1,2-Dichlorobenzene	BDL		BDL	
Bis2ChloroisopropylEthr	BDL		BDL	
Hexachloroethane	BDL		BDL	
n-Nitrosodipropylamine	BDL		BDL	
Nitrobenzene	BDL		BDL	
Isophorone	BDL		BDL	
Bis2ChloroethoxyMethane	BDL		BDL	
Naphthalene	BDL		BDL	
Hexachlorobutadiene	BDL		BDL	
Hexachlorcyclopentadien	BDL		BDL	
2-Chloronaphthalene	BDL		BDL	
Acenaphthylene	BDL		BDL	
Dimethylphthalate	BDL		BDL	
2,6-Dinitrotoluene	BDL		BDL	
Acenaphthene	BDL		BDL	
2,4-Dinitrotoluene	BDL		BDL	
Fluorene	BDL		BDL	
4ChlorophenylPhenylEthe	BDL		BDL	
Diethylphthalate	BDL		BDL	
n-Nitrosodiphenylamine	BDL		BDL	
4-BromophenylPhenylEthe	BDL		BDL	
Hexachlorobenzene	BDL		BDL	

Base Neutrals continued on the following page

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC #336/SC #99008)
Project#9505-013 10 Site Name BLDG 1613 1-4

LAB ID.	1797	LAB BLANK
DATE SAMPLED	05/03/95	* *
DATE EXTRACTED	05/08/95	05/08/95
FIELD ID.	1613-11	* *

METHOD

ANALYTE	ug/l	pql	ug/l	pql
625 B/N Continued				
Anthracene	BDL	10	BDL	10
Phenanthrene	BDL		BDL	
Di-N-Butylphthalate	BDL		BDL	
Fluoranthene	BDL		BDL	
Pyrene	BDL		BDL	
Benzidine	BDL	50	BDL	50
Indeno(1,2,3-cd)Pyrene	BDL	10	BDL	10
Butyl Benzyl Phthalate	BDL	20	BDL	20
Chrysene	BDL	10	BDL	10
Benzo(a)Anthracene	BDL		BDL	
3,3'-Dichlorobenzidine	BDL	20	BDL	20
Bis2EthylhexylPhthalate	BDL	10	18.0	10
Di-N-Octylphthalate	BDL		BDL	
Benzo(b)Fluoranthene	BDL		BDL	
Benzo(k)Fluoranthene	BDL		BDL	
Benzo(a)Pyrene	BDL		BDL	
Dibenz(a,h)Anthracene	BDL		BDL	
Benzo(g,h,i)Perylene	BDL		BDL	
625 Acid Extractables				
2-Chlorophenol	BDL	10	BDL	10
Phenol	BDL		BDL	
2-Nitrophenol	BDL		BDL	
2,4-Dimethylphenol	BDL		BDL	
2,4-Dichlorophenol	BDL		BDL	
4-Chloro-3-Methylphenol	BDL	20	BDL	20
2,4,6-Trichlorophenol	BDL	10	BDL	10
2,4-Dinitrophenol	BDL		BDL	
4-Nitrophenol	BDL	50	BDL	50
4,6-Dinitro-2Methylphen	BDL		BDL	
Pentachlorophenol	BDL		BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.
** * = sample has been blank subtracted.*

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GeoChem, Incorporated
Environmental Laboratories

QUALITY CONTROL RESULTS

METHOD	RECOVERY	METHOD DETECTION LIMIT
625		
Base/Neutrals		
1,4-Dichlorobenzene	69 %	10 ppb
n-Nitroso-di-n-propylamine	73 %	
1,2,4-Trichlorobenzene	82 %	
Acenaphthene	77 %	
2,4-Dinitrotoluene	81 %	
Pyrene	93 %	
Acid Extractables		
Phenol	65 %	10 ppb
2-Chlorophenol	37 %	
4-Chloro-3-methylphenol	97 %	
4-Nitrophenol	47 %	
Pentachlorophenol	59 %	

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QUALITY CONTROL RESULTS

METHOD	RECOVERY	METHOD DETECTION LIMIT
601		
Trichloroethene	89 %	0.5 ppb
1,1,1-Trichloroethane	108 %	
Bromoform	99 %	
602		
Benzene	105 %	0.5 ppb
Toluene	102 %	
Chlorobenzene	101 %	
Ethylbenzene	103 %	
Xylenes	104 %	
1,3-Dichlorobenzene	95 %	
1,4-Dichlorobenzene	110 %	
1,2-Dichlorobenzene	101 %	

REVIEWED BY

REVIEWED BY

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Report To: Teri Piver
RC+A

GeoChem, Incorporated

Environmental Laboratories

2500 Gate Way Centre Blvd., Suite 300
Morrisville, NC 27560

Bill To: RC+A
Wilmington

Chain of Custody Record

508 / 510 Page 1 of 1

PROJECT SITE NUMBER: 94127-F
PO#: 950504-6
GEOCHEM PROJECT #: 9505-013
SITE NAME: BLDG 1613 1-4
DATE DUE: ~~5-10-95~~ 5-17-95
COLLECTED BY (Signature): Tim Lupo
VERBAL/FAX/HARDCOPY

ANALYSES: 601, 602, 625

FIELD SAMPLE ID	TURNAROUND IN DAYS	SAMPLE MATRIX	DATE AND TIME COLLECTED		NO. OF CONTAINERS PER LOCATION	601	602	625								REMARKS	LAB ID NO. (for lab use only)
T613-1	Standard	Ground water	5-3-95	1345	2	✓	✓										1790
T1613-2	↓	↓	↓	1315	2	✓	✓										1791
T1613-4				1510	2	✓	✓										1792
T1613-5				1430	2	✓	✓										1793
T1613-6				1415	2	✓	✓										1794
1613-7				1200	2	✓	✓										1795
T1613-8				1530	2	✓	✓										1796
T1613-11				1445	4	✓	✓	✓									1787
T1613-13	↓	↓	↓	1230	2	✓	✓										1798

REMARKS

RELINQUISHED BY:	DATE	TIME
Tim Lupo	5-4-95	0800

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
K Gaskel	5-4-95	11:15				Raymond Lencioni	5-4-95	~~11:15~~ PM 2:15			

This Chain of Custody is considered a written contract to perform the services requested in the analyses section of this document.

GeoChem, Incorporated

Environmental Laboratories

May 18, 1995

Ms. Teri Piver
Richard Catlin & Assoc.
P. O. Box 10279
Wilmington, NC 28405-3755

Reference: **BLDG 1613 1-4**
94127 F
GCI# 9505-016 (complete)

Dear Ms. Teri Piver:

This is the analytical report for the above referenced project. On May 5, 1995 we received ten ground water samples for analysis. The analytical and quality control results are presented in separate tables for your convenience. Brief summaries of analytical methods employed are as follows. GeoChem analytical reports contain information based strictly on the analysis requested on the chain of custody (COC) accompanying this report. All soil values are calculated using dry weights. Non-target compounds are not identified or quantified. Our clients must request such additional documentation in writing.

EPA method 601

Samples are loaded into a specially designed purging chamber at ambient temperature. Helium is bubbled through the sample. This drives the organics onto a sorbent trap. Once purging has been completed the sorbent column is rapidly heated. This efficiently transfers the organics into the gas chromatograph which separates the components of the sample. The purgeable organics are then detected using a halide specific detector.

GeoChem, Incorporated

Environmental Laboratories

EPA method 602

Samples are loaded into a specially designed purging chamber at ambient temperature. Helium is bubbled through the sample. This drives the organics onto a sorbent trap. Once purging has been completed the sorbent column is rapidly heated. This efficiently transfers the organics into the gas chromatograph which separates the components of the sample. The purgeable organics are then detected using flame ionization and photo ionization detectors.

Semivolatiles EPA 625

This method is used to determine the concentration of semivolatile organic compounds in extracts prepared from waste water and ground water. The components are separated via gas chromatograph and detected using a mass spectrometer. This method can be used to quantify most neutral, acidic, and basic organic compounds that are soluble in methylene chloride.

If there are any technical questions please feel free to call me at 919-460-8093. Thank you for allowing **GEOCHEM** to serve your analytical needs.

Sincerely,

Dean Gokel
President

2500 Gate Way Centre Blvd., Suite 300 • Morrisville, NC 27560
Telephone: 919-460-8093 • FAX: 919-460-0167

GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9505-016 1 Site Name BLDG 1613 1-4

LAB ID.	1801		1802		1803	
DATE SAMPLED	05/04/95		05/04/95		05/03/95	
DATE ANALYZED	05/08/95		05/08/95		05/08/95	
FIELD ID.	1613-3		1613-9		1613-10	

METHOD

ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
EPA 601						
Dichlorodifluoromethane	BDL	0.5	BDL	0.5	BQL	50.0
Chloromethane	BDL		BDL		BQL	
Vinyl chloride	BDL		BDL		BQL	
Bromomethane	BDL		BDL		BQL	
Chloroethane	BDL		BDL		BQL	
Trichlorofluoromethane	BDL		BDL		BQL	
1,1-Dichloroethene	BDL		BDL		BQL	
Methylene Chloride	BDL		BDL		BQL	
trans-1,2-dichloroethene	BDL		1.1		BQL	
1,1-Dichloroethane	BDL		BDL		BQL	
Chloroform	BDL		BDL		BQL	
1,1,1-Trichloroethane	BDL		BDL		BQL	
Carbon tetrachloride	BDL		BDL		BQL	
1,2-Dichloroethane	BDL		BDL		BQL	
Trichloroethene	BDL		31.6		BQL	
2-Chloroethylvinyl Ether	BDL		BDL		BQL	
1,2-Dichloropropane	BDL		BDL		BQL	
Bromodichloromethane	BDL		BDL		BQL	
cis-1,3-Dichloropropene	BDL		BDL		BQL	
trans1,3Dichloropropene	BDL		BDL		BQL	
1,1,2-Trichloroethane	BDL		BDL		BQL	
Tetrachloroethene	BDL		BDL		BQL	
Dibromochloromethane	BDL		BDL		BQL	
Chlorobenzene	BDL		BDL		BQL	
1,1,1,2Tetrachloroethane	BDL		BDL		BQL	
Bromoform	BDL		BDL		BQL	
1,1,2,2Tetrachloroethane	BDL		BDL		BQL	
1,3-Dichlorobenzene	BDL		BDL		BQL	
1,4-Dichlorobenzene	BDL		BDL		BQL	
1,2-Dichlorobenzene	BDL		BDL		BQL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9505-016 2 Site Name BLDG 1613 1-4

LAB ID.	1804		1805		1806	
DATE SAMPLED	05/04/95		05/03/95		05/04/95	
DATE ANALYZED	05/08/95		05/08/95		05/09/95	
FIELD ID.	1613-12		1613-14		1613-15	

METHOD

ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
EPA 601						
Dichlorodifluoromethane	BDL	0.5	BDL	0.5	BDL	0.5
Chloromethane	BDL		BDL		BDL	
Vinyl chloride	BDL		BDL		BDL	
Bromomethane	BDL		BDL		BDL	
Chloroethane	BDL		BDL		BDL	
Trichlorofluoromethane	BDL		BDL		BDL	
1,1-Dichloroethene	BDL		0.7		BDL	
Methylene Chloride	BDL		BDL		BDL	
trans-1,2-dichloroethene	BDL		5.6		BDL	
1,1-Dichloroethane	BDL		BDL		BDL	
Chloroform	BDL		0.8		BDL	
1,1,1-Trichloroethane	BDL		BDL		BDL	
Carbon tetrachloride	BDL		BDL		BDL	
1,2-Dichloroethane	BDL		BDL		BDL	
Trichloroethene	BDL		78.9*		15.7	
2-Chloroethylvinyl Ether	BDL		BDL		BDL	
1,2-Dichloropropane	BDL		BDL		BDL	
Bromodichloromethane	BDL		BDL		BDL	
cis-1,3-Dichloropropene	BDL		BDL		BDL	
trans1,3Dichloropropene	BDL		BDL		BDL	
1,1,2-Trichloroethane	BDL		BDL		BDL	
Tetrachloroethene	BDL		BDL		BDL	
Dibromochloromethane	BDL		BDL		BDL	
Chlorobenzene	BDL		BDL		BDL	
1,1,1,2Tetrachloroethane	BDL		BDL		BDL	
Bromoform	BDL		BDL		BDL	
1,1,2,2Tetrachloroethane	BDL		BDL		BDL	
1,3-Dichlorobenzene	BDL		BDL		BDL	
1,4-Dichlorobenzene	BDL		BDL		BDL	
1,2-Dichlorobenzene	BDL		BDL		BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.
** = exceeds calibration curve >20%. values reported are considered minimum concentrations.*

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Geochem (NC # 336/SC # 99008)
Project#9505-016 3 Site Name BLDG 1613 1-4

LAB ID.	1807	1808	1809
DATE SAMPLED	05/04/95	05/04/95	05/04/95
DATE ANALYZED	05/09/95	05/08/95	05/09/95
FIELD ID.	1613-16	1613-WC	1613-TB

METHOD

ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
EPA 601						
Dichlorodifluoromethane	BDL	0.5	BDL	0.5	BDL	0.5
Chloromethane	BDL		BDL		BDL	
Vinyl chloride	BDL		BDL		BDL	
Bromomethane	BDL		BDL		BDL	
Chloroethane	BDL		BDL		BDL	
Trichlorofluoromethane	BDL		BDL		BDL	
1,1-Dichloroethene	BDL		BDL		BDL	
Methylene Chloride	BDL		BDL		BDL	
trans-1,2-dichloroethene	BDL		BDL		BDL	
1,1-Dichloroethane	BDL		BDL		BDL	
Chloroform	BDL		1.0		BDL	
1,1,1-Trichloroethane	BDL		BDL		BDL	
Carbon tetrachloride	BDL		BDL		BDL	
1,2-Dichloroethane	BDL		BDL		BDL	
Trichloroethene	1.3		0.9		BDL	
2-Chloroethylvinyl Ether	BDL		BDL		BDL	
1,2-Dichloropropane	BDL		BDL		BDL	
Bromodichloromethane	BDL		BDL		BDL	
cis-1,3-Dichloropropene	BDL		BDL		BDL	
trans1,3Dichloropropene	BDL		BDL		BDL	
1,1,2-Trichloroethane	BDL		BDL		BDL	
Tetrachloroethene	BDL		BDL		BDL	
Dibromochloromethane	BDL		BDL		BDL	
Chlorobenzene	BDL		BDL		BDL	
1,1,1,2Tetrachloroethane	BDL		BDL		BDL	
Bromoform	BDL		BDL		BDL	
1,1,2,2Tetrachloroethane	BDL		BDL		BDL	
1,3-Dichlorobenzene	BDL		BDL		BDL	
1,4-Dichlorobenzene	BDL		BDL		BDL	
1,2-Dichlorobenzene	BDL		BDL		BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9505-016 4 Site Name BLDG 1613 1-4

LAB ID.	LAB BLANK
DATE SAMPLED	* *
DATE ANALYZED	05/08/95
FIELD ID.	* *

METHOD

ANALYTE	ug/l	pql
EPA 601		
Dichlorodifluoromethane	BDL	0.5
Chloromethane	BDL	
Vinyl chloride	BDL	
Bromomethane	BDL	
Chloroethane	BDL	
Trichlorofluoromethane	BDL	
1,1-Dichloroethene	BDL	
Methylene Chloride	BDL	
trans-1,2-dichloroethene	BDL	
1,1-Dichloroethane	BDL	
Chloroform	BDL	
1,1,1-Trichloroethane	BDL	
Carbon tetrachloride	BDL	
1,2-Dichloroethane	BDL	
Trichloroethene	BDL	
2-Chloroethylvinyl Ether	BDL	
1,2-Dichloropropane	BDL	
Bromodichloromethane	BDL	
cis-1,3-Dichloropropene	BDL	
trans1,3Dichloropropene	BDL	
1,1,2-Trichloroethane	BDL	
Tetrachloroethene	BDL	
Dibromochloromethane	BDL	
Chlorobenzene	BDL	
1,1,1,2Tetrachloroethane	BDL	
Bromoform	BDL	
1,1,2,2Tetrachloroethane	BDL	
1,3-Dichlorobenzene	BDL	
1,4-Dichlorobenzene	BDL	
1,2-Dichlorobenzene	BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9505-016 5 Site Name BLDG 1613 1-4

LAB ID.	1801		1802		1803	
DATE SAMPLED	05/04/95		05/04/95		05/03/95	
DATE ANALYZED	05/08/95		05/08/95		05/08/95	
FIELD ID.	1613-3		1613-9		1613-10	

METHOD

ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
EPA 602						
Benzene	BDL	0.5	BDL	0.5	804	50.0
Toluene	BDL		BDL		6780*	.
Chlorobenzene	BDL		BDL		BQL	
Ethylbenzene	BDL		BDL		1280	
Xylenes	BDL	1.5	BDL	1.5	9290*	150
1,3 Dichlorobenzene	BDL	0.5	BDL	0.5	BQL	50.0
1,4 Dichlorobenzene	BDL		BDL		BQL	
1,2 Dichlorobenzene	BDL		BDL		BQL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.
** = exceeds calibration curve >20%. values reported are considered mimimum concentrations.*

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Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9505-016 6 Site Name BLDG 1613 1-4

LAB ID.	1804		1805		1806	
DATE SAMPLED	05/04/95		05/03/95		05/04/95	
DATE ANALYZED	05/08/95		05/08/95		05/09/95	
FIELD ID.	1613-12		1613-14		1613-15	
METHOD						
ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
EPA 602						
Benzene	BDL	0.5	BDL	0.5	BDL	0.5
Toluene	BDL		BDL		BDL	
Chlorobenzene	BDL		BDL		BDL	
Ethylbenzene	BDL		BDL		BDL	
Xylenes	BDL	1.5	BDL	1.5	BDL	1.5
1,3 Dichlorobenzene	BDL	0.5	BDL	0.5	BDL	0.5
1,4 Dichlorobenzene	BDL		BDL		BDL	
1,2 Dichlorobenzene	BDL		BDL		BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9505-016 7 Site Name BLDG 1613 1-4

LAB ID.	1807		1808		1809	
DATE SAMPLED	05/04/95		05/04/95		05/04/95	
DATE ANALYZED	05/09/95		05/08/95		05/09/95	
FIELD ID.	1613-16		1613-WC		1613-TB	
METHOD						
ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
EPA 602						
Benzene	5.0	0.5	2.5	0.5	BDL	0.5
Toluene	2.4		18.9		BDL	
Chlorobenzene	BDL		BDL		BDL	
Ethylbenzene	BDL		4.8		BDL	
Xylenes	44.8	1.5	23.1	1.5	BDL	1.5
1,3 Dichlorobenzene	BDL	0.5	BDL	0.5	BDL	0.5
1,4 Dichlorobenzene	BDL		BDL		BDL	
1,2 Dichlorobenzene	BDL		BDL		BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC # 336/SC # 99008)
Project#9505-016 8 Site Name BLDG 1613 1-4

LAB ID.	LAB BLANK
DATE SAMPLED	* *
DATE ANALYZED	05/08/95
FIELD ID.	* *

METHOD

ANALYTE	ug/l	pql
EPA 602		
Benzene	BDL	0.5
Toluene	BDL	
Chlorobenzene	BDL	
Ethylbenzene	BDL	
Xylenes	BDL	1.5
1,3 Dichlorobenzene	BDL	0.5
1,4 Dichlorobenzene	BDL	
1,2 Dichlorobenzene	BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC #336/SC #99008)
Project#9505-016 9 Site Name BLDG 1613 1-4

LAB ID.	1802		1803		1804	
DATE SAMPLED	05/04/95		05/03/95		05/04/95	
DATE EXTRACTED	05/08/95		05/08/95		05/08/95	
FIELD ID.	1613-9		1613-10		1613-12	
METHOD						
ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
625 Base/Neutral						
1,2,4-Trichlorobenzene	BDL	10	BDL	10	BDL	10
Bis2Chloroethyl Ether	BDL		BDL		BDL	
1,3-Dichlorobenzene	BDL		BDL		BDL	
1,4-Dichlorobenzene	BDL		BDL		BDL	
1,2-Dichlorobenzene	BDL		BDL		BDL	
Bis2ChloroisopropylEthr	BDL		BDL		BDL	
Hexachloroethane	BDL		BDL		BDL	
n-Nitrosodipropylamine	BDL		BDL		BDL	
Nitrobenzene	BDL		BDL		BDL	
Isophorone	BDL		BDL		BDL	
Bis2ChloroethoxyMethane	BDL		BDL		BDL	
Naphthalene	BDL		303*		BDL	
Hexachlorobutadiene	BDL		BDL		BDL	
Hexachlorcyclopentadien	BDL		BDL		BDL	
2-Chloronaphthalene	BDL		BDL		BDL	
Acenaphthylene	BDL		BDL		BDL	
Dimethylphthalate	BDL		BDL		BDL	
2,6-Dinitrotoluene	BDL		BDL		BDL	
Acenaphthene	BDL		BDL		BDL	
2,4-Dinitrotoluene	BDL		BDL		BDL	
Fluorene	BDL		BDL		BDL	
4ChlorophenylPhenylEthe	BDL		BDL		BDL	
Diethylphthalate	BDL		BDL		BDL	
n-Nitrosodiphenylamine	BDL		BDL		BDL	
4-BromophenylPhenylEthe	BDL		BDL		BDL	
Hexachlorobenzene	BDL		BDL		BDL	

Base Neutrals continued on the following page

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.
** = exceeds calibration curve >20%. Values reported are considered minimum concentrations.*

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC #336/SC #99008)
Project#9505-016 10 Site Name BLDG 1613 1-4

LAB ID.	1802		1803		1804	
DATE SAMPLED	05/04/95		05/03/95		05/04/95	
DATE EXTRACTED	05/08/95		05/08/95		05/08/95	
FIELD ID.	1613-9		1613-10		1613-12	

METHOD

ANALYTE	ug/l	pql	ug/l	pql	ug/l	pql
625 B/N Continued						
Anthracene	BDL	10	BDL	10	BDL	10
Phenanthrene	BDL		BDL		BDL	
Di-N-Butylphthalate	BDL		BDL		BDL	
Fluoranthene	BDL		BDL		BDL	
Pyrene	BDL		BDL		BDL	
Benzidine	BDL	50	BDL	50	BDL	50
Indeno(1,2,3-cd)Pyrene	BDL	10	BDL	10	BDL	10
Butyl Benzyl Phthalate	BDL	20	BDL	20	BDL	20
Chrysene	BDL	10	BDL	10	BDL	10
Benzo(a)Anthracene	BDL		BDL		BDL	
3,3'-Dichlorobenzidine	BDL	20	BDL	20	BDL	20
Bis2EthylhexylPhthalate	BDL	10	BDL	10	BDL	10
Di-N-Octylphthalate	BDL		BDL		BDL	
Benzo(b)Fluoranthene	BDL		BDL		BDL	
Benzo(k)Fluoranthene	BDL		BDL		BDL	
Benzo(a)Pyrene	BDL		BDL		BDL	
Dibenz(a,h)Anthracene	BDL		BDL		BDL	
Benzo(g,h,i)Perylene	BDL		BDL		BDL	
625 Acid Extractables						
2-Chlorophenol	BDL	10	BDL	10	BDL	10
Phenol	BDL		BDL		BDL	
2-Nitrophenol	BDL		BDL		BDL	
2,4-Dimethylphenol	BDL		BDL		BDL	
2,4-Dichlorophenol	BDL		BDL		BDL	
4-Chloro-3-Methylphenol	BDL	20	BDL	20	BDL	20
2,4,6-Trichlorophenol	BDL	10	BDL	10	BDL	10
2,4-Dinitrophenol	BDL		BDL		BDL	
4-Nitrophenol	BDL	50	BDL	50	BDL	50
4,6-Dinitro-2Methylphen	BDL		BDL		BDL	
Pentachlorophenol	BDL		BDL		BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC #336/SC #99008)
Project#9505-016 11 Site Name BLDG 1613 1-4

LAB ID.	1810	LAB BLANK
DATE SAMPLED	05/03/95	* *
DATE EXTRACTED	05/08/95	05/08/95
FIELD ID.	1613-10DUP	* *

METHOD

ANALYTE	ug/l	pql	ug/l	pql
625 Base/Neutral				
1,2,4-Trichlorobenzene	BDL	10	BDL	10
Bis2Chloroethyl Ether	BDL		BDL	
1,3-Dichlorobenzene	BDL		BDL	
1,4-Dichlorobenzene	BDL		BDL	
1,2-Dichlorobenzene	BDL		BDL	
Bis2ChloroisopropylEthr	BDL		BDL	
Hexachloroethane	BDL		BDL	
n-Nitrosodipropylamine	BDL		BDL	
Nitrobenzene	BDL		BDL	
Isophorone	BDL		BDL	
Bis2ChloroethoxyMethane	BDL		BDL	
Naphthalene	280		BDL	
Hexachlorobutadiene	BDL		BDL	
Hexachlorcyclopentadien	BDL		BDL	
2-Chloronaphthalene	BDL		BDL	
Acenaphthylene	BDL		BDL	
Dimethylphthalate	BDL		BDL	
2,6-Dinitrotoluene	BDL		BDL	
Acenaphthene	BDL		BDL	
2,4-Dinitrotoluene	BDL		BDL	
Fluorene	BDL		BDL	
4ChlorophenylPhenylEthe	BDL		BDL	
Diethylphthalate	BDL		BDL	
n-Nitrosodiphenylamine	BDL		BDL	
4-BromophenylPhenylEthe	BDL		BDL	
Hexachlorobenzene	BDL		BDL	

Base Neutrals continued on the following page

	soil	*water*
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

Geochem (NC #336/SC #99008)
Project#9505-016 12 Site Name BLDG 1613 1-4

LAB ID.	1810	LAB BLANK
DATE SAMPLED	05/03/95	* *
DATE EXTRACTED	05/08/95	05/08/95
FIELD ID.	1613-10DUP	* *

METHOD

ANALYTE	ug/l	pql	ug/l	pql
625 B/N Continued				
Anthracene	BDL	10	BDL	10
Phenanthrene	BDL		BDL	
Di-N-Butylphthalate	BDL		BDL	
Fluoranthene	BDL		BDL	
Pyrene	BDL		BDL	
Benzidine	BDL	50	BDL	50
Indeno(1,2,3-cd)Pyrene	BDL	10	BDL	10
Butyl Benzyl Phthalate	BDL	20	BDL	20
Chrysene	BDL	10	BDL	10
Benzo(a)Anthracene	BDL		BDL	
3,3'-Dichlorobenzidine	BDL	20	BDL	20
Bis2EthylhexylPhthalate	BDL	10	18.0	10
Di-N-Octylphthalate	BDL		BDL	
Benzo(b)Fluoranthene	BDL		BDL	
Benzo(k)Fluoranthene	BDL		BDL	
Benzo(a)Pyrene	BDL		BDL	
Dibenz(a,h)Anthracene	BDL		BDL	
Benzo(g,h,i)Perylene	BDL		BDL	
625 Acid Extractables				
2-Chlorophenol	BDL	10	BDL	10
Phenol	BDL		BDL	
2-Nitrophenol	BDL		BDL	
2,4-Dimethylphenol	BDL		BDL	
2,4-Dichlorophenol	BDL		BDL	
4-Chloro-3-Methylphenol	BDL	20	BDL	20
2,4,6-Trichlorophenol	BDL	10	BDL	10
2,4-Dinitrophenol	BDL		BDL	
4-Nitrophenol	BDL	50	BDL	50
4,6-Dinitro-2Methylphen	BDL		BDL	
Pentachlorophenol	BDL		BDL	

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.
** * = samples have been blank subtracted.*

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GeoChem, Incorporated

Environmental Laboratories

QUALITY CONTROL RESULTS

METHOD	RECOVERY	METHOD DETECTION LIMIT
601		
Trichloroethene	87 %	0.5 ppb
1,1,2-Trichloroethane	112 %	
Bromoform	112 %	
602		
Benzene	96 %	0.5 ppb
Toluene	94 %	
Chlorobenzene	105 %	
Ethylbenzene	95 %	
Xylenes	96 %	
1,3-Dichlorobenzene	85 %	
1,4-Dichlorobenzene	95 %	
1,2-Dichlorobenzene	93 %	

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GeoChem, Incorporated
Environmental Laboratories

QUALITY CONTROL RESULTS

METHOD	RECOVERY	METHOD DETECTION LIMIT
625		
Base/Neutrals		
1,4-Dichlorobenzene	71 %	10 ppb
n-Nitroso-di-n-propylamine	70 %	
1,2,4-Trichlorobenzene	74 %	
Acenaphthene	72 %	
2,4-Dinitrotoluene	68 %	
Pyrene	83 %	
Acid Extractables		
Phenol	67 %	10 ppb
2-Chlorophenol	73 %	
4-Chloro-3-methylphenol	71 %	
4-Nitrophenol	55 %	
Pentachlorophenol	65 %	

REVIEWED BY

Dena J. Barrett

REVIEWED BY

Kevin Bo[illegible]

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Telephone: 919-460-8093 • FAX: 919-460-0167

Report To: Teri Piver
RC+A

GeoChem, Incorporated

Environmental Laboratories

2500 Gate Way Centre Blvd., Suite 300
Morrisville, NC 27560

Bill To: RC+A
Wilmington

Chain of Custody Record

0509 / 0511

PROJECT SITE NUMBER 94127-F | PO# 950505-5 | GEOCHEM PROJECT # 9505-016

SITE NAME BLDG 1613 1-4

DATE DUE ~~5/12/95~~ 5-11-95 / 5/18/95

COLLECTED BY (Signature) Tim Lupo

VERBAL/FAX/HARDCOPY

ANALYSES

FIELD SAMPLE ID	TURNAROUND IN DAYS	SAMPLE MATRIX	DATE AND TIME COLLECTED	NO. OF CONTAINERS PER LOCATION	601	602	625								REMARKS	LAB ID NO. (for lab use only)
1613-3	Standard	GW	5.4.95 1000	2	✓	✓										1801
1613-9	↓	↓	5.4.95 1030	4	✓	✓	✓									1802
1613-10	↓	↓	5.3.95 1315	4	✓	✓	✓									1803
1613-12	↓	↓	5.4.95 1115	4	✓	✓	✓									1804
1613-14	↓	↓	5.3.95 1300	2	✓	✓										1805
1613-15	↓	↓	5.4.95 1230	2	✓	✓										1806
1613-16	↓	↓	5.4.95 1400	2	✓	✓										1807
1613-WC	↓	↓	5.4.95 1415	2	✓	✓										1808
1613-TB	↓	↓	5.4.95 1430	2	✓	✓										1809
1613-10DUP	↓	↓	5.3.95 1315	2		✓									wrong sample container has head space (2)	1810

REMARKS

RELINQUISHED BY:	DATE	TIME
Tim Lupo	5-4-95	1700

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
[illegible signature]	5-5-95	2:45	Bridget Colmeze	5-5	11:55	Ruth Marsh	5/5/95	11:56			

This Chain of Custody is considered a written contract to perform the services requested in the analyses section of this document.

GeoChem, Incorporated

Environmental Laboratories

May 26, 1995

Ms. Teri Piver
Richard Catlin & Assoc.
P.O. Box 10279
Wilmington, NC 28405-3755

Reference: **Bld 1613**
94127-F
GCI# 9505-057 (partial)

Dear Ms. Teri Piver:

This is the analytical report for the above referenced project. On May 19, 1995 we received one soil sample for analysis. The analytical and quality control results are presented in separate tables for your convenience. Brief summaries of analytical methods employed are as follows. GeoChem analytical reports contain information based strictly on the analysis requested on the chain of custody (COC) accompanying this report. All soil values are calculated using dry weights. Non-target compounds are not identified or quantified. Our clients must request such additional documentation in writing.

TPH

Samples are analyzed by following the California U.S.T. manual. This methodology incorporates EPA purge and trap (meth. 5030) techniques for analysis of volatile fuels such as gasoline. Less volatile fuels such as diesel fuel and kerosene must be extracted using solvents prior to analysis (soils are sonicated, meth. 3550). A standard calibration curve is created from the pure fuel of interest. The standards serve two functions; they create a "finger print" pattern for comparisons and they allow the chemist to calculate the concentration of that fuel analyzed for.

If there are any technical questions please feel free to call me at 919-460-8093. Thank you for allowing **GEOCHEM** to serve your analytical needs.

Sincerely,

Dean Gokel
President

2500 Gate Way Centre Blvd., Suite 300 • Morrisville, NC 27560
Telephone: 919-460-8093 • FAX: 919-460-0167

GeoChem, Incorporated

Environmental Laboratories

Geochem (NC #336/SC #99008)
Project#9505-057 1 Site Name Bld 1613

LAB ID.	1990	Lab Blank
DATE SAMPLED	05/17/95	* *
DATE EXTRACTED	05/23/95	05/23/95
FIELD ID.	1613-SC	* *

METHOD

ANALYTE	mg/kg	pql	mg/kg	pql
TPH/diesel	BDL	5.0	BDL	5.0

LAB ID.	1990	Lab Blank
DATE SAMPLED	05/17/95	* *
DATE ANALYZED	05/19/95	05/19/95
FIELD ID.	1613-SC	* *

METHOD

ANALYTE	mg/kg	pql	mg/kg	pql
TPH/gas	BDL	1.0	BDL	1.0

	soil	water
parts per million =	*mg/kg*	*mg/l*
parts per billion =	*ug/kg*	*ug/l*

pql = practical quantitation limit due to matrix effects.
bdl = below method detection limit.
bql = below quantitation limit.

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GeoChem, Incorporated

Environmental Laboratories

QUALITY CONTROL RESULTS

METHOD	RECOVERY	METHOD DETECTION LIMIT
TPH/diesel	94 %	5.0 ppm
TPH/gas	85 %	1.0 ppm

REVIEWED BY

Dena J. Barrett

REVIEWED BY

Kevin R[illegible]

2500 Gate Way Centre Blvd., Suite 300 • Morrisville, NC 27560
Telephone: 919-460-8093 • FAX: 919-460-0167

Report To:
Teri Piner
RC & A

GeoChem, Incorporated

Environmental Laboratories

2500 Gate Way Centre Blvd., Suite 300
Morrisville, NC 27560

Bill To: RC & A
Wilm NC

Chain of Custody Record

0523/0525 Page 1 of 1

PROJECT SITE NUMBER: 94127-F
PO#: 950519-2
SITE NAME: BW 1613
COLLECTED BY (Signature): [illegible]

GEOCHEM PROJECT #: 9505-057
DATE DUE: 5-25-95 / 6-1-95
VERBAL/FAX/HARDCOPY:

ANALYSES: TPH 5030 / TPH 3550 / Pb

FIELD SAMPLE ID	TURNAROUND IN DAYS	SAMPLE MATRIX	DATE AND TIME COLLECTED	NO. OF CONTAINERS PER LOCATION	TPH 5030	TPH 3550	Pb							REMARKS	LAB ID NO. (for lab use only)
1613-SC	NORM	SOIL	5/17/95 1600	1	✓	✓	✓								1990

REMARKS:

RELINQUISHED BY:	DATE	TIME

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME
DEG	5-19-95	11:27	Billie G. Waller	5/19/95	11:27	[illegible]	5-19-95	3:04			

This Chain of Custody is considered a written contract to perform the services requested in the ...

APPENDIX J

ANALYTICAL DATA REVIEW REPORT

Data Management-Jacksonville Lab

All GeoChem SOPs and QA Procedures are applicable to the mobile laboratory.

1) Chemists will run morning standards and MeCl blanks first thing every morning as normal. All blanks, calibration verifications and spikes are faxed to Raleigh as generated.

2) As samples are received and checked-in the corresponding Chain of Custody is faxed to the Raleigh lab immediately.

3) The chemists will analyze the samples as soon as possible (always on the day received unless an extraction is necessary.)

4) The chemists (at the Jacksonville lab) will complete the projects received as soon as possible (within 24-36 hours) and fax the summary data sheets to the Raleigh lab upon completion. The chemist may also be required to fax the results to a client if this agreement is reached between the individual client and Geochem (only acceptable if approved by Dean Gokel).

5) The completed project folders will be brought to Raleigh every Friday afternoon by the chemist from the mobile lab and given to Data Management in order for the hard copy of the report to be issued by the following Tuesday to the client.

Transferring Data from Jacksonville to Raleigh:

1) Every Friday afternoon a chemist will archive the data directories for volatiles and semivolatiles.

2) Then they will transfer the archived file from the volatile computer to the semivolatile computer directory C:\FER.

3) The chemist will then connect the modem to the semivolatile computer and exit the HP-Chem software and enter the Anywhere ver. 4.5 software used to operate the modem.

4) The modem will be left in the HOST mode and fully connected in order for the Raleigh lab to transfer by modem the files for the previous week to the Geochem network in Raleigh.

5) The files will be located in their own directory which will be accessible to the chemists and Quality Assurance Officer through the network at the Raleigh lab.

6) The mobile lab files will be deleted from the network just as all other files on the Geochem network every two months onto a timed backup tape which is kept by Dean Gokel (President) for at least three years.

GeoChem, Incorporated

Environmental Laboratories

QUALITY ASSURANCE PROGRAM PLAN

GENERAL QA/QC PROCEDURES FOR GEOCHEM, INC.
MORRISVILLE ANALYTICAL FACILITY

Prepared by:
Steven Branch
Dean Gokel

Date January 1, 1992

Reviewed and Approved by:

Laboratory Manager	Kevin Behen	(K. Behen)
Quality Assurance Officer	Dean Gokel	(D. Gokel)
Extraction and Inorganic Supervisor	Steven A Branch	(S. Branch)

GeoChem President	Dean Gokel	(D. Gokel)

Revision No. 1
Date: March 7, 1991

CONTENTS

Standard Operating Procedures referenced in this manual are under seperate cover titled GeoChem, Inc. Standard Operating Procedures.

Revision No. 1
Date: March 7, 1991

APPENDIX I
TABLES AND FIGURES

1.0 INTRODUCTION

The purpose of this document is to describe the Quality Assurance Program for all analytical measurements performed by GeoChem Analytical Laboratory. This plan outlines the policies, organization, functional responsibilities, and general procedures designed to ensure that every measurement effort results in valid, defensible data of known quality. For convenience, this plan is presented in the general format prescribed for Quality Assurance Project Plans (EPA Document QAMS-005/80).

GeoChem is dedicated to maintaining a Quality Assurance/Quality Control program which will provide data of known quality with respect to accuracy, precision, completeness, comparability, and representativeness. Although the Laboratory Manager is ultimately responsible for all technical work on projects and for all aspects of the QA/QC program, this responsibility may be delegated to QA/QC Coordinators.

Due to the diversity of GeoChem's technical endeavors, there is no single, all inclusive QA/QC protocol for the various programs. Instead, GeoChem's QA/QC program consists of a centrally-administered effort, coordinated by the QA Officer. Under his direction, specific approaches are implemented for each work assignment. In formulating QA/QC strategies, GeoChem establishes specific data quality objectives for each measurement parameter. These objectives provide the framework for designing an effective QA/QC system which is responsive to the needs of the projects and contracts.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

GeoChem's overall system for generating data of high quality involves integrating both QA and QC activities which may include:

- proper specification of program objectives,
- sufficient analytical performance to meet the program's objectives,
- inspection of resulting product to determine if specifications are met, and
- review of activities to provide for any necessary specification changes.

As the delegated manager of the GeoChem QA program, all efforts expended by the QA Officer are defined as QA functions.

2.1 LABORATORY MANAGER

Lab personnel and office management are responsible for organizing, managing, and directing the project's technical activities as well as for presenting data to the client. Therefore, the Laboratory Manager is ultimately responsible for development, implementation, and documentation of all aspects of the QC program to ensure that data quality objectives are met. For effective management, this responsibility may be shared with designated QC coordinators for specific technical areas and involve day-to-day interactions with the technical staff.

The Laboratory Manager has both QA and QC responsibilities. He has the overall responsibility for managing the GeoChem QA Program by coordination with the QA Officer. The Laboratory Manager makes the final decision(s) on QA related matters.

2.2 QA OFFICER

The QA Officer is responsible for the supervising of QA activities in all phases of analysis, including test/QA plan design, execution, data reduction, and reporting. Thus, he/she is the one who ensures that the overall QC system is operating effectively. Some activities that the QA Officer may perform include:

(1) coordinating preparation of the Quality Assurance Project Plan which documents the project-specific policies, organization, objectives, functional activities, and specific QA/QC procedures to achieve data quality goals or requirements;

(2) conducting an independent performance assessment through QA audits;

(3) reviewing data packages and/or deliverables leaving the lab;

(4) providing a mechanism whereby quality problems may be brought to the attention of the management and assisting in implementing corrective action;

(5) documenting results of all QA/QC activities in reports to GeoChem Management and to clients;

(6) evaluating all external audit reports;

(7) implementing and approving GeoChem Standard Operating Procedures (SOP's);

(8) maintaining a master listing of available GeoChem SOP's;

(9) recommending QA policy changes to the GeoChem Laboratory Manager; and

(10) revising the GeoChem QA Program Plan as required.

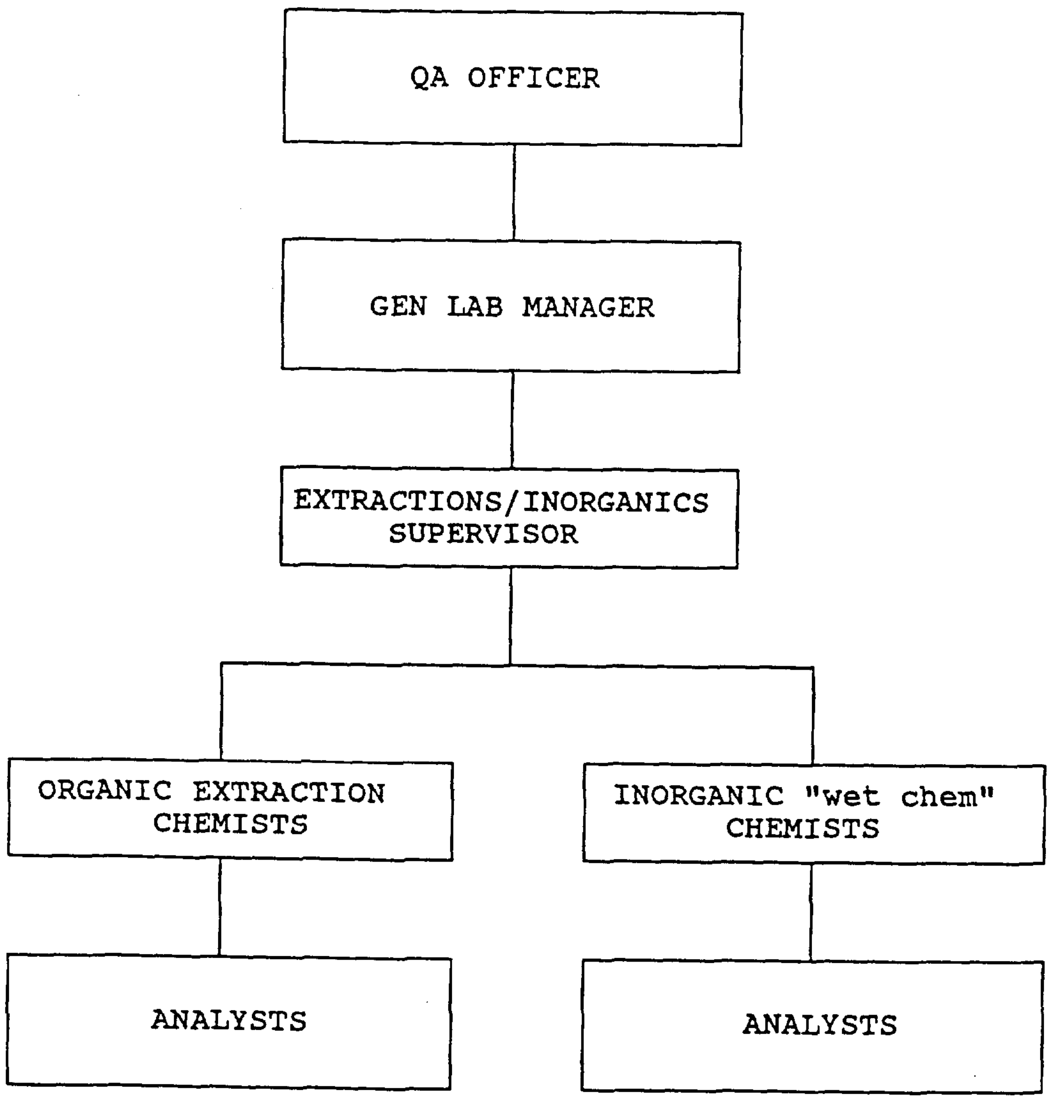

Figure 2.1. Data Quality Program Organization.

3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

GeoChem's corporate comprehensive QA/QC program is designed to assure the accuracy and validity of data collected in all areas of environmental measurements. The primary objective of the QA/QC program is to provide data of known quality with respect to:

- accuracy,
- precision;
- completeness,
- representativeness, and
- comparability.

These data quality indicators are defined as follows:

Accuracy - degree of agreement of a measurement (or an average of measurements of the same thing), X, with an accepted reference or true value, T, usually expressed as the difference between the two values, X-T, or the difference as a percentage of the reference or true value, 100 (X-T)/T, and sometimes expressed as a ratio, X/T. Accuracy is a measure of the bias in a system.

Precision - a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is best expressed in terms of the standard deviation. Various measures of precision exist depending upon the "prescribed similar conditions."

Completeness - a measure of the amount of valid data obtained from a measurement system compared to the amount that was required to be able to meet specified objectives.

Representativeness - the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

Comparability - the confidence with which one data set can be compared to another.

The QA/QC effort for each GeoChem contract is tailored for (1) the nature of the services provided, (2) the client's needs, and (3) the technical objectives of the project. For measurement programs which require routine analyses using standard methods, the QA/QC approach focuses heavily on the control of measurement data quality within the established acceptance limits. However, when programs require the validation or use of a new or modified measurement technique, the QA/QC effort emphasizes the assessment of the method including evaluation and data validation.

When formulating QA/QC strategies, GeoChem establishes specific data quality objectives for each measurement parameter. Table 3-1 is an example summary of several QA objectives for a field testing program. Included are typical objectives for precision, accuracy, and completeness of the measurement data.

All analytical measurements are made so that results are representative of the media and conditions being measured. Unless otherwise specified, all data are reported in units consistent with other organizations reporting similar data so that data bases may be compared at some future time.

TABLE 3-1. EXAMPLE SUMMARY OF QA OBJECTIVES FOR DATA PRECISION, ACCURACY, AND COMPLETENESS

	Parameter	Precision (%)	Accuracy (%)	Completeness (%)
Method 602 (BTEX)	Benzene	+/- 5	+/- 8	90
	Toluene	+/- 6	+/- 3	95
	Ethylbenzene	+/- 3	+/- 5	98
	Total Xylenes	+/- 7	+/- 6	98

$$\text{Accuracy} = \frac{\text{Measured Value - Actual Value}}{\text{Actual Value}} \times 100\%$$

$$\text{Precision} = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100\%$$

Valid data percentage of total tests conducted.

4.0 ANALYTICAL PROCEDURES

GeoChem maintains state-of-the-art analytical facilities which are responsive to a wide variety of environmental measurement programs and applications. Standard reference methods (EPA, ASTM, or NIOSH) are used whenever possible so that measurement data may be compared. Routine analytical procedures are discussed below.

4.1 REAGENTS AND SOLVENTS

For most inorganic analyses, analytical reagent (AR) grade chemicals are used. For other analyses such as trace metals and trace organics, special ultra pure reagents are required. Whenever available, lot analyses of chemicals being purchased are requested by the purchaser and kept on file at the GeoChem laboratory. As a control check, all untested reagents are checked for background contaminants. Additionally, a method blank and standard are prepared and analyzed using both the new and old reagents for comparison. If the new reagent is found to contain interfering substances, the reagent is replaced or purified before use.

All chemical or reagent containers are labeled to indicate the date of receipt and expiration date. Out-of-date reagents are discarded. Chemical/reagent inventories are maintained on a first-in, first-out basis. Reagents and solvents are stored according to the manufacturer's instructions. Light sensitive materials are stored in dark bottles and in a dark place. Labile reagents are stored in refrigerator or freezers, as required, to prevent deterioration or evaporation.

4.2 CHEMICAL STANDARDS

Reagents certified as traceable to the National Bureau of Standards (NBS) are used as primary standards, whenever available. Alternately, standards are prepared from analytical grade chemicals and standardized with NBS standards, if available. In either case, the purity of standards is measured and documented. The EPA quality control standards are used for comparison with internally prepared standards whenever applicable.

All standards purchased for atomic absorption and emission spectroscopy are certified as spectroquality by the vendor. Ultrapure nitric and hydrochloric acids, used to stabilize trace metal standards and to digest samples, may also be prepared by distillation in borosilicate glass.

Organic compounds used as reference standards are assayed and/or purified to meet the required 98 percent or higher purity. Stock solutions of these reference materials are prepared in high-boiling, inert solvent, if possible, to minimize errors due to evaporation or solvent induced decomposition.

4.3 STANDARD OPERATING PROCEDURES

GeoChem Standard Operating Procedures (SOP's) are documented methods for performing certain routine or repetitive tasks, see the Appendix for detailed discussions on each. These tasks involve such operations as instrument or method calibrations, preventive and corrective maintenance, internal quality control, and date reduction and analysis. The format presented in Table 4-1 for GeoChem SOP's is used throughout the laboratory to ensure uniform formatting for easy use and understanding by any user within the laboratory. The SOP's are prepared in document control format and are maintained on file by the QA Officer, the Laboratory Supervisors, and the Laboratory Managers.

4.4 GLASS CLEANING PROCEDURES

The general procedures used by the GeoChem Laboratory for cleaning all glassware are discussed in detail in Appendix II, Standard Glassware Cleaning Procedures (SOP 102).

TABLE 4-1. STANDARD FORMAT FOR GEOCHEM SOPs

Section Number	Title	Items to be Included
1.0	Purpose	Purpose of SOP, scope of procedure, applicability of procedure.
2.0	Apparatus & Materials,	Equipment, instrumentation & expendable materials.
3.0	Reagents	Reagents and standards.
4.0	Procedure	Detailed, step-by-step procedure, with sufficient detail to permit two or more people with an appropriate technical background, without additional information or guidance, to perform the procedure in the same manner and produce virtually identical products or results.
5.0	Documentation	Specific documentation requirements, recommended formats, standardized forms, data sheets, etc.
6.0	Quality Control	Analytical QC procedures (e.q., spikes, blanks, duplicates, etc.), cross-check against reference standards.
7.0	Review and Validation	Review procedures and responsibilities, validation procedures and responsibilities.

5.0 SAMPLE CUSTODY PROCEDURES

A stringent chain-of-custody system is important in assuring the future usefulness of measurement data. A documented, traceable link between any given measurement and the sample and parameter which it is reported to represent are necessary. The chain-of-custody system provides a definitive link between the program results (i.e. data output) and the measurement parameters involved. This documented history represents a legally acceptable record which covers all aspects of the presampling preparation, sample collection, post-sampling handling, storage, and analysis process. This record will originate with the preparation of any sample containers which are used and will indicate "who did what and when" until final disposition of the sample. The custody procedures used will also provide assurance that the integrity of the sample is maintained throughout the course of the collection, handling, and analysis process, i.e. that there is no opportunity for inadvertent contamination, etc.

The types of documentation which are typically associated with environmental measurement programs include:

- dated instrument hardcopy (e.g. strip chart records, chromatograms, etc.);
- field data sheets;
- field notes, dated and initialed;
- analytical data sheets;
- "raw" analytical data, dated and initialed;
- summary data sheets;
- sample logbooks;
- records of maintenance activities;
- records of equipment and apparatus calibration;
- records of audit activities;
- chain-of-custody records; and
- records of deviations from and/or modifications to any measurement protocol.

While all of the above types of documentation together comprise a record of the measurement process, some aspects of this recordkeeping process are discussed in the following sections of this document.

5.1 TRANSFER OF CUSTODY FROM FIELD TO LABORATORY (fig 5.1)

All sample shipments are conveyed to GeoChem's analytic laboratory following the protocol below:

(1) All samples are accompanied by the original chain-of-custody forms which are signed and dated by the transfer and transferee.

(2) The field sampler is responsible for packaging and dispatching samples to the analytical laboratory. The sampler also retains a copy of all chain-of-custody sheets.

(3) All post office receipts and bills of lading are retaine as part of the permanent chain-of-custody documentatior

(4) Upon receipt at GeoChem's analytical laboratory, all samples are placed in the proper storage area.

5.2 ANALYTICAL LABORATORY CUSTODY (fig 5.2)

The following custody procedures are adhered to for al samples received by GeoChem's analytical laboratory:

(1) All incoming sample custody sheets are received, signed and filed by the designated sample custodian.

(2) Upon receipt, all samples are cross-checked with their enclosed chain-of-custody sheets, and checked for damag and/or leaks. Any abnormalities are documented and immediately brought to the attention of the Quality Assurance Officer.

(3) The sample custodian ensures that all samples are properl logged into the laboratory's master sample log and computerized sample tracking system immediately upon receipt.

(4) All samples are stored in a clean, dry, isolated storag room or refrigerator.

(5) Samples are handled by the minimum number of persons possible.

(6) All pertinent information associated with each sample analysis is recorded by the analyst in his designated laboratory notebook. Entries are signed and dated by the analyst. Sample travelers are filled out to accompany sample through laboratory.

(7) Following sample analyses, remaining sample portions are retained in their designated storage area until sample disposal, or upon return to the customer.

All laboratory personnel are responsible for the care and custody of samples received by the laboratory. The laboratory area is maintained as a secured area restricted at all times to authorized personnel.

5.4 COMPUTERIZED PROJECT, SAMPLE AND ANALYSIS TRACKING SYSTEM (fig 5.3)

GeoChem's analytical laboratory has a computer system designed to track and handle information generated by an analytical chemistry laboratory. This system is able to track and control samples by the following basis:

(1) GCI project numbering system; year month -sequential project for that month. Each month starts - 001. Example: 9010-001, the first report for Oct. 1990.

(2) Analysis requested for each sample.

(3) Sample numbering; chronological numbering up to 9999. Once up to 9999 for a year, count restarts at 0001. Each sample number also contains matrix indicated on the chain-of-custody. Example: 2000 soil.

(4) Earliest hold time expiration date.

(5) Date project is required to be completed.

All samples received at GeoChem will be immediately logged into the system.

Report To:

GeoChem, Incorporated

Environmental Laboratories
2500 Gate Way Centre Blvd., Suite 300
Morrisville, NC 27560

Bill To:

Chain of Custody Record

Page ____ of ____

PROJECT SITE		PO#		NO. OF CONTAINERS PER LOCATION	ANALYSES							GeoChem PROJECT #	
SITE NAME												DATE REPORT DUE	
COLLECTED BY (*Signature*)												VERBAL / FAX / HARDCOPY	
FIELD SAMPLE ID	TURNAROUND IN DAYS	SAMPLE MATRIX	DATE COLLECTED									REMARKS	LAB ID NO. (*for lab use only*)

REMARKS									RELINQUISHED BY:		DATE	TIME
RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:		DATE	TIME
RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:		DATE	TIME

This Chain of Custody is considered a written contract to perform the services requested in the analyses section of this document.

Figure 5.1 GeoChem Chain of Custody

(A) Date Receive	(B) GCI #	(C) Site Identification	(D) GCI Sample #	(E) Matrix	(F) Due Date
4-7-90	9004-008		0110	water	4-20-90
4-11-90	9004-009		0111-0114	water	5-1-90
4-11-90	9004-010		0115	air	5-1-90
4-19-90	9004-023		0165-0168	soil	5-2-90

(A) Date that sample was received with completed chain-of-custody. Log book and samples are color coded by month.

(B) Project number assigned by GeoChem for tracking purposes in the laboratory.

(C) Origin of samples taken from chain-of custody including client firm requesting work to be performed.

(D) Laboratory sample number in a sequential numbering system providing a "blind analysis" for lab personnel. Samples are also color coded for ease in sample location in refrigerators.

(E) Physical classification of sample for tracking.

(F) Data that data and complete report due.

Figure 5.2 GeoChem Master Logbook

(A) Project	(B) Analysis	(C) Lab # soil/water	(D) Date Collected	(E) Due
9011-060	btex, mtbe	2000 water	11-21-90	12-13-90
9011-060	fuel #2	2000 water	11-21-90	12-13-90
9011-062	fuel oil	2012 soil	11-21-90	12-13-90
9011-062	pH	2012 soil	11-21-90	12-13-90
9011-062	tclp metals	2012 soil	11-21-90	12-13-90
9011-063	gas	2013 soil	11-21-90	12-13-90

(A) Project number assigned to chain-of-custody when samples are received.

(B) Method of analysis to be performed on sample.

(C) Laboratory sample number assigned to sample when checked in and physical classification of sample.

(D) Date that samples were collected.

(E) Date that completed written report is due to client.

Figure 5.3 GeoChem Computerized
Sample Tracking Sheet

6.0 CALIBRATION PROCEDURES

Information is presented in this section pertaining to the calibration of the analytical systems. Included is a description of typical procedures or a reference to applicable standard operating procedures.

6.1 ANALYTICAL CALIBRATION PROCEDURES

Calibration of an analytical system involves systematic quantitation of the system response to an accepted reference standard for the analyte of interest. The calibration procedures and standards used directly influence the validity of the resulting measurement data. Most standard analytical methods, including EPA, ASTM, and NIOSH methods, specify specific calibration procedures and/or requirements. These standard procedures are followed whenever applicable. When circumstances dictate the use of alternate procedures, or when an analytical technique is used for which there is no single set of "accepted" calibration procedures, a calibration protocol is devised and documented prior to initiation of sample analyses. Detailed calibration procedures are typically documented in a test plan and/or in a Quality Assurance Project Plan.

6.2 TYPICAL INSTRUMENT CALIBRATION TECHNIQUES

The most common type of calibration for analytical instrumentation is some form of multipoint calibration. The multipoint calibration effectively establishes the working range of the method. In order to carry out a regression analysis consistent with a linear function, several different concentrations of the calibration standards should be measured (in duplicate or triplicate for some types of analyses). The concentrations chosen should bracket the expected concentration of the analyte in the field sample. The lowest standard should be at or near the limit of quantitation of the analytical method, and the highest standard usually should have a concentration 10 to 20 times that of the lowest standard.

The data set generated by a multipoint instrument calibration may consist of pairs of values for the calibration concentrations (plotted as X_i) and the instrument responses (Y_i). These data pairs can be plotted and inspected visually for linearity and subsequently analyzed by linear regression techniques. The measured net signal, Y, should be a linear function of the analyte concentration. The equation of the resulting straight line can be expressed as $Y = mX + b$, where m is the slope of the line and b the intercept of the Y axis.

After the calibration curve is plotted and observed to be reasonably linear, the correlation coefficient, slope, and intercept can be calculated, using the method of least squares linear regression analysis. The resulting equation is used to calculate the concentrations of the analyte in the samples analyzed.

The relative variability of analytical measurements decreases as the analyte concentration increases. The three regions of reliability, listed in order of increasing reliability, are the regions of uncertain detection, of detection, and of quantitation.

The limit of detection (LOD) is the lowest concentration of an analyte that the analytical process can reliably detect. The LOD in instrumental methods is based on the relationship between the net signal S_x, resulting from the presence of analyte x, and the variability of the field blank . S_x, in turn, is the difference between the total or gross signal S_t and the blank signal S_b x $S_x = S_t - S_b$.

If field blanks are not available, or if a single sample is being analyzed for which there are no field blank data, then the limit of detection is based on the peak-to-peak noise ( ), measured on the base line closest to the analyte peak.

The limit of detection can be defined in terms of the extent to which the gross signal S_t exceeds the field blank signal S_b.

$$S_x = S_t - S_b > K_b$$

where

As the analyte signal increases, the numerical significance of the apparent analyte concentration also increases, until, at some point clearly above the LOD, the limit of quantitation (LOD) is reached. The LOQ can be defined by the expression:

$$S_t - S_b > K_q$$

GeoChem generally uses minimum values of $K_b = 3$ and $K_q = 10$, as recommended by the ACS Committee on Environmental Improvement. Thus, the LOD is located at 3 and the LOQ at 10 above the gross blank signal S_b.

Signals below 3 should be reported as below detection limit (BDL) with the limit of detection given in parenthesis. Signals in the region of detection between 3 and 10 should be measured and reported as "detected" or with an approximate concentration, e.g., " 0.1 ppm".

7.0 DATA REDUCTION, VALIDATION, AND REPORTING

7.1 DATA REDUCTION

Typically, raw data reduction responsibilities fall upon those who collect or generate the data. The person who performs the analysis usually reduces the raw analytical data to units of concentration at the time of analysis.

Following initial data reduction, data summaries are prepared by the analyst. These data summaries then may be used in the reporting task.

7.2 DATA VALIDATION

Measurement data are typically validated based upon representative process conditions during testing procedures, consistency with expected and/or other results, adherence to prescribed QC procedures, and the specific acceptance criteria. The calibration procedures section and the internal quality control checks section of the applicable Quality Assurance Project Plan define limits of acceptability for calibrations and routine QC procedures (e.g. control samples, replicate analyses, etc.).

Identification of outliers is also a part of the data validation process. An outlier is an unusually large (or small) value in a set of observations. There are many possible reasons for outliers. Among them are:

- faulty instrument or component;
- inaccurate reading of a record, dial, etc.;
- error in transcribing data; or
- calculational errors.

Sometimes analysts or operators can identify outliers by noting the above types of occurrences when they record observations. These faulty observations may then be removed from the data set before it is summarized.

7.3 REPORTING

Written reports are generated in two basic manners. The first type are general correspondence, proposals, form letters etc. The second type of report is generated by GeoChem technical report staff. These people possess the skills required to perform the analytical tests they are reporting. This technical background minimizes reporting errors as far as units, decimal placement etc.

Internal laboratory documentation is vital to defensible data. Permanent laboratory notebooks and laboratory tracking sheets provide the documentation necessary to trace every thing done to a particular sample. Laboratory tracking sheets are filled out for each parameter being tested, these physically accompany the sample throughout the laboratory. Laboratory notebooks serve as permanent records of what has happened in the laboratory, there are separate notebooks for each lab function. See figures 7.1 through 7.8 for inspection of each.

SAMPLE WORKSHEET FOR MASS SPEC

GeoChem Lab No.____________________ Analyst______________________

Field ID No.________________________ Extraction Solvent____________

Date Extracted______________________

Sample Size____________________grams

Surrogate Spike:
Volume Acid_______________mL Volume B/N__________________mL

Compound(s)/Concentration of Spiking Solution_________________

Fractions: Solvent/Final Volume

(1)_____________/___________ Sample in Notebook #_________

(2)_____________/___________

(3)_____________/___________ Notebook Page(s)_____________

(4)_____________/___________

(5)_____________/___________

Comments:____

____

____

File No.__________Date Injected____/___/____ Analyst______________

Sample Dilution:____________mL diluted to____________mL

Internal Standard: Phenanthrene-d_{10} Other____________________

Concentration, ug/mL 20, 50, Other____________________

Comments:____

____

____

Figure 7.1 Sample Tracking Form GC/MS.

SAMPLE WORK SHEET FOR GC

SAMPLE ID	EXTRACTION DATE	GC RUN #
________	______________	________
FINAL VOLUME	**INITIAL SAMPLE AMOUNT**	**SPIKE GC RUN #**
___________	___________________	_____________

EXTRACTION METHOD

LIQUID/LIQUID SONICATION PURGE & TRAP MICRO-VOLATILE

NOTES/CALCULATIONS

Figure 7.2 Sample Tracking Form - GC.

(A) Date	(B) GCI #	(C) Sample ID(s)	(D) Matrix	(E) Extracted	(F) Spike
1/20/90	9011-085	1975-1977	soil	SB	SB
	9011-086	1991, 1992	water	SB	-
1/21/90	9011-088	2010-2018	soil	SB	SB
	9011-090	2036	water	SB	-
	9011-093	2055, 2057	water	SB	SB
________ Supervisor's approval (signed and dated)					

(A) Date sample was extracted.

(B) Project number obtained from Sample Tracking Sheet.

(C) Laboratory sample number assigned when sample was checked in.

(D) Physical classification of sample.

(E) Person performing extraction.

(F) Person responsible for placing spike in sample.

Figure 7.3 GeoChem Extraction Log Book.

(A) (B) (C)

9011-085 Soil Sample for 3550 Method 11-21-90

(E)

	initial wt.	Na_2SO_4 wt.	final vol.	
(D) 1975	50.32 g	25.11 g	2.0 mL	
1976	49.78 g	28.34 g	2.0 mL	
1977	50.16 g	30.01 g	2.0 mL	
matrix spike1976 2.0 ul of 15.2 ug/ul GC-50	50.08 g	27.85 g	2.0 mL	(F) SRB

9011-086 Water Samples for 610 Analysis 11-21-90

	initial vol.	final vol.	
1991	995 mL	2.0 mL	
1992	1000 mL	2.0 mL	SRB

(A) Project number obtained from Sample Tracking Sheet.

(B) Method that was used to extract sample.

(C) Date that extraction was performed.

(D) Laboratory sample number assigned when sample was checked in.

(E) Raw data recorded during extraction.

(F) Person performing extraction.

Figure 7.4 GeoChem Organic Chemistry Notebook.

11-18-90

Performed pH measurement on following samples, after calibration of pH meter with buffers 7.00 +/- 0.01 and 10.00 +/- 0.01.

2048	pH 6.74
2049	pH 5.32
2050	pH 7.04

SRB

Performed fluoride ion analysis on following samples, after calibration of fluoride ion selective electrode with NaF standard prepared 11-16-90.

2150	1.74 ppm
2151	0.91 ppm
2153	1.32 ppm

SRB

Figure 7.5 GeoChem Inorganic Chemistry Notebook.

(A) Date	(B) Run #	(C) Auto Sample	(D) Sample ID	(E) Notes	(F) Method	(G)	(H)
12/8/90	768	1	2232		TPH-diesel	2uL	BAM
12/8/90	769	2	2233		TPH-diesel	2uL	BAM
12/8/90	770	3	2234		TPH-diesel	2uL	BAM
12/8/90	771	4	2235	1:20 dilution	TPH-diesel	2uL	BAM
12/8/90	772	5	2236		TPH-diesel	2uL	BAM
12/8/90	773	6	2237		TPH-diesel	2uL	BAM

(A) Date injection of sample was performed.

(B) Chronological numbering of instrument runs including standards and blanks.

(C) Position sample was located in run sequence.

(D) Laboratory sample number assigned when sample was checked in.

(E) Notes of any abnormalities or observations.

(F) Method of analysis for sample.

(G) The amount of sample that was injected.

(H) Analyst performing sample injection.

Figure 7.6. GeoChem GC injection log.

GC-8 BTEX STOCK @ 10,000 ng/ul
To a 10 ml volumetric flask, added

Benzene	d=0.874	added	114.4 ul
Toluene	d= 0.867	added	115.3 ul
Ethylbenzene	d= 0.867	added	115.3 ul
m-xylene	d= 0.866	added	115.2 ul

diluted to volume with methanol

GC-21 BETX STANDARD @ 50.0 ng/ul
To a 5 ml volumetric flask added

25 ul of GC-8

diluted to volume with methanol

Figure 7.7 GeoChem Organic Standards Prep Notebook.

11-16-90 (C)

(A) Sodium Fluoride stock solution

(B) 221.0 mg of NaF lot # ____________
dissolved in 1.0 L reagent water lot # ____________
1.00 mL = 100 ug F^-

Sodium Fluoride standard solution
Diluted 100 mL of stock NaF
to 1.0 L with reagent water lot # ____________
1.00 mL = 10.0 ug F^-

SRB (D)

11-18-90

(1.0 N) Sodium hydroxide
Dissolved 40.0 g NaOH lot # ____________
in 1.0 L of reagent water lot # ____________

SRB

(E) ____________________ Supervisor's Approval
(signed and dated)

(A) Description of solution that was prepared.

(B) Solution which was prepared.

(C) Raw data including weights, total volume and lot numbers.

(D) Person who prepared solution.

(E) Immediate supervisor of analyst preparing solution.

Figure 7.8. GeoChem Inorganic Standards Preparation Notebook

8.0 INTERNAL QUALITY CONTROL CHECKS

An internal quality control (QC) system is a set of routine internal procedures for measuring and defining the quality of the data output. A well-defined QC program must be capable of controlling and measuring the quality of the data in terms of precision and accuracy. Precision reflects the influence of the inherent variability in any measurement system. Accuracy reflects the degree to which the measured value represents the actual or "true" value for a given parameter, and includes elements of both bias and precision.

Generally, internal QC procedures fall into two categories:

(1) control of data quality, and
(2) quantitative assessment of data quality.

Each assesses data in terms of precision, accuracy, and completeness. Some internal QC procedures, by their nature, fall into both categories.

8.1 TYPES OF SAMPLES USED TO CONTROL AND ASSESS DATA QUALITY

The types of samples which are most often used for both control and assessment of data quality are defined below.

8.1.1 Replicates

A replicate is a sample which has been divided into aliquots (in the field or preparation laboratory) and is carried through the analytical process at different times, by different people and/or using different instruments.

8.1.2 Blanks

8.1.2.A Field Blank. A blank sample has been carried to the sampling site and exposed to sampling conditions (bottle caps removed, etc.), sample preparation, and the measurement system.

8.1.2.B Instrument Blank. The signal derived from a measurement device when no materials other than those normally in the instrument are present while the instrument is cycled through the measurement sequence, i.e., baseline instrument signal level.

8.1.2.C Method Blank. A "clean" sample which has been carried through all steps of the analytical procedures using all reagents, glassware, and equipment used for preparation and measurement.

8.1.2.D Reagent Blank. A sample of chemical reagent used in sample preparation analyzed for contamination.

8.1.2.E Trip Blank. A blank sample which has been carried to the sampling site and transported to the analysis laboratory without being exposed to sampling conditions.

8.1.3 Check Standards

Most methods call for control or check standard analyses at prescribed intervals to verify that the standard curve remains in effect. The standard curve is the result of standardization and is usually presented in the form of an equation or a graph of target parameter versus instrument output.

8.1.4 Matrix Spikes

A matrix spike is a sample which has been spiked in either the field or the laboratory with a known amount of target parameters in order to determine the recovery efficiency of the analytical method and to estimate matrix effects.

8.1.5 Audit Spikes

A sample which contains known quantities of target parameters and is presented to the analytical laboratory disguised as a field sample.

8.1.6 Surrogates

A non-target parameter added to all samples in order to estimate recovery of target parameters. Surrogates are usually compounds which are not normally expected in the matrix being analyzed, but which are expected to mimic target parameters in the analytical method.

8.2 ADDITIONAL DATA QUALITY CONTROL PROCEDURES

The control procedures or checks discussed previously are quantitative. However, other types of QC checks exist which are more qualitative than quantitative. Strict adherence to prescribed measurement protocols falls into this category. Examples of qualitative QC checks include:

- training of personnel,
- preventive maintenance procedures,
- strict calibration procedures,
- strict documentation procedures,
- use of formatted data worksheets,
- strict adherence to Standard Operating Procedures (SOP's),
- consistent data reduction procedures,
- adequate statistical data evaluation, and
- careful data review and validation.

The procedures listed above are often the most important QC checks in terms of overall impact on measurement data quality.

9.0 PERFORMANCE AND SYSTEMS AUDITS

A quality assurance (QA) audit is an independent assessment of a measurement system which typically includes

(1) a performance audit, and,
(2) a systems audit.

The performance audit consists of independently obtaining quantitative data for comparison with routinely obtained data in the measurement system. The performance evaluation is quantitative and is conducted using apparatus and/or standards that are independent of those used for the project. The systems audit is qualitative and consists of an on-site review of a laboratory quality assurance system.

9.1 THE QA OFFICER

The QA Officer designs and may also perform QA performance and systems audits. It is especially important to be able to identify which components of the system are critical to overall data quality. The auditor's technical background and experience should also provide a basis for appropriate audit standard selection, audit design, and data interpretation.

9.2 AUDIT ACTIVITIES

9.2.1 Systems Audit

Generally, the auditor observes and documents the overall procedures and techniques used in the various measurement efforts. This may include a check of the following procedures:

(1) calibration documentation,
(2) adherence to prescribed QC (including SOPs),
(3) document control,
(4) data validation and review,
(5) data storage and filing,
(6) sample logging,
(7) sample custody, and
(8) equipment maintenance.

Checklists which delineate the critical aspects of each methodology are used by the GeoChem auditor during the audit to document all observations.

9.2.2 Performance Audit

Although the systems audit is a qualitative evaluation, the performance audit represents a quantitative assessment of the data quality. Audit standards and test equipment which are traceable to acceptable reference standards are used to assess the performance of each analytical method and/or measurement device. If properly designed, they provide a direct, point-in-time evaluation of the accuracy of the various measurement systems. The key functions of a QA performance audit are to:

(1) challenge the various measurement systems with audit standards,
(2) assess the overall data quality, and
(3) identify and correct any weaknesses in the analytical approach.

9.3 QA AUDIT REPORTS

Upon completion of the audit, the auditor discusses any specific weaknesses with office management and makes recommendations for corrective action. This report outlines the audit approach and presents a summary of results and recommendations.

10.0 PREVENTIVE MAINTENANCE

The primary objective of a comprehensive preventive maintenance program is to help ensure the timely and effective completion of a measurement effort. GeoChem's preventive maintenance program is designed to minimize the down time of crucial sampling and/or analytical equipment due to component failure. Preventive maintenance efforts focus on:

- maintenance responsibilities, and
- maintenance schedules for major and/or critical instrumentation and apparatus.

Each is discussed in detail in the following sections.

10.1 MAINTENANCE RESPONSIBILITIES

Maintenance responsibilities for the laboratory are assigned to the respective laboratory supervisor who then establishes maintenance procedures and schedules for each major piece of equipment. Maintenance responsibilities for as-needed equipment are coordinated through the laboratory manager.

10.2 MAINTENANCE SCHEDULES

The effectiveness of any maintenance program depends to a large extent on adherence to specific maintenance schedules for each major piece of equipment. A schedule is established for all routine maintenance activities. Other maintenance activities are identified on an as-needed basis. Manufacturer's recommendations provide the primary basis for establishing maintenance schedules. Maintenance activities are documented in a maintenance log which indicates the required maintenance frequency and provides for dated entries. An example of a maintenance log format is shown in Figure 11-1.

12-15-90

Changed UHP Helium (He) gas cylinder with full cylinder. KJB

Replaced DB-624 column in gasoline GC with new 30 m DB-624 column. KJB

Replaced septa on Diesel GC before analysis of diesel standard. KJB

Figure 10.1. Example Maintenance Log.

11.0 ASSESSMENT OF DATA PRECISION, ACCURACY, AND COMPLETENESS

Performance audits and QC analyses conducted during an environmental measurement program are designed to provide a quantitative assessment of the data. Two aspects of data quality which are of primary concern are precision and accuracy. As explained in Section 9, precision is a measure of the variability associated with the measurement system. Accuracy reflects the degree to which the measured value represents the actual or "true" value for a given parameter, and includes elements of both bias and precision. Completeness of the data is typically evaluated based upon the valid data percentage of the total number of tests conducted. Each of these aspects of data quality is discussed in the following sections.

11.1 PRECISION

Precision, by the definition presented in the EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume I, Principles (EPA-600/9-76-005), is "a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions." Different measures of precision exist, depending upon these "prescribed similar conditions." GeoChem typically uses the EPA definitions for replicability, repeatability, and reproducibility, taken from the EPA Quality Assurance Handbook referred to above.

Quality control procedures, such as control sample analyses and replicate analyses are the primary mechanism for evaluating measurement data variability, or precision. Replicate analyses are used to define analytical replicability, while results for replicate analyses may be used to define the total variability (replicability) of the sampling/analytical system as a whole. Control sample analyses are typically used to measure day-to-day variability, or repeatability. Reproducibility data consist primarily of results from interlaboratory comparisons and/or method comparisons. Using special techniques such as nested sampling and analysis design and analysis of variance techniques, the relative influence of different sources of variability may be individually measured. (Nested designs are designs in which some factors (i.e., variability sources) are subsamples of other factors.)

11.1.1 Measures of Dispersion/Variability

Two commonly used summary statistics for measuring dispersion or variability are the standard deviation and the range.

11.1.1.A Standard Deviation. The standard deviation is a measure of the average distance of individual observations from the mean. It is usually denoted s and defined as:

where n is the sample size,
X_i is the ith observation in the sample, and
X is the sample mean.

11.1.1.B Range. The range is the largest observation in a data set minus the smallest observation in the data set. It is often denoted R.

For samples from a normal distribution, the range can be used to estimate the standard deviation. This is done by dividing the range by a factor denoted d_2. d_2 values for given sample sizes are listed below:

n	d_2
2	1.128
3	1.693
4	2.059
5	2.326
6	2.534
7	2.704
8	2.847
9	2.970
10	3.078
11	3.173
12	3.258

11.1.1.C Coefficient of Variation (CV) and Percent Difference. There are two other commonly used measures of variability which are adjusted for the magnitude of the values in the sample. One is the coefficient of variation (CV), or relative standard deviation, which is defined as:

$$\% \ CV = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100\%$$

The coefficient of variation is used most often when the size of the standard deviation changes with the size of the mean. When individual measurements of CV or standard deviation are combined (pooled) to obtain an overall measure of variability for a given type of analysis or measurement, the following technique may be used:

Pooled CV =

where x_i = CV of data set i (e.g., CV for one duplicate pair, i)

DF_i = degrees of freedom for data set i (k_i - 1)

n = total number of data sets (e.g., total number of duplicate pairs)

k_i = number of data points in set i (e.g., k=2 for duplicates)

i = data set 1, 2, 3 . . . n

The other measure of variability which adjusts for the magnitude of the measured values is percent difference. This measure is used when the sample contains only two observations and is defined as:

$$\%D = \frac{X_1 - X_2}{(X_1 + X_2)/2} \times 100$$

The percent difference is especially useful when duplicate tests are done on sets of samples.

In addition to summary statistics, graphical presentations are often used to illustrate variability.

11.1.1.D <u>Variance and Interquartile Range</u>. Two other measures of variability are used less often but deserve a brief discussion. One is the variance, which is the square of the standard deviation. The other is the interquartile range, defined as the 75th percentile minus the 25th percentile of a data set. (The 75th percentile is the value which has 75 percent of the observations in a data set below it and 25 percent of the observations above it.)

11.2 ACCURACY

Accuracy, according to the EPA definition presented in the Quality Assurance Handbook for Air Pollution Measurement Systems, is "the degree of agreement of a measurement (or an average of measurements of the same thing), with an accepted reference or true value T." In the case of accuracy of individual measurements equates accuracy with bias and precision (i.e., both systematic and random error). On the other hand, accuracy of the average of individual measurements equates accuracy with bias and represents an attempt to quantitate systematic error (bias) independent of random error (precision). Under this approach, a set of measurements could be said to be accurate without being precise. Under the other approach, where individual measurements are considered, precision is a requisite of accuracy since random variability is a component of the total measurement error and does not get "averaged out." The validity, or significance, of the estimate of bias is directly related to the number of individual measurements used to compute the average. It is based on the principle that as the number of individual measurements is increased indefinitely, the same mean, X, approaches a definite value, u. The difference between u and the true value, T, represents the magnitude of the measurement bias, or systematic error. The error in each individual represents this systematic bias plus random error due to imprecision.

11.2.1 Performance Audit Samples

The choice of definitions of accuracy is made based on the specific applications and the meaningfulness of the choice in the context of the application. Regardless of the definition chosen, it is important to remember that performance audit results provide only a point-in-time measure of accuracy and actually reflect only the capability of the system. In most cases, the results provide some insight into the precision, as well as the bias of measurements. These data supplement data generated by the internal QC procedures. Extrapolation of the audit and QC data to actual samples and measurements is the primary mechanism whereby error limits for various measurements may be estimated and the confidence in the measurement data defined.

11.2.2 Control Sample Analyses

Control sample analyses are used to assess measurement bias. While performance audit results represent a point-in-time assessment of measurement error, the average degree of agreement between measured values and actual values for control samples provides a long-term, or average estimate of measurement bias, as well as precision (repeatability).

11.3 COMPLETENESS

Measurement data completeness measures the extent to which the data base resulting from a measurement effort fulfills objectives for the amount of data required. Completeness is typically expressed in the following way:

$$\% \text{ Completeness} = \frac{\text{Amount of Valid Data Collected}}{\text{Total Amount of Data Collected}} \times 100$$

12.0 CORRECTIVE ACTION

During the course of a measurement program, the laboratory manager will initiate corrective action in the event that QC results or QA audit sample results exceed prescribed acceptance limits.

Corrective action for GeoChem's laboratory is categorized as either (1) on-the-spot, or (2) long-term. Both types of corrective action are discussed below. The type of corrective action taken (1 or 2) depends on the nature of the problem.

(1) On-The-Spot. On-the-spot corrective actions are usually immediate in nature and are implemented by the analyst. Whenever possible, such actions are taken as part of the normal operating procedure. Since on-the-spot actions such as instrument recalibration and reanalysis of QC samples are an everyday part of the QA/QC system they are noted only in laboratory notebooks.

(2) Long-Term. Long-term actions are most often identified through standard QC procedures, control charts, and audits. Any problem that cannot be solved by on-the-spot corrective action falls into this category, including problems which require external services (i.e., instrument repair). Long-term action calls for more formal documentation than notation in laboratory notebooks. A "Correction Action Notice" (Figure 13-1) is processed by the person who detected the problem.

GEOCHEM
CORRECTIVE ACTION NOTICE

Date: ____________________

Name of Person Who Identified the Problem: ______________________________

____

Signature: ______________________________

I. Summary of Problem:

II. Recommended Action:

Distribution: Laboratory Manager
Laboratory Supervisor
QA Officer
Project File

Figure 12.1. Corrective Action Notice

Appendix A

Definition and Procedure for the Determination of the Method Detection Limit

The method detection limit (MDL) is defined as the minimum concentration of a substance that can be identified, measured and reported with 99% confidence that the analyte concentration is greater than zero and determined from analysis of a sample in a given matrix containing analyte.

Scope and Application

This procedure is designed for applicability to a wide variety of sample types ranging from reagent (blank) water containing analyte to wastewater containing analyte. The MDL for an analytical procedure may vary as a function of sample type. The procedure requires a complete, specific and well defined analytical method. It is essential that all sample processing steps of the analytical method be included in the determination of the method detection limit.

The MDL obtained by this procedure is used to judge the significance of a single measurement of a future sample.

The MDL procedure was designed for applicability to a broad variety of physical and chemical methods. To accomplish this, the procedure was made device-or instrument-independent.

Procedure

1. Make an estimate of the detection limits using one of the following:

   (a) The concentration value that corresponds to an instrument signal/noise ratio in the range of 2.5 to 5. If the criteria for qualitative identification of the analyte is based upon pattern recognition techniques, the least abundant signal necessary to achieve identification must be considered in making the estimate.
   (b) The concentration value that corresponds to three times the standard deviation of replicate instrumental measurements for the analyte in reagent water.
   (c) The concentration value that corresponds to known instrumental limitations.

It is recognized that the experience of the analyst is important to this process. However, the analyst must include the above considerations in the estimate of the detection limit.

2. Prepare reagent (blank) water that is as free of analyte as possible. Reagent or interference free water is defined as a water sample in which analyte and interferant concentrations are not detected at the method detection limit of each analyte of interest. Interferences are defined as systematic errors in the measured analytical signal of an established procedure caused by the presence of interfering species (interferant). The interferant concentration is presupposed to be normally distributed in representative samples of a given matrix.

3. (a) If the MDL is to be determined in reagent water (blank), prepare a laboratory standard (analyte in reagent water) at a concentration which is at least equal to or in the same concentration range as the estimated MDL. (Recommend between 1 and 5 times the estimated MDL). Proceed to Step 4.

   (b) If the MDL is to be determined in another sample matrix, analyze the sample. If the measured level of the analyte is in the recommended range of one to five times the estimated MDL, proceed to Step 4.

   If the measured concentration of analyte is less than the estimated MDL, add a known amount of analyte to bring the concentration of analyte to between one and five times the MDL. In the case where an interference is co-analyzed with the analyte.

   If the measured level of analyte is greater than five times the estimated MDL, there are two options:

   (1) Obtain another sample of lower level of analyte in sample matrix if possible.

   (2) The sample may be used as is for determining the MDL if the analyte level does not exceed 10 times the MDL of the analyte in reagent water. The variance of the analytical method changes as the analyte concentration increases from the MDL, hence the MDL determined under these circumstances may not truly reflect method variance at lower analyte concentrations.

4. (a) Take a minimum of seven aliquots of the sample to be used to calculate the MDL and process each through the entire analytical method. Make all computations according to the defined method with final results in the method reporting units. If blank measurements are required to calculate the measured level of analyte, obtain separate blank measurements for each sample aliquot analyzed. The average blank measurement is subtracted from the respective sample measurements.

(b) It may be economically and technically desirable to evaluate the estimated MDL before proceeding with 4a. This will: (1) prevent repeating this entire procedure when the costs of analyses are high and (2) insure that the procedure is being conducted at the correct concentration. It is quite possible that an incorrect MDL can be calculated from data obtained at many times the real MDL even though the background concentration of analyte is less than five times the calculated MDL. To insure that the estimate of the MDL is a good estimate, it is necessary to determine that a lower concentration of analyte will not result in a significantly lower MDL. Take two aliquots of the sample to be used to calculate the MDL and process each through the entire method, including blank measurements as described above in 4a. Evaluate these data:

(1) If these measurements indicate the sample is in the desirable range for determining the MDL, take five additional aliquots and proceed. Use all seven measurements to calculate the MDL.

(2) If these measurements indicate the sample is not in the correct range, reestimate the MDL, obtain new sample as in 3 and repeat either 4a or 4b.

5. Calculate the variance (S^2) and standard deviation (S) of the replicate measurements, as follows:

$$S^2 = \frac{1}{n-1}\left[\sum_{i=1}^{n} x_i^2 - \left(\sum_{i=1}^{n} x_i\right)^2 / n\right]$$

$$S = (S^2)^{1/2}$$

where: the x_i, i = 1 to n are the analytical results in the final method reporting units obtained from the n sample aliquots and $\sum_{i=1}^{n} X_i^2$ refers to the sum of the X values from i = 1 to n.

6. (a) Compute the MDL as follows:

$$MDL = T_{(n-1,\ 1-a\ =\ .99)}\ (S)$$

where:

MDL = the method detection

$t_{(n-11,\ 1-a\ =\ .99)}$ = The students' t value appropriate for a 99% confidence level and a standard deviation estimate with n-1 degrees of freedom. See Table.

S = Standard deviation of the replicate analyses.

(b) The 95% confidence limits for the MDL derived in 6a are computed according to the following equations derived from percentiles of the chi square over degrees of freedom distribution (X^2/df) and calculated as follows:

MDL_{LCL} = 0.69 MDL
MDL_{UCL} = 1.92 MDL

where MDL_{LCL} are the lower and upper 95% confidence limits respectively based on seven aliquots.

7. Optional iterative procedure to verify the reasonableness of the estimated MDL and calculated MDL of subsequent MDL determinations.

(a) If this is the initial attempt to compute MDL based on the estimated MDL in Step 1, take the MDL as calculated in Step 6, spike in the matrix at the calculated MDL and proceed through the procedure starting with Step 4.

(b) If the current MDL determination is an iteration of the MDL procedure for which the spiking level does not permit qualitative identification, report the MDL as that concentration between the current spike level and the previous spike level which allows qualitative identification.

(c) If the current MDL determination is an iteration of the MDL procedure and the spiking level allows qualitative identification, use S^2 from the current MDL calculation and S^2 from the previous MDL calculation to compute the F ratio.

$$\text{if } \frac{S^2_A}{S^2_B} < 3.05$$

then compute the pooled standard deviation by the following equation:

$$S_{pooled} = \left[\frac{6S^2_A + 6S^2_B}{12}\right]^{1/2}$$

if $\frac{S^2_A}{S^2_B}$ > 3.05, respike at the last calculated MDL and process the samples through the procedure starting with Step 4.

(d) Use the S_{pooled} as calculated in 7b to compute the final MDL according to the following equation:

$$MDL = 2.681\ (S_{pooled})$$

where 2.681 is equal to $t_{(12,\ 1-a\ =\ .99)}$.

(e) The 95% confidence limits for MDL derived in 7c are computed according to the following equations derived from percentiles of the chi squared over degrees of freedom distribution.

$$MDL_{LCL} = 0.72 \text{ MDL}$$
$$MDL_{UCL} = 1.65 \text{ MDL}$$

where LCL and UCL are the lower and upper 95% confidence limits respectively based on 14 aliquots.

Reporting

The analytical method used must be specifically identified by number or title and the MDL for each analyte expressed in the appropriate method reporting units. If the analytical method permits options which affect the method detection limit, these conditions must be specified with the MDL value. The sample matrix used to determine the MDL must also be identified with the MDL value. Report the mean analyte level with the MDL. If a laboratory standard or a sample that contained a known amount analyte was used for this determination, report the mean recovery, and indicate if the MDL determination was iterated.

If the level of the analyte in the sample matrix exceeds 10 times the MDL of the analyte in reagent water, do not report a value for the MDL.

Reference

Glaser, J.A., Foerst, D.L., McKee, G.D., Quave, S.A. and Budde, W.L., "Trace Analysis for Wastewaters", Environmental Science and Technology, 15, 1426 (1981).

Table of Students' t Values at the 99 Percent Confidence Level

Number of Replicates	Degrees of Freedom (n-1)	$t_{(n-1,\ 1-a\ =\ .99)}$
7	6	3.143
8	7	2.998
9	8	2.896
10	9	2.821
11	10	2.764
16	15	2.602
21	20	2.528
26	25	2.485
31	30	2.457
61	60	2.390
--	--	2.326

PART B

III. PROBLEM RESOLUTION

Date: ______________________

Summary of Corrective Action:

____
(Signature of person responsible for correcting the problem)

Date: ______________________

Distribution: Laboratory Manager
Laboratory Supervisor
QA Officer
Project File

Figure 12.1. (Continued).

13.0 QUALITY ASSURANCE REPORTING

At a minimum, this report includes monthly QC data summaries and test data summaries. Laboratory managers are responsible for submitting these reports to the QA Officer. These status reports address some or all of the following:

- summary of calibration data,
- summary of unscheduled maintenance activities,
- summary of corrective action notices,
- status of any unresolved problems,
- assessment and summary of data completeness, and
- summary of any significant QA/QC problems and recommended and/or implemented solutions not included above.

The QA Officer prepares audit reports following each performance and systems audit which addresses data quality, and the qualitative assessment of overall system performance. This includes a separate QA/QC section which summarizes the audit results, as well as the QC data collected for the period in question.

GeoChem, Incorporated

Environmental Laboratories

EQUIPMENT LIST

MANUFACTURER	MODEL	SERIAL
Milton Roy Co. Spec 21 D	332278	3152138011
Orion 720A pH/mV meter	720A	1175
Paragon Electric Kiln	TNK233	284647
Gallenkamp	100.130M	89/10/576
Glas-Col 1000mL stir mantle	TEM108	238976
Glas-Col 1000mL stir mantle	TEM108	238973
Glas-Col stir control	EMC4	238980
Glas-Col minitrol	PL-312	320042
Glas-Col minitrol	PL-312	319809
Gelman Sciences ZHE	15400	P1234
Gelman Sciences ZHE	15400	P1236
Glas-Col 1000mL mantle	408	1369409
Glas-Col 1000mL mantle	408	1369408
Electrothermal mantle 5L	EM5000/CE	
Nitrate electrode	93-07	
Double junction reference electrode	90-02	
Fluoride/com. fluoride electrode	94-09,96-09	
Oxygen electrode	97-08	
Ross sure-flow electrode	81-72	
Thermolyne stir hot plate	SP46925	469900918321
Thermolyne stir hot plate	SP46925	469900918320
CMS digital conductivity meter		22948
Corning pH meter	M106	4795
Ohaus top loader balance	E400D	3049
Ohaus analytical balance	GA200D	4021
Tekmar sonic disrupter	TM600-2	12415
Sonics & Materials tungston horn	V1A	V01422
Sonics & Materials tungston horn	V1A	V91141
Equatherm environmental incubator	273791	990-003
Lars Lande rotator extractor		
Tekmar auto sampler	14-2962-200	90047023
Tekmar purge & trap	14-2000-0000	90038030
Hewlett Packard integrater	33968	2841A12050
OI Corp - ELCD	4420ELCD	90-165
Hewlett Packard analog digital converter	35900	
Hewlett Packard 5890 series II gas chromatograph		2950A25959
Hewlett Packard 5890 series II gas chromatograph		2950A27461

EQUIPMENT LIST continued

Hewlett Packard laser jet printer	HP33471A	2937J87987
Hewlett Packard computer Vectra/QS/20	D1430A	3029A18593
Tekmar purge & trap	14-2000-0000	90187003
Hewlett Packard integrater	33968	2841P03235
Hewlett Packard gauge controller	59822B	3411
Hewlett Packard mass spectometer	5971A	3022A01250
Hewlett Packard 5890 series II gas chromatograph		3033A30960
Elroy-Somer vacuum pump		3320
Edwards 2 stage vacuum pump	E2M2	33245
Hewlett Packard computer Vectra/QS/20	D1430A	3029A18634
Hewlett Packard color moniter	D1182A	90 25 J42283
Hewlett Packard color moniter	D1182A	90 15 J29875
Hewlett Packard integrater	33968	2841A12046
Equatherm vacuum pump	92308-001	10049001

APPENDIX K

EIGHT HOUR AQUIFER TEST DATA AND CALCULATIONS

PUMPING TEST RESULTS DRAWDOWN INFLUENCE IN FEET BUILDING 1613, USTs 1613 1-4 MARINE CORPS BASE CAMP LEJEUNE, NORTH CAROLINA								
	DEPTH TO WATER (feet)							
ELAPSED TIME (IN HOURS)	**1613-1**	**1613-2**	**1613-3**	**1613-4**	**1613-5**	**1613-6**	**1613-7**	**1613-8**
0	16.02	12.49	13.66	6.10	8.44	16.23	11.42	7.97
1	16.02	--	--	--	--	--	--	--
2	16.00	12.49	--	--	--	--	--	--
3	16.02	--	--	--	--	--	--	--
4	16.02	--	--	--	--	--	--	--
5	16.02	12.49	--	--	--	--	--	--
6	16.02	--	--	--	--	--	--	--
7	16.02	--	--	--	--	--	--	--
8	16.02	12.49	13.63	6.05	8.43	16.20	11.40	7.97
NET INFLUENCE	0.00	0.00	0.03	0.05	0.01	0.03	0.02	0.00

NOTE: An average flow rate of 2.4 gallons per minute was gauged throughout the pumping test.

PUMPING TEST RESULTS DRAWDOWN INFLUENCE IN FEET BUILDING 1613, USTs 1613 1-4 MARINE CORPS BASE CAMP LEJEUNE, NORTH CAROLINA								
	DEPTH TO WATER (feet)							
ELAPSED TIME (IN HOURS)	1613-9	1613-10	1613-11	1613-12	1613-13	1613-14	1613-15	1613-16
0	6.14	16.89	13.44	14.14	13.03	15.94	19.24	15.24
1	--	17.03	--	--	--	16.17	--	25.81
2	--	17.07	--	--	--	16.17	--	25.58
3	--	17.07	--	--	--	16.18	--	25.04
4	--	17.09	--	--	--	16.15	--	24.78
5	--	17.12	--	--	--	16.15	--	24.66
6	--	17.11	--	--	--	16.14	--	24.63
7	--	17.10	--	--	--	16.12	--	24.33
8	6.12	17.09	13.39	14.08	12.99	16.10	19.15	24.66
NET INFLUENCE	0.02	-0.20	0.05	0.06	0.04	-0.16	0.09	-9.42

NOTE: An average flow rate of 2.4 gallons per minute was gauged throughout the pumping test.

YIELD TEST BUILDING 1613, USTs 1613 1-4 PUMPING WELL 1613-16 MARINE CORPS BASE CAMP LEJEUNE, NORTH CAROLINA		
Depth to Water In Feet	**Time In Minutes**	**Flow Rate In Gallons Per Minute**
15.66 (static)	0	0
24.10	20	2

JOB: 91dg 1613 COMPUTED BY: TMP DATE: 5.31.95

DESCRIPTION: Pumping Test Calcs CHECKED BY: DATE:

Calculate Hydraulic Conductivity Utilizing Dupuit* Assumptions

Calculations Assume:

(1) The velocity of the flow is proportional to the tangent of the hydraulic gradient

(2) The flow is horizontal and uniform everywhere in a vertical section

(3) Steady State Conditions have been obtained

$$K = \frac{Q}{\pi(h_2^2 - h_1^2)} \ln \frac{r_2}{r_1}$$

Where: K = Hydraulic Conductivity (ft/day)

Q = Well Discharge (gal/day)

h_1 = Head in well 1613-10 (feet)

h_2 = Head in well 1613-2 (feet)

r_1 = Radius From Pumping Well to Well 1613-14 (feet)

r_2 = Radius From Pumping Well to Well 1613-10 (feet)

JOB: 211. 1162 COMPUTED BY: JMP DATE: 5-31-9-

DESCRIPTION: CHECKED BY: DATE:

Therefore:

$Q = 2.4$ gal/min or 3,456 gal/day

$h_1 = 33.86$ ft (34.06 ft $- 0.20$ ft)

$h_2 = 34.06$ ft (34.06 ft $- 0.0$ ft)

$r_1 = 22$ ft

$r_2 = 178$ ft

$$K = \frac{3{,}456 \text{ gal/day}}{\pi \left((34.06 \text{ ft})^2 - (33.86 \text{ ft})^2 \right)} \ln \frac{22 \text{ ft}}{15 \text{ ft}}$$

$$K = \frac{3{,}456 \text{ gal/day}}{\pi (1160.1 \text{ ft}^2 - 1146.5 \text{ ft}^2)} \ln 1.5$$

$$K = \frac{3{,}456 \text{ gal/day}}{\pi \ (13.6 \text{ ft}^2)} \cdot 0.4$$

$$K = \frac{3{,}456 \text{ gal/day}}{42.7 \text{ ft}^2} \cdot 0.4$$

JOB: Bldg 1613 COMPUTED BY: JMP DATE: 5-31-95

DESCRIPTION: CHECKED BY: DATE:

$K = 80.9 \text{ gal/day/ft}^2 \times 0.4$

$K = 32.36 \text{ gal/day/ft}^2$

$K = 32.36 \frac{gal}{day} \cdot \frac{1}{\cancel{ft^2}} \cdot \frac{ft^3}{7.48 \, gal}$

$K = 4.3 \text{ ft/day}$

Note: No aquiclude was encountered; therefore, the static water column in well 1613-14 (Type III) was used as the aquifer thickness (34.06 ft).