[illegible]

Report

Site Assessment
Tank S781
Midway Park
Marine Corps Base
Camp LeJeune
North Carolina

Contract N62470-90-R-7626

Naval Facilities Engineering Command
Norfolk, Virginia

May 1992

O'BRIEN & GERE

✓

01.06-5/1/92-00269

REPORT

SITE ASSESSMENT
TANK S781
MIDWAY PARK
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA
CONTRACT # N62470-90-R-7626

MAY 1992

PREPARED BY:

O'BRIEN & GERE ENGINEERS, INC.
440 VIKING DRIVE, SUITE 250
VIRGINIA BEACH, VIRGINIA 23452

TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

APPENDICES

EXHIBITS

SECTION 1 - INTRODUCTION

1.01 Purpose and Scope

The objective of this report is to present information that has been gathered regarding any subsurface contamination in the vicinity of Tank S781, located near Building 45 at Midway Park, Marine Corps Base, Camp Lejeune, North Carolina. O'Brien & Gere Engineers, Inc. (OBG) has completed a site investigation which included monitoring well installation, penetrometer probes (hydropunch), soil borings, ground water elevation and free product monitoring, soil and ground water sampling and analysis and in-situ permeability testing. This report presents a Site Assessment, a Risk Assessment and a Remediation Assessment for the study area.

1.02 Site Description

Building 45 at Midway Park is in an enclosed compound which services large machinery for the Marine Corps Base, Camp Lejeune. The compound accommodates several garage-type buildings and storage sheds, a pump house, a small vehicle re-fueling area, and an above ground storage tank with a capacity of approximately 176,000 gallons (Tank S781). Prior to the Marine Base acquisition, pre-1942, the land was owned by Carolina Power and Lighting (CP&L) (formerly known as Tidewater Electric) and used to house a power plant. CP&L still maintains and operates two power plant substations just outside of the compound's fence to the south.

Preliminary site investigations were conducted in November 1990 by Dewberry and Davis. During these investigations five hand augers, five soil borings and two monitoring wells were completed proximal to Tank S781. While the ground water samples did not indicate contaminant levels above method detection limits, three soil samples demonstrated Total Petroleum Hydrocarbon (TPH) concentrations above the action level of 10 ppm. TPH concentrations ranged from below method detection limits to 2200 ppm. The highest concentration (2200 ppm) was found along the suspected vicinity of underground piping from the pump house toward the main building.

SECTION 2 - SITE ASSESSMENT

2.01 Hydrogeology

2.01.1 Subsurface Field Investigation

A subsurface investigation designed to define the site's geologic conditions and delineate the extent of a possible contaminant plume was completed in December 1991. To delineate the vertical and horizontal extent of a possible contaminant plume, fourteen monitoring wells (seven nested pairs), four soil borings and ten penetrometer probes (hydropunches) were completed in the study area.

Site field activities were completed between December 4 and 12, 1991. In accordance with drilling procedures outlined in Appendix E, and under the supervision of an OBG geologist, drilling operations were performed by ATEC Associates, Inc. (ATEC) of Raleigh, N.C. An illustration of the various drill locations is provided as Figure 2.

Initially, two shallow monitoring wells (MW1 and MW3) were installed. These two monitoring wells, in addition to the two wells previously installed, aided in establishing a ground water flow direction. Secondly, ten hydropunches (H1 - H10) were completed in order to provide a preliminary delineation of the horizontal extent of contamination. Finally, the remaining monitoring wells (MW2, 4, 5 - 14), and four soil borings (B1 - B4) were completed in an effort to define the vertical extent of contamination.

To delineate the boundary of a possible dissolved plume, ten hydropunches were installed. Hydropunch installation involved pushing the hydropunch apparatus to approximately four feet below the water table and then retrieving a ground water sample from each sample chamber for field screening and laboratory analysis. Ground water collected from the hydropunch was screened in the field for volatile organics using a photoionization detector (PID).

Monitoring wells were installed in nested pairs, comprised of one shallow well and one deep well. Each monitoring well was constructed of 2" I.D., schedule 40 PVC with various lengths of 0.01 slot PVC screen. Shallow wells (odd numbered) were installed to a depth of between 12 and 20 feet below grade depending on the depth of the first encountered ground water. Within three feet of each shallow well a deep monitoring well (even numbered) was emplaced to a depth of between 27 and 30 feet below grade. Appendix A contains well construction diagrams for each well. Soil borings were terminated at the water table. Cuttings generated from drilling activities were contained in 55-gallon drums, labelled, placed on wooden pallets and left at the site for appropriate management by Activity personnel.

Split spoon samples were collected during the drilling of the seven deep wells and the four soil borings. Split spoon sampling occurred continuously from grade to six feet below grade and in five foot intervals thereafter. All soil sampling was conducted under the guidelines of ASTM D-1586. Appendix A contains lithologic descriptions of each soil sample, recorded in the field at the time of collection. The head space of each soil sample was screened for volatile organics with a PID. Two soil samples from each deep well and soil boring were selected for laboratory analysis as discussed in Section 2.02.2.

During installation it is possible that fine grained materials may have inadvertently entered the well. It is necessary to remove these particles; this is accomplished by continuous low yield pumping development. Water generated by each well's development was containerized in 55-gallon drums and transported to an area designated for discharge to an oil/water separator.

Upon the completion of field activities, Robert H. Davis, RLS conducted a survey in order to establish each well's horizontal location and top of casing elevation. All measurements were taken to 0.01 foot accuracy (Exhibit A).

2.01.2 Site Geologic Conditions

Camp Lejeune is situated in the Atlantic Coastal Plain Physiographic Province which, in North Carolina, is characterized by low elevations and limited topographic relief (USGS, 1988). The Camp Lejeune area overlies cretaceous sediments of sands, silts and clays that thicken towards the east and reach a thickness of approximately 2500 feet. The subsurface investigation at Tank S781 involved the upper 30 feet of sediments. Split spoon samples (Appendix A) revealed a subsurface geology characterized by unconsolidated sands, silts and clays. Below the topsoil and the brown, medium to fine grained sand of the uppermost four feet lie at least twenty feet of sands with small amounts of silt and clay which vary in colors from buff to orange, brown and white. At approximately 11 to 19 feet below grade lies a thin lamina of coarse to very coarse sand, which is underlain by gray to greenish-gray medium sands. Figures 4 and 5 present an approximate geologic cross section of the study area.

2.01.3 Aquifer Testing

In-situ permeability tests were conducted on thirteen of the fourteen wells (MW2 - MW14) in order to estimate the hydraulic permeability (or conductivity). The test was unable to be completed at MW1 due to limited ground water available and the presence of fine sands within the well. The performance of the test requires that several gallons of water be removed from each well, creating a potential for flow into the well from the surrounding aquifer. As ground water re-enters the well, liquid levels are measured until the well's static water level is approached. Ground water levels during the tests were measured with an electronic oil/water interface probe. Values of hydraulic conductivity were calculated based on the change in water level versus the change in time using Horselov's formula. Appendix D contains the test data and procedures. Summarization of the calculations appear on Table 2. Using this method the geometric mean for hydraulic conductivity was calculated to be 39.2 gpd/ft^2.

2.01.4 Ground Water Flow

On two separate occasions ground water elevations were gauged in all of the monitoring wells at the site. Using an electronic oil/water interface probe, ground water was measured to be between

6 and 19 feet below the top of casing, or between 3 and 5 feet above mean sea level (AMSL). Using the elevational data summarized on Table 1, a ground water contour map was derived. Figure 3 illustrates the ground water flow for December 1991. The measurements obtained on the second monitoring event (January 1992) support this flow direction. The ground water measurements at MW7 were dubious on both monitoring occasions and this measurement was not used when formulating the ground water contour map. Applying an estimated effective porosity of 0.40, and an average hydraulic gradient of 0.002 ft/ft, the ground water appears to be flowing in a north to northwesterly direction at approximately 0.03 ft/day or 10 ft/yr. Ground water elevations, flow direction and local topography all suggest that ground water from the site discharges to Northeast Creek.

2.02 Environmental Assessment

2.02.1 Free Product Characterization

Using an electronic oil/water interface probe, ground water and possible free product were measured in each monitoring well. On two separate occasions all fourteen monitoring wells were gauged and free product was not detected in any of the wells. Ground water samples obtained from the penetrometer probes were also scrutinized for the possible presence of free phased hydrocarbons. None of the ten samples contained free product.

2.02.2 Air Characterization

During all field activities ambient air and sample head space were monitored for volatile organics using a calibrated photoionization detector (PID). At no time did the worker's breathing zone or the ambient air quality exceed 1 ppm.

As each sample, both soil and liquid, was collected the PID was used to monitor the head space. All liquid samples registered below 1 ppm on the PID. All soil samples except those collected from soil boring B4 were also less than 1 ppm. Soil obtained from B4 expressed volatile emissions ranging from 0.2 ppm to 146 ppm.

2.02.3 Soil Characterization

Two soil samples from each soil boring and deep monitoring well were selected for laboratory analysis. At each location a sample from the water table and five feet above the water table were sent to Environmental Testing Services, Inc., in Norfolk, Virginia for analysis of Total Petroleum Hydrocarbons (TPH) (California TPH method). Five water table samples (MW2, MW4, MW6, MW8 and MW12) were also analyzed for flash point (Pensky-Martin closed cup technique) and pH (EPA Method 1.50.1). Two water table samples (MW2 and MW4) were selected for Toxicity Characteristic Leacheate Procedure (TCLP) analysis. Laboratory results are presented in Appendix C.

Concentrations of TPH ranged from 4.32 mg/kg to 12,000 mg/kg. The highest concentrations were found in soils obtained from MW4 (255 mg/kg) and B4 (12,000 mg/kg). Both locations are proximal to and directly downgradient of Tank S781.

Flash point testing on five soil samples was negative at the maximum temperature tested (110°C). TCLP testing demonstrated non-detectable values for all of the forty substances analyzed.

2.02.4 Ground Water Characterization

Between December 6 and 12, 1991 ground water samples were collected from each monitoring well and hydropunch location. Hydropunch sampling was accomplished by the methods previously described in Section 2.01.1. Ground water samples from each monitoring well were obtained by using a stainless steel bailer and following the procedures dictated in Appendix F. Ground water samples were sent to OBG Laboratories in Syracuse, N.Y. for analysis by EPA methods 8010, 8020, 8100 and TCLP. EPA 8000 methods (8010, 8020, 8100) are derived from the EPA 600 methods (601, 602, 610, respectively). The two methods apply the same technique and number of parameters. Laboratory results are available for review in Appendix B.

All parameters for analytical methods EPA 8100 and TCLP demonstrated values below method detection limits. Constituents of the EPA 8010 and 8020 methodologies that were found to be above method detection limits were below Ambient Water Quality Criteria.

2.03 Quality Assurance/Quality Control

Throughout field operations steps were taken to maintain quality assurance and quality control (QA/QC). Field instruments such as the PID, pH meter and specific conductivity meter were calibrated on site and daily. The PID was calibrated to 100 ppm isobutylene. Specific conductivity and pH meters were calibrated to standardized solutions.

Sampling equipment was decontaminated by using a series of rinses involving distilled water, non-phosphate detergent, methanol and dilute nitric acid. A rinse blank (field blank) was included in the analysis to confirm the decontamination process effectiveness.

Standard laboratory QA/QC procedures were applied in accordance with the referenced EPA Methods. In addition, trip blanks and duplicate samples were used.

SECTION 3 - RISK ASSESSMENT

3.01 Introduction

This section presents an evaluation of the risk to human health associated with the former operation of an aboveground waste oil storage tank, #S-781, located within the Building 45 compound at the Marine Corps Base (MCB), Camp Lejeune, North Carolina. This risk assessment specifically addresses the risk to human health related to identified environmental contamination in the immediate area of the tank, resulting from the past operation of the tank. The results of this risk assessment are used in developing a corrective action/remedial action strategy, as presented in Section 4 of this report.

The associated field investigation for this project is previously described in Sections 1 and 2 of this report.

This risk assessment has been prepared for the Atlantic Division Naval Facilities Engineering Command. Marine Corps Base, Camp Lejeune will submit this document to the North Carolina Department of Environment, Health and Natural Resources (DEHNR). The DEHNR will then make a determination regarding potential corrective action requirements, as discussed in Section 4 of this report. Criteria discussed and/or used in this risk assessment are drawn from DEHNR and parallel U.S. Environmental Protection Agency (EPA) regulations and/or guidelines, where applicable. This document is consistent with typical goals of performing risk assessments related to environmental contamination. The primary guidance document applied is the EPA's "Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual". As such, it analyzes potential site-related acute and chronic health risks presented to on-site and off-site receptors, under both current and future use scenarios.

3.02 Site-Specific Descriptive Information

3.02.1 History

The 176,000 gallon capacity storage tank was originally owned and operated by Tidewater Electric, prior to 1942, and was used to store fuel oil. Following the Marine Corp acquisition of the property in 1942, the tank was used to store waste oils, primarily related to diesel engine maintenance and repair. The tank is surrounded by a brick retaining wall, approximately five feet high. Ground level inside the retaining wall slopes downward toward the tank.

The tank was emptied in 1988, according to Tom Morris, Environmental Management Department, MCB Camp Lejeune, N.C. for this project. According to Mr. Morris, approximately eight inches of thick sludge still remains in the bottom of the tank. There is no history of leaks from the tanks. However, Mr. Morris reported that a pump leak occurred, possibly when the tank was emptied. According to Mr. Morris, this leak resulted in excavation of the impacted soils within the surrounding brick wall.

Preliminary site investigations were conducted in November 1990 by Dewberry and Davis. Five hand auger, five soil borings and two monitoring wells were completed in the area of tank S-781. While the ground water samples did not indicate contaminant levels above method detection limits, three soil samples yielded total petroleum hydrocarbon (TPH) concentrations exceeding 10 ppm. TPH concentrations ranged from below method detection limits to 2200 ppm.

3.02.2 Site & Surrounding Area Description

The tank is located adjacent to Building 45, the Base's heavy equipment maintenance and storage building. The tank and Building 45 are located approximately 130 feet southwest of the Camp Lejeune railroad, which parallels a four-lane road (Hwy 24). Residential housing is located on the other side of this road, northeast of the tank. There are no water supply wells within 1500 feet of the site. The area south and west of the tank/Building 45 is undeveloped and wooded. The Building 45 area, including tank S-781 is enclosed by a locked fence. Access is gained only during regular work hours. The fencing to the east runs between the site and the railroad tracks. Surface drainage ditches parallel the railroad, between the fence and the railroad.

The ground cover in the immediate area of the tank is grassy, with some pavement and gravel immediately adjacent to Building 45. The nearest surface water is Northeast Creek, approximately 800 feet to the northwest. There are no water supply wells within 1500 feet of the site. The only utilities servicing the site are above ground electric lines as illustrated on Figure 6. A map of the site is presented as Figure 2.

3.02.3 Demographics

The population at Camp Lejeune includes military personnel and their families, as well as civilian employees. Based on observations made during a site visit, approximately 10 - 20 people are employed at the Building 45 compound, a typical 8-hour/day, 5-day/week job.

3.03 Current Site Data

The site investigation involved the installation, development and sampling of seven shallow monitoring wells and seven deep monitoring wells (as nested pairs; MW1 - MW14), four soil borings (B1 - B4), and ten hydropunches (H1 - H10). These are described in detail in Section 2.01 of this report.

3.03.1 Soil Data

Two soil samples from each of the four soil borings, and two soil samples from each of the seven deep monitoring wells were selected for laboratory analyses for TPH using a gas chromatograph/flame ionization detector (GC-FID). Soil samples were collected at the water table and five feet above the water table. Five soil samples collected from the water table (MW2, MW4, MW6, MW8, and MW12) were analyzed for flash point and pH. Two other soil samples (MW2 and MW4) were selected for full-scan toxicity characteristic leaching procedure (TCLP) analyses.

The pH results ranged from 4.8 to 7.4; flash point tests were negative; the TCLP results were below EPA regulatory criteria for this procedure.

Soil TPH results ranged from 4.3 mg/kg in MW14 (0′ - 2′ depth) to 12,000 mg/kg in B4 (4′ - 6′ depth). Twelve soil samples exceeded 10 mg/kg TPH, as follows:

Sample #	Sample Depth	TPH (mg/kg)
MW2	14′-16′	19
MW2	9′ - 11′	15
MW4	9′ - 11′	15
MW4	14′ - 16′	255
MW6	9′ - 11′	14
MW6	14′ - 16′	13
MW8	11′ - 6′	23
MW10	4′ - 6′	17
MW14	2′ - 4′	11
B1	4′ - 6′	11
B4	4′ - 6′	12,000
B4	9′ - 11′	11,000

3.03.01.1 Soil Data Evaluation

Two sampling locations stand out as having TPH-contaminated soils significantly exceeding 10 mg/kg. These are monitoring well MW4 and soil boring B4. Referencing Figure 2, B4 is located west of the tank, while MW4 is southwest of the tank. Located in the immediate area of B4, MW4 and tank S-781 is a small uncovered, subgrade structure that appears to be a pit or catch basin, and a small building that appears to be the pump house for the tank system. As such, it is reasonable to assume that subsurface piping related to the tank system exists in the area of B4, running between the tank, the pump house, and perhaps the catch basin. MW4 is located perpendicular to the downgradient direction of tank S-781 and B4, approximately 25 feet west of the pump house and catch basin.

In summary, it appears that TPH-soil contamination is present in close proximity to the tank and associated pump house and catch basin, and is likely related to the former operation of tank S-781. Raleigh, N.C. and Jacksonville, N.C. offices of Carolina Power and Light (CP&L) were contacted regarding the operation of tank S781 under the ownership of CP&L (previously named Tidewater Electric), prior to 1942. No historical information on the past operation of the tank was available from CP&L. According to Environmental Management Department, MCB Camp Lejeune, the operation of the tank involved the tank itself, the pump house, lines between the tank and pump house, and lines running from the tank to the building and there are no other sources or avenues for petroleum hydrocarbons at the site. According to Major McLain, Facilities Utilization Officer, in charge of the operations at building 45, there are no other sources or avenues for petroleum hydrocarbons at the site related to tank S781 other than the pump house and building 45. The presence of the TPH materials in soil samples from MW4 and B4 are considered in the exposure pathways, as discussed in subsections 3.05.2, 3.05.4 and 3.05.5.

3.03.2 Ground Water Data

No free product was detected in the fourteen ground water monitoring wells, nor was free product detected in the ten hydropunches.

Ground water samples from each monitoring well and hydropunch were analyzed for volatile organic compounds by SW-846 methods 8010 and 8020 (equivalent to EPA Methods 601 and 602). In addition, samples from MW1, MW7 and MW11 were analyzed by EPA SW-846 method 8100 equivalent to Method 610), (polynuclear aromatic hydrocarbons;

PAHs). Ground water samples from MW3 were analyzed for full scan TCLP compounds. Section 2 of this report provides additional details on the analytical scheme.

TCLP results were below regulatory limits; PAHs results were less than the detection limits.

The 8010/8020 results were below method detection limits, with the exception of the following compounds:

Detected Compound	Sample Number	Results (mg/l)	NC Standard (mg/l)	MCL (mg/l)
chlorobenzene	H5	0.005	0.3	0.1 *
1,2-dichlorobenzene	H8	0.031	0.62	0.6 *
1,3-dichlorobenzene	H5	0.006	0.62	0.6 *
1,4-dichlorobenzene	H5	0.084	0.0018	0.075
1,1-dichloroethane	MW3	0.016 40 proposed	n/a	n/a
"	H1	0.002 .310 mg/l	n/a	n/a
1,1-dichloroethylene	MW4 (dup)	0.002	0.007	0.007
1,2-dichloroethylene	MW4	0.002	n/a	0.07 *
ethylbenzene	MW3	0.016	0.029	0.7 *
toluene	MW12	0.002	1.0	2.0 *
"	H9	0.002	1.0	2.0 *
vinyl chloride	MW4 (dup)	0.002	0.000015	0.002

The NC standards are the water quality standards applicable to the ground waters of North Carolina, as dictated in Title 15, Subchapter 2L, Section 0.0200, of the North Carolina Administrative Code, dated 12/1/89. The standard applies to Class GA waters, which are considered to be drinkable in their natural state (i.e., potable water supplies).

MCL's are the Maximum Contaminant Level allowable for drinking water, under the National Primary Drinking Water Regulations. Those marked with the * indicate proposed limits; all others are final and current limits.

"n/a" indicates that North Carolina has not established a criterion for this chemical.

3.03.02.2 Ground Water Data Evaluation

The following compounds were detected in excess of the North Carolina criteria:

- 1,4-dichlorobenzene (p-dichlorobenzene) in H5
- vinyl chloride, in duplicate sample for MW4.

1,4-dichlorobenzene, detected in H5 at 0.084 mg/l, exceeds the regulatory criteria. This is an isolated occurrence of a compound not typically related to waste diesel oils. Therefore, the 1,4-dichlorobenzene detected in H5 is not likely related to the past operation of tank S-781. However, it is considered in the exposure scenarios, as discussed in subsections 3.05.02, 3.05.03 and 3.05.04.

The vinyl chloride was below detection limits in the other portion of the duplicate sample for MW4. Vinyl chloride detected at 0.002 mg/l is within the federal MCL criterion.

The other organic compounds detected in the ground water samples are within regulatory limits, as presented on the above table. The only exception is 1,1-dichloroethane, for which no regulatory limit has been established to date. < Region III RBC of .810mg/l.

Ground water flow, based on data collected from the seven nested wells, is in a west-northwesterly direction; ground water flow velocity is calculated to be approximately 10 feet/year. It is possible that ground water samples collected during the summer season, rather than the winter season, may reflect different analytical results.

3.03.03 Ambient Air Data

Ambient air quality was monitored during field activities with a photoionizing organic vapor detector (PID) with a 10.2 eV lamp. PID readings were recorded from the breathing zone of the on-site workers and at the ground surface every 15 to 30 minutes. The PID readings did not exceed the detection limit of the PID (1 ppm) at any time during the ambient air monitoring.

3.04 Identification of Chemicals and Media of Concern

Based on the results of the site investigation, as described in the previous section, the environmental contaminants to be considered in the following exposure scenarios are 1,4-dichlorobenzene in the ground water, and TPH in the subsurface soils.

3.05 Risk Assessment Approach

3.05.1 Introduction

This risk assessment addresses the potential for exposure to the ground water and TPH-contaminated subsurface soils in the area of tank #S-781, under current and reasonably anticipated future conditions and site uses. Four potential exposure pathways are considered in assessing potential risk related to the identified contamination: 1) air, 2) surface water, 3) ground water, and 4) soil.

In the analysis of each exposure pathway, three key components are considered:

1. known source;
2. mechanisms for release and medium/vehicle for transport of contaminant(s);
3. potential receptor populations.

If an exposure pathway has these three components, it is considered as a complete exposure pathway. If an exposure pathway lacks one of these necessary components it is concluded that there is no potential for exposure via that incomplete pathway, and therefore no risk. Each pathway is analyzed separately in the following sections. Each analysis includes the following:

1. a description of the waste source;
2. mechanisms for release and transport of contamination in the environment;
3. the time frame of potential releases (i.e., continuous or episodic);
4. the existence of potential receptor populations;
5. potential exposure scenarios;
6. potential uptake routes (ingestion, inhalation, dermal absorption);

Should all of the above be present, it is determined that the exposure pathway is complete, and further quantitative analysis is then made. Exposure point concentrations are estimated, followed by exposure intakes.

Exposure scenarios may include current and future use conditions, children and adult exposures, and both carcinogenic and non-carcinogenic effects of chemicals involved in the exposure, as applicable. The calculated exposure intake is then compared to human-health based reference data, and an assessment of the potential for adverse health effects is then made. Details of this quantitative analysis process are presented for the exposure pathway(s) to which it is applied.

3.05.2 Air Exposure Pathway

Three potential mechanisms for release of identified contamination to the air are considered in assessing risks related to the air exposure pathway:

1) episodic fugitive dust emissions of contaminated soil particulates;
2) continuous emissions of volatile components of soil contamination, through the soil, to the ambient air at the site; and

3) continuous emissions of volatile components of soil contamination, through soils, into subsurface structures at the site.

3.05.2.1 Potential Exposure to Fugitive Dust Emissions

Episodic releases of contaminated fugitive dusts to the general atmosphere would result if contaminated surface and/or subsurface soils were exposed to surface scouring action (e.g., wind, vehicle traffic, foot traffic, heavy equipment operation). The area surrounding B4 and MW4 (the locations of high TPH concentrations) are primarily covered by vegetation (grass and weeds). No surface contamination was visually observed. While contamination was detected between 4 - 16 feet below grade, no analyses on samples from 0 - 4 feet were conducted. Therefore, the potential for surface contamination has been neither confirmed nor negated. Based on the available analytical information, fugitive emissions would require scouring actions on subsurface contaminated soils at least four feet below grade. However, there is at least four feet of cover (vegetative cover preventing erosion) over the detected soil contamination, thus minimizing the potential for regular site activities (foot traffic) to result in scouring actions on subsurface contaminated soils. Based on this information, the potential for fugitive dust emissions in the area is eliminated under current use conditions. It is acknowledged, however, that data limitations exist pertaining to the area of boring B4, with the high TPH concentrations. Data regarding the soils from 0 - 4 feet are not available.

Based on information provided by Tom Morris, there are no plans to alter the study area; uses and operations of the area will not undergo substantial change with respect to land use, operations, or materials in the foreseeable future. Based on this, there is no potential for scouring actions to impact existing contaminated subsurface soils under future anticipated conditions.

3.05.02.2 Potential Exposure to Volatile Emissions in the General Atmosphere

Volatilization involves evaporation of volatile components from contaminated media. Vapors can then migrate up through the soils to release at the soil surface under certain conditions.

The identified ground water contaminant is 1,4-dichlorobenzene. This compound is relatively nonvolatile (vapor pressure of 0.4 mm Hg) and relatively insoluble in water (solubility of 0.008 g/100 g water). Thus, it is expected that 1,4-dichlorobenzene would not volatilize from the ground water, through several feet of soil, to any significant extent.

Based on the available information on the nature of the waste diesel engine oils, such oils may contain trace amounts of volatile organic compounds. Such waste oils were formerly contained in tank #S-781. It can be assumed that the TPH concentrations detected in the soils near the tank indicate the presence of waste oils, and therefore may indicate the potential presence of trace amounts of volatile organic compounds. However, the four feet or more of soil cover would both inhibit and dilute such volatilization, to the extent that the release of such vapors into the general atmosphere would be insignificant. Soil interactions such as adsorption and degradation, as indicated by environmental degradation half-lives, as well as dilution and dispersion actions of ambient air movement, would result in minimal concentrations of such vapors with respect to concern for human exposure. Field monitoring supports this. The ambient air monitoring conducted throughout the field activities, which temporarily disturbed and exposed subsurface soils, indicated that no volatile organic compounds were detected, with a detection limit of 1 ppm in the breathing zone of the workers.

Based on the above discussions, no significant vapor emissions related to subsurface soil contamination are reasonably expected in the area of the tank. Thus, the risk potentially associated with volatile emissions from subsurface soils is negligible.

3.05.02.3 Potential Exposure to Volatile Emissions Released into Subsurface Structures

Building 45 is most likely built on a concrete slab, although Mr. Morris could not confirm this. The catch basin, located just southwest of tank S-781, is a sub-grade structure. The pump house, also located southwest of the tank, is an open, above ground structure. These areas are neither enclosed nor occupied. Based on observations, the pump house area was not used by personnel, nor frequently entered.

In general, there are few subsurface structures at Camp Lejeune, due to the high water table. Therefore, most buildings are constructed on slab. The only likely subsurface items are utility conduits, including piping to/from the tank. Any subsurface piping related to this tank system likely runs between the tank, the pump house, and perhaps the catch basin. Thus, no identified receptor areas exist to complete the end of the transport route. Based on this, the exposure pathway for volatile constituents of site contaminants that might migrate through soils into on-site subsurface structures is incomplete. As such, there is no risk of exposure via this mechanism.

3.05.02.4 Conclusion on Air Exposure Pathway

There is no significant risk of exposure via the air exposure pathway.

3.05.03 Surface Water Exposure Pathway

Two mechanisms for release of identified contamination to surface waters are considered in assessing risks related to the surface water exposure pathway:

1) contamination of surface water by contact with surface contamination; and
2) contamination of surface water by ground water discharge.

There are no identified surface water streams within the study area. The nearest surface water is Northeast Creek, approximately 800 feet to the west (generally downgradient).

3.05.03.1 Potential Exposure to Contaminated Surface Water in Contact with Surface Contamination

There was no observed surface contamination in the immediate area of the tank. As stated above, there are no permanent surface water bodies, including streams, within the study area. As there is no observable surface contamination, nor is there surface water at the study area to serve as either a source or a transport vehicle, this potential exposure pathway is incomplete, and therefore there is no risk associated with this pathway.

3.05.03.2 Potential Exposure to Contaminated Surface Water via Ground Water Discharge

Based on information obtained from this investigation, the following ground water discharge-to-surface water scenario is possible. The ground water flows west-northwesterly; the nearest downgradient surface water body (Northeast Creek) is 800 feet to the west. As such, ground water from the study area would likely flow west-northwesterly via natural migration pathways and discharge to Northeast Creek, over an extended period of time. While ground water might flow with the subsurface conduits or pipes in the area of the tank system, it is unlikely that these pipes lead away from the tank area. The potential for exposures occurring in surface water contaminated by ground water flowing from the Site to Northeast Creek far in the future is beyond both the current and reasonably anticipated future use/conditions scenarios. In addition, 1,4-dichlorobenzene is not readily soluble in water, therefore such transport would be inhibited. Finally, prolonged migration of such a low concentration of 1,4-dichlorobenzene would lead to negligible concentrations over such a distance, due to soil interactions, degradation, etc.

Therefore, the potential impact of site-related ground water on surface water is negligible.

3.05.03.3 Conclusion on Surface Water Exposure Pathway

There is no significant human health risk, based on current and reasonably anticipated future use scenarios, via the surface water pathway.

3.05.04 Ground Water Exposure Pathway

Two mechanisms for release of identified contamination to or through ground waters are considered in assessing risks related to the ground water exposure pathway:

1) Direct withdrawal and use/consumption of contaminated ground water (contamination, as detected, or contamination via leaching from subsurface soils); and

2) Exposure to ground water during subsurface disturbance.

3.05.04.1 Potential Exposure via Contaminated Ground Water Use/ Consumption

There are no identified ground water users. According to Tom Morris, the ground water of the shallow aquifer at Camp Lejeune is not used for human consumption or other operations/purposes which might lead to potential human exposure. Potable ground water use in the area is limited to a deeper aquifer (known as the Castle Hayne aquifer) approximately 150′ below the ground surface. There are no known users/uses of the shallow aquifer (15′ below grade). Thus there is no receptor population.

Based on the lack of a receptor population, this exposure pathway is incomplete, and therefore there is no risk to human health related to use/consumption of the ground water at the tank area.

3.05.04.2 Potential Exposure via Disturbance/Contact with Ground Water

Based on information provided by Tom Morris, there are no current nor anticipated plans to change the use of the study area; i.e., there are no known nor anticipated subsurface disturbance activities to take place in the study area. Therefore, there is no potential for exposure via contact with ground waters.

3.05.04.3 Conclusion on Ground Water Pathway

There is no potential for exposure, and therefore no significant risk related to the ground water exposure pathway.

3.05.05 Soil Exposure (Direct Contact) Pathway

One mechanism for exposure related to identified contamination is considered in assessing risks related to the soil exposure pathway:

1. Direct contact.

Subsurface soil contamination was detected at the site, as listed in Section 3.03.01, at concentrations up to 12,000 mg/kg. Depth of contamination ranged from 4 to 16 feet.

3.05.05.1 Potential Exposure via Direct Contact with Contaminated Subsurface Soils

There is no current nor anticipated disturbance of contaminated subsurface soils (see also discussion in Sections 3.05.02.1 and 3.05.04.3). Thus there is no potential for direct contact with contaminated subsurface soils under current or anticipated future conditions.

In summary, under current and anticipated future conditions, there is no potential for exposure related to direct contact with the contaminated subsurface soils. However, if excavation of soils in the area of B4 were to occur, there is potential for exposure which may involve significant health risk, related to exposure to the contaminated subsurface soils.

3.06 Conclusion

Based on the above assessment, there is no significant risk associated with the TPH-contaminated subsurface soils and ground water contamination (1,4-dichlorobenzene) in the area of tank #S-781, Camp Lejeune, North Carolina.

However, further consideration of the 11,000 - 12,000 mg/kg TPH detected at B4 is reasonable. Such results indicate an area of significant contamination, possibly related to a pipe leak. The subsurface (>4 feet below grade) nature of these soils makes exposure unlikely, and thus a subsequent risk to human health is unlikely. The TPH residues in proximity of this boring to the tank and the catch basin/pump-house area may pose a future health risk if changes in the use of the tank facilities are made (although not currently planned, as stated in previous text). Based on the evolving nature of the regulations involving storage tanks, this is a reasonable consideration. Should plans to grade, remove piping, decommission the tank, etc. be instituted, the issue of TPH contamination in the soils at the immediate area of boring B4 should be re-visited prior to ground-breaking activities. Such subsurface disturbance may pose a health risk, which should be evaluated at that time.

SECTION 4 - REMEDIATION ASSESSMENT

The results of the risk assessment indicate that for the contaminants present in concentrations above North Carolina regulations, there is no significant risk of exposure. The human health exposure risk was evaluated and determined to be insignificant via air, surface water, groundwater, or soil pathways based on both current and future use scenarios.

4.01 Recommendations

While recent laboratory results indicate that the groundwater and soils surrounding the tank pose no risk, the Risk Assessment stated that any excavation or ground-breaking activities in this area may pose a health threat. Should the tank and/or piping be removed, remediation will be necessary. Therefore remediation of the soil in this area will have to be performed at some point.

4.02 Preliminary Evaluation of Remedial Alternatives

Laboratory results indicate that a possible need for soil remediation exists in the vicinity of Tank S781. The following assessment of remedial alternatives focuses on the mitigation of residual petroleum hydrocarbons. Based on the hydrogeologic study, laboratory results and remedial technologies available, the methods discussed below are deemed to be appropriate technologies for consideration by the Navy.

Volatilization

This process removes volatile compounds from the soil by forced or drawn air currents. A system of air injection and extraction pipes are placed over the area of the contaminant plume.

Air is withdrawn from the extraction pipes, treated and allowed to return to the ambient air. Compounds with higher vapor pressure and lower water solubilities are more efficiently removed or stripped. Waste Oil would not be expected to be removed by this method due to its low volatility; therefore this technology is not appropriate for this site.

Soil Leaching

This process is generally used to remove petroleum products that are immobilized in the unsaturated zone. Water is introduced to the soil by either gravity or injection pipes. The water introduced into the soil remobilizes the product and is subsequently recovered and treated. Surfactants are occasionally introduced along with the water to increase the leaching of the soils. Choosing a surfactant requires laboratory testing and evaluation of the surfactant's chemical and environmental properties. Once the surfactant of choice has been introduced to the subsurface and soil abatement has occurred it is then necessary to remove the surfactant from the water. This approach can be costly and has limited potential for remediation at the site.

Containment

Containment is a process by which an area of concern is separated from the surrounding environment thereby minimizing the migration of hydrocarbon compounds. This separation may be accomplished by the installation of cut-off walls. The wall should extend into a stratum of low permeability. Containment prevents further migration of petroleum hydrocarbons but the destruction of compounds is not accomplished. The absence of a confining layer at the site reduces the effectiveness of this technology and thus is not recommended for this site.

Bioremediation

Bioremediation is a process by which the growth and activity of naturally occurring microorganisms are stimulated to degrade the compounds of interest. Stimulation of microbial growth and activity for hydrocarbon removal is accomplished through the addition of oxygen and nutrients. There are several factors that dictate the appropriateness of biodegradation. These include, but are not limited to the following: availability of oxygen and nutrients; type of hydrocarbon present and characteristics of the contaminated soils.

Bioremediation can be implemented in-situ or ex-situ. To implement in-situ biodegradation, wells and infiltration galleries are used to transport oxygen and nutrients to contaminated soils. To implement ex-situ bioremediation, contaminated soil is excavated and placed on treatment pads. The soil is tilled to oxygenate it and nutrients are added periodically to effect the remediation.

Bioremediation can be effective for heavier petroleum products such as waste oil. In-situ bioremediation is most feasible for sites where excavation is inappropriate due to facility operation requirements or excessive volumes. Ex-situ biodegradation generally offers better process control. Both versions of the technology will therefore be retained for further evaluation.

Excavation/Disposal

Excavation is the process by which affected soils are removed from the site for disposal. This technique allows an immediate site clean-up of contaminated soils. Once the soils have been excavated they can be disposed of in an appropriate landfill. However, North Carolina requires treatment to 100 ppm of TPH prior to landfill disposal which could prove costly. While this process could be potentially successful at this site, high costs could be encountered for soil transportation, treatment and replacement. Prior to selecting this approach, borings in the vicinity of the pipeline between Tank S781 and the pump house, would be required to better define the horizontal and vertical boundaries of TPH contamination.

Excavation/Recycle

Excavation of soils for recycling involves the removal of the contaminated materials for use in the manufacturing of items such as bricks. This process operates as follows: Contaminated material is fed into a brick kiln at temperatures exceeding 600°F for two days reaching a peak temperature of 2000°F. Petroleum hydrocarbons are treated through volatilization and incineration. One such company involved in this form of recycling is Cherokee Environmental Group, in Sanford, North Carolina. Before acceptance for processing, a representative soil sample and the results of laboratory analysis must be submitted. Cherokee Sanford Environmental Group will not accept materials classified as hazardous materials under RCRA, CERCLA, or any Federal or North Carolina regulation. Also, wastes containing PCBs above non-detectable (1 ppm) will not be accepted (Miller, 1991). The absence of PCBs in tank sludge (Dewberry Davis, 1991) suggests that this will not be a limitation for management of petroleum-contaminated soils located near B4 and MW4. Therefore, this technology would be considered applicable at this location.

— but we have known PCB problem potential in [illegible] contaminated areas...

Conclusions

The lack of significant ground water contamination suggests that remediation focus on the soil containing residual petroleum product. Although no current, significant risks are identified for the Tank S781 area, subsurface concentrations of TPH in soil are considered unacceptable to the State of North Carolina. Available data suggests that the contamination is localized around the transfer pipeline between the tank and the pump house. However, precise definition of the TPH affected area is not available from the borings and wells installed during this and previous studies. The technical and economic feasibility of excavation and either treatment or off-site disposal cannot be determined without additional definition of the TPH containing soil.

REFERENCES

Dewberry & Davis, January 1991. Technical Memorandum No.2 Results of Field Investigation, Marine Corps Base, Camp Lejeune, North Carolina.

O'Brien & Gere Engineers Inc., July 1988. Contaminated Groundwater Study, Camp Lejeune, North Carolina.

Lloyd, O.Jr. and Daniel, C.III; U.S.Geological Survey, 1988. Water Resources Investigations Report 88-4034.

Tables

O'BRIEN & GERE

TABLE 1
GROUNDWATER ELEVATIONS

Tank S781, Midway Park
Marine Corps Base, Camp Lejeune, North Carolina

Well #	Top of Casing Elevation	Depth to Water 12/91	Groundwater Elevation (AMSL) 12/91	Depth to Water 1/92	Groundwater Elevation (AMSL) 1/92
MW1	22.26	19.01	3.25	17.96	4.30
MW2	22.10	18.85	3.25	17.80	4.30
MW3	18.63	15.42	3.21	14.45	4.18
MW4	18.39	15.29	3.10	14.25	4.14
MW5	19.06	16.00	3.06	14.78	4.28
MW6	18.13	15.10	3.03	13.92	4.21
MW7	8.72	6.50	2.22	5.05	3.67
MW8	8.90	6.74	2.16	5.25	3.65
MW9	12.90	10.74	2.16	9.50	3.40
MW10	12.90	10.76	2.14	9.50	3.40
MW11	19.13	11.75	7.38	9.96	9.17
MW12	19.24	16.02	3.22	14.34	4.90
MW13	8.91	6.84	2.07	5.45	3.46
MW14	8.94	6.90	2.04	5.64	3.30
MW A	14.50	11.26	3.24	10.01	4.49
MW B	13.96	10.67	3.29	9.32	4.64

TABLE 2
IN-SITU PERMEABILITY RESULTS

Tank S781, Midway Park
Marine Corps Base, Camp Lejeune, North Carolina

WELL #	IN-SITU PERMEABILITY	
	FT/SEC	GPD/FT^2
MW1	*	*
MW2	1.3×10^{-4}	84.0
MW3	7.4×10^{-5}	47.7
MW4	4.2×10^{-5}	27.3
MW5	2.8×10^{-4}	180.0
MW6	6.6×10^{-5}	42.4
MW7	1.0×10^{-4}	67.4
MW8	6.8×10^{-5}	44.1
MW9	8.3×10^{-5}	53.7
MW10	1.1×10^{-4}	69.4
MW11	5.7×10^{-6}	3.7
MW12	1.5×10^{-5}	9.5
MW13	5.7×10^{-5}	36.9
MW14	6.7×10^{-5}	43.2

GEOMETRIC MEAN = 6.1×10^{-5} FT/SEC; 39 GPD/FT^2

* Unable to complete test due to difficult field conditions

TABLE 3
pH AND SPECIFIC CONDUCTIVITY MEASUREMENTS

Tank S781, Midway Park
Marine Corps Base, Camp Lejeune, North Carolina

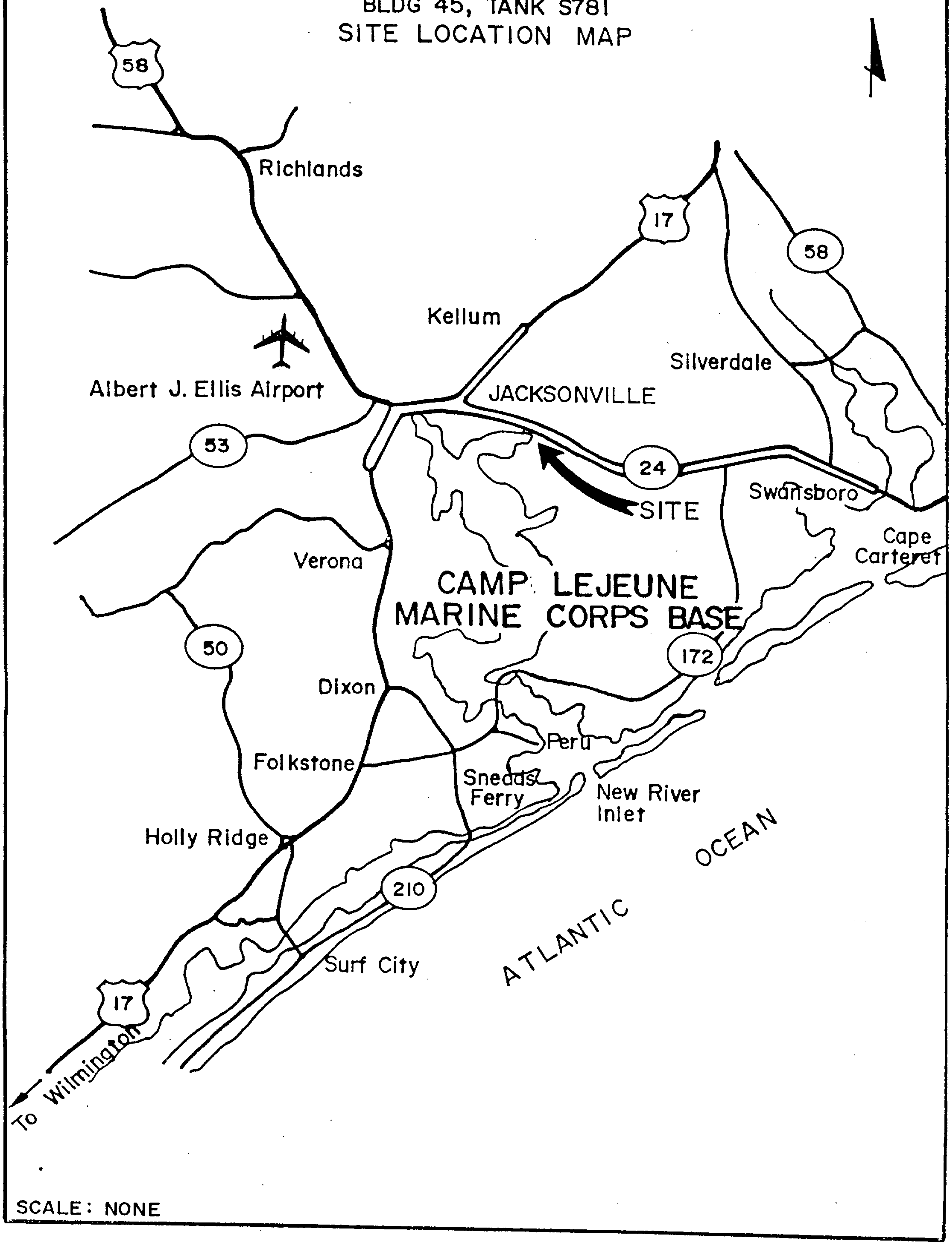
Well #	pH (Standard Units)	Specific Conductivity (uMHOS/Cn)
MW1	7.5	100
MW2	7.5	100
MW3	6.5	700
MW4	6.5	500
MW5	7.5	200
MW6	7.5	100
MW7	6.5	300
MW8	7.0	600
MW9	7.0	300
MW10	7.5	300
MW11	7.0	500
MW12	7.0	200
MW13	6.5	500
MW14	6.5	300

Figures

O'BRIEN & GERE

FIGURE 1

MIDWAY PARK
CAMP LEJEUNE N.C.
BLDG 45, TANK S781
SITE LOCATION MAP



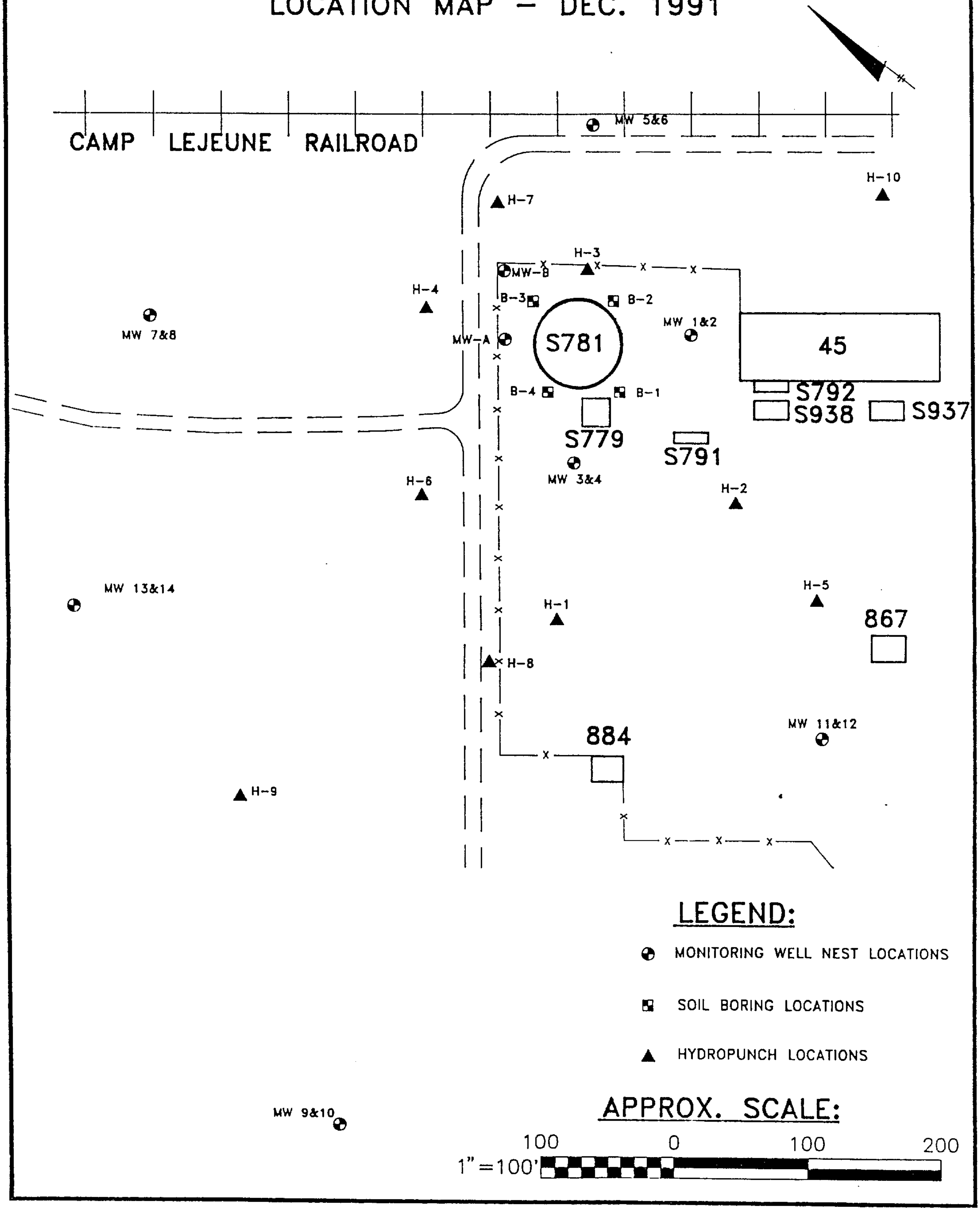
SCALE: NONE

O'BRIEN & GERE ENGINEERS, INC

FIGURE 2

MIDWAY PARK
CAMP LEJEUNE N.C.
BLDG 45, TANK S781

SUBSURFACE INVESTIGATION LOCATION MAP – DEC. 1991

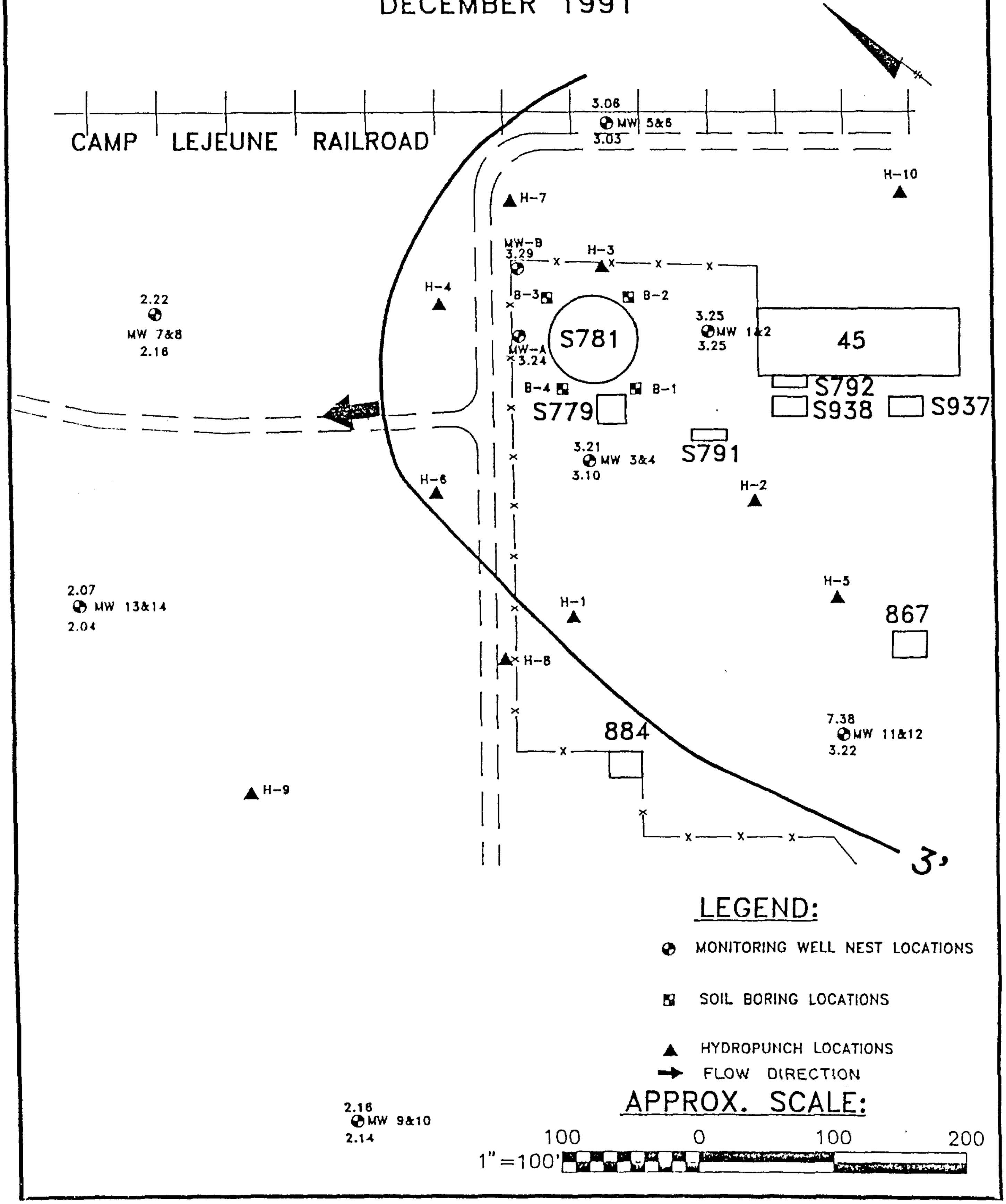


O'BRIEN & GERE
ENGINEERS, INC.

FIGURE 3

MIDWAY PARK
CAMP LEJEUNE N.C.
BLDG 45, TANK S781

GROUNDWATER CONTOUR MAP
DECEMBER 1991

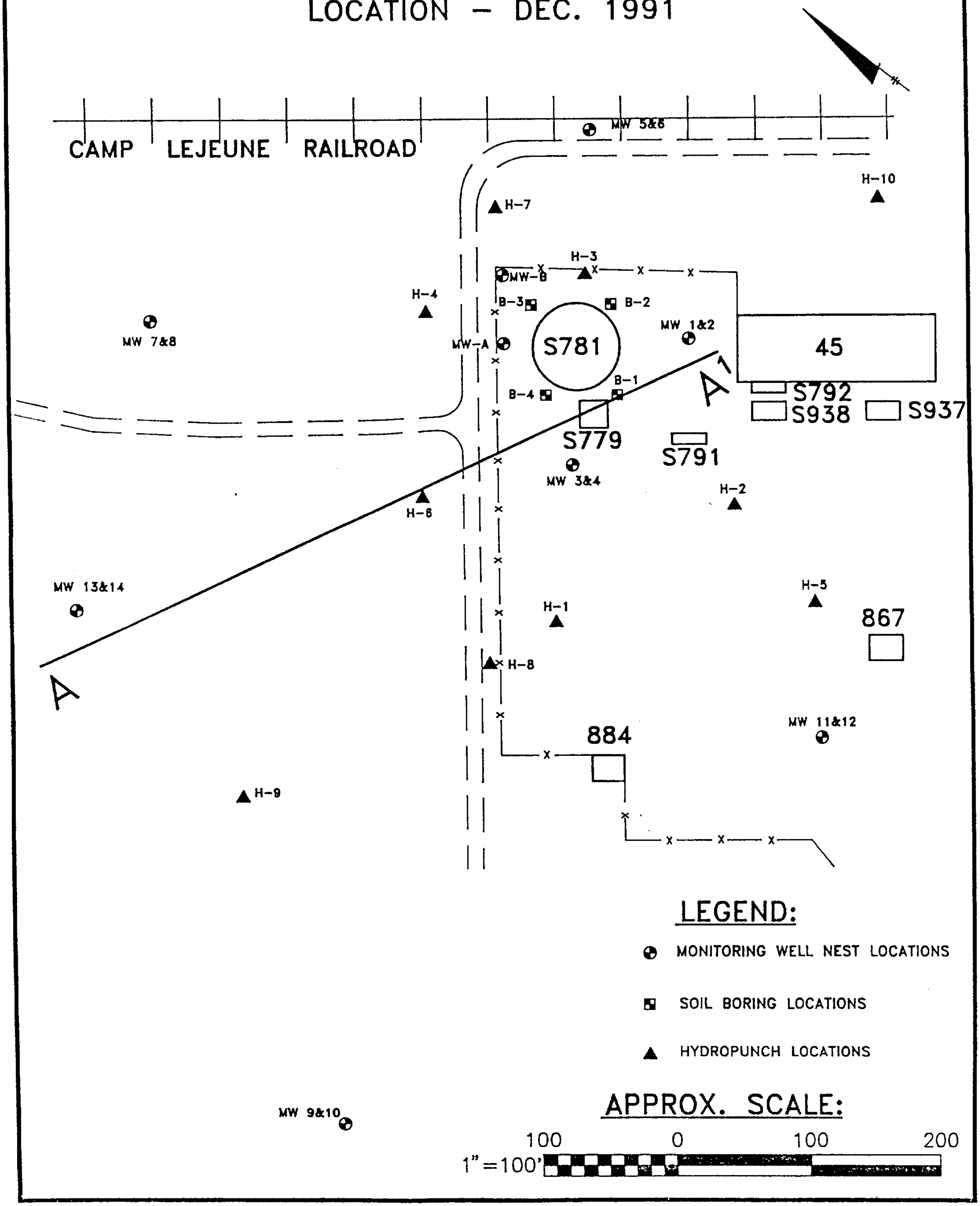


O'BRIEN & GERE
ENGINEERS, INC

FIGURE 4

MIDWAY PARK
CAMP LEJEUNE N.C.
BLDG 45, TANK S781

GEOLOGIC CROSS-SECTION A-A1 LOCATION - DEC. 1991



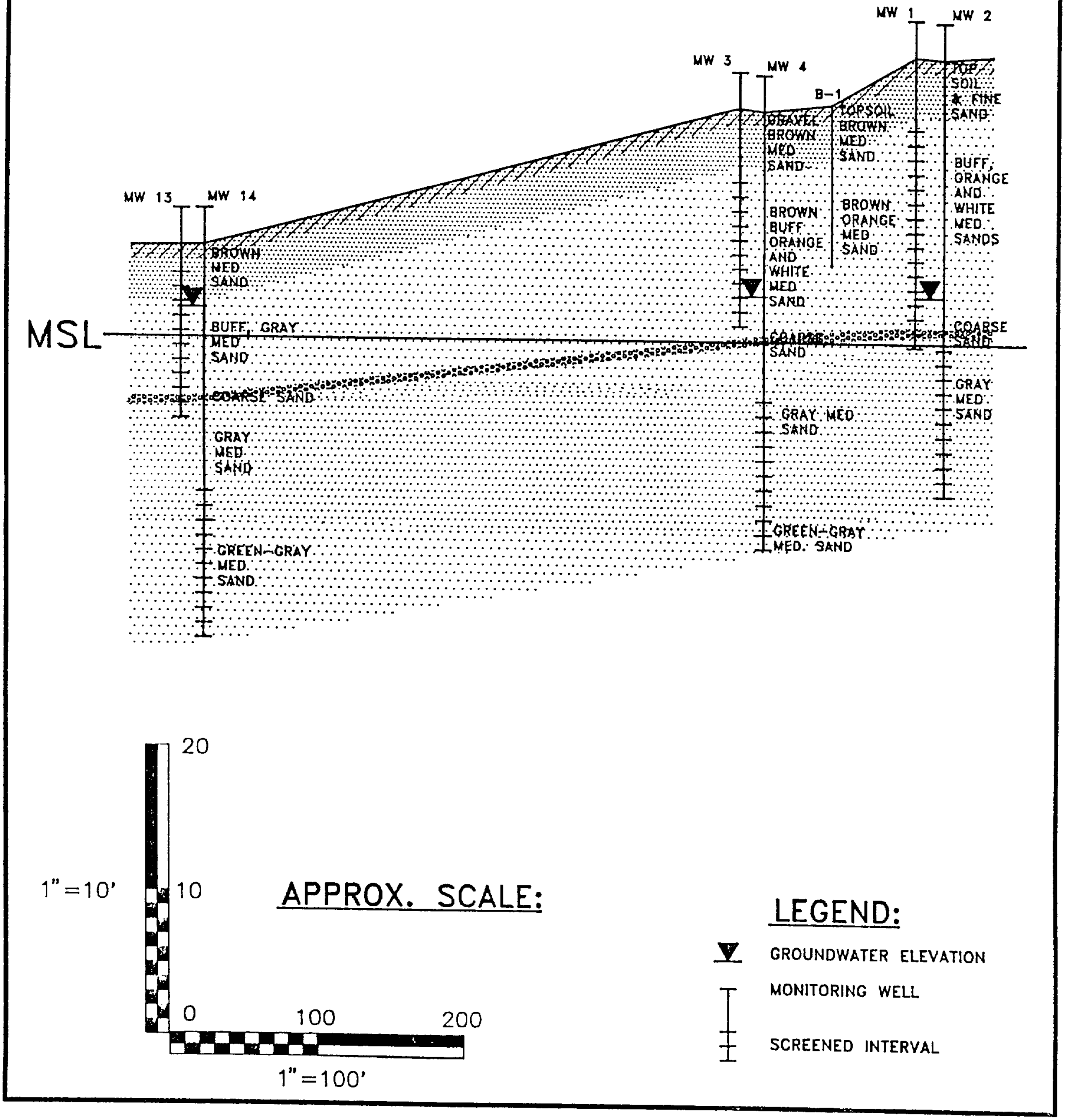
O'BRIEN & GERE ENGINEERS, INC.

FIGURE 5

MIDWAY PARK
CAMP LEJEUNE N.C.
BLDG 45, TANK S781

GEOLOGIC CROSS–SECTION A–A^1

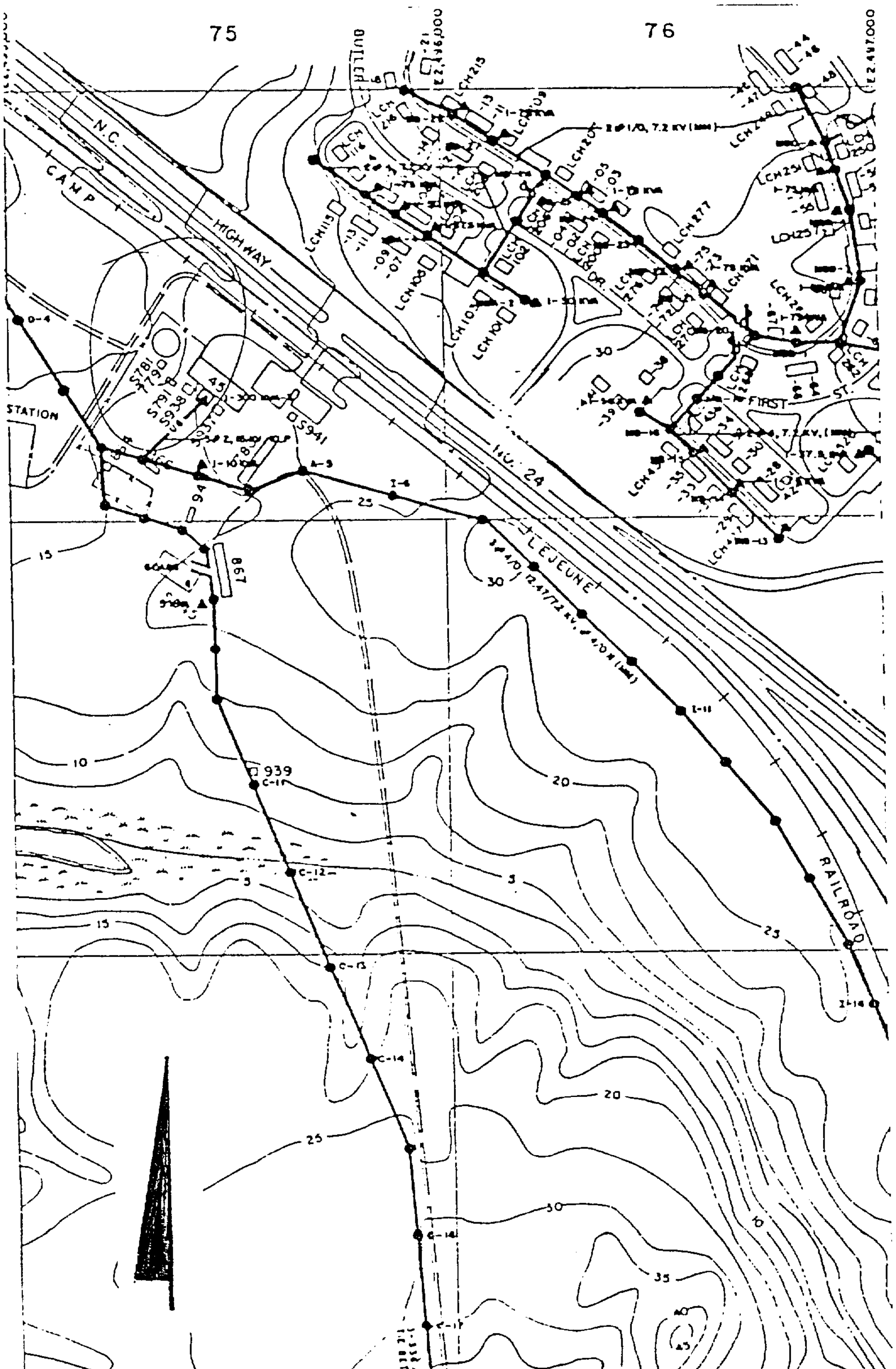
DEC. 1991



O'BRIEN & GERE
ENGINEERS, INC.

Figure 6

UTILITY LINE LOCATION
TANK S781, MIDWAY PARK
MCB CAMP LEJEUNE, N.C.



Appendices

O'BRIEN & GERE

APPENDIX A

BORE LOGS AND WELL CONSTRUCTION DATA

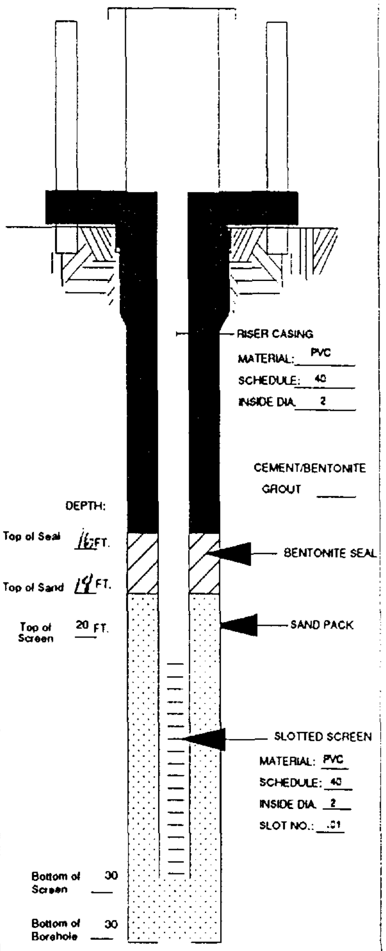
O'Brien & Gere Engineers, Inc.	Boring Log/Protective Casing Well	Report of Boring No. MW-2 Sheet 1 of 1
Location: Midway Pk Client: Navy Drilling Type: Hollow Stem	SAMPLER Type: 2" O.D. Split Spoon Hammer: 140# Fall: 30"	Ground Water Depth File No.

Boring Co.: ATEC
Foreman: Tom Sweeting
OBG Geologist T. Bickerstaff

Dates:
Started: 12/5/91 Ended: 12/5/91

Depth	Sample				Sample Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value	
0	0-2	4/3/3/4	24/24	.3	Topsoil. Fine sand, some coarse.
2	2-4	2/3/3/2	24/24	1.1	Very fine, buff sand.
4	4-6	2/3/3/3	24/24	.6	Buff sand (top 1/2), sharp contact; bottom 1/2 of spoon brown, find sand with silt and clay.
9	9-11	6/12/16/22	24/24	-.1	Interbedded b uff, white and orange medium sands.
14	14-16	8/11/10/13	24/24	-.2	Buff to white and orange, medium sand. Tip is wet.
19	19-21	3/4/4/5	24/20	.7	Gray and orange, mediumm sand. Some coarse.
24	24-26	2/3/4/5	24/24	.1	Gray medium sand.
29	29-31	4/6/13/16	24/20	-.1	Gray medium sand.
30					Bottom of well.

Monitoring Well Specifications



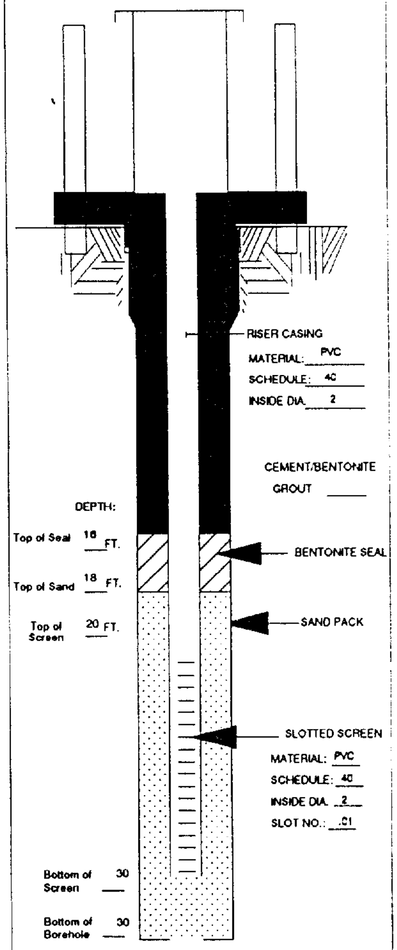
O'Brien & Gere Engineers, Inc.	Boring Log/Protective Casing Well	Report of Boring No. MW-4 Sheet 1 of 1
Location: Midway PK Client: Navy Drilling Type: Hollow Stem	SAMPLER Type: 2" O.D. Split Spoon Hammer: 140# Fall: 30"	Ground Water Depth File No.

Boring Co.: ATEC
Foreman: Tom Sweeting
OBG Geologist T. Bickerstaff

Dates:
Started: 12/5/91 Ended: 12/5/91

Depth	Sample				Sample Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value	
0	0-2	6/12/21/23	24/12	0	Tcpsoil. Fossiliferous pebbles and medium sand.
2	2-4	20/16/16/15	24/12	0	Brown, medium sand.
4	4-6	4/5/6/8	24/20	0	Medium orange sand. Moist
9	9-11	9/16/17/20	24/15	0	Medium buff to white sand.
14	14-16	5/6/5/5	24/19	0	Saturated, coarse, brown sand with gray clay stringers and some pebbles.
19	19-21	1/1/2/2	24/24	.1	Medium, gray and brown sand. odor, but no PID reading.
24	24-26	3/5/19/38	24/24	7.5	Fine, gray sand. Odor.
29	29-31	3/19/28/52	24/24	3.5	Fine, gray to green sand. Odor.
30					Bottom of well.

Monitoring Well Specifications



RISER CASING
MATERIAL: PVC
SCHEDULE: 40
INSIDE DIA. 2

CEMENT/BENTONITE GROUT

DEPTH:
Top of Seal 16 FT.
Top of Sand 18 FT.
Top of Screen 20 FT.
Bottom of Screen 30
Bottom of Borehole 30

SLOTTED SCREEN
MATERIAL: PVC
SCHEDULE: 40
INSIDE DIA. 2
SLOT NO.: .01

O'Brien & Gere
Engineers, Inc.

Boring Log/Protective Casing Well

Report of Boring No. MW-6
Sheet 1 of 1

Location: Midway PK :
Client: Navy
Drilling Type: Hollow Stem

SAMPLER
Type: 2" O.D. Split Spoon
Hammer: 140# Fall: 30"

Ground Water Depth

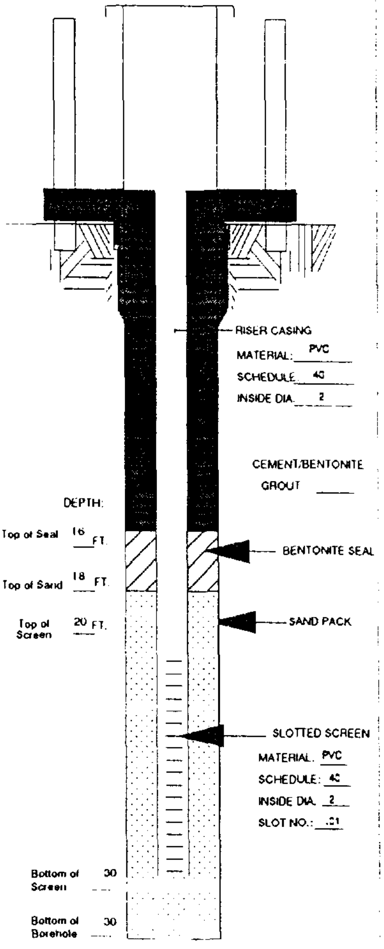
File No.

Boring Co.: ATEC
Foreman: Tom Sweeting
OBG Geologist T. Bickerstaff

Dates:
Started: 12/6/91 Ended: 12/6/91

Depth	Sample				Sample Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value	
0	0-2	6/6/6/10	24/24	0	Topsoil. Medium gray sand.
2	2-4	7/7/7/6	24/24	0	Medium gray sand.
4	4-6	4/3/6/8	24/24	-.1	Medium gray sand.
9	9-11	7/5/4/5	24/24	0	Very fine, gray sand on top. Silt with clay and sand on bottom.
14	14-16	7/3/7/11	24/24	0	Saturated, orange, coarse sand. Gray, medium sand on top.
19	19-21	4/5/8/11	24/24	-,2	Grayish-green, medium sand.
24	24-26	1/1/1/1	24/24	-.2	Grayish-green, medium sand.

Monitoring Well Specifications



RISER CASING
MATERIAL: PVC
SCHEDULE 40
INSIDE DIA. 2

CEMENT/BENTONITE GROUT ____

DEPTH:
Top of Seal 16 FT.
Top of Sand 18 FT.
Top of Screen 20 FT.
Bottom of Screen 30
Bottom of Borehole 30

SLOTTED SCREEN
MATERIAL. PVC
SCHEDULE: 40
INSIDE DIA. 2
SLOT NO.: .01

O'Brien & Gere
Engineers, Inc.

Boring Log/Protective Casing Well

Report of Boring No. MW-8
Sheet 1 of 1

Location: Midway PK
Client: Navy
Drilling Type: Hollow Stem

SAMPLER
Type: 2" O.D. Split Spoon
Hammer: 140# Fall: 30"

Ground Water Depth

File No.

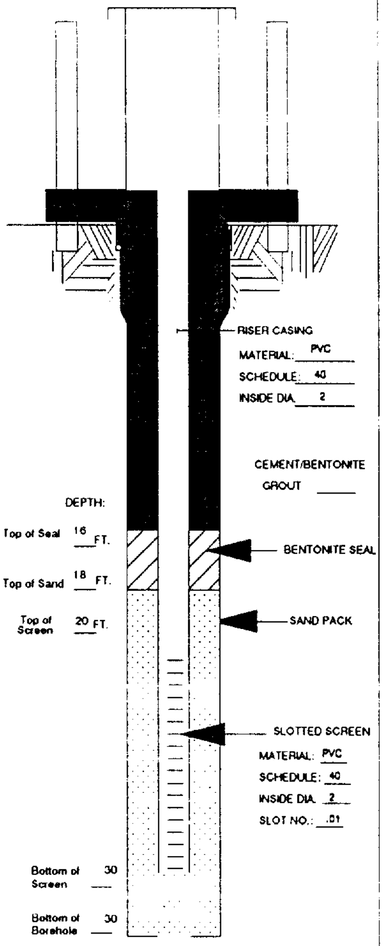
Boring Co.: ATEC
Foreman: Tom Sweeting
OBG Geologist T. Bickerstaff

Dates:
Started: 12/6/91 Ended: 12/6/91

Depth	Sample				Sample Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value	
0	0-2	2/4/5/5	24/12	* .2	Topsoil. Medium sand, brown.
2	2-4	4/5/8/10	24/24	0	Gray, medium to fine sand. Some silt.
4	4-6	8/6/4/3	24/18	.2	Bottom 1/2 wet, fine, gray sand.
9	9-11	1/1/1/2	24/24	0	Green, gray, medium sand. Streaks of greener sand.
14	14-16	1/2/4/5	24/24	.1	Green, gray, medium sand. Streaks of greener sand.
19	19-21	8/16/26/31	24/24	.3	Green, gray, medium sand. Streaks of greener sand.
24	24-26	10/25/29/35	24/	.4	Green, gray, medium sand. Streaks of greener sand.
30					Bottom of well.

*AMBIENT AIR REGISTERED
0.3 PPM ON PID

Monitoring Well Specifications



O'Brien & Gere Engineers, Inc.	Boring Log/Protective Casing Well	Report of Boring No. MW-10 Sheet 1 of 1
Location: Midway PK Client: Navy Drilling Type: Hollow Stem	SAMPLER Type: 2" O.D. Split Spoon Hammer: 140# Fall: 30"	Ground Water Depth File No.

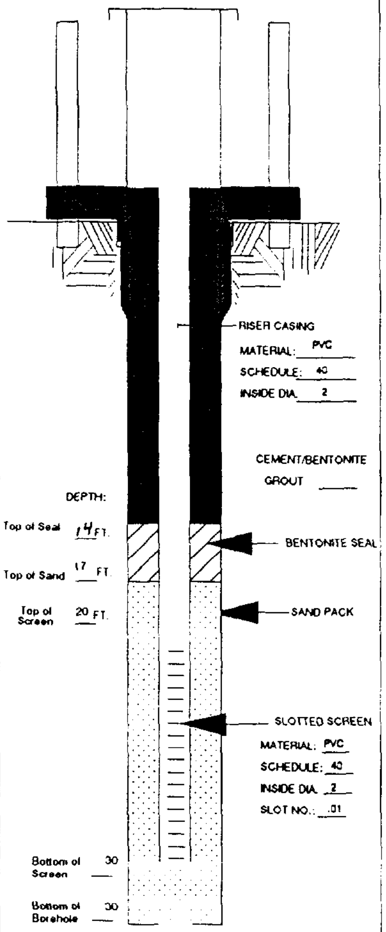
Boring Co.: ATEC
Foreman: Tim Williams
OBG Geologist T. Bickerstaff

Dates:
Started: 12/9/91 Ended: 12/9/91

Depth	Sample				Sample Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value	
0	0-2	2/3/5/6	24/20	* 1.3	Light brown, medium sand.
2	2-4	4/4/3/4	24/24	1.3	Buff, medium sand.
4	4-6	4/3/2/3	24/16	1.4	White and buff, medium sand.
9	9-11	4/3/3/4	24/24	1.3	Medium, white sand on top of orange and green-gray sand. Wet.
14	14-16	4/5/6/6	24/24	1.3	Green-gray, fine sand.
19	19-21	1/2/5/8	24/24	1.4	Gray, medium sand.
24	24-26	10/17/27/31	24/24	1.3	Medium. gray sand.
29	29/31	9/13/22/27	24/24	1.3	Medium. gray sand.

* AMBIENT AIR RECORDED 1.3 PPM ON PID

Monitoring Well Specifications



RISER CASING
MATERIAL: PVC
SCHEDULE: 40
INSIDE DIA. 2

CEMENT/BENTONITE GROUT ____

DEPTH:
Top of Seal 14 FT.
Top of Sand 17 FT.
Top of Screen 20 FT.
Bottom of Screen 30
Bottom of Borehole 30

SLOTTED SCREEN
MATERIAL: PVC
SCHEDULE: 40
INSIDE DIA. 2
SLOT NO.: .01

O'Brien & Gere Engineers, Inc.	Boring Log/Protective Casing Well	Report of Boring No. MW-12 Sheet 1 of 1
Location: Midway Pk Client: Navy Drilling Type: Hollow Stem	SAMPLER Type: 2" O.D. Split Spoon Hammer: 140# Fall: 30"	Ground Water Depth File No.

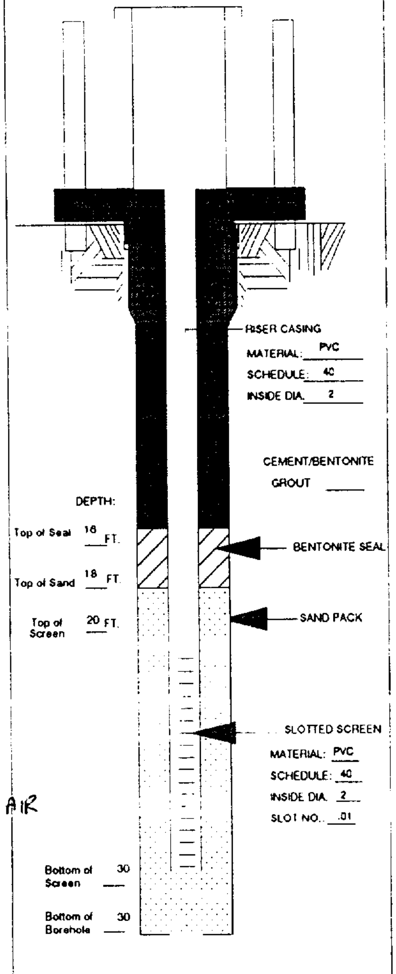
Boring Co.: ATEC
Foreman: Tom Sweeting
OBG Geologist T. Bickerstaff

Dates:
Started: 12/9/91 Ended: 12/10/91

Depth	Sample				Sample Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value	
0	0-2	1/2/3/5	24/24	* 1.3	Brown, medium sand.
2	2-4	5/5/5/5	24/24	1.3	Gray, medium sand on top of brown, medium sand with silt and clay.
4	4-6	1/3/5/8	24/24	1.4	Gray silt, clay with some sand on top of medium, buff sand.
9	9-11	1/1/1/3	24/24	1.3	Silt on top of gray silt and clay interbedded with laminae of red, medium sand. Wet.
14	14-16	6/8/10/7	24/24	1.3	Gray-red clay grading to gray, medium sand with silt.
19	19-21	1/1/1/4	24/24	1.4	Medium gray sand with silt.
24	24-26	1/3/2/1	24/24	1.3	Orange, medium sand.
30					Bottom of well.

*PID RECORDED 1.3 FOR AMBIENT AIR

Monitoring Well Specifications



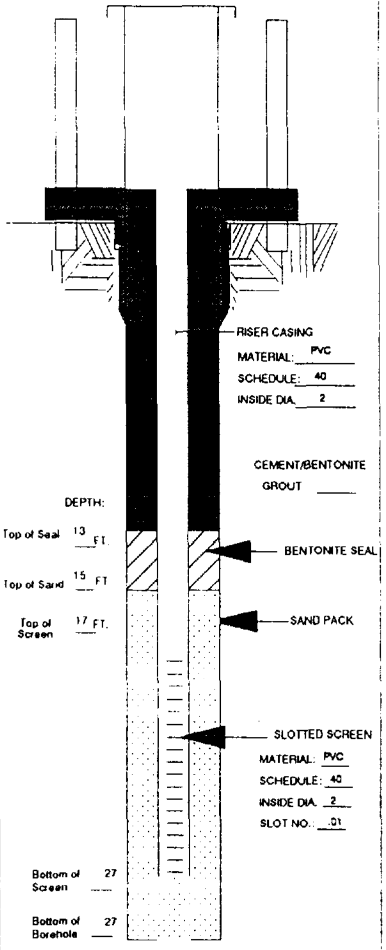
O'Brien & Gere Engineers, Inc.	Boring Log/Protective Casing Well	Report of Boring No. MW-14 Sheet 1 of 1
Location: Midway PK Client: Navy Drilling Type: Hollow Stem	SAMPLER Type: 2" O.D. Split Spoon Hammer: 140# Fall: 30"	Ground Water Depth File No.

Boring Co.: ATEC
Foreman: Tom Sweeting
OBG Geologist T. Bickerstaff

Dates:
Started: 12/9/91 Ended: 12/10/91

Depth	Sample Depth	Sample Blows /6"	Sample Penetr/ Recovery	Sample PID Value	Sample Description
0	0-2	1/1/1/2	24/24	.3	Light brown, medium sand, some fines.
2	2-4	2/2/2/3	24/24	.2	Light brown, medium to very fine sand. Some silt. Bottom 1/2 of spoon wet.
4	4-6	3/3/3/4	24/18	0	Gray, fine to very fine sand.
9	9-11	1/2/4/6	24/24	0	Gray-green to brown, medium to coarse sand.
14	14-16	1/1/3/4	24/24	0	Gray, medium sand. Tip is orangey-brown, coarse sand.
19	19-21	11/6/20/24	24/24	0	Green-gray, medium sand.
26					
27					Bottom of well.

Monitoring Well Specifications



RISER CASING
MATERIAL: PVC
SCHEDULE: 40
INSIDE DIA. 2

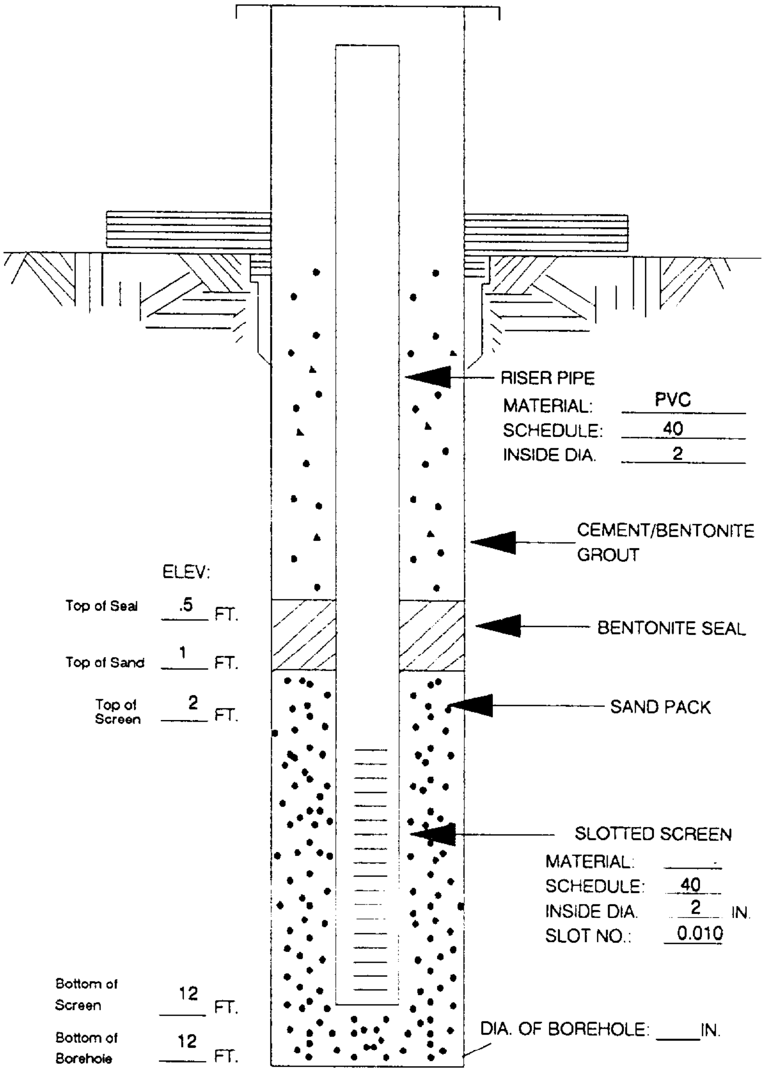
CEMENT/BENTONITE GROUT ____

DEPTH:
Top of Seal 13 FT.
Top of Sand 15 FT.
Top of Screen 17 FT.
Bottom of Screen 27
Bottom of Borehole 27

BENTONITE SEAL

SAND PACK

SLOTTED SCREEN
MATERIAL: PVC
SCHEDULE: 40
INSIDE DIA. 2
SLOT NO.: .01



RISER PIPE
MATERIAL: PVC
SCHEDULE: 40
INSIDE DIA. 2

CEMENT/BENTONITE GROUT

BENTONITE SEAL

SAND PACK

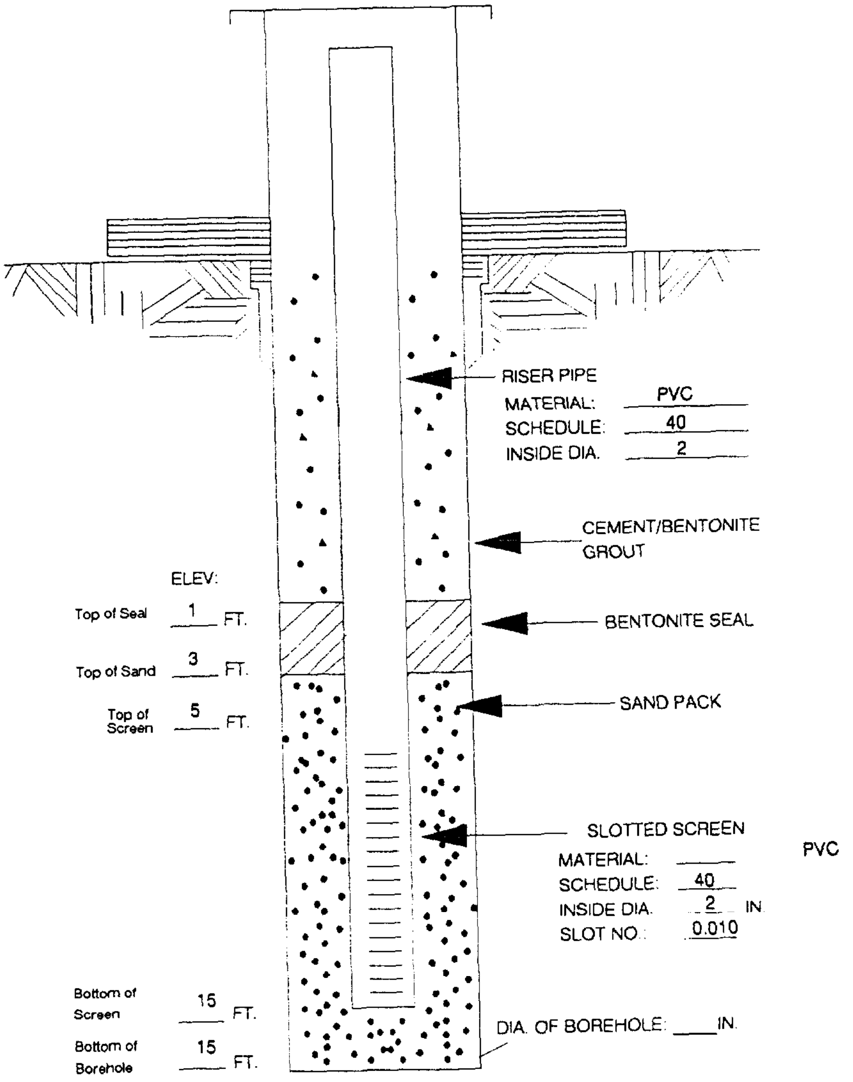
SLOTTED SCREEN
MATERIAL: PVC
SCHEDULE: 40
INSIDE DIA. 2 IN.
SLOT NO.: 0.010

DIA. OF BOREHOLE: ____ IN.

ELEV:
Top of Seal .5 FT.
Top of Sand 1 FT.
Top of Screen 2 FT.
Bottom of Screen 12 FT.
Bottom of Borehole 12 FT.

TYPICAL OVERBURDEN MONITORING WELL
N.T.S.

MIDWAY PARK
MW-13
12/11/91



RISER PIPE
MATERIAL: PVC
SCHEDULE: 40
INSIDE DIA. 2

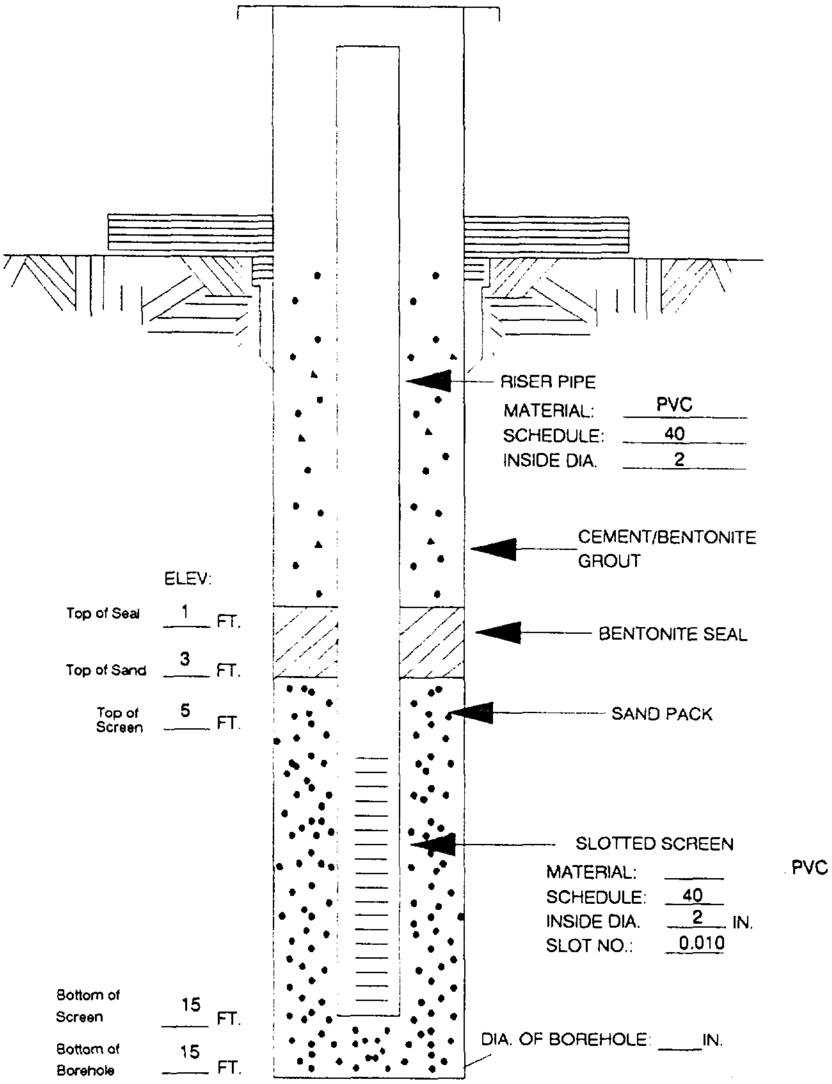
SLOTTED SCREEN
MATERIAL: PVC
SCHEDULE: 40
INSIDE DIA. 2 IN
SLOT NO. 0.010

DIA. OF BOREHOLE: ____IN.

ELEV:
Top of Seal 1 FT.
Top of Sand 3 FT.
Top of Screen 5 FT.
Bottom of Screen 15 FT.
Bottom of Borehole 15 FT.

TYPICAL OVERBURDEN MONITORING WELL
N.T.S

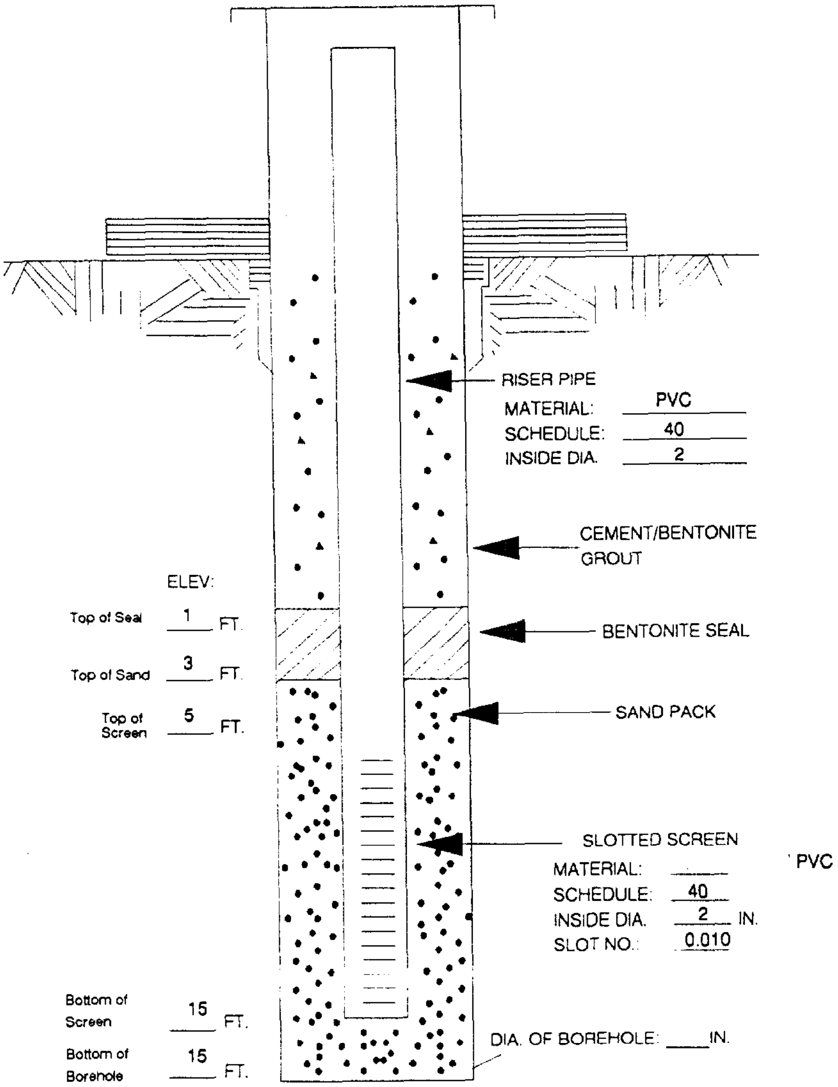
MIDWAY PARK
MW-11
12/9/91



TYPICAL OVERBURDEN MONITORING WELL

N.T.S

MIDWAY PARK
MW-9
12/9/91



RISER PIPE
MATERIAL: PVC
SCHEDULE: 40
INSIDE DIA. 2

CEMENT/BENTONITE GROUT

BENTONITE SEAL

SAND PACK

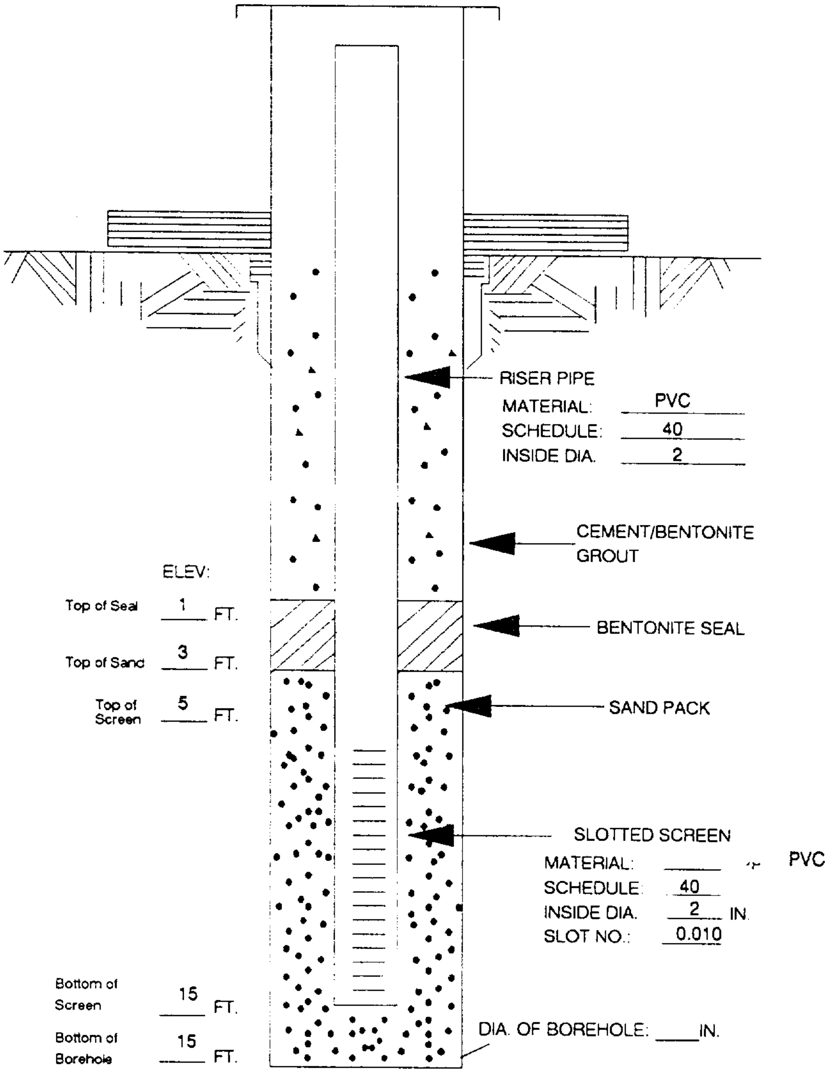
SLOTTED SCREEN
MATERIAL: ____ PVC
SCHEDULE: 40
INSIDE DIA. 2 IN.
SLOT NO.: 0.010

DIA. OF BOREHOLE: ____ IN.

ELEV:
Top of Seal 1 FT.
Top of Sand 3 FT.
Top of Screen 5 FT.
Bottom of Screen 15 FT.
Bottom of Borehole 15 FT.

TYPICAL OVERBURDEN MONITORING WELL
N.T.S.

MIDWAY PARK
MW-7
12/6/91



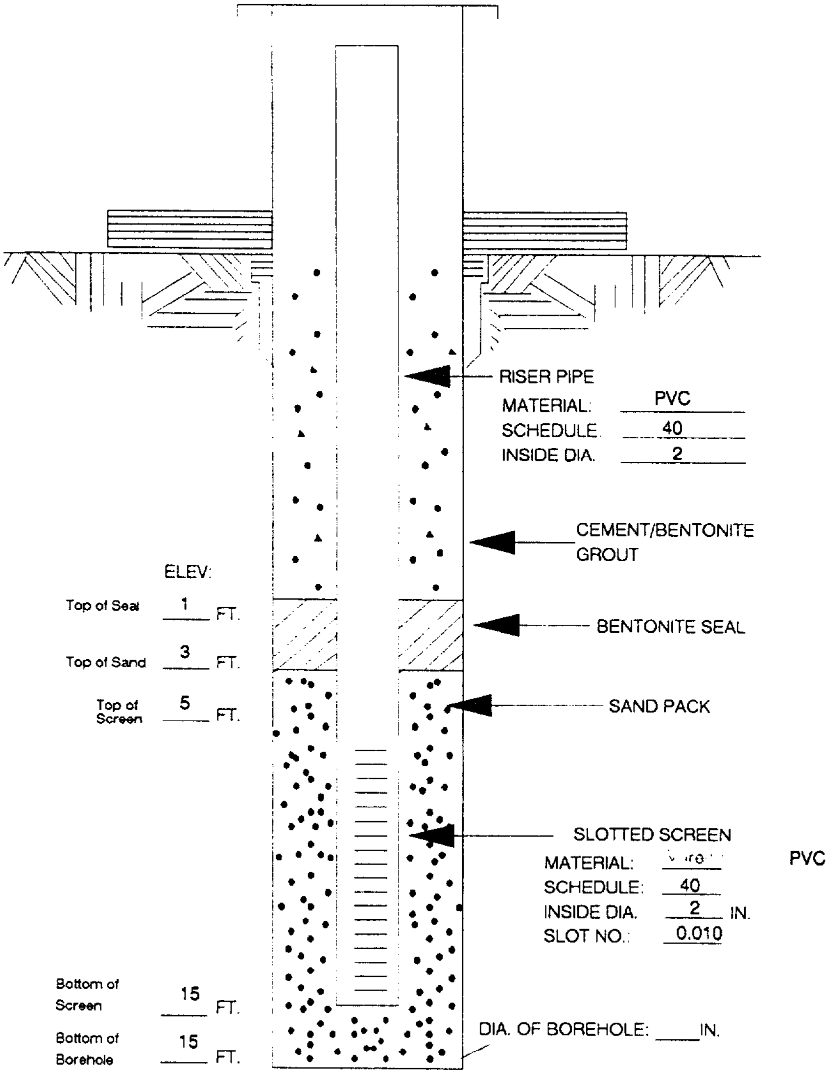
TYPICAL OVERBURDEN MONITORING WELL

N.T.S

MIDWAY PARK

MW-5

12/6/91



RISER PIPE
MATERIAL: PVC
SCHEDULE: 40
INSIDE DIA. 2

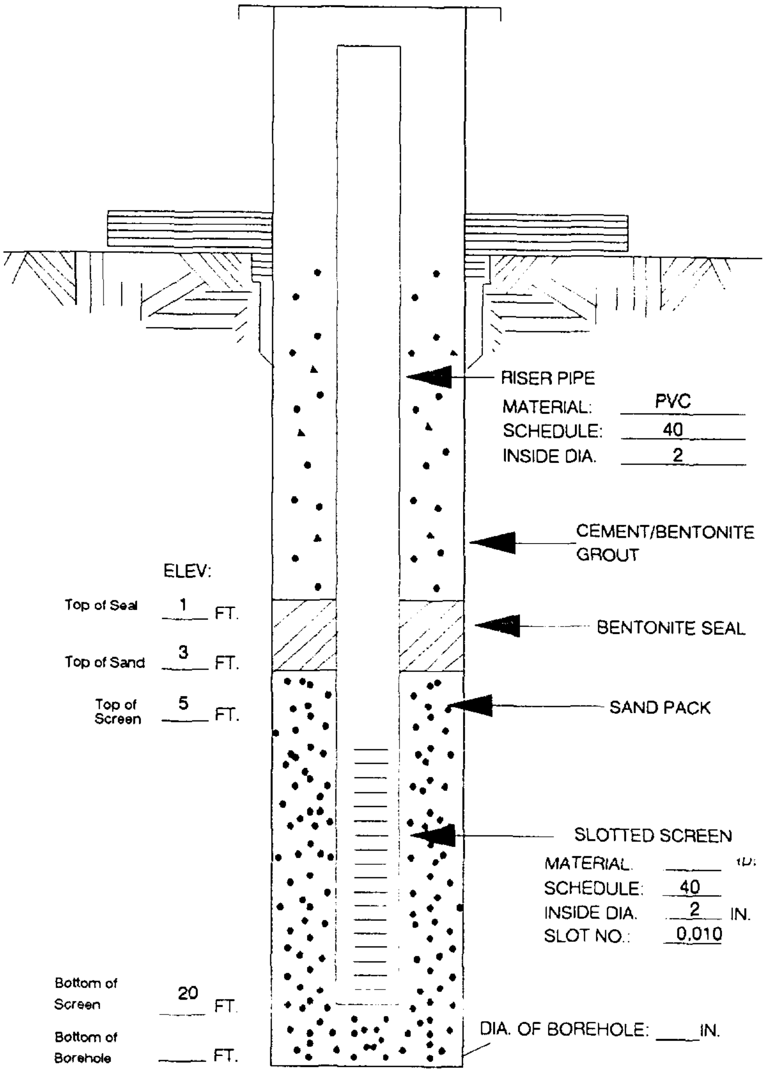
Top of Seal 1 FT.
Top of Sand 3 FT.
Top of Screen 5 FT.
Bottom of Screen 15 FT.
Bottom of Borehole 15 FT.

SLOTTED SCREEN
MATERIAL: [illegible] PVC
SCHEDULE: 40
INSIDE DIA. 2 IN.
SLOT NO.: 0.010

DIA. OF BOREHOLE: ____IN.

TYPICAL OVERBURDEN MONITORING WELL
N.T.S

MIDWAY PARK
MW-3
12/4/91



RISER PIPE
MATERIAL: PVC
SCHEDULE: 40
INSIDE DIA. 2

CEMENT/BENTONITE GROUT

BENTONITE SEAL

SAND PACK

SLOTTED SCREEN
MATERIAL. ______ PVC
SCHEDULE: 40
INSIDE DIA. 2 IN.
SLOT NO.: 0,010

DIA. OF BOREHOLE: ____ IN.

ELEV:
Top of Seal 1 FT.
Top of Sand 3 FT.
Top of Screen 5 FT.
Bottom of Screen 20 FT.
Bottom of Borehole ____ FT.

TYPICAL OVERBURDEN MONITORING WELL
N.T.S.

MIDWAY PARK
MW-1
12/4/91

O'Brien & Gere Engineers, Inc.	TEST BORING LOG	Report of Boring No. B4 Sheet 1 of 1
Project Location: Midway Park Client: Navy Drill Type: HOLLOW STEM AUGER	SAMPLER Type: 2" OD. SPLIT SPOON Hammer: 140# Fall: 30"	Ground Water Depth File No.
Boring Co.: ATEC Foreman: Chip Lefever OBG Geologist T. Bickerstaff		Dates: Started: 12/5/91 Ended: 12/5/91

Depth	Sample				Sample Description	Stratum Change General Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value		
0	0-2	5/5/5/8	24/20	.2	Brown, medium sand.	
2	2-4	7/8/9/5	24/10	.2	Medium, brown sand with medium, dark brown sand at tip.	
4	4-6	2/3/3/4	24/24	78.6	Black, tar-like, medium to fine sand. Free product.	
6	6-8	10/16/16/18	24/24	116	Black, tar-like, medium to fine sand. Free product.	
9	9-11	9/16/14/19	24/24	146	Black, tar-like, medium to fine sand. Free product.	

O'Brien & Gere Engineers, Inc.	TEST BORING LOG	Report of Boring No. B1 Sheet 1 of 1
Project Location: Midway Park Client: Navy Drill Type: Hollow Stem Auger	SAMPLER Type: 2" OD SPLIT SPOON Hammer: 140 lbs. Fall: 30"	Ground Water Depth File No.
Boring Co.: ATEC Foreman: Chip Lefever OBG Geologist T. Bickerstaff		Dates: Started: 12/5/91 Ended: 12/5/91

Depth	Sample				Sample Description	Stratum Change General Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value		
0	0-2	4/6/8/9	24/20	0	Topsoil. Medium brown sand. Piece of broken coal at bottom of spoon.	
2	2-4	6/6/5/5	24/20	-.1	Medium loose, brown sand.	
4	4-6	3/2/3/5	24/18	0	Medium. orange sand.	
9	9-11	6/8/10/11	24/24	.1	Brown, medium sand. Saturated.	

O'Brien & Gere
Engineers, Inc.

TEST BORING LOG

Report of Boring No. B2
Sheet 1 of 1

Project Location: Midway Park
Client: Navy
Drill Type: HOLLOW STEM AUGER

SAMPLER
Type: 2" OD. SPLITSPOON
Hammer: 140# Fall: 30"

Ground Water Depth

File No.

Boring Co.: ATEC
Foreman: Chip Lefever
OBG Geologist T. Bickerstaff

Dates:
Started: 12/5/91 Ended: 12/5/91

Depth	Sample				Sample Description	Stratum Change General Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value		
0	0-2	3/3/3/4	24/24	.2	Topsoil on top of brown, medium sand.	
2	2-4	3/1/2/1	24/20	.3	Medium brown sand.	
4	4-6	WOH	24/18	0	Very fine, brown sand.	
9	9-11	6/16/24/23	24/24	.2	White, fine sand.	
11	11-13	5/13/17/20	24/	.2	Fine, white sand. Tip is orange, medium sand. Wet.	

O'Brien & Gere Engineers, Inc.	TEST BORING LOG	Report of Boring No. B3 Sheet 1 of 1
Project Location: Midway Park Client: Navy Drill Type: HOLLOW STEM AUGER	SAMPLER Type: 2" OD SPLIT SPOON Hammer: 140# Fall: 30"	Ground Water Depth File No.
Boring Co.: ATEC Foreman: Chip Lefever OBG Geologist T. Bickerstaff		Dates: Started: 12/5/91 Ended: 12/5/91

Depth	Sample				Sample Description	Stratum Change General Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value		
0	0-2	2/2/4/4	24/24	.1	Fine to medium, brown sand.	
2	2-4	1/1/2/1	24/20	.3	Medium, brown sand.	
4	4-6	7/4/6/8	24/20	.4	Medium, buff sand.	
9	9-11	6/9/13/12	24/24	.5	Medium, brown sand. Tip is saturated. Some coarse sand.	

APPENDIX B

LABORATORY RESULTS - LIQUIDS

OBG LABORATORIES, INC.

Volatile Organics
Method 8010/8020

CLIENT U.S. NAVY JOB NO. 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

MATRIX: Water

DATE COLLECTED 12-6-91 DATE RECEIVED 12-9-91 DATE ANALYZED 12-14,16-91

DESCRIPTION:	H1	H2	H3	H4	H5	H6
SAMPLE NO.:	N9213	N9214	N9215	N9216	N9217	N9218
Benzene	<1.	<1.	<1.	<1.	<1.	<1.
Benzyl chloride	<10.	<10.	<10.	<10.	<10.	<10.
Bis (2-chloroethoxy) methane	<5000.	<5000.	<5000.	<5000.	<500,000.**	<5000.
Bromobenzene	<5.	<5.	<5.	<5.	<5.	<5.
Bromodichloromethane	<1.	<1.	<1.	<1.	<1.	<1.
Bromoform	<10.	<10.	<10.	<10.	<10.	<10.
Bromomethane	<10.	<10.	<10.	<10.	<10.	<10.
Carbon tetrachloride	<1.	<1.	<1.	<1.	<1.	<1.
Chlorobenzene	↓	↓	↓	↓	5.	↓
Chloroethane	↓	↓	↓	↓	<1.	↓
2-Chloroethylvinyl ether	<10.	<10.	<10.	<10.	<10.	<10.
Chloroform	<1.	<1.	<1.	<1.	<1.	<1.
1-Chlorohexane	<10.	<10.	<10.	<10.	<10.	<10.
Chloromethane	<10.	<10.	<10.	<10.	<10.	<10.
Chloromethylmethyl ether	<100.	<100.	<100.	<100.	<100.	<100.
2-Chlorotoluene	<5.	<5.	<5.	<5.	<5.	<5.
4-Chlorotoluene	<5.	<5.	<5.	<5.	<50.*	<5.
Dibromochloromethane	<1.	<1.	<1.	<1.	<1.	<1.
Dibromomethane	<10.	<10.	<10.	<10.	<10.	<10.
1,2-Dichlorobenzene	<5.	<5.	<5.	<5.	<100.**	<5.
1,3-Dichlorobenzene	↓	↓	↓	↓	6.*	↓
1,4-Dichlorobenzene	↓	↓	↓	↓	84.**	↓
Dichlorodifluoromethane	<10.	<10.	<10.	<10.	<10.	<10.

Authorized:

Date: January 7, 1992

LABORATORIES, INC.

Volatile Organics
Method 8010/8020

CLIENT U.S. NAVY **JOB NO.** 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

MATRIX: Water

DATE COLLECTED 12-6-91 **DATE RECEIVED** 12-9-91 **DATE ANALYZED** 12-14,16-91

DESCRIPTION:	H1	H2	H3	H4	H5	H6
SAMPLE NO.:	N9213	N9214	N9215	N9216	N9217	N9218
1,1-Dichloroethane	2.	<1.	<1.	<1.	<1.	<1.
1,2-Dichloroethane	<1.	↓	↓	↓	↓	↓
1,1-Dichloroethylene	↓					
1,2-Dichloroethylene (total)						
Dichloromethane						
1,2-Dichloropropane						
cis-1,3-Dichloropropylene						
trans-1,3-Dichloropropylene						
Ethylbenzene						
1,1,2,2-Tetrachloroethane						
1,1,1,2-Tetrachloroethane						
Tetrachloroethylene						
Toluene						
1,1,1-Trichloroethane						
1,1,2-Trichloroethane						
Trichloroethylene						
Trichlorofluoromethane						
1,2,3-Trichloropropane						
Vinyl chloride						
Xylene (total)	<3.	<3.	<3.	<3.	<3.	<3.

Comments: *1,3-Dichlorobenzene and 4-Chlorotoluene coelute using Method 8010/8020. The value at this retention time was quantitated using a 1,3-Dichlorobenzene standard.

** 1,2-Dichlorobenzene, 1,4-Dichlorobenzene and Bis (2-chloroethoxy)methane coelute using Method 8010/8020. The value at this retention time was quantitated using 1 1,4-Dichlorobenzene standard.

Methodology: USEPA,SW-846, November 1986, 3rd Edition

Certification No.: 315

Units: µg/l

Authorized:

Date: January 7, 1992

OBG
LABORATORIES, INC.

Volatile Organics
Method 8010/8020

CLIENT U.S. NAVY
JOB NO. 3543.001.517
DESCRIPTION Midway Park, Camp Lejeune, NC
MATRIX: Water
DATE COLLECTED 12-6-91
DATE RECEIVED 12-9-91
DATE ANALYZED 12-16-91

DESCRIPTION:	H7					
SAMPLE NO.:	N9219					
Benzene	<1.					
Benzyl chloride	<10.					
Bis (2-chloroethoxy) methane	<5000.					
Bromobenzene	<5.					
Bromodichloromethane	<1.					
Bromoform	<10.					
Bromomethane	<10.					
Carbon tetrachloride	<1.					
Chlorobenzene	↓					
Chloroethane	↓					
2-Chloroethylvinyl ether	<10.					
Chloroform	<1.					
1-Chlorohexane	<10.					
Chloromethane	<10.					
Chloromethylmethyl ether	<100.					
2-Chlorotoluene	<5.					
4-Chlorotoluene	<5.					
Dibromochloromethane	<1.					
Dibromomethane	<10.					
1,2-Dichlorobenzene	<5.					
1,3-Dichlorobenzene	↓					
1,4-Dichlorobenzene	↓					
Dichlorodifluoromethane	<10.					

Authorized:
Date: January 7, 1992

OBG Laboratories, Inc., *an O'Brien & Gere Limited Company*
5000 Brittonfield Parkway / Suite 300, Box 4942 / Syracuse, NY 13221 / (315) 437-0200

LABORATORIES, INC.

Volatile Organics
Method 8010/8020

CLIENT U.S. NAVY **JOB NO.** 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

MATRIX: Water

DATE COLLECTED 12-6-91 **DATE RECEIVED** 12-9-91 **DATE ANALYZED** 12-16-91

DESCRIPTION:	H7					
SAMPLE NO.:	N9219					
1,1-Dichloroethane	<1.					
1,2-Dichloroethane						
1,1-Dichloroethylene						
1,2-Dichloroethylene (total)						
Dichloromethane						
1,2-Dichloropropane						
cis-1,3-Dichloropropylene						
trans-1,3-Dichloropropylene						
Ethylbenzene						
1,1,2,2-Tetrachloroethane						
1,1,1,2-Tetrachloroethane						
Tetrachloroethylene						
Toluene						
1,1,1-Trichloroethane						
1,1,2-Trichloroethane						
Trichloroethylene						
Trichlorofluoromethane						
1,2,3-Trichloropropane						
Vinyl chloride	↓					
Xylene (total)	<3.					

Comments:

Methodology: USEPA,SW-846, November 1986, 3rd Edition

Certification No.: 315

Units: µg/l

Page 2 of 2

Authorized:

Date: January 7, 1992

LABORATORIES, INC.

Volatile Organics
Method 8010/8020

CLIENT U.S. NAVY JOB NO. 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

MATRIX: Water

DATE COLLECTED 12-12-91 DATE RECEIVED 12-13-91 DATE ANALYZED 12-20,22-91

DESCRIPTION:	MW-1	MW-3	MW-5	MW-7	MW-11	MW-4
SAMPLE NO.:	N9617	N9618	N9619	N9620	N9621	N9622
Benzene	<1.	<10.	<1.	<1.	<1.	<1.
Benzyl chloride	<10.	<100.	<10.	<10.	<10.	<10.
Bis (2-chloroethoxy) methane	<500.	<5000.	<500.	<500.	<500.	<500.
Bromobenzene	<5.	<50.	<5.	<5.	<5.	<5.
Bromodichloromethane	<1.	<10.	<1.	<1.	<1.	<1.
Bromoform	<10.	<100.	<10.	<10.	<10.	<10.
Bromomethane	<1.	<10.	<1.	<1.	<1.	<1.
Carbon tetrachloride	↓	↓	↓	↓	↓	↓
Chlorobenzene	↓	↓	↓	↓	↓	↓
Chloroethane	↓	↓	↓	↓	↓	↓
2-Chloroethylvinyl ether	<10.	<100.	<10.	<10.	<10.	<10.
Chloroform	<1.	<10.	<1.	<1.	<1.	<1.
1-Chlorohexane	<10.	<100.	<10.	<10.	<10.	<10.
Chloromethane	<1.	<10.	<1.	<1.	<1.	<1.
Chloromethylmethyl ether	<100.	<1000.	<100.	<100.	<100.	<100.
2-Chlorotoluene	<5.	<50.	<5.	<5.	<5.	<5.
4-Chlorotoluene	<5.	<50.	<5.	<5.	<5.	<5.
Dibromochloromethane	<1.	<10.	<1.	<1.	<1.	<1.
Dibromomethane	<10.	<100.	<10.	<10.	<10.	<10.
1,2-Dichlorobenzene	<5.	<50.	<5.	<5.	<5.	<5.
1,3-Dichlorobenzene	↓	↓	↓	↓	↓	↓
1,4-Dichlorobenzene	↓	↓	↓	↓	↓	↓
Dichlorodifluoromethane	<10.	<100.	<10.	<10.	<10.	<10.

Authorized: Noriko Santucci

Date: January 8, 1992

OBG LABORATORIES, INC.

Volatile Organics
Method 8010/8020

CLIENT U.S. NAVY **JOB NO.** 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

MATRIX: Water

DATE COLLECTED 12-12-91 **DATE RECEIVED** 12-13-91 **DATE ANALYZED** 12-20,22-91

DESCRIPTION:	MW-1	MW-3	MW-5	MW-7	MW-11	MW-4
SAMPLE NO.:	N9617	N9618	N9619	N9620	N9621	N9622
1,1-Dichloroethane	<1.	16.	<1.	<1.	<1.	<1.
1,2-Dichloroethane	↓	<10.	↓	↓	↓	↓
1,1-Dichloroethylene	↓	↓	↓	↓	↓	↓
1,2-Dichloroethylene (total)	↓	↓	↓	↓	↓	2.
Dichloromethane	↓	↓	↓	↓	↓	<1.
1,2-Dichloropropane	↓	↓	↓	↓	↓	↓
cis-1,3-Dichloropropylene	↓	↓	↓	↓	↓	↓
trans-1,3-Dichloropropylene	↓	↓	↓	↓	↓	↓
Ethylbenzene	↓	16.	↓	↓	↓	↓
1,1,2,2-Tetrachloroethane	↓	<10.	↓	↓	↓	↓
1,1,1,2-Tetrachloroethane	↓	↓	↓	↓	↓	↓
Tetrachloroethylene	↓	↓	↓	↓	↓	↓
Toluene	↓	↓	↓	↓	↓	↓
1,1,1-Trichloroethane	↓	↓	↓	↓	↓	↓
1,1,2-Trichloroethane	↓	↓	↓	↓	↓	↓
Trichloroethylene	↓	↓	↓	↓	↓	↓
Trichlorofluoromethane	↓	↓	↓	↓	↓	↓
1,2,3-Trichloropropane	↓	↓	↓	↓	↓	↓
Vinyl chloride	↓	↓	↓	↓	↓	↓
Xylene (total)	<3.	<30.	<3.	<3.	<3.	<3.

Comments:

Methodology: USEPA,SW-846, November 1986, 3rd Edition

Certification No.: 315

Units: µg/l

Page 2 of 2

Authorized: Monika Santucci

Date: January 8, 1992

LABORATORIES, INC.

Volatile Organics
Method 8010/8020

CLIENT U.S. NAVY JOB NO. 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

MATRIX: Water

DATE COLLECTED 12-12-91 DATE RECEIVED 12-13-91 DATE ANALYZED 12-22,23-91

DESCRIPTION:	MW-4 Field Dup.	MW-2	MW-6	MW-8	MW-9	MW-10
SAMPLE NO.:	N9623	N9624	N9625	N9626	N9627	N9628
Benzene	<1.	<1.	<1.	<10.	<1.	<1.
Benzyl chloride	<10.	<10.	<10.	<100.	<10.	<10.
Bis (2-chloroethoxy) methane	<500.	<500.	<500.	<5000.	<500.	<500.
Bromobenzene	<5.	<5.	<5.	<50.	<5.	<5.
Bromodichloromethane	<1.	<1.	<1.	<10.	<1.	<1.
Bromoform	<10.	<10.	<10.	<100.	<10.	<10.
Bromomethane	<1.	<1.	<1.	<10.	<1.	<1.
Carbon tetrachloride	↓	↓	↓	↓	↓	↓
Chlorobenzene	↓	↓	↓	↓	↓	↓
Chloroethane	↓	↓	↓	↓	↓	↓
2-Chloroethylvinyl ether	<10.	<10.	<10.	<100.	<10.	<10.
Chloroform	<1.	<1.	<1.	<10.	<1.	<1.
1-Chlorohexane	<10.	<10.	<10.	<100.	<10.	<10.
Chloromethane	<1.	<1.	<1.	<10.	<1.	<1.
Chloromethylmethyl ether	<100.	<100.	<100.	<1000.	<100.	<100.
2-Chlorotoluene	<5.	<5.	<5.	<50.	<5.	<5.
4-Chlorotoluene	<5.	<5.	<5.	<50.	<5.	<5.
Dibromochloromethane	<1.	<1.	<1.	<10.	<1.	<1.
Dibromomethane	<10.	<10.	<10.	<100.	<10.	<10.
1,2-Dichlorobenzene	<5.	<5.	<5.	<50.	<5.	<5.
1,3-Dichlorobenzene	↓	↓	↓	↓	↓	↓
1,4-Dichlorobenzene	↓	↓	↓	↓	↓	↓
Dichlorodifluoromethane	<10.	<10.	<10.	<100.	<10.	<10.

Authorized: Monika Santucci

Date: January 8, 1992

OBG
LABORATORIES, INC.

Volatile Organics
Method 8010/8020

CLIENT U.S. NAVY **JOB NO.** 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

MATRIX: Water

DATE COLLECTED 12-12-91 **DATE RECEIVED** 12-13-91 **DATE ANALYZED** 12-22,23-91

DESCRIPTION:	MW-4 Field Dup.	MW-2	MW-6	MW-8	MW-9	MW-10
SAMPLE NO.:	N9623	N9624	N9625	N9626	N9627	N9628
1,1-Dichloroethane	<1.	<1.	<1.	<10.	<1.	<1.
1,2-Dichloroethane	<1.	↓	↓	↓	↓	↓
1,1-Dichloroethylene	2.					
1,2-Dichloroethylene (total)	<1.					
Dichloromethane	↓					
1,2-Dichloropropane						
cis-1,3-Dichloropropylene						
trans-1,3-Dichloropropylene						
Ethylbenzene						
1,1,2,2-Tetrachloroethane						
1,1,1,2-Tetrachloroethane						
Tetrachloroethylene						
Toluene						
1,1,1-Trichloroethane						
1,1,2-Trichloroethane						
Trichloroethylene						
Trichlorofluoromethane						
1,2,3-Trichloropropane						
Vinyl chloride	2.					
Xylene (total)	<3.	<3.	<3.	<30.	<3.	<3.

Comments:

Methodology: USEPA,SW-846, November 1986, 3rd Edition

Certification No.: 315

Units: µg/1

Authorized: Monika Santucci

Date: January 8, 1992

OBG Laboratories, Inc., *an O'Brien & Gere Limited Company*
5000 Brittonfield Parkway / Suite 300, Box 4942 / Syracuse, NY 13221 / (315) 437-0200

LABORATORIES, INC.

Volatile Organics
Method 8010/8020

CLIENT U.S. NAVY	**JOB NO.** 3543.001.517
DESCRIPTION Midway Park, Camp Lejeune, NC	
	MATRIX: Water

DATE COLLECTED 12-9,12-91 **DATE RECEIVED** 12-13-91 **DATE ANALYZED** 12-23-91

DESCRIPTION:	MW-12	MW-13	MW-14	H8	H9	H10
SAMPLE NO.:	N9629	N9630	N9631	N9632	N9633	N9634
Benzene	<1.	<1.	<1.	<1.	<1.	<1.
Benzyl chloride	<10.	<10.	<10.	<10.	<10.	<10.
Bis (2-chloroethoxy) methane	<500.	<500.	<500.	<500.	<500.	<500.
Bromobenzene	<5.	<5.	<5.	<5.	<5.	<5.
Bromodichloromethane	<1.	<1.	<1.	<1.	<1.	<1.
Bromoform	<10.	<10.	<10.	<10.	<10.	<10.
Bromomethane	<1.	<1.	<1.	<1.	<1.	<1.
Carbon tetrachloride	↓	↓	↓	↓	↓	↓
Chlorobenzene						
Chloroethane						
2-Chloroethylvinyl ether	<10.	<10.	<10.	<10.	<10.	<10.
Chloroform	<1.	<1.	<1.	<1.	<1.	<1.
1-Chlorohexane	<10.	<10.	<10.	<10.	<10.	<10.
Chloromethane	<1.	<1.	<1.	<1.	<1.	<1.
Chloromethylmethyl ether	<100.	<100.	<100.	<100.	<100.	<100.
2-Chlorotoluene	<5.	<5.	<5.	<5.	<5.	<5.
4-Chlorotoluene	<5.	<5.	<5.	<5.	<5.	<5.
Dibromochloromethane	<1.	<1.	<1.	<1.	<1.	<1.
Dibromomethane	<10.	<10.	<10.	<10.	<10.	<10.
1,2-Dichlorobenzene	<5.	<5.	<5.	31.*	<5.	<5.
1,3-Dichlorobenzene	↓	↓	↓	<5.	↓	↓
1,4-Dichlorobenzene				*		
Dichlorodifluoromethane	<10.	<10.	<10.	<10.	<10.	<10.

Authorized: Monika Santucci

Date: January 8, 1992

OBG LABORATORIES, INC.

Volatile Organics
Method 8010/8020

CLIENT	U.S. NAVY	**JOB NO.**	3543.001.517
DESCRIPTION	Midway Park, Camp Lejeune, NC		
		MATRIX:	Water

DATE COLLECTED 12-9,12-91 **DATE RECEIVED** 12-13-91 **DATE ANALYZED** 12-23-91

DESCRIPTION:	MW-12	MW-13	MW-14	H8	H9	H10
SAMPLE NO.:	N9629	N9630	N9631	N9632	N9633	N9634
1,1-Dichloroethane	<1.	<1.	<1.	<1.	<1.	<1.
1,2-Dichloroethane	↓	↓	↓	↓	↓	↓
1,1-Dichloroethylene	↓	↓	↓	↓	↓	↓
1,2-Dichloroethylene (total)	↓	↓	↓	↓	↓	↓
Dichloromethane	↓	↓	↓	↓	↓	↓
1,2-Dichloropropane	↓	↓	↓	↓	↓	↓
cis-1,3-Dichloropropylene	↓	↓	↓	↓	↓	↓
trans-1,3-Dichloropropylene	↓	↓	↓	↓	↓	↓
Ethylbenzene	↓	↓	↓	↓	↓	↓
1,1,2,2-Tetrachloroethane	↓	↓	↓	↓	↓	↓
1,1,1,2-Tetrachloroethane	↓	↓	↓	↓	↓	↓
Tetrachloroethylene	↓	↓	↓	↓	↓	↓
Toluene	2.	↓	↓	↓	2.	↓
1,1,1-Trichloroethane	<1.	↓	↓	↓	<1.	↓
1,1,2-Trichloroethane	↓	↓	↓	↓	↓	↓
Trichloroethylene	↓	↓	↓	↓	↓	↓
Trichlorofluoromethane	↓	↓	↓	↓	↓	↓
1,2,3-Trichloropropane	↓	↓	↓	↓	↓	↓
Vinyl chloride	↓	↓	↓	↓	↓	↓
Xylene (total)	<3.	<3.	<3.	<3.	<3.	<3.

Comments: *1,2-Dichlorobenzene and 1,4-Dichlorobenzene coelute using EPA Method 8010/8020. The value at this retention time was quantitated using a 1,2-Dichlorobenzene standard.

Methodology: USEPA,SW-846, November 1986, 3rd Edition

Certification No.: 315

Units: µg/1

Page 2 of 2

Authorized: Monika Santucci

Date: January 8, 1992

OBG
LABORATORIES, INC.

Volatile Organics
Method 8010/8020

CLIENT U.S. NAVY JOB NO. 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

MATRIX: Water

DATE COLLECTED 12-12-91 DATE RECEIVED 12-13-91 DATE ANALYZED 12-24-91

DESCRIPTION:	Field Blank	QC Trip Blank				
SAMPLE NO.:	N9635	N9636				
Benzene	<1.	<1.				
Benzyl chloride	<10.	<10.				
Bis (2-chloroethoxy) methane	<500.	<500.				
Bromobenzene	<5.	<5.				
Bromodichloromethane	<1.	<1.				
Bromoform	<10.	<10.				
Bromomethane	<1.	<1.				
Carbon tetrachloride	↓	↓				
Chlorobenzene	↓	↓				
Chloroethane	↓	↓				
2-Chloroethylvinyl ether	<10.	<10.				
Chloroform	<1.	<1.				
1-Chlorohexane	<10.	<10.				
Chloromethane	<1.	<1.				
Chloromethylmethyl ether	<100.	<100.				
2-Chlorotoluene	<5.	<5.				
4-Chlorotoluene	<5.	<5.				
Dibromochloromethane	<1.	<1.				
Dibromomethane	<10.	<10.				
1,2-Dichlorobenzene	<5.	<5.				
1,3-Dichlorobenzene	↓	↓				
1,4-Dichlorobenzene	↓	↓				
Dichlorodifluoromethane	<10.	<10.				

Authorized: Monika Santucci

Date: January 8, 1992

OBG
LABORATORIES, INC.

Volatile Organics
Method 8010/8020

CLIENT U.S. NAVY **JOB NO.** 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

MATRIX: Water

DATE COLLECTED 12-12-91 **DATE RECEIVED** 12-13-91 **DATE ANALYZED** 12-24-91

DESCRIPTION:	Field Blank	QC Trip Blank				
SAMPLE NO.:	N9635	N9636				
1,1-Dichloroethane	<1.	<1.				
1,2-Dichloroethane	↓	↓				
1,1-Dichloroethylene	↓	↓				
1,2-Dichloroethylene (total)	↓	↓				
Dichloromethane	↓	1.*				
1,2-Dichloropropane	↓	<1.				
cis-1,3-Dichloropropylene	↓	↓				
trans-1,3-Dichloropropylene	↓	↓				
Ethylbenzene	↓	↓				
1,1,2,2-Tetrachloroethane	↓	↓				
1,1,1,2-Tetrachloroethane	↓	↓				
Tetrachloroethylene	↓	↓				
Toluene	↓	↓				
1,1,1-Trichloroethane	↓	↓				
1,1,2-Trichloroethane	↓	↓				
Trichloroethylene	↓	↓				
Trichlorofluoromethane	↓	↓				
1,2,3-Trichloropropane	↓	↓				
Vinyl chloride	↓	↓				
Xylene (total)	<3.	<3.				

Comments: *Laboratory contaminant

Methodology: USEPA,SW-846, November 1986, 3rd Edition

Certification No.: 315

Units: µg/l

Page 2 of 2

Authorized: Monika Santucci

Date: January 8, 1992

OBG LABORATORIES, INC.

Laboratory Report

CLIENT U.S. NAVY JOB NO. 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

Toxicity Characteristic Leaching Procedure MATRIX: Water

DATE COLLECTED 12-12-91 DATE RECEIVED 12-13-91

Description	MW-3			
Sample #	N9616			
TCLP Volatile Organics:				
BENZENE	<0.05			
CARBON TETRACHLORIDE	<0.05			
CHLOROBENZENE	<10.0			
CHLOROFORM	<0.60			
1,2-DICHLOROETHANE	<0.05			
1,1-DICHLOROETHYLENE	<0.07			
METHYL ETHYL KETONE	<20.0			
TETRACHLOROETHYLENE	<0.07			
TRICHLOROETHYLENE	<0.05			
VINYL CHLORIDE	<0.02			
Analytical Record:				
Date Leachate Created -				
Date Analyzed 12-26-91				

Comments:

Certification No.: 315

Units: mg/l

Authorized: Monika Santucci

Date: January 8, 1992

LABORATORIES, INC.

Laboratory Report

CLIENT U.S. NAVY **JOB NO.** 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

Toxicity Characteristic Leaching Procedure MATRIX: Water

DATE COLLECTED 12-12-91 **DATE RECEIVED** 12-13-91

Description	MW-3				
Sample #	N9616				
TCLP Metals:					
ARSENIC	<0.5				
BARIUM	<10.				
CADMIUM	<0.1				
CHROMIUM	<0.5				
LEAD	<0.5				
MERCURY	<0.0005				
SELENIUM	<0.1				
SILVER	<0.5				

Comments:

Certification No.: 315

Units: mg/l

Authorized: Monika Santucci

Date: January 8, 1992

LABORATORIES, INC.

Laboratory Report

CLIENT U.S. NAVY **JOB NO.** 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

Toxicity Characteristic Leaching Procedure MATRIX: Water

DATE COLLECTED 12-12-91 **DATE RECEIVED** 12-13-91

Description	MW-3				
Sample #	N9616				
TCLP Pesticides/Herbicides:					
CHLORDANE	<0.01				
ENDRIN	<0.005				
HEPTACHLOR	<0.005				
HEPTACHLOR EPOXIDE	<0.005				
LINDANE	<0.005				
METHOXYCHLOR	<0.01				
TOXAPHENE	<0.05				
2,4-D	<0.01*				
2,4,5-TP (SILVEX)	<0.01*				

Analytical Record:

Date Leachate Created 12-17-91

Date Herbicide Extracted Sub

Date Pesticide Extracted 12-19-91

Date Herbicide Analyzed Sub

Date Pesticide Analyzed 1-6-92

Comments: *Laboratory analysis subcontracted to Hudson Environmental Services, Inc., NYS DOH Lab ID# 11140

Certification No.: 10155

Units: mg/l

Authorized: Monika Santucci

Date: January 14, 1992

OBG
LABORATORIES, INC.

Laboratory Report

CLIENT U.S. NAVY JOB NO. 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

Toxicity Characteristic Leaching Procedure MATRIX: Water

DATE COLLECTED 12-12-91 DATE RECEIVED 12-13-91

Description	MW-3				
Sample #	N9616				
TCLP Semivolatile Organics:					
o-CRESOL	<0.1				
m-CRESOL	↓				
p-CRESOL					
CRESOL, TOTAL					
1,4-DICHLOROBENZENE					
2,4-DINITROTOLUENE					
HEXACHLOROBENZENE					
HEXACHLOROBUTADIENE					
HEXACHLOROETHANE					
NITROBENZENE					
PENTACHLOROPHENOL	<0.5				
PYRIDINE	<1.0				
2,4,5-TRICHLOROPHENOL	<0.5				
2,4,6-TRICHLOROPHENOL	<0.1				
Analytical Record:					
Date Leachate Created	12-17-91				
Date Extracted	12-18-91				
Date Analyzed	12-31-91				

Comments:

Certification No.: 315

Units: mg/1

Authorized: Monika Santucci

Date: January 14, 1992

LABORATORIES, INC.

METHOD 8100

Laboratory Report

CLIENT U.S. NAVY **JOB NO.** 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

POLY NUCLEAR AROMATIC HYDROCARBONS MATRIX: Water

Date Analyzed 1-1-92 **DATE COLLECTED** 12-12-91 **DATE RECEIVED** 12-13-91

Description	MW-1	MW-7	MW-11		
Sample #	N9617	N9620	N9621		
ACENAPHTHENE	<50.	<10.	<45.		
ACENAPHTHYLENE	↓	↓	↓		
ANTHRACENE	↓	↓	↓		
BENZ(a)ANTHRACENE	↓	↓	↓		
BENZO(a)PYRENE	↓	↓	↓		
BENZO(b)FLUORANTHENE	↓	↓	↓		
BENZO(k)FLUORANTHENE	↓	↓	↓		
BENZO(g,h,i)PERYLENE	↓	↓	↓		
CHRYSENE	↓	↓	↓		
DIBENZ(a,h)ANTHRACENE	↓	↓	↓		
FLUORANTHENE	↓	↓	↓		
FLUORENE	↓	↓	↓		
INDENO(1,2,3-cd)PYRENE	↓	↓	↓		
NAPHTHALENE	↓	↓	↓		
PHENANTHRENE	↓	↓	↓		
PYRENE	↓	↓	↓		

Comments: Elevated detection limits due to limited sample.

Certification No.: 315

Units: µg/l

Authorized: Monika Santucci

Date: January 14, 1992

APPENDIX C

LABORATORY RESULTS - SOIL

ENVIRONMENTAL TESTING SERVICES, INC.
P.O. Box 12715 • 888 Norfolk Square • Norfolk, Virginia 23502 • (804) 461-ETSI (3874) • Fax (804) 461-0379

January 8, 1992

ANALYTICAL SERVICES REPORT SHEET

Customer:
Mr. John Conway
O'Brien & Gere Engineers, Inc.
440 Viking Drive
Virginia Beach, Virginia 23452

Sample Description:
2 soil samples delivered on
December 19, 1991 designated
as Midway Park.

RESULTS

I. Total Petroleum Hydrocarbons: California Method GC/FID.

Sample ID	TPH in mg/kg
B 4 (4-6)	12,000
B 4 (9-11)	11,000

Anne S. Burnett
Anne S. Burnett
Quality Control Officer

ENVIRONMENTAL TESTING SERVICES, INC.

P.O. Box 12715 • 888 Norfolk Square • Norfolk, Virginia 23502 • (804) 461-ETSI (3874) • Fax (804) 461-0379

January 8, 1992

ANALYTICAL SERVICES REPORT SHEET

Customer:
Mr. John Conway
O'Brien & Gere Engineers, Inc.
440 Viking Drive
Virginia Beach, Virginia 23452

Sample Description:
9 soil samples delivered on December 19, 1991 designated as Midway Park.

RESULTS

I. **Total Petroleum Hydrocarbons**: California Method, GC/FID.

Sample ID	TPH in mg/kg
MW 12 (4-6)	7.32
MW 12 (9-11)	9.11
MW 14 (0-2)	4.32
MW 14 (2-4)	11.4
B 1 (4-6)	11.1
B 1 (9-11)	6.84
B 2 (4-6)	8.12
B 2 (11-13)	9.57
B 3 (4-6)	7.89

Anne S Burnett

Anne S. Burnett
Quality Control Officer

ENVIRONMENTAL TESTING SERVICES, INC.

P.O. Box 12715 • 888 Norfolk Square • Norfolk, Virginia 23502 • (804) 461-ETSI (3874) • Fax (804) 461-0379

II. pH Analysis: Orion ion-analyzer with a two point calibration.

Sample ID	Analyst	pH
MW 12 (9-11)	JK	5.06

III. Flashpoint: EPA SW-846 Method 1010.

Sample ID	Analyst	Flashpoint
MW 12 (9-11)	JK	Negative to 110°C

Anne S. Burnett

Anne S. Burnett
Quality Control Officer

ENVIRONMENTAL TESTING SERVICES, INC.
P.O. Box 12715 • 888 Norfolk Square • Norfolk, Virginia 23502 • (804) 461-ETSI (3874) • Fax (804) 461-0379

January 17, 1992
Page 1 of 6

ANALYTICAL SERVICES REPORT SHEET

<u>Customer</u>:
Ms. Tina Bickerstaff
O'Brien & Gere Engineers, Inc.
440 Viking Drive
Virginia Beach, Virginia 23452

<u>Sample Description</u>:
10 soil samples delivered on December 19, 1991 designated as Midway Park.

RESULTS

I. <u>Total Petroleum Hydrocarbons</u>: California Method, GC/FID.

Sample ID	TPH in mg/kg
MW2 14-16	18.6
MW2 9-11	14.6
MW4 9-11	15.4
MW4 14-16	255.0
MW6 9-11	14.0
MW6 14-16	12.6
MW8 0-2	6.72
MW8 11-6	22.8
MW10 4-6	16.7
MW10 9-11	8.38

Anne S Burnett
Anne S. Burnett
Quality Control Officer

II. pH Analysis: EPA Method 150.1.

Sample ID	pH
MW2 14-16	5.03
MW4 14-16	6.23
MW6 14-16	4.81
MW8 4-6	7.36

III. Flashpoint: EPA SW-846 Method 1010.

Sample ID	Results
MW2 14-16	Negative to 110°C
MW4 14-16	Negative to 110°C
MW6 14-16	Negative to 110°C
MW8 4-6	Negative to 110°C

IV. Toxicity Characteristic Leaching Process (TCLP): EPA SW-846 Method 1311.

Sample ID	Results
MW2 14-16	See attached compound list
MW4 14-16	See attached compound list

Anne S. Burnett

Anne S. Burnett
Quality Control Officer

The information presented in the report represents the laboratory analyses performed on the samples provided to Environmental Testing Services, Inc. in accordance with the test methods requested and described above. Environmental Testing Services, Inc. is not responsible for any use of this information by its clients and shall not reveal these results to any person or entity without written authorization from its client. Any liability on the part of Environmental Testing Services, Inc. shall not exceed the sum paid by the client to Environmental Testing Services, Inc for the work performed.

TOXICITY CHARACTERISTICS LEACHING PROCESS (TCLP) CONSTITUENT AND REGULATORY LEVELS

Toxicity Characteristic Leaching Process (TCLP): EPA Manual SW-846 Method 1311.

Sample ID: MW2 14-16

Compound	Concentration (mg/l)	Regulatory Level (mg/l)
Arsenic	<0.050	5.0
Barium	0.62	100.0
Benzene	<0.009	0.5
Cadium	<0.010	1.0
Carbon tetrachloride	<0.005	0.5
Chlordane	<0.008	0.03
Chlorobenzene	<0.005	100.0
Chloroform	<0.005	6.0
Chromium	<0.050	5.0
o-Cresol	<0.020	200.0
m-Cresol	<0.040	200.0
p-Cresol	<0.040	200.0
Cresol	<0.005	200.0
2,4-D	<0.010	10.0
1,4-Dichlorobenzene	<0.005	7.5
1,2-Dichloroethane	<0.005	0.5
1,1-Dichloroethylene	<0.005	0.7
2,4-Dinitrotoluene	<0.008	0.13

Anne S Burnett

Anne S. Burnett
Quality Control Officer

TOXICITY CHARACTERISTICS LEACHING PROCESS (TCLP)
CONSTITUENT AND REGULATORY LEVELS
CONTINUED

Sample ID: MW2 14-16

Compound	Concentration (mg/l)	Regulatory Level (mg/l)
Endrin	<0.005	0.02
Heptachlor (and its hydroxide)	<0.004	0.008
Hexachlorobenzene	<0.010	0.13
Hexachloro-1,3-butadiene	<0.010	0.5
Hexachloroethane	<0.010	3.0
Lead	<0.010	5.0
Lindane	<0.002	0.4
Mercury	<0.002	0.2
Methoxychlor	<0.010	10.0
Methyl ethyl ketone	<0.005	200.0
Nitrobenzene	<0.010	2.0
Pentachlorophenol	<0.020	100.0
Pyridine	<0.010	5.0
Selenium	<0.050	1.0
Silver	<0.010	5.0
Tetrachloroethylene	<0.005	0.7
Toxaphene	<0.010	0.5
Trichloroethylene	<0.005	0.5
2,4,5-Trichlorophenol	<0.010	400.0
2,4,6-Trichlorophenol	<0.010	2.0
2,4,5-TP (Silvex)	<0.005	1.0
Vinyl chloride	<0.010	0.2

Anne S. Burnett

Anne S. Burnett
Quality Control Officer

The information presented in the report represents the laboratory analyses performed on the samples provided to Environmental Testing Services, Inc. in accordance with the test methods requested and described above. Environmental Testing Services, Inc. is not responsible for any use of this information by its clients and shall not reveal these results to any person or entity without written authorization from its client. Any liability on the part of Environmental Testing Services, Inc. shall not exceed the sum paid by the client to Environmental Testing Services, Inc.

TOXICITY CHARACTERISTICS LEACHING PROCESS (TCLP) CONSTITUENT AND REGULATORY LEVELS

Toxicity Characteristic Leaching Process (TCLP): EPA Manual SW-846 Method 1311.

Sample ID: MW4 14-16

Compound	Concentration (mg/l)	Regulatory Level (mg/l)
Arsenic	<0.050	5.0
Barium	1.24	100.0
Benzene	<0.009	0.5
Cadium	<0.010	1.0
Carbon tetrachloride	<0.005	0.5
Chlordane	<0.008	0.03
Chlorobenzene	<0.005	100.0
Chloroform	<0.005	6.0
Chromium	<0.050	5.0
o-Cresol	<0.020	200.0
m-Cresol	<0.040	200.0
p-Cresol	<0.040	200.0
Cresol	<0.005	200.0
2,4-D	<0.010	10.0
1,4-Dichlorobenzene	<0.005	7.5
1,2-Dichloroethane	<0.005	0.5
1,1-Dichloroethylene	<0.005	0.7
2,4-Dinitrotoluene	<0.008	0.13

Anne S Burnett

Anne S. Burnett
Quality Control Officer

TOXICITY CHARACTERISTICS LEACHING PROCESS (TCLP)
CONSTITUENT AND REGULATORY LEVELS
CONTINUED

Sample ID: MW4 14-16

Compound	Concentration (mg/l)	Regulatory Level (mg/l)
Endrin	<0.005	0.02
Heptachlor (and its hydroxide)	<0.004	0.008
Hexachlorobenzene	<0.010	0.13
Hexachloro-1,3-butadiene	<0.010	0.5
Hexachloroethane	<0.010	3.0
Lead	<0.010	5.0
Lindane	<0.002	0.4
Mercury	<0.002	0.2
Methoxychlor	<0.010	10.0
Methyl ethyl ketone	<0.005	200.0
Nitrobenzene	<0.010	2.0
Pentachlorophenol	0.179	100.0
Pyridine	<0.010	5.0
Selenium	<0.050	1.0
Silver	<0.010	5.0
Tetrachloroethylene	<0.005	0.7
Toxaphene	<0.010	0.5
Trichloroethylene	<0.005	0.5
2,4,5-Trichlorophenol	<0.010	400.0
2,4,6-Trichlorophenol	<0.010	2.0
2,4,5-TP (Silvex)	<0.005	1.0
Vinyl chloride	<0.010	0.2

Anne S. Burnett

Anne S. Burnett
Quality Control Officer

The information presented in the report represents the laboratory analyses performed on the samples provided to Environmental Testing Services, Inc. in accordance with the test methods requested and described above. Environmental Testing Services, Inc. is not responsible for any use of this information by its clients and shall not reveal these results to any person or entity without written authorization from its client. Any liability on the part of Environmental Testing Services, Inc. shall not exceed the sum paid by the client to Environmental Testing Services, Inc.

APPENDIX D

IN-SITU PERMEABILITY TEST

IN-SITU HYDRAULIC CONDUCTIVITY TEST PROTOCOL

Introduction

The following presents the methods and procedures to be employed in completing in-situ hydraulic conductivity (K) tests. The purpose of the test is to obtain estimates of aquifer permeability which in turn will be used to estimate ground water flow velocity. A Quality Control/Quality Assurance (QA/QC) program for the K-tests has also been formulated and is presented herein.

Testing Methods and Procedures

Potential Hydraulic Difference Creation:

To complete an in-situ hydraulic conductivity (K) test, a potential hydraulic difference must be created between the well being monitored and the surrounding aquifer. This will be accomplished by rapidly inserting a solid piece of one-inch (1") diameter PVC into the well's water column, thereby displacing the water column upward and creating a potential for flow from the well to the surrounding aquifer. The rate of decline of the water level in the well will be monitored as it comes into equilibrium with the aquifer. Subsequent to the well water level approaching the hydraulic head static level, the displacing rod will be removed. This will result in a water level in the well that is lower than the surrounding aquifer and therefore will create a potential for flow from the aquifer into the well. This recovery will also be monitored until the static level is approached.

Revised
6/26/91

Ground Water Level Monitoring Equipment and Time Sequence:

Ground water levels during the tests will be monitored using an Enviro-Labs Data Logging System which employs a conventional analog signal generating pressure reducing that directly measures feet of hydraulic head to the one-hundredth (0.01) of a foot. During the tests, ground water level (hydraulic head) data will be collected for both the head decline and recovery periods according to the following time schedule:

Time After Potential Difference Induced	Time Between Water Level Readings
0 - 1 minutes	2 seconds
1 - 3 minutes	5 seconds
3 - 5 minutes	15 seconds
5 - 10 minutes	30 seconds
10 - 30 minutes	60 seconds

Note: It is anticipated that the well's water level will be near the pre-test measured static level after thirty (30) minutes.

Step by Step Testing Procedure:

1. Install pressure transducer and couple to data logging unit, noting depth installed.
2. Measure and record static ground water level in well to be tested.
3. Insert displacing rod.
4. Monitor water level declines to static level.
5. Remove displacing rod.
6. Monitor water level recovery.

Manual Methods

Under some field conditions, it may be appropriate to conduct in-situ conductivity testing manually without the aid of an electronic data logger. In these instances, the following procedures will be utilized:

1. The depth to ground water will be measured.
2. A potential hydraulic difference will be created by bailing or pumping ground water from the well to be measured.
3. Subsequent ground water recovery will be measured at appropriate intervals as determined by the field geologist.
4. Depth to ground water will be measured to the nearest 0.01 foot.
5. Measurements will be obtained until ground water has recovered to its static level or, if site conditions warrant, a minimum of 90% of the static level.

Equipment Decontamination

Following each respective test, equipment coming in contact with ground water will be decontaminated. This will be accomplished using a mild soap solution wash followed by a control source water rinse.

Quality Assurance/Quality Control Program

The objective of the Quality Assurance/Quality Control program is to ensure that the in-situ hydraulic conductivity (k) test data is of a known and acceptable quality. This will be accomplished by completing the following:

1. Daily manufacturer-specified pressure transducer and data logging instrument calibration,
2. Periodic physical ground water level measurements collected at five (5) minute intervals during the test to cross check pressure transducer readings.

Data Analysis

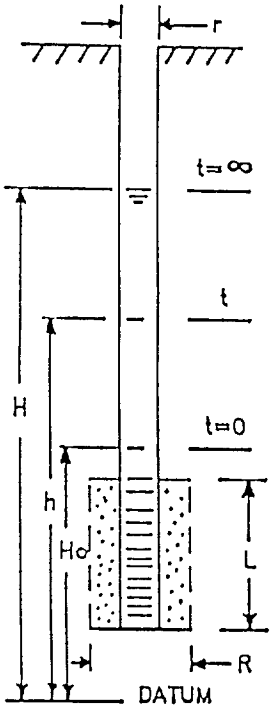
Values of hydraulic conductivity will be calculated from the change in head versus the change in time data using Hvorselv's formula.

Revised
6/26/91

IN–SITU PERMEABILITY TEST
FIELD LOG

PROJECT S781
WELL NUMBER MW 2
DATE 12-10-91

LOCATION MIDWAY PK
ELEVATION



STATIC HEAD (H) 18.83'

PIPE RADIUS (r) .08'

SCREEN RADIUS (R) .36'

SCREEN LENGTH (L) 10'

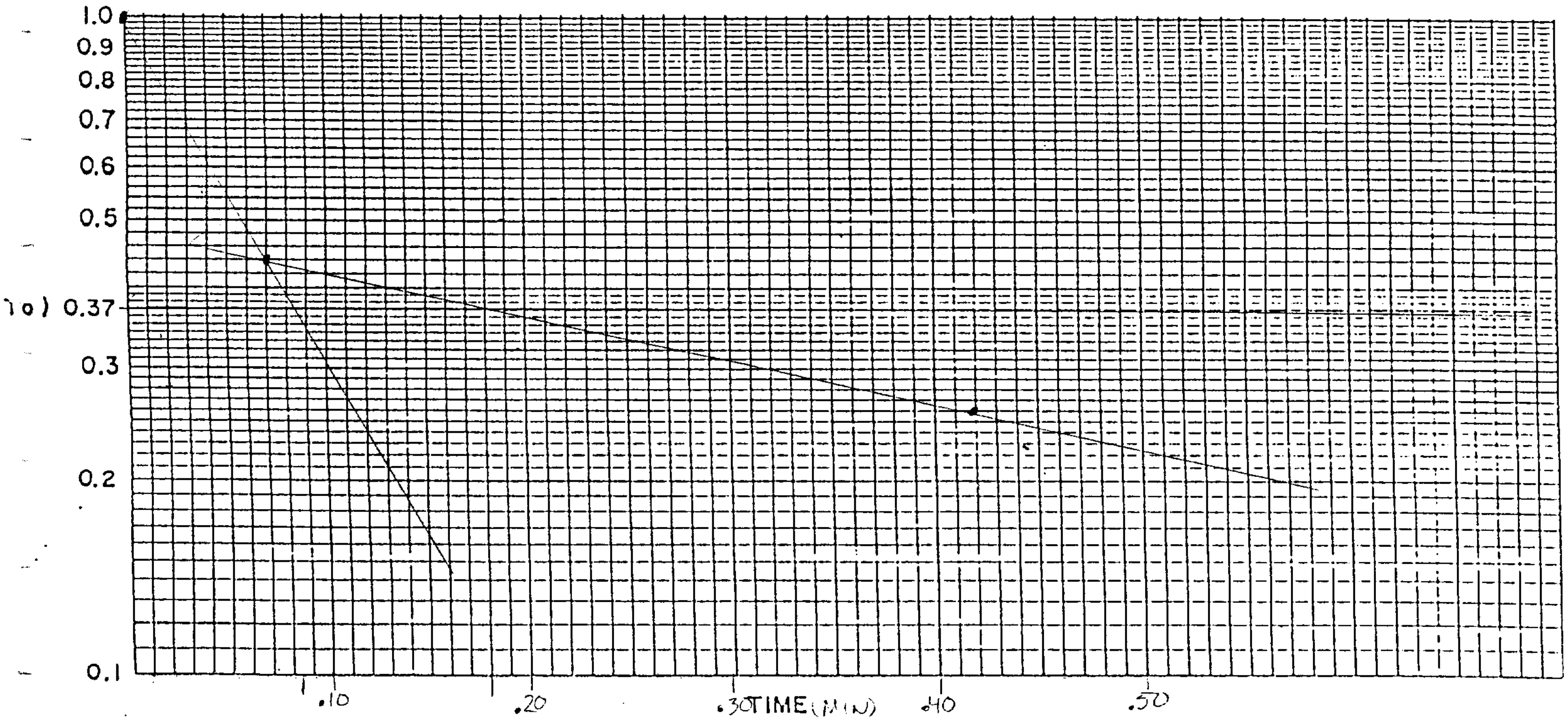
INITIAL HEAD (Ho) 19.1'

HYDRAULIC CONDUCTIVITY :

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

$$K = \frac{(.08)^2 \ln(10/.36)}{2(10 \cdot 7.95)} \quad \frac{.02}{159} = 1.3 \times 10^{-4} \text{ ft/sec} (6.464 \times 10^5) = 84.0 \text{ gpd/ft}^2$$

TIME sec	WATER DEPTH	t min	h	$\frac{H-h}{H-Ho-.27}$
0		0	19.1	1
4.5		.07	18.95	.44
25		.42	18.90	.26
111		1.85	18.95	.07

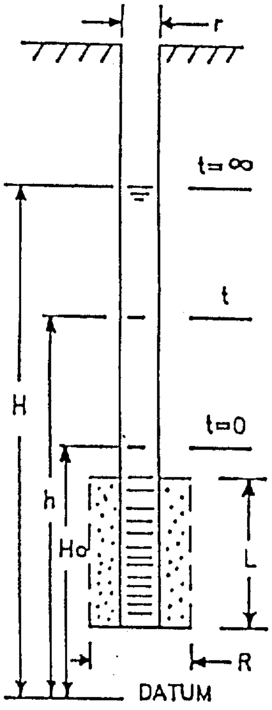


To = .085min = 5.1 sec To = .18min = 10.8 sec $\bar{X}$ = 7.95 sec

IN-SITU PERMEABILITY TEST
FIELD LOG

PROJECT S-781
WELL NUMBER MW3
DATE 12-10-91

LOCATION MIDWAY PARK
ELEVATION



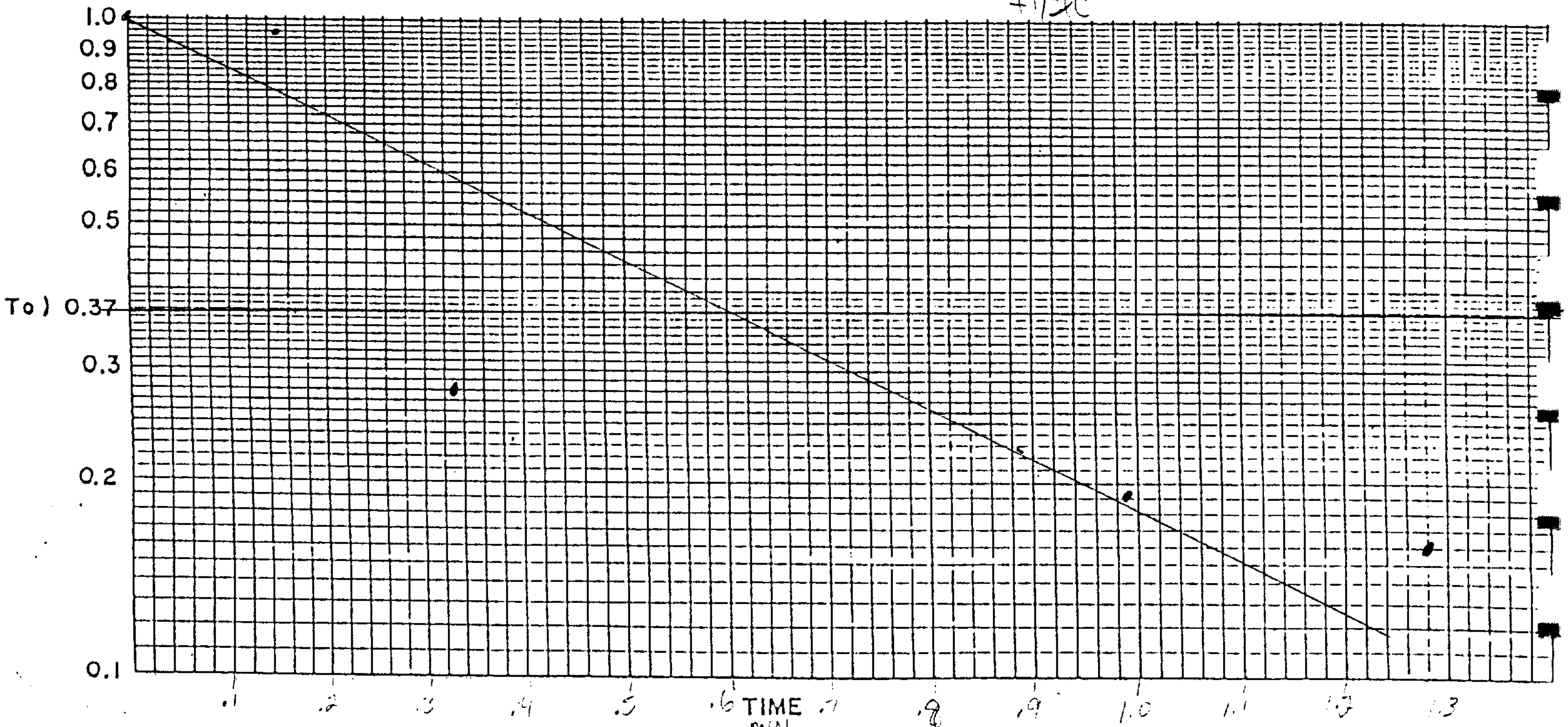
STATIC HEAD (H) 15.34'
PIPE RADIUS (r) .08'
SCREEN RADIUS (R) .36'
SCREEN LENGTH (L) 2.16'
INITIAL HEAD (Ho) 17.0'
HYDRAULIC CONDUCTIVITY :

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

$$K=\frac{(.08)^2\ln\left(2.16/.36\right)\,1.15\times10^{-2}}{2(2.16\cdot .36)=155.52}=7.37\times10^{-5}\,(6.464\times10^{5})=47.7\text{ gpd/ft}^2$$

ft/sec

TIME sec	WATER DEPTH	t min	h	$\frac{H-h}{H-Ho}$ -1.63
0		0	17.0	1
9		.15	16.9	.96
20		.33	15.8	.28
58		.97	15.65	.19
76		1.27	15.60	.16

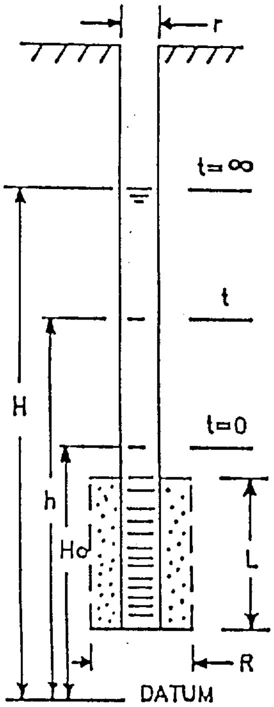


To= .6min = 36 sec

IN-SITU PERMEABILITY TEST
FIELD LOG

PROJECT S-781
WELL NUMBER MW 4
DATE

LOCATION Midway Park
ELEVATION

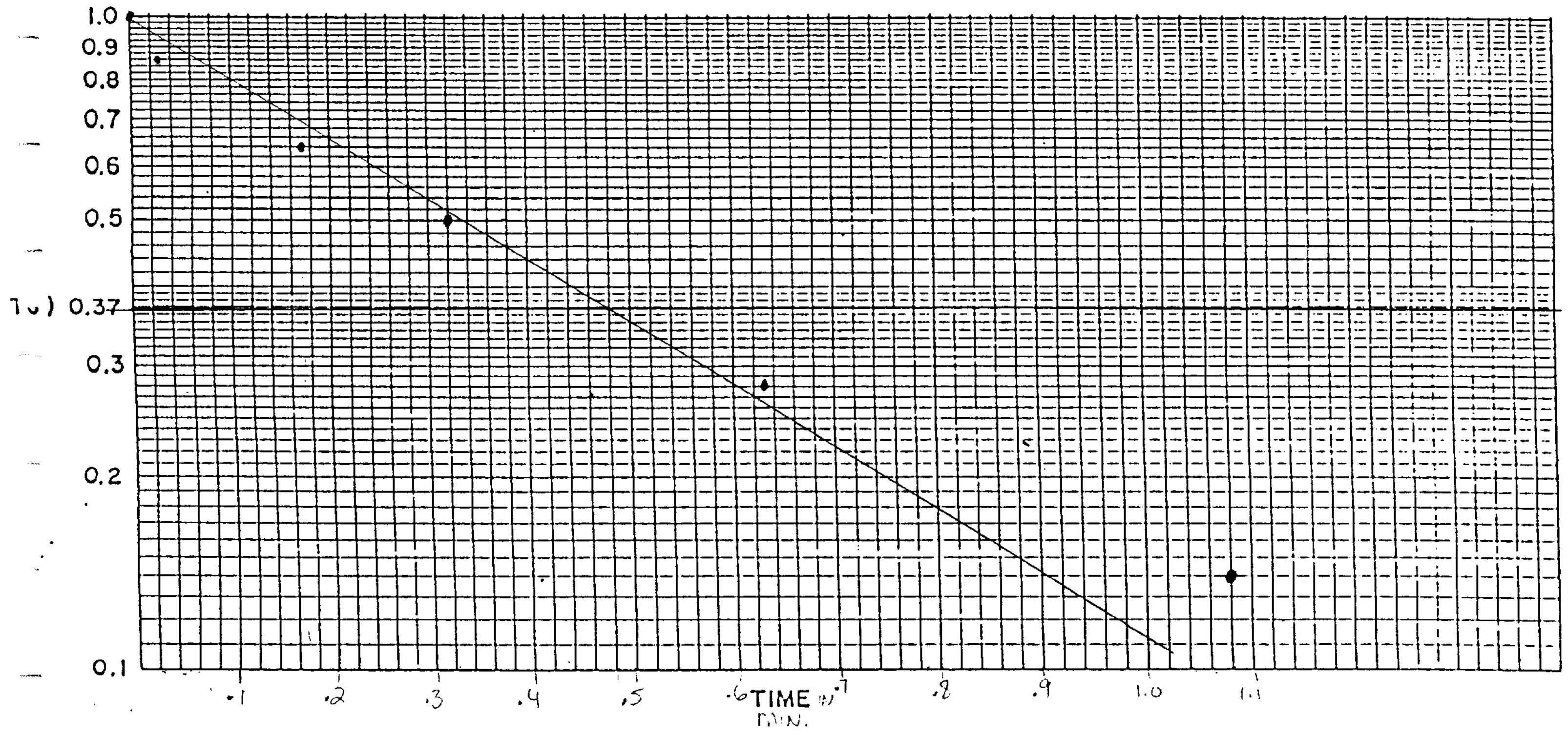


STATIC HEAD (H) 15.40'
PIPE RADIUS (r) .08'
SCREEN RADIUS (R) .36'
SCREEN LENGTH (L) 10'
INITIAL HEAD (Ho) 16.1'
HYDRAULIC CONDUCTIVITY :

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

$$K=\frac{(.08)^2\ln(16.1/.36)=.024}{2(10\cdot28.8)=576}=4.2\times10^{-5}\text{ft/sec}(6.464\times10^{5})=27.3\text{ gpd/ft}^2$$

TIME sec	WATER DEPTH	t min	h	$\frac{H-h}{H-Ho}$ -.7
0		0	16.1	1
2		.03	16.0	.86
10		.17	15.85	.64
19		.32	15.75	.50
38		.63	15.60	.29
65		1.08	15.50	.14

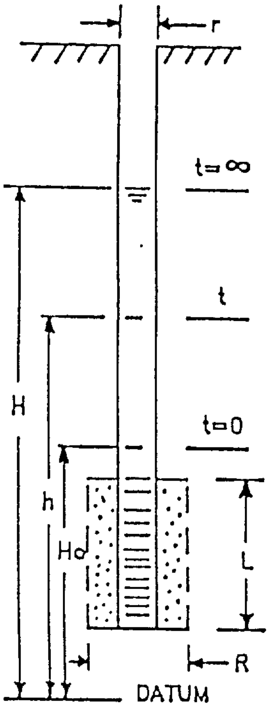


To = 48min = 28.8 sec

IN–SITU PERMEABILITY TEST
FIELD LOG

PROJECT S-781
WELL NUMBER MW 5
DATE 12-10-91

LOCATION midway Park
ELEVATION



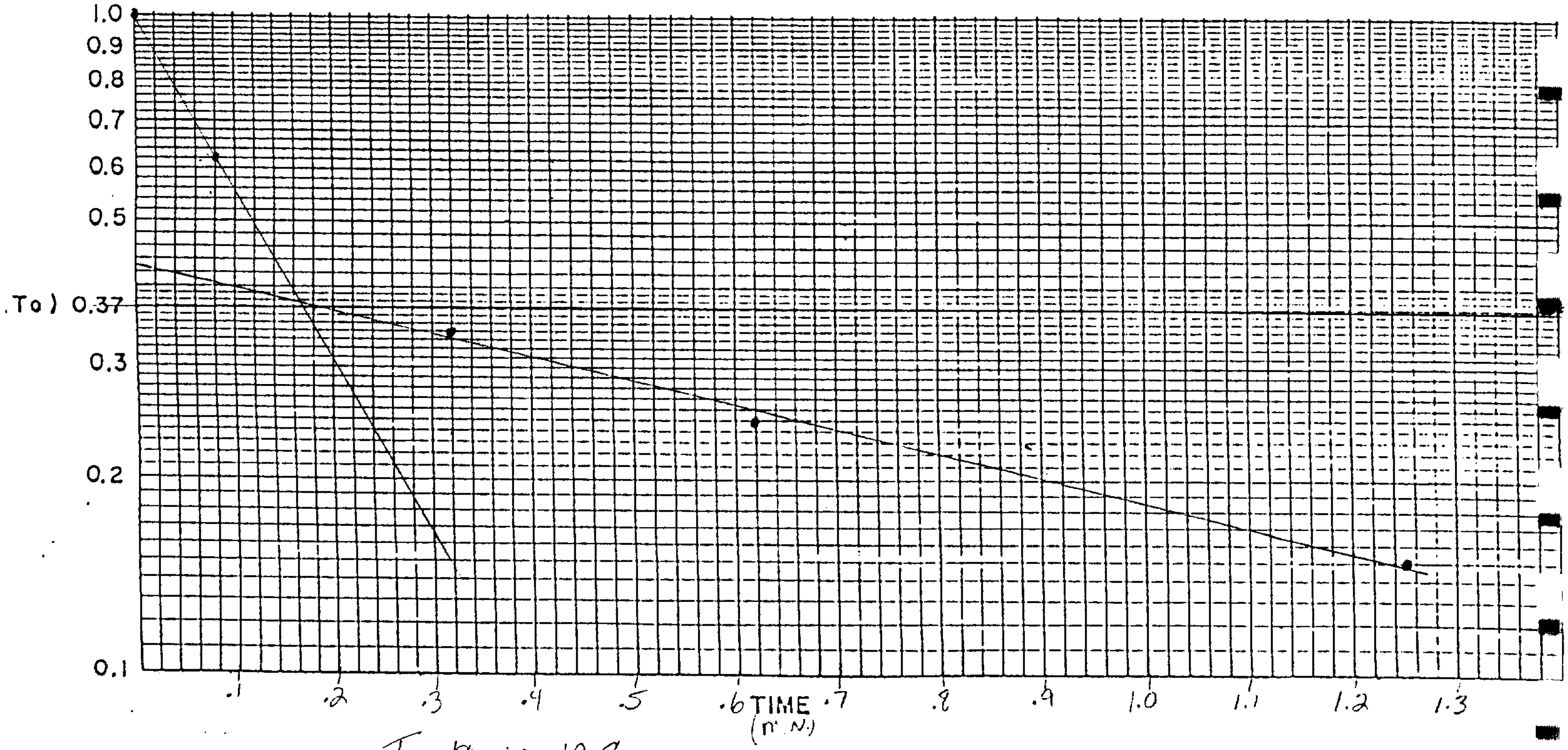
STATIC HEAD (H) 5.94'
PIPE RADIUS (r) .08'
SCREEN RADIUS (R) .36'
SCREEN LENGTH (L) 1.56'
INITIAL HEAD (Ho) 17.0'

TIME sec	WATER DEPTH	t min	h	$\frac{H-h}{H-Ho}$ -1.06
0		0	17.0	1
5		.08	16.6	.62
19		.32	16.3	.34
37		.62	16.2	.25
75		1.25	16.1	.15

HYDRAULIC CONDUCTIVITY :

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

$$K=\frac{(.08)^2\ln(1.56/.36)=.0094}{2(1.56\cdot10.8)=33.7}=2.8\times10^{-4}\text{ ft/sec}(6.464\times10^5)=180\text{ gpd/ft}^2$$



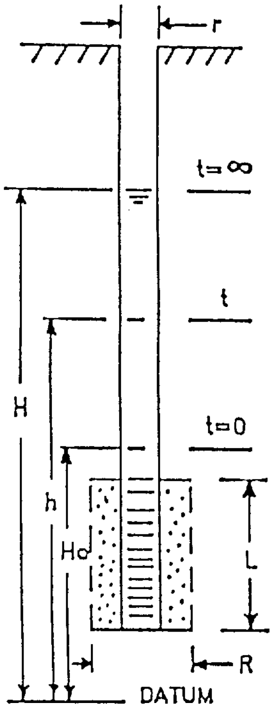
To=.18min=10.8sec

O'BRIEN & GERE

IN–SITU PERMEABILITY TEST
FIELD LOG

PROJECT S-781
WELL NUMBER MW 6
DATE 12-11-91

LOCATION Midway Park
ELEVATION

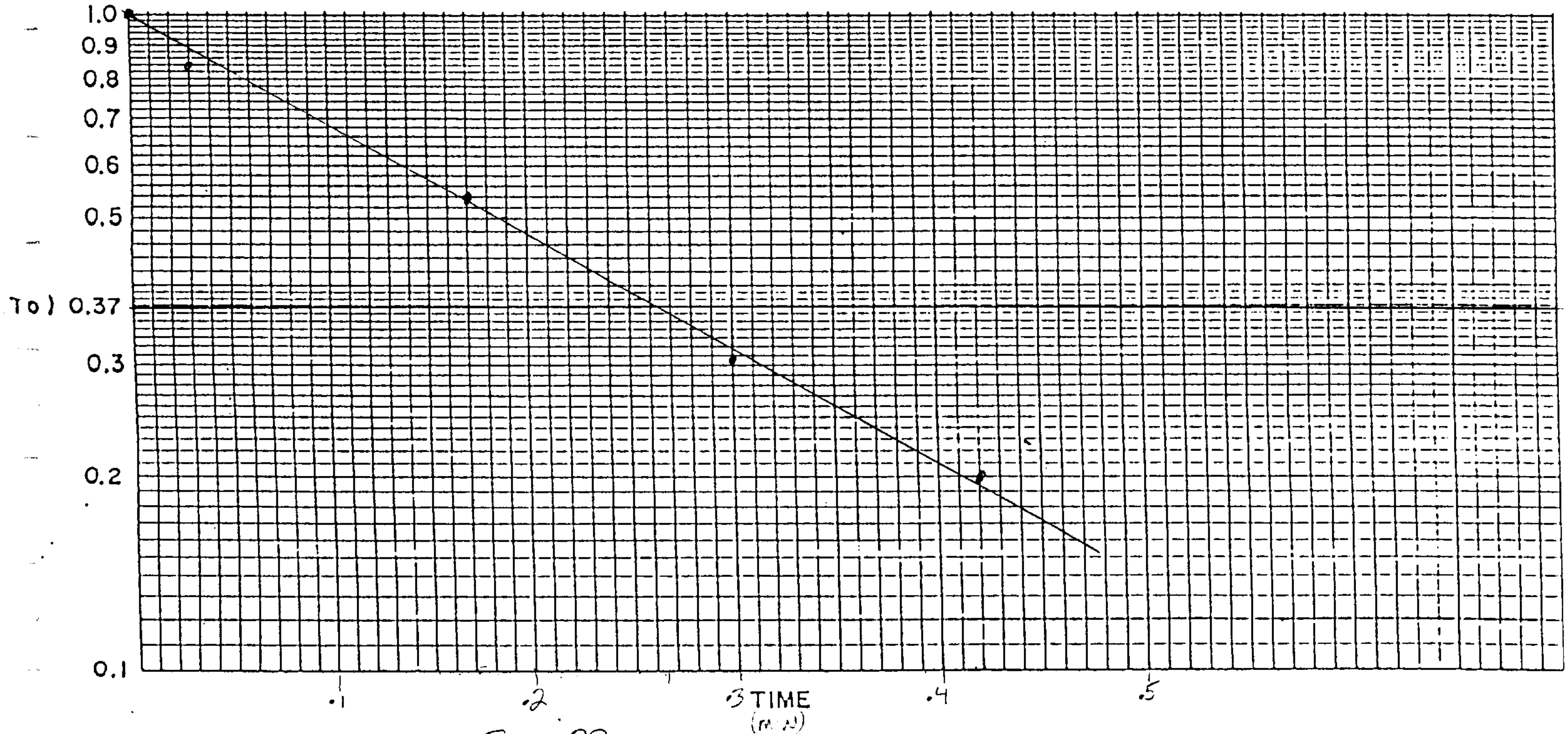


STATIC HEAD (H) 15.32'
PIPE RADIUS (r) .08'
SCREEN RADIUS (R) .36'
SCREEN LENGTH (L) 10'
INITIAL HEAD (Ho) 17.2'
HYDRAULIC CONDUCTIVITY :

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

$$K=\frac{(.08)^2\ln(10/.36)=.02}{2(10\cdot16.2)=324}=6.6\times10^{-5}\text{ ft/sec }(6.464\times10^5)=42.4\text{ gpd/ft}^2$$

TIME sec	WATER DEPTH	t min	h	$\frac{H-h}{H-Ho}$ -1.88
0		0	17.2	1
2		.03	16.9	.84
10		.17	16.3	.52
14		.30	15.9	.31
25		.42	15.7	.20
40		.67	15.5	.09
83		1.38	15.4	.04



To= .27 min=16.2 sec

IN–SITU PERMEABILITY TEST
FIELD LOG

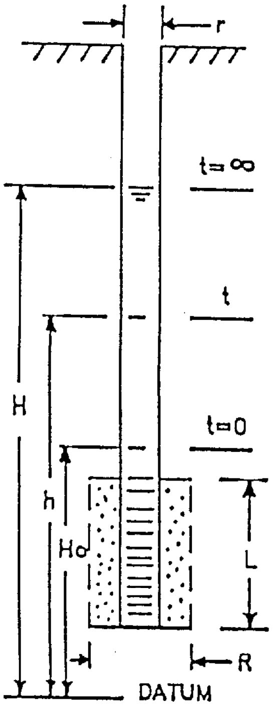
PROJECT S-781

WELL NUMBER MW 7

DATE 12-11-91

LOCATION Midway PK.

ELEVATION



STATIC HEAD (H) 6.49'

PIPE RADIUS (r) .08'

SCREEN RADIUS (R) .36'

SCREEN LENGTH (L) 8.51'

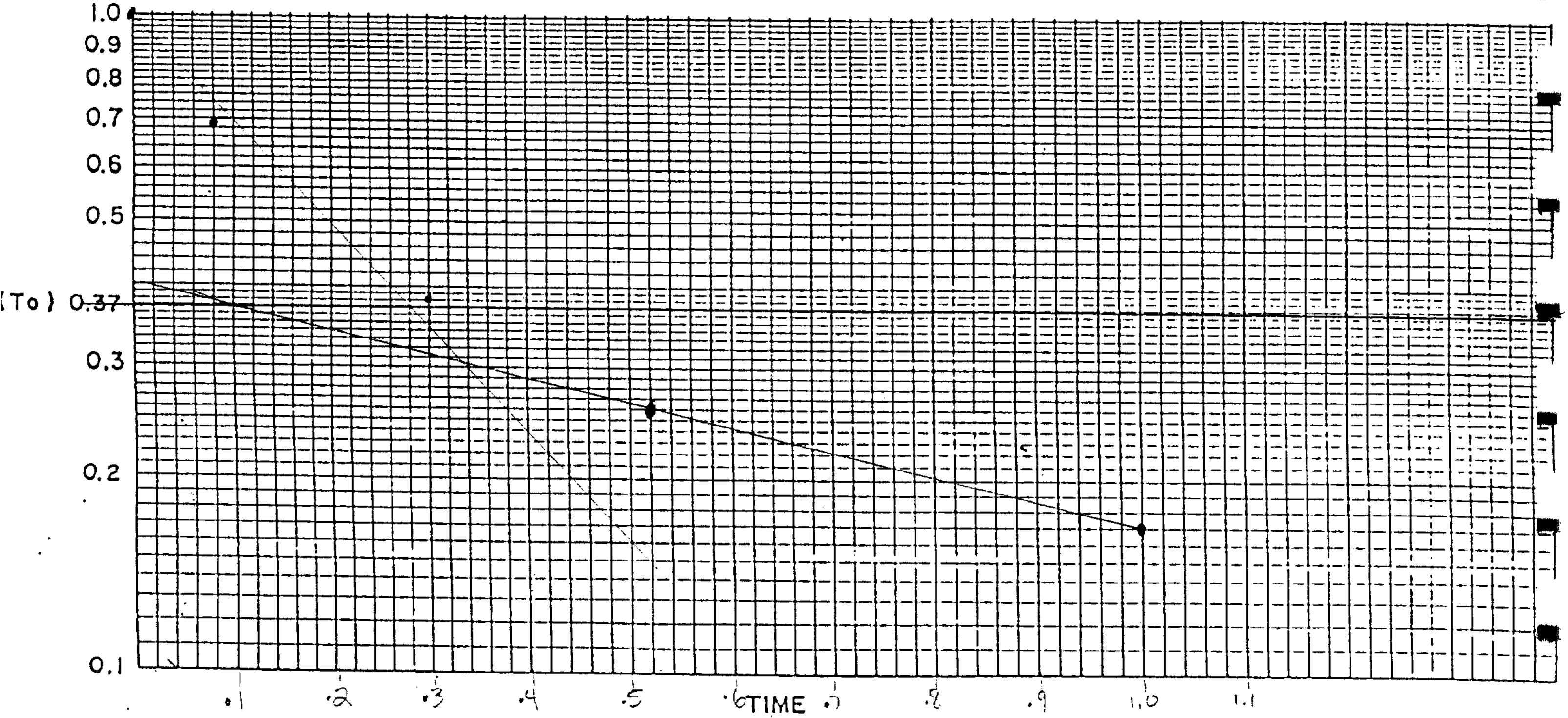
INITIAL HEAD (Ho) 10.7'

HYDRAULIC CONDUCTIVITY :

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

$$K=\frac{(.08)^2\ln(8.51/.36)=.02}{2(8.51\cdot 11.4)=194.0}=1.0\times10^{-4}\text{ ft/sec}(6.464\times10^{5})=67.4\text{ gpd/ft}^2$$

TIME sec	WATER DEPTH	t MIN	h	$\frac{H-h}{H-Ho}$ -4.21
0		0	10.7	1
5		.08	9.4	.69
18		.30	8.1	.38
31		.52	7.6	.26
60		1.0	7.2	.17
109		1.82	7.1	.14



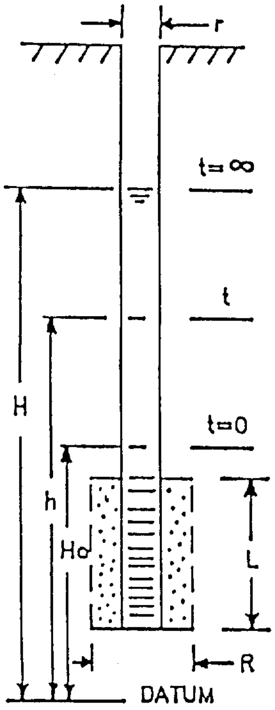
To = .1 min = 6 sec To = .28 min = 16.8 sec

$\overline{X}$ = 11.4

IN–SITU PERMEABILITY TEST
FIELD LOG

PROJECT S-781
WELL NUMBER MW8
DATE 12-11-91

LOCATION Midway Park
ELEVATION

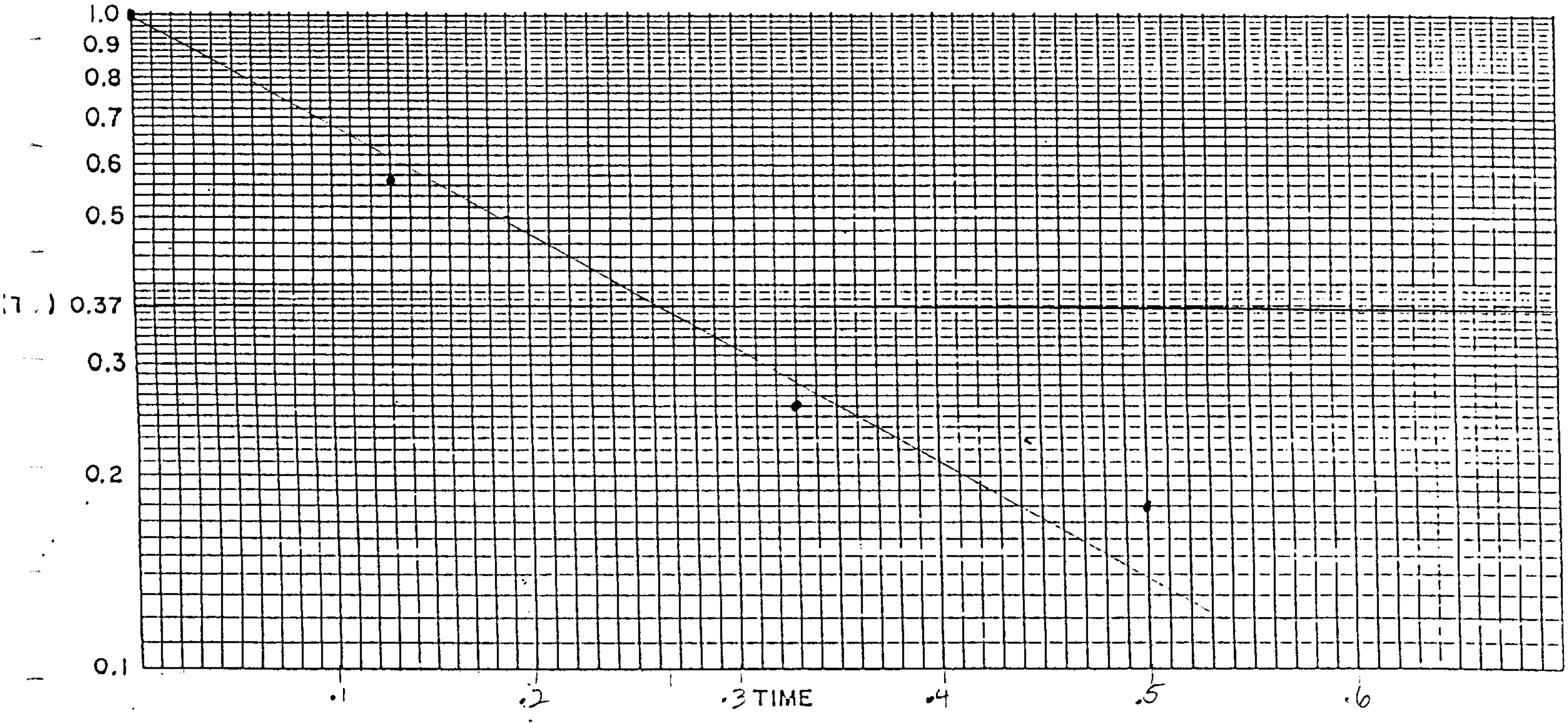


STATIC HEAD (H) 6.82'
PIPE RADIUS (r) .08'
SCREEN RADIUS (R) .36'
SCREEN LENGTH (L) 10'
INITIAL HEAD (Ho) 15.0'
HYDRAULIC CONDUCTIVITY :

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

$$K=\frac{(.08)^2\ln(10/.36)=.021}{2(10\cdot 15.6)=312}=6.8\times10^{-5}\ \text{ft/sec}\,(6.464\times10^{5})=44.1\ \text{gpd/ft}^2$$

TIME sec	WATER DEPTH	t min	h	$\frac{H-h}{H-Ho}$ -8.18
0		0	15.0	1
8		.13	11.5	.57
20		.33	8.95	.26
30		.50	9.0	.14
36		.60	7.6	.09
46		.77	7.3	.06
63		1.05	7.1	.03

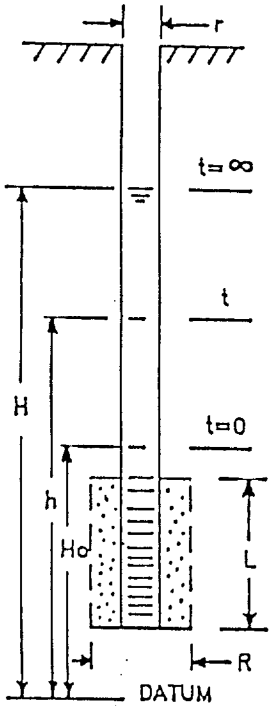


To = .26 min = 15.6 sec

IN–SITU PERMEABILITY TEST
FIELD LOG

PROJECT S-781
WELL NUMBER MW9
DATE 12-11-91

LOCATION Midway PK
ELEVATION



STATIC HEAD (H) 10.69'

PIPE RADIUS (r) .08'

SCREEN RADIUS (R) .36'

SCREEN LENGTH (L) 4.31'

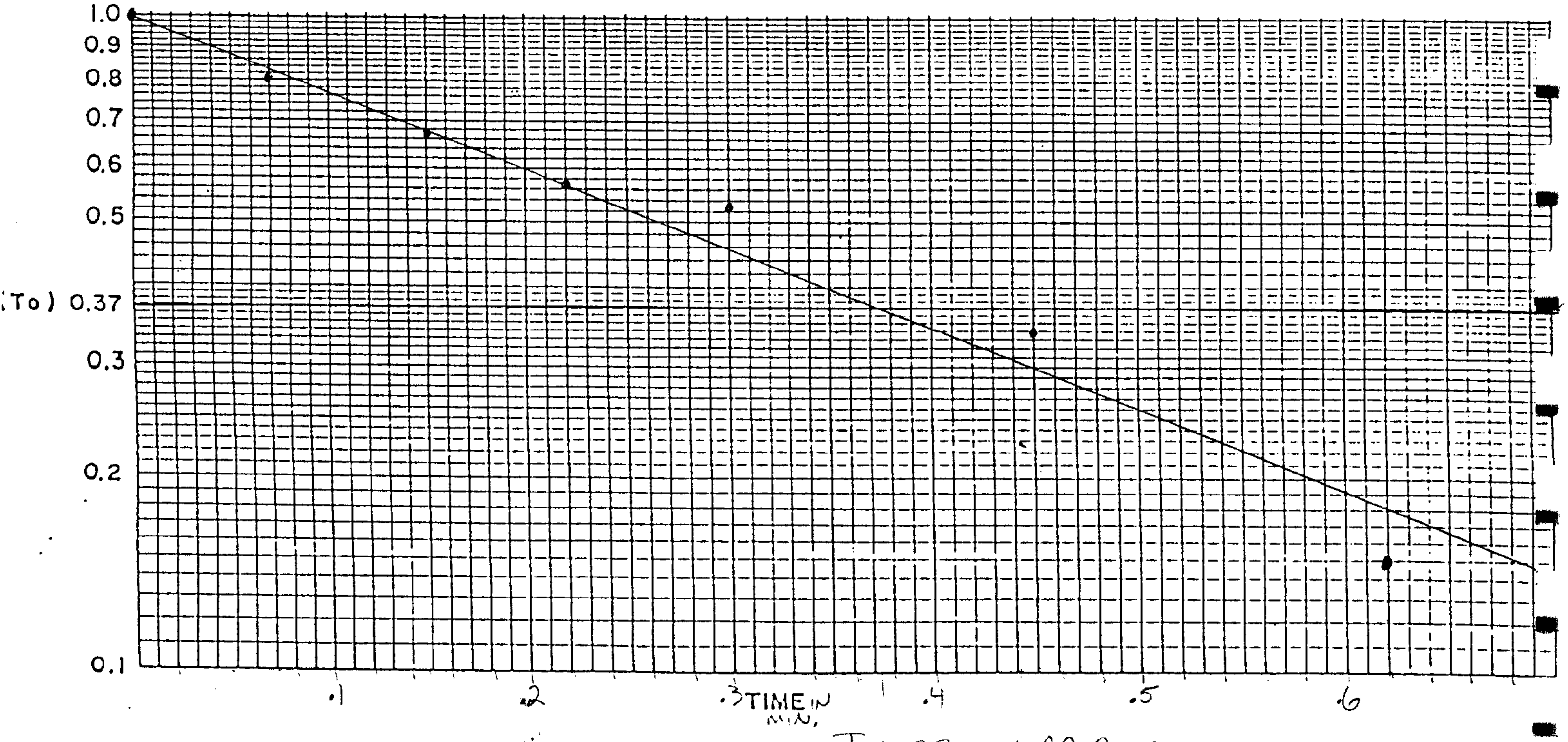
INITIAL HEAD (Ho) 2.8'

HYDRAULIC CONDUCTIVITY :

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

$$K=\frac{(.08)^2\ln(4.31/.36)=.016}{2(4.31\cdot 22.2)=191.4}=8.3\times10^{-5}\text{ ft/sec}(6.464\times10^5)=53.7\text{ gpd/ft}^2$$

TIME sec	WATER DEPTH	t min	h	$\frac{H-h}{H-Ho}$ -2.11
0		0	12.8	1
4		.07	12.4	.81
9		.15	12.1	.67
13		.22	11.9	.57
18		.30	11.8	.53
27		.45	11.4	.34
37		.62	11.0	.15
75		1.25	10.9	.05



To = .37 min = 22.2 sec

IN–SITU PERMEABILITY TEST
FIELD LOG

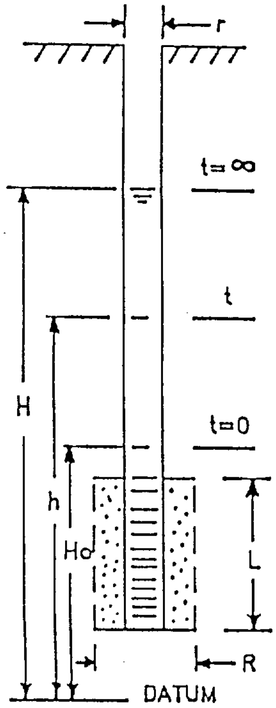
PROJECT S-781

WELL NUMBER MW10

DATE 12-11-91

LOCATION Midway PK

ELEVATION



STATIC HEAD (H) 10.78'

PIPE RADIUS (r) .08'

SCREEN RADIUS (R) .36'

SCREEN LENGTH (L) 10'

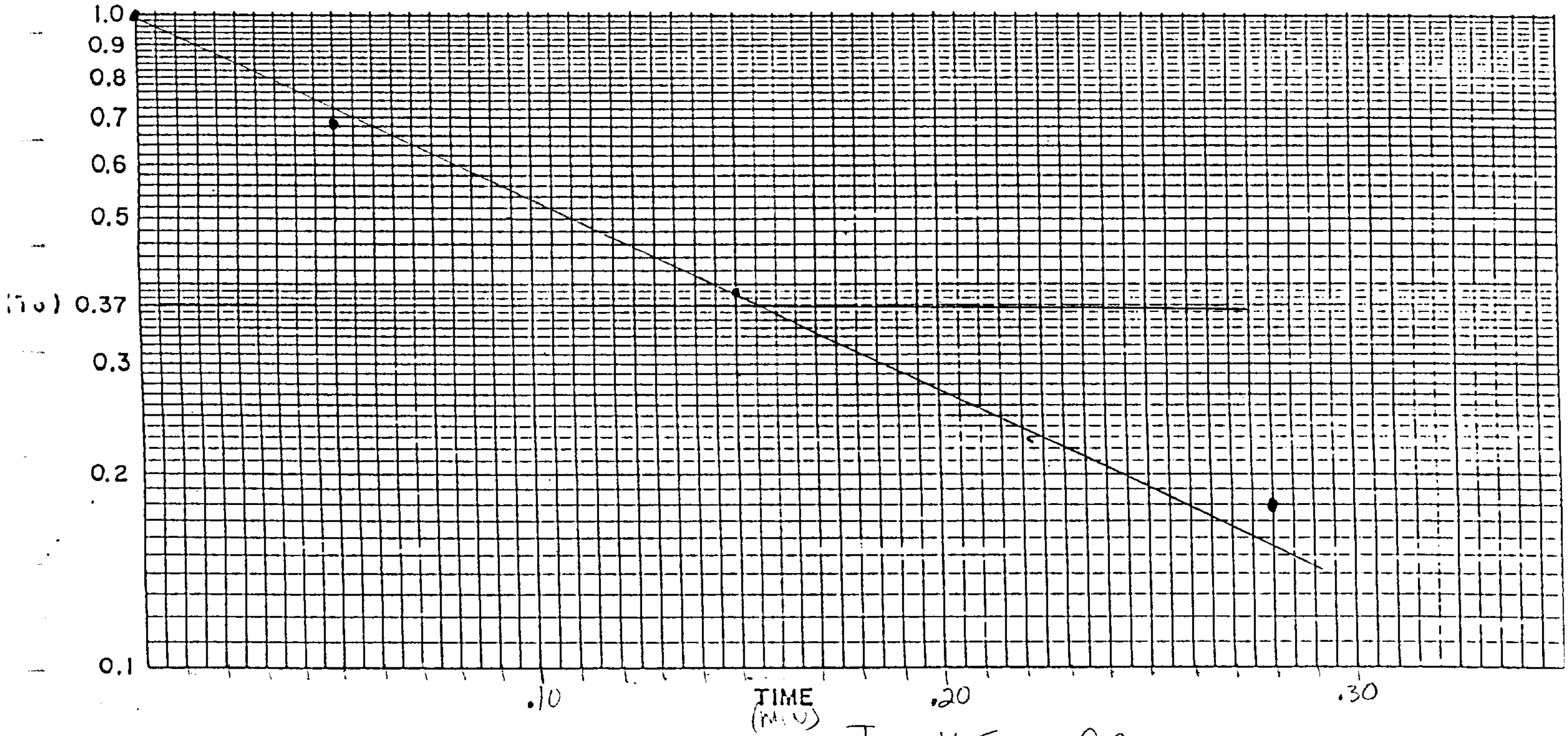
INITIAL HEAD (Ho) 16'

HYDRAULIC CONDUCTIVITY :

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

$$K=\frac{(.08)^2 \ln(10/.36) = .021}{2(10 \cdot 9.9) = 198} = 1.1 \times 10^{-4} \text{ ft/sec } (6.464 \times 10^5) = 69.4 \text{ gpd/ft}^2$$

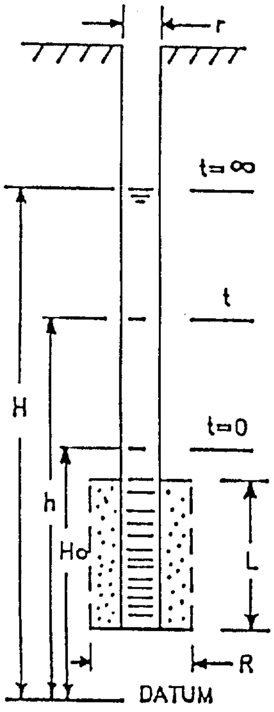
TIME sec	WATER DEPTH	t min	h	$\frac{H-h}{H-H_o}$ -5.22
0		0	16	1
3		.05	14.4	.69
9		.15	12.8	.39
17		.28	11.7	.18
35		.58	11.0	.04
44		.73	10.9	.02
63		1.05	10.8	.003



To = .165 min = 9.9 sec

IN–SITU PERMEABILITY TEST
FIELD LOG

PROJECT S-781
WELL NUMBER MW11
DATE 12-12-91
LOCATION Midway PK
ELEVATION



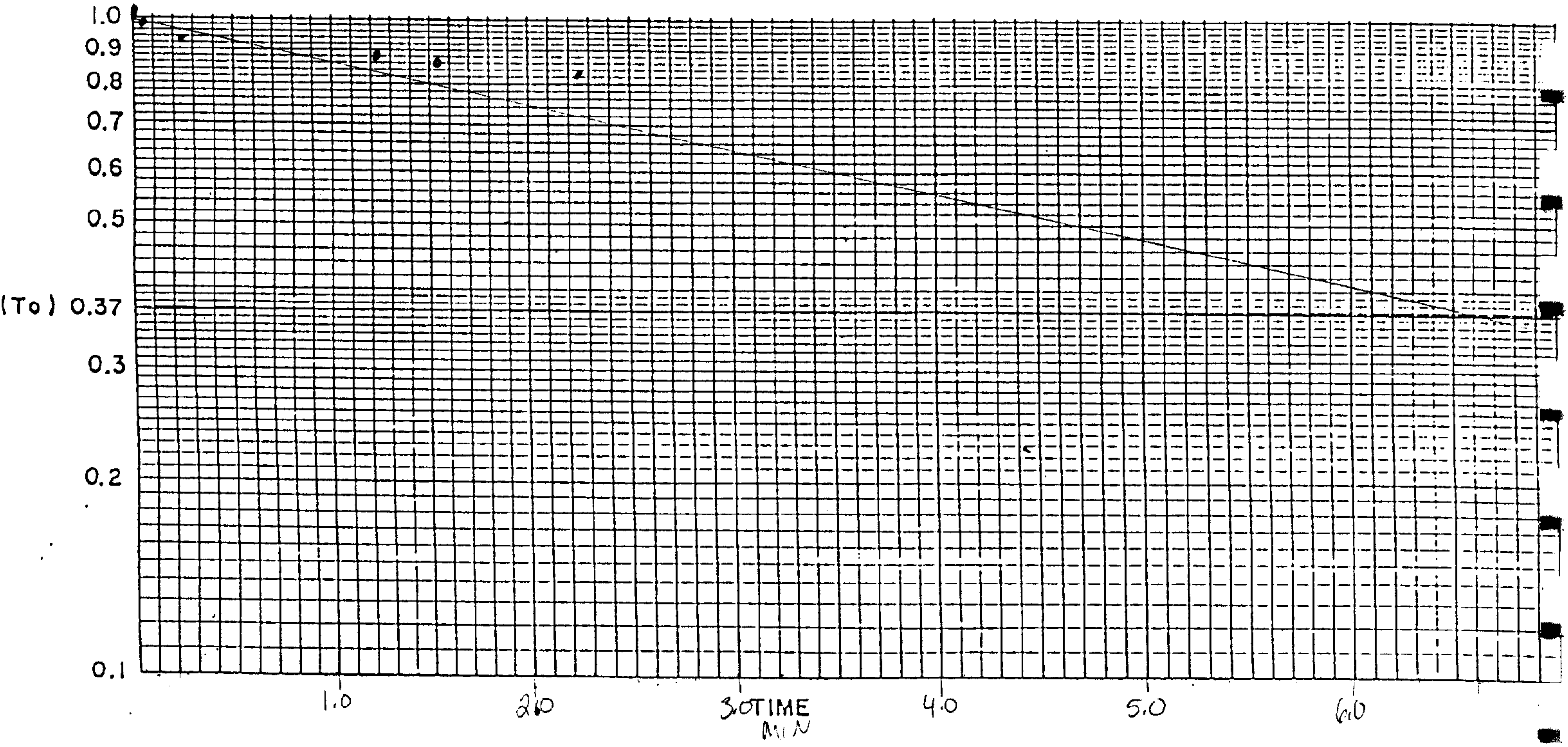
STATIC HEAD (H) 12.0'
PIPE RADIUS (r) .08'
SCREEN RADIUS (R) .36'
SCREEN LENGTH (L) 3.0'
INITIAL HEAD (Ho) 17.8'

HYDRAULIC CONDUCTIVITY :

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

$$K=\frac{(.08)^2\ln(3.0/.36)=.013}{2(3.0\cdot 396)=2376}=5.7\times10^{-6}\ \text{ft/sec}\ (6.464\times10^5)=3.7\ \text{gpd/ft}^2$$

TIME sec	WATER DEPTH	t min	h	$\frac{H-h}{H-Ho}$ -5.8
0		0	17.8	1
4		.07	17.7	.98
16		.26	17.4	.93
73		1.22	17.1	.88
92		1.53	17.0	.86
137		2.28	16.8	.83

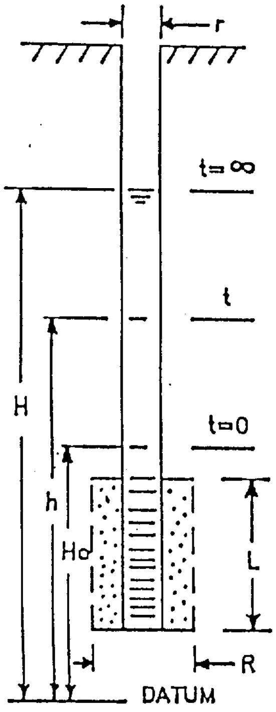


TO=6.6min=396sec

IN–SITU PERMEABILITY TEST
FIELD LOG

PROJECT S-781
WELL NUMBER MW12
DATE 12-11-91

LOCATION Midway Park
ELEVATION

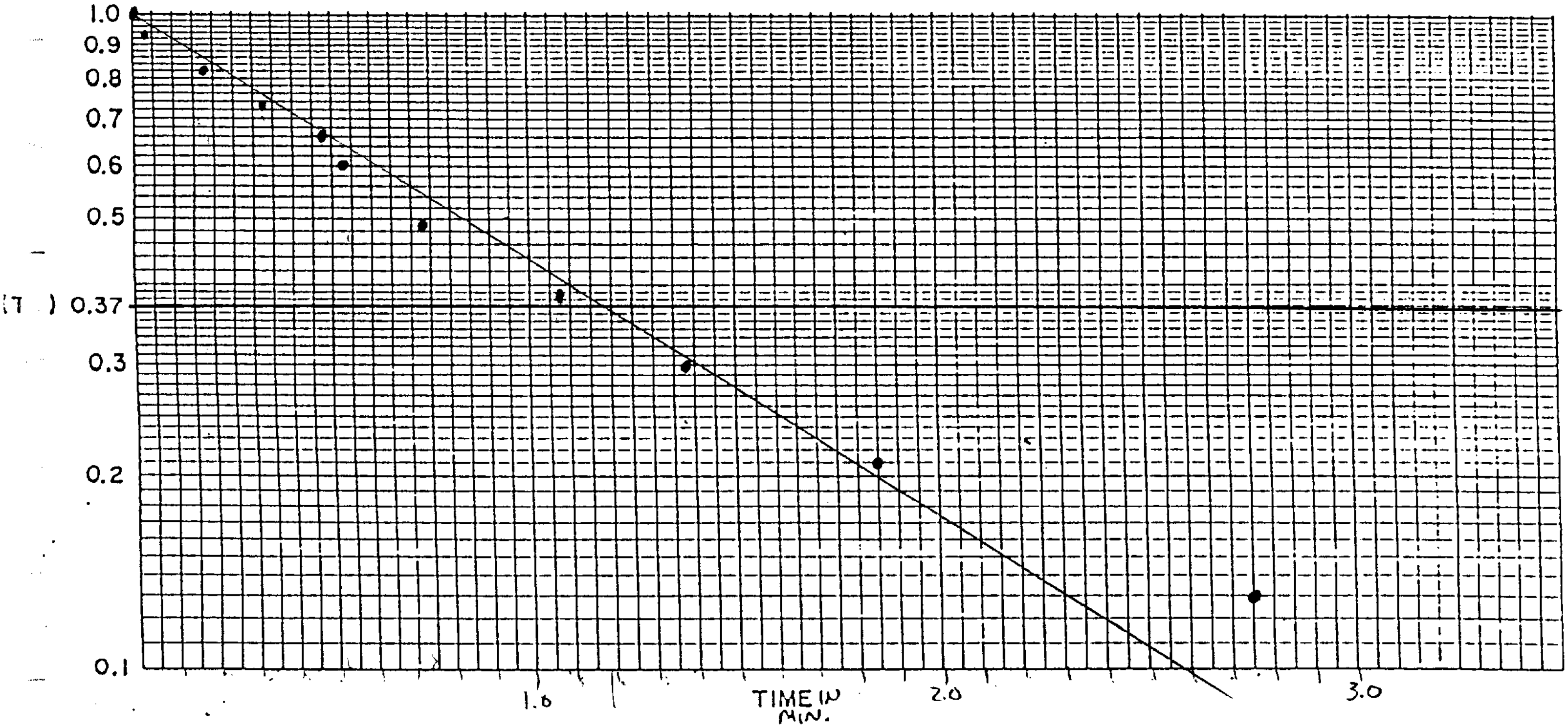


STATIC HEAD (H) 15.54'
PIPE RADIUS (r) .08'
SCREEN RADIUS (R) .36'
SCREEN LENGTH (L) 10'
INITIAL HEAD (Ho) 27.0'
HYDRAULIC CONDUCTIVITY :

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

$$K=\frac{(.08)^2 \ln(10/.36) = .021}{2(10 \cdot 71.4) = 1428} = 1.5\times10^{5} \text{ ft/sec} (6.464\times10^{5}) = 9.5 \text{ gpd/ft}^2$$

TIME sec	WATER DEPTH	t min	h	$\frac{H-h}{H-Ho}$ -11.46
0		0	27.0	1
2		.03	26.2	.93
11		.18	24.9	.82
19		.32	23.9	.73
26		.43	23.1	.66
31		.52	22.4	.60
46		.77	21.2	.49
64		1.07	20.0	.39
83		1.38	19.0	.30
111		1.85	18.0	.21
165		2.75	17.0	.13

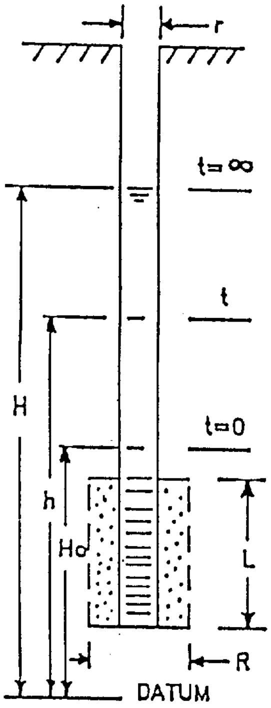


$T_o = 1.19 \text{ min} = 71.4 \text{ sec}$

IN–SITU PERMEABILITY TEST
FIELD LOG

PROJECT S 781
WELL NUMBER MW13
DATE 12/11/91

LOCATION Midway Park
ELEVATION



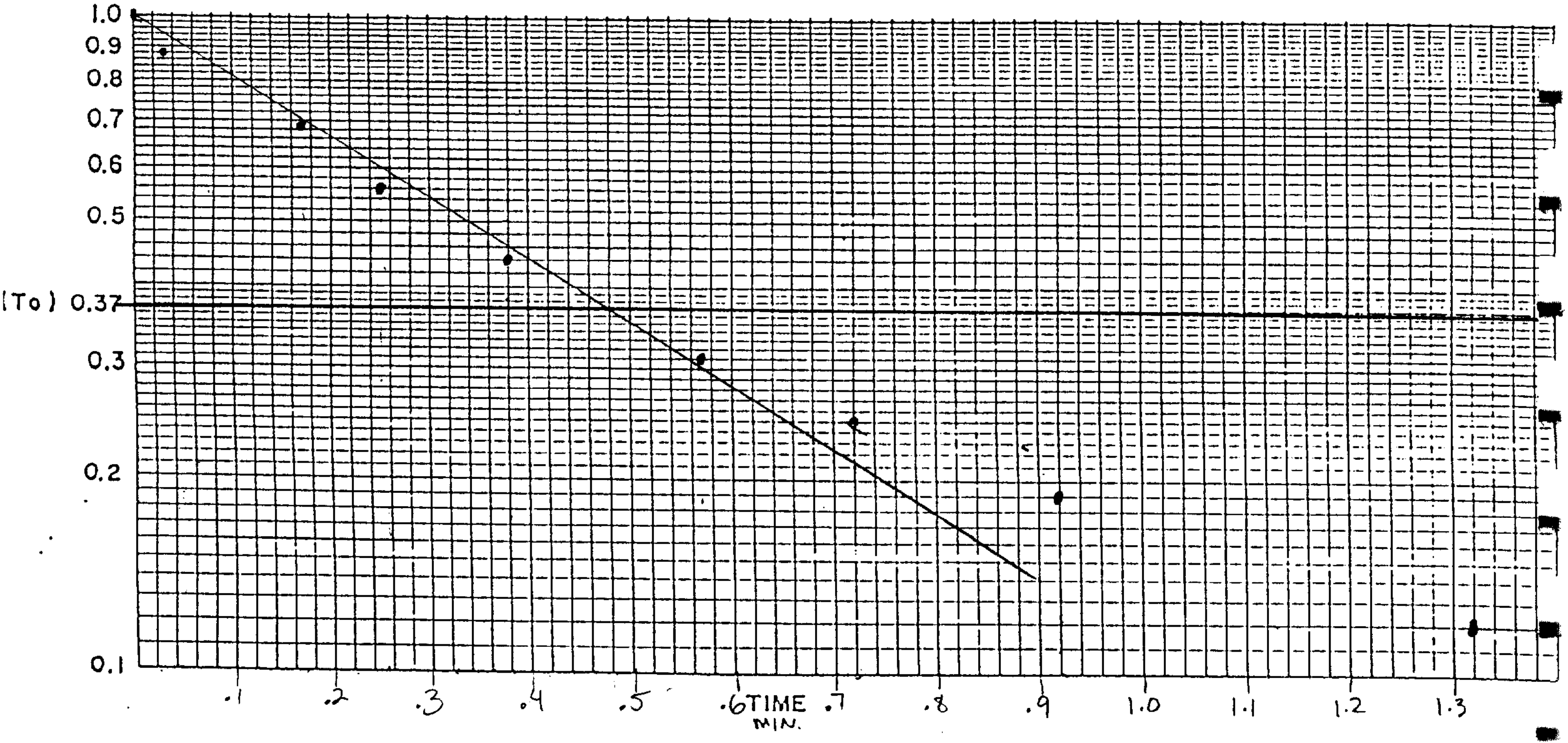
STATIC HEAD (H) 6.80′
PIPE RADIUS (r) .08′
SCREEN RADIUS (R) .36′
SCREEN LENGTH (L) 5.20′
INITIAL HEAD (Ho) 8.40′

HYDRAULIC CONDUCTIVITY :

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

$$K = \frac{(.08)^2 \ln(5.2/.36) = .0171}{2(5.20 \cdot 28.8) = 299.52} = 5.7\times10^{-5}\text{ ft/sec}\,(6.464\times10^5) = 36.9\text{ gpd/ft}^2$$

TIME sec	WATER DEPTH	t min	h	H−h / H−Ho −1.6
0		0	8.4	1
2		.03	8.2	.88
10		.17	7.9	.69
15		.25	7.7	.56
23		.38	7.5	.44
34		.57	7.3	.31
43		.72	7.2	.25
55		.92	7.1	.19
79		1.32	7.0	.12

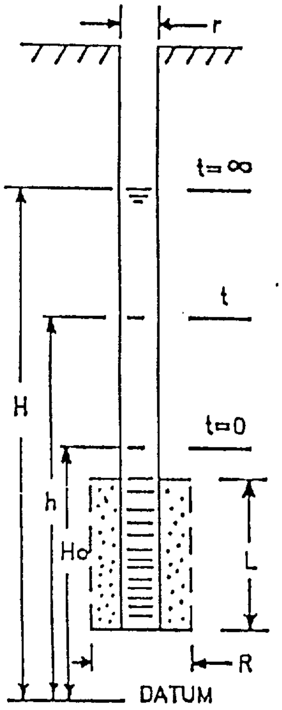


To = .48 mm = 28.8 sec

IN–SITU PERMEABILITY TEST
FIELD LOG

PROJECT S-781
WELL NUMBER mw14
DATE 12-11-92

LOCATION Midway Park
ELEVATION

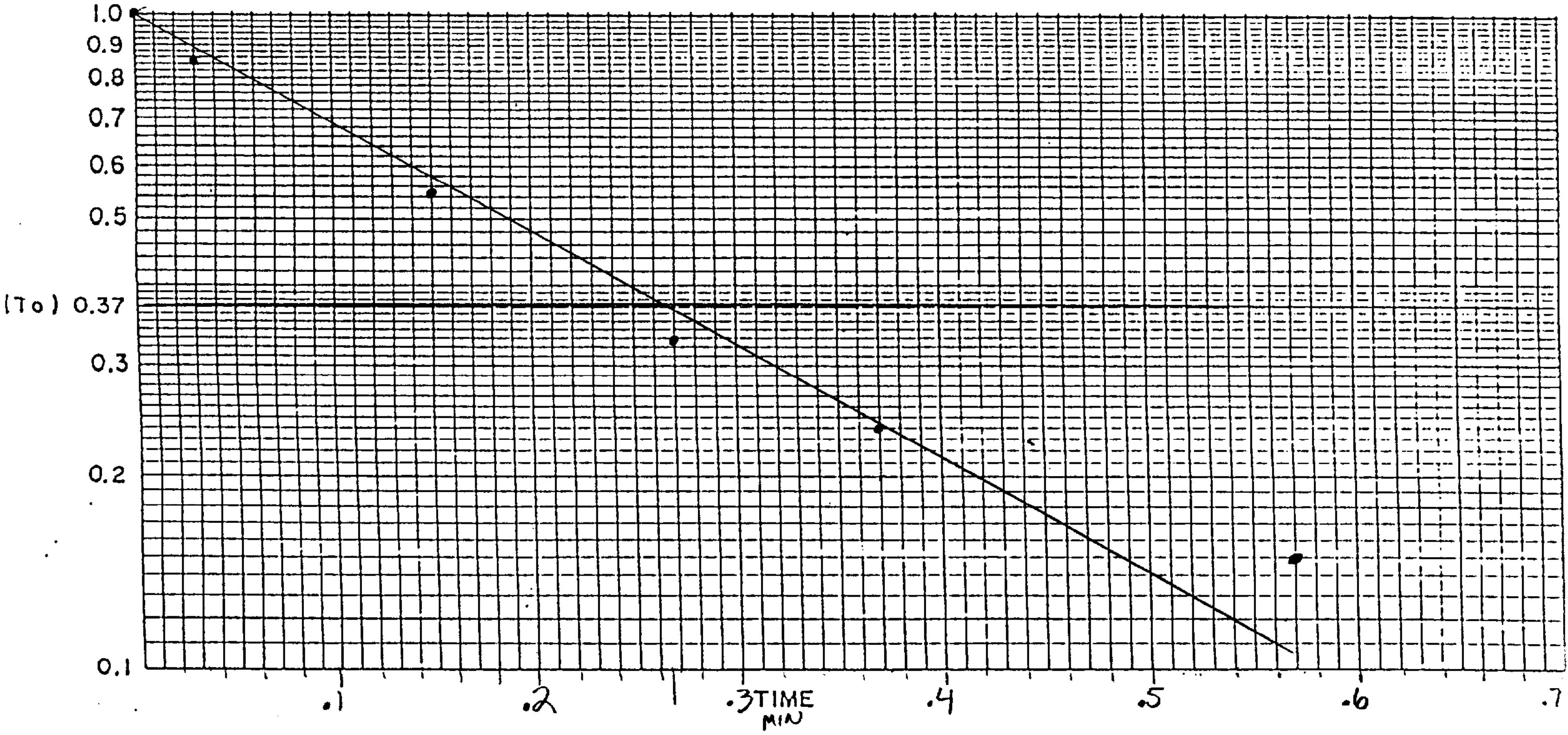


STATIC HEAD (H) 6.99'
PIPE RADIUS (r) .08'
SCREEN RADIUS (R) .36'
SCREEN LENGTH (L) 10'
INITIAL HEAD (Ho) 10.2'
HYDRAULIC CONDUCTIVITY :

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

$$K=\frac{(.08)^2\ln(10/.36)\ .021}{2(10\cdot 15.9)=\ 318}\ 6.7\times10^{-5}\,\text{ft/sec}\,(6.464\times10^{5})=43.2\,\text{gpd/ft}^2$$

TIME SEC	WATER DEPTH	t MIN	h	$\frac{H-h}{H-Ho}$ -3.31
0		0	10.20	1
2		.03	9.70	.85
9		.15	8.65	.53
16		.27	8.00	.33
22		.37	7.70	.24
34		.57	7.40	.15
55		.92	7.20	.09
150		2.5	7.00	.03



To= .265 =15.9 sec

APPENDIX E

DRILLING PROCEDURES

UST MONITORING WELL CONSTRUCTION

AND

FIELD OPERATIONS

REQUIREMENTS

Well permits required by state agencies are the responsibility of the contractor. All monitoring wells will be installed in accordance with the following Navy UST monitoring well specifications.

DRILLING

During the drilling program, boreholes will be advanced using conventional hollow stem auger drilling methods. If it is the opinion of the contractor that air or mud rotary drill methods are necessary, approval must be obtained from the EIC. Presentation of justification for a boring method change shall be presented prior to drilling.

The wells will be constructed of flush joint threaded PVC well screen and riser casing depending on conditions encountered during borehole completion.

Well construction details are shown in Figures A-1 and A-2. A drill mounted on an All-Terrain-Vehicle (ATV) may be required for access to remote areas. Each rig will use necessary tools, supplies and equipment supplied by the contractor to drill each site. Drill crews should consist of an experienced driller and a driller assistant for work on each rig. A geologist, experienced in hazardous waste site investigations, shall be on site to monitor the drillers efforts and for air monitoring/safety control. Additional contractor personnel may be needed to transport water to the rigs, clean tools, assist in the installation of the security and marker pipes, construct the concrete aprons/collars and develop the wells. A potable water source on base will be designated by the Government.

Standard penetration tests will be performed in accordance with ASTM D-1586. Standard penetration tests will be performed at the following depths: 0.0-foot to 1.5-foot; 1.5-foot to 3.0-foot; 3.0-foot to 4.5-foot; and 5-foot centers thereafter. A boring log of the soil type, stratification, consistency and groundwater level will be prepared.

Groundwater sampling using a Hydropunch penetrometer (or similar penetrometer probe) and the corresponding laboratory analysis will be used to help define the lateral and horizontal extent of the contamination. The Hydropunch sample shall be obtained from either the upper or lower portion of the aquifer as needed. The use of augering to provide a pilot hole shall not be used. The Hydropunch operation shall not produce soil debris or excess groundwater. The proposed location of Hydropunch penetrometer sampling shall be detailed in the preliminary well location plan.

SAMPLING

Two soil samples will be obtained from each boring/well in accordance with ASTM Method D-1586 for split barrel sampling. The first sample will be obtained from 2 to 5 feet below ground surface. The second soil sample will be from the water table to 5 feet above the water table. Each soil sample will be screened in the field using an HNu photoionizer, organic vapor detector or similar type direct readout instrument to identify the presence of petroleum product within the soils. This field screening will provide a preliminary indication of the vertical and horizontal extent of petroleum contamination in order to select the optimum locations of other monitoring wells during the drilling program. Based on the field screening, monitoring wells will be installed at the locations where the most significant accumulation of fuel is encountered. Groundwater sample shall be obtained from each well and penetrometer probe after development is completed per the instructions below.

DEVELOPMENT

After completion of the soil sampling and drilling to the specified depth, 2-inch or 4-inch (as required by the EIC) I.D. flush-threaded Schedule 40 PVC (Schedule 80 in traffic areas) monitoring wells with slotted screens and well casings will be installed in the borehole. A 5 to 15-foot section of 0.01 inch slotted PVC well screen should be used in each well. Deep/shallow well pairs are to be used to obtain samples from both the upper and lower portions of the surficial aquifer. A sand pack will be placed around each slotted well screen extending to 2 feet above the top of the screen. A bentonite seal (minimum thickness - 1 ft.) will be placed on top of the sand pack. Finally, a ground mixture of two parts sand and one part cement, thoroughly mixed with the specified amount of potable water, will be placed in the borehole and rodded to insure a proper seal.

All wells will be developed following their installation to remove fine ground materials that may have entered the well during construction. This will be accomplished by either bailing or continuous low yield pumping. Equipment used for well installation, that may have come in contact with potentially contaminated material will be decontaminated with a high pressure steam clean wash followed by a potable supply water rinse. For the purpose of this scope of work, it is assumed that all fluid generated from well development and equipment decontamination can be disposed of on the ground at each respective well site.

After development, a standard slug permeability test will be done at each 2" monitoring well that does not contain product.

Soil removed from the borehole will containerized in DOT approved barrels and properly identified. It is expected that sampling required for this effort will suffice for determining if the material is hazardous. The drill equipment and tools will be cleaned prior to drilling each well using a portable decontamination system/operation supplied by the contractor. Wash water at the sites will not be contained, unless otherwise directed by the Government, and may seep into the ground locally.

Supplies and equipment will be transported to the lay-down area designated on the station by the Government. Any office space, trailers, etc., required for drilling, subsequent sampling and shipping shall be arranged and provided by the contractor.

WELL HEAD COMPLETION

A 4-inch diameter security pipe with a hinged locking cap will be installed on the well casing top having an embedment depth of 2.5 feet into the grout.

There are two acceptable methods of completing the wellheads.

In non-traffic areas the acceptable method of finishing a wellhead is shown in figure A-1. Each well will be marked with three Schedule 40 steel pipes, 3-inch I.D., imbedded in a minimum of 2.5-foot of 3,000 psi concrete. (The concrete used to secure the three pipes will be poured at the same time and be an integral part of the 5-foot by 5-foot by 0.5-foot concrete apron described above.). The security pipes will extend a minimum 2.5 feet and maximum 4.0 feet above the ground surface. The steel marker pipes will be filled with concrete and painted day-glo yellow or an equivalent.

In traffic areas (and non-traffic areas where required), a "flush" manhole type cover shall be built into a concrete pad as shown in figure A-2. If the well as installed through a paved or concrete surface, the annular space between the casing and the bore hole shall be grouted to a depth of at least 2.5 feet and finished with a concrete collar. If the well was not installed through a concrete or paved medium and still finished as a high traffic area well, a concrete apron measuring 5-foot by 5-foot by 0.5 foot will be constructed around each well. This apron/collar will be constructed of 3,000 psi ready-mixed concrete. The concrete will be crowned to provide and to meet the finished grade of surrounding pavement as required. The concrete pads can be constructed within five days after all of the wells have been installed.

In all finishing methods, the well covers will be properly labeled by metal stamping on the exterior of the security pipe locking cap and by labeling vertically on the exterior of the security pipe or manhole cover as appropriate. The labeling shall consist of the letters UGW (UST Groundwater) (to describe the medium and the reason for the well) and a number specific to each well.

A sign reading "NOT FOR POTABLE USE OR DISPOSAL" SHALL BE FIRMLY ATTACHED TO EACH WELL.

* The contractor or project team may supplement these requirements, but may not modify or delete them, in total or in part, without prior approval of the Contracting Officer.

APPENDIX F

SAMPLING PROCEDURES

GROUNDWATER SAMPLING PROTOCOL

Use of the following procedures for sampling cf ground water observation wells is dependent upon the size and depth of the well to be sampled and the presence of immiscible petroleum product in the well. To obtain representative ground water samples from wells containing only a few gallons of ground water and no product present, the bailing procedures is preferred. To obtain representative ground water samples from wells containing more than a few gallons if an immiscible product layer is apparent, the pumping procedure generally facilitates more representative sampling. Each of these procedures is explained in detail below.

1. Identify the well and record the location on the Ground Water Sampling Field Log, Attachment A.
2. Put on a new pair of disposable gloves.
3. Cut a slit in the center of the plastic sheet, and slip it over the well creating clean surface onto which the sampling equipment can be positioned.
4. Clean all meters, tools, equipment, etc., before placing on the plastic sheet.
5. Using an electric well probe, measure the depth of the water tube and the bottom of the well. Record this information in the Ground Water Sampling Field Log.
6. Clean the well depth probe with an acetone soaked towel and rinse it with distilled water after use.
7. Compute the volume of water in the well, and record this volume on the Ground Water Sampling Field Log.
8. Attach enough polypropylene rope to a bailer to reach the bottom of the well, and lower the bailer slowly into the well making certain to submerge it only far enough to fill one-half full. The purpose of this is to recover any oil film, if one is present on the water table.

9. Pull the bailer out of the well keeping the polypropylene rope on the plastic sheet. Empty the ground water from the bailer into a glass quart container and observe its appearance. NOTE: This sample will not undergo laboratory analysis, and is collected to observe the physical appearance of the ground water only.

10. Record the physical appearance of the ground water on the Ground Water Sampling Field Log.

11. Lower the bailer to the bottom of the well and agitate the bailer up and down to resuspend any material settled in the well.

12. Initiate bailing the well from the well bottom. All groundwater should be dumped from the bailer into a graduated pail to measure the quantity of water removed from the well.

13. Continue bailing the well throughout the water column and from the bottom until three times the volume of groundwater in the well has been removed, or until the well is bailed dry. If the well is bailed dry, allow sufficient time (several hours to overnight) for the well to recover before proceeding with Step 13. Record this information on the Groundwater Sampling Field Log.

14. Remove the sampling bottles from their transport containers and prepare the bottles for receiving samples. Inspect all labels to insure proper sample identification. Sample bottles should be kept cool with their caps on until they are ready to receive samples. Arrange the sampling containers to allow for convenient filling.

15. To minimize agitation of the water in the well, initiate sampling by lowering the bailer slowly into the well making certain to submerged it only far enough to fill it completely. Fill each sample container following the instructions listed in the Sample Containerization Procedures, Attachment B. Return each sample bottle to its proper transport container.

16. If the sample bottle cannot be filled quickly, keep them cool with the caps on until they are filled. The vials (3) labeled purgeable priority pollutant analysis should be filled from one bailer than securely capped. NOTE: Samples must not be allowed to freeze

17. Record the physical appearance of the groundwater observed during sampling on the Groundwater Sampling Field Log.

18. After the last sample has been collected, record the data and time, and, and if required, empty one bailer of water from the surface of the water in the well into the 200 ml beaker and measure and record the pH , conductivity and temperature of the ground water following the procedures outlined in the equipment operation manuals. Record this information on the Ground Water Sampling Field Log. The 200 ml beaker must then be rinsed with distilled water prior to reuse.

19. Begin the Chain of Custody Record.

20. Replace the well cap, and lock the well protection assembly before leaving the well location.

21. Place the polypropylene rope, gloves, rags and plastic sheeting into a plastic bag for disposal.

22. Clean the bailer by rinsing with control water and then distilled water. Store the clean bailer in a fresh plastic bag.

Sampling Procedures (PUMP)

1. Identify the well and record the location on the Ground Water Sampling Field Log.

2. Put on a new pair of disposable gloves.

3. Cut a slit in the center of the plastic sheet, and slip it over the well creating a clean surface onto which the sampling equipment can be positioned.

4. Clean all meters, tools, equipment, etc., before placing on the plastic sheet.

5. Using an electric well probe, measure the depth of the water tube and the bottom of the well. Record this information in the Ground Water Sampling Field Log.

6. Clean the well depth probe with an acetone soaked towel and rinse it with distilled water after use.

7. Compute the volume of water in the well, and record this volume on the Ground Water Sampling Field Log.

8. Attach enough polypropylene rope to a bailer to reach the bottom of the well, and lower the bailer slowly into the well making certain to submerge it only far enough to fill one-half full. The purpose of this is to recover any oil film, if one is present on the water table.

9. Pull the bailer out of the well keeping the polypropylene rope on the plastic sheet. Empty the ground water from the bailer into a glass quart container and observe its appearance. NOTE: This sample will not undergo laboratory analysis, and is collected to observe the physical appearance of the ground water only.

10. Record the physical appearance of the ground water on the Ground Water Sampling Field Log.

11. Prepare the submersible pump for operation. A pump with a packer inflated above the screened interval is preferred.

12. Lower the bailer to just below the top of the water column and pump the ground water into a graduated pail. Pumping should continue until sufficient well volumes have been removed or the well is pumped dry. If the well is pumped dry, allow sufficient time for the well to recover before proceeding with Step 16. Record this information on the Ground Water Sampling Field Log.

13. Remove the sampling bottles from their transport containers and prepare the bottles for receiving samples. Inspect all labels to insure proper sample identification. Sample bottles should be kept cool with their caps on until they are ready to receive samples. Arrange the sampling containers to allow for convenient filling.

14. With submersible pump raised to a level just below the surface of the water in the well, fill each sample container following the instructions listed in the Sample Containerization Procedures. Return each sampling bottle to its proper transport container. NOTE: A clean bottom loading stainless steel or Teflon bailer should be used to collect the sample used to fill the sample vials labeled purgeable priority pollutant analysis. Gently lower the bailer into the water to minimize agitation of the water. The vials (2) should be filled from one bailer.

15. If the sample bottle cannot be filled quickly, keep them cool with the caps on until they are filled. The vials (3) labeled purgeable priority pollutant analysis should be filled from one bailer than securely capped. NOTE: Samples must not be allowed to freeze.

16. Record the physical appearance of the groundwater observed during sampling on the Groundwater Sampling Field Log.

17. After the last sample has been collected, record the data and time, and, and if required, empty one bailer of water from the surface of the water in the well into the 200 ml beaker and measure and record the pH, conductivity and temperature of the ground water following the procedures outlined in the equipment operation manuals. Record this information on the Ground Water Sampling Field Log. The 200 ml beaker must then be rinsed with distilled water prior to reuse.

18. Begin the Chain of Custody Record. A separate form is required for each well with the required analysis listed individually.

19. Remove the submersible pump from the well and clean the pump and necessary tubing both internally and externally. Cleaning is comprised of rinses with a source water and acetone or methanol mixture, and distilled water using disposable towers and separate wash basins. The pump should then be returned to its covered storage box.

20. Replace the well cap, and lock the well protection assembly before leaving the well location.

21. Place the gloves, towels, disposable shoe covers and plastic sheet into a plastic bag for disposal.

Exhibits

O'BRIEN & GERE

EXHIBIT A

SITE SURVEY DATA

TINA BICKERSTAFF

ROBERT H. DAVIS, RLS
SURVEYORS AND PLANNERS
7175 HIGHWAY 70 EAST
NEW BERN, NORTH CAROLINA 28562
919-636-2109

JOB 91130 05 O'BRIEN & GERE
SHEET NO. 2 OF 2
CALCULATED BY R. Davis DATE 03 Jan 92
CHECKED BY R. Davis DATE 03 Jan 92
SCALE None

Point	Northing	Easting	Elevation
HP 01	246.6 S	42.2 E	15.73
HP 02	180.3 S	176.0 E	19.93
HP 03	7.4 S	66.6 E	14.31
HP 04	35.6 S	53.1 W	9.98
HP 05	NOT FOUND		
HP 06	174.7 S	57.3 W	10.56
HP 07	45.4 N	0.9 E	13.25
HP 08	298.1 S	8.1 W	11.67
HP 09	398.7 S	193.9 W	9.13
HP 10	48.8 N	287.0 E	—
GW A	56.7 S	5.5 E	14.50
* GW B	6.0 S	5.1 E	13.96
GW 01	53.2 S	143.7 E	22.26
GW 02	53.2 S	143.7 E	22.10
GW 03	148.7 S	56.0 E	18.63
GW 04	148.7 S	56.0 E	18.39
GW 05	102.8 N	71.1 E	19.06
GW 06	102.8 N	71.1 E	18.13
GW 07	39.6 S	257.8 W	8.72
GW 08	39.6 S	257.8 W	8.90
GW 09	642.7 S	119.7 W	12.90
GW 10	642.7 S	119.7 W	12.90
GW 11	351.6 S	239.9 E	19.13
GW 12	351.6 S	239.9 E	19.24
GW 13	256.3 S	315.0 W	8.91
GW 14	256.3 S	315.0 W	8.94
** Unknown 01	95.1 S	90.9 E	16.44
Unknown 02	28.1 S	85.7 E	16.84
Unknown 03	27.7 S	26.3 E	12.93
Unknown 04	94.9 S	36.5 E	14.78

* GW = MW

** UNKNOWN LOCATIONS = SOIL BORING LOCATIONS

Note: Water level Northeast Creek 0.8 02 Jan 92
Elevations based on NC DOT Bridge Elevation

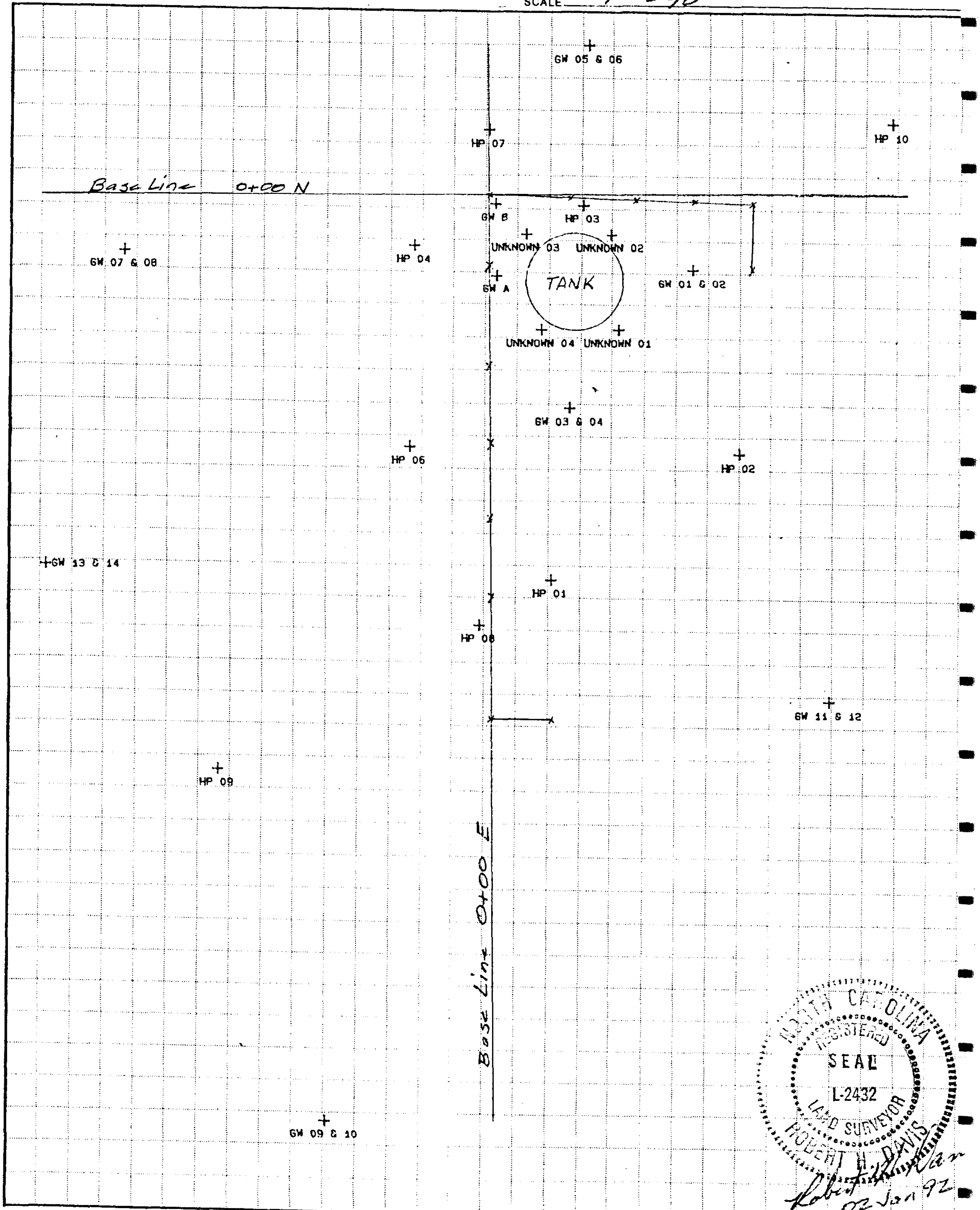
SEAL L-2432 ROBERT H. DAVIS

Robert H. Davis
02 Jan 92

TINA BICKERSTAFF

ROBERT H. DAVIS, RLS
SURVEYORS AND PLANNERS
7175 HIGHWAY 70 EAST
NEW BERN, NORTH CAROLINA 28562
919-636-2109

JOB 91130 05 O'BRIEN & GERE
SHEET NO. 1 OF 2
CALCULATED BY R. Davis DATE 02 Jan 92
CHECKED BY R. Davis DATE 02 Jan 92
SCALE 1" = 90'



L-2432
ROBERT H. DAVIS

Robert H. Davis
02 Jan 92

EXHIBIT B

TECHNICAL MEMORANDUM NO. 2
RESULTS OF FIELD INVESTIGATION

Prepared for:

Public Works Division
Marine Corps Base, Camp Lejeune

Contract N62470-C090-6796

D&D Project No: LZ682-000001-93160-D086

Prepared by:

Dewberry & Davis
5238 Valleypointe Parkway
Suite One-B
Roanoke, Virginia 24019

(703) 362-7725

January 1991

The TCLP constituents detected in the sample leachate above their detection limits include Trichloroethylene, Arsenic, Barium, Cadmium, Chromium and Lead. Only Trichloroethylene exceeded its regulatory level; 6.13 ppm vs. 0.5 ppm.

The sample did not contain PCBs above the detection limit of 5.0 ppm and was not hazardous by reactivity, ignitability or corrosivity.

6.2 Site Geology. The site was investigated by five hand augers advanced to a depth of 1 to 4.5 feet, five soil borings advanced to a depth of 5 feet and two monitor wells advanced to a depth of 20 feet. The test locations are shown on the Midway Park Site sheet in the sleeve at the back of this report. The general locations are as follows:

- Hand augers MPHA-1, 2, 3 and 4 were around the perimeter of the tank, inside the brick containment wall.
- Hand auger MPHA 5 was near the pump house where piping was suspected to enter.
- Soil boring MPSB-1 was located near the suspected vicinity of the underground piping halfway between the tank and pump house.
- Soil borings MPSB 2, 3, 4 and 5 were located along the suspected vicinity of underground piping from the pump house southeast toward the main building.

A surface sample was obtained of a black tar/asphalt substance on the surface within the brick containment wall (sample MPHA-4A). The monitor wells, MPMW-1 and 2 were installed to the northwest and north-northwest of the tank near the perimeter fence, in attempt to intercept the suspected downgradient flow of groundwater at the site.

The soils encountered at each of the hand auger and soil boring location are described in Table 5. The soils encountered in the monitor wells are presented in boring logs (Plates 1 and 2). The soils encountered at all test locations were almost exclusively very fine to fine sands with trace to no silt. These sands were grey to brown to orange in the upper few feet, then graded to light tan to orangish tan and near white with depth. MPHA-5 encountered approximately 1 foot of fine sand with little silt then refused on the concrete associated with the pump house (four attempts were made). Some wood debris was encountered at an approximate depth of 3 feet in soil boring MPSB-3 and some wood and concrete debris was

TABLE 4

(CONTINUED)

CAMP LEJEUNE HAZARDOUS WASTE OIL TANKS LABORATORY RESULTS OF TANK CONTENTS

SITE	HOLCOMB	MIDWAY	NEW RIVER	TARAWA
DATE SAMPLED	11/27/90	11/26/90	11/27/90	11/26/90
TANK DESIGNATION	891	S-781	AS421	STT-66
OTHER				
PCB	<5.0	<0.200	<5.0	<5.0
REACTIVITY				
TOTAL HYDROGEN CYANIDE	<5	<5	<5	<5
TOTAL HYDROGEN SULFIDE	<10	<10	<10	<10
IGNITABILITY				
FLASHPOINT	>212 F	>212 F	>212.2 F	208.4 F
CORROSIVITY				
pH	9.0 S.U.	5.88 S.U.	5.31 S.U.	7.25 S.U.

NOTES:

1) ALL RESULTS ARE PRESENTED IN PARTS PER MILLION (PPM), WHICH IS ANALOGOUS TO MILLIGRAMS PER KILOGRAM FOR THE VOC'S, PCB'S, REACTIVITY AND THE TCLP FOR HOLCOMB, NEW RIVER AND TARAWA. PPM IS ANALOGOUS TO MILLIGRAMS PER LITER FOR THE TCLP FOR MIDWAY. FLASHPOINT IS IN DEGREES FAHRENHEIT (F) AND pH IS IN STANDARD UNITS.
2) VOLATILE ORGANIC COMPOUNDS (VOC) IS A PARTIAL LIST CONSISTING OF 34 CHEMICALS. THOSE NOT INCLUDED IN THE TABLE WERE BELOW THEIR DETECTION LIMITS. THE DETECTION LIMIT FOR VOC'S WERE 0.125 PPM AT MIDWAY AND 0.500 PPM AT THE OTHER SITES.
3) TOXICITY CHARACTERISTIC LEACHING PROCEDURE (TCLP) WAS WAS ONLY APPLICABLE TO THE MIDWAY SITE; THE OTHER SITES CONSISTED OF OIL SAMPLES FOR WHICH THE EXTRACTION WAS NOT APPLICABLE. THEREFORE, THE RESULTS FOR THOSE THREE SITES ARE FOR TOTAL CONCENTRATIONS IN THE WASTE OIL, WHILE THE RESULTS FOR MIDWAY ARE FOR THE LEACHATE FROM THE SLUDGE SAMPLED.
4) ND – NOT DETECTED; "<" – LESS THAN THE DETECTION LIMIT.
5) "O.294/1.9" FOR MIDWAY INDICATE RESULTS FROM FIRST AND SECOND LABORATORIES.
6) S.U. – STANDARD UNITS
7) F – DEGREES FAHRENHEIT
8) MCL – MAXIMUM CONTAMINANT LEVEL

TABLE 4

CAMP LEJEUNE HAZARDOUS WASTE OIL TANKS LABORATORY RESULTS OF TANK CONTENTS

SITE	HOLCOMB	MIDWAY	NEW RIVER	TARAWA	
DATE SAMPLED	11/27/90	11/26/90	11/27/90	11/26/90	
TANK DESIGNATION	891	S-781	AS421	STT-66	
ESTIMATED VOLUME	24600 GAL	5100 GAL	330 GAL	450 GAL	
VOC'S					MCL
CHLOROBENZENE	0.607	0.597	ND	ND	0.06
CHLOROFORM	ND	0.914	5.27	ND	0.1
CHLOROMETHANE	ND	0.547	ND	ND	—
1,1-DICHLOROETHANE	ND	0.294/1.9	ND	1.45	—
1,1-DICHLOROETHENE	3.69	ND	ND	ND	—
METHYLENE CHLORIDE	ND	0.562	0.542	ND	—
TETRACHLOROETHENE	ND	0.709	ND	5.12	—
1,1,1-TRICHLOROETHANE	11.1	2.00/13.0	ND	4.43	0.2
TRICHLOROETHENE	2.23	314.0	1.08	ND	—
TRICHLOROFLUOROMETHANE	2.06	1.18	1.39	2.94	—
1,1,2-TRICHLOROTRI-FLUOROETHANE	ND	10.5	0.513	ND	—
BENZENE	7.31	2.78/11.0	ND	3.15	0.005
1,2-DICHLOROBENZENE	ND	0.213	ND	ND	0.62
ETHLYBENZENE	19.7	6.97/39.0	0.571	22.6	0.68
TOLUENE	6.20	20.5/96.0	2.80	7.12	2.0
TOTAL XYLENES	73.7	23.2/260.0	3.97	87.9	0.44
TCLP					REG. LEVEL
ARSENIC	0.100	0.002	0.151	0.100	5.0
BARIUM	15	1.8	ND	40	100.0
BENZENE	7.31	ND	ND	3.15	0.50
CADMIUM	2.24	0.138	1.01	1.74	1.0
CHLOROFORM	ND	ND	5.27	ND	6.0
CHROMIUM	80	0.14	55	95	5.0
1,1-DICHLOROETHYLENE	3.69	ND	ND	ND	0.70
LEAD	20	0.4	15	25	5.0
MERCURY	ND	ND	2.40	0.200	0.2
METHYL ETHYL KETONE	11.2	ND	7.19	20.4	200.0
TRICHLOROETHYLENE	2.23	6.13	1.08	ND	0.5
TETRACHLOROETHYLENE	ND	ND	ND	5.12	0.7

TABLE 5

SOIL DESCRIPTIONS
MIDWAY PARK WASTE OIL TANK

LOCATION	DEPTH	DESCRIPTIONS	DEPTH/ TPH	BLOW COUNT
MPHA-1	0'-1'	BROWN AND DARK GREY FINE SAND, NO ODOR, MOIST.	0'-1'	N/A
	1'-2'	GRADING BROWN TO TAN.	<10 PPM	
	2'-3'	GRADING TAN TO LIGHT TAN.	2'-4'	
	3'-4'	GRADING LIGHT TAN TO WHITE.	<10 PPM	
MPHA-2	0'-1'	BROWN AND GREY FINE SAND, OCCASIONAL PIECES OF TAR OR ASPHALT, NO ODOR, MOIST.	0'-1' <10 PPM	N/A
	1'-2'	GRADING DARK ORANGISH TAN, NO TAR/ASPHALT.	1'-4'	
	2'-3'	GRADING LIGHT ORANGISH TAN.	<10 PPM	
	3'-4'	GRADING LIGHT TAN TO NEAR WHITE.		
MPHA-3	0'-1'	TAN FINE SAND, TRACE SILT, NO ODOR, MOIST.	0'-4.5'	N/A
	1'-1.5'	GRADING LIGHT BROWN, LITTLE SILT.	<10 PPM	
	1.5'-3'	GRADING YELLOWISH TAN.		
	3'-4.5'	GRADING LIGHT BROWN.		
MPHA-4	0'	SOME TAR/ASPHALT ON SURFACE.	0'	N/A
	0'-1'	ORANGISH TAN FINE SAND, LITTLE SILT, NO ODOR, MOIST.	<10 PPM 0'-4'	
	1'-2'	GRADING LIGHT TAN, TRACE SILT.	<10 PPM	
	2'-4'	GRADING LIGHT TAN TO WHITE.		
MPHA-5	0'-1'	BROWN FINE SAND, LITTLE SILT, NO ODOR, MOIST.	0'-1'	N/A
	1'	REFUSAL ON CONCRETE.	<10 PPM	
MPSB-1	0'-1'	2″ TOP SOIL. BROWN FINE SAND, LITTLE SILT, NO ODOR, MOIST.	0'-5' 1200 PPM	0'-2' 2-5-9-9
	1'-4.5'	GRADING TAN AND BROWN, TRACE SILT.		3'-5'
	4.5'-5'	GRADING ORANGE.		3-3-4-2
MPSB-2	0'-0.5'	CRUSHED GRAVEL.	0'-5'	0'-2'
	0.5'-1'	GREY FINE SAND, TRACE SILT, NO ODOR, MOIST.	2200 PPM	9-11-16-16
	1'-1.5'	GRADING BROWN, TRACE GRAVEL.		3'-5'
	1.5'-2'	GRADING LAYERED BROWN AND BLACK, MODERATE PETROLEUM ODOR.		3-3-4-2
	3'-4.5'	TAN FINE SAND, TRACE SILT, NO ODOR, MOIST.		
	4.5'-5'	GRADING ORANGE.		
MPSB-3	0'-0.5'	CRUSHED GRAVEL.	2'-5'	
	0.5'-1'	DARK BROWN FINE SAND, NO ODOR, MOIST.	<10 PPM	1'-3'
	1'-2'	GRADING MOTTLED BROWN AND ORANGE, LITTLE GRAVEL.		11-9-7-7
	2'-2.7'	GRADING MOTTLED TAN AND BLACK.		
	2.7'-3'	GRADING DARK ORANGE BROWN AND TAN, PIECE OF WOOD IN SPOON.		3'-5' 4-4-8-4
	3'-4'	GRADING TAN, 2″ WOOD.		
	4'-5'	GRADING ORANGE.		
MPSB-4	0'-0.5'	CRUSHED GRAVEL.		
	0.5'-5'	MOTTLED ORANGE AND TAN FINE SAND, TRACE SILT, NO ODOR, MOIST.	1'-5' <10 PPM	1'-3' 11-12-9-6 3'-5' 2-2-1-2

TABLE 5

(CONTINUED)

SOIL DESCRIPTIONS
MIDWAY PARK WASTE OIL TANK

LOCATION	DEPTH	DESCRIPTIONS	DEPTH/ TPH	BLOW COUNT
MPSB-5	0'-0.5'	CRUSHED GRAVEL.	3'-5'	
	0.5'-1.8'	ORANGISH BROWN FINE SAND, NO ODOR, MOIST.	<10 PPM	1'-3'
	1.8'-2.5'	5" WOOD AND CONCRETE IN SPOON. CONCRETE OBSTRUCTION IN SIDE OF BORING AT 2'.		5-8-4-3
	2.5'-5'	DARK ORANGE BROWN FINE SAND, TRACE SILT, NO ODOR, MOIST. PIECE OF WOOD AT 4.5'.		3'-5' 2-1-1-2

NOTES:

1) DEPTHS ARE APPROXIMATE.
2) TPH – TOTAL PETROLEUM HYDROCARBONS.
3) PPM– CONCENTRATION IN PARTS PER MILLION, WHICH IS ANALOGOUS TO MILLIGRAMS PER KILOGRAM.
4) BLOW COUNTS ARE THE NUMBER OF BLOWS REQUIRED TO DRIVE A STANDARD SPLIT SPOON 2 FEET IN 6 INCH INCRIMENTS.
5) SEE INDIVIDUAL LOGS FOR MONITOR WELLS MPMW-1 AND MPMW-2.

BORING: MPMW-1
LOCATION: MIDWAY PARK, CAMP LEJEUNE
DATE COMPLETED: NOVEMBER 27, 1990

DEPTH (FEET)	TEST SAMPLE	BLOW COUNT	SOIL CLASS	DESCRIPTION
0				MOTTLED BROWN FINE SAND, SOME SILT, NO
-	#1	4-4-5-5	SM	ODOR, MOIST, MEDIUM DENSE.
-	0'-2'		ML	3" BLACK SILT (OLD TOP SOIL?).
-			SP	BROWN TO ORANGISH TAN FINE SAND, LITTLE
-			--	SILT, MOIST.
-			SM	
-	#2	2-2-2-3		ORANGISH TAN FINE SAND, TRACE SILT,
-	3'-5'			NO ODOR, MEDIUM DENSE, MOIST.
-				GRADING LIGHT ORANGISH TAN.
-				
5				GRADING LIGHT TAN.
-				
-				
-				
-				
-				
-				
-				
-				
-				
10		CUTTINGS	SP	GRADING FINE TO MEDIUM GRAINED,
-				VERY MOIST TO WET.
-				
-				
-				
-				
-				
-				
-				
-				
15		CUTTINGS		GRADING WITH TRACE COARSE SAND AND
-				FINE GRAVEL, SATURATED.
-				
-				
-				
-				
-				
-				
-				
-				
20			▨	
-				
-				

BORING COMPLETED AT A DEPTH OF 20 FEET.

WELL CONSTRUCTION: 2 INCH I.D. PVC PIPE WITH 15 FEET OF SCREEN SET AT 23 FEET (DEEPER DUE TO LOSE SAND BELOW WELL TIP), FILTER SAND PACK UP TO 5 FEET, BENTONITE UP TO 3 FEET, GROUT TO SURFACE, LOCKING CASE, STICKUP = 3.21 FT.

WATER LEVELS:		
	DATE	11-30-90
	DEPTH	11.59 FT. FROM TOP OF CASING.

PLATE 1

TABLE 6

MIDWAY PARK WASTE OIL TANK
LABORATORY RESULTS OF SOIL AND WATER SAMPLES

SAMPLE	DEPTH	TPH	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES	V7	V17	V20	V25	V27	TOX	PCB
MPHA-1A	0'-1'	ND	--	--	--	--	--	--	--	--	--	--	--
MPHA-1B	2'-4'	ND	--	--	--	--	--	--	--	--	--	--	--
MPHA-2A	0'-1'	ND	--	--	--	--	--	--	--	--	--	--	--
MPHA-2B	1'-4'	ND	--	--	--	--	--	--	--	--	--	--	--
MPHA-3	0'-4.5'	ND	ND	0.046	ND	ND	ND	ND	ND	ND	ND	--	--
MPHA-4A	SURFACE	ND	--	--	--	--	--	--	--	--	--	--	--
MPHA-4B	0'-4'	ND	--	--	--	--	--	--	--	--	--	--	--
MPHA-5	0'-1'	ND	--	--	--	--	--	--	--	--	--	--	--
MPSB-1	0'-5'	1200 IR	--	--	--	--	--	--	--	--	--	--	--
MPSB-2	0'-5'	2200 IR 1480 IR*	ND	0.014	ND	0.026	0.006	0.029	0.044	0.240	0.020	--	--
MPSB-3	2'-5'	ND	--	--	--	--	--	--	--	--	--	--	--
MPSB-4	1'-5'	ND	--	--	--	--	--	--	--	--	--	--	--
MPSB-5	3'-5'	ND	--	--	--	--	--	--	--	--	--	--	--
MPMW-1A	0'-2'	20 D 2400 IR	--	--	--	--	--	--	--	--	--	--	--
MPMW-1B	3'-5'	ND D 70 IR	--	--	--	--	--	--	--	--	--	--	--
MPMW-1W	WATER	ND	--	--	--	--	--	--	--	--	--	0.008	ND
MPMW-2	0'-5'	ND	--	--	--	--	--	--	--	--	--	--	2.03**
MPMW-2W	WATER	ND	--	--	--	--	--	--	--	--	--	0.034	ND

NOTES:

1) ALL RESULTS ARE PRESENTED IN PARTS PER MILLION (PPM), WHICH IS ANALOGOUS TO MILLIGRAMS PER KILOGRAMS.

2) TPH- TOTAL PETROLEUM HYDROCARBONS. TEST METHOD IS BY GAS CHROMATOGRAPH (GC); "D" INDICATES DIESEL, "IR" - INDICATES INFRARED SPECTROPHOTOMETRY METHOD IN LIEU OF OR IN ADDITION TO GC METHOD. "*" - INDICATES TEST RESULTS FROM SECOND LABORATORY.

3) VOLATILE ORGANIC COMPOUNDS (VOC) ARE 34 COMMON PRIORITY POLLUTANTS. V7 - CHLOROFORM, V17 MEHYLENE CHLORIDE, V20 - 1,1,1 TRICHLOROETHANE, V25 - 1,1,2 TRICHLOROTRIFLUOROETHANE (FREON), V27 - CHLOROBENZENE. INCLUDES BENZENE, TOLUENE, ETHYLBENZENE AND TOTAL XYLENES (BTEX). ALL OTHER COMPOUNDS WERE BELOW THEIR DETECTION LIMITS.

4) TOX - TOTAL ORGANIC HALIDES.

5) PCB - POLYCHLORINATED BIPHENOLS. "**" - QUANTIFICATION BASED UPON AROCLOR 1242

6) "ND" - NOT DETECTED. DETECTION LIMITS: TPH IN SOIL = 10 PPM, TPH IN WATER = 1.0 PPM, VOC AND BTEX IN SOIL = 0.005 PPM. PCB IN SOIL = 0.050 PPM, PCB IN WATER = 0.001 PPM