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REMEDIAL INVESTIGATION ADDENDUM FOR SITE 45 FORMER MORALE, WELFARE, AND RECREATION DRY CLEANING FACILITY, MCRD PARRIS ISLAND SC

4/1/2012

TETRA TECH, INC.

Comprehensive **L**ong-term **E**nvironmental **A**ction **N**avy

CONTRACT NUMBER N62467-94-D-0888

Remedial Investigation Addendum
for
Site 45 - Former Morale, Welfare, and Recreation Dry Cleaning Facility

Marine Corps Recruit Depot
Parris Island, South Carolina

Contract Task Order 0335

April 2012

NAS Jacksonville
Jacksonville, Florida 32212-0030

REVISION 4
April 2012

REMEDIAL INVESTIGATION ADDENDUM FOR SITE 45 FORMER MWR DRY CLEANING FACILITY

FOR

MARINE CORPS RECRUIT DEPOT
PARRIS ISLAND, SOUTH CAROLINA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Naval Facilities Engineering Command
Southeast
NAS Jacksonville
Jacksonville, Florida 32212-0300

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April 2012

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ACRONYM LIST

ASTM	American Society for Testing and Materials
ATSDR	Agency for Toxic Substances and Disease Registry
B&R	Brown and Root Environmental
BAF	Bioaccumulation Factor
BCF	Bioconcentration Factor
bgs	Below Ground Surface
BOD	Biological Oxygen Demand
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-Term Environmental Action Navy
CMS	Corrective Measures Study
COC	Chemical of Concern
COD	Chemical Oxygen Demand
COPC	Chemical of Potential Concern
CSF	Cancer Slope Factor
CTO	Contract Task Order
DCE	Dichloroethene
DNAPL	Dense Non-Aqueous Phase Liquid
DO	Dissolved Oxygen
DPT	Direct-Push Technology
DQO	Data Quality Objective
EE/WP	Engineering Evaluation and Interim Removal Remedial Work Plan
ET	Exposure time
FEMA	Federal Emergency Management Agency
FID	Flame Ionization Detector
FS	Feasibility Study
GC	Gas Chromatograph
gpm	Gallons per Minute
HEAST	Health Effects Assessment Summary Tables
HI	Hazard Index
HQ	Hazard Quotient
IAS	Initial Assessment Study
ICR	Incremental Cancer Risk
ID	Inner Diameter
IDW	Investigation-Derived Waste
ILCR	Incremental Lifetime Cancer Risk

IR	Installation Restoration
IRIS	Integrated Risk Information System
K	Hydraulic Conductivity
LOAEL	Lowest-Observed-Adverse-Effect Level
MCL	Maximum Contaminant Level
MCRD	Marine Corps Recruit Depot
MCL	Maximum Contaminant Level
µg/kg	Micrograms Per Kilogram
µg/L	Micrograms Per liter
MIP	Membrane Interface Probe
MS/MSD	Matrix Spike/Matrix Spike Duplicate
msl	Mean Sea Level
MW	Monitoring Well
MWR	Morale, Welfare and Recreation
NACIP	Naval Assessment and Control of Installation Pollutants
NAD 83	North American Datum 1983
NAPL	Non-Aqueous-Phase Liquids
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NEESA	Naval Energy and Environmental Support Activity
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No-Observed-Adverse-Effect Level
NTU	Nephelometric Turbidity Unit
ORP	Oxidation-Reduction Potential
PAH	Polynuclear Aromatic Hydrocarbon
PAI	Parris Island
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethene
PEF	Particulate Emissions Factor
PID	Photoionization Detector
PRG	Preliminary Remediation Goal
PSI	Per Square Inch
QA	Quality Assurance
QAP	Quality Assurance Plan
QA/QC	Quality Assurance/Quality Control
RAGS	Risk Assessment Guidance for Superfund

RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facilities Assessment
RfC	Reference Concentration
RfD	Reference Dose
RFI	RCRA Facility Investigation
RGO	Remedial Goal Options
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
RPD	Relative Percent Difference
SARA	Superfund Amendments and Reauthorization Act
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SOUTHDIV	Southern Division
SP	Poorly Graded Sand
SP/SM	Poorly Graded Sand to Silt Sand
SSL	Soil Screening Level
SVOC	Semivolatile Organic Compound
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TCE	Trichloroethene
TCL	Target Compound List
TEF	Toxicity Equivalence Factor
TOC	Total Organic Carbon
Tetra Tech	Tetra Tech, Inc.
UCL	Upper Confidence Limit
USCS	Unified Soil Classification System
U.S. EPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geologic Survey
UV	Ultraviolet
VC	Vinyl Chloride
VF	Volatilization Factor
VOCs	Volatile Organic Compound

EXECUTIVE SUMMARY

Tetra Tech, Inc. (Tetra Tech) prepared this remedial investigation (RI)/Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) Addendum report to summarize field activities conducted in the Spring of 2005 at the former Morale, Welfare and Recreation (MWR) Drying Cleaning Facility [Site 45/Solid Waste Management Unit (SWMU) 45], located at the Marine Corps Recruit Depot (MCRD) Parris Island, South Carolina. Other information, as available from other sources [e.g. United States Geologic Survey (USGS) and GSI Environmental], has also been incorporated. This report was prepared for the United States Navy (Navy) Southern Division (SOUTHDIV) Naval Facilities Engineering Command (NAVFAC) under Contract Task Order (CTO) 0335, for the Comprehensive Long-Term Environmental Action Navy (CLEAN) III Contract Number N62467-94-D-0888. This RFI Addendum adds to the body of knowledge discussed in more detail in the Site 45 – Former MWR Dry Cleaning Facility RI/RFI Report prepared in December 2004 (Tetra Tech, 2004a).

The objectives of this RFI Addendum investigation were to further characterize the nature and extent of contaminant migration in groundwater caused by past releases at Site 45. Data collected during this investigation was used to assess the human health risks associated with intrusion of VOCs into buildings.

Field investigation activities for this phase of the Site 45 investigation were performed from February through April 2005. Primary activities consisted of membrane interface probe (MIP) screening, installation of 15 temporary wells, installation of 29 permanent wells, groundwater sampling of 62 wells (existing and newly installed), water-level measurements, data collection for vapor intrusion modeling, surveying and investigation-derived waste (IDW) management. The USGS investigation was completed from 2007 to 2009, and the GSI Environmental investigation was conducted in June and July 2009.

Key conclusions and recommendations developed during the Site 45 RFI Addendum are summarized as follows.

- PCE and its degradation products (TCE, cis-1,2-DCE, total 1,2-DCE and VC) were detected in the surficial upper and surficial lower aquifers at numerous locations above the most stringent regulatory screening criteria. The concentrations in the deep wells were below screening levels indicating contamination is not migrating vertically to any great extent with a maximum cis-1,2-DCE “detected” concentration of 2.0J µg/L at MW-07D during the RI Addendum sampling. USGS sampling results similarly show concentrations in the deep wells are below screening levels, with all VOCs detections being less than 1 µg/L.

- Nature and extent of contamination is well-defined with only a few areas of refinement needed. It is believed that there was at least one source release (near MW08 and MW24). It appears that the source of the 'southern plume' is leakage from an abandoned sanitary sewer line near the southeast corner of the new dry cleaner building. Any further refinement, if necessary, could be accomplished as part of future phases of regulatory activity at this Site.

- Additional data may be necessary to evaluate the potential remedies in a Feasibility Study. On-going pilot testing at the source area will provide additional data points for the evaluation. Ongoing pilot testing activities will be statused in the Feasibility Study for Site 45.

- Based on the following, evaluation of groundwater remedial solutions appears warranted:

  - Likelihood of a DNAPL pool serving as a continuing source of groundwater contamination,

  - Likelihood of a continuing release from a segment of abandoned sanitary sewer near the south-east corner of the new dry cleaner building,

  - Potential risk of impact to surface waters from contaminated groundwater infiltration to the storm sewer network,

  - Potential vapor intrusion issues at the current dry cleaners, Building 293, and/or hypothetical vapor intrusion risk to structures associated with future development of the site.

- Groundwater contamination results in potential human health risks and pathways that need to be mitigated. A Feasibility Study will follow to present possible remedial alternatives.

- Sediment and surface water will be discussed separately rather than in this RFI Addendum, as not enough data exists at this time to make conclusions or be able to proceed with the CERCLA process.

1.0 INTRODUCTION

1.1 PURPOSE OF REPORT

Tetra Tech, Inc. (Tetra Tech) prepared this Remedial Investigation (RI) Addendum report to summarize field activities conducted in the Spring of 2005 at the former Morale, Welfare and Recreation (MWR) Drying Cleaning Facility [Site 45/Solid Waste Management Unit (SWMU) 45], located at the Marine Corps Recruit Depot (MCRD) Parris Island, South Carolina. This report was prepared for the United States Navy (Navy) Southern Division (SOUTHDIV) Naval Facilities Engineering Command (NAVFAC) under Contract Task Order (CTO) 0335, for the Comprehensive Long-Term Environmental Action Navy (CLEAN) III Contract Number N62467-94-D-0888.

This RI Addendum adds to the body of knowledge discussed in more detail in the Site 45 – Former MWR Dry Cleaning Facility RI/RFI Report prepared in December 2004 (Tetra Tech, 2004a). Information provided in that report will be repeated in this Addendum only if it is necessary to understand the context of the work described in this Addendum. Examples of topics that will not be repeated in this report include the regulatory setting, discussions of previous Site 45 investigations and pilot studies, and other topics similar to these.

1.2 HISTORICAL INFORMATION AND OTHER INVESTIGATIONS

1.2.1 Facility Background

MCRD Parris Island is located along the southern coast of South Carolina, approximately 1 mile south of the city of Port Royal and 3 miles south of the city of Beaufort within Beaufort County. MCRD Parris Island covers approximately 8,047 acres that consist of dry land, salt marshes, saltwater creeks, and ponds, as shown in Figure 1-1. MCRD Parris Island is the reception and recruit training facility for the Marine Corps for enlisted men from states east of the Mississippi River and for enlisted women nationwide.

1.2.2 Site 45 Background and History

Prior to 2001, Site 45 – MWR Dry Cleaning Facility was in a building located in the Main Post area of MCRD Parris Island, between Panama Street to the north, Kyushu Street to the south, and Samoa Street to the east (Figure 1-2). West of the facility are currently other commercial establishments, including a cobbler, a tailor, a coin-operated laundry facility, and a new dry cleaning facility. South of the facility is Building 293, attorneys' offices.

Four above-ground storage tanks were situated along the northern side of the former building. These tanks were first put into place in 1988, following the removal of an underground storage system (located at approximately the same location) where hydrocarbon cleaning solvents were previously stored. The former dry-cleaning facility began operations in the 1950s, thus the USTs were most likely in operation from the 1950s through the mid-1980s. The new storage tanks are positioned within a concrete catch basin used to contain any overflow during tank filling.

On March 11, 1994, a tetrachloroethene [also known as perchloroethlyene (PCE)] spill of unknown quantity was released into soil near the above ground PCE storage tanks of Site 45. It was reported that one of the tanks was overfilled, causing the liquid PCE to spill onto the concrete catch basin and subsequently to the surrounding surface soil. Contaminated soil was excavated, and an interim remedial action was initiated. It is also believed that many smaller spills have occurred in the vicinity of the tanks (northern plume), and due to precipitation and infiltration, PCE from these smaller spills could have been released into the soil as well.

In late 1997, the dry-cleaning operations were moved to a new facility, approximately 130 ft west of the former dry-cleaning building (USGS, 2009). With the move to a new facility, the dry-cleaning operation switched from using PCE as the cleaning solvent to using a non-hazardous hydrocarbon-based cleaner (ExxonMobil DF-2000®) that contains no chlorinated solvents, and the equipment was replaced with refrigeration for recirculation and recovery of the solvent (Center for Waste Minimization, 2000). In early 2001, the main dry cleaning building, solvent tanks, and other related structures were demolished and removed from the site.

Investigations in 2005 and 2006 showed a second groundwater contamination plume of chlorinated solvents, known as the southern plume, south and southwest of the former dry-cleaning facility, appearing to originate from the direction of the new dry-cleaning facility. The southern plume consists of groundwater contamination extending southeastward from an area approximately 40 feet from the southeastern corner of the new dry-cleaning facility to about the intersection of Samoa Street and the driveway into the parking lot for Building 293. The two plumes of groundwater contamination present are apparently intermingling in downgradient areas.

Currently, the site is a vacant lot covered with mowed grass. Some isolated shrubs and trees are also present. Physical features remaining at the site consist of three above-ground extraction well housing units (approximately 2 feet by 2 feet by 3 feet) and one groundwater treatment system shed (approximately 10 feet by 20 feet).

Tetrachloroethene (PCE), is a chlorinated hydrocarbon used in many commercial applications including chemical syntheses, dry cleaning, and metal degreasing. It is a nonflammable volatile organic compound (VOC) that can leach into groundwater if released into the environment. United States Environmental Protection Agency (USEPA) studies have shown that elevated levels of oral PCE intake by biological receptors may have significant impacts on neurological, renal, and hepatic functions and may also, through natural metabolic processes, cause genetic aberrations leading to higher cancer risks.

The objectives of this RI Addendum investigation are to further characterize the nature and extent of contaminant migration in groundwater caused by past PCE releases at Site 45. Data collected during this investigation were used to update and refine plume migration models and to assess the human health risks associated with intrusion of VOCs into buildings. The risks to human and ecological receptors have already been evaluated in the RI/RFI for Site 45 (Tetra Tech, 2004). Based on information collected in this investigation, along with existing data, future actions at the site (including potential remedial actions) will be evaluated and determined.

The surficial (upper and lower) groundwater flow at Site 45 is primarily to the south-southeast whereas the deep groundwater flow at Site 45 is generally to the southwest. The surficial groundwater flow is consistent with the 2001 field event. The leading edge of the Site 45 groundwater plume is approximately 800 feet from the marsh in the direction of groundwater flow. Based on 5 years of monitoring data from 1996 through 2001, there was no obvious migration of groundwater contamination. However, sampling at one location in early 2003 did indicate that some downgradient migration had occurred, which resulted in the need for this RI Addendum investigation for VOCs.

1.2.3 United States Geological Survey Storm Sewer Investigation and Related Investigations

The United Stated Geological Survey (USGS), in cooperation with the NAVFAC Southeast, began investigations at the site in 2006 to examine the role that sewer lines play in contaminant source, distribution, attenuation, and transport in both the northern and southern plumes, further delineate contamination in the southern plume, and examine natural attenuation aspects of groundwater contamination in the southern plume (USGS, 2009). During the investigation it was determined that most of the groundwater contamination near the new dry-cleaning facility is present from a few feet below ground surface (bgs) to about 11.5 ft bgs. Within that interval, most of the contamination is at a depth of about 8 to 11.5 ft bgs, with the greatest concentrations near the bottom of that interval. Although the southern plume spatially originates from the new dry-cleaning facility, the new dry-cleaning facility is not likely the source of the contamination. Engineering blueprints, flow testing, and video imaging of sanitary sewers at the site, as well as the lack of a viable contaminant source at the new dry-cleaning facility, indicated that the contaminant source in the southern plume was a leak from a sanitary sewer in the vicinity of the new dry-cleaning facility.

Once in the aquifer, contamination in both the northern and southern plumes is transported southeastward, where most of the dissolved contamination is intercepted by leaky storm sewers. According to the USGS report, because the storm sewers at Site 45 range in diameter from 12 to 36 inches and a tidal change of greater than 3 ft takes place in some of the storm sewers at Site 45, the VOCs entering the storm sewers are substantially diluted upon entry. Volatilization probably also removes some of the VOC contamination in the storm sewers. During outgoing tides, the diluted contamination in the storm sewer is transported southward and discharges to Ballast Creek (USGS, 2009). The USGS report is included as Appendix A, and results are discussed further in this report when they are related.

It is possible that the sediments and surface water have been impacted by contamination in other ways. For example, historical releases of PCE product may have been transported down the storm sewers, either at the time of release, or from soil/subsurface soil sources prior to the initial clean-up efforts. Product transported down the storm drains and deposited into the marsh could have impacted sediments in the outfall area.

1.2.4 GSI Environmental Vapor Intrusion Study

GSI Environmental Vapor Intrusion, in cooperation with the NAVFAC Southeast, began investigations at the site in 2009 to complete a vapor screening study at Site 45. The difference in attenuation factors between radon and PCE detected suggests that the vast majority of the PCE inside the building is coming from inside the building. Several other VOCs were detected in the indoor air at concentrations greater than those in the ambient air samples. The GSI Environmental data tables are included as Appendix B and the results are discussed and used in the vapor intrusion risk assessment in Section further in this report when they are related.

1.3 REPORT ORGANIZATION

This report is divided into seven sections. Section 1.0, Introduction, provides historic information about MCRD Parris Island and Site 45 in particular. Section 2.0, Environmental Setting, provides geological and geographical information about MCRD Parris Island and the surrounding areas. Section 3.0, Investigation Summary, summarizes the sampling program and presents the Site 45 geology and hydrogeology based on the field results. Section 4.0, Nature and Extent of Contamination, addresses the updated nature and extent of groundwater contamination. Section 5.0, Contaminant Fate and Transport, describes the chemical and physical properties of the analytes positively detected at Site 45. Section 6.0, Human Health Risk Assessment presents the methodology and results of the human health risk assessment for vapor intrusion. Section 7.0, Conclusions and Recommendations, focuses on the proposed actions and remedies, if any, to address identified risks. Appendices A through O provide

supporting documentation for the field investigation and supplemental information for the evaluation of results.

SOURCE: PARRIS ISLAND 1998 AERIAL PHOTOGRAPH

DRAWN BY HJB DATE 2/15/02			CONTRACT NO. 0502
CHECKED BY DATE		SITE 45 – MWR DRY CLEANING FACILITY MCRD PARRIS ISLAND PARRIS ISLAND, SOUTH CAROLINA	APPROVED BY DATE
COST/SCHED-AREA			APPROVED BY DATE
SCALE NOT TO SCALE			DRAWING NO. FIGURE 1-1 / REV. 0

FORM CADD NO. SOCV_AV.DWG – REV 0 – 1/30/98

ACAD:0502CM14.dwg 02/15/02 HJB

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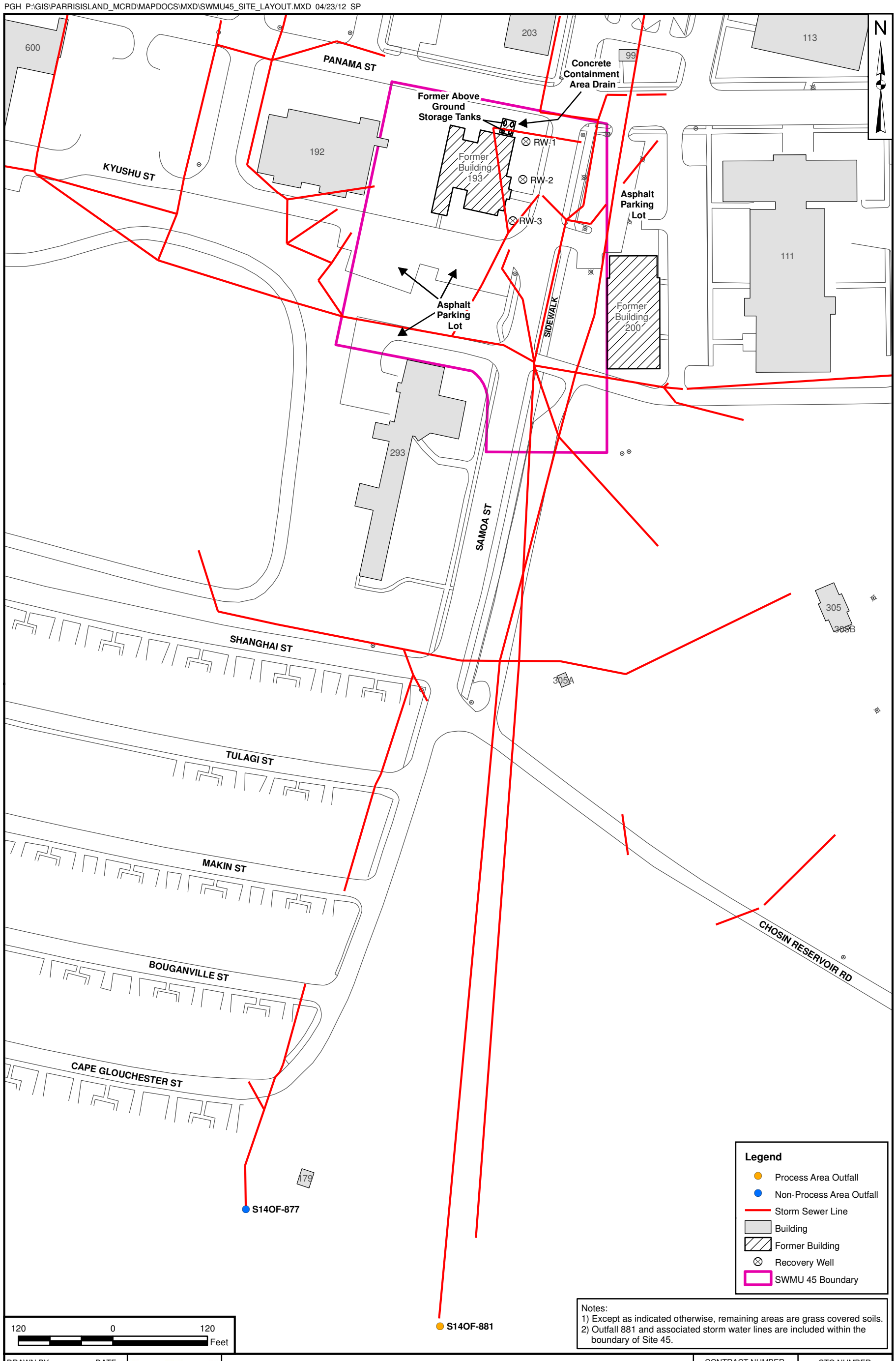

Notes:
1) Except as indicated otherwise, remaining areas are grass covered soils.
2) Outfall 881 and associated storm water lines are included within the boundary of Site 45.

DRAWN BY	DATE
S. PAXTON	04/23/12
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P. CHURCHILL	04/23/12
REVISED BY	DATE
SCALE	
AS NOTED	

NAVFAC

SITE BOUNDARY
SITE 45
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	CTO NUMBER
N5260	
APPROVED BY	DATE
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FIGURE NO. FIGURE 1 - 2	REV 0

2.0 ENVIRONMENTAL SETTING

This section contains general information about the environmental setting common to all the sites currently under investigation at MCRD Parris Island. A comprehensive discussion of the environmental setting at the MCRD can be found in the Master Work Plan (B&R Environmental 1998) or the Initial Assessment Study (IAS) (NEESA, 1986).

2.1 CLIMATE

MCRD Parris Island is in the southernmost region of South Carolina, where the climate is milder than elsewhere in the state. This low-lying coastal area has numerous islands, inlets, streams, and marshes and a temperature regime that clearly reflects the influences of its maritime and southern location. The climate is subtropical, with long and hot summers followed by short and mild winters. Precipitation is abundant, averaging about 49 inches per year and remaining within the range of 40 to 58 inches during most years. Precipitation in the amount of 0.1 inch or more falls on an average of about 77 days per year. The annual distribution shows a major monthly maximum of about 7 inches in July and a major monthly minimum of about 2 inches in November. The period from April through October, which includes the growing season for most crops in this area, receives an average of about 34 inches of rain, about 70 percent of the annual total.

2.2 TOPOGRAPHY

MCRD Parris Island lies in the Lower Coastal Plain physiographic province. Elevations range from sea level to 22 feet above mean sea level (msl); the elevation at Site 45 ranges from approximately 6 to 9 feet above msl. The Depot consists of Parris Island (the largest and most developed island), seven smaller, named islands, many small unnamed islands, salt marshes, and related tidal creeks. Because of the low elevation, most of the Depot is within the 100-year flood plain. The majority of the area of Parris Island north of Ballast Creek, the east-central area of Page Field, and the central part of Horse Island are the only surfaces above the 100-year flood plain (NEESA, 1986).

The Depot covers 8,047 acres: 1,502 acres are devoted to forest management; 744 acres are grass and facilities; 4,344 acres are saltwater marsh; and the remainder consists of creeks, ponds, and causeways. Dry land makes up 3,274 acres (NEESA, 1986).

2.3 SURFACE WATER DRAINAGE

Drainage off the land surface is to the nearest surface water body. Three generally east-west trending creeks drain much of the Depot. Archers Creek, at the northern boundary of the Depot, connects Battery

Creek to the north with the Broad River to the west of Parris Island. Ribbon Creek drains the area between Horse and Parris Islands and flows westward into the Broad River. Ballast Creek drains the middle of Parris Island and flows eastward into the Beaufort River. Surface water at Site 45 drains into base storm sewers and then into Ballast Creek. Smaller unnamed creeks drain the areas west and east of Page Field.

The Beaufort and Broad Rivers meet at the southern end of Parris Island to form Port Royal Sound, which extends about 4 miles southeastward to the Atlantic Ocean. A 1998 aerial photograph of the major portions of Parris Island, including Site 45 is shown on Figure 1-1.

2.4 SOIL

Soil at MCRD Parris Island has been mapped by the U.S. Soil Conservation Service as both individual soil and groupings of soil (units). The Depot has been mapped as having 15 individual soil types, but only eight types are present beneath sites currently under investigation. Three soil units have been mapped for the Depot (the Wando-Seabrook-Seewee, Coosaw-Williman-Ridgeland, Bohicket-Capers-Handsboro Soil Unit). A further discussion of the soil and soil units identified at the MCRD can be found in the Master Work Plan for MCRD Parris Island (B&R Environmental, 1998) or the IAS (NEESA, 1986).

2.5 GEOLOGY

Four geological units are present in the Beaufort-Jasper County Area. These units from the youngest (Pleistocene age) to the oldest (Eocene age) are the Pleistocene sands and clays, Hawthorn Formation, Cooper Marl, and Santee Limestone. A further discussion of the descriptive and structural geology of the Beaufort-Jasper County area can be found in the Master Work Plan for MCRD Parris Island (B&R Environmental, 1998) or the IAS (NEESA, 1986). The geology of Site 45 is further discussed in Section 3.3.

2.6 HYDROGEOLOGY

Two primary aquifers are present within the Beaufort-Jasper County Area: the surficial aquifer and the Floridan Aquifer. These aquifers are generally separated by the Hawthorn Formation and Cooper Marl, which act as confining units to the underlying Floridan Aquifer.

In the MCRD Parris Island area, the shallow, unconfined aquifer generally consists of permeable, fine to medium, Pleistocene age sands and clays. Surface relief is relatively low. The area is drained by fresh and brackish-water streams inland and by tidal streams along the coast. The water table in the MCRD Parris Island area usually ranges from 0 to 10 feet bgs and is most commonly found at a depth of

3 feet bgs. Water-table fluctuations are a function of recharge, evaporation, and transpiration and have been observed to be as great as 6.5 feet at some locations (Glowacz, et al., 1980). The direction of groundwater flow in the upper portion of the shallow surficial aquifer is generally toward the nearest surface water body, such as a pond, river, tidal creek, or the ocean. Recent groundwater contour maps are provided at the end of Section 3.

In the Beaufort-Jasper County Area, the Floridan Aquifer system occurs near land surface, and confining beds vary from essentially 0 to more than 150 feet in thickness. Groundwater in the Floridan Aquifer occurs in solutionally enlarged openings or cavities in the limestone. In general, groundwater occurs in a series of broadly defined water-bearing (permeable) zones that serve as aquifers and are separated by less permeable bedrock. Two hydrogeologic zones within the Floridan Aquifer lie beneath the MCRD Parris Island area. These two hydrogeologic units consist of a 200-foot-thick Upper Hydrogeologic Unit that contains an upper permeable zone and an 800-foot-thick Lower Hydrogeologic Unit that has a somewhat lower permeability compared to the Upper Unit.

A further discussion of the hydrogeological characteristics of the Beaufort-Jasper County area can be found in the Master Work Plan for MCRD Parris Island (B&R Environmental, 1998). The hydrogeology of Site 45 is detailed in Section 3.4.

2.7 ECOLOGY

General discussions on the ecoystems present and threatened and endangered plants and animals that occur or potentially occur on MCRD Parris Island can be found in the Master Work Plan for MCRD Parris Island (B&R Environmental, 1998) or the IAS (NEESA, 1986).

Specific ecology information about Site 45 includes that it is located in a highly developed portion of MCRD Parris Island. The site consists of a small area (40 feet by 120 feet) of turf grass. Paved streets border the site on three sides, and a building borders the site on the fourth side (Figure 1-2). Parking lots, streets, buildings, and construction areas are located in the immediate area surrounding the site. Five cabbage palms (*Sabal palmetto*), one slash pine (*Pinus elliottii*), and eight small ornamental shrubs occur as roadside plants immediately beyond the periphery of the site. Thus, Site 45 and the adjacent areas provide only limited terrestrial habitat of poor quality in a developed (urban-type) setting. Ecological receptors that occur at Site 45 consist of those typically found in urban areas, such as terrestrial invertebrates and lizards. Various songbirds occasionally forage on the site. Mammals at the site are probably limited to rodents such as the black rat and house mouse. No signs of moles (*Talpidae*) were observed in several visits by Tetra Tech biologists.

No surface water bodies or wetlands are present or within the immediate area of the site. The terrain is flat, and surface water runoff in the vicinity is collected by the storm sewer system. The nearest surface water body is a shallow tidal marsh approximately 900 feet south-southeast of the site.

The marsh is dominated by cordgrass (*Spartina alterniflora*). Black needlerush (*Juncus roemerianus*) is also present in the marsh, and seashore saltgrass (*Distichlis spicata*) and glasswort (*Salicornia virginica*) occur in portions of the marsh/upland boundary. A narrow wooded area occurs immediately upslope of the marsh. The wooded area is dominated by slash pine and loblolly pine (*Pinus taeda*), with an understory of various shrubby species. The marsh provides habitat for a variety of fauna, such as fish and crustaceans, as well as several species of animals that prey upon the fish and crustaceans. Various shorebirds and wintering waterfowl forage in the marsh.

Based on information collected to date, the groundwater exposure route is negligible for ecological receptors at this time.

In summary, Site 45 provides only 0.1 acre of terrestrial habitat in an industrial setting. Terrestrial habitat consists of mowed turf grass and receptors consist of species acclimated to urban and industrial conditions. A complete exposure pathway has three components: a source of contaminants that can be released to the environment; a route of contaminant transport through an environmental medium; and an exposure or contact point for an ecological receptor. The poor habitat, the urban/industrial nature of the area, and the small size of Site 45 result in an exposure pathway that is essentially incomplete. Therefore, with the possible exception of receptors such as soil invertebrates, the potential for ecological impacts from site-related contaminants does not exist, and the terrestrial exposure pathway was not evaluated further. Potential effects to soil invertebrates (if any) would be limited to an extremely small area and would not be ecologically significant. The USGS report indicates that groundwater contamination is migrating through the storm drains to the marsh. Further surface water and sediment sampling is required to determine if there are potential ecological impacts at the site.

3.0 INVESTIGATION SUMMARY

Field investigation activities for this phase of the SWMU 45 (Site 45) investigation were performed from February through April 2005. Primary activities consisted of membrane interface probing (MIP), screened interval sampling, temporary well installation, permanent well installation, water-level measurements, groundwater sampling, data collection for vapor intrusion modeling, surveying and investigation-derived waste (IDW) management.

3.1 RI/RFI ADDENDUM INVESTIGATION OBJECTIVES

Field activities were conducted in accordance with the Site/SWMU 45 RI/RFI Addendum Work Plan for Marine Corps Recruit Depot, Parris Island, South Carolina (Tetra Tech, 2004b). These field activities supported the collection of data to meet the following objectives:

- Further characterize the nature and extent of contaminant migration in groundwater caused by past chlorinated solvent releases at Site 45.

- Assess the human health risks associated with intrusion of select VOCs into buildings. The overall risks to human and ecological receptors have already been evaluated in the RI/RFI for Site 45.

Based on the project objectives listed above, a summary of the field investigation activities and the rationale for these activities is presented in Table 3-1.

Information collected during the investigation was used to supplement existing information at Site 45. The following sections discuss the field activities conducted and additional information gained regarding the site-specific geologic and hydrogeologic setting at Site 45. The layout of Site 45 is shown in Figure 1-2.

3.2 RI/RFI ADDENDUM FIELD INVESTIGATION

The following sub-sections discuss the field activities conducted at Site 45 conducted during the February through April 2005 RI Addendum investigation

3.2.1 Membrane Interface Probe (MIP)

MIP was employed as the first step in the investigation to provide real-time, continuous vertical profiling of VOC contaminant levels at Site 45. Results were used to guide placement of borings and wells without the need for collecting and analyzing samples at a fixed-base laboratory.

Forty-nine (49) MIP points (SB101 to SB149) including two contingency points (SB201 and SB202) were advanced by Vironex, Inc. The MIP point sampling tools were advanced using direct push technology (DPT), which used hydraulic pressure and/or percussion hammers to advance the boring. MIP/soil conductivity (SC) logging was used in conjunction with DPT drilling to collect real-time, continuous VOC-related data and soil conductivity data in the vadose and saturated zone. A single upgradient MIP point (SB101) was advanced and logged to 30 feet below ground surface (bgs), through the peat/clay layer to obtain a baseline for the site. This boring was backfilled with cement grout upon completion of data gathering. The balance of the MIP points were advanced approximately 20 to 22 feet bgs to the top of the peat/clay layer to minimize the potential for the migration of contaminants to deeper zones. Locations of the MIP points are shown on Figure 3-1.

Tetra Tech collaborated daily with the subcontractor to correlate MIP readings with previously collected soil lithologic data. Daily data printouts were provided for the parameters listed below at each MIP boring (see Appendix C):

- Conductivity
- Probe advance rate
- Temperature
- FID response
- Electron capture detector (ECD) response
- PID response

Plots were made for each of the six (6) dependent variables listed above (y-axis) versus the depth of the probe in feet (x-axis) at each MIP location. Based on the MIP data, a total of 15 temporary monitoring wells were located and installed as discussed below in Section 3.2.3

Upon completion, each MIP point was abandoned from the bottom of the boring to the ground surface with cement/bentonite grout in accordance with SCDHEC regulations.

3.2.2 Screened Interval Sampling

After the MIP/SC work and the temporary wells were completed, soil samples were collected from the screened interval using split-spoon sampling. Four monitoring wells (PAI-45-MW22-SU, PAI-45-MW22-SL, PAI-45MW21-SU, and PAI-45MW21-SL) were selected to obtain representative samples from the screened intervals. These samples were submitted directly to the Navy, which will proceed with analyses to support microbial studies not related to this report.

3.2.3 Temporary Well Installation

The MIP results were used to establish locations for installation of fifteen DPT temporary well points as shown in Figure 3-2. The temporary well points consisted of 1-inch diameter PVC screen and riser pipe having a slot size of approximately 0.010 inch. Continuous soil boring logs were recorded from the deepest well of each cluster for the purpose describing soil lithology using DPT macro core sampling techniques. DNAPL screening was performed using a field-screening, ultraviolet unit on selected subsurface soil samples. The samples to be screened for DNAPL were selected based on the locations of elevated photo-ionization readings. These DNAPL results (all negative) were recorded on the temporary monitoring well boring logs presented in Appendix D, and in the field log book notes from the investigation.

During temporary well construction, PVC screens and risers were installed through the open borehole to sample-specific depths. No temporary wells were advanced through the peat/clay layer. Well screen depths were determined based on MIP results. The SCDHEC approval letter for installation of monitoring wells and temporary monitoring well diagrams, including screened intervals are presented in Appendix E.

At each temporary well, groundwater was purged and sampled using a peristaltic pump. Measurements of the pH, temperature, turbidity, and specific conductivity were recorded during the purging process. The temporary wells were purged prior to sampling until a minimum of three well volumes were removed, and stabilization of successive pH, conductivity, and turbidity measurements (per well purging SOPs), or a maximum of 10 well volumes was removed. Chain of Custody forms and analytical data are presented in Appendix F.

Upon completion of the groundwater sampling at each location, the well point was removed, and the boring was abandoned by pressure grouting from the bottom of the boring to the ground surface, as described in Section 3.2.1

3.2.4 Permanent Monitoring Well Installation

Twenty-nine (29) permanent monitoring wells were installed and constructed in accordance with all applicable State of South Carolina regulations (e.g., Code of Laws of South Carolina 2002, Regulation 61-71 Well Standards) and Volume II of the Master Work Plan (B&R, 1998). The locations of these wells are shown on Figure 3-3. As with the MIP locations and temporary monitoring wells, a formal request letter was submitted to SCDHEC prior to advancement of the permanent wells. Following well installation, a monitoring well record was submitted to SCDHEC.

Twenty-nine monitoring wells (25 shallow [split between surficial upper and lower] and 4 deep) were drilled and installed at Site 45 during this field effort. The monitoring wells were installed in accordance with the Work Plan (Tetra Tech, 2004b) and screened using field data (MIP logging) and/or available historical data, temporary well data, and information obtained through conversations with the Navy. Shallow wells fell into two categories:

1. Wells screened in the upper portion of the surficial aquifer (nominally 7 to 9 feet bgs) were denoted as "SU" (surficial upper).

2. Wells screened in the lower portion of the surficial aquifer immediately above the peat/clay layer (nominally 15 to 16 feet bgs) were denoted as "SL" (surficial lower).

Wells screened within the deep portion of the surficial aquifer below the peat/clay layer were denoted as "D" (deep).

Boreholes for lower surficial monitoring wells were advanced to the top of the semi-confining unit underlying the surficial aquifer. That is, the bottom of the screened interval for each of the lower surficial monitoring wells was placed even with, or slightly below, the top of the peat/clay layer. Deep well screens were placed entirely below the bottom of the peat/clay layer. Soil boring logs were maintained for the purpose of soil lithology and for determination of depth to confining unit. DNAPL screening was performed as described in Section 3.2.3 on selected samples collected within the source area (northern portion of the former dry cleaning facility) and at locations with high PID measurements. All DNAPL screening results were observed to be negative.

Surficial upper (SU) and lower surficial monitoring wells (SL) were installed using 4.25-inch hollow-stem augers to the desired depth. The monitoring wells were installed through the augers upon completion of each boring. For the deep surficial aquifer monitoring wells (D), a 6-inch steel casing was set and grouted into the peat/clay confining layer by using large-diameter hollow-stem augers. The grout was allowed to set for a minimum of 24 hours, then drilling proceeded through the 6-inch casing with mud rotary methods to the final depth of the borehole. Based on regional experience, the drilling subcontractor felt that mud rotary would be more effective for advancing the well boring through the clay confining layer and the set-in-place 6-inch casing to install the actual well to the final depth. This method was utilized in order to ensure that contaminant migration from the upper surficial aquifer down to the deeper zone would not occur during well installation. During monitoring well installation, discreet intervals of the boring were sampled for lithology to the termination depth of the boring. When the final depth was reached, the monitoring well was installed through the hollow-stem augers. Table 3-2 provides

groundwater monitoring well construction information for the permanent wells installed during this investigation.

All wells were constructed with certified clean well construction material. Monitoring wells were constructed of 2-inch inside diameter (ID), flush-threaded polyvinyl chloride (PVC) well screen and flush-threaded PVC well casing riser. PVC material consisted of National Sanitation Foundation (NSF) Standard 14 as specified in U.S. EPA's EISOPQAM (1996). Well screens for shallow surficial aquifer monitoring wells were 5-feet long depending on placement interval based on lithology encountered during drilling, with 0.010-inch openings. One exception to this was PAI-45-MW23-SU, which had a well screen that was 7-feet long. Well screens for deep surficial aquifer monitoring wells were 10-feet long with 0.010-inch openings.

A primary filter pack of clean silica sand was installed from approximately 3 to 6 inches below the bottom of the well to a minimum of 2 feet above the top of the well screen using a No. 1 Drilling Services Inc. (DSI) sand. A minimum 2-foot-thick seal of 100 percent sodium bentonite pellets was installed directly above the primary filter pack and allowed to hydrate in accordance with the manufacturer's recommendations. The annular space above the bentonite seal was grouted with neat cement or a bentonite/cement mixture from the top of the bentonite seal to a point at least 2 feet bgs. The concrete used to form the pad filled the remaining annular space.

Permanent monitoring wells were installed as at-grade wells. An at-grade protective steel casing equipped with a sealing, locking cap was installed around all wells. At-grade covers were installed in accordance with SCDHEC requirements. Monitoring well construction diagrams for both the shallow and the deep wells are presented in Appendix G.

A 4-inch by 4-inch aluminum identification plate (when available) will be affixed to each well and will contain the following information:

- Well identification number
- Date of construction
- Name of consultant
- Depth of well
- Screened interval
- Top of casing elevation
- Northing of well
- Easting of well
- Reference datum

- Well information contact

A boring log was maintained as described in the Master FSP for each soil boring by the Tetra Tech field geologist. In the case of well cluster drilling, soil boring logs were maintained solely for the deepest boring at each well cluster. Field screening and head-space analysis results and a lithologic description of each soil sample was recorded on the boring log. The soil samples from the deep borings were examined to determine if the Hawthorn Formation was present. Regionally, the Hawthorne Formation forms a significant confining unit. At a minimum, the information outlined in the Master FSP (B&R, 1998) was recorded on the boring log for each boring. Boring Logs are presented in Appendix H.

Prior to sampling, all monitoring wells were developed to remove formation cuttings (as well as any residual drilling fluids), as described in the Master FSP, Volume II (B&R, 1998). Well Development forms are also included in Appendix I.

3.2.5 Groundwater Sampling

Groundwater sampling was performed in the temporary wells, select permanent existing wells and all of the newly installed wells. The 15 temporary wells, 15 existing wells and 29 newly installed wells were sampled in February, March and April of 2005. This section describes the sampling equipment and techniques used for groundwater sample collection. Groundwater sampling locations for this investigation are shown on Figure 3-4. Table 3-3 provides the groundwater summary statistics, including a frequency of detection (FOD) summary for all parameters analyzed. Table 3-4 is a summary of positive detections compared to applicable criteria and Table 3-5 is a complete listing of all analytical results.

3.2.5.1 Temporary Monitoring Well Sampling

A total of 15 groundwater samples were collected from the temporary wells. Groundwater sampling was performed using a peristaltic pump and pre-cleaned disposable tubing. The tubing was lowered in the temporary well to approximately the midpoint to bottom one-third of the well screen. The wells were then purged in accordance with the low-flow sampling techniques specified in the approved work plan. Water-level data and water quality parameters, such as temperature, pH, specific conductivity, turbidity, dissolved oxygen, and salinity, were collected during purging of the monitoring wells and recorded on Low-Flow Purge Data Sheets and Groundwater Sample Log Sheets (included in Appendix J). The groundwater sample from each well was collected by reducing the flow to minimize volatilization of the sample and collecting the sample in the appropriate containers directly from the tubing after it passed through the peristaltic pump. All the temporary wells were sampled for quick-turnaround VOC analyses. A summary of the positive detections for parameters analyzed is provided in Table 3-4.

3.2.5.2 Permanent Monitoring Well Sampling

Eighteen (18) groundwater samples were collected from pre-existing monitoring wells and twenty nine (29) groundwater samples were collected from the newly installed monitoring wells. All 47 locations were sampled for VOCs.

Groundwater sampling for the permanent wells was similar to that of the temporary wells. Peristaltic pumps with pre-cleaned disposable tubing were used to purge the wells. Prior to purging, the intake of the sampling tube was placed approximately between the midpoint of the screen and the bottom of the well. Purging was performed using the low-flow technique described in the work plan.

The groundwater samples were analyzed in a fixed-base laboratory for VOCs. General water quality parameters (including dissolved oxygen, salinity, temperature, pH, and turbidity) were also measured and are included on the Sample Log Sheets provided in Appendix K. Data validation letters for samples collected as part of this investigation are provided in Appendix L.

3.2.6 Water-Level Measurements

One round of synoptic water-level measurements was collected from all newly installed permanent monitoring wells, specific existing monitoring wells, and existing piezometers to determine groundwater flow direction. Figures 3-5 through 3-7 show groundwater (potentiometric) contours and general groundwater directions for upper surficial, lower surficial and deep water-bearing zones measured as part of this investigation. Appendix M contains copies of the field groundwater level measurement sheets.

All water-level measurements were taken within a short time period (maximum 4 hours) of consistent weather conditions to minimize atmospheric/precipitation effects on groundwater levels. Measurements were taken with an electric water-level indicator using the top of the well riser as the reference point for determining depths to water. Water-level measurements were recorded to the nearest 0.01 foot on a groundwater level measurement form.

3.2.7 Decontamination

Decontamination of major equipment and sampling equipment was in accordance with the Master FSP (B&R, 1998) and SOP SA-7.1, Decontamination of Field Equipment and Waste Handling. An area for the decontamination pad for major equipment and a source of potable water for steam washing was arranged by the Field Operations Leader (FOL) through MCRD personnel.

3.2.8 Waste Handling

All solid and liquid wastes generated as a result of this investigation were handled in accordance with the procedures described in Section 2.11 of the Master FSP (B&R, 1998) and SOP SA-7.1, Decontamination of Field Equipment and Waste Handling.

Soil cuttings were placed in a roll-off box. These cuttings were disposed off site. Well development water and purged water was collected in a 5000 gallon bulk tank. Based on previous test results, from previous investigations, the water was taken off site for disposal. Decontamination water was also collected in the bulk tank, and then processed as the well development and purged water.

3.2.9 Data Collection for Vapor Intrusion Model

To gather input data for the Vapor Intrusion Model, the following was conducted or obtained:

- Inspection of Building 293 revealed that it has a “crawl space” that goes below grade, however access to this area was not possible. It was locked, marked and labeled because of the presence of asbestos. Photos of the building are provided in Appendix N.

- Survey points for Building 293 were obtained for use in determining location with regard to contaminant plumes and dimensions.

3.2.10 Surveying

All MIP locations, temporary wells, and permanent groundwater monitoring wells were surveyed. The corner locations of Building 293 and the Thrift Shop were also surveyed. A few of the existing wells were also surveyed as check of previously surveyed data.

The North American Datum (NAD) 1983 was used as the horizontal datum. Sample locations were surveyed to the nearest 0.10-foot. Vertical elevations will be referenced to 1988 National Geodetic Vertical Datum (NGVD). Elevations for the monitoring wells were determined at the measuring point where the uncapped PVC well riser pipe is notched and at the top of the protective casing, to the nearest 0.01 foot. For all sample locations, including monitoring wells, ground surface elevations were surveyed to the nearest 0.01 foot.

3.3 SITE-SPECIFIC GEOLOGY

Geologic conditions at Site 45 were characterized as part of the 2001 and 2005 field investigations. Subsurface materials at Site 45 were visually classified based on split-spoon samples collected during the drilling of test borings and the temporary and permanent monitoring wells and from existing well data.

The shallow subsurface lithology of Site 45 to a depth of approximately 17 feet consists of a heterogeneous mixture of Pliocene- to Holocene-age sediments of the Pamplico and Waccamaw Formations (Bechtel Environmental Inc., 1997), consisting primarily of fine sand and silty sand with a few discontinuous clayey sand seams. Previous laboratory sieve analysis of samples from these deposits indicates that the Unified Soil Classification System (USCS) description of these sediments is SP (poorly graded sand) to SP/SM (poorly graded sand to silty sand). Thin, discontinuous lenses of finer-grained silty clay and clayey sand were also encountered within the predominantly sandy sediments. Please see Appendices D and H for the infrequent exceptions to this general description.

A thin (less than 1 to 3 feet) layer of peat was encountered below the shallow sandy sediments at depths ranging from 17 to 21 feet below ground. The peat was directly underlain by a 3- to 6-foot-thick clay unit, encountered at depths ranging from approximately 18 to 27 feet bgs. Beneath this potential confining layer formed by the peat and clay, the four newly installed deep well borings encountered unconsolidated deposits consisting primarily of sand, clayey sand, and silty fine sand with traces of shell fragments. Total depths of the deep well borings ranged from 38 to 41 feet bgs.

The Miocene-age Hawthorn Formation, a regional confining unit that separates the surficial deposits from the underlying Floridan aquifer, reportedly underlies MCRD Parris Island at an average elevation of 30 feet below msl. The Hawthorn Formation is reportedly approximately 25 to 40 feet thick in the area, except where it has been eroded away by tidal scour and stream erosion (Bechtel Environmental Inc., 1997). The deep borings at Site 45 did not confirm the presence of this unit locally.

3.4 SITE-SPECIFIC HYDROGEOLOGY

The hydrogeologic conditions at Site 45 were interpreted from data obtained during the subsurface investigation activities, including drilling and well installation, groundwater sampling, and groundwater-level measurements.

3.4.1 Hydrogeologic Framework

The surficial aquifer underlying Site 45 consists of the sandy Pliocene to Holocene sediments to an average depth of approximately 18 feet. In general, the water table encountered within these

heterogeneous sediments is shallow and is typically encountered at a depth of 3 to 4 feet bgs at the site. Groundwater is expected to preferentially migrate through the higher permeability sandy sediments within the surficial aquifer. Because of their limited areal extents, the localized silty/clayey lenses found within the surficial aquifer are not expected to function as significant confining units. Localized hydraulic effects were observed because of silt and clay (Tetra Tech, 2004a). Recharge to the surficial aquifer is likely to occur primarily through infiltration of precipitation.

The peat and clayey material found underlying the surficial aquifer sediments throughout the site at depths ranging from 17 to 27 feet bgs is expected to function locally as a confining unit to groundwater flow. Based on the results of previous laboratory hydraulic conductivity testing of six samples from this unit, the geometric mean vertical hydraulic conductivity for this confining unit is 0.00166 feet per day (5.8×10^{-7} cm/sec). This, in combination with an average thickness of 5 to 6 feet, indicates that the unit significantly restricts vertical groundwater flow.

The silty sand deposits that were encountered beneath the peat/clay layer form a deeper aquifer within the Pliocene/Holocene sediments beneath the site. The thickness of this deeper unit is unknown because the Hawthorn Formation, a regional confining unit expected to directly underlie these deposits, was not identified in the deep borings drilled at the site.

Site 45 is located within the 100-year flood plain, according to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (1986).

3.4.2 Groundwater Flow Directions

Groundwater flow directions were established based on one round of water-level measurements collected in April of 2005 (Figures 3-5 through 3-7). Groundwater flow directions in the upper portion of the surficial aquifer were evaluated using water-level data from –SU monitoring wells; water level data from the –SL wells were used to evaluate groundwater flow directions in the lower portion of the surficial aquifer; and water levels from the –D wells were used to evaluate groundwater flow directions in the upper portion of the deeper aquifer at the site. The April 2005 round of water levels was evaluated to identify both surficial aquifer flow patterns and to evaluate the deeper groundwater flow pattern. All groundwater level measurements discussed herein were taken under non-pumping conditions.

For the upper portion of the surficial aquifer, the groundwater flow direction is to the southeast, as shown on Figure 3-5 (April 26, 2005 round of water levels). Using Figure 3-5, an overall groundwater flow gradient of 0.005 was calculated for the upper surficial wells. Using this gradient and data from Section 3.0 of the Site 45 RI/RFI (Tetra Tech, 2004a), an upper surficial seepage velocity of approximately 48.7 feet per year was calculated (see Appendix O).

For the lower portion of the surficial aquifer, the groundwater flow direction is also to the southeast, as shown on Figure 3-6 (April 26, 2005 round of water levels). Using Figure 3-6, an overall groundwater flow gradient of 0.006 was calculated for the lower surficial wells. Using this gradient and data from Section 3.0 of the Site 45 RI/RFI (Tetra Tech, 2004a), a lower surficial seepage velocity of approximately 14.6 feet per year was calculated (see Appendix O). The overall gradients are generally consistent across the study area. In general, the water levels and the flow patterns for the upper and lower portions of the surficial aquifer match up closely, indicating a strong hydraulic connection.

With few exceptions, vertical gradients at upper/lower surficial aquifer well clusters were minimal, with typical differences in water levels of less than 0.1 feet. A notable exception to this was at well cluster 6SU/SL, where the deeper well had a water level approximately 0.4 foot higher than the water level in the upper surficial aquifer well. There was also no apparent overall pattern to the vertical head differentials in terms of shallow versus deep; some clusters had consistent upward or downward gradients, and others varied.

The overall groundwater flow direction in the deeper aquifer is to the south-southwest, as shown on Figure 3-7 (April 26, 2005 round of water levels). In general, the flow patterns for the surficial aquifer and the deeper aquifer indicate that there is a limited hydraulic connection between the two flow systems. Using Figure 3-7, an overall groundwater flow gradient of 0.004 was calculated for the deep wells. Using this gradient and data from Section 3.0 of the Site 45 RI/RFI (Tetra Tech, 2004a), a deep seepage velocity of approximately 4.9 feet per year was calculated (see Appendix O).

3.5 USGS FIELD INVESTIGATION

3.5.1 Goals of the Investigation

The USGS investigation was conducted with three goals: to explore the role that the sewer lines on site play in the contaminant source, distribution, attenuation, and transport in the northern and southern plumes, to further delineate the southern plume and determine the potential for contaminant migration into the deeper aquifer, and to evaluate natural attenuation aspects of groundwater contamination in the southern plume.

3.5.2 Field Investigation Activities

The investigation involved examination of historical records and engineering drawings of buildings, video imaging of storm sewers, water-level monitoring by synoptic measurements in wells and by use of continuous data loggers, installation and sampling of temporary wells, and water and sediment sampling.

The water sampling included wells, storm drains, and surface water. Water samples were collected from 23 permanent wells in the target aquifer, several of which were sampled on multiple occasions. Five of these wells were installed during this investigation. The wells were located predominantly in the southern plume. Samples were analyzed for VOCs and water chemistry. Selected groundwater samples were analyzed for molecular biological tools (MBTs) and for compound-specific stable carbon isotopes.

Groundwater samples also were collected from four wells screened deeper than the known contamination, three of which were installed during this investigation. Water samples were collected from 96 temporary wells installed during this investigation. Membrane Interface Probe (MIP) logs were collected at seven borings in the southern plume. Additional water samples for VOC analysis were collected from storm sewers and from surface water at the sewer outfall. Sediment was collected for VOC analysis at the storm-sewer outfall. Aquifer core samples were analyzed for total organic carbon.

3.5.3 Geology and Hydrogeology

The site geology was not determined during this investigation to differ from the conditions described above. The site hydrology was found to be influenced by a complex mixture of hydrogeologic aspects and by exchange of groundwater and surface water from leakage at storm sewers.

The surficial aquifer at Site 45 is unconfined. Depth to water is about 2–6 ft. Groundwater is recharged primarily from rainfall infiltration in non-paved areas. Some amount of recharge also may take place during rainfall events through partially collapsed storm sewers. A primary discharge path for groundwater at Site 45 appears to be to storm sewers. The bottoms of some sections of the storm-sewer system at Site 45 are below the high-tide level and below the groundwater level. Because the storm-sewer system connects to tidally influenced Ballast Creek, tidal water enters the storm drains through an open drain approximately 1,400 ft south of Site 45 during incoming tides, and moves inland through the sewer system at least as far as to Site 45. A water-level logger recorded tidally induced water-level increases of more than 3 ft in the storm sewer at manhole STS06. Surficial aquifer groundwater levels in the vicinity of the storm sewers also rise and fall in response to tidal cycles. In general, where the bottom of the storm sewer is below the water table, groundwater levels tend to be higher than water levels in the storm sewer at low tide and lower than in the storm sewer about 1 to 2 hours preceding and following high tide. The higher water levels in the storm sewers than in the groundwater about 1 to 2 hours preceding and following high tide indicate a short-term potential for movement of tidal water from the storm sewers to the aquifer.

The groundwater contours in the SU wells show strong curvature toward some of the storm sewers where the inverts of the sewers are deeper than the water table, indicating that groundwater discharges to the storm-sewer system in those areas. Curvature of the groundwater contours is less pronounced for the SL

wells than for the SU wells, possibly reflecting a diminished hydraulic influence from the storm sewers on the deeper part of the surficial aquifer.

Further discussion of the influence of storm sewers on groundwater flow can be found in the USGS report in Appendix A.

TABLE 3-1

INVESTIGATION RATIONALE – SPRING 2005
SITE 45 – FORMER MWR DRY CLEANING FACILITY
MCRD PARRIS ISLAND, SOUTH CAROLINA

Medium	Identified/Suspected Contaminants	Preliminary Assessment	Data Gap/Need	Resolution Of Data Gap/Need
Groundwater	VOCs: PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, vinyl chloride.	Groundwater is a risk to human health. Extent of plume is uncertain. Vapor intrusion may pose an unacceptable risk to human health.	RI/RFI Addendum • Nature and extent characterization • Vapor intrusion risk evaluation FS/CMS • Modeling • Site hydrogeology	• VOCs • Additonal monitoring wells • Vapor intrusion modeling parameters • Water-level measurements

Note:
FS/CMS – Feasibility Study/Corrective Measures Study.

TABLE 3-2

GROUNDWATER MONITORING WELL CONSTRUCTION INFORMATION
SITE 45 – FORMER MWR DRY CLEANING FACILITY
MCRD PARRIS ISLAND, SOUTH CAROLINA

Well Number	Installation Date	Northing (feet)	Easting (feet)	Ground Elevation (feet amsl)	Top of Riser Elevation (feet amsl)	Total Depth (feet bgs)[1]	Screened Interval			
							Top (feet bgs)	Bottom (feet bgs)	Top (feet amsl)	Bottom (feet amsl)
PAI-45-MW01-D	4/2/2005	187466.4933	2099311.3517	7.02	6.71	41.00	30.00	40.00	-22.98	-32.98
PAI-45-MW06-D	3/31/2005	187283.0718	2099308.8271	6.82	6.44	41.00	30.00	40.00	-23.18	-33.18
PAI-45-MW07-D	4/1/2005	187340.8135	2099306.4135	7.06	6.75	41.00	30.00	40.00	-22.94	-32.94
PAI-45-MW10-SU	4/12/2005	187227.7997	2099260.9518	6.28	5.92	9.00	3.00	8.00	3.28	-1.72
PAI-45-MW10-SL	4/12/2005	187228.5239	2099256.8740	6.23	5.89	17.00	11.00	16.00	-4.77	-9.77
PAI-45-MW13-SU	4/13/2005	187185.8092	2099305.9101	6.80	6.27	10.00	4.00	9.00	2.80	-2.20
PAI-45-MW13-SL	4/13/2005	187191.0517	2099307.1594	6.75	6.41	17.00	11.00	16.00	-4.25	-9.25
PAI-45-MW14-SU	4/12/2005	187339.5910	2099445.0504	6.24	5.96	10.00	4.00	9.00	2.24	-2.76
PAI-45-MW14-SL	4/12/2005	187335.0293	2099444.4475	6.19	5.89	16.00	10.00	15.00	-3.81	-8.81
PAI-45-MW15-SU	4/3/2005	187266.9908	2099452.2144	8.61	8.34	10.00	4.00	9.00	4.61	-0.39
PAI-45-MW15-SL	4/3/2005	187266.5413	2099456.6725	8.47	8.15	19.00	13.00	18.00	-4.53	-9.53
PAI-45-MW16-SU	4/3/2005	187235.8851	2099428.7718	9.58	9.25	10.00	4.00	9.00	5.58	0.58
PAI-45-MW16-SL	4/3/2005	187235.8635	2099433.3686	9.63	9.27	19.00	13.00	18.00	-3.37	-8.37
PAI-45-MW17-SU	4/13/2005	187076.1206	2099345.8211	6.53	6.15	10.00	4.00	9.00	2.53	-2.47
PAI-45-MW17-SL	4/13/2005	187068.7813	2099343.8757	6.42	5.99	16.00	10.00	15.00	-3.58	-8.58
PAI-45-MW18-SU	4/13/2005	187106.7279	2099210.2550	7.41	7.03	10.00	4.00	9.00	3.41	-1.59
PAI-45-MW18-SL	4/13/2005	187108.1863	2099204.8133	7.38	7.06	17.00	11.00	16.00	-3.62	-8.62
PAI-45-MW19-SU	4/1/2005	187177.1683	2099201.5452	6.01	5.71	9.00	3.00	8.00	3.01	-1.99
PAI-45-MW19-SL	4/1/2005	187179.1713	2099196.1380	6.05	5.70	17.00	11.00	16.00	-4.95	-9.95
PAI-45-MW20-SU	4/12/2005	187130.3147	2099264.3546	7.12	6.79	10.00	4.00	9.00	3.12	-1.88
PAI-45-MW20-SL	4/12/2005	187129.9329	2099269.9716	7.15	6.74	17.00	11.00	16.00	-3.85	-8.85
PAI-45-MW21-SU	3/31/2005	187339.9632	2099244.6950	6.81	6.43	9.00	3.00	8.00	3.81	-1.19
PAI-45-MW21-SL	3/31/2005	187346.2882	2099245.3398	6.73	6.39	16.00	10.00	15.00	-3.27	-8.27
PAI-45-MW21-D	4/4/2005	187342.2046	2099250.6134	6.76	6.36	38.00	27.00	37.00	-20.24	-30.24
PAI-45-MW22-SU	3/30/2005	187393.8912	2099265.8432	6.90	6.61	9.00	3.00	8.00	3.90	-1.10
PAI-45-MW22-SL	3/30/2005	187398.6082	2099262.4690	6.89	6.56	16.00	10.00	15.00	-3.11	-8.11
PAI-45-MW23-SU	4/2/2005	187283.8965	2099391.4879	6.78	6.50	11.00	3.00	10.00	3.78	-3.22
PAI-45-MW23-SL	4/2/2005	187279.0976	2099390.1054	6.78	6.39	16.00	10.00	15.00	-3.22	-8.22
PAI-45-MW24-SU	4/13/2005	187374.2764	2099284.2981	7.06	6.63	9.00	3.00	8.00	4.06	-0.94

TABLE 3-3

GROUNDWATER SUMMARY STATISTICS
SITE 45 – FORMER MWR DRY CLEANING FACILITY
MCRD PARRIS ISLAND, SOUTH CAROLINA

Parameter - Volatile Organics (ug/L)	EPA Tap Water Regional Screening Level	Federal Maximum Contaminant Level Criteria (fedmcl)	Average of all Positive Detections	Average of all Values	Frequency Detected	Minimum Value Detected	Maximum Value Detected	Range of Values Detected	Location(s) of the Maximum Value
1,1,2-Trichlorotrifluoroethane	53,000	none established	0.75	4.0	2/62	0.5	1.0	0.5 - 1	PAI-45-GW04-D-02
1,1-Dichloroethane (DCA)	2.4	none established	19.7	5.2	7/62	0.4	97	0.4 - 97	PAI-45-TW109-SU-08
1,1-Dichloroethene (DCE)	260	7	6.9	5.3	29/62	0.4	74	0.4 - 74	PAI-45-GW24-SU-02
1,2-Dichlorobenzene	280	600	3.7	4.1	2/62	0.4	7.0	0.4 - 7	PAI-45-TW109-SU-08
1,2-Dichloroethane (DCA)	0.15	5	0.30	4.0	1/62	0.3	0.3	0.3	PAI-45-GW13-SL-02
1,4-Dichlorobenzene	0.42	75	0.80	4.0	1/62	0.8	0.8	0.8	PAI-45-TW109-SU-08
2-Butanone	4,900	none established	10.0	5.9	2/32	4.0	16	4 - 16	PAI-45-TW109-SU-08
Acetone	12,000	none established	8.7	8.1	27/30	2.0	65	2 - 65	PAI-45-GW24-SU-02-D
Benzene	0.39	5	2.6	4.0	3/62	0.7	5.0	0.7 - 5	PAI-45-TW109-SU-08
Carbon Disulfide	720	none established	0.93	3.9	7/62	0.4	2.0	0.4 - 2	PAI-45-GW04-SL-02 and PAI-45-GW04-SU-02
Chlorobenzene	72	100	0.97	3.9	6/62	0.4	2.0	0.4 - 2	PAI-45-GW10-SL-02
Chloroform	0.19	80	1.0	3.8	11/62	0.4	2.0	0.4 - 2	PAI-45-GW06-D-02; PAI-45-GW07-D-02; and PAI-45-GW14-SL-02
Chloromethane	190	none established	0.90	4.0	1/62	0.9	0.9	0.9	PAI-45-GW06-SU-02
Cis-1,2-Dichloroethene (DCE)	28	70	4,503	3,341	46/62	0.3	110,000	0.3 - 110,000	PAI-45-TW109-SU-08
Ethylbenzene	1.3	700	10.0	4.2	8/62	0.3	54	0.3 - 54	PAI-45-GW24-SU-02-D
Isopropylbenzene	390	none established	24.5	4.3	3/62	0.9	59	0.9 - 59	PAI-45-GW24-SU-02
M+P-Xylenes	190	10,000	9.4	7.2	9/62	0.5	50	0.5 - 50	PAI-45-TW109-SU-08
Methyl Acetate	16,000	none established	10.0	4.2	1/62	10	10	10	PAI-45-GW06-SU-02
Methyl Cyclohexane	none established	none established	7.3	4.1	1/62	12	12	12	PAI-45-TW134-SL-15-D
O-Xylene	190	10,000	7.2	3.8	7/62	0.4	38	0.4 - 38	PAI-45-TW109-SU-08
Tetrachloroethene (PCE)	9.7	5	2,099	1,152	34/62	0.5	26,000	0.5 - 26,000	PAI-45-GW08-SU-02
Toluene	860	1,000	12.1	7.4	27/62	0.2	200	0.2 - 200	PAI-45-TW109-SU-08
Total 1,2-Dichloroethene (DCE)	130	none established	4,996	3,386	42/62	0.6	110,000	0.6 - 110,000	PAI-45-TW109-SU-08
Total Xylenes	190	10,000	19.3	11.1	7/62	2.0	88	2 - 88	PAI-45-TW109-SU-08
Trans-1,2-Dichloroethene (DCE)	86	100	188	104	34/62	0.5	3,400	0.5 - 3,400	PAI-45-TW109-SU-08
Trichloroethene (TCE)	0.44	5	2,786	1,933	43/62	0.3	35,000	0.3 - 35,000	PAI-45-TW109-SU-08
Vinyl Chloride	0.015	2	311	173	34/62	0.5	3,000	0.5 - 3,000	PAI-45-TW109-SU-08

shaded cells indicate potential evidence of PCE degradation

r9tapw = Region 9 Tap Water Criteria
fedmcl = Federal Maximum Contaminant Level Criteria

Groudwater Summary Statistics
SITE 45 MWR DRY CLEANING FACILITY
MCRD Parris Island, South Carolina

Parameter - Volatile Organics (ug/L)	EPA Tap Water Regional Screening Level	Federal Maximum Contaminant Level Criteria (fedmcl)	Average of all Positive Detections	Average of all Values	Frequency Detected	Minimum Value Detected	Maximum Value Detected	Range of Values Detected	Location(s) of the Maximum Value
Tetrachloroethene (PCE)	9.7	5	2,099	1,152	34/62	0.5	26,000	0.5 - 26,000	PAI-45-GW08-SU-02
Trichloroethene (TCE)	0.44	5	2,786	1,933	43/62	0.3	35,000	0.3 - 35,000	PAI-45-TW109-SU-08
Total 1,2-Dichloroethene (DCE)	130	none established	4,996	3,386	42/62	0.6	110,000	0.6 - 110,000	PAI-45-TW109-SU-08
Cis-1,2-Dichloroethene (DCE)	28	70	4,503	3,341	46/62	0.3	110,000	0.3 - 110,000	PAI-45-TW109-SU-08
Vinyl Chloride	0.015	2	311	173	34/62	0.5	3,000	0.5 - 3,000	PAI-45-TW109-SU-08
Trans-1,2-Dichloroethene (DCE)	86	100	188	104	34/62	0.5	3,400	0.5 - 3,400	PAI-45-TW109-SU-08
Isopropylbenzene	390	none established	24.5	4.3	3/62	0.9	59	0.9 - 59	PAI-45-GW24-SU-02
1,1-Dichloroethane (DCA)	2.4	none established	19.7	5.2	7/62	0.4	97	0.4 - 97	PAI-45-TW109-SU-08
Total Xylenes	190	10,000	19.3	11.1	7/62	2.0	88	2 - 88	PAI-45-TW109-SU-08
Toluene	860	1,000	12.1	7.4	27/62	0.2	200	0.2 - 200	PAI-45-TW109-SU-08
2-Butanone	4,900	none established	10.0	5.9	2/32	4.0	16	4 - 16	PAI-45-TW109-SU-08
Methyl Acetate	16,000	none established	10.0	4.2	1/62	10	10	10	PAI-45-GW06-SU-02
Ethylbenzene	1.3	700	10.0	4.2	8/62	0.3	54	0.3 - 54	PAI-45-GW24-SU-02-D
M+P-Xylenes	190	10,000	9.4	7.2	9/62	0.5	50	0.5 - 50	PAI-45-TW109-SU-08
Acetone	12,000	none established	8.7	8.1	27/30	2.0	65	2 - 65	PAI-45-GW24-SU-02-D
Methyl Cyclohexane	none established	none established	7.3	4.1	1/62	12	12	12	PAI-45-TW134-SL-15-D
O-Xylene	190	10,000	7.2	3.8	7/62	0.4	38	0.4 - 38	PAI-45-TW109-SU-08
1,1-Dichloroethene (DCE)	260	7	6.9	5.3	29/62	0.4	74	0.4 - 74	PAI-45-GW24-SU-02
1,2-Dichlorobenzene	280	600	3.7	4.1	2/62	0.4	7.0	0.4 - 7	PAI-45-TW109-SU-08
Benzene	0.39	5	2.6	4.0	3/62	0.7	5.0	0.7 - 5	PAI-45-TW109-SU-08
Chloroform	0.19	80	1.0	3.8	11/62	0.4	2.0	0.4 - 2	PAI-45-GW06-D-02; PAI-45-GW07-D-02; and PAI-45-GW14-SL-02
Chlorobenzene	72	100	0.97	3.9	6/62	0.4	2.0	0.4 - 2	PAI-45-GW10-SL-02
Carbon Disulfide	720	none established	0.93	3.9	7/62	0.4	2.0	0.4 - 2	PAI-45-GW04-SL-02 and PAI-45-GW04-SU-02
Chloromethane	190	none established	0.90	4.0	1/62	0.9	0.9	0.9	PAI-45-GW06-SU-02
1,4-Dichlorobenzene	0.42	75	0.80	4.0	1/62	0.8	0.8	0.8	PAI-45-TW109-SU-08
1,1,2-Trichlorotrifluoroethane	53,000	none established	0.75	4.0	2/62	0.5	1.0	0.5 - 1	PAI-45-GW04-D-02
1,2-Dichloroethane (DCA)	0.15	5	0.30	4.0	1/62	0.3	0.3	0.3	PAI-45-GW13-SL-02

shaded cells indicate potential evidence of PCE degradation

TABLE 3-4

SUMMARY OF POSITIVE DETECTIONS COMPARED TO APPLICABLE CRITERIA
SITE 45 – FORMER MWR DRY CLEANING FACILITY
MCRD PARRIS ISLAND, SOUTH CAROLINA

Volatile Organics (ug/L) parameter>>		TRICHLOROETHENE	TETRACHLOROETHENE	VINYL CHLORIDE	TOTAL 1,2-DICHLOROETHENE	CIS-1,2-DICHLOROETHENE	1,1-DICHLOROETHENE	1,4-DICHLOROBENZENE	1,2-DICHLOROETHANE	CHLOROFORM	BENZENE	TRANS-1,2-DICHLOROETHENE
Region 9 Tap Water Criteria (r9tapw) >>		0.028	0.1	0.02	61	61	340	0.5	0.12	0.17	0.35	120
Federal Maximum Contaminant Level (fedmcl)>>		5	5	2	None Promulgated	70	7	75	5	80	5	100
Sample Location	Date Sampled											
PAI-45-MW04-SU-02	2/23/05	140	47	10	37	36	0.6 J					0.9 J
PAI-45-MW06-SU-02	2/14/05	20	110	11	93	91						2 J
PAI-45-MW07-SU-02	2/14/05	0.8 J	0.6 J		0.6 J	0.6 J						
PAI-45-MW07-SU-02-AVG	2/14/05	0.7 J	0.6 J		0.6 J	0.5 J						
PAI-45-MW07-SU-02-D	2/14/05	0.6 J	0.6 J			0.4 J						
PAI-45-MW08-SU-02	2/24/05	5300	26000	220 J	2700 J	2600	4 J			0.8 J		54
PAI-45-MW10-SU-02	4/17/05	370		18	180	170	1 J					9
PAI-45-MW13-SU-02	4/19/05	0.6 J		0.5 J	10	10						
PAI-45-MW17-SU-02	4/18/05				2 J	2 J				0.5 J		
PAI-45-MW18-SU-02	4/18/05	1 J	0.9 J							0.6 J		
PAI-45-MW20-SU-02	4/17/05	2600	1100	99	440 J	430	2 J					13
PAI-45-MW21-SU-02	4/14/05	690	240	2 J	510	500	1 J					7
PAI-45-MW22-SU-02	4/14/05	860	1300	2400	7200	7000	4 J					250 J
PAI-45-MW23-SU-02	4/15/05	500	4 J	300	1200	1200	2 J					39
PAI-45-MW24-SU-02	4/19/05	21000	1600	1200	72000	70000	74 J					2200
PAI-45-MW24-SU-02-AVG	4/19/05	20500	1500	1150	67500	65500	72.5 J					2150
PAI-45-MW24-SU-02-D	4/19/05	20000	1400	1100	63000	61000	71 J					2100
PAI-45-TW109-SU-08	3/10/05	35000	700 J	3000	110000	110000	67	0.8 J			5 J	3400
PAI-45-TW134-SU-08	3/11/05	10		2 J	4 J	4 J						
PAI-45-TW138-SU-11	3/11/05	2100	1600	120	390 J	380	2 J					7
PAI-45-TW146-SL-10	3/12/05	2300	67	1300	5400	5200	6					160
PAI-45-MW03-SL-02	2/15/05	300	55	26	770	770	1 J					2 J
PAI-45-MW04-SL-02	2/23/05	6800	7100	280 J	1200	1200	7					19
PAI-45-MW05-SL-02	2/25/05	12			91	91						0.5 J
PAI-45-MW06-SL-02	2/14/05	160	1 J	0.5 J	310	300	1 J					6
PAI-45-MW07-SL-02	2/14/05	3400	590	15	670	640	2 J					27
PAI-45-MW08-SL-02-D	2/24/05	2300	8200	300	1400 J	1400	2 J					34
PAI-45-MW10-SL-02	4/17/05	1100	2 J	21	170	170	0.8 J					3 J
PAI-45-MW13-SL-02	4/19/05	24		14	550	550	0.6 J		0.3 J	0.6 J		2 J
PAI-45-MW14-SL-02	4/17/05	3 J	2 J							2 J		
PAI-45-MW17-SL-02	4/18/05					0.4 J				0.8 J		

Note: Black-shaded cells indicate values that exceed criteria

TABLE 3-4

SUMMARY OF POSITIVE DETECTIONS COMPARED TO APPLICABLE CRITERIA
SITE 45 – FORMER MWR DRY CLEANING FACILITY
MCRD PARRIS ISLAND, SOUTH CAROLINA

Volatile Organics (ug/L) parameter>>		TRICHLOROETHENE	TETRACHLOROETHENE	VINYL CHLORIDE	TOTAL 1,2-DICHLOROETHENE	CIS-1,2-DICHLOROETHENE	1,1-DICHLOROETHENE	1,4-DICHLOROBENZENE	1,2-DICHLOROETHANE	CHLOROFORM	BENZENE	TRANS-1,2-DICHLOROETHENE
Region 9 Tap Water Criteria (r9tapw) >>		0.028	0.1	0.02	61	61	340	0.5	0.12	0.17	0.35	120
Federal Maximum Contaminant Level (fedmcl)>>		5	5	2	None Promulgated	70	7	75	5	80	5	100
Sample Location	Date Sampled											
PAI-45-MW18-SL-02	4/18/05	0.8 J	0.9 J		4 J	4 J				0.8 J		
PAI-45-MW19-SL-02	4/16/05	100		22	29	28	0.4 J					0.8 J
PAI-45-MW20-SL-02	4/17/05	5800	2900	180	730 J	720	4 J					14
PAI-45-MW21-SL-02	4/14/05	14	6		12	12						
PAI-45-MW22-SL-02	4/14/05	0.6 J		3 J	21	20						0.8 J
PAI-45-MW23-SL-02	4/15/05	88	2 J	140	600	590	0.6 J					13
PAI-45-MW23-SL-02-AVG	4/15/05	85	2 J	140	600	590	0.65 J					12.5
PAI-45-MW23-SL-02-D	4/15/05	82	2 J	140	600	590	0.7 J					12
PAI-45-TW107-SL-12	3/12/05	520	8	21	690	680	2 J					7
PAI-45-TW109-SL-16	3/10/05	3300	11000	20	230	220	1 J				0.7 J	10
PAI-45-TW118-SL-11	3/11/05	27	61		16	16						
PAI-45-TW119-SL-15	3/12/05	1600	720	3 J	720	710	1 J					10
PAI-45-TW125-SL-16	3/11/05	9000	3200		700	670						26 J
PAI-45-TW134-SL-15	3/11/05	1200		66	260	250	2 J					14
PAI-45-TW134-SL-15-AVG	3/11/05	1250		67.5	260	250	2 J					14
PAI-45-TW134-SL-15-D	3/11/05	1300		69	260	250	2 J					14
PAI-45-TW138-SL-16	3/11/05	9700	3300	270	1800	1800	8					23
PAI-45-TW148-SL-12	3/12/05	350		10	450	440	1 J					8
PAI-45-TW158-SL-11	3/10/05	42	61	22	80	80						0.7 J
PAI-45-MW08-SL-02	2/24/05	2200	7300	220 J	1400 J	1400	2 J					36
PAI-45-MW08-SL-02-AVG	2/24/05	2250	7750	260 J	1400 J	1400	2 J					35
PAI-45-MW01D-02	4/16/05									0.5 J	2 J	
PAI-45-MW01D-02-AVG	4/16/05									0.45 J	2 J	
PAI-45-MW01D-02-D	4/16/05									0.4 J	2 J	
PAI-45-MW06-D-02	4/18/05					0.3 J				2 J		
PAI-45-MW07-D-02	4/18/05				2 J	2 J				2 J		
PAI-45-MW21-D-02	4/14/05	0.3 J	0.5 J			0.4 J				0.4 J		
PAI-45-MW-AMW-2-02	2/25/05	550	540	490	970	930	2 J					40
PAI-45-MW-AMW-5-02	2/15/05	3000	1400	86	1700	1700	2 J					31

Note: Black-shaded cells indicate values that exceed criteria

TABLE 3-5

ALL RESULTS COMPARED TO APPLICABLE CRITERIA
SITE 45 – FORMER MWR DRY CLEANING FACILITY
MCRD PARRIS ISLAND, SOUTH CAROLINA

	location			PAI-45-MW-AMW-2	PAI-45-MW-AMW-5	PAI-45-MW01-D	PAI-45-MW01-D	PAI-45-MW02-SL	PAI-45-MW02-SU	PAI-45-MW03-SL	PAI-45-MW03-SU	PAI-45-MW04-D	PAI-45-MW04-SL	PAI-45-MW04-SU	PAI-45-MW05-SL
	matrix			GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
	gis_date			20050225	20050215	20050416	20050416	20050413	20050413	20050215	20050215	20050223	20050223	20050223	20050225
cas	**Volatile Organics (ug/L)**	**r9tapw***	**fedmcl****												
71-55-6	1,1,1-TRICHLOROETHANE	3200	200	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
79-34-5	1,1,2,2-TETRACHLOROETHANE	0.055	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
79-00-5	1,1,2-TRICHLOROETHANE	0.2	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
76-13-1	1,1,2-TRICHLOROTRIFLUOROETHANE	59000	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1 J	5 U	0.5 J	5 U
75-34-3	1,1-DICHLOROETHANE	810	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1 J	5 U	5 U
75-35-4	1,1-DICHLOROETHENE	340	7	2 J	2 J	5 U	5 U	5 U	5 U	1 J	5 U	5 U	**7**	0.6 J	5 U
120-82-1	1,2,4-TRICHLOROBENZENE	7.2	70	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
96-12-8	1,2-DIBROMO-3-CHLOROPROPANE	0.048	0.2	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
106-93-4	1,2-DIBROMOETHANE	0.0056	0.05	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
95-50-1	1,2-DICHLOROBENZENE	370	600	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
107-06-2	1,2-DICHLOROETHANE	0.12	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
78-87-5	1,2-DICHLOROPROPANE	0.16	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
541-73-1	1,3-DICHLOROBENZENE	180	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
106-46-7	1,4-DICHLOROBENZENE	0.5	75	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
78-93-3	2-BUTANONE	7000	None Promulgated	5 U	5 UR	5 UR	5 UR	5 U	5 U	5 UR	5 UR	5 U	5 UR	5 UR	5 U
591-78-6	2-HEXANONE	None Promulgated	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
108-10-1	4-METHYL-2-PENTANONE	2000	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
67-64-1	ACETONE	5500	None Promulgated	5 U	5 UR	4 J	4 J	3 J	3 J	5 UR	5 UR	5 UR	5 UR	5 UR	5 U
71-43-2	BENZENE	0.35	5	5 U	5 U	**2 J**	**2 J**	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-27-4	BROMODICHLOROMETHANE	0.18	80	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-25-2	BROMOFORM	8.5	80	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
74-83-9	BROMOMETHANE	8.7	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-15-0	CARBON DISULFIDE	1000	None Promulgated	5 U	5 U	0.5 J	0.5 J	5 U	5 U	5 U	5 U	5 U	2 J	2 J	5 U
56-23-5	CARBON TETRACHLORIDE	0.17	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
108-90-7	CHLOROBENZENE	110	100	5 U	5 U	5 U	5 U	5 U	5 U	1 J	5 U	5 U	0.6 J	5 U	5 U
124-48-1	CHLORODIBROMOMETHANE	0.13	80	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-00-3	CHLOROETHANE	4.6	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
67-66-3	CHLOROFORM	0.17	80	5 U	5 U	**0.5 J**	**0.4 J**	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
74-87-3	CHLOROMETHANE	160	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
156-59-2	CIS-1,2-DICHLOROETHENE	61	70	**930**	**1700**	5 U	5 U	5 U	5 U	**770**	0.3 J	5 U	**1200**	36	**91**
10061-01-5	CIS-1,3-DICHLOROPROPENE	0.4	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
110-82-7	CYCLOHEXANE	35000	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-71-8	DICHLORODIFLUOROMETHANE	390	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
100-41-4	ETHYLBENZENE	1300	700	5 U	5 U	0.9 J	0.8 J	5 U	5 U	5 U	5 U	5 U	0.4 J	5 U	5 U
98-82-8	ISOPROPYLBENZENE	660	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
TTNUS054	M+P-XYLENES	None Promulgated	10000	10 U	10 U	2 J	2 J	10 U	10 U	10 U	10 U	10 U	1 J	10 U	10 U
79-20-9	METHYL ACETATE	6100	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
108-87-2	METHYL CYCLOHEXANE	5200	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1634-04-4	METHYL TERT-BUTYL ETHER	11	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-09-2	METHYLENE CHLORIDE	4.3	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
95-47-6	O-XYLENE	210	10000	5 U	5 U	0.9 J	1 J	5 U	5 U	5 U	5 U	5 U	0.4 J	5 U	5 U
100-42-5	STYRENE	1600	100	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
127-18-4	TETRACHLOROETHENE	0.1	5	**540**	**1400**	5 U	5 U	5 U	5 U	**55**	5 U	5 U	**7100**	**47**	5 U
108-88-3	TOLUENE	720	1000	0.4 J	2 J	2 J	2 J	0.3 J	5 U	5 U	5 U	5 U	3 J	5 U	5 U
540-59-0	TOTAL 1,2-DICHLOROETHENE	61	None Promulgated	**970**	**1700**	10 U	10 U	10 U	10 U	**770**	10 U	10 U	**1200**	37	**91**
1330-20-7	TOTAL XYLENES	210	10000	15 U	15 U	3 J	3 J	15 U	15 U	15 U	15 U	15 U	2 J	15 U	15 U
156-60-5	TRANS-1,2-DICHLOROETHENE	120	100	40	31	5 U	5 U	5 U	5 U	2 J	5 U	5 U	19	0.9 J	0.5 J
10061-02-6	TRANS-1,3-DICHLOROPROPENE	0.4	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
79-01-6	TRICHLOROETHENE	0.028	5	**550**	**3000**	5 U	5 U	5 U	5 U	**300**	5 U	5 U	**6800**	**140**	**12**
75-69-4	TRICHLOROFLUOROMETHANE	1300	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-01-4	VINYL CHLORIDE	0.02	2	**490**	**86**	5 U	5 U	5 U	5 U	**26**	5 U	5 U	**280 J**	**10**	5 U

*r9tapw = Region 9 Tap Water Criteria
**fedmcl = Federal Maximum Contaminant Level Criteria

Note: Black-shaded cells indicate values that exceed criteria

TABLE 3-5

ALL RESULTS COMPARED TO APPLICABLE CRITERIA
SITE 45 – FORMER MWR DRY CLEANING FACILITY
MCRD PARRIS ISLAND, SOUTH CAROLINA

	location			PAI-45-MW05-SU	PAI-45-MW06-D	PAI-45-MW06-SL	PAI-45-MW06-SU	PAI-45-MW07-D	PAI-45-MW07-SL	PAI-45-MW07-SU	PAI-45-MW07-SU	TBDPAI-45-MW08-SL	PAI-45-MW08-SL	PAI-45-MW08-SU	PAI-45-MW09-D
	matrix			GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
	gis_date			20050413	20050418	20050214	20050214	20050418	20050214	20050214	20050214	20050224	20050224	20050224	20050224
cas	**Volatile Organics (ug/L)**	**r9tapw***	**fedmcl****												
71-55-6	1,1,1-TRICHLOROETHANE	3200	200	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
79-34-5	1,1,2,2-TETRACHLOROETHANE	0.055	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
79-00-5	1,1,2-TRICHLOROETHANE	0.2	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
76-13-1	1,1,2-TRICHLOROTRIFLUOROETHANE	59000	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-34-3	1,1-DICHLOROETHANE	810	None Promulgated	5 U	5 U	5 U	5 U	5 U	0.6 J	5 U	5 U	5 U	5 U	5 U	5 U
75-35-4	1,1-DICHLOROETHENE	340	7	5 U	5 U	1 J	5 U	5 U	2 J	5 U	5 U	2 J	2 J	4 J	5 U
120-82-1	1,2,4-TRICHLOROBENZENE	7.2	70	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
96-12-8	1,2-DIBROMO-3-CHLOROPROPANE	0.048	0.2	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
106-93-4	1,2-DIBROMOETHANE	0.0056	0.05	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
95-50-1	1,2-DICHLOROBENZENE	370	600	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
107-06-2	1,2-DICHLOROETHANE	0.12	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
78-87-5	1,2-DICHLOROPROPANE	0.16	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
541-73-1	1,3-DICHLOROBENZENE	180	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
106-46-7	1,4-DICHLOROBENZENE	0.5	75	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
78-93-3	2-BUTANONE	7000	None Promulgated	5 U	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 U	5 U	5 U	5 U
591-78-6	2-HEXANONE	None Promulgated	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
108-10-1	4-METHYL-2-PENTANONE	2000	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
67-64-1	ACETONE	5500	None Promulgated	5 UR	4 J	3 J	3 J	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 U
71-43-2	BENZENE	0.35	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-27-4	BROMODICHLOROMETHANE	0.18	80	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-25-2	BROMOFORM	8.5	80	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
74-83-9	BROMOMETHANE	8.7	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-15-0	CARBON DISULFIDE	1000	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
56-23-5	CARBON TETRACHLORIDE	0.17	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
108-90-7	CHLOROBENZENE	110	100	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
124-48-1	CHLORODIBROMOMETHANE	0.13	80	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-00-3	CHLOROETHANE	4.6	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
67-66-3	CHLOROFORM	0.17	80	5 U	**2 J**	5 U	5 U	**2 J**	5 U	5 U	5 U	5 U	5 U	**0.8 J**	5 U
74-87-3	CHLOROMETHANE	160	None Promulgated	5 U	5 U	5 U	0.9 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
156-59-2	CIS-1,2-DICHLOROETHENE	61	70	5 U	0.3 J	**300**	**91**	2 J	**640**	0.6 J	0.4 J	**1400**	**1400**	**2600**	5 U
10061-01-5	CIS-1,3-DICHLOROPROPENE	0.4	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
110-82-7	CYCLOHEXANE	35000	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-71-8	DICHLORODIFLUOROMETHANE	390	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
100-41-4	ETHYLBENZENE	1300	700	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
98-82-8	ISOPROPYLBENZENE	660	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
TTNUS054	M+P-XYLENES	None Promulgated	10000	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
79-20-9	METHYL ACETATE	6100	None Promulgated	5 U	5 U	5 U	10	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
108-87-2	METHYL CYCLOHEXANE	5200	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1634-04-4	METHYL TERT-BUTYL ETHER	11	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-09-2	METHYLENE CHLORIDE	4.3	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
95-47-6	O-XYLENE	210	10000	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
100-42-5	STYRENE	1600	100	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
127-18-4	TETRACHLOROETHENE	0.1	5	5 U	5 U	**1 J**	**110**	5 U	**590**	**0.6 J**	**0.6 J**	**7300**	**8200**	**26000**	5 U
108-88-3	TOLUENE	720	1000	5 U	5 U	5 U	5 U	5 U	0.7 J	5 U	5 U	2 J	2 J	4 J	5 U
540-59-0	TOTAL 1,2-DICHLOROETHENE	61	None Promulgated	10 U	10 U	**310**	**93**	2 J	**670**	0.6 J	10 U	**1400 J**	**1400 J**	**2700 J**	10 U
1330-20-7	TOTAL XYLENES	210	10000	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U
156-60-5	TRANS-1,2-DICHLOROETHENE	120	100	5 U	5 U	6	2 J	5 U	27	5 U	5 U	36	34	54	5 U
10061-02-6	TRANS-1,3-DICHLOROPROPENE	0.4	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
79-01-6	TRICHLOROETHENE	0.028	5	5 U	5 U	**160**	**20**	5 U	**3400**	**0.8 J**	**0.6 J**	**2200**	**2300**	**5300**	5 U
75-69-4	TRICHLOROFLUOROMETHANE	1300	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-01-4	VINYL CHLORIDE	0.02	2	5 U	5 U	**0.5 J**	**11**	5 U	**15**	5 U	5 U	**220 J**	**300**	**220 J**	5 U

*r9tapw = Region 9 Tap Water Criteria
**fedmcl = Federal Maximum Contaminant Level Criteria

Note: Black-shaded cells indicate values that exceed criteria

TABLE 3-5

ALL RESULTS COMPARED TO APPLICABLE CRITERIA
SITE 45 – FORMER MWR DRY CLEANING FACILITY
MCRD PARRIS ISLAND, SOUTH CAROLINA

	location			PAI-45-MW10-SL	PAI-45-MW10-SU	PAI-45-MW13-SL	PAI-45-MW13-SU	PAI-45-MW14-SL	PAI-45-MW14-SU	PAI-45-MW15-SL	PAI-45-MW15-SU	PAI-45-MW16-SL	PAI-45-MW16-SU	PAI-45-MW17-SL	PAI-45-MW17-SU	PAI-45-MW18-SL
	matrix			GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
	gis_date			20050417	20050417	20050419	20050419	20050417	20050417	20050416	20050416	20050415	20050415	20050418	20050418	20050418
cas	**Volatile Organics (ug/L)**	**r9tapw***	**fedmcl****													
71-55-6	1,1,1-TRICHLOROETHANE	3200	200	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
79-34-5	1,1,2,2-TETRACHLOROETHANE	0.055	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
79-00-5	1,1,2-TRICHLOROETHANE	0.2	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
76-13-1	1,1,2-TRICHLOROTRIFLUOROETHANE	59000	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-34-3	1,1-DICHLOROETHANE	810	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-35-4	1,1-DICHLOROETHENE	340	7	0.8 J	1 J	0.6 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
120-82-1	1,2,4-TRICHLOROBENZENE	7.2	70	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
96-12-8	1,2-DIBROMO-3-CHLOROPROPANE	0.048	0.2	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
106-93-4	1,2-DIBROMOETHANE	0.0056	0.05	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
95-50-1	1,2-DICHLOROBENZENE	370	600	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
107-06-2	1,2-DICHLOROETHANE	0.12	5	5 U	5 U	**0.3 J**	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
78-87-5	1,2-DICHLOROPROPANE	0.16	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
541-73-1	1,3-DICHLOROBENZENE	180	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
106-46-7	1,4-DICHLOROBENZENE	0.5	75	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
78-93-3	2-BUTANONE	7000	None Promulgated	5 U	5 U	5 U	5 UR	5 U	5 U	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 U
591-78-6	2-HEXANONE	None Promulgated	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
108-10-1	4-METHYL-2-PENTANONE	2000	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
67-64-1	ACETONE	5500	None Promulgated	5 J	6 J	2 J	3 J	3 J	5 UR	5 UR	4 J	5 UR	4 J	5 J	3 J	5 UR
71-43-2	BENZENE	0.35	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-27-4	BROMODICHLOROMETHANE	0.18	80	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-25-2	BROMOFORM	8.5	80	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
74-83-9	BROMOMETHANE	8.7	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-15-0	CARBON DISULFIDE	1000	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
56-23-5	CARBON TETRACHLORIDE	0.17	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
108-90-7	CHLOROBENZENE	110	100	2 J	5 U	0.9 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
124-48-1	CHLORODIBROMOMETHANE	0.13	80	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-00-3	CHLOROETHANE	4.6	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
67-66-3	CHLOROFORM	0.17	80	5 U	5 U	**0.6 J**	5 U	**2 J**	5 U	5 U	5 U	5 U	5 U	**0.8 J**	**0.5 J**	**0.8 J**
74-87-3	CHLOROMETHANE	160	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
156-59-2	CIS-1,2-DICHLOROETHENE	61	70	**170**	**170**	**550**	10	5 U	5 U	5 U	5 U	5 U	5 U	0.4 J	2 J	4 J
10061-01-5	CIS-1,3-DICHLOROPROPENE	0.4	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
110-82-7	CYCLOHEXANE	35000	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-71-8	DICHLORODIFLUOROMETHANE	390	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
100-41-4	ETHYLBENZENE	1300	700	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
98-82-8	ISOPROPYLBENZENE	660	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
TTNUS054	M+P-XYLENES	None Promulgated	10000	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
79-20-9	METHYL ACETATE	6100	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
108-87-2	METHYL CYCLOHEXANE	5200	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1634-04-4	METHYL TERT-BUTYL ETHER	11	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-09-2	METHYLENE CHLORIDE	4.3	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
95-47-6	O-XYLENE	210	10000	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
100-42-5	STYRENE	1600	100	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
127-18-4	TETRACHLOROETHENE	0.1	5	**2 J**	5 U	5 U	5 U	**2 J**	5 U	5 U	5 U	5 U	5 U	5 U	5 U	**0.9 J**
108-88-3	TOLUENE	720	1000	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
540-59-0	TOTAL 1,2-DICHLOROETHENE	61	None Promulgated	**170**	**180**	**550**	10	10 U	10 U	10 U	10 U	10 U	10 U	10 U	2 J	4 J
1330-20-7	TOTAL XYLENES	210	10000	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U
156-60-5	TRANS-1,2-DICHLOROETHENE	120	100	3 J	9	2 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
10061-02-6	TRANS-1,3-DICHLOROPROPENE	0.4	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
79-01-6	TRICHLOROETHENE	0.028	5	**1100**	**370**	**24**	**0.6 J**	**3 J**	5 U	5 U	5 U	5 U	5 U	5 U	5 U	**0.8 J**
75-69-4	TRICHLOROFLUOROMETHANE	1300	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-01-4	VINYL CHLORIDE	0.02	2	**21**	**18**	**14**	**0.5 J**	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U

*r9tapw = Region 9 Tap Water Criteria
**fedmcl = Federal Maximum Contaminant Level Criteria

Note: Black-shaded cells indicate values that exceed criteria

TABLE 3-5

ALL RESULTS COMPARED TO APPLICABLE CRITERIA
SITE 45 – FORMER MWR DRY CLEANING FACILITY
MCRD PARRIS ISLAND, SOUTH CAROLINA

	location			PAI-45-MW18-SU	PAI-45-MW19-SL	PAI-45-MW19-SU	PAI-45-MW20-SL	PAI-45-MW20-SU	PAI-45-MW21-D	PAI-45-MW21-SL	PAI-45-MW21-SU	PAI-45-MW22-SL	PAI-45-MW22-SU	PAI-45-MW23-SL	PAI-45-MW23-SL
	matrix			GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
	gis_date			20050418	20050416	20050416	20050417	20050417	20050414	20050414	20050414	20050414	20050414	20050415	20050415
cas	**Volatile Organics (ug/L)**	**r9tapw***	**fedmcl****												
71-55-6	1,1,1-TRICHLOROETHANE	3200	200	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
79-34-5	1,1,2,2-TETRACHLOROETHANE	0.055	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
79-00-5	1,1,2-TRICHLOROETHANE	0.2	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
76-13-1	1,1,2-TRICHLOROTRIFLUOROETHANE	59000	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-34-3	1,1-DICHLOROETHANE	810	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.4 J	5 U	5 U
75-35-4	1,1-DICHLOROETHENE	340	7	5 U	0.4 J	5 U	4 J	2 J	5 U	5 U	1 J	5 U	4 J	0.6 J	0.7 J
120-82-1	1,2,4-TRICHLOROBENZENE	7.2	70	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
96-12-8	1,2-DIBROMO-3-CHLOROPROPANE	0.048	0.2	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
106-93-4	1,2-DIBROMOETHANE	0.0056	0.05	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
95-50-1	1,2-DICHLOROBENZENE	370	600	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
107-06-2	1,2-DICHLOROETHANE	0.12	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
78-87-5	1,2-DICHLOROPROPANE	0.16	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
541-73-1	1,3-DICHLOROBENZENE	180	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
106-46-7	1,4-DICHLOROBENZENE	0.5	75	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
78-93-3	2-BUTANONE	7000	None Promulgated	5 U	5 UR	5 UR	5 U	5 U	5 U	5 UR	5 U	5 UR	4 J	5 UR	5 UR
591-78-6	2-HEXANONE	None Promulgated	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
108-10-1	4-METHYL-2-PENTANONE	2000	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
67-64-1	ACETONE	5500	None Promulgated	3 J	8 J	4 J	5 UR	6 J	5 UR	3 J	16 J	10 J	19 J	5 J	5 J
71-43-2	BENZENE	0.35	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-27-4	BROMODICHLOROMETHANE	0.18	80	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-25-2	BROMOFORM	8.5	80	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
74-83-9	BROMOMETHANE	8.7	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-15-0	CARBON DISULFIDE	1000	None Promulgated	5 U	0.4 J	5 U	5 U	5 U	5 U	5 U	0.8 J	5 U	5 U	0.4 J	0.4 J
56-23-5	CARBON TETRACHLORIDE	0.17	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
108-90-7	CHLOROBENZENE	110	100	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
124-48-1	CHLORODIBROMOMETHANE	0.13	80	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-00-3	CHLOROETHANE	4.6	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
67-66-3	CHLOROFORM	0.17	80	**0.6 J**	5 U	5 U	5 U	5 U	**0.4 J**	5 U	5 U	5 U	5 U	5 U	5 U
74-87-3	CHLOROMETHANE	160	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
156-59-2	CIS-1,2-DICHLOROETHENE	61	70	5 U	28	5 U	**720**	**430**	0.4 J	12	**500**	20	**7000**	**590**	**590**
10061-01-5	CIS-1,3-DICHLOROPROPENE	0.4	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
110-82-7	CYCLOHEXANE	35000	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-71-8	DICHLORODIFLUOROMETHANE	390	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
100-41-4	ETHYLBENZENE	1300	700	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
98-82-8	ISOPROPYLBENZENE	660	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
TTNUS054	M+P-XYLENES	None Promulgated	10000	10 U	10 U	10 U	0.5 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
79-20-9	METHYL ACETATE	6100	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
108-87-2	METHYL CYCLOHEXANE	5200	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1634-04-4	METHYL TERT-BUTYL ETHER	11	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-09-2	METHYLENE CHLORIDE	4.3	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
95-47-6	O-XYLENE	210	10000	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
100-42-5	STYRENE	1600	100	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
127-18-4	TETRACHLOROETHENE	0.1	5	**0.9 J**	5 U	5 U	**2900**	**1100**	**0.5 J**	**6**	**240**	5 U	**1300**	**2 J**	**2 J**
108-88-3	TOLUENE	720	1000	5 U	5 U	5 U	2 J	0.9 J	5 U	5 U	5 U	0.2 J	2 J	0.2 J	5 U
540-59-0	TOTAL 1,2-DICHLOROETHENE	61	None Promulgated	10 U	29	10 U	**730 J**	**440 J**	10 U	12	**510**	21	**7200**	**600**	**600**
1330-20-7	TOTAL XYLENES	210	10000	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U
156-60-5	TRANS-1,2-DICHLOROETHENE	120	100	5 U	0.8 J	5 U	14	13	5 U	5 U	7	0.8 J	**250 J**	13	12
10061-02-6	TRANS-1,3-DICHLOROPROPENE	0.4	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
79-01-6	TRICHLOROETHENE	0.028	5	**1 J**	**100**	5 U	**5800**	**2600**	**0.3 J**	**14**	**690**	**0.6 J**	**860**	**88**	**82**
75-69-4	TRICHLOROFLUOROMETHANE	1300	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-01-4	VINYL CHLORIDE	0.02	2	5 U	**22**	5 U	**180**	**99**	5 U	5 U	**2 J**	**3 J**	**2400**	**140**	**140**

*r9tapw = Region 9 Tap Water Criteria
**fedmcl = Federal Maximum Contaminant Level Criteria

Note: Black-shaded cells indicate values that exceed criteria

TABLE 3-5

ALL RESULTS COMPARED TO APPLICABLE CRITERIA
SITE 45 – FORMER MWR DRY CLEANING FACILITY
MCRD PARRIS ISLAND, SOUTH CAROLINA

	location			PAI-45-MW23-SU	PAI-45-MW24-SU	PAI-45-MW24-SU	PAI-45-TW-107-SL	PAI-45-TW-108-SL	PAI-45-TW-108-SU	PAI-45-TW-109-SL	PAI-45-TW-109-SU	PAI-45-TW-118-SL	PAI-45-TW-119-SL	PAI-45-TW-125-SL	PAI-45-TW-134-SL
	matrix			GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
	gis_date			20050415	20050419	20050419	20050312	20050310	20050310	20050310	20050310	20050311	20050312	20050311	20050311
cas	**Volatile Organics (ug/L)**	**r9tapw***	**fedmcl****												
71-55-6	1,1,1-TRICHLOROETHANE	3200	200	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
79-34-5	1,1,2,2-TETRACHLOROETHANE	0.055	None Promulgated	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
79-00-5	1,1,2-TRICHLOROETHANE	0.2	5	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
76-13-1	1,1,2-TRICHLOROTRIFLUOROETHANE	59000	None Promulgated	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
75-34-3	1,1-DICHLOROETHANE	810	None Promulgated	5 U	27 J	45 J	5 U	5 U	5 U	5 U	97	5 U	5 U	100 U	5 U
75-35-4	1,1-DICHLOROETHENE	340	7	2 J	**74 J**	**71 J**	2 J	5 U	5 U	1 J	**67**	5 U	1 J	100 U	2 J
120-82-1	1,2,4-TRICHLOROBENZENE	7.2	70	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
96-12-8	1,2-DIBROMO-3-CHLOROPROPANE	0.048	0.2	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
106-93-4	1,2-DIBROMOETHANE	0.0056	0.05	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
95-50-1	1,2-DICHLOROBENZENE	370	600	5 U	100 U	100 U	5 U	5 U	5 U	0.4 J	7	5 U	5 U	100 U	5 U
107-06-2	1,2-DICHLOROETHANE	0.12	5	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
78-87-5	1,2-DICHLOROPROPANE	0.16	5	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
541-73-1	1,3-DICHLOROBENZENE	180	None Promulgated	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
106-46-7	1,4-DICHLOROBENZENE	0.5	75	5 U	100 U	100 U	5 U	5 U	5 U	5 U	**0.8 J**	5 U	5 U	100 U	5 U
78-93-3	2-BUTANONE	7000	None Promulgated	5 UR	100 U	100 U	5 UR	5 U	5 U	5 U	16	5 U	5 UR	100 U	5 UR
591-78-6	2-HEXANONE	None Promulgated	None Promulgated	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
108-10-1	4-METHYL-2-PENTANONE	2000	None Promulgated	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
67-64-1	ACETONE	5500	None Promulgated	5 J	61 J	65 J	5 UR	5 UR	5 UR	5 UR	37 J	5 UR	5 UR	100 UR	5 UR
71-43-2	BENZENE	0.35	5	5 U	100 U	100 U	5 U	5 U	5 U	**0.7 J**	**5 J**	5 U	5 U	100 U	5 U
75-27-4	BROMODICHLOROMETHANE	0.18	80	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
75-25-2	BROMOFORM	8.5	80	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
74-83-9	BROMOMETHANE	8.7	None Promulgated	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
75-15-0	CARBON DISULFIDE	1000	None Promulgated	0.4 J	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
56-23-5	CARBON TETRACHLORIDE	0.17	5	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
108-90-7	CHLOROBENZENE	110	100	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
124-48-1	CHLORODIBROMOMETHANE	0.13	80	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
75-00-3	CHLOROETHANE	4.6	None Promulgated	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
67-66-3	CHLOROFORM	0.17	80	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
74-87-3	CHLOROMETHANE	160	None Promulgated	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
156-59-2	CIS-1,2-DICHLOROETHENE	61	70	**1200**	**70000**	**61000**	**680**	5 U	5 U	**220**	**110000**	16	**710**	**670**	**250**
10061-01-5	CIS-1,3-DICHLOROPROPENE	0.4	None Promulgated	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
110-82-7	CYCLOHEXANE	35000	None Promulgated	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
75-71-8	DICHLORODIFLUOROMETHANE	390	None Promulgated	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
100-41-4	ETHYLBENZENE	1300	700	5 U	52 J	54 J	5 U	5 U	5 U	0.8 J	22	5 U	0.3 J	100 U	5 U
98-82-8	ISOPROPYLBENZENE	660	None Promulgated	5 U	59 J	58 J	5 U	5 U	5 U	0.9 J	14	5 U	5 U	100 U	5 U
TTNUS054	M+P-XYLENES	None Promulgated	10000	10 U	22 J	24 J	10 U	10 U	10 U	1 J	50	10 U	0.7 J	200 U	10 U
79-20-9	METHYL ACETATE	6100	None Promulgated	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
108-87-2	METHYL CYCLOHEXANE	5200	None Promulgated	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
1634-04-4	METHYL TERT-BUTYL ETHER	11	None Promulgated	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
75-09-2	METHYLENE CHLORIDE	4.3	5	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
95-47-6	O-XYLENE	210	10000	5 U	7 J	8 J	5 U	5 U	5 U	1 J	38	5 U	5 U	100 U	5 U
100-42-5	STYRENE	1600	100	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
127-18-4	TETRACHLOROETHENE	0.1	5	**4 J**	**1600**	**1400**	**8**	5 U	5 U	**11000**	**700 J**	**61**	**720**	**3200**	5 U
108-88-3	TOLUENE	720	1000	0.5 J	36 J	33 J	5 U	5 U	0.9 J	1 J	200 J	4 J	8	100 U	1 J
540-59-0	TOTAL 1,2-DICHLOROETHENE	61	None Promulgated	**1200**	**72000**	**63000**	**690**	10 U	10 U	**230**	**110000**	16	**720**	**700**	**260**
1330-20-7	TOTAL XYLENES	210	10000	15 U	29 J	33 J	15 U	15 U	15 U	2 J	88	15 U	15 U	300 U	15 U
156-60-5	TRANS-1,2-DICHLOROETHENE	120	100	39	**2200**	**2100**	7	5 U	5 U	10	**3400**	5 U	10	26 J	14
10061-02-6	TRANS-1,3-DICHLOROPROPENE	0.4	None Promulgated	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
79-01-6	TRICHLOROETHENE	0.028	5	**500**	**21000**	**20000**	**520**	5 U	5 U	**3300**	**35000**	**27**	**1600**	**9000**	**1200**
75-69-4	TRICHLOROFLUOROMETHANE	1300	None Promulgated	5 U	100 U	100 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	100 U	5 U
75-01-4	VINYL CHLORIDE	0.02	2	**300**	**1200**	**1100**	**21**	5 U	5 U	**20**	**3000**	5 U	**3 J**	100 U	**66**

*r9tapw = Region 9 Tap Water Criteria
**fedmcl = Federal Maximum Contaminant Level Criteria

Note: Black-shaded cells indicate values that exceed criteria

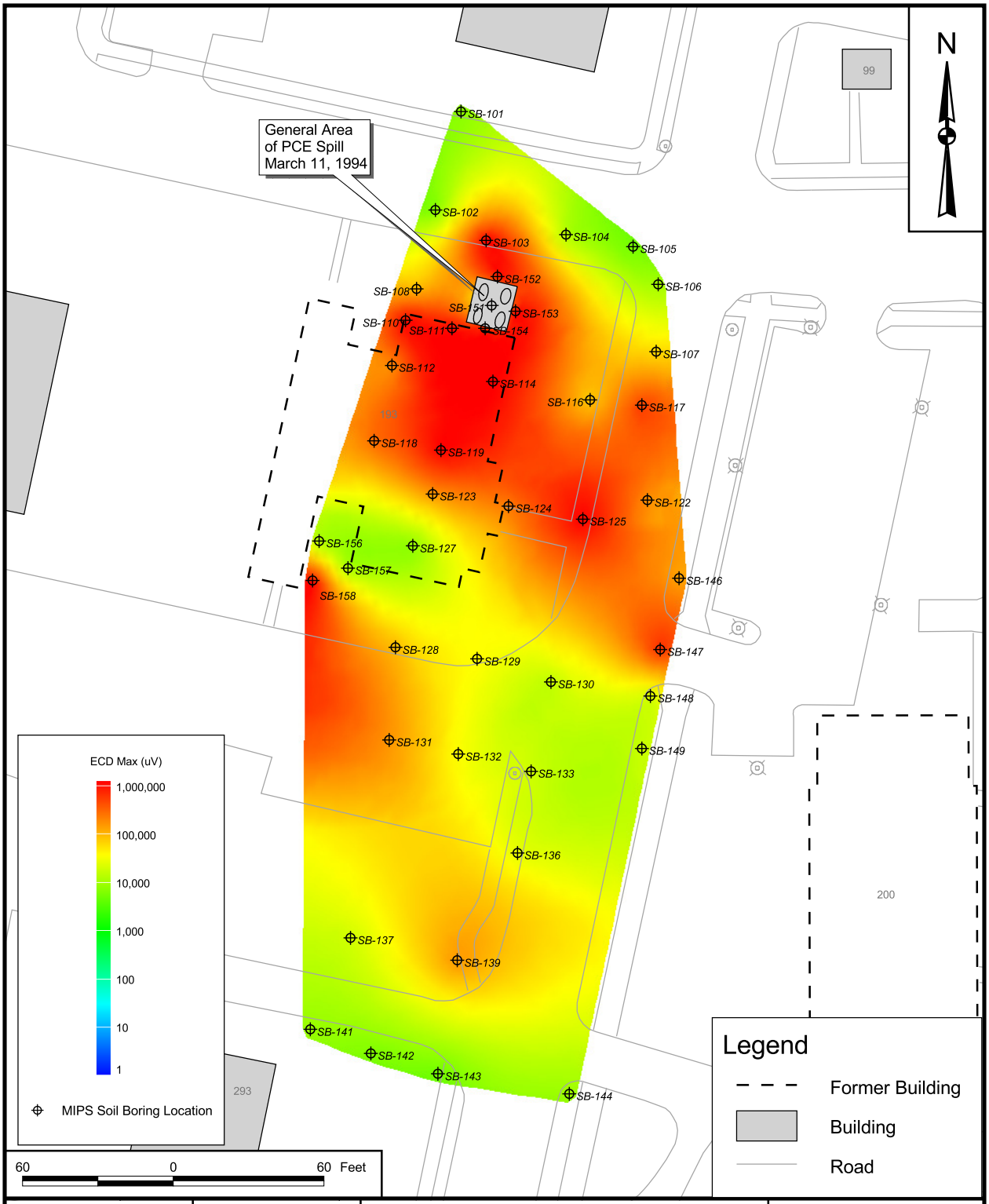
TABLE 3-5

ALL RESULTS COMPARED TO APPLICABLE CRITERIA
SITE 45 – FORMER MWR DRY CLEANING FACILITY
MCRD PARRIS ISLAND, SOUTH CAROLINA

	location			PAI-45-TW-134-SL	PAI-45-TW-134-SU	PAI-45-TW-138-SL	PAI-45-TW-138-SU	PAI-45-TW-146-SU	PAI-45-TW-148-SL	PAI-45-TW-158-SL
	matrix			GW	GW	GW	GW	GW	GW	GW
	gis_date			20050311	20050311	20050311	20050311	20050312	20050312	20050310
cas	**Volatile Organics (ug/L)**	**r9tapw***	**fedmcl****							
71-55-6	1,1,1-TRICHLOROETHANE	3200	200	5 U	5 U	5 U	5 U	5 U	5 U	5 U
79-34-5	1,1,2,2-TETRACHLOROETHANE	0.055	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U
79-00-5	1,1,2-TRICHLOROETHANE	0.2	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U
76-13-1	1,1,2-TRICHLOROTRIFLUOROETHANE	59000	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-34-3	1,1-DICHLOROETHANE	810	None Promulgated	5 U	5 U	2 J	5 U	0.8 J	5 U	5 U
75-35-4	1,1-DICHLOROETHENE	340	7	2 J	5 U	**8**	2 J	6	1 J	5 U
120-82-1	1,2,4-TRICHLOROBENZENE	7.2	70	5 U	5 U	5 U	5 U	5 U	5 U	5 U
96-12-8	1,2-DIBROMO-3-CHLOROPROPANE	0.048	0.2	5 U	5 U	5 U	5 U	5 U	5 U	5 U
106-93-4	1,2-DIBROMOETHANE	0.0056	0.05	5 U	5 U	5 U	5 U	5 U	5 U	5 U
95-50-1	1,2-DICHLOROBENZENE	370	600	5 U	5 U	5 U	5 U	5 U	5 U	5 U
107-06-2	1,2-DICHLOROETHANE	0.12	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U
78-87-5	1,2-DICHLOROPROPANE	0.16	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U
541-73-1	1,3-DICHLOROBENZENE	180	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U
106-46-7	1,4-DICHLOROBENZENE	0.5	75	5 U	5 U	5 U	5 U	5 U	5 U	5 U
78-93-3	2-BUTANONE	7000	None Promulgated	5 U	5 UR	5 U	5 UR	5 UR	5 U	5 U
591-78-6	2-HEXANONE	None Promulgated	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U
108-10-1	4-METHYL-2-PENTANONE	2000	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U
67-64-1	ACETONE	5500	None Promulgated	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR	5 UR
71-43-2	BENZENE	0.35	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-27-4	BROMODICHLOROMETHANE	0.18	80	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-25-2	BROMOFORM	8.5	80	5 U	5 U	5 U	5 U	5 U	5 U	5 U
74-83-9	BROMOMETHANE	8.7	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-15-0	CARBON DISULFIDE	1000	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U
56-23-5	CARBON TETRACHLORIDE	0.17	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U
108-90-7	CHLOROBENZENE	110	100	5 U	5 U	0.4 J	5 U	5 U	5 U	0.9 J
124-48-1	CHLORODIBROMOMETHANE	0.13	80	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-00-3	CHLOROETHANE	4.6	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U
67-66-3	CHLOROFORM	0.17	80	5 U	5 U	5 U	5 U	5 U	5 U	5 U
74-87-3	CHLOROMETHANE	160	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U
156-59-2	CIS-1,2-DICHLOROETHENE	61	70	**250**	4 J	**1800**	**380**	**5200**	**440**	**80**
10061-01-5	CIS-1,3-DICHLOROPROPENE	0.4	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U
110-82-7	CYCLOHEXANE	35000	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-71-8	DICHLORODIFLUOROMETHANE	390	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U
100-41-4	ETHYLBENZENE	1300	700	5 U	2 J	0.5 J	5 U	5 U	5 U	5 U
98-82-8	ISOPROPYLBENZENE	660	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U
TTNUS054	M+P-XYLENES	None Promulgated	10000	10 U	4 J	2 J	10 U	10 U	10 U	10 U
79-20-9	METHYL ACETATE	6100	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U
108-87-2	METHYL CYCLOHEXANE	5200	None Promulgated	12	5 U	5 U	5 U	5 U	5 U	5 U
1634-04-4	METHYL TERT-BUTYL ETHER	11	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-09-2	METHYLENE CHLORIDE	4.3	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U
95-47-6	O-XYLENE	210	10000	5 U	2 J	0.6 J	5 U	5 U	5 U	5 U
100-42-5	STYRENE	1600	100	5 U	5 U	5 U	5 U	5 U	5 U	5 U
127-18-4	TETRACHLOROETHENE	0.1	5	5 U	5 U	**3300**	**1600**	**67**	5 U	**61**
108-88-3	TOLUENE	720	1000	0.9 J	44	7	1 J	3 J	1 J	0.9 J
540-59-0	TOTAL 1,2-DICHLOROETHENE	61	None Promulgated	**260**	4 J	**1800**	**390 J**	**5400**	**450**	**80**
1330-20-7	TOTAL XYLENES	210	10000	15 U	6 J	3 J	15 U	15 U	15 U	15 U
156-60-5	TRANS-1,2-DICHLOROETHENE	120	100	14	5 U	23	7	**160**	8	0.7 J
10061-02-6	TRANS-1,3-DICHLOROPROPENE	0.4	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U
79-01-6	TRICHLOROETHENE	0.028	5	**1300**	**10**	**9700**	**2100**	**2300**	**350**	**42**
75-69-4	TRICHLOROFLUOROMETHANE	1300	None Promulgated	5 U	5 U	5 U	5 U	5 U	5 U	5 U
75-01-4	VINYL CHLORIDE	0.02	2	**69**	**2 J**	**270**	**120**	**1300**	**10**	**22**

*r9tapw = Region 9 Tap Water Criteria
**fedmcl = Federal Maximum Contaminant Level Criteria

Note: Black-shaded cells indicate values that exceed criteria



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A. JANOCHA	03/29/05
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M. BOERIO	07/30/10
REVISED BY	DATE
T. WHEATON	07/30/10
SCALE	
AS NOTED	

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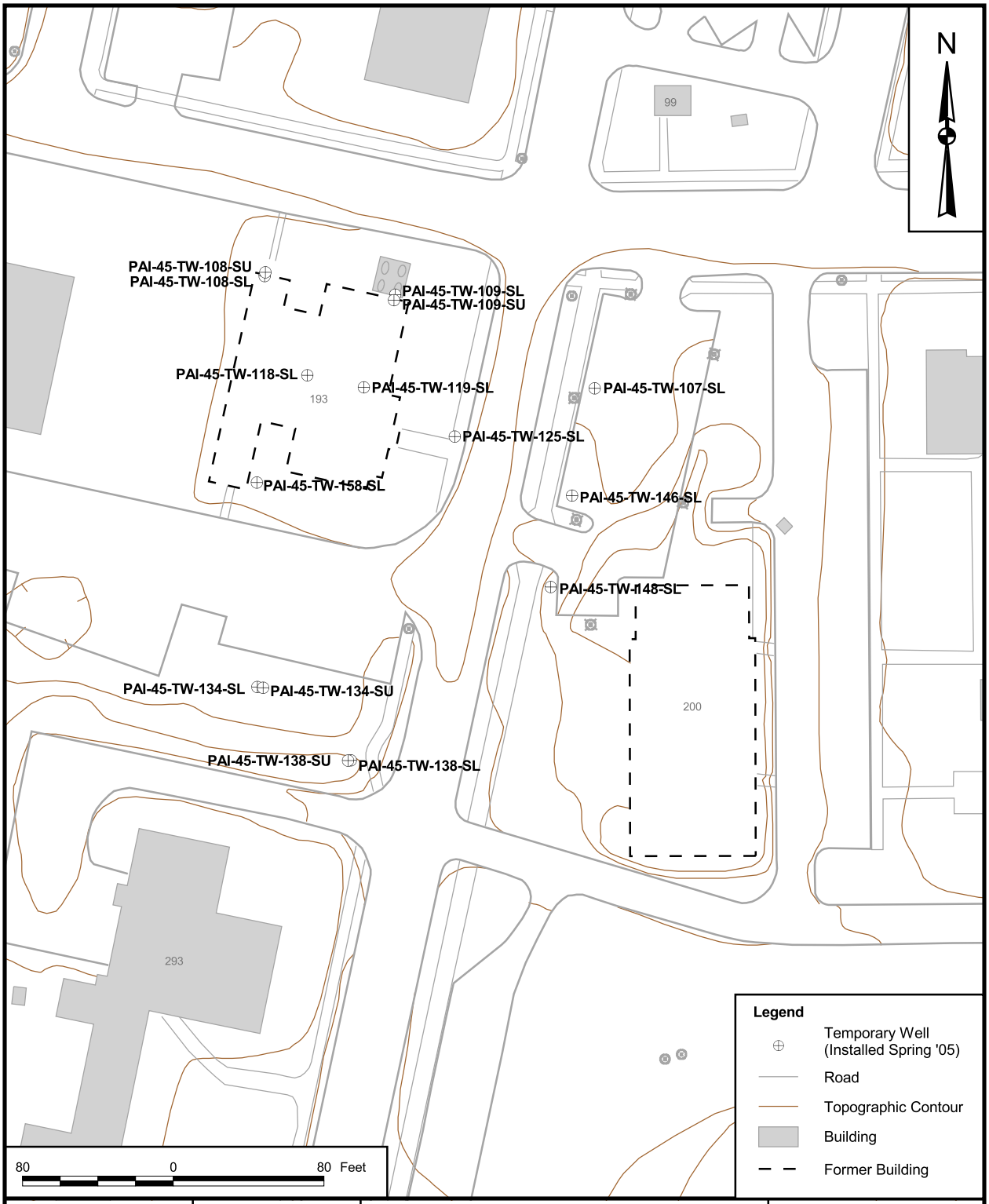
MEMBRANE INTERFACE PROBE (MIP) LOCATIONS
SWMU 45 - MWR DRY CLEANING FACILITY
RI/RFI ADDENDUM
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
N5260	
APPROVED BY	DATE
___	___
APPROVED BY	DATE
___	___
DRAWING NO.	REV
FIGURE 3 - 1	0

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_WORKPLAN.APR MIPS SURFACE LAYOUT - A 07/30/10 TW



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TEMPORARY WELLS INSTALLED SPRING 2005
SWMU 45 - MWR DRY CLEANING FACILITY
RI/RFI ADDENDUM
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
N5260	
APPROVED BY	DATE
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APPROVED BY	DATE
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DRAWING NO.	REV
FIGURE 3 - 2	0

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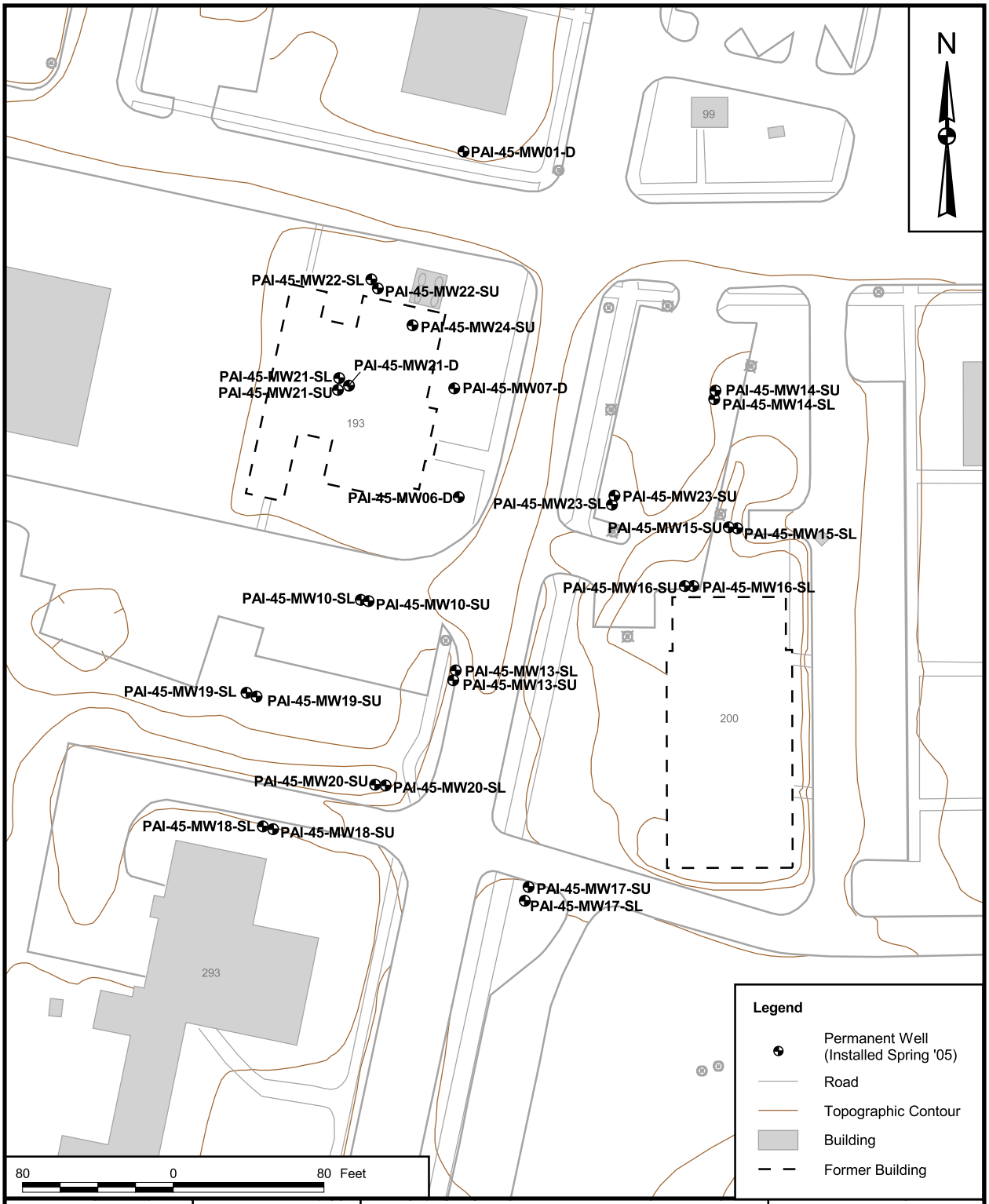

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M. BOERIO	07/30/10
REVISED BY	DATE
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PERMANENT WELLS INSTALLED SPRING 2005
SWMU 45 - MWR DRY CLEANING FACILITY
RI/RFI ADDENDUM
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
N5260	
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APPROVED BY	DATE
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DRAWING NO.	REV
FIGURE 3 - 3	0

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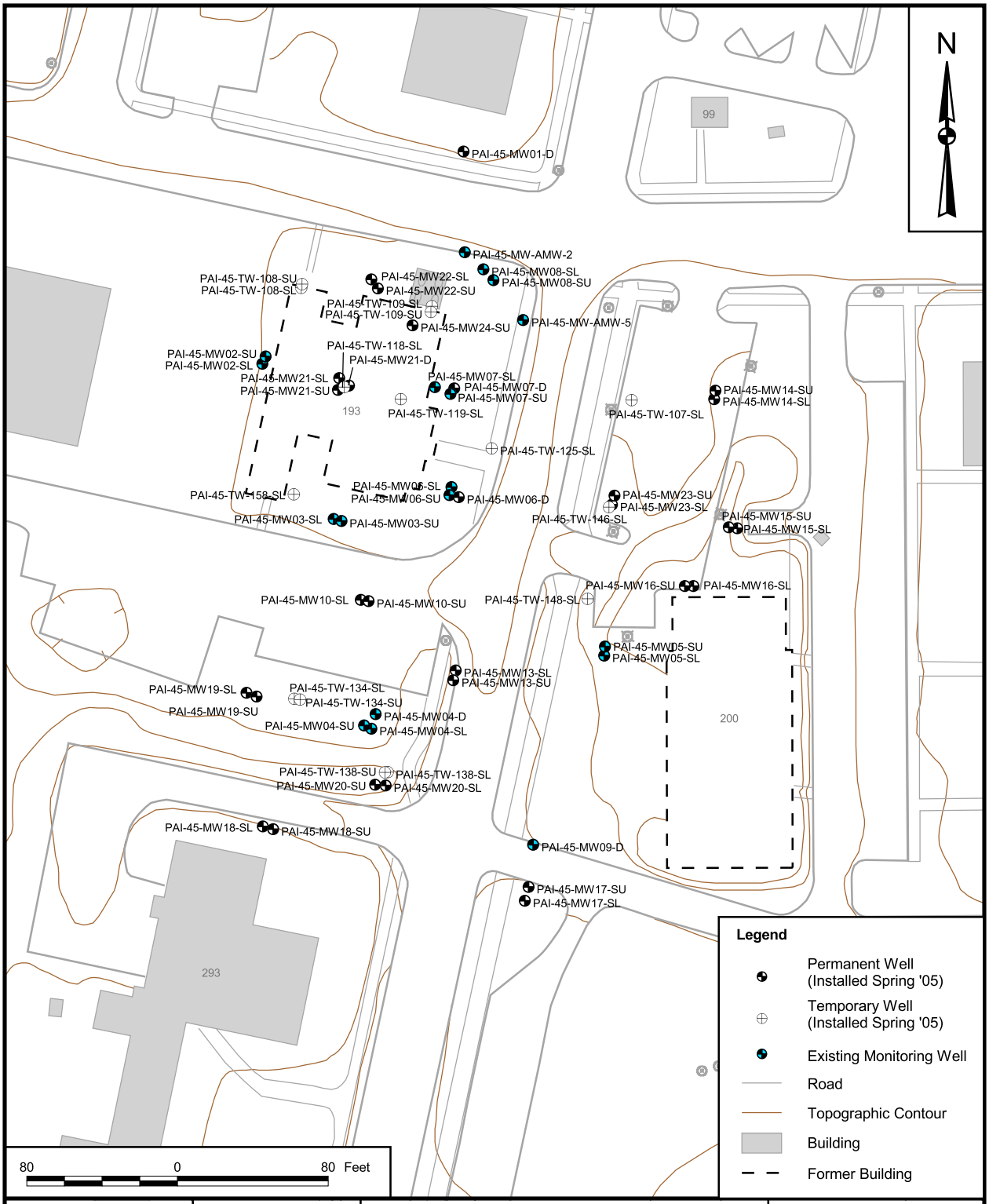

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WELLS SAMPLED IN 2005
SWMU 45 - MWR DRY CLEANING FACILITY
RI/RFI ADDENDUM
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

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N5260	
APPROVED BY	DATE
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APPROVED BY	DATE
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DRAWING NO.	REV
FIGURE 3 - 4	0

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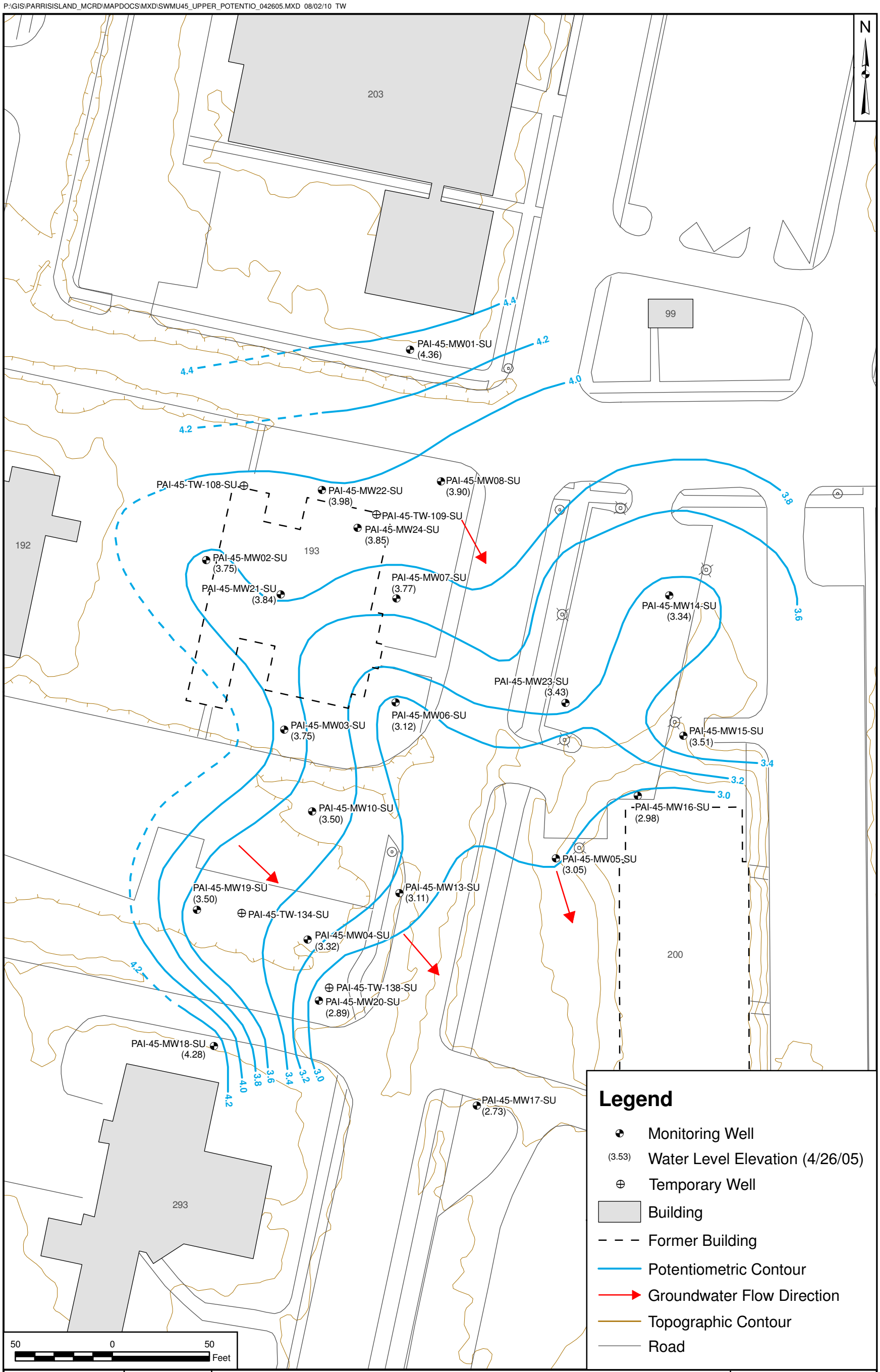

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POTENTIOMETRIC CONTOURS - UPPER SURFICIAL WELLS
(APRIL 26, 2005)
SWMU 45 - MWR DRY CLEANING FACILITY
RI/RFI ADDENDUM
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
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APPROVED BY	DATE
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APPROVED BY	DATE
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FIGURE NO.	REV
FIGURE 3-5	0

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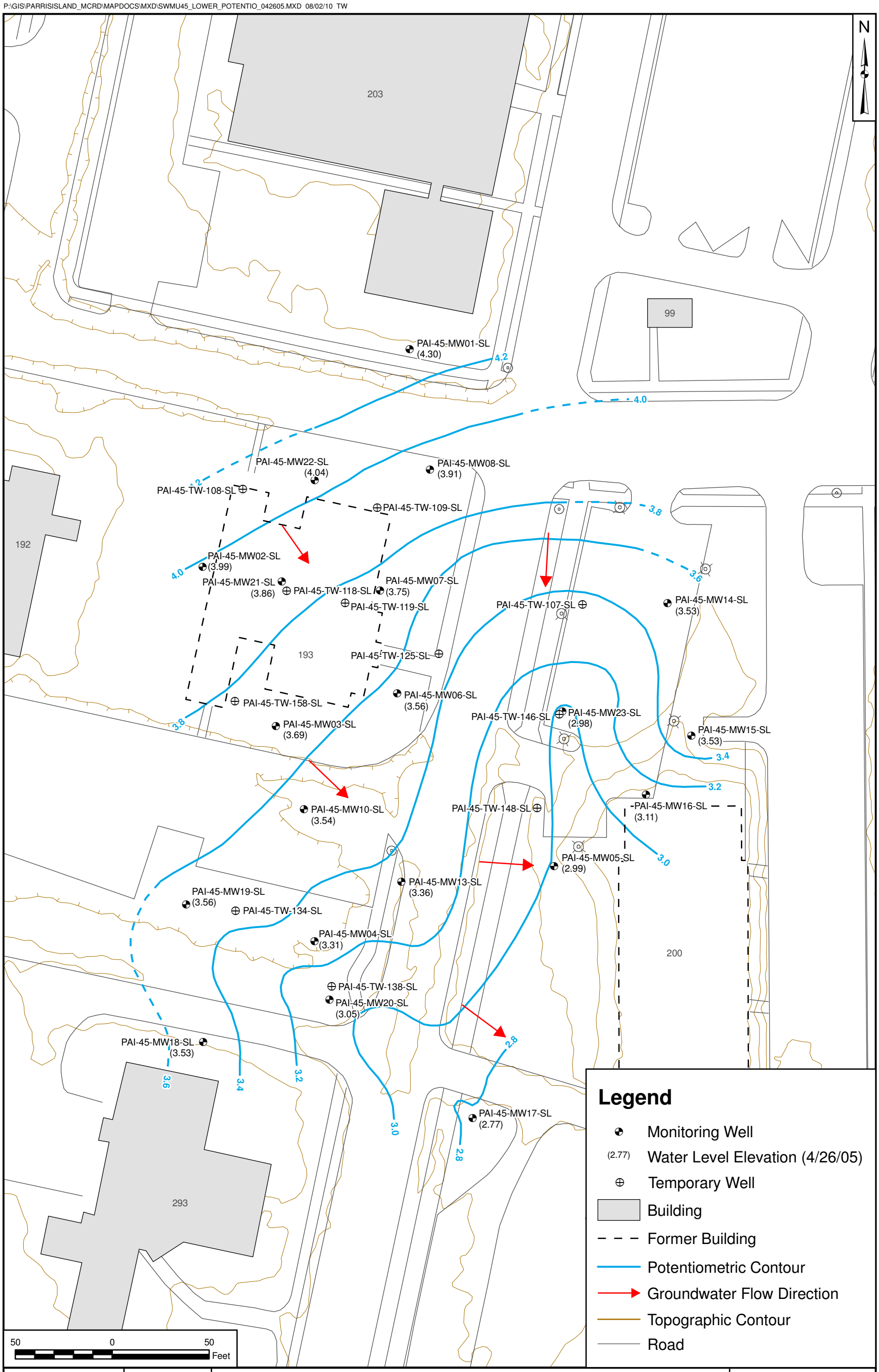

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SCALE	
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POTENTIOMETRIC CONTOURS - LOWER SURFICIAL WELLS
(APRIL 26, 2005)
SWMU 45 - MWR DRY CLEANING FACILITY
RI/RFI ADDENDUM
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
N5260	
APPROVED BY	DATE
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APPROVED BY	DATE
___	___
FIGURE NO.	REV
FIGURE 3-6	0

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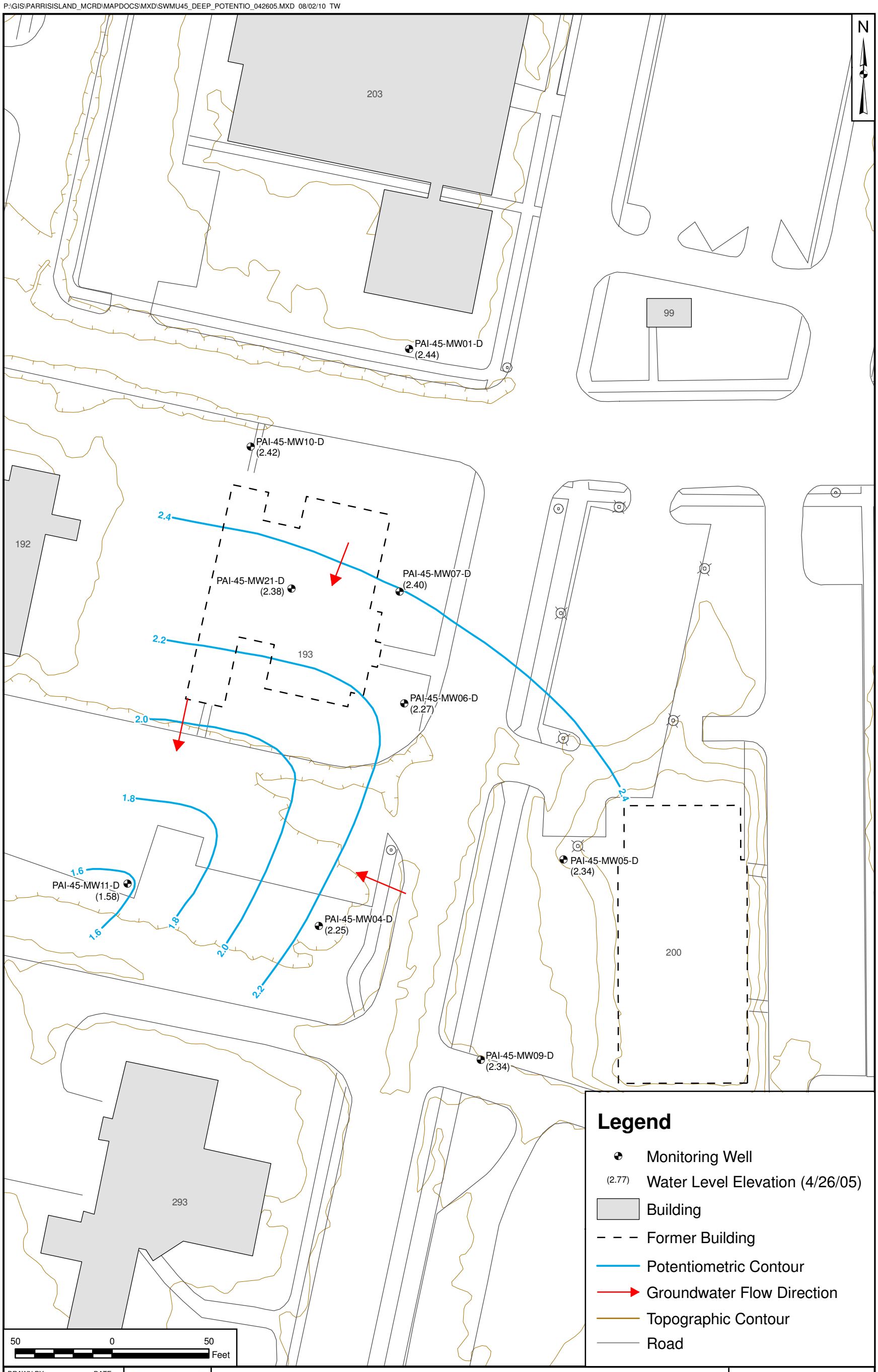

DRAWN BY T. WHEATON	DATE 08/02/10	POTENTIOMETRIC CONTOURS - DEEP WELLS (APRIL 26, 2005) SWMU 45 - MWR DRY CLEANING FACILITY RI/RFI ADDENDUM MCRD PARRIS ISLAND PARRIS ISLAND, SOUTH CAROLINA	CONTRACT NUMBER N5260
CHECKED BY M. BOERIO	DATE 08/02/10		APPROVED BY ___ DATE ___
REVISED BY ___	DATE ___		APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 3-7 / REV 0

4.0 NATURE AND EXTENT OF CONTAMINATION

This section adds to the body of knowledge regarding nature and extent of volatile organic compound (VOC) contamination in groundwater evaluated as part of the 2005 follow-up field investigation at Site/SWMU 45. The original Site 45 RI/RFI Report (Tetra Tech, 2004a) provides details regarding all media and analytical fractions investigated previously. This RI Addendum is narrower in scope – both from the standpoint of media investigated (limited to groundwater only) and chemical compounds analyzed (limited to VOCs only). It is believed that the information presented in this RI Addendum provides enough information to move onto the next steps in the CERCLA/RCRA processes (FS/CMS) for site remediation. The Site 45 Conceptual Site Model (CSM) has been updated based on the findings of the 2005 investigation, USGS investigation, and vapor intrusion analysis and can be found in Appendix P.

4.1 GROUNDWATER SAMPLING RESULTS

4.1.1 2005 Sampling Results

Based on the site history and the Site 45 Addendum Work Plan (Tetra Tech, 2004b), additional wells were installed as described in Section 3 to further delineate groundwater contamination. Analytical and groundwater modeling results are presented graphically in a series of figures. For clarity, the tag maps present those chemicals and results that are of primary concern from a chlorinated solvent standpoint and associated degradation products. Figure 4-1 presents a tag map of results for tetrachloroethene (PCE), trichloroethene (TCE), Total 1,2 – dichloroethene (DCE) (please note that the 61 µg/L criterion for cis-1,2 DCE is used as a benchmark for total 1,2 DCE on all figures), and vinyl chloride in the upper surficial wells sampled in Spring 2005. Figure 4-2 presents a tag map of results for PCE, TCE, Total 1,2 – DCE, and vinyl chloride in the lower surficial wells sampled in Spring 2005. The concentrations in the deep wells were below screening levels, with all “detected” concentrations being less than laboratory detection limits and thus labeled as “estimated” values with a “J”-qualifier. The maximum cis-1,2-DCE “detected” concentration of 2.0J µg/L at MW-07D. Other “estimated” (“J”-qualified) concentrations are also shown in the table below:

Sample Location	PCE	TCE	cis-1,2-DCE
PAI-45-MW06-D-02	ND	ND	0.3 J
PAI-45-MW07-D-02	ND	ND	2 J
PAI-45-MW21-D-02	0.5 J	0.3 J	0.4 J

ND = not detected

These results indicate that contamination is not migrating vertically to any great extent. Tables 3-3 through 3-5 provides all of the data used to produce tag maps 4-1 and 4-2, and for evaluations discussed in this nature and extent of contamination Section. These tables present the following:

- frequency of detection
- range of detection
- range of nondetects
- location of maximum concentration
- average of positive results
- average of all results (using one-half the detection limit for nondetected results)
- exceedances of regulatory criteria
- plus a complete list of all results provided in Table 3-5

4.1.2 USGS Sampling Results

This investigation focused on the southern plume, because the northern plume was previously studied extensively. Analytical and groundwater modeling results are presented graphically in a series of figures. For clarity, the tag maps present those chemicals and results that are of primary concern from a chlorinated solvent standpoint and associated degradation products. Figure 4-3 presents a tag map of results for PCE and TCE in all wells sampled during the investigation. Figure 4-4 presents a tag map of results for cis-1,2-DCE and vinyl chloride in all wells sampled during the investigation.

The deep wells, consistent with the results from the 2005 sampling results, indicated concentrations below screening levels, with all “detected” concentrations being less than laboratory detection limits and thus labeled as “estimated” values with a “J”-qualifier. The maximum concentration of PCE was consistently detected at well PAI-45-MW25-SL, with the greatest concentration detected in September 2008 (20,600 µg/L). Concentrations of PCE, TCE, and 1,2-DCE exceeded cleanup goals during all sampling events, and vinyl chloride exceeded cleanup goals in June and September 2008. The highest concentration of TCE was detected at well PI-45-MW20-SL in March 2006. PCE, TCE, 1,2-DCE, and vinyl chloride consistently exceeded cleanup goals at sampling events at this well. The following table presents the wells and dates of the highest detections for each COC, along with the concentrations of the other COCs during that event.

Sample Location	Sample Date	PCE µg/L	TCE µg/L	cis-1,2-DCE µg/L	Vinyl Chloride µg/L
PAI-45-MW25-SL	9/9/2008	20,600	3,920	447	60.3
PAI-45-MW20-SL	3/7/2006	782	5,840	905	117
PAI-45-MW31-SLR	9/9/2008	7,840	4,670	3,270	228
PAI-45-MW31-SUR	9/9/2008	3,000	2,090	1,230	263

All data collected during the USGS investigation is presented in the associated report, which can be found in Appendix A. frequency of detection.

4.2 GROUNDWATER MODELING OF CHLORINATED ORGANICS

As discussed earlier, it has become clear that a subset of the chlorinated organics analyzed and associated degradation products are governing the evaluation and future actions at Site 45. To help visualize contamination of these compounds that are driving site decisions, geostatistical modeling was conducted to illustrate the extent of contamination and depict current contamination patterns using the data provided in Section 3.0. Figures 4-5 through 4-14 are two-dimensional visualizations that were generated using Ctech's Environmental Visualization System (EVS) software, version 8.0 beta (this is the latest version recommended by Ctech which corrects a few deficiencies noted in the 7.92 version). For each data set where kriging was used, the values used in the process ranged from half of the detection limit to the maximum result for the minimum and maximum input parameters. The kriging boundary for two-dimensional kriging is defined by the adaptive grid of the data set. This boundary is irregular in shape because it is defined by the outermost data points. To visualize this type of boundary, it can be described as fitting a rubber band around all of the data points. The points on the outer edges of the data set would establish the boundary for the kriging area.

Appendix Q provides a second set of Figures 4-5 through 4-14 (numbered in parallel with Section 4 for easy comparison) using only the permanent monitoring well data. Comparison of these two sets of figures does not show significant differences in contamination levels or patterns for any of the parameters modeled, so the combined monitoring well data (temporary and permanent) was used for the interpretations of contamination extent that follow in the next sub-sections.

Appendix A includes the USGS report. Figure 12 through Figure 15 of this report show the approximate distribution of PCE, TCE, DCE, and vinyl chloride at Site 45 based on the USGS investigation results.

All plumes shown in these figures are approximately 83,000 square feet in size and show the extent of concentrations exceeding approximately 5.0 µg/L - the typical lower limit of detection for each of the

modeled parameters. It should be noted that the screening criteria for some parameters are much lower than the limits of detection by the currently recognized environmental analytical methods.

The following subsections (4.2.1 through 4.2.5) discussing chlorinated parameters are in the order they would degrade under anoxic, reductive dechlorinating conditions, as follows:

> PCE degrades to ➔ TCE, which degrades to ➔ cis1,2 DCE (total 1,2 DCE also shown), which degrades to ➔ vinyl chloride, which degrades to ➔ ethene, which degrades to ➔ ethane

4.2.1 2005 PCE Groundwater Plumes – Surficial Upper and Surficial Lower

Figures 4-5 and 4-6 present the most recent (Spring 2005) PCE groundwater-modeled (kriged estimate) contamination plumes using analytical data obtained from the permanent and temporary monitoring wells sampled as shown in Figure 3-4. The maximum concentrations in these modeling runs were detected in:

- PAI-45-MW08-SU for the upper aquifer at 26,000 µg/L, which is located just east of the general area where the spill occurred on March 11, 1994, and

- PAI-45-TW109-SL for the lower aquifer at 11,000 µg/L, which is located near the southeast corner of the tank area where the spill occurred.

These figures indicate the PCE plume is well-bounded down to analytical detection limits in all directions except due north of the center of the plume near PAI-45-MW-08-SU and PAI-45-MW-20-SU. It is anticipated that the plume could easily be bounded to the north (if necessary) during future phases of regulatory activity at this site. South of PAI-45-MW-20-SU, MIP screening data suggests that the plume is bound (see Figure 3-1), although these screening results were not verified by analytical data.

At location 158, the high MIP ECD result did not correlate well with the much lower temporary well sampling results at the same location. Since that time, February 2006 follow-up work did identify a second plume south of location 158, currently referred to as the Southern Plume.

4.2.2 2005 TCE Groundwater Plumes – Surficial Upper and Surficial Lower

Figures 4-7 and 4-8 present the most recent (Spring 2005) TCE groundwater-modeled (kriged estimate) contamination plumes using analytical data obtained from the permanent and temporary monitoring wells sampled as shown in Figure 3-4. The maximum concentrations in these modeling runs were detected in:

- PAI-45-TW-109-SU for the upper aquifer at 35,000 µg/L, which is located near the southeast corner of the tank area where the spill occurred on March 11, 1994, and

- PAI-45-TW-138-SL for the lower aquifer at 9,700 µg/L, which is located in the southern portion of the secondary (smaller) plume about 250 feet south-southwest of the tank area where the spill occurred.

Figure 4-7 indicates the TCE plume is well-bounded down to analytical detection limits in the surficial upper aquifer in all directions except due north of the spill location and to a lesser extent, due south of PAI-45-MW-20-SU. Figure 4-8 indicates the TCE plume is not as well-bounded in the surficial lower aquifer as it is in the upper aquifer. Plume edges to the north, west, and south could probably be refined with one more well location in those directions. However, it is anticipated that any such refinement of plume margins could be completed in those directions (if necessary) during future phases of regulatory activity at this site.

Note: TCE's extremely low EPA Region 9 Tap Water criterion (0.028 µg/L) will make plume delineation to that concentration unachievable with currently recognized environmental analytical methods.

4.2.3 2005 cis-1,2 DCE Groundwater Plumes – Surficial Upper and Surficial Lower

Figures 4-9 and 4-10 present the most recent (Spring 2005) cis-1,2 DCE groundwater-modeled (kriged estimate) contamination plumes using analytical data obtained from the permanent and temporary monitoring wells sampled as shown in Figure 3-4. The maximum concentrations in these modeling runs were detected in:

- PAI-45-TW-109-SU for the upper aquifer at 110,000 µg/L, which is located near the southeast corner of the tank area where the spill occurred on March 11, 1994, and

- PAI-45-TW-146-SL for the lower aquifer at 5,200 µg/L, which is located in the eastern portion of the plume about 150 feet southeast of the tank area where the spill occurred.

As with TCE, Figure 4-9 indicates the cis-1,2 DCE plume is well-bounded in the surficial upper aquifer in all directions except due north of the spill location and south of PAI-45-MW-20-SU. Figure 4-10 indicates the cis-1,2 DCE plume is larger in the surficial lower aquifer at the 100 to 1000 µg/L range of concentrations, but is fairly well-bounded with regard to the 61 µg/L criterion except to the north. However, it is anticipated that any such refinement of plume margins to the north could be completed (if necessary) during future phases of regulatory activity at this site. South of PAI-45-MW-20, MIP screening data suggests that the plume is bound (see Figure 3-1), although these screening results were not verified by analytical data.

4.2.4 2005 Total 1,2 DCE Groundwater Plumes – Surficial Upper and Surficial Lower

Figures 4-11 and 4-12 present the most recent (Spring 2005) total-1,2 DCE (the sum of cis-1,2- and trans-1,2 DCE) groundwater-modeled (kriged estimate) contamination plumes using analytical data obtained from the permanent and temporary monitoring wells sampled as shown in Figure 3-4. The maximum concentrations in these modeling runs were detected in the same wells as for cis-1,2 DCE :

- PAI-45-TW-109-SU for the upper aquifer at 110,000 µg/L, which is located near the southeast corner of the tank area where the spill occurred on March 11, 1994, and

- PAI-45-TW-146-SL for the lower aquifer at 5,400 µg/L, which is located in the eastern portion of the plume about 150 feet southeast of the tank area where the spill occurred.

As with cis-1,2 DCE, Figure 4-11 indicates the total-1,2 DCE plume is well-bounded in the surficial upper aquifer in all directions except due north of the spill location. Figure 4-12 indicates the total-1,2 DCE plume is larger in the surficial lower aquifer at the 100 to 1000 µg/L range of concentrations, but is fairly well-bounded with regard to the 61 µg/L criterion except to the north. However, it is anticipated that any such refinement of plume margins to the north could be completed (if necessary) during future phases of regulatory activity at this site.

4.2.5 2005 Vinyl Chloride Groundwater Plumes – Surficial Upper and Surficial Lower

Figures 4-13 and 4-14 present the most recent (Spring 2005) vinyl chloride groundwater-modeled (kriged estimate) contamination plumes using analytical data obtained from the permanent and temporary monitoring wells sampled as shown in Figure 3-4. The maximum concentrations in these modeling runs were detected in:

- PAI-45-TW-109-SU for the upper aquifer at 3,000 µg/L, which is located near the southeast corner of the tank area where the spill occurred on March 11, 1994, and

- PAI-45-TW-146-SL for the lower aquifer at 1,300 µg/L, which is located in the eastern portion of the plume about 150 feet southeast of the tank area where the spill occurred.

Figure 4-13 indicates the vinyl chloride plume is well-bounded down to analytical detection limits in the surficial upper aquifer in all directions except due north of the spill location and to a lesser extent, due south of PAI-45-MW-20-SU. Figure 4-14 indicates the vinyl chloride plume is larger, and split into two segments in the surficial lower aquifer. In addition to the north and south plume fringes possibly needing

more refinement, the west edge of the lower aquifer does not appear completely bounded with regard to detection limits. However, it is anticipated that any such refinement of plume margins to the north could be completed (if necessary) during future phases of regulatory activity at this site.

Note: Vinyl chloride's extremely low criterion (0.02 µg/L) will make plume delineation to that concentration unachievable with currently recognized environmental analytical methods.

4.2.6 Vertical Profiling of Groundwater Contamination

Figures 4-15 through 4-19 have been provided to visualize vertical profiling of groundwater-modeled (kriged estimate) contamination through specific cross-sections using analytical data obtained from the permanent and temporary monitoring wells sampled in 2005. Because vertical contamination distribution patterns for the five (5) parameters modeled were very similar, TCE was selected for this profiling exercise as it qualitatively represented the best combination of extremes for the five. The following text describes the geostatistical modeling results in order of site-wide perspective through specific cross-section interpretations.

Figure 4-15 presents the three cross-section layouts (A-A'; B-B', and C-C') for which individual vertical profiles were modeled. These cross-sections were selected to transect areas of higher concentrations (source, or sources) in order to visualize the nature of subsurface contamination. The northern-most portions of A-A' and C-C' focus on the known source of PCE release in March, 1994, while B-B' transects the second area of higher concentrations. This area is of interest because it is not clear whether this is a second source, or simply an area of higher concentrations.

Figure 4-16 presents all three of the 2-dimensional vertical TCE profiles combined into one visualization for the cross-sections shown in Figure 4-15. This figure shows these vertical profiles as viewed from west of Site 45 and at about a 40-degree elevation. The left side of this figure (north) corresponds to the known PCE source release area in 1994, with the right side (south) depicting downgradient areas of this known release. Individual cross-section discussions are provided in the next three paragraphs.

Figure 4-17 shows the 2-dimensional vertical TCE profile for the A-A' cross-section shown in Figure 4-15. Even though only a few well locations are shown to orient the reader, all of the well location data (SU+SL) was used to generate the geostatistical contouring shown in Figures 4-16 through 4-18. Of note in this visualization (Figure 4-17) is that the higher concentrations of TCE contamination are clearly shown in the upper aquifer close to where the PCE was released (TW-109). In fact, the highest concentration of TCE was noted at PAI-45-TW-109-SU (35,000 µg/L). The direction of groundwater flow from the perspective in this figure is generally left to right (northwest to southeast). With that in mind, decreasing concentrations can be seen as TCE contamination moves in groundwater downgradient. These

decreasing concentrations can simply be caused by dilution as you move farther away from the source, but there is also clear evidence that decreases are also being caused by natural attenuation (see Section 4.3).

Figure 4-18 shows the 2-dimensional vertical TCE profile for the B-B' cross-section shown in Figure 4-15. This cross-section is showing a slice through the second area of higher concentrations in the southern portion of the site (it is not yet known if this is truly a second "source"). The higher concentrations of TCE contamination noted here are in the lower aquifer, clustered around MW-04-SL, MW-20-SL, and TW-138-SL. The direction of groundwater flow from the perspective in this figure is also generally left to right (northwest to southeast). With that in mind, you would generally expect to see decreasing concentrations with increasing distance in the downgradient groundwater direction. Future phases of regulatory activity at this site may yield more understanding of what is happening in this localized area. There is also clear evidence that natural attenuation is functioning here as well (see Section 4.3).

Figure 4-19 shows the 2-dimensional vertical TCE profile for the C-C' cross-section shown in Figure 4-15. This cross-section is showing a slice starting east of the known release site, then heading in a southwest and cross-gradient direction finally passing by the second area of higher concentrations in the southern portion of the site to the west. This profile also shows higher concentrations of TCE in the upper aquifer close to where the PCE was released (MW-08) and slightly increasing to the intersection point of cross-section A-A" at TW-125. The remainder of this profile shows decreasing concentrations in the southwestern direction toward MW-18. The direction of groundwater flow from the perspective in this figure is perpendicular to the viewer (into and through the page). With that in mind, decreasing concentrations are not as much related to downgradient groundwater flow, but rather lateral distance away from the original release area.

For all of the modeling exercises conducted, it is known that there was at least one PCE source release near the northern edge of the investigation area at MW08 and MW24. The USGS report found that the likely source of PCE contamination in the southern plume (near MW01 and MW20) was a leak from a sanitary sewer in the vicinity of the new dry cleaning facility. Figures from the USGS investigations can be found in the report in Appendix A.

4.3 NATURAL ATTENUATION UPDATE

This section provides a brief summary of continuing evidence that natural attenuation is taking place. Appendix G of the original RI Report (Tetra Tech, 2004a) provides a very detailed presentation and evaluation of the natural-attenuation-related data that were previously collected. Additional data yields no change in the conclusion that natural attenuation is functioning at the site.

Evaluating the ratio of cis-1,2-DCE to trans-1,2-DCE is one way of determining whether the biodegradation of TCE is occurring. Typically the biodegradation of TCE will result in higher concentrations of cis-1,2-DCE when compared to concentrations of trans-1,2-DCE. When evaluating groundwater data collected during this phase of the investigation, samples with positive detects (including estimated values "J") indicate higher ratios of cis-1,2-DCE to trans-1,2-DCE than were noted previously. Samples collected from wells during March and April 2001, indicated a cis-/trans- ratio ranging from approximately 4:1 to 124:1, while samples collected from wells during March through April 2005, indicated cis-/trans- ratios ranging from approximately 18:1 to 385:1. Table 4-1 provides a summary of these ratios in all wells that had positive detections for both cis-, and trans-1,2 DCE.

The highest ratios (all greater than 180:1 and all in the lower aquifer) were observed at PAI-45-MW03-SL-02 (ratio of 385); PAI-45-MW13-SL-02 (ratio of 275); and PAI-45-MW05-SL-02 (ratio of 182). These wells are all downgradient of the original release source, which is encouraging from the standpoint of increasing evidence supporting PCE/TCE degradation.

Two of the lowest cis-/trans- ratios (both 25:1, or lower and in the lower aquifer) were observed at PAI-45-MW22-SL-02 (ratio of 25) and PAI-45-TW109-SL-16 (ratio of 22). These wells are very close to the original release source, which probably means there has not been enough time for higher concentrations of PCE at those locations (or above those locations in the upper aquifer) to degrade.

Given the ratios of cis-1,2-DCE to trans-1,2-DCE observed in the groundwater samples, it is reasonable to continue believing that TCE biodegradation is occurring. Also, as the in-text table shows below, there are dramatic increases in degradation products (particularly cis-1,2-DCE) in source and downgradient locations. (Note: When the value on Table 4-2 was listed as "0" for 1996, a "0.1" was used to be able to calculate a percentage)

Well	**PCE**	**TCE**	**cis 1,2-DCE**	**VC**
% (2005 result divided by 1996 result)				
MW08SU	81%	108%	236%	220,000%
MW05SL	0%	16%	2,395%	All non-detect
MW04SU	26%	4,828%	36,000%	10,000%

Qualitative evaluation of dissolved oxygen levels measured in 2005 (field instrument - see Appendix K) show decreasing oxygen concentrations with depth in the permanent wells. This limited data also supports a conclusion for an environment conducive for reductive dechlorination.

Table 4-2 is a comparison of 1996 to 2005 sampling results for wells MW08SU, MW06SU, MW05SL, and MW04SU. The relative proportions of PCE, TCE, DCE, and VC to the total amount of chlorinated ethenes were calculated for each well for each sampling round, then were compared to see whether the proportions changed over time. For the source area well (MW08SU), the amount of PCE present in 2005 is less than what it was in 1996, but greater than in 2001. As mentioned above, a good indicator that degradation is headed in the right direction is that the relative proportions of TCE, DCE, and VC are still increasing when compared to 1996. In well MW04SU, the relative proportion of PCE dropped in 2005 compared to 1996, and the proportions of TCE, DCE and VC increased dramatically compared to both 1996 and 2001. These results show a favorable pattern for dechlorination over time that is indicative of biodegradation activities.

The USGS report investigated the presence of biological agents in the groundwater that could enhance the biodegradation of chlorinated VOCs. It was presented that a density of 1×10^7 cells of the microbe *Dehalococcoides* per liter of groundwater was generally sufficient to produce a useful rate of natural attenuation of chlorinated VOCs. The density of *Dehalococcoides* in the groundwater at Site 45 was found to be greater than 1×10^7 cells per liter, thus there is a sufficient density of the microbe to produce significant biodegradation of the solvents to the end product, ethylene. The USGS report also determined that the presence of enzymes involved in the dehalogenation process in the groundwater at Site 45 indicated that microbial degradation of chlorinated VOCs is occurring in the southern plume. The pH can also affect reductive dechlorination, and thought the pH in the groundwater at Site 45 was found to be between 5.77 and 6.03 pH units (less than the optimal 6.8 to 7.6 pH units), the pH is not low enough to prohibit the reductive dechlorination process. Overall, the USGS report states that although biodegradation and other natural attenuation processes are occurring.

4.4 SURFACE WATER AND SEDIMENT CONTAMINATION

The amount and nature of the sediment and surface water data that has been collected during the 2005, 2006, and USGS investigations is not sufficient to justify decisions about the sediment and surface water contamination. The USGS investigation included the collection of ten sediment samples, four surface water samples in Ballast Creek and several samples from storm sewers. The data was not conclusive, although contaminant concentrations in water samples were generally less than MCLs in surface water and back up through the storm sewer for at least the first 100 feet. No site related compounds were identified in sediment samples. The collection of additional storm sewer samples and sediment samples (as a part of the Site 14 SI) is expected to be completed in time to be considered in the Site 45 PRAP/ROD. The FS evaluation of soil, groundwater, and VI remedial options is not expected to be impacted by the lack of additional surface water or sediment data at this time.

4.5 CONCLUSIONS

- PCE and its degradation products (TCE, cis-1,2-DCE, total 1,2-DCE and VC) were detected in the surficial upper and surficial lower aquifers at numerous locations above the most stringent regulatory screening criteria. The concentrations in the deep wells were below screening levels indicating contamination is not migrating vertically to any great extent with a maximum cis-1,2-DCE "detected" concentration of 2.0J µg/L at MW-07D.

- Nature and extent of contamination is well-defined with only a few areas of refinement needed. This refinement, if deemed necessary could be accomplished as part of future phases of regulatory activity at this site.

- Substantial evidence exists that natural attenuation is functioning at the site to degrade PCE and daughter products all the way to vinyl chloride.

- There is not currently enough or sufficient sediment and surface water data, so any remedial actions addressing these media will be investigated separately at a later date.

- Additional soil gas data associated with Building 192 and Building 293 will be provided as part of future remedial design phases of the CERCLA process and as called for in a risk management decision pertaining to VI.

TABLE 4-1

RATIOS OF CIS-1,2 DCE TO TRANS-1,2 DCE
SITE 45 – FORMER MWR DRY CLEANING FACILITY
MCRD PARRIS ISLAND, SOUTH CAROLINA

Sample Location	Date Sampled	CIS-1,2-DICHLOROETHENE	TRANS-1,2-DICHLOROETHENE	Ratio of cis to trans DCE
PAI-45-MW03-SL-02	2/15/05	770	2	385
PAI-45-MW13-SL-02	4/19/05	550	2	275
PAI-45-MW05-SL-02	2/25/05	91	0.5	182
PAI-45-TW158-SL-11	3/10/05	80	0.7	114
PAI-45-TW107-SL-12	3/12/05	680	7	97
PAI-45-TW138-SL-16	3/11/05	1800	23	78
PAI-45-MW21-SU-02	4/14/05	500	7	71
PAI-45-TW119-SL-15	3/12/05	710	10	71
PAI-45-MW04-SL-02	2/23/05	1200	19	63
PAI-45-MW10-SL-02	4/17/05	170	3	57
PAI-45-TW148-SL-12	3/12/05	440	8	55
PAI-45-MW-AMW-5-02	2/15/05	1700	31	55
PAI-45-TW138-SU-11	3/11/05	380	7	54
PAI-45-MW20-SL-02	4/17/05	720	14	51
PAI-45-MW06-SL-02	2/14/05	300	6	50
PAI-45-MW08-SU-02	2/24/05	2600	54	48
PAI-45-MW23-SL-02-AVG	4/15/05	590	12.5	47
PAI-45-MW06-SU-02	2/14/05	91	2	46
PAI-45-MW08-SL-02-AVG	2/24/05	1400	35	40
PAI-45-MW04-SU-02	2/23/05	36	0.9	40
PAI-45-MW19-SL-02	4/16/05	28	0.8	35
PAI-45-MW20-SU-02	4/17/05	430	13	33
PAI-45-TW146-SL-10	3/12/05	5200	160	33
PAI-45-TW109-SU-08	3/10/05	110000	3400	32
PAI-45-MW23-SU-02	4/15/05	1200	39	31
PAI-45-MW24-SU-02-AVG	4/19/05	65500	2150	30
PAI-45-MW22-SU-02	4/14/05	7000	250	28
PAI-45-TW125-SL-16	3/11/05	670	26	26
PAI-45-MW22-SL-02	4/14/05	20	0.8	25
PAI-45-MW07-SL-02	2/14/05	640	27	24
PAI-45-MW-AMW-2-02	2/25/05	930	40	23
PAI-45-TW109-SL-16	3/10/05	220	10	22
PAI-45-MW10-SU-02	4/17/05	170	9	19
PAI-45-TW134-SL-15-AVG	3/11/05	250	14	18

TABLE 4-2

PCE/TCE/CIS-1,2-DCE/VINYL CHLORIDE TRENDS (ug/L)
SITE 45-MWR DRY CLEANING FACILITY
MCRD PARRIS ISLAND,
SOUTH CAROLINA

Well	Date	PCE	TCE	cis 1,2-DCE	VC	Sum (PCE/ TCE/DCE/VC)	PCE/Sum	TCE/Sum	DCE/Sum	VC/Sum
MW08SU	1996	32000	4900	1100	0	38000	0.84	0.13	0.03	0.00
	2001	10000	10000	3400	710	24110	0.41	0.41	0.14	0.03
	2005	26000	5300	2600	220	34120	0.76	0.16	0.08	0.01
MW06SU	1996	360	130	610	170	1270	0.28	0.10	0.48	0.13
	2001	200	120	1400	630	2350	0.09	0.05	0.60	0.27
	2005	110	20	91	11	232	0.47	0.09	0.39	0.05
MW05SL	1996	66	77	3.8	0	146.8	0.45	0.52	0.03	0.00
	2001	9	9	0	0	18	0.50	0.50	0.00	0.00
	2005	0	12	91	0	103	0.00	0.12	0.88	0.00
MW04SU	1996	180	2.9	0	0	182.9	0.98	0.02	0.00	0.00
	2001	6	11	2	0	19	0.32	0.58	0.11	0.00
	2005	47	140	36	10	233	0.20	0.60	0.15	0.04

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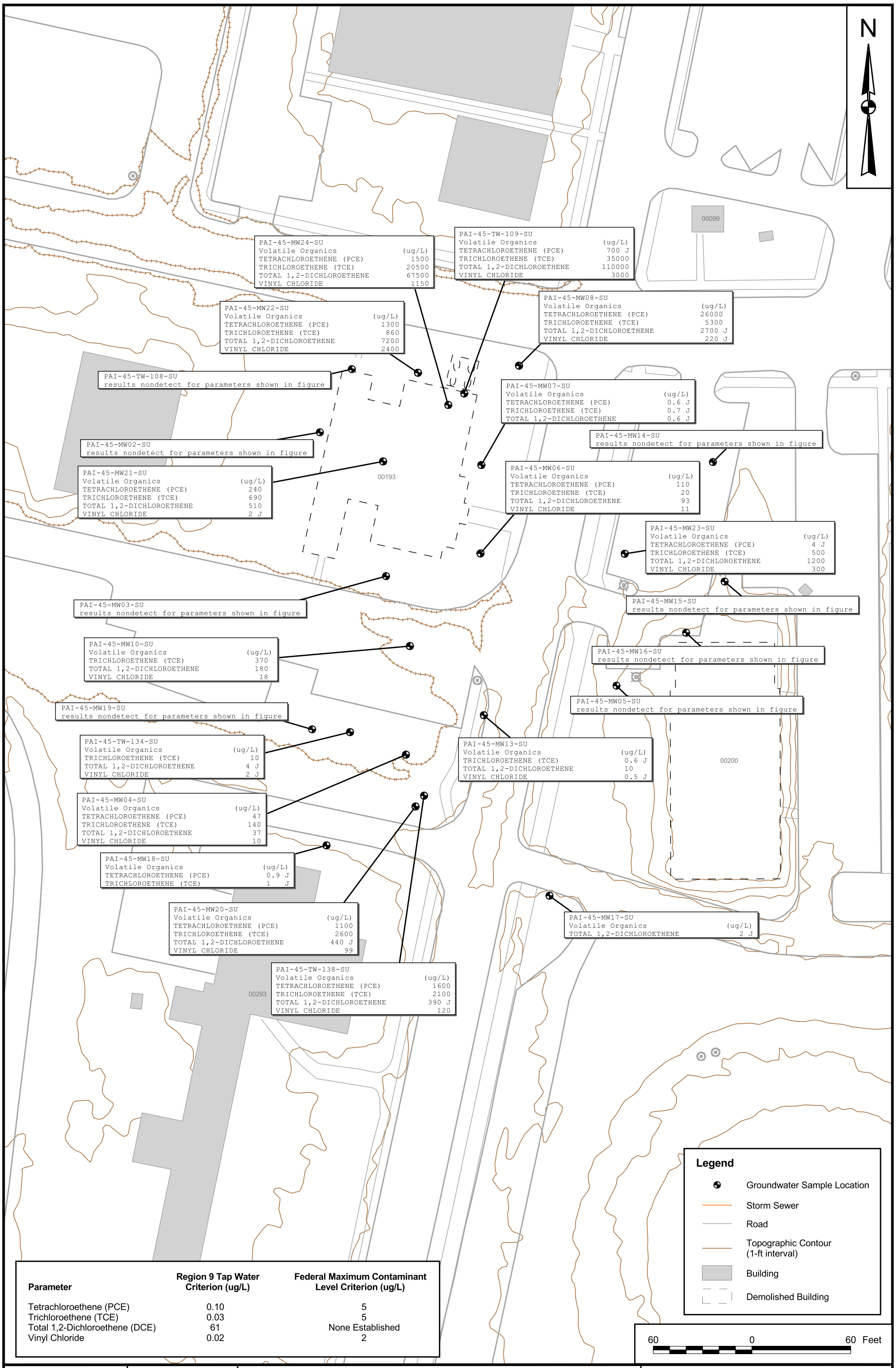

Parameter	Region 9 Tap Water Criterion (ug/L)	Federal Maximum Contaminant Level Criterion (ug/L)
Tetrachloroethene (PCE)	0.10	5
Trichloroethene (TCE)	0.03	5
Total 1,2-Dichloroethene (DCE)	61	None Established
Vinyl Chloride	0.02	2

DRAWN BY C. SPEHAR	DATE 08/11/05	SELECT GROUNDWATER PARAMETER CONCENTRATIONS - UPPER SURFICIAL WELLS SITE 45 - FORMER MWR DRY CLEANING FACILITY FEASIBILITY STUDY MCRD PARRIS ISLAND PARRIS ISLAND, SOUTH CAROLINA
CHECKED BY M. BOERIO	DATE 08/02/10	CONTRACT NUMBER N5260
REVISED BY T. WHEATON	DATE 08/02/10	APPROVED BY ___ DATE ___
SCALE AS NOTED	NAVFAC	APPROVED BY ___ DATE ___
		DRAWING NO. FIGURE 4-1 REV 0

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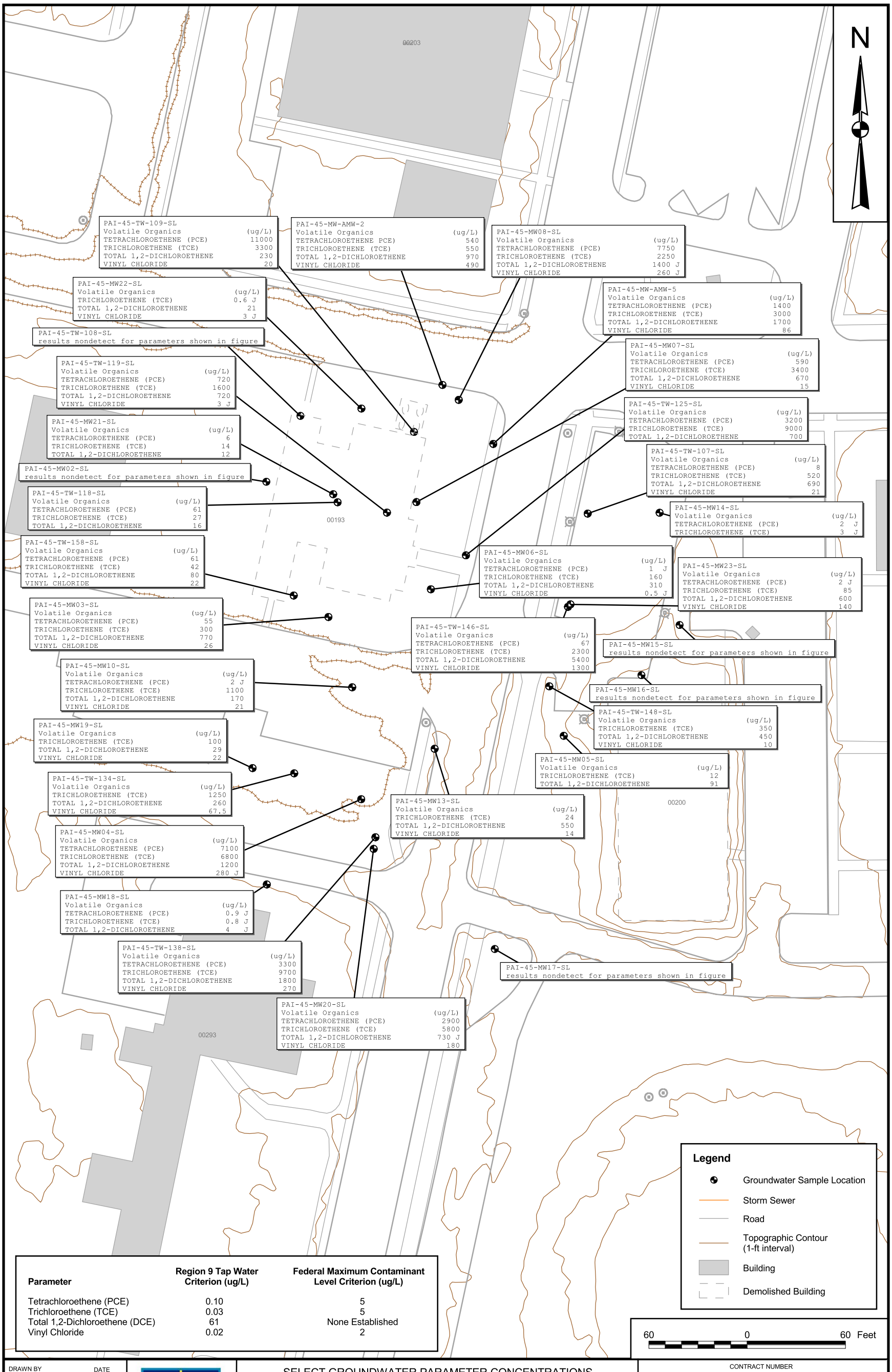

Parameter	Region 9 Tap Water Criterion (ug/L)	Federal Maximum Contaminant Level Criterion (ug/L)
Tetrachloroethene (PCE)	0.10	5
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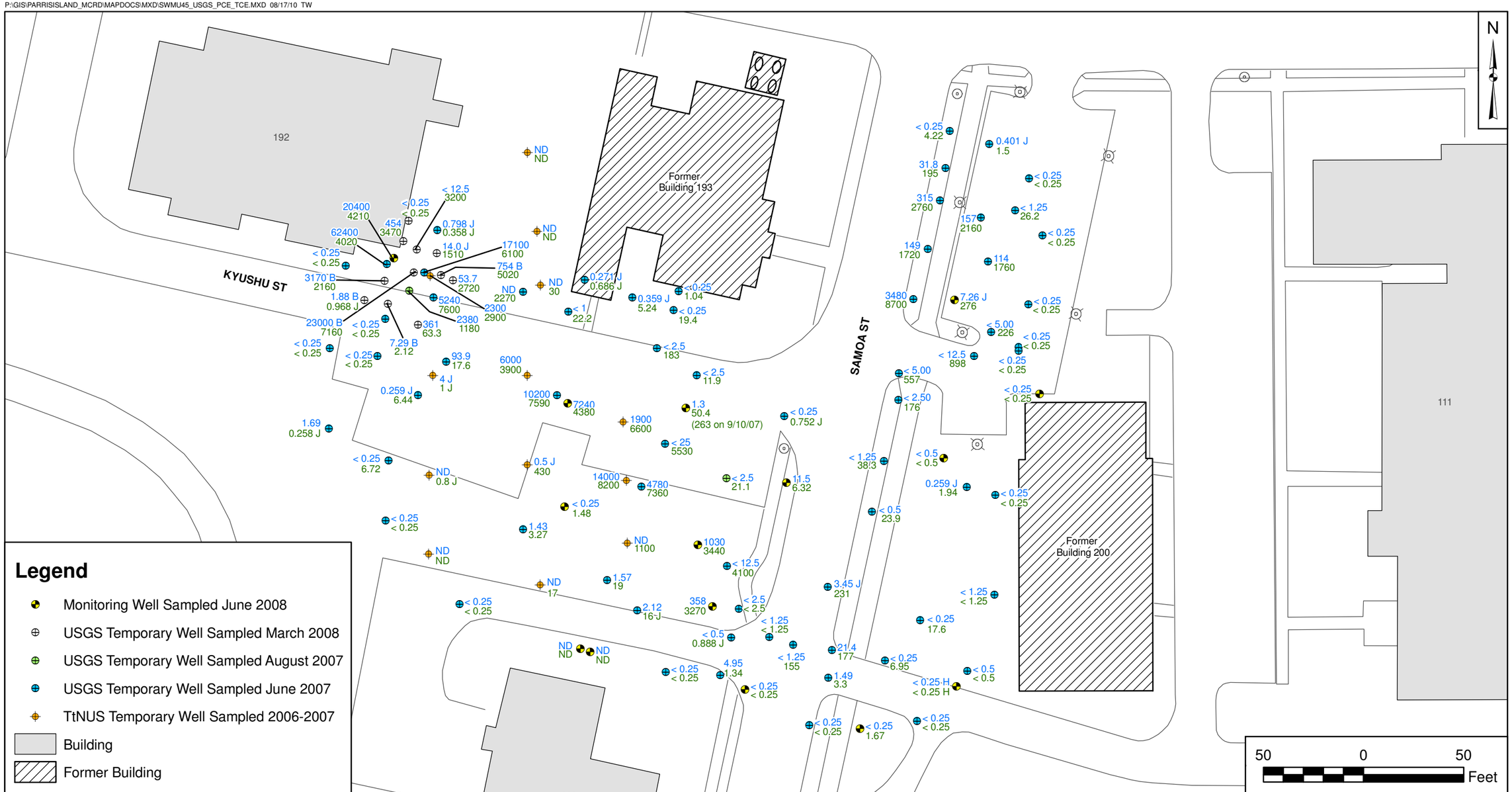
Total 1,2-Dichloroethene (DCE)	61	None Established
Vinyl Chloride	0.02	2

DRAWN BY C. SPEHAR	DATE 08/11/05	SELECT GROUNDWATER PARAMETER CONCENTRATIONS - LOWER SURFICIAL WELLS SITE 45 - FORMER MWR DRY CLEANING FACILITY FEASIBILITY STUDY MCRD PARRIS ISLAND PARRIS ISLAND, SOUTH CAROLINA	CONTRACT NUMBER N5260
CHECKED BY M. BOERIO	DATE 08/02/10		APPROVED BY ___ DATE ___
REVISED BY T. WHEATON	DATE 08/02/10		APPROVED BY ___ DATE ___
SCALE AS NOTED			DRAWING NO. FIGURE 4-2 REV 0

P:\GIS\PARRISISLAND_MCRD\MAPDOCS\MXD\SWMU45_USGS_PCE_TCE.MXD 08/17/10 TW



Legend

- Monitoring Well Sampled June 2008
- USGS Temporary Well Sampled March 2008
- USGS Temporary Well Sampled August 2007
- USGS Temporary Well Sampled June 2007
- TtNUS Temporary Well Sampled 2006-2007
- Building
- Former Building
- Road

1.43 Tetrachloroethene concentration in ug/L
3.27 Trichloroethene concentration in ug/L
J - Estimated
H - Analyzed Out of Holding Time
ND - Not Detected

DRAWN BY	DATE
T. WHEATON	08/05/10
CHECKED BY	DATE
M. BOERIO	08/17/10
COST/SCHEDULE-AREA	
SCALE AS NOTED	

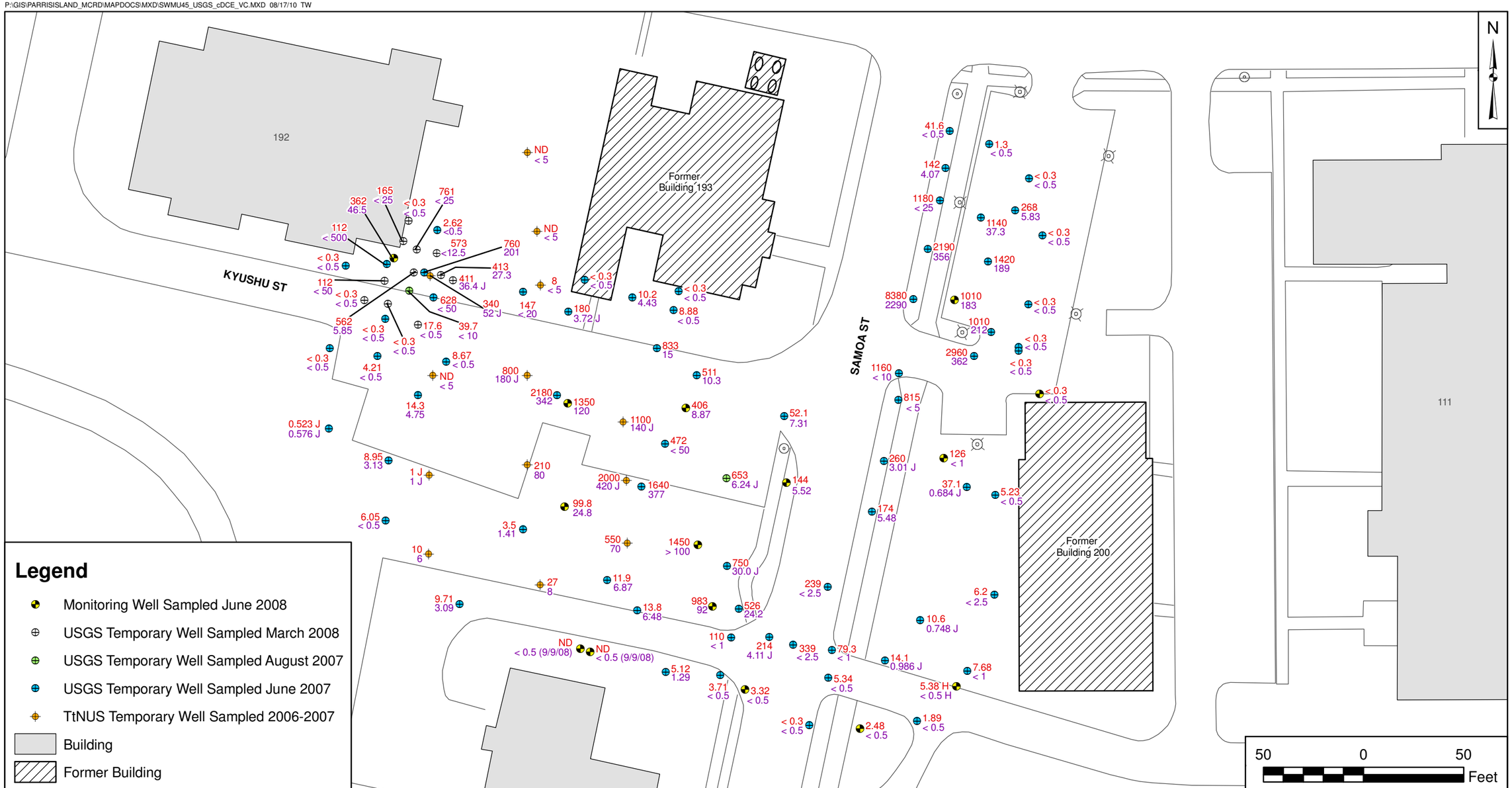
NAVFAC

USGS WELL LOCATIONS WITH SELECTED PARAMETER CONCENTRATIONS
SITE 45 - MWR DRY CLEANING FACILITY
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER N5260

APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO. FIGURE 4-3	REV 0

P:\GIS\PARRISISLAND_MCRD\MAPDOCS\MXD\SWMU45_USGS_cDCE_VC.MXD 08/17/10 TW



Legend

- Monitoring Well Sampled June 2008
- USGS Temporary Well Sampled March 2008
- USGS Temporary Well Sampled August 2007
- USGS Temporary Well Sampled June 2007
- TtNUS Temporary Well Sampled 2006-2007
- Building
- Former Building
- Road

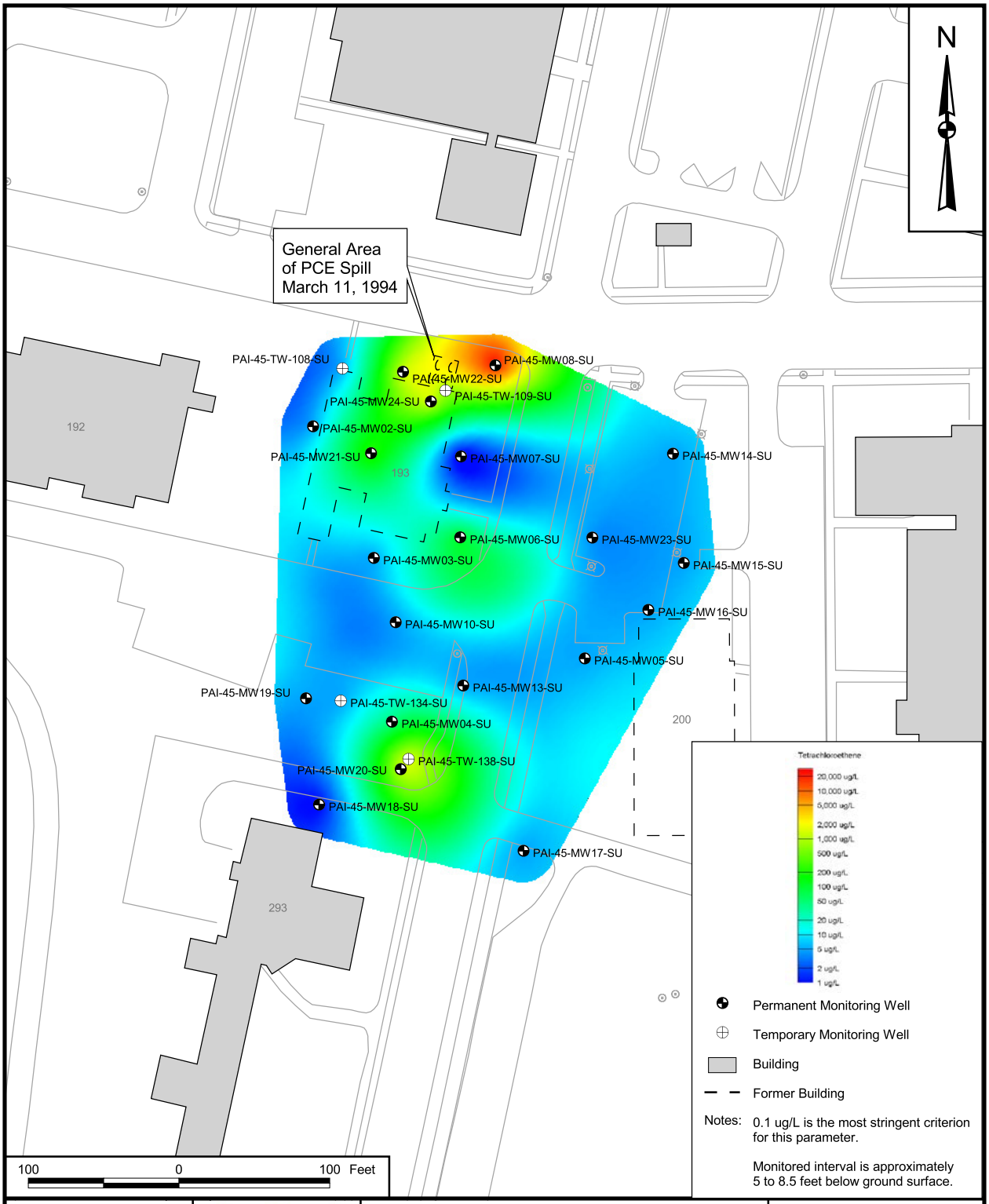
0.523 J cis-1,2 Dichloroethene concentration in ug/L
0.576 J Vinyl Chloride concentration in ug/L
J - Estimated
H - Analyzed Out of Holding Time
ND - Not Detected

DRAWN BY T. WHEATON	DATE 08/05/10
CHECKED BY M. BOERIO	DATE 08/17/10
COST/SCHEDULE-AREA	
SCALE AS NOTED	

NAVFAC

USGS WELL LOCATIONS WITH SELECTED PARAMETER CONCENTRATIONS
SITE 45 - MWR DRY CLEANING FACILITY
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER N5260	
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO. FIGURE 4-4	REV 0



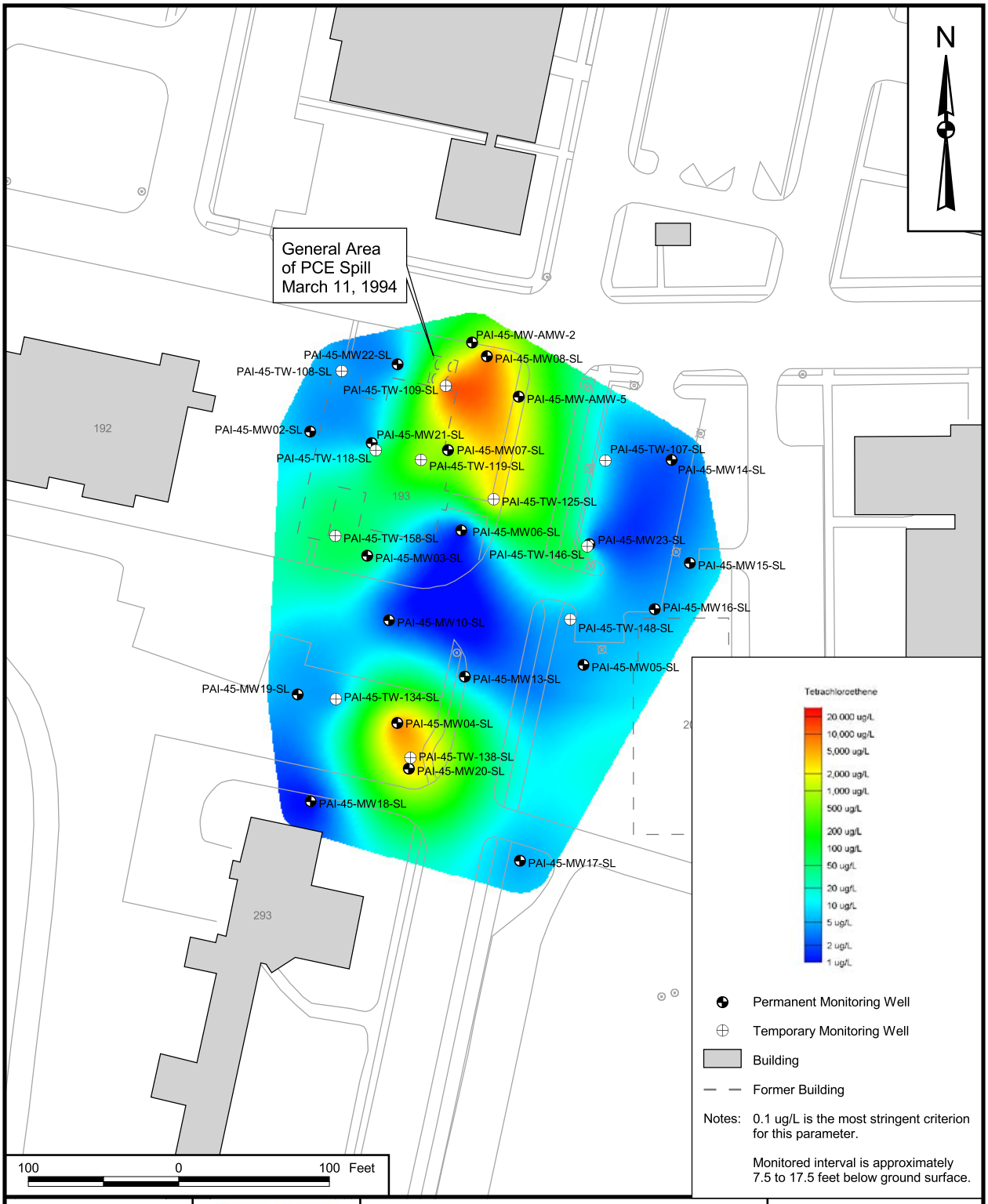
DRAWN BY	DATE
A. JANOCHA	07/29/05
CHECKED BY	DATE
M. BOERIO	08/02/10
REVISED BY	DATE
T. WHEATON	08/02/10
SCALE	
AS NOTED	

NAVFAC

PCE IN SURFICIAL UPPER WELLS
SITE 45
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
N5260	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	REV
FIGURE 4-5	0

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS.APR REVISED PCE SHALLOW LAYOUT 08/02/10 TW



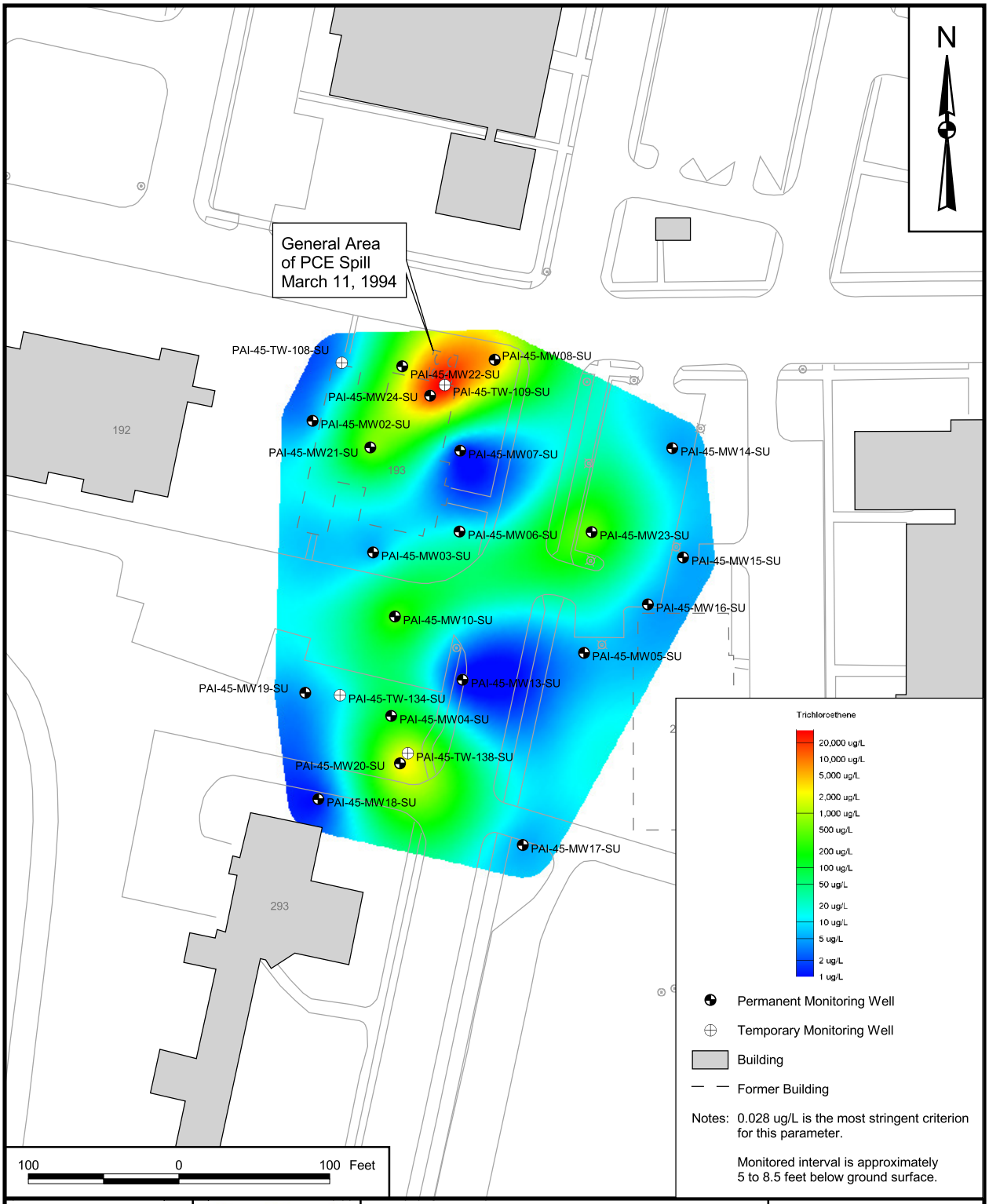
DRAWN BY	DATE
A. JANOCHA	07/29/05
CHECKED BY	DATE
M. BOERIO	08/03/10
REVISED BY	DATE
T. WHEATON	08/03/10
SCALE	
AS NOTED	

NAVFAC

PCE IN SURFICIAL LOWER WELLS
SITE 45
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
N5260	
APPROVED BY	DATE
___	___
APPROVED BY	DATE
___	___
DRAWING NO.	REV
FIGURE 4-6	0

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS.APR REVISED PCE INTERMEDIATE LAYOUT 08/03/10 TW



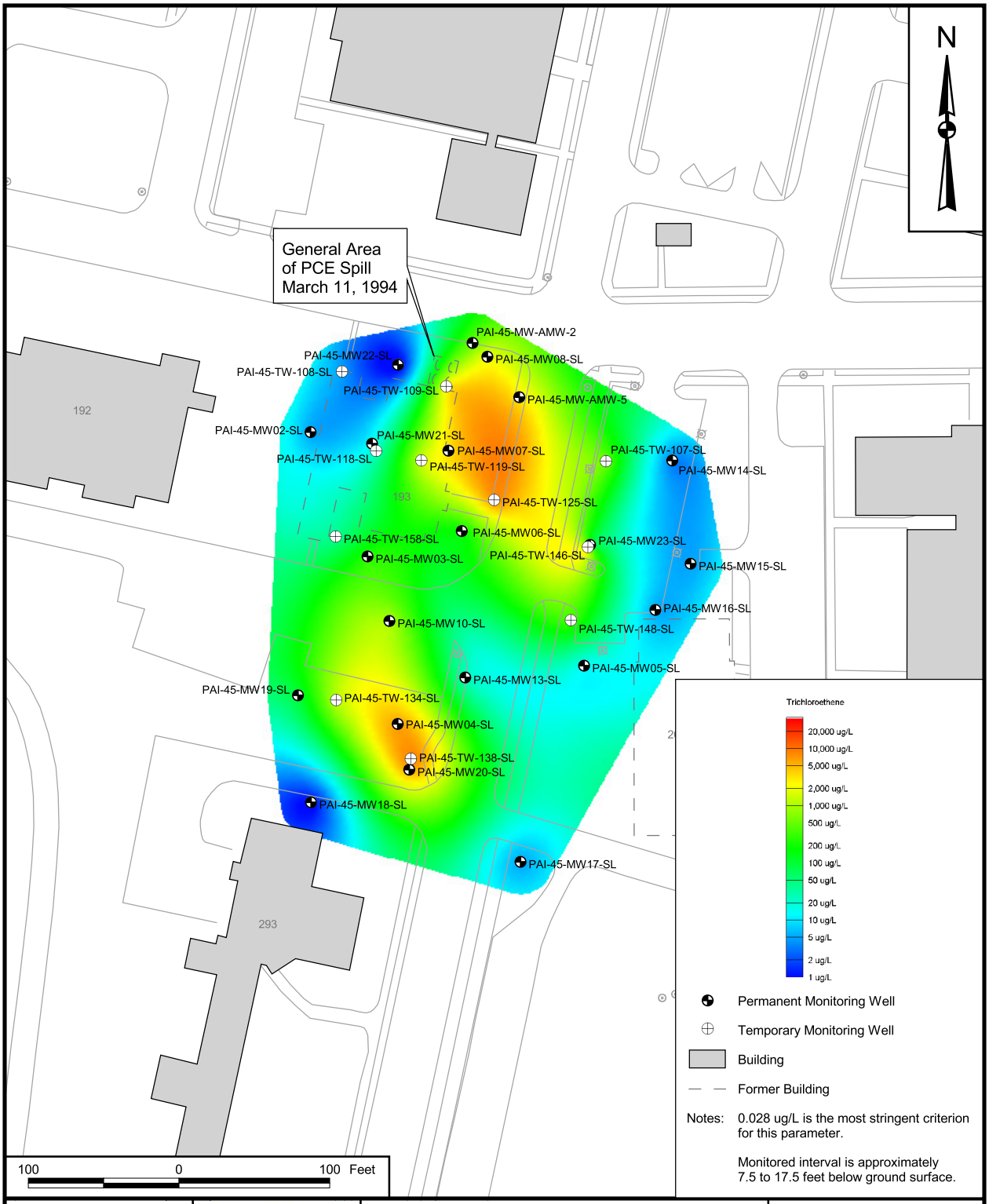
DRAWN BY	DATE
A. JANOCHA	07/29/05
CHECKED BY	DATE
M. BOERIO	08/03/10
REVISED BY	DATE
T. WHEATON	08/03/10
SCALE	
AS NOTED	

NAVFAC

TCE IN SURFICIAL UPPER WELLS
SITE 45
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
N5260	
APPROVED BY	DATE
___	___
APPROVED BY	DATE
___	___
DRAWING NO.	REV
FIGURE 4-7	0

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS.APR REVISED TCE SHALLOW LAYOUT 08/03/10 TW



DRAWN BY	DATE
A. JANOCHA	07/29/05
CHECKED BY	DATE
M. BOERIO	08/03/10
REVISED BY	DATE
T. WHEATON	08/03/10
SCALE	
AS NOTED	

NAVFAC

TCE IN SURFICIAL LOWER WELLS

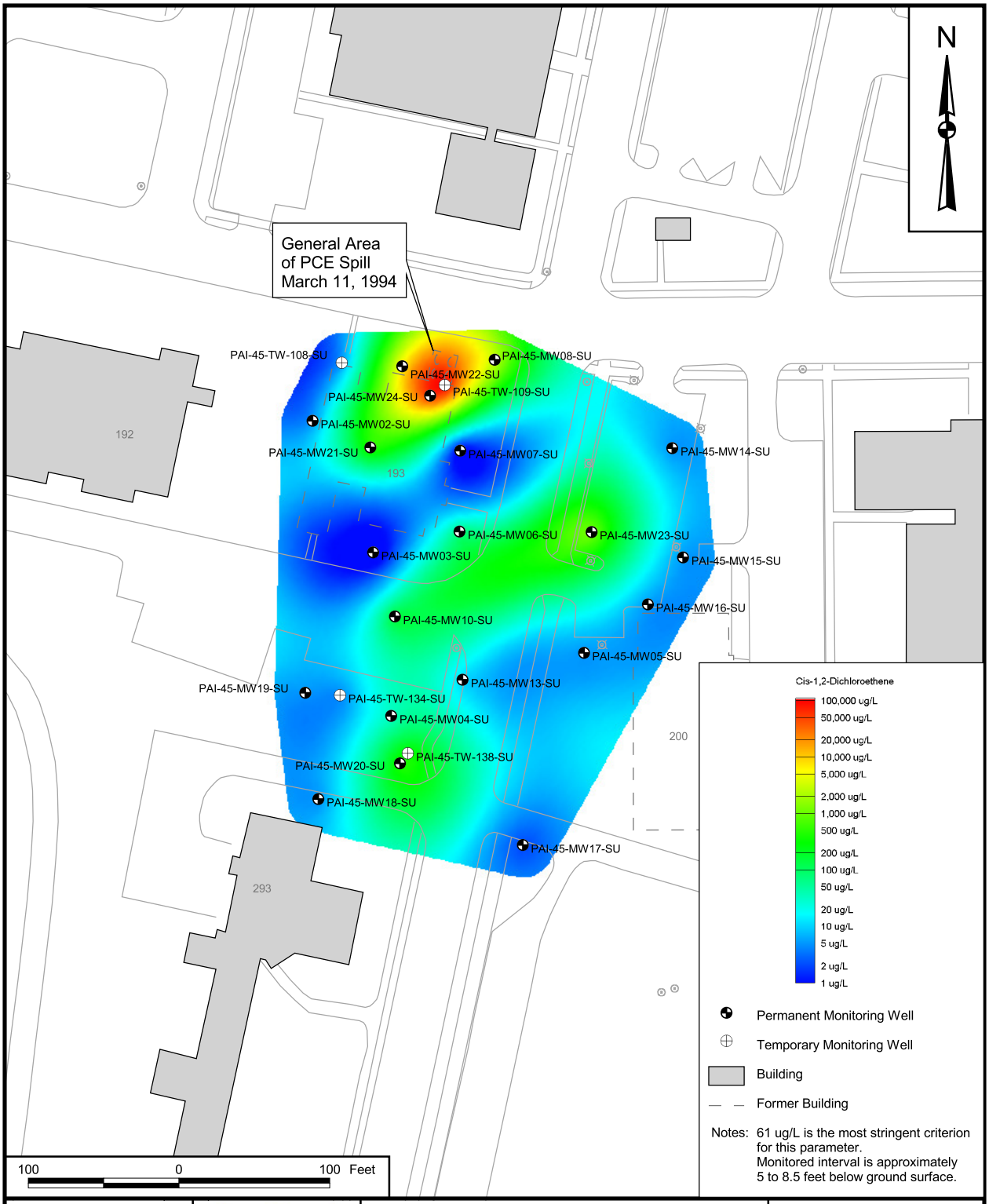
SITE 45

MCRD PARRIS ISLAND

PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
N5260	
APPROVED BY	DATE
___	___
APPROVED BY	DATE
___	___
DRAWING NO.	REV
FIGURE 4-8	0

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS.APR REVISED TCE INTERMEDIATE LAYOUT 08/03/10 TW



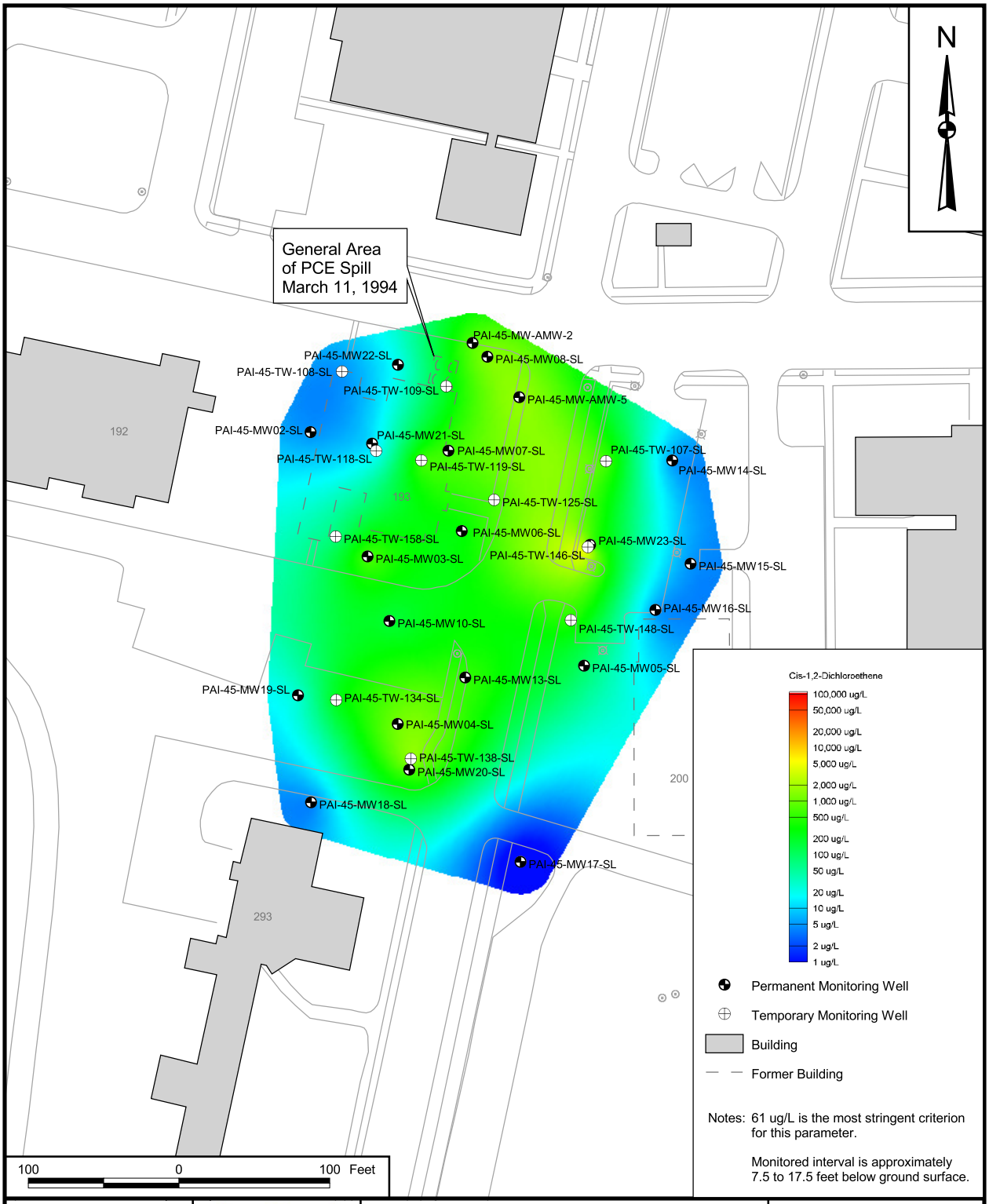
DRAWN BY	DATE
A. JANOCHA	08/02/05
CHECKED BY	DATE
M. BOERIO	08/03/10
REVISED BY	DATE
T. WHEATON	08/03/10
SCALE	
AS NOTED	

NAVFAC

CIS-1,2-DICHLOROETHENE IN SURFICIAL UPPER WELLS
SITE 45
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
N5260	
APPROVED BY	DATE
___	___
APPROVED BY	DATE
___	___
DRAWING NO.	REV
FIGURE 4-9	0

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS.APR REVISED CIS SHALLOW LAYOUT 08/03/10 TW

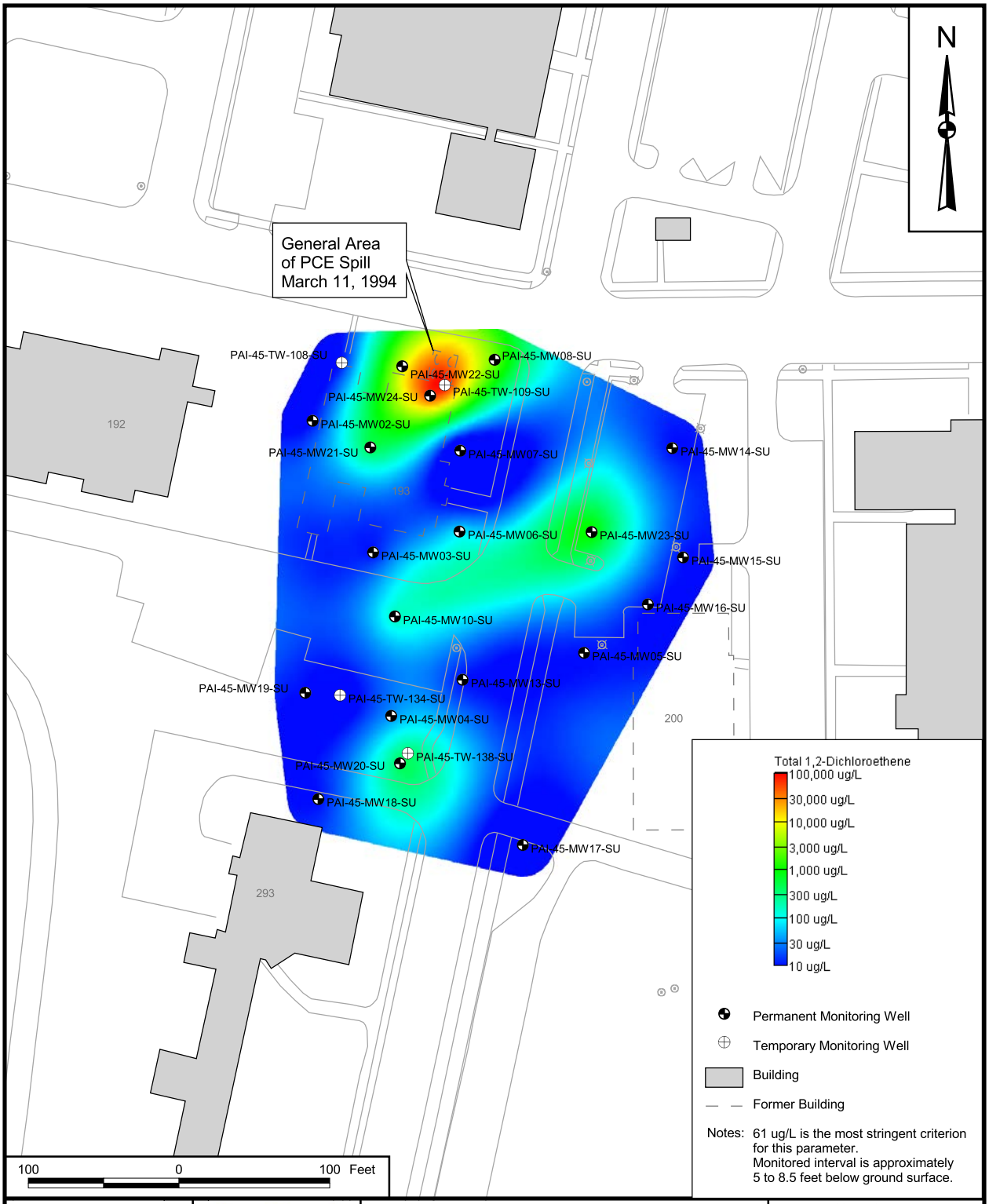


Notes: 61 ug/L is the most stringent criterion for this parameter.

Monitored interval is approximately 7.5 to 17.5 feet below ground surface.

DRAWN BY: A. JANOCHA	DATE: 08/02/05	CIS-1,2-DCE IN SURFICIAL LOWER WELLS SITE 45 MCRD PARRIS ISLAND PARRIS ISLAND, SOUTH CAROLINA	CONTRACT NUMBER: N5260
CHECKED BY: M. BOERIO	DATE: 08/03/10		APPROVED BY: ___ DATE: ___
REVISED BY: T. WHEATON	DATE: 08/03/10		APPROVED BY: ___ DATE: ___
SCALE: AS NOTED			DRAWING NO.: FIGURE 4-10 REV: 0

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS.APR REVISED CIS INTERMEDIATE LAYOUT 08/03/10 TW



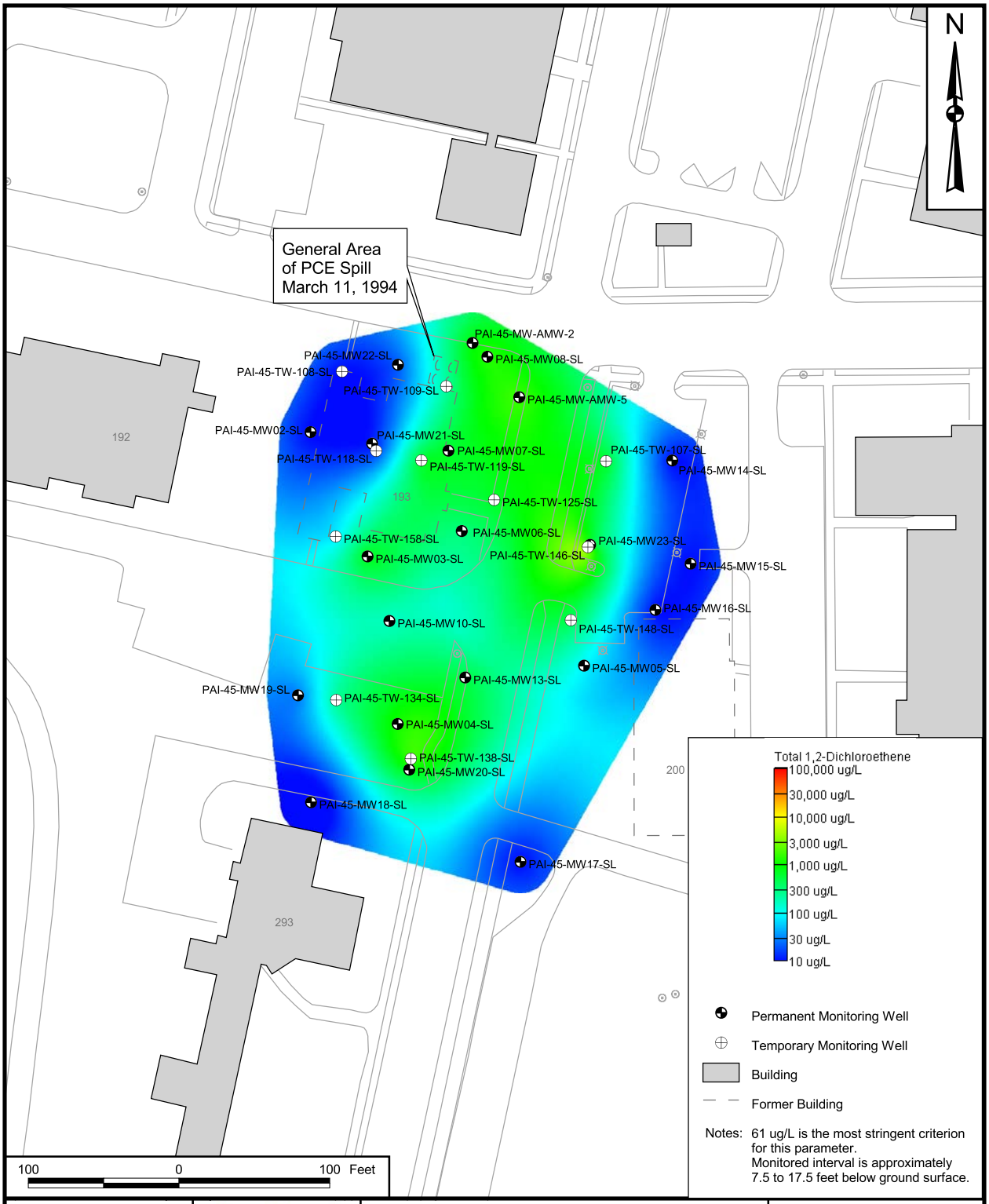
DRAWN BY	DATE
A. JANOCHA	08/02/05
CHECKED BY	DATE
M. BOERIO	08/03/10
REVISED BY	DATE
T. WHEATON	08/03/10
SCALE	
AS NOTED	

NAVFAC

TOTAL 1,2-DCE IN UPPER SURFICIAL WELLS
SITE 45 - FORMER MWR DRY CLEANING FACILITY
FEASIBILITY STUDY
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
N5260	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	REV
FIGURE 4-11	0

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS.APR TOTAL SHALLOW LAYOUT 08/03/10 TW



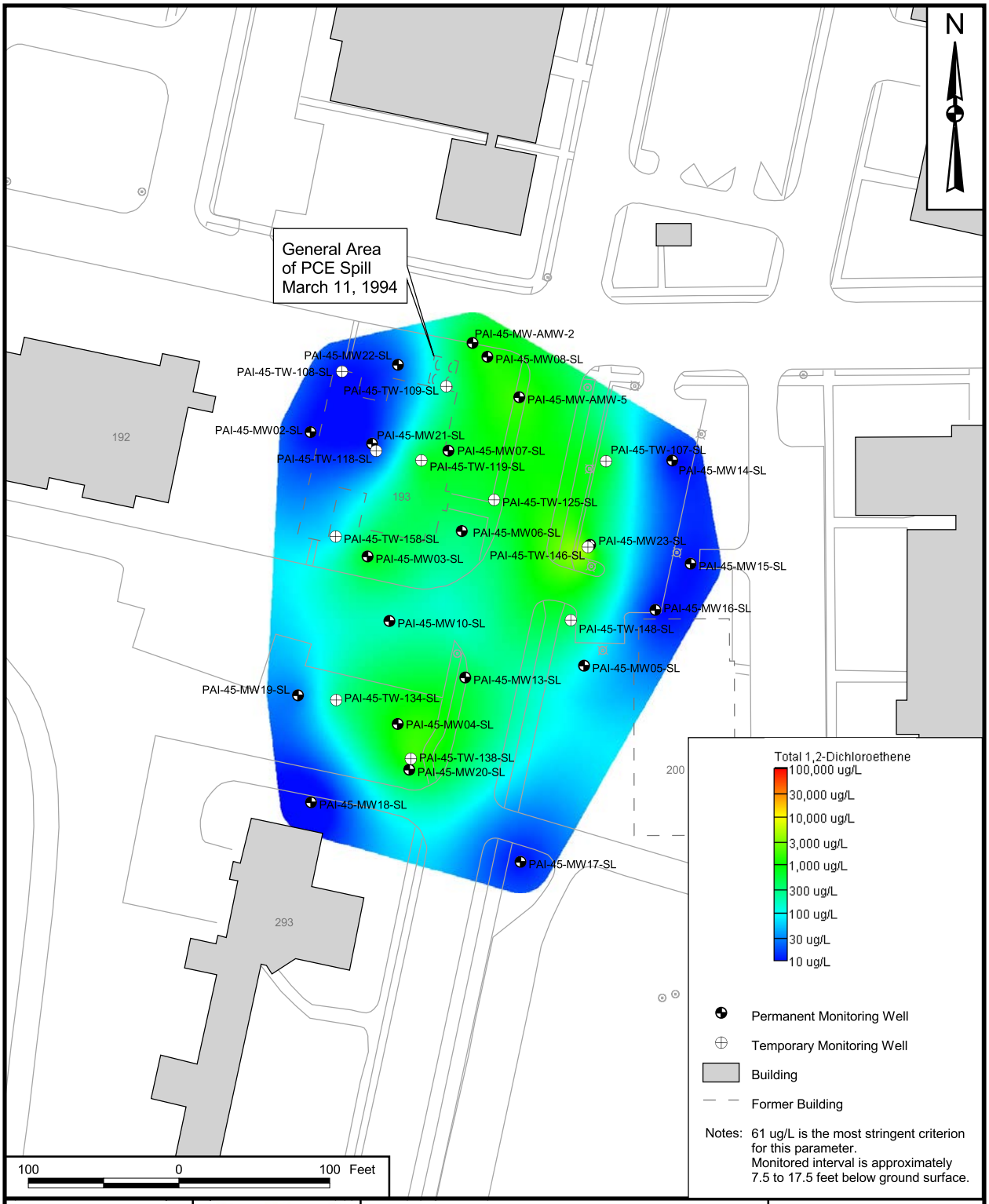
DRAWN BY	DATE
A. JANOCHA	08/02/05
CHECKED BY	DATE
M. BOERIO	08/03/10
REVISED BY	DATE
T. WHEATON	08/03/10
SCALE	
AS NOTED	

NAVFAC

TOTAL 1,2-DCE IN LOWER SURFICIAL WELLS
SITE 45 - FORMER MWR DRY CLEANING FACILITY
FEASIBILITY STUDY
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
N5260	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	REV
FIGURE 4-12	0

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS.APR TOTAL INTERMEDIATE LAYOUT 08/03/10 TW



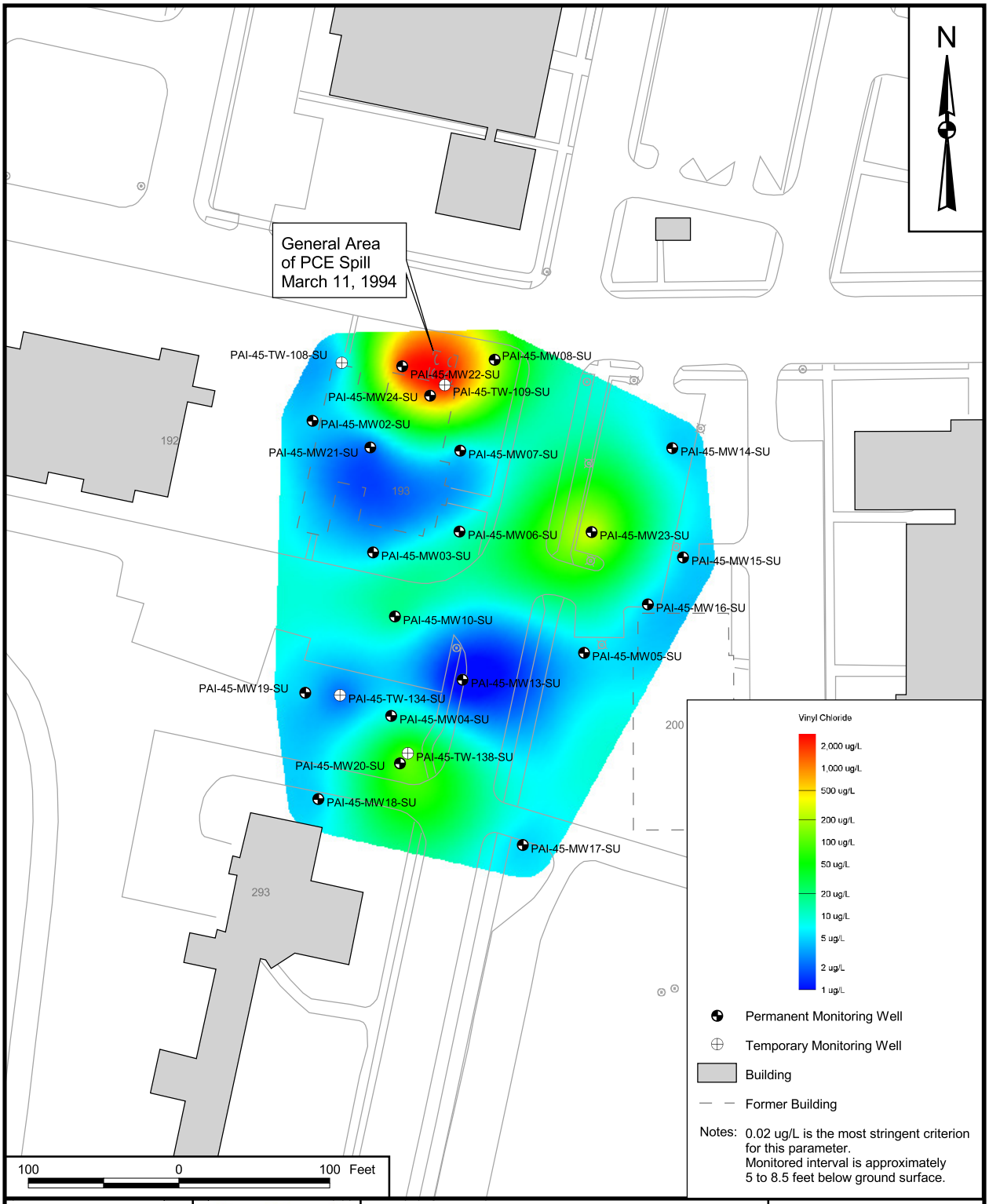
DRAWN BY	DATE
A. JANOCHA	08/02/05
CHECKED BY	DATE
M. BOERIO	08/03/10
REVISED BY	DATE
T. WHEATON	08/03/10
SCALE	
AS NOTED	

NAVFAC

TOTAL 1,2-DCE IN LOWER SURFICIAL WELLS
SITE 45 - FORMER MWR DRY CLEANING FACILITY
FEASIBILITY STUDY
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
N5260	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	REV
FIGURE 4-12	0

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS.APR TOTAL INTERMEDIATE LAYOUT 08/03/10 TW



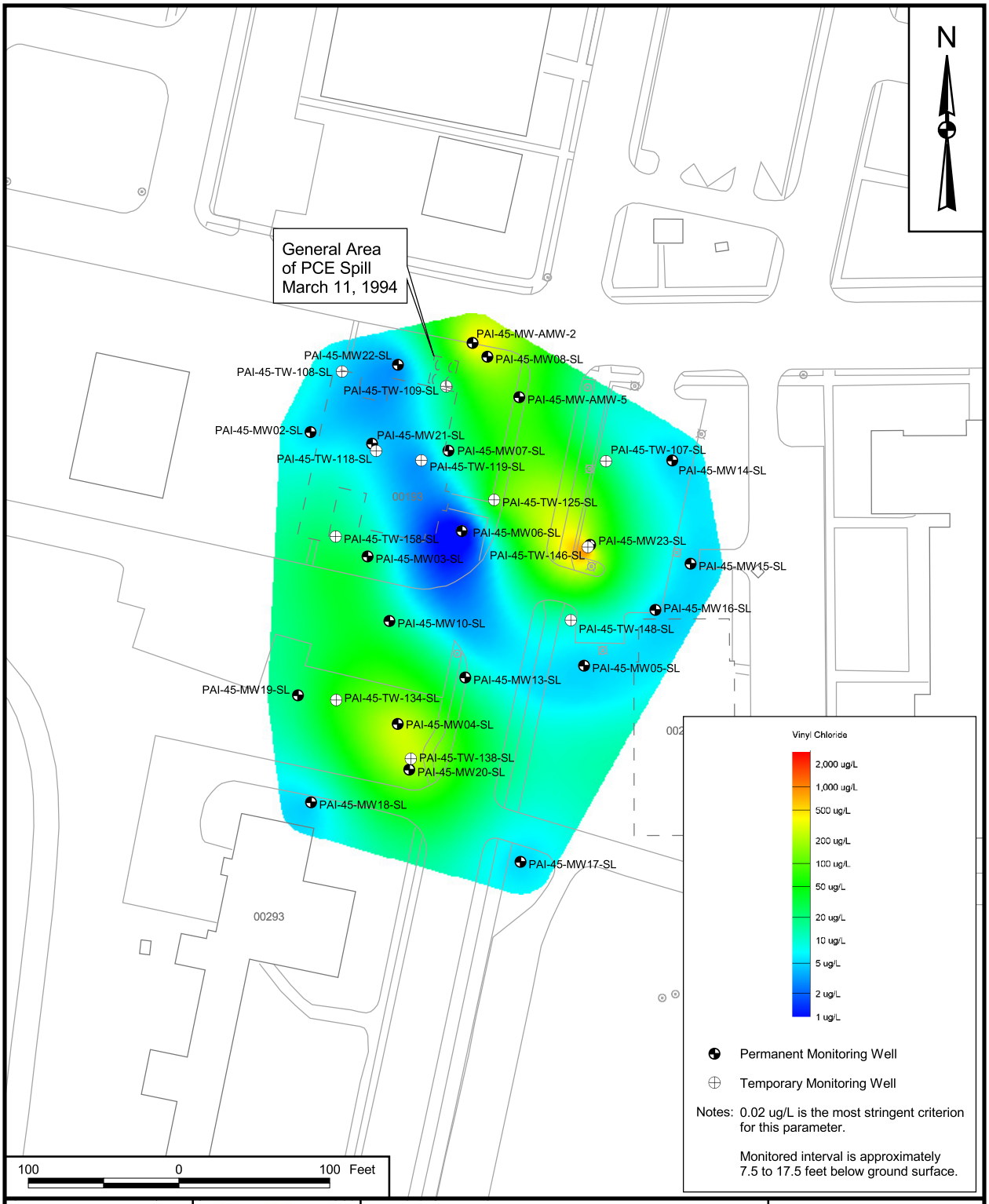
DRAWN BY	DATE
A. JANOCHA	08/02/05
CHECKED BY	DATE
M. BOERIO	08/03/10
REVISED BY	DATE
T. WHEATON	08/03/10
SCALE	
AS NOTED	

NAVFAC

VINYL CHLORIDE IN SURFICIAL UPPER WELLS
SITE 45
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

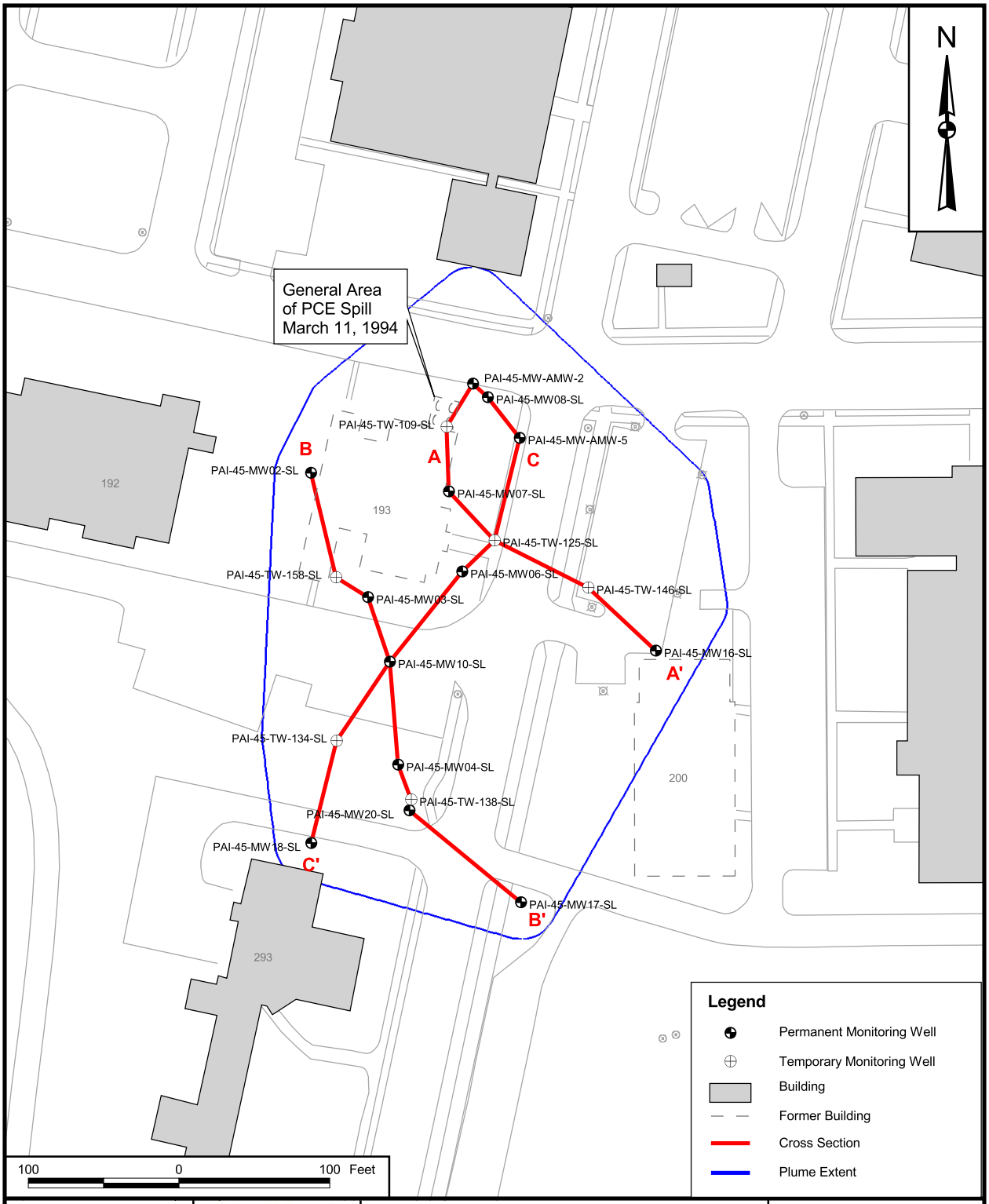
CONTRACT NUMBER	
N5260	
APPROVED BY	DATE
___	___
APPROVED BY	DATE
___	___
DRAWING NO.	REV
FIGURE 4-13	0

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS.APR REVISED VC SHALLOW LAYOUT 08/03/10 TW



DRAWN BY	DATE			CONTRACT NUMBER
A. JANOCHA	8/02/05		VINYL CHLORIDE IN SURFICIAL LOWER WELLS	N5260
CHECKED BY	DATE		SITE 45	APPROVED BY / DATE
G. STIEGEL	2/13/09		MCRD PARRIS ISLAND	___ / ___
COST/SCHEDULE-AREA			PARRIS ISLAND, SOUTH CAROLINA	APPROVED BY / DATE
				___ / ___
SCALE				DRAWING NO. / REV
AS NOTED				FIGURE 4-14 / 0

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS.APR REVISED VC INTERMEDIATE LAYOUT 2/13/09 SP



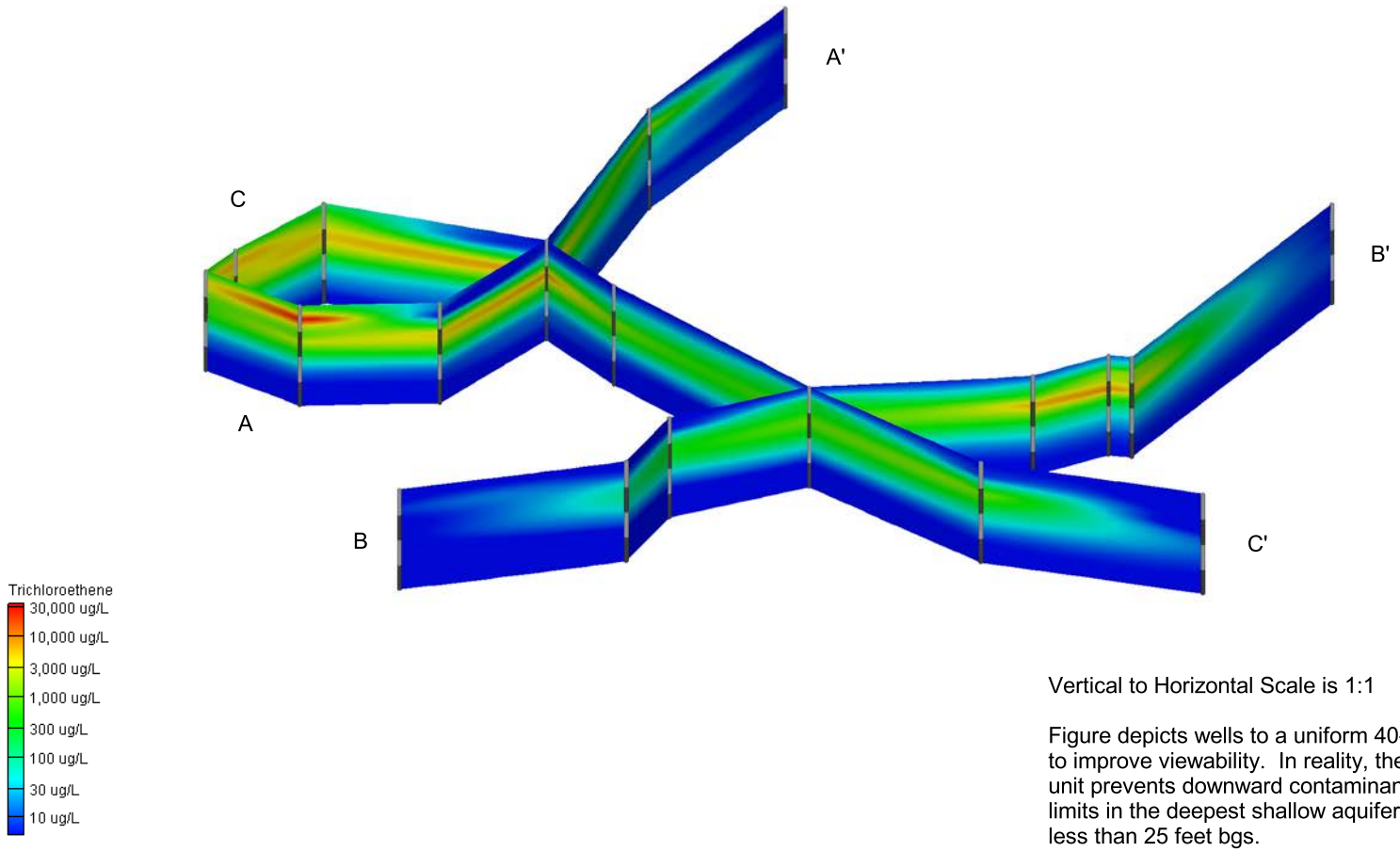
DRAWN BY	DATE
A. JANOCHA	09/12/05
CHECKED BY	DATE
M. BOERIO	08/03/10
REVISED BY	DATE
T. WHEATON	08/03/10
SCALE	
AS NOTED	

NAVFAC

CROSS SECTION LOCATIONS
SITE 45 - FORMER MWR DRY CLEANING FACILITY
FEASIBILITY STUDY
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
N5260	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	REV
FIGURE 4-15	0

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS.APR CROSS SECTION LAYOUT 08/03/10 TW

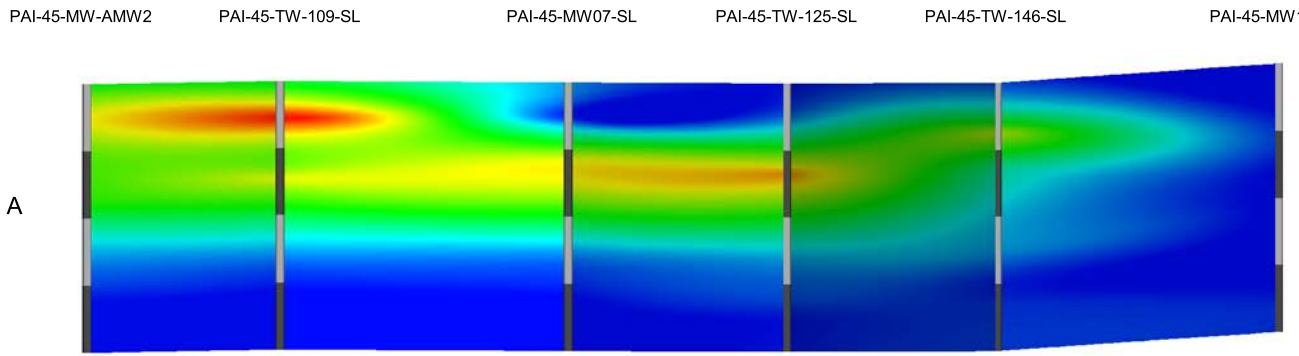


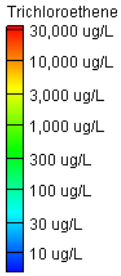
Vertical to Horizontal Scale is 1:1

Figure depicts wells to a uniform 40-foot depth to improve viewability. In reality, the clay confining unit prevents downward contaminant migration and limits in the deepest shallow aquifer wells to less than 25 feet bgs.

DRAWN BY	DATE	TCE CROSS SECTIONS VIEWED FROM DUE WEST (AZIMUTH 270 DEGREES) SITE 45 - FORMER MWR DRY CLEANING FACILITY MCRD PARRIS ISLAND PARRIS ISLAND, SOUTH CAROLINA	CONTRACT NUMBER 5260
A. JANOCHA	09/13/05		
CHECKED BY	DATE		APPROVED BY ___ DATE ___
M. BOERIO	08/18/10		
REVISED BY	DATE		APPROVED BY ___ DATE ___
T. WHEATON	08/18/10		
SCALE AS NOTED			DRAWING NO. FIGURE 4-16 / REV 0

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS.APR CROSS SECTION ALL LAYOUT 08/18/10 TW



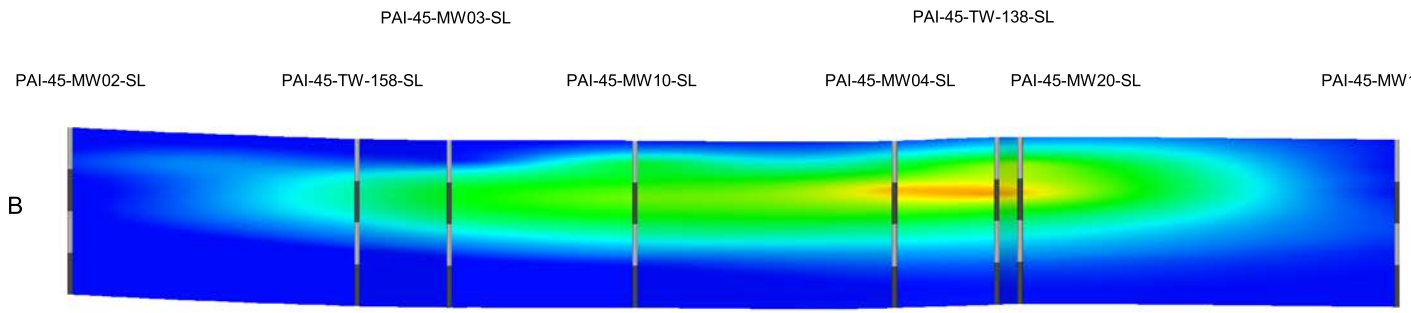


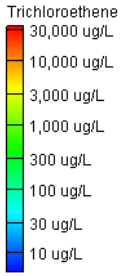
Vertical to Horizontal Scale is 1:1

Figure depicts wells to a uniform 40-foot depth to improve viewability. In reality, the clay confining unit prevents downward contaminant migration and limits in the deepest shallow aquifer wells to less than 25 feet bgs.

DRAWN BY: A. JANOCHA	DATE: 09/13/05	TCE CROSS SECTION A - A' VIEWED FROM DUE WEST (AZIMUTH 270 DEGREES) SITE 45 - FORMER MWR DRY CLEANING FACILITY MCRD PARRIS ISLAND PARRIS ISLAND, SOUTH CAROLINA	CONTRACT NUMBER: 5260
CHECKED BY: M. BOERIO	DATE: 08/18/10		APPROVED BY: ___ DATE: ___
REVISED BY: T. WHEATON	DATE: 08/18/10		APPROVED BY: ___ DATE: ___
SCALE: AS NOTED			DRAWING NO.: FIGURE 4-17 REV: 0

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS.APR CROSS SECTION A - A' LAYOUT 08/18/10 TW





Vertical to Horizontal Scale is 1:1

Figure depicts wells to a uniform 40-foot depth to improve viewability. In reality, the clay confining unit prevents downward contaminant migration and limits in the deepest shallow aquifer wells to less than 25 feet bgs.

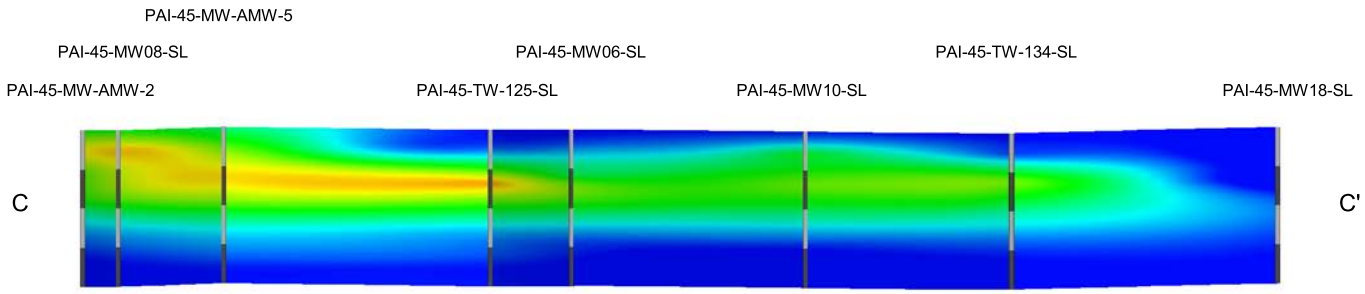
DRAWN BY	DATE	
A. JANOCHA	09/13/05	
CHECKED BY	DATE	
M. BOERIO	08/18/10	
REVISED BY	DATE	
T. WHEATON	08/18/10	
SCALE		
AS NOTED		

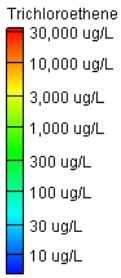
NAVFAC

TCE CROSS SECTION B - B'
VIEWED FROM THE WEST-SOUTHWEST (AZIMUTH 240 DEGREES)
SITE 45 - FORMER MWR DRY CLEANING FACILITY
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER 5260		
APPROVED BY ___	DATE ___	
APPROVED BY ___	DATE ___	
DRAWING NO. FIGURE 4-18		REV 0

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS.APR CROSS SECTION B - B' LAYOUT 08/18/10 TW





Vertical to Horizontal Scale is 1:1

Figure depicts wells to a uniform 40-foot depth to improve viewability. In reality, the clay confining unit prevents downward contaminant migration and limits in the deepest shallow aquifer wells to less than 25 feet bgs.

DRAWN BY: A. JANOCHA	DATE: 09/13/05	TCE CROSS SECTION C - C' VIEWED FROM DUE WEST (AZIMUTH 270 DEGREES) SITE 45 - FORMER MWR DRY CLEANING FACILITY MCRD PARRIS ISLAND PARRIS ISLAND, SOUTH CAROLINA	CONTRACT NUMBER: 5260
CHECKED BY: M. BOERIO	DATE: 08/18/10		APPROVED BY: ___ DATE: ___
REVISED BY: T. WHEATON	DATE: 08/18/10		APPROVED BY: ___ DATE: ___
SCALE: AS NOTED			DRAWING NO.: FIGURE 4-19 REV: 0

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS.APR CROSS SECTION C - C' LAYOUT 08/18/10 TW

5.0 CHEMICAL FATE AND TRANSPORT ANALYSIS

Section 5.0 of the Site 45 RI/RFI Report issued in November 2004 (Tetra Tech, 2004a) contained detailed information on contaminant fate and transport and the chemical properties affecting contaminant migration at Site 45. Because the focus of this Site 45 RI Addendum was to gather additional data on compound classes already discussed in great detail in that original RI/RFI Report (VOCs including ketones, monocyclic aromatics, halogenated aliphatics, etc.), the information provided at that time is still directly relevant to site conditions and will not be repeated here.

The following summarizes what is available in that original report (Tetra Tech, 2004a):

- Section 5.1 discussed the chemical and physical properties of the detected analytes
- Section 5.2 presented brief discussions of contaminant persistence
- Section 5.3 presented a summary of contaminant migration
- Section 5.4 presented a natural attenuation evaluation using site-specific data

As discussed in Section 4.3, there is continuing evidence suggesting natural attenuation is functioning to break down the chlorinated VOC species found in the groundwater. Of note is the fact that PCE degradation product concentrations are generally on the increase at key locations, along with the detections of *Dehalococcoides* microbes at a density that is appropriate for reductive dechlorination as described in the USGS report (Appendix A). Geostatistical groundwater modeling described in Section 4.2 has also provided insight into the ultimate fate and transport of contamination investigated thus far.

There is evidence of VOCs in subslab soil gas beneath Building 192 and Building 293. Although these two buildings may be upgradient or side gradient of the VOC groundwater plume, soil vapors do not necessarily follow groundwater flow and can be influenced by preferential pathways, presence of pavement, and other factors.

The USGS report discusses several influences on the fate and migration of contaminants in groundwater, including the storm sewers, site hydraulics, biodegradation, and sorption of contaminants to soil. The USGS report can be found in Appendix A

6.0 VAPOR INTRUSION HUMAN HEALTH RISK ASSESSMENT

A baseline human health risk assessment (HHRA) was performed as part of the RI/RFI prepared in November 2004 (Tetra Tech, 2004a) to characterize and quantify potential health risks at Site 45 in the absence of remedial action. The results of the baseline risk assessment are also used to focus the evaluation of remedial action alternatives, if action is required. The only remaining HHRA activity post the 2004 HHRA was the evaluation of potential risks to future building occupants as a consequence of the migration of VOCs from groundwater to indoor air of a building (i.e., groundwater contaminant vapor intrusion). COPCs for this vapor intrusion modeling exercise included tetrachloroethene, trichloroethene, and associated degradation products: cis-1,2-dichloroethene, trans-1,2-dichloroethene, 1,1-dichloroethene, 1,1-dichloroethane, 1,2-dichloroethane, and vinyl chloride. The Site 45 CSM has been updated based on the findings of this vapor intrusion HHRA, and can be found in Appendix P.

Because (1) there are buildings within 100 feet horizontally or vertically of the groundwater contamination plume, (2) the concentrations of volatile COCs in the groundwater exceed vapor intrusion screening levels, and (3) the groundwater at Site 45 is less than 5 feet bgs, the USEPA's draft Vapor Intrusion guidance document (USEPA, 2002) recommends soil gas and/or soil gas plus indoor air sampling in these buildings. Human health risk for inhabitants of existing buildings, and also the human health risk hypothetical structures onsite, should be completed and understood because vapor intrusion poses a potentially serious risk if the groundwater plume was to migrate beneath a building.

An ecological risk assessment will need to be performed on the existing surface water and sediment data, along with any future data collected. This was not done at this time, as all sediment and surface water discussion and decisions are being deferred to a later date.

6.1 POTENTIAL RISKS ASSOCIATED WITH THE MIGRATION OF CHEMICALS FROM GROUNDWATER THROUGH BUILDING FOUNDATIONS INTO INDOOR AIR

The vapor intrusion pathway was evaluated using USEPA's Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (USEPA, 2002) and USEPA's Johnson and Ettinger vapor intrusion model (USEPA, 2004). The approaches suggested in the draft guidance are primarily designed to ensure protection of the public in residential settings, but may be adjusted to evaluate human exposures in non-residential settings (e.g., commercial, industrial, and recreational).

6.1.1 Site Setting

Building 193 has been removed and no buildings remain within the Site 45 boundary. Building 293, the Depot Law Center, though not part of Site 45, is within 100 feet of Site 45 groundwater contamination. The structure is located approximately 200 feet south of the former dry cleaners (Building 193) in the southwest corner of the Site (Figure 1-2). Photos of Building 293 are included in Appendix N. There is a vented crawl space beneath Building 293. The entrance to the crawl space is locked and access is restricted because of asbestos concerns (Photo 2, Appendix N). The new dry cleaning facility, though not a part of Site 45, is also within 100 feet of Site 45 groundwater contamination and the indoor air and soil gas samples taken during the GSI investigation showed PCE exceedances, thus treatment of potential vapor intrusion in the new dry cleaning facility will be included with Site 45 activities.

As shown on Figures 4-1 and 4-2, the extent of the groundwater plume does not appear to extend underneath Building 293. The closest monitoring well is PAI-45-MW-18, which is located northeast of Building 293. PCE and TCE were detected at concentrations of 0.9 J µg/L and 1 J µg/L, respectively in groundwater samples collected in the upper surficial zone at this location. PCE, TCE, and total 1,2-dichloroethene were detected at concentrations of 0.9 J µg/L, 0.8 J µg/L, and 4 J µg/L, respectively, in groundwater samples collected in the lower surficial zone at this location. Groundwater flow in the vicinity of Building 293 is to the west in the upper and lower surficial zones (Figures 3-5 and 3-6) and to the east in the deep zone (Figure 3-7). Based on groundwater flow, Building 293 appears to be located upgradient or side gradient of the groundwater plume.

6.1.2 Exposure Assessment

USEPA's Vapor Intrusion Guidance (2002) recommends that the vapor intrusion exposure pathway be considered when a building is within 100 feet of a potential source area. Building 293 and the new dry cleaning facility are the only buildings that are currently within 100 feet of the groundwater plume. However, as discussed above, the groundwater plume does not extend underneath Building 293 or the new dry cleaning facility and groundwater flow suggests that both buildings are located upgradient or side-gradient of the groundwater plume. Because soil gas follows preferential pathways and does not necessarily follow a groundwater plume, vapor intrusion may be a potential exposure pathway for Building 293 and the new dry cleaning facility.

The USEPA's Johnson and Ettinger vapor intrusion model (USEPA, 2004) was used to evaluate risks to potential, future receptors hypothetically exposed to VOCs migrating from the groundwater to the indoor air of a building at Site 45. Hazard indices (HIs) and incremental lifetime cancer risks (ILCRs) were estimated for two scenarios. It was assumed that a hypothetical residence was placed over the

groundwater plume with the maximum detected groundwater concentration providing the basis for predicting the indoor air concentrations.

Input parameters for the Johnson and Ettinger vapor intrusion model are presented in Table 6-1. Because of the shallow depth to groundwater, slab on grade construction was assumed. Therefore the model default value of 15 cm was used as the depth below grade to the bottom of the floor space. The average depth to groundwater at Site 45 is 110 cm (3.6 feet). The average soil/groundwater temperature was obtained from USEPA's User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings (2004). The SCS soil type was obtained from the boring logs. The bulk density, total porosity, and water-filled porosity are the model recommended values for loamy sand soil.

Exposure concentrations were calculated for residential exposure using the predicted indoor air concentrations from the Johnson and Ettinger model and in accordance with USEPA's Risk Assessment Guidance for Superfund Part F (Supplemental Guidance for Inhalation Risk Assessment) (USEPA 2009). Exposure concentrations are defined by the following equation:

$$EC = \frac{(C_{air})(ET)(EF)(ED)}{(AT)(24\ \text{hours/day})}$$

where:

EC	=	exposure concentration (µg/m^3)
Cair	=	predicted indoor air concentration by Johnson Ettinger Model (µg/m^3)
ET	=	exposure time (24 hours/day)
EF	=	exposure frequency (350 days/yr)
ED	=	exposure duration (30 yr)
AT	=	averaging time (days)
		for non-carcinogens, AT = ED x 365 days per year
		for carcinogens, AT = 70 years x 365 days per year.

A future scenario was not evaluated for Building 293 because the Johnson and Ettinger model only evaluates slab on grade or basement construction and Building 293 has a vented crawl space. For this type of building, the guidance recommends a site specific assessment be conducted, gathering soil gas and/or indoor air samples as needed. A future industrial scenario was not evaluated because there is too much uncertainty associated with the required input parameters (e.g., building construction, building size, ventilation rate). While the distance from the highest concentration in the plume suggests that soil gas may not impact Building 293, the unpredictability of soil gas migration suggests that there is still a potential for vapor intrusion. Therefore, a near-slab soil gas investigation may be conducted at Building 293 as part of a remedial design.

6.1.3 Toxicity Criteria

Inhalation RfCs and IURs used in the risk calculations were obtained from the following primary USEPA literature sources, selected per USEPA guidance (2003):

- Tier 1 - Integrated Risk Information System (IRIS)

- Tier 2 - USEPA's Provisional Peer Reviewed Toxicity Values (PPRTVs) — The Office of Research and Development/National Center for Environmental Assessment (NCEA) Superfund Health Risk Technical Support Center develops chemical-specific PPRTVs when requested by USEPA's Superfund program

- Tier 3 - Other toxicity values— These sources include, but are not limited to, California Environmental Protection Agency (Cal EPA) toxicity values, Agency for Toxic Substances and Disease Registry (ATSDR) values, and the Annual Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997b).

Although toxicity criteria can be found in several toxicological sources, USEPA's IRIS online database is the preferred source of toxicity values. This database is continuously updated, and its values are verified by USEPA.

Current toxicity criteria, as outlined in the hierarchy discussed above, are being used in this assessment, as presented in EPA's Regional Screening Level (RSL) table (USEPA 2011). Since the most recent RSL table was issued, the toxicity factors for PCE have been finalized and are not presented in the current RSL table. The inhalation unit risk (IUR) and the reference concentration (RfC) for PCE are 2.6×10^{-7} $(\mu g/m^3)^{-1}$ and 0.04 mg/m^3, respectively. These correspond to residential air screening levels of 9.4 and 42 $\mu g/m^3$ for carcinogenic and noncarcinogenic effects, respectively. In the latter half of 2011, the EPA also finalized the toxicity factors for TCE. The IUR and RfC for TCE are 4.1×10^{-6} $(\mu g/m^3)^{-1}$ and 2×10^{-3} $\mu g/m^3$, respectively. These correspond to residential air screening levels of 0.43 and 2.1 $\mu g/m^3$ for carcinogenic and noncarcinogenic effects, respectively.

6.1.4 Risk Characterization

Risks were calculated by relating the Exposure Concentrations (EC) (Table 6-2) to the residential RSLs for the contaminants. The residential carcinogenic RSLs correspond to a cancer risk of 1 x 10-6. And the residential noncarcinogenic RSLs correspond to a hazard quotient (HQ) of 1.0. Therefore, the incremental lifetime cancer risk (ILCR) and HQ for each contaminant are defined by the following equations:

ILCR = EC(carcinogenic) * 10-6 / RSL(carcinogenic)

HQ = EC(noncarcinogenic) / RSL(noncarcinogenic)

Results of the evaluation are presented in Table 6-2. Printouts for the Johnson and Ettinger vapor intrusion model are presented in Appendix R.

The HI for hypothetical residents exposed to the indoor air concentration predicted by using the maximum detected groundwater concentration was 1,790. The ILCR for the hypothetical residents exposed to indoor air concentrations predicted by using the maximum detected groundwater concentration was 6 x 10^{-3}.

To provide total receptor risks (i.e., vapor intrusion plus other exposure pathways investigated in the November 2004 HHRA), the results for residents from the 2004 HHRA are presented here and added to the residential risk estimates for vapor intrusion. The child resident is the most conservative receptor for the HI estimates. The total HI estimated for child residents exposed to surface soil (via ingestion and dermal contact) and groundwater (via ingestion, dermal contact, and inhalation) was 248. The lifelong resident is the most conservative receptor for cancer risks. The total ILCR estimated for lifelong residents exposed to surface soil (via ingestion and dermal contact) and groundwater (via ingestion, dermal contact, and inhalation) was 5.5 x 10^{-2}. Using these values, the following table displays the total risks and hazards for residents exposed to media/exposure pathways investigated in the 2004 HHRA plus vapor intrusion using the most recent EPA toxicity criteria:

Medium	ILCR	HI
SS(1)	1.1 x 10^{-5}	0.2
GW: Surficial Aquifer(1)	5.5 x 10^{-2}	248
GW: Deep Aquifer(1)	9.2 x 10^{-6}	0.1
VI	6 x 10^{-3}	1,790
Total SS + GW: Surficial Aquifer + GW: Deep Aquifer + VI	6 x 10^{-2}	2,038

1 – For surface soil and groundwater, the lifelong resident ILCR and child resident HI from the November 2004 HHRA are presented for the ILCR and HI values, respectively.

GW = groundwater

HI = hazard index

ILCR = incremental lifetime cancer risk

SS = surface soil

VI = vapor intrusion

6.1.5 Uncertainty Analysis

The results of the vapor intrusion modeling are subject to the following sources of uncertainty:

- Use of the maximum groundwater concentrations to predict indoor air concentrations would overestimate potential risks associated with vapor intrusion.

- The model does not take into account transformation processes. As discussed in Section 4, evidence exists that natural attenuation is functioning at the site to degrade tetrachloroethene and daughter products all the way to vinyl chloride.

- The model assumes an infinite source. As discussed in Section 1 the main dry cleaning building, solvent tanks, and other related structures were demolished and removed from the site in 2001. VOCs are no longer being released to groundwater at Site 45.

- The model treats the entire building as a single chamber with instantaneous and homogenous vapor dispersion. The model neglects contaminant sinks and room to room variation in vapor concentrations due to unbalanced mechanical and/or natural ventilation.

- The default building area of 10 meters (32.8 feet) by 10 meters is based on a Michigan study and corresponds to the 10th percentile floor space area for residential single family dwellings. The slab on grade scenario assumes a single floor dwelling 2.44 meters (8 feet) high. The modeling results may be different for a building with different dimensions.

- The EPA Guidance on Vapor Intrusion indicates that modeling is not appropriate for actual existing facilities when the top of the groundwater is less than 5 feet bgs since there is too much variability in the fate and transport of vapors at such shallow depths. Therefore, modeling for hypothetical facilities when the top of the groundwater is less than 5 feet bgs would be in question also.

- Absence of seasonal or temporal data contributes to the uncertainty by not accounting for the variability in groundwater concentrations.

6.2 GSI ENVIRONMENTAL, INC. VAPOR INTRUSION PILOT TEST SAMPLING

Eight soil gas samples (SUBSLAB-NP-1 through SUBSLAB-NP-3 and SUBSLAB-PP-1 through SUBSLAB-PP-3) were collected by GSI Environmental, Inc. (GSI) on June 30 and July 1, 2009, at the new dry cleaners. The sample collection was part of a planned multi-media vapor intrusion pilot test. The work was not sponsored by Navy, however access was provided to Site 45 (and other sites at other

bases). Completion of the project was complicated by an unexpectedly high groundwater table at the time of the sampling, and may have resulted in postponing or suspension of the remainder of the project.

GSI's plans were provided in their workplan, ***Field Validation of Tier 2 Screening Criteria and Tier 3 Field Procedures for Evaluation of Vapor Intrusion, ESTCP Project ER-0707, May 18, 2009*** (Appendix B)***.*** The vapor samples were chemically analyzed to evaluate the presence of VOCs in subsurface soil and the potential for migration of subsurface vapors into air within workspace areas of the new dry cleaning facility. The overall objective of research project ER-0707 was to develop simple procedures for i) Tier 2-level site-specific evaluation and screening and ii) limited Tier 3 field investigation of the vapor intrusion pathway. GSI reported that sub-slab soil vapor samples were collected in accordance with standard operating procedures developed by the USEPA Environmental Response Team (ERT) for soil vapor sampling (USEPA, 1996), as well as methodologies developed by the USEPA Office of Research and Development (USEPA, 2004). Stainless steel soil vapor probes were installed into the concrete building slabs on June 30 and July 1, 2009. Prior to installation, total VOC measurements were obtained in the concrete borehole using a portable photoionization detector (PID). Subslab soil vapor samples were collected in six-liter SUMMA canisters at a low flow rate for a minimum of 8 hours using Teflon® tubing attached to the stainless steel vapor probe. VOC analysis was performed using USEPA Method Toxic Organic 15 (TO-15) for the collection and analysis of VOCs (USEPA, 1999).

Table 6-3 summarizes the results of the vapor screening within the new dry cleaners facility at Site 45. The results of the sub slab samples analyses indicate positive detections of multiple VOCs in samples. The results include positive detections of petroleum-related VOCs such as BTEX, and chlorinated solvents (tetrachloroethene, TCE, 1,1,1-trichloroethane) and their degradation products (e.g., 1,2-dichloroethane, cis-1,2-dichloroethene, vinyl chloride). Only three VOCs (benzene, ethylbenzene, and tetrachloroethene) exceed residential USEPA Regional Screening Levels. However, only tetrachlorethene concentrations exceeded both residential and industrial USEPA Regional Screening Levels in 6 of the 9 sub-slab soil gas samples collected. Concentrations of tetrachloroethene ranged from 74 to 240 $\mu g/m^3$.

Table 6-4 summarizes the results for indoor and ambient air samples collected within the new dry cleaners facility at Site 45. The results include positive detections of petroleum-related VOCs such as BTEX, and chlorinated solvents (tetrachloroethene, TCE, 1,1,1-trichloroethane) and their degradation products (e.g., 1,2-dichloroethane, cis-1,2-dichloroethene, and vinyl chloride). Only four VOCs (benzene, 1,2-dichloroethane, trichloroethene, and tetrachloroethene) exceed residential USEPA Regional Screening Levels. However, only tetrachlorethene concentrations exceeded both residential and industrial USEPA Regional Screening Levels in seven of the nine indoor and ambient air samples

collected, including the duplicate sample of Indoor-NP-3. Concentrations of tetrachloroethene ranged from 0.29 to 54 µg/m^3.

During the sample collection procedure, a leak tracer compound (SF6) was released into a sample shroud placed over the sample point. The concentration of this leak tracer compound in the sample was expected to be used to evaluate leakage during sample collection. Sulfur hexafluoride (SF6) was detected in the duplicate sub-slab sample of SUBSLAB-NP-3 at a concentration of 10 µg/m^3. SF6 was not detected in any other sub-slab samples collected at Site 45, including SUBSLAB-NP-3. SF6 concentrations ranging from 45 to 190 µg/m^3 were detected in all of the indoor air samples collected at Site 45. SF6 was not detected in ambient air samples Ambient-1 and Ambient-2. SF6 results for sub-slab and indoor and ambient air samples are summarized in Tables 6-5 and 6-6. GSI did not provide any analysis of the SF6 results.

Results of the radon analysis for sub-slab and indoor and ambient air samples collected are summarized in Table 6-7. Radon concentrations ranged from 2,073 to 2,752 picoCurie per liter (pCi/L) in sub-slab samples collected at Site 45. Radon concentrations ranged from 0.11 to 0.49 pCi/L in indoor and ambient air samples collected at Site 45.

The GSI Lead Researcher concluded the following in an informal report to the Navy: ”The pressure control method did not work well in this building, most likely due to the very leaky nature of the building. (The building has ventilation slats in the walls that cannot be closed.) Based on the pressure readings, we were not able to achieve good pressure control. Pressure gradients were similar under the ‘negative pressure’ and ‘positive pressure’ test conditions. The radon concentration data also show an absence of pressure control with similar indoor radon concentrations under negative and positive test conditions. PCE concentrations in indoor air range from 11 to 54 ug/m3, compared to 74 to 240 ug/m3 below the foundation (AF < 10) Radon concentrations range from 0.21 to 0.49 pCi/L, compared to 2073 to 2752 pCI/L below the foundation (AF is about 8000).”

Radon is widely used to provide a means of comparison for the attenuation of other chemicals. When the attenuation rate of radon is considered, the data suggests that the vast majority of PCE inside the building is coming from sources inside the building, likely due to the continued dry cleaning operations where the transfer, handling, and storage of dry cleaned clothing occurs.

6.3 POTENTIAL RISKS ASSOCIATED WITH THE MIGRATION OF CHEMICALS FROM SOIL GAS INTO INDOOR AIR – NEW DRY CLEANING FACILITY

A review and evaluation of soil gas data collected during sampling in June-July 2010 and indoor air samples collected at the new dry cleaning facility (described in Section 6.1.1) were conducted to

determine if the contaminant concentrations in groundwater pose a potential risk associated with vapor intrusion (VI). EPA's *Draft Vapor Intrusion Guidance* (November 2002) was used to conduct a screening evaluation (See Appendix S).

Screening criteria for evaluating the vapor intrusion to indoor air are published in Table 2c of the draft USEPA guidance titled: Evaluating the Vapor Intrusion into Indoor Air (USEPA, 2002). The criteria were derived in 2002 and the toxicity criteria for a number of chemicals have changed since the criteria were originally derived. Consequently, the USEPA residential air Regional Screening Levels (RSLs) (November 2011) were adjusted to a sub slab concentration by assuming an attenuation factor of 0.1 and were used for toxicity screening (Table 6-3). For indoor air, the USEPA residential air RSLs were used for toxicity screening (Table 6-4).

For soil gas, the target risk levels are the EPA risk range (1×10^{-4} to 1×10^{-6}) for carcinogens or a hazard quotient of 0.1 for noncarcinogens. Concentrations of benzene, ethylbenzene, and tetrachloroethene (PCE) exceed the residential screening criteria;concentrations of PCE also exceed the industrial screening criterion.

For indoor air, concentrations of benzene, 1,2-dichloroethane (1,2-DCA), TCE and PCE exceeded residential screening criteria. Only PCE concentrations exceeded the industrial screening criterion..

6.3.1 Exposure Assessment

As discussed in Section 6.1.2, the new dry cleaning facility is located within 100 feet of the groundwater plume at Site 45. The groundwater plume does not currently extend under the new dry cleaning facility. Potential receptors are dry cleaning facility workers exposed to chemicals via vapor intrusion.

Both indoor air data and soil gas data were included in the evaluation. A commercial worker scenario was evaluated for the new dry cleaning facility. The commercial worker receptor is assumed to be representative of exposures for dry cleaning facility workers.
Indoor air concentrations were estimated by incorporating the maximum detected soil gas concentrations into the Johnson and Ettinger Model. Input parameters for the soil gas evaluation using the Johnson and Ettinger vapor intrusion model are the same as those presented in Table 6-1 for the depth below grade to the bottom of the floor space, the average soil/groundwater temperature, and the SCS soil type. The soil gas sampling depth of 0.8 feet (24.4 centimeters) below ground surface was used as a model input. An indoor exchange rate of 0.83 $hours^{-1}$ was used for the building due to its commercial nature. Default USEPA exposure assumptions for reasonable maximum exposures were utilized in the evaluation (e.g., an exposure frequency of 250 days per year and an exposure duration of 25 years). Exposure concentrations were calculated for industrial exposure using the predicted indoor air concentrations from

the Johnson and Ettinger model based on maximum detected soil gas concentrations and in accordance with USEPA's Risk Assessment Guidance for Superfund Part F (Supplemental Guidance for Inhalation Risk Assessment) (USEPA 2009). Exposure concentrations are defined by the following equation:

$$EC = \frac{(C_{air})(ET)(EF)(ED)}{(AT)(24\ \text{hours/day})}$$

where:

EC	=	exposure concentration (µg/m^3)
Cair	=	predicted indoor air concentration by Johnson Ettinger model (µg/m^3)
ET	=	exposure time (8 hours/day)
EF	=	exposure frequency (250 days/yr)
ED	=	exposure duration (25 yr)
AT	=	averaging time (days)
		for non-carcinogens, AT = ED x 365 days per year
		for carcinogens, AT = 70 years x 365 days per year.

Exposure concentrations were also calculated for industrial exposure using the maximum measured indoor air concentrations and in accordance with USEPA's Risk Assessment Guidance for Superfund Part F (Supplemental Guidance for Inhalation Risk Assessment) (USEPA 2009) using the above referenced equation.

6.3.2 Risk Characterization – Soil Gas

Quantitative risk evaluations conducted for the dry cleaning worker exposed by inhalation to exposure concentrations derived from the indoor air concentrations predicted by the maximum soil gas concentrations using the Johnson and Ettinger Model (Appendix S) are presented in Table 6-8.

The cumulative ILCR is less than the USEPA target cancer risk range and the total HI for noncarcinogens is less than the target of 1. Therefore, the results of the soil gas evaluation indicate that cancer risks and noncancer hazards are within acceptable limits.

6.3.3 Risk Characterization – Indoor Air

Quantitative risk evaluations conducted for the dry cleaning worker exposed by inhalation to exposure concentrations derived from the maximum measured indoor air concentrations are presented in Table 6-9. The cumulative ILCR for this scenario is approximately equal to the lower end of the target risk range (1 x 10^{-6}), but the cumulative HI is less than 1. The ILCR of 10^{-6} suggests that risks may need to be managed.

6.3.4 Uncertainty Analysis

- The same uncertainties regarding modeling vapor intrusion risks from groundwater listed in Section 6.1.5 also apply to the soil gas evaluation for the new dry cleaning facility.

- Site-specific input parameters in addition to those discussed in Section 6.3.2 were not used in the Johnson and Ettinger Model for the soil gas evaluation. Instead, default parameters were used for these input values (e.g., enclosed space floor thickness, floor-wall seam crack width, etc.). Default parameters are designed to be conservative. Therefore, there is some uncertainty associated with the use of default parameters instead of additional site-specific input parameters; however, because the modeling results are within acceptable levels, this uncertainty does not impact risk assessment conclusions.

- For indoor air data, the Lead Researcher of the GSI Environmental vapor intrusion evaluation conducted at the new dry cleaning facility noted that good pressure control was not achieved during sampling potentially due to ventilation slats in the building that cannot be closed; therefore, under negative pressure conditions outside air could be drawn into the building.

- As stated in the Subsurface Vapor Intrusion Guidance (USEPA, November 2002), indoor air quality can be influenced by background levels of volatile chemicals within a building. In the case of the new dry cleaning facility, it is likely that the majority of the PCE detected in the indoor air samples is originating from within the dry cleaning facility based on the difference in attenuation factors between radon and PCE noted by the GSI Lead Researcher.

- While USEPA does not support measuring radon to determine sub-slab vapor intrusion attenuation factors, it is a line of evidence supported by the Interstate Technical Regulatory Council (ITRC) to assist in interpreting modeling results. Spatial heterogeneity of the PCE source zones versus the more homogenous nature of the radon contamination zones may contribute to the variability in attenuation factors between radon and PCE. The temporal variability of a mobile PCE source plume versus the stationary wide-spread radon source may also contribute to these differences.

- Research conducted by Tichenor *et al.* (1990) conducted to evaluate PCE emissions from dry cleaned fabrics in residences indicates that emissions from newly dry-cleaned clothes can raise indoor air concentrations of PCE in residences containing the clothes. This supports the conclusion that the majority of the PCE detected in the indoor air samples is likely originating from the dry cleaning facility because the facility is currently a distribution center for dry-cleaned fabrics.

- Uncertainty is associated with indoor air concentrations because it is possible that ambient air chemical concentrations can affect indoor air concentrations. The two ambient air samples collected have concentrations of benzene that exceed the residential screening level, and one ambient air sample has a PCE concentration that exceeds the residential screening level. However, because indoor air concentrations result in acceptable risks, this uncertainty does not impact risk assessment conclusions.

6.4 CONCLUSIONS

Conclusions regarding human health risks based on the vapor intrusion modeling are as follows:

- While risk estimates based on the vapor intrusion modeling for hypothetical residents at a structure located within Site 45 exceed standard risk management benchmarks (e.g., the USEPA's target risk range of 10^{-4} to 10^{-6}), this scenario (constructing a residence over the hot spot of the plume) is not very probable. However, the modeling results do provide useful information for risk managers tasked with risk management decisions for Site 45. Based on the modeled risk, any future construction planned for Site 45 must address the vapor intrusion pathway. Institutional controls should be considered to ensure this happens.

- Based on current plume dimensions and groundwater flow directions shown in Figures 3-5 and 3-6, Building 293 is located to the west of the significant contaminant plume at Site 45. However, the groundwater contamination plume has migrated nearer to Building 293, and changes that are proposed to be made to the stormwater drains at the site may influence the groundwater flow directions unexpectedly. Therefore, it is possible that significant VOC concentrations will migrate to the Building 293 at some point in the future. Near-slab soil gas sampling may be conducted at Building 293 during the remedial design to better characterize the potential for vapor intrusion.

- The new dry cleaning facility is located upstream of the groundwater plume, so the risk of an unacceptable level of indoor air contamination caused by vapor intrusion is very unlikely.

- Tetrachlorethene concentrations exceeded both residential and industrial USEPA Regional Screening Levels in 6 of the 9 sub-slab soil gas samples collected in the new dry cleaner building during 2009 pilot testing sampling unrelated to RI Field activities. Concentrations of tetrachloroethene ranged from 74 to 240 µg/m^3. Tetrachlorethene concentrations also exceeded both residential and industrial USEPA Regional Screening Levels in seven of the nine indoor and ambient air samples collected, including a duplicate sample. Concentrations of tetrachloroethene ranged from 0.29 to 54 µg/m^3. The results of the quantitative risk assessments based on maximum soil gas concentrations indicate that current vapor intrusion risks are less than target risk levels for workers at the new dry cleaning

facility. The results of the risk assessment based on measure maximum indoor air concentrations indicate that the carcinogenic risk is at the lower end of USEPA's target risk range and the hazard index is less than its target of 1.0. This suggests that the risks should be managed for the new dry cleaning facility.

- Risks for the new dry cleaning facility based on Johnson and Ettinger predicted indoor air concentrations using maximum soil gas concentrations indicate that risks associated with vapor intrusion are negligible. In contrast, risks associated with measured indoor air concentrations, while at the lower end of USEPA's target risk range, are greater than those measured using the soil gas concentrations. This suggests that there is a large in-building contribution to indoor air contribution relative to that from vapor intrusion. Moreover, evidence from Tichenor's research (1990) supports the possibility of significant off-gassing from clothes dry-cleaned with PCE, and the presence of PCE in indoor air to be less likely from vapor intrusion. Overall, the Navy intends to address site-related contamination in soil and groundwater. This ultimately reduce the potential for vapor intrusion over time.

TABLE 6-1

INPUT PARAMETERS FOR THE JOHNSON & ETTINGER MODEL
SITE 45 MWR DRY CLEANING FACILITY
MCRD PARRIS ISLAND, SOUTH CAROLINA

Input Parameter	**Default Value**	**Values Used in Analysis**
Depth below grade to bottom of enclosed space (cm).	15	15
Depth below grade to water table (cm).	400	110(1)
SCS soil type directly above water table.	SC (Sandy Clay)	LS (Loamy Sand)(1)
Average soil/groundwater temperature (°C)	10	20(2)
Vadose zone SCS soil type.	SC	LS(1)
Vadose zone soil dry bulk density (gm/cm^3).	1.63	1.62(3)
Vadose zone soil total porosity (unitless).	0.385	0.39(3)
Vadose zone soil water-filled porosity (cm^3/cm^3).	0.197	0.076(3)

Notes:
1 - Site specific value.
2 - Value is from USEPA's User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings, Figure 8.
3 - Model recommended value for SCS soil type.

TABLE 6-2

VAPOR INTRUSION MODELING RESULTS
MAXIMUM DETECTED GROUNDWATER CONCENTRATIONS
HYPOTHETICAL RESIDENTIAL RISKS
SITE 45 MWR DRY CLEANING FACILITY
MCRD PARRIS ISLAND, SOUTH CAROLINA

Chemical	Maximum Groundwater Concentration	Predicted Indoor Air Concentration(1)	Carcinogenic			Noncarcinogenic		
			Residential Exposure Concentration(2)	Residential RSL(3)	ILCR(4)	Residential Exposure Concentration(2)	Residential RSL(3)	HQ(5)
	ug/L	ug/m^3	ug/m^3	ug/m^3		ug/m^3	ug/m^3	
1,1-Dichloroethane	97	5.56E+00	2.28E+00	1.5	1.5E-06	5.34E+00	NA	-
1,1-Dichloroethene	74	2.25E+01	9.23E+00	NA	-	2.16E+01	210	1.0E-01
1,2-Dichloroethane	0	3.85E-03	1.58E-03	0.094	1.7E-08	3.70E-03	7.3	5.1E-04
cis-1,2-Dichloroethene	110,000	4.58E+03	1.88E+03	NA	-	4.40E+03	NA	-
trans-1,2-Dichloroethene	3,400	3.15E+02	1.29E+02	NA	-	3.02E+02	63	4.8E+00
Tetrachloroethene(6)	26000	4.40E+03	1.80E+03	9.4	1.9E-04	4.22E+03	42	1.0E+02
Trichloroethene	35000	3.66E+03	1.50E+03	0.43	3.5E-03	3.51E+03	2.1	1.7E+03
Vinyl Chloride	3000	1.09E+03	4.47E+02	0.16	2.8E-03	1.05E+03	100	1.0E+01
				Total ILCR	**6.5E-03**		**Total HI**	**1.8E+03**

1 Johnson and Ettinger Model Results (Appendix R)
2 Calcuated for residential exposure in accordance with RAGS Part F (USEPA 2009)
3 USEPA Regional Screening Level Table (November 2011)
4 Ratio of the Carcinogenic Residential Exposure Concentration and the Carcinogenic Residential RSL x 10^{-6}
5 Ratio of the Noncarcinogenic Residential Exposure Concentration and the Noncarcinogenic Residential RSL
6 RSLs for Tetrachloroethene corresponds to February 2012 IRIS toxicological profile (values not in November 2011 RSL table).

TABLE 6-3

SUMMARY OF KEY RESULTS OF SUB-SLAB SAMPLES
SITE 45 – FORMER MWR DRY CLEANING FACILITY
MCRD PARRIS ISLAND, SOUTH CAROLINA

Parameter	EPA Regional Screening Level[3] ($\mu g/m^3$)				SUBSLAB-NP-1 ($\mu g/m^3$)	SUBSLAB-NP-2 ($\mu g/m^3$)	SUBSLAB-NP-3 ($\mu g/m^3$)	SS-DUP-1 ($\mu g/m^3$)	SG-2-2FT-NP ($\mu g/m^3$)	SUBSLAB-PP-1 ($\mu g/m^3$)	SUBSLAB-PP-2 ($\mu g/m^3$)	SUBSLAB-PP-3 ($\mu g/m^3$)	SG-2-2FT-PP ($\mu g/m^3$)
	Residential		Industrial										
Benzene	3.1	C	16	C	**3.4**	**1**	**1.2**	**1.6**	**0.93**	**0.98**	**0.83**	< 0.45	< 0.46
Dichloroethane, 1,2-	0.94	C	4.7	C	**0.5**	< 0.45	< 0.47	**0.88**	< 0.45	< 0.46	< 0.46	< 0.45	< 0.46
Dichloroethene, cis-1,2-	NA		NA		< 0.44	< 0.45	< 0.47	< 0.49	< 0.45	< 0.46	< 0.46	< 0.45	< 0.46
Dichloroethene, trans-1,2-	63	N	260	N	< 0.44	< 0.45	< 0.47	< 0.49	< 0.45	< 0.46	< 0.46	< 0.45	< 0.46
Ethylbenzene	9.7	C	49	C	**6.1**	**13**	**3.7**	< 2.4	< 2.2	< 2.3	< 2.3	< 2.3	< 2.3
Tetrachloroethene[4]	42	N[5]	180	N[5]	**190**	**240**	**89**	**120**	**190**	**74**	**160**	**91**	**170**
Toluene	5,200	N	22,000	N	**5.6**	< 2.3	< 2.3	**18**	< 2.2	**2.4**	< 2.3	< 2.3	< 2.3
Trichloroethane, 1,1,1-	5,200	N	22,000	N	< 0.44	< 0.45	< 0.47	< 0.49	< 0.45	< 0.46	< 0.46	< 0.45	< 0.46
Trichloroethene	2.1	N[5]	8.8	N[5]	**0.71**	**0.95**	< 0.47	< 0.49	< 0.45	< 0.46	< 0.46	< 0.45	< 0.46
Vinyl Chloride	1.6	C	28	C	< 0.44	< 0.45	< 0.47	< 0.49	< 0.45	< 0.46	< 0.46	< 0.45	< 0.46
Xylene, o-	100	N	440	N	**4.5**	**30**	**3.2**	< 2.4	< 2.2	< 2.3	< 2.3	< 2.3	< 2.3
Xylenes, m,p-	100	N	440	N	**21**	**66**	**14**	**2.9**	**7.5**	< 2.3	< 2.3	< 2.3	< 2.3

Notes:
1. Samples were analyzed by Columbia Analytical Services, Inc. in Simi Valley, California by Method TO-15.
2. Detected analytes are presented in **bold** type.
3. USEPA Regional Screening Levels, November 2011. Air concentrations have been adjusted to a sub slab concentration assuming an attenuation factor of 0.1 (USEPA 2002, Draft Guidance for Evaluating the Indoor Air Pathway for Groundwater and Soils (Subsurface Vapor Intrusion Guidance)). Values correspond to a cancer risk of 1E-06 for carcinogenis (C) or a hazard index of 0.1 for noncarcinogens (N).
4. USEPA Regional Screening Levels based on February 2012 IRIS Toxicological Profile (values currently not in RSL table).
5. One-tenth the noncarciogenic screening level is less than the carcinogenic screening value; therefore, the noncarcinogenic screening level is presented.

Exceeds residential screening level.

Exceeds residential and industrial screening level.

TABLE 6-4

SUMMARY OF KEY RESULTS FOR INDOOR AND AMBIENT AIR SAMPLES
SITE 45 – FORMER MWR DRY CLEANING FACILITY
MCRD PARRIS ISLAND, SOUTH CAROLINA

Parameter	EPA Regional Screening Level[3] (µg/m³)				Indoor-NP-1	Indoor-NP-2	Indoor-NP-3	Dup-1	Ambient-1	Indoor-PP-1	Indoor-PP-2	Indoor-PP-3	Ambient-2
	Residential		Industrial		(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)
Benzene	0.31	C	1.6	C	**0.41**	**0.49**	**0.43**	**0.42**	**0.46**	**0.71**	**0.68**	**0.69**	**0.84**
Dichloroethane, 1,2-	0.094	C	0.47	C	**0.13**	**0.19**	**0.17**	**0.19**	**0.059**	**0.15**	**0.12**	**0.095**	**0.058**
Dichloroethene, cis-1,2-	NA		NA		**0.49**	**2.2**	**1.8**	**2.5**	< 0.043	< 0.038	< 0.041	< 0.041	< 0.038
Dichloroethene, trans-1,2-	6.3	N	26	N	< 0.041	< 0.044	< 0.047	< 0.043	< 0.043	< 0.038	< 0.041	< 0.041	< 0.038
Ethylbenzene	0.97	C	4.9	C	**0.31**	**0.69**	**0.57**	**0.7**	**0.25**	**0.62**	**0.62**	**0.6**	**0.46**
Tetrachloroethene[4]	4.2	N[5]	18	N[5]	**11**	**23**	**35**	**22**	**0.29**	**36**	**54**	**51**	**0.43**
Toluene	520	N	2,200	N	**5.1**	**13**	**13**	**13**	**1.6**	**5.3**	**5.6**	**5.1**	**2.7**
Trichloroethane, 1,1,1-	520	N	2,200	N	**0.055**	**0.054**	**0.056**	**0.54**	**0.054**	**0.054**	**0.053**	**0.054**	**0.054**
Trichloroethene	0.21	N[5]	0.88	N[5]	**0.15**	**0.65**	**0.54**	**0.73**	< 0.043	< 0.038	< 0.041	< 0.041	< 0.038
Vinyl Chloride	0.16	C	2.8	C	< 0.041	**0.11**	**0.09**	**0.12**	< 0.043	< 0.038	< 0.041	< 0.041	< 0.038
Xylenes, m,p-	10	N	44	N	**0.64**	**1.1**	**0.91**	**1.1**	**0.65**	**1.3**	**1.3**	**1.3**	**1.3**
Xylene, o-	10	N	44	N	**0.26**	**0.4**	**0.35**	**0.42**	**0.26**	**0.54**	**0.51**	**0.51**	**0.54**

Notes:
1. Samples were analyzed by Columbia Analytical Services, Inc. in Simi Valley, California by Method TO-15 SIM.
2. Detected analytes are presented in **bold** type.
3. USEPA Regional Screening Levels, May 2011. Values correspond to a cancer risk of 1E-06 for carcinogenis (C) or a hazard index of 0.1 for noncarcinogens (N).
4. USEPA Regional Screening Levels based on February 2012 IRIS Toxicological Profile (values currently not in RSL table).
5. One-tenth the noncarciogenic screening level is less than the carcinogenic screening value; therefore, the noncarcinogenic screening level is presented.

Exceeds residential screening level.

Exceeds residential and industrial screening level.

TABLE 6-5

ANALYTICAL RESULTS OF SULFUR HEXAFLUORIDE TRACER GAS: SUB-SLAB GAS SAMPLES
SITE 45 – FORMER MWR DRY CLEANING FACILITY
MCRD PARRIS ISLAND, SOUTH CAROLINA

Parameter	SUBSLAB-NP-1 (µg/m$^{3)}$	SUBSLAB-NP-2 (µg/m$^{3)}$	SUBSLAB-NP-3 (µg/m$^{3)}$	SS-DUP-1 (µg/m$^{3)}$	SG-2-2FT-NP (µg/m$^{3)}$	SUBSLAB-PP-1 (µg/m$^{3)}$	SUBSLAB-PP-2 (µg/m$^{3)}$	SUBSLAB-PP-3 (µg/m$^{3)}$	SG-2-2FT-PP (µg/m$^{3)}$
Sulfur Hexafluoride (SF6)	< 6.5	< 6.6	< 6.6	**10**	< 7.3	< 6.4	< 6.4	< 6.4	< 6.5

Notes:
1. Samples were analyzed by Columbia Analytical Services, Inc. in Simi Valley, California by NIOSH Method 6602 Modified.
2. Detected analytes are presented in **bold** type.
3. SF6 release start time: 29 June 2009 at 14:30; Average SF6 release rate: 120 mL/min.

TABLE 6-6

ANALYTICAL RESULTS OF SULFUR HEXAFLUORIDE TRACER GAS: INDOOR AND AMBIENT AIR SAMPLES
SITE 45 – FORMER MWR DRY CLEANING FACILITY
MCRD PARRIS ISLAND, SOUTH CAROLINA

Parameter	Indoor-NP-1 (µg/m$^{3)}$	Indoor-NP-2 (µg/m$^{3)}$	Indoor-NP-3 (µg/m$^{3)}$	Dup-1 (µg/m$^{3)}$	Ambient-1 (µg/m$^{3)}$	Indoor-PP-1 (µg/m$^{3)}$	Indoor-PP-2 (µg/m$^{3)}$	Indoor-PP-3 (µg/m$^{3)}$	Ambient-2 (µg/m$^{3)}$
Sulfur Hexafluoride (SF6)	**42**	**150**	**110**	**160**	< 10	**190**	**110**	**58**	< 9.1

Notes:
1. Samples were analyzed by Columbia Analytical Services, Inc. in Simi Valley, California by NIOSH Method 6602 Modified.
2. Detected analytes are presented in **bold** type.
3. SF6 release start time: 29 June 2009 at 14:30; Average SF6 release rate: 120 mL/min.

TABLE 6-7

RESULTS OF RADON ANALYSIS
SITE 45 – FORMER MWR DRY CLEANING FACILITY
MCRD PARRIS ISLAND, SOUTH CAROLINA

Parameter	SUBSLAB-NP-1 (pCi/L)	SUBSLAB-NP-2 (pCi/L)	SUBSLAB-NP-3 (pCi/L)	DUP-1 (pCi/L)	SG-2-2FT-NP (pCi/L)	SUBSLAB-PP-1 (pCi/L)	SUBSLAB-PP-2 (pCi/L)	SUBSLAB-PP-3 (pCi/L)	SG-2-2FT-PP (pCi/L)
Radon	2405	2681	2372	2752	2728	2073	2471	2468	2737

Parameter	Indoor-1-NP (pCi/L)	Indoor-2-NP (pCi/L)	Indoor-3-NP (pCi/L)	Dup-1 (pCi/L)	Ambient-1-NP (pCi/L)	Indoor-1-PP (pCi/L)	Indoor-2-PP (pCi/L)	Indoor-3-PP (pCi/L)	Ambient-2 (pCi/L)
Radon	0.27	0.21	0.3	-	0.11	0.25	0.49	0.4	0.22

Notes:
1. Radon samples were analyzed by Dr. Douglas E. Hammond at the University of Southern California in Los Angeles, California
2. Detected analytes are presented in bold type.
3. The lower detection limit for radon (95% confidence level as recommended by EPA 402-R-95-012, October 1997) is 0.14 pCi/L.
4. Results corrected to in-situ pressure of 1.00 atm based on assumed Parris Island elevation of 100 ft above sea level.

7.0 CONCLUSIONS

The conclusions developed during the Site 45 RI Addendum are summarized as follows. Recommendations based on these conclusions will be discussed in the Site 45 Feasibility Study.

SITE CHARACTERISTICS

- A neighboring structure, Building 200, a former temporary lodging facility, was noted in the original Site 45 RI, but has since been demolished. No new structure has been constructed on its footprint.

- Investigations in 2005 and 2006 showed a second groundwater contamination plume of chlorinated solvents, known as the southern plume, south and southwest of the former dry-cleaning facility, appearing to originate from the direction of the new dry-cleaning facility. The southern plume consists of groundwater contamination extending in a southeastern direction from an area approximately 40 feet from the southeastern corner of the new dry-cleaning facility to about the intersection of Samoa Street and the driveway into the parking lot for Building 293. The two plumes of groundwater contamination present are apparently intermingling in downgradient areas.

- Engineering blueprints, flow testing, and video imaging of sanitary sewers at the site, as well as the lack of a viable contaminant source at the new dry-cleaning facility, indicated that the contaminant source of the southern plume was very likely a leak from an abandoned sanitary sewer segment in the vicinity of the new dry-cleaning facility.

NATURE AND EXTENT / CHARACTERIZATION

- PCE and its degradation products (TCE, cis-1,2-DCE, total 1,2-DCE and VC) were detected in the surficial upper and surficial lower aquifers at numerous locations above the most stringent regulatory screening criteria. The deep wells were very clean indicating contamination is not migrating vertically to any great extent with a maximum cis-1,2-DCE “detected” concentration of 2.0J µg/L at MW-07D during the RI Addendum sampling. USGS sampling results similarly show that deep wells are clean, with all VOCs detections being less than 1 µg/L.

- Nature and extent of contamination is well-defined with only a few areas of refinement needed. It is believed that there was at least one source release (near MW08 and MW24). It appears that the source of the ‘southern plume’ is leakage from an abandoned sanitary sewer line near the south-east corner of the new dry cleaner building. Any further refinement, if necessary could be accomplished as part of future phases of regulatory activity at this site.

- Based on current plume dimensions and groundwater flow directions shown in Figure 3-5, it would appear that Building 293 and the new dry cleaning facility are within 100 feet vertically or horizontally of the groundwater contamination plume, and the groundwater exhibits concentrations of COCs greater than vapor intrusion screening criteria. A site-specific facility assessment is required to address the vapor intrusion concern based on the USEPA guidance.

- DNAPL field screening tests indicated no free product within the site areas investigated, and none was observed during the field investigation. Presence of DNAPL cannot, however, be ruled out, and based on groundwater contaminant concentrations, is likely.

- Substantial evidence exists that natural attenuation is functioning at the site to degrade PCE and daughter products all the way to vinyl chloride.

VAPOR INTRUSION

- While the groundwater vapor intrusion modeling for hypothetical residents shows excessive calculated risks, this scenario (constructing a residence within 100 feet vertically or horizontally of the maximum detected concentrations of the plume) is not very likely. However, the modeling results do provide a benchmark for future comparisons of COPC concentrations as they are observed over the coming years. Based on the modeled risk, any future construction planned for Site 45 must address the vapor intrusion pathway. Institutional controls should be considered to ensure this happens.

- The plume has not yet reached Building 293 (Attorney offices) in detectable concentrations for the COPCs. Uncertainties in modeling output with regard to predicted concentrations (biased high or low) could be checked by collecting air samples for these COPCs indoors. The highest concentrations of the groundwater plume are not under or adjacent to the building and would not be for several years if at all. However, the facility is currently within 100 feet horizontally or vertically of groundwater with contaminant levels that exceed vapor intrusion screening levels; the criteria in the USEPA vapor intrusion guidance that mandates further investigation. Also, there has been discussion about sealing the stormwater drains at the site, which could influence the groundwater flow rate and direction unexpectedly.

- Tetrachloroethene concentrations exceeded both residential and industrial USEPA Regional Screening Levels in 6 of 9 sub-slab soil gas samples collected in the new dry cleaner building during 2009 GSI Environmental pilot testing sampling unrelated to RI Field activities. Concentrations of tetrachloroethene ranged from 74 to 240 $\mu g/m^3$. Tetrachloroethene concentrations also exceeded

both residential and industrial USEPA Regional Screening Levels in seven of the nine indoor and ambient air samples collected, including a duplicate sample. Concentrations of tetrachloroethene ranged from 0.29 to 54 µg/m^3. Because sub-slab soil gas samples exceed screening criteria, it is concluded that a site-related source is likely contributing to the sub-slab soil gas concentrations, and potentially acting as a source of indoor air contamination. A quantitative risk assessment using the GSI soil gas data and indoor air data for the new dry cleaning facility was completed. For the soil gas risk assessment, the cumulative ILCR is less than the USEPA target cancer risk range of 10^{-6} to 10^{-4}, and the total HI for noncarcinogens is less than the target of 1. For the maximum measured indoor air concentration risk assessment, the ILCR is approximately equal to 1×10^{-6}, the lower end of the USEPA target risk range, and its HI is less than the target of 1. The ILCR at the lower end of the target risk range indicates that any action at the site is subject to a risk management decision.

- A site-specific vapor intrusion assessment was not completed for Building 293. Soil gas and additional groundwater data will be collected at this building during the remedial design phase of the process.

GENERAL GROUNDWATER CONCLUSIONS

These conclusions should be combined with the conclusions of the Site 45 RI. In the case of conflicting conclusions (such as locations of maximum detections), the conclusions made in this Site 45 RI Addendum override the previous conclusions.

- Additional data may be necessary to evaluate the potential remedies in a Feasibility Study. On-going pilot testing at the source area will provide additional data points for the evaluation. Ongoing pilot testing activities will be statused in the Feasibility Study for Site 45.

- Based on the following, evaluation of groundwater remedial solutions appears warranted:

  - Likelihood of a DNAPL pool serving as a continuing source of groundwater contamination,

  - Likelihood of a continuing release from a segment of abandoned sanitary sewer near the south-east corner of the new dry cleaner building,

  - Potential risk of impact to surface waters from contaminated groundwater infiltration to the storm sewer network,

  - Potential vapor intrusion issues at Building 293 and/or hypothetical vapor intrusion risk to structures associated with future development of the site.

- Groundwater contamination results in potential human health risks and pathways that need to be mitigated. A Feasibility Study will follow to present possible remedial alternatives.

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APPENDIX A

USGS: SOURCE, TRANSPORT, AND FATE OF GROUNDWATER CONTAMINATION AT SITE 45

Prepared in cooperation with the Naval Facilities Engineering Command Southeast

Source, Transport, and Fate of Groundwater Contamination at Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina

Scientific Investigations Report 2009–5161

U.S. Department of the Interior
U.S. Geological Survey

Cover photograph. Still picture from a video taken by a borehole camera in the now abandoned sanitary sewer system from the former dry-cleaning facility at Site 45, Parris Island, showing cracks in the sewer with roots extending through the cracks. Video by Deigler Waste Services, Inc. (Ridgeland, South Carolina).

Source, Transport, and Fate of Groundwater Contamination at Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina

By Don A. Vroblesky, Matthew D. Petkewich, James E. Landmeyer, and Mark A. Lowery

Prepared in cooperation with the Naval Facilities Engineering Command Southeast

Scientific Investigations Report 2009–5161

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Conversion Factors

Inch/Pound to SI

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Volume	
gallon (gal)	3.785	liter (L)
gallon (gal)	0.003785	cubic meter (m^3)
gallon (gal)	3.785	cubic decimeter (dm^3)
cubic inch (in^3)	0.01639	liter (L)
cubic foot (ft^3)	28.32	cubic decimeter (dm^3)
cubic foot (ft^3)	0.02832	cubic meter (m^3)
	Flow rate	
foot per day (ft/d)	0.3048	meter per day (m/d)
foot per minute (ft/min)	0.3048	meter per minute (m/min)
foot per year (ft/yr)	0.3048	meter per year (m/yr)
	Hydraulic conductivity	
foot per day (ft/d)	0.3048	meter per day (m/d)
	Hydraulic gradient	
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)

SI to Inch/Pound

Multiply	By	To obtain
	Length	
centimeter (cm)	0.3937	inch (in.)
millimeter (mm)	0.03937	inch (in.)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
	Volume	
liter (L)	0.2642	gallon (gal)
cubic meter (m^3)	264.2	gallon (gal)
cubic decimeter (dm^3)	0.2642	gallon (gal)
liter (L)	61.02	cubic inch (in^3)
cubic decimeter (dm^3)	0.03531	cubic foot (ft^3)
cubic meter (m^3)	35.31	cubic foot (ft^3)
	Flow rate	
meter per minute (m/min)	3.281	foot per minute (ft/min)
meter per day (m/d)	3.281	foot per day (ft/d)
meter per year (m/yr)	3.281	foot per year ft/yr)
	Mass	
gram (g)	0.03527	ounce, avoirdupois (oz)
kilogram (kg)	2.205	pound avoirdupois (lb)
megagram (Mg)	1.102	ton, short (2,000 lb)
megagram (Mg)	0.9842	ton, long (2,240 lb)
metric ton per day	1.102	ton per day (ton/d)
megagram per day (Mg/d)	1.102	ton per day (ton/d)
megagram per day per square kilometer [(Mg/d)/km^2]	2.8547	ton per day per square mile [(ton/d)/mi^2]
megagram per year (Mg/yr)	1.102	ton per year (ton/yr)
metric ton per year	1.102	ton per year (ton/yr)
	Hydraulic conductivity	
meter per day (m/d)	3.281	foot per day (ft/d)
	Hydraulic gradient	
meter per kilometer (m/km)	5.27983	foot per mile (ft/mi)

Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) as follows:

°C=(°F–32)/1.8

Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88).

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Altitude, as used in this report, refers to distance above the vertical datum.

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25 °C).

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L).

Abbreviations

‰	per mil: a unit expressing the ratio of stable isotope abundance of an element in a sample to those of a standard material. Per mil units are equivalent to parts per thousand.
^{12}C	carbon 12 isotope
^{13}C	carbon 13 isotope
16S rRNA	16S ribosomal ribonucleic acid
BLS	below land surface
BVC	functional gene associated with vinyl chloride reductase
bvcA	reductase gene in *Dehalococcoides* strain BAV1
*c*DCE	*cis*-1,2-dichloroethene
cm/d	centimeters per day
CSIA	compound-specific isotope analysis
DNA	deoxyribose nucleic acid
DNAPL	dense nonaqueous-phase liquid
DO	dissolved oxygen
DSR	functional gene associated with sulfate-reducing bacteria
ECD	electron-capture detector
f_{oc}	fraction organic carbon
ft/d	feet per day
ft/yr	feet per year
H_2	molecular hydrogen
I.D.	inside diameter
IDW	investigation-derived waste
K	hydraulic conductivity
K_d	distribution coefficient between water and sediment
K_{oc}	organic carbon sorption coefficient
log K_{oc}	soil absorption coefficient for organic carbon
MBT	molecular biological tool
MCL	maximum contaminant level
MCRD	Marine Corps Recruit Depot
mg/kg	milligrams per kilogram
mg/mL	milligrams per milliliter
MIP	Membrane Interface Probe
mRNA	messenger ribonucleic acid
mS/M	millisiemens per meter
nM	nanomoles per liter
PCE	tetrachloroethene
ppm	parts per million
PVC	polyvinyl chloride
qDHB	DNA or 16SrRNA associated with *Dehalobacter* sp.
qDHC	DNA or 16SrRNA associated with *Dehalococcoides* sp.
qDSM	DNA or 16SrRNA associated with *Desulfuromonas* sp.
qEBAC	DNA or 16SrRNA associated with *Eubacteria*
qMGN	DNA or 16SrRNA associated with methanogenic bacteria
RNA	ribonucleic nucleic acid
TCE	trichloroethene
TceA	trichloroethene reductase gene
*t*DCE	*trans*-1,2-dichloroethene
TEAP	terminal electron accepting process
TOC	total organic carbon
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
VC	vinyl chloride
VcrA	vinyl chloride reductase gene
VOA	volatile organic analysis
VOC	volatile organic compound
$\delta^{13}C$	ratio of $^{13}C/^{12}C$ relative to a reference standard of the Vienna Pee Dee Belemnite
µS/cm	microsiemens per centimeter
µV	microvolts

Source, Transport, and Fate of Groundwater Contamination at Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina

By Don A. Vroblesky, Matthew D. Petkewich, James E. Landmeyer, and Mark A. Lowery

Abstract

Groundwater contamination by tetrachloroethene and its dechlorination products is present in two partially intermingled plumes in the surficial aquifer near a former dry-cleaning facility at Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina. The northern plume originates from the vicinity of former above-ground storage tanks. Free-phase tetrachloroethene from activities in this area entered the groundwater and the storm sewer. The southern plume originates at a nearby new dry-cleaning facility, but probably was the result of contamination released to the aquifer from a leaking sanitary sewer line from the former dry-cleaning facility. Discharge of dissolved groundwater contamination is primarily to leaking storm sewers below the water table. Extensive biodegradation of the contamination takes place in the surficial aquifer; however, the biodegradation is insufficient to reduce trichloroethene to less than milligram-per-liter concentrations prior to discharging into the storm sewers. The groundwater volatile organic compounds entering the storm sewers are substantially diluted by tidal flushing upon entry and are subject to volatilization as they are transported through the storm sewer to a discharge point in a tributary to Ballast Creek. TCE concentrations of about 2–6 micrograms per liter were present in storm-sewer water near the discharge point (sampled at manhole STS26). On three out of four sampling events at manhole STS14, the storm-sewer water contained no vinyl chloride. During a time of relatively high groundwater levels, however, 20 micrograms per liter of vinyl chloride was present in STS14 storm-sewer water. Because groundwater leaks into that storm sewer and because the storm sewer upgradient from manhole STS14 is adjacent to part of the aquifer where 2,290 micrograms per liter of vinyl chloride have been detected, there is a potential for substantially increased concentrations of vinyl chloride to discharge at the storm-sewer outfall under conditions of high groundwater levels and low tidal flushing. In addition, the observation that free-phase tetrachloroethene may have entered the storm-sewer system during the 1994 discharge means that dense nonaqueous phase liquid tetrachloroethene could have leaked from various parts of the storm sewer or discharged to surface water at the storm-sewer outfall.

Introduction

Marine Corps Recruit Depot (MCRD), Parris Island, is in the southeastern part of South Carolina (fig. 1). Site 45 is a former dry-cleaning facility and the surrounding area near the intersections of Panama Street, Samoa Street, and Kyushu Street (fig. 2). The area includes a new dry-cleaning facility. Groundwater contamination is present at the site, consisting primarily of tetrachloroethene (PCE) and its dechlorination products trichloroethene (TCE), *cis*-1,2-dichloroethene (*c*DCE), and vinyl chloride (VC).

The former dry-cleaning facility began operations in the 1950s. In 1988, above-ground storage tanks were installed in an overflow catch basin (fig. 2). On March 11, 1994, one of the above-ground tanks was overfilled with PCE, and PCE spilled into the catch basin. The PCE was released from the catch basin to the surrounding soil when the containment basin was drained following heavy rains (S&ME, Inc., 1994). PCE may have entered the storm drains during this event. Evidence for entry of PCE to the storm drain was that when the site was investigated in the days after the spill, there was a wedge-shaped area of dead vegetation widening away from the spill area and intersecting Panama Street (James Clark, Environmental Officer, Parris Island, oral commun., 2008). A storm drain was present on Panama Street within a few tens of feet from the area where the wedge intersected the street. Multiple solvent releases were reported in 1995 (James Clark, Environmental Officer, Parris Island, oral commun., 2008), and the field investigation associated with the 1994 release concluded that additional solvent releases of lesser magnitude occurred over time predating the 1994 spill (S&ME, Inc., 1994). Underground storage tanks, possibly containing petroleum-based solvents, also were present at the site and were removed prior to construction of the above-ground storage tanks (S&ME, Inc., 1994). The former dry-cleaning facility was demolished, and related structures were removed from the site in early 2001 (Tetra Tech NUS, Inc., 2004). Groundwater contamination in the vicinity of and downgradient from the area of former above-ground storage tanks is designated as the northern plume in this report (fig. 2).

In late 1997, the dry-cleaning operations were moved to a new facility, approximately 130 feet (ft) west of the former

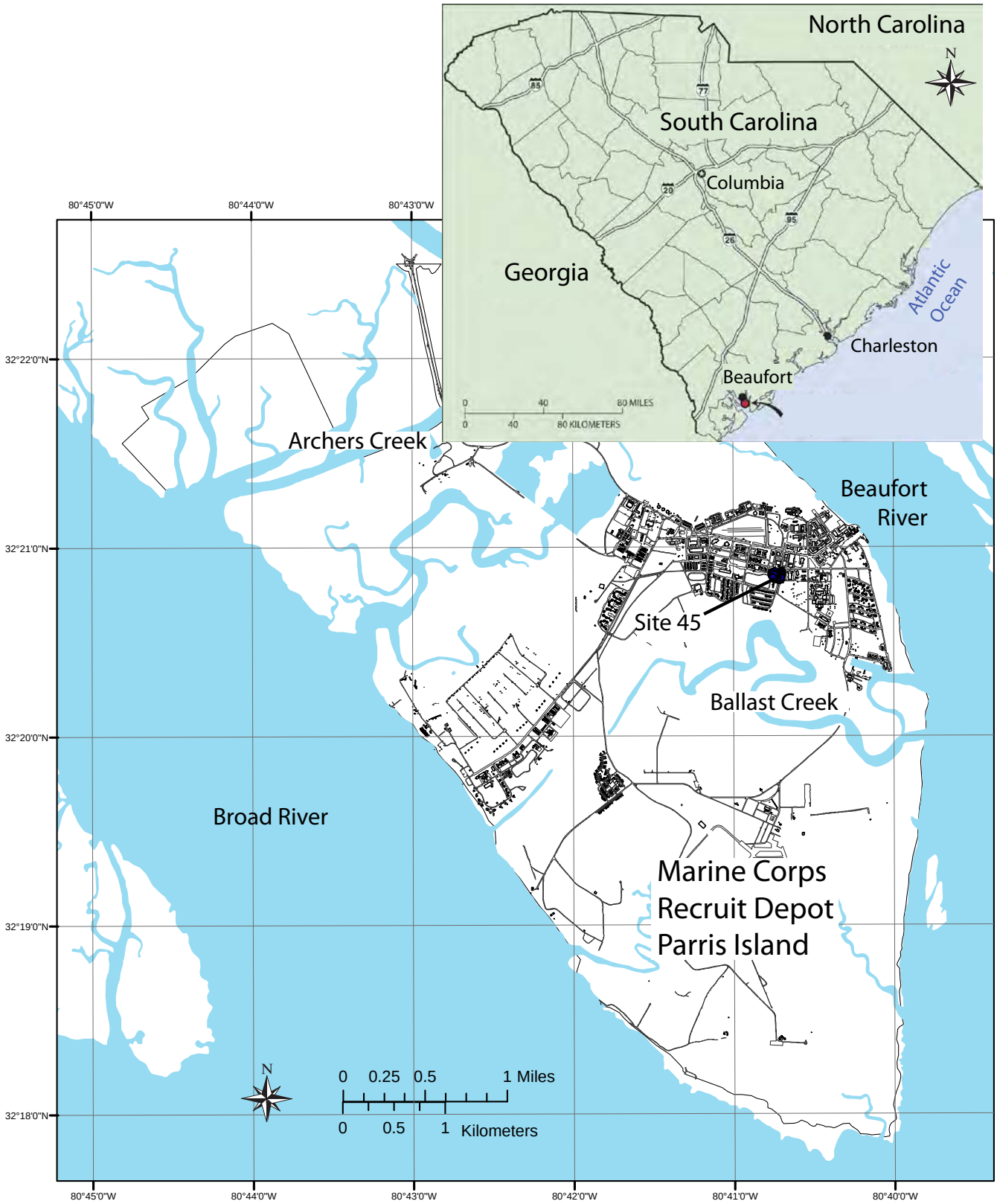


Figure 1. Location of Site 45 and Marine Corps Recruit Depot, Parris Island, South Carolina.

dry-cleaning building (fig. 2). With the move to a new facility, the dry-cleaning operation switched from using PCE as the cleaning solvent to using a non-hazardous hydrocarbon-based cleaner (ExxonMobil DF-2000®) that contains no chlorinated solvents, and the equipment was replaced with refrigeration for recirculation and recovery of the solvent (Center for Waste Minimization, 2000). Investigations in 2005 and 2006 showed the presence of a second groundwater contamination plume of chlorinated solvents, hereafter known as the southern plume, south and southwest of the former dry-cleaning facility (fig. 2), appearing to originate from the new dry-cleaning facility (Tetra Tech NUS, Inc., 2005; Mark Sladic, Tetra Tech NUS, Inc., written commun., 2006). Groundwater flow directions were to the southeast, making it improbable that the contamination at the new dry-cleaning facility was caused by groundwater transport from the documented spill at the former dry-cleaning facility.

Prior to initiation of the present investigation, the U.S. Geological Survey (USGS) conducted groundwater

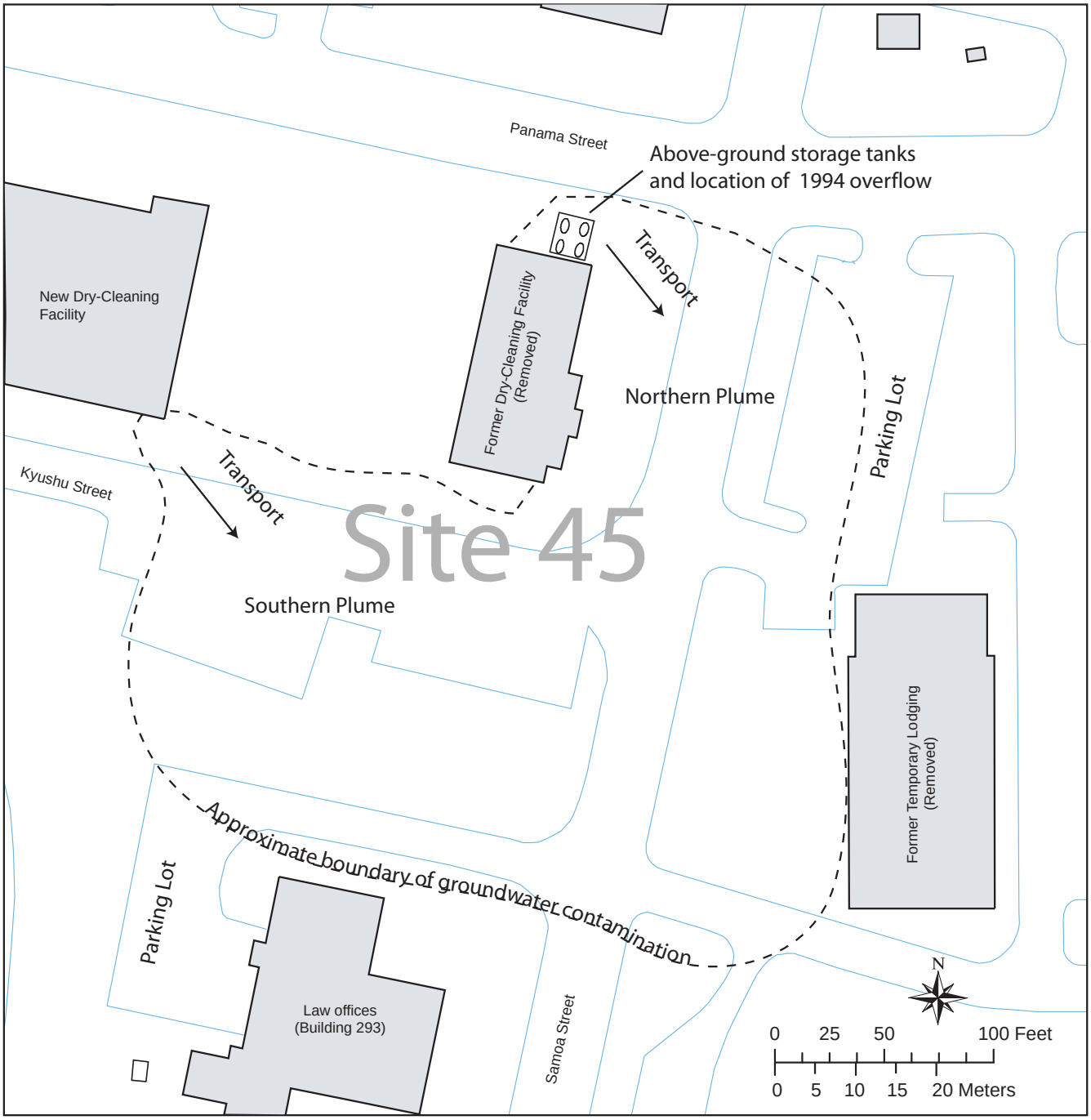


Figure 2. Location of above-ground storage tanks and approximate boundary of groundwater contamination, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina.

investigations at Site 45 beginning in 2005 to examine issues related to the influence of in-well convection on groundwater sample quality (Vroblesky and others, 2007). The USGS initiated the present investigation in 2007 for several reasons. (1) Measurements made by the USGS indicated that several storm-sewer lines intersecting the site were below the water table, and information was needed on whether those sewer lines influenced contaminant movement. (2) Further delineation of the southern plume was needed. (3) Additional information was needed on the fate and transport of the southern plume.

The purposes of this report are (1) to examine the role that sewer lines play in contaminant source, distribution, attenuation, and transport in both the northern and southern plumes, (2) to present data further delineating the main body of contamination in the southern plume and on the potential for contaminant movement to the deeper aquifer system, and (3) to examine natural attenuation aspects of groundwater contamination in the southern plume. The investigation involved examination of historical records and engineering drawings of buildings, video imaging of storm sewers, water-level monitoring by synoptic measurements in wells and by use of continuous data loggers, installation and sampling of temporary wells, and water and sediment sampling. The water sampling included wells, storm drains, and surface water. Water samples were collected from 23 permanent wells in the target aquifer, several of which were sampled on multiple occasions. Five of these wells were installed during this investigation. The wells were located predominantly in the southern plume. Samples were analyzed for volatile organic compounds (VOCs) and water chemistry. Selected groundwater samples were analyzed for molecular biological tools (MBTs) and for compound-specific stable carbon isotopes. Groundwater samples also were collected from four wells screened deeper than the known contamination, three of which were installed during this investigation. Water samples were collected from 96 temporary wells installed during this investigation. Membrane Interface Probe (MIP) logs were collected at seven borings in the southern plume. Additional water samples for VOC analysis were collected from storm sewers and from surface water at the sewer outfall. Sediment was collected for VOC analysis at the storm-sewer outfall. Aquifer core samples were analyzed for total organic carbon. This report contains several appendixes, which include well-construction and lithologic information, water and sediment chemistry, and synoptic water-level data.

Methods

This investigation involved monitoring existing permanent wells and installation and monitoring of additional permanent and temporary wells (figs. 3 and 4). Monitoring also involved determination of groundwater levels by collecting synoptic and continuous water-level data from wells and storm sewers. Subsurface sewer lines were mapped, sampled, and subjected to a dye test to measure transport times. Sediment samples and surface-water samples were collected and analyzed. Water-level data and well samples were not collected from wells with the prefix PFM (originally used for a passive flux-meter investigation) because the 15-ft well screens were substantially longer than in the other monitoring wells (4–5 ft) in the surficial aquifer (fig. 3). One of the PFM wells was used, however, to obtain a vertical distribution of specific conductance in the surficial aquifer.

Well Installation

Temporary borings were installed using direct-push technology. MIP logs run in the temporary borings at seven locations in the southern plume provided information on the depth of the contamination (fig. 5). An MIP is a semi-quantitative field-screening device that typically is advanced into the soil and sediment by push technology and detects volatile organic compounds by heating and capturing vapor from the soil and transporting it to the surface for onsite analysis (U.S. Environmental Protection Agency, 2005).

Other temporary borings functioned as wells for water sampling or as sources for analysis of sediment cores. Temporary wells were constructed by advancing a stainless-steel well screen with a retractable cover to the target depth. Retracting the cover at the target depth exposed 4 ft of screen. The depth of investigation at each site was based primarily on vertical profiling using MIPs during this investigation and a previous investigation (Tetra Tech NUS, Inc., 2005). The depth of maximum electron-capture-detector (ECD) response on the MIP logs in areas outside the 1994 PCE spill area varied from about 9.5 to 14 ft. Therefore, the targeted depth for exposing the 4-ft screened interval of investigation was within the range of 5 to 15 ft depth, with the site-specific depth depending on nearby MIP data.

At some temporary-well locations, water samples were collected from multiple depths. On the east side of the facility at wells PAI-45-USGS-TW9 and PAI-45-USGS-TW20, multiple depths were sampled by sampling in two different boreholes, each with its own well name (PAI-45-USGS-TW18 and PAI-45-USGS-TW21, respectively). Near the new dry-cleaning facility, multiple depths were obtained by advancing the retractable well point to a shallow depth, sampling the well, removing and cleaning the equipment, and using the same borehole to advance the retractable well point to a deeper depth for sampling. The temporary wells and MIP borings installed as part of this investigation were filled in by grouting with Portland® cement within 24 hours of sampling.

A South Carolina certified well driller installed all permanent wells. The permanent wells in the surficial aquifer were installed using hollow-stem augers. The wells were 2-inch inside diameter (ID) polyvinyl chloride (PVC) flush-threaded casing with 5-ft screen lengths having 0.010-inch openings. The filter pack consisted of clean silica #1 sand installed adjacent to the screen from approximately 3–6 inches below the bottom of the well to approximately 2 ft above the well screen. The seal overlying the sand pack consisted of a minimum

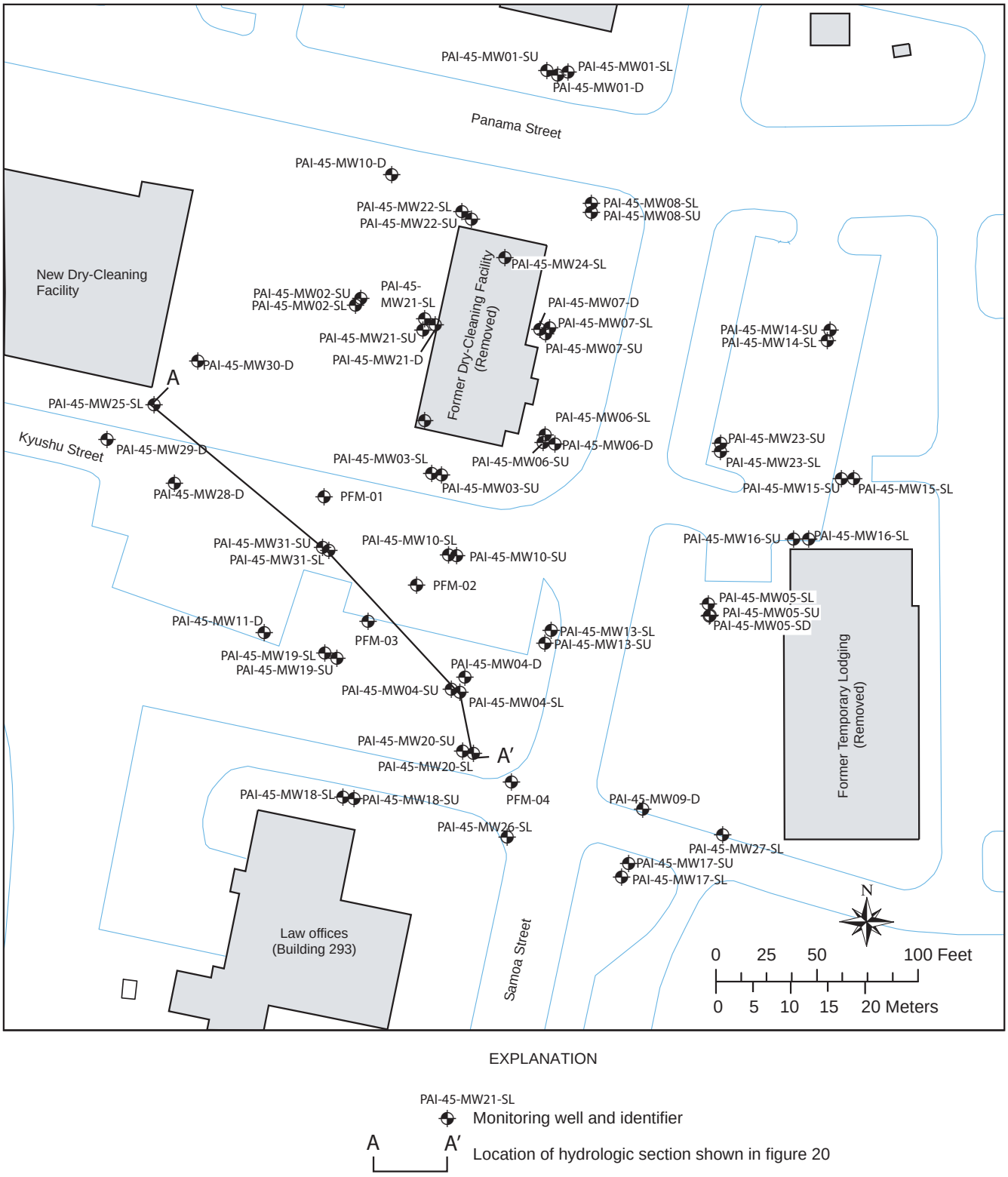
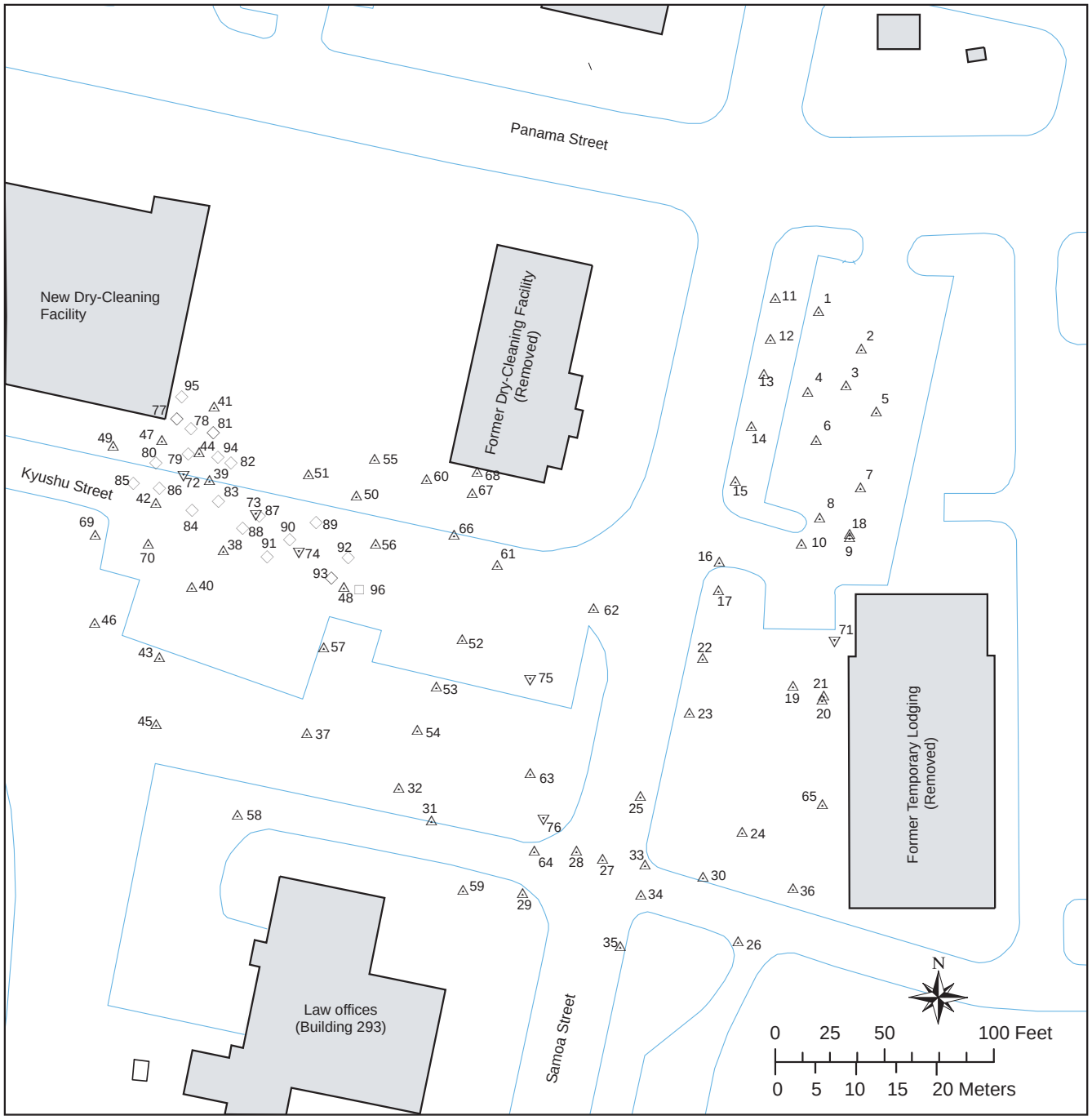


Figure 3. Locations of monitoring wells used in the U.S. Geological Survey investigation, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina.



EXPLANATION

96 Temporary well installed and sampled April 2008, and abbreviated well name

92 Temporary well installed and sampled March 2008, and abbreviated well name

76 Temporary well installed and sampled August 2007, and abbreviated well name

41 Temporary well installed and sampled June 2007, and abbreviated well name

Abbreviated well names refer to names prefixed by “PAI-45-USGS-TW”

Figure 4. Locations of temporary wells installed and sampled as part of the U.S. Geological Survey investigation, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina.

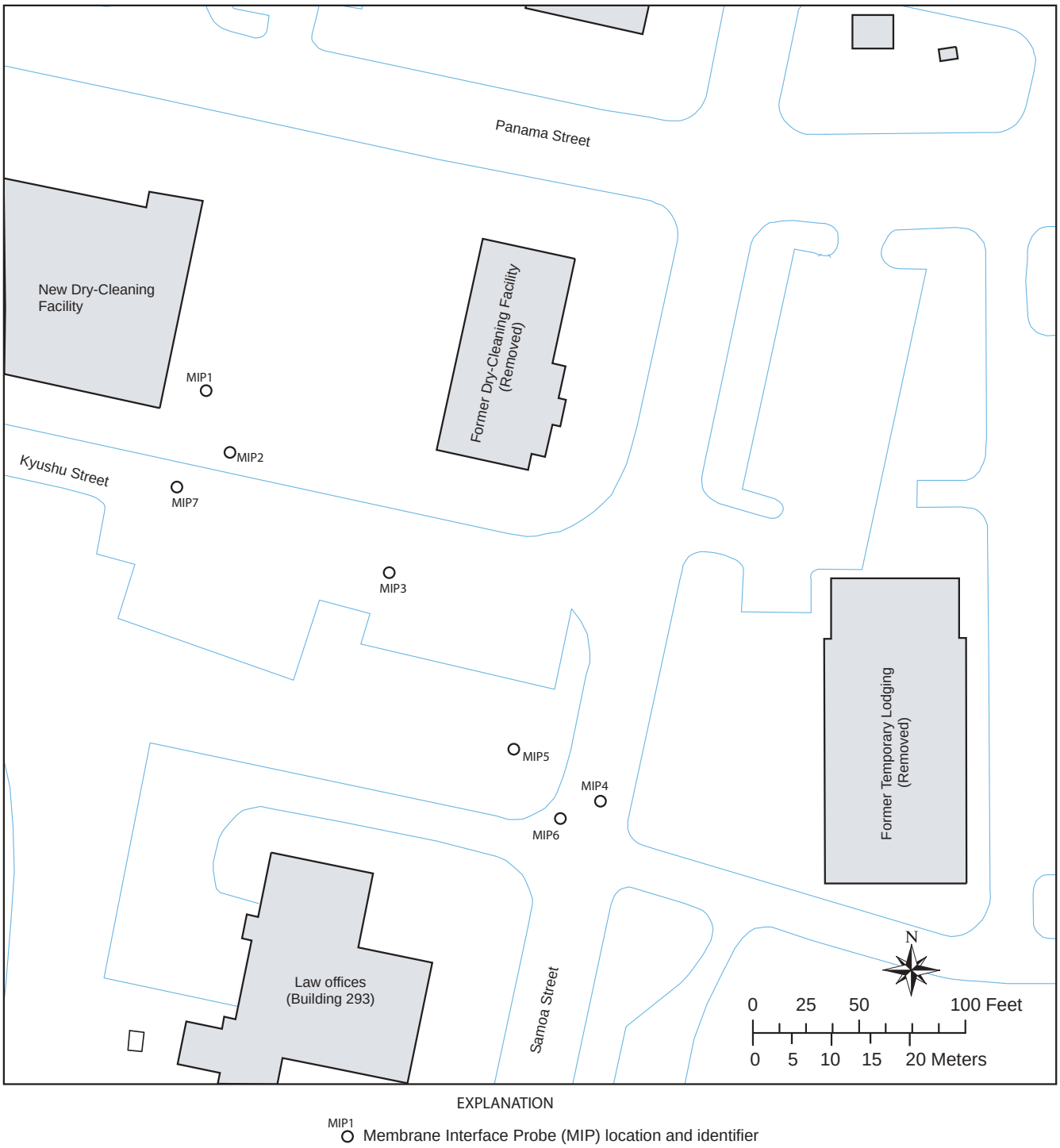


Figure 5. Locations of Membrane Interface Probe borings installed during the U.S. Geological Survey investigation, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina.

2-ft-thick layer of 100 percent sodium bentonite pellets that were allowed to hydrate for 1 hour or longer before grouting. Portland cement (100 percent) grout filled the remaining annular space above the bentonite seal to a point at least 2 ft below ground surface. The wells were flush mounted with at-grade protective steel casings equipped with sealing, locking caps, at-grade covers, and concrete pads at the well heads. All monitoring wells were developed by pumping to remove formation cuttings and residual fluids from drilling prior to initial sampling.

The three wells beneath the surficial aquifer were installed using hollow-stem augers and mud rotary. The driller used hollow-stem augers to set 6-inch-diameter Schedule-40 PVC outer casing from land surface to within the clay confining unit at the base of the surficial aquifer at a depth of approximately 19 to 20 ft. After grouting the surface casing in place with Portland® cement, the casing grout cured for approximately 24 hours. The driller then used a 5- to 5-5/8-inch-diameter roller cone bit with mud rotary to drill through the grouted bottom of the surface casing to a total depth of approximately 34–35 ft. The well constructed within the surface casing consisted of 2-inch ID PVC flush-threaded casing with 10-ft screen length having 0.010-inch openings. The primary filter pack consisted of clean silica #1 sand from approximately 3–6 inches below the bottom of the well to approximately 2 ft above the well screen. The overlying seal consisted of a minimum 2-ft-thick seal of 100 percent sodium bentonite pellets installed directly above the primary filter pack and allowed to hydrate for 1 hour or longer before grouting. Portland® cement (100 percent) grout filled the remaining annular space above the bentonite seal to a point at least 2 ft below ground surface. The wells were flush mounted with at-grade protective steel casings equipped with sealing, locking caps, at-grade covers, and concrete pad at the well heads. The monitoring wells were developed by pumping to remove formation cuttings and residual fluids from drilling prior to initial sampling.

On July 3, 2008, measurements of wells PAI-45-MW26-SL and PAI-45-MW27-SL showed that fine-grained sand had filled the screened interval, apparently as a result of the driller using a sand pack that was too coarse for the aquifer material. The driller returned to the site and modified the wells by removing the sand and constructing a 1-inch ID PVC well within each of the existing 2-inch diameter casings. The driller filled the remaining annular space of about 3/8 inch with sand. Subsequent examination of the wells showed that the modification was adequate to prevent further infilling with sand. A private surveying company, Andrews and Burgess, Inc., determined new vertical datums for the modified wells.

Water-Level Measurements

Water-level measurements in monitoring wells at Site 45 provided information to determine groundwater flow directions. Continuous water-level data from the storm sewers and the aquifer indicated that water levels increase in both during high tide. Before the data loggers provided information on the tidal influence, a synoptic water-level measurement on April 14, 2007, resulted in data that were not reproducible, with groundwater depths changing over the course of minutes in some wells. Therefore, subsequent synoptic water-level measurements were made at low tide, when water levels changed little over the course of hours. The measurements involved opening the caps on all of the wells and allowing the water levels to stabilize for at least 30 minutes, then deploying multiple people to measure water levels using electric tapes in a time period of less than about 30 minutes. To ensure that the water levels were corrected to a uniform datum, Andrews and Burgess, Inc., remeasured the altitudes of all of the wells in 2008. The water-level measurements provided synoptic data for six dates in the surficial aquifer and five dates in the deeper aquifer. Solinst Leveloggers provided continuous water-level monitoring in several wells and selected storm sewers.

Sewer Mapping

This investigation used a variety of approaches to map and investigate the sanitary and storm sewers at Site 45 (fig. 6). In the initial stages of this investigation, the direction of transport in an abandoned sanitary sewer that drained the former dry-cleaning facility was determined by pouring water into the manhole. Scanned images of historical as-built engineering drawings of buildings and sewer lines imported into a geographic information system map of the site, including surveyed locations of manholes, provided the framework for generating the map of sanitary- and storm-sewer locations. A commercial in-line sewer camera, used in the sanitary sewer from the former dry-cleaning facility and in several of the storm sewers, provided information on sewer integrity and confirmed connections between manholes. The altitudes of the sewer inverts (bottom of the pipe entering a manhole) were determined by comparing surveyed altitudes of manholes to field tape-down measurements. The nomenclature for manholes and storm-sewer drains in this report includes a prefix of “SAS” for sanitary sewer or “STS” for storm sewer, followed by a numeric identifier.

The USGS conducted a dye test on August 30, 2007, to verify the location of the storm-sewer discharge and to determine the time-of-transport for water in the storm sewer to reach the discharge location from Site 45. The test involved inserting 1 liter of Red 25 dye (KingsCote Chemicals®) into manhole STS06 at 12:51, 12 minutes after high tide (fig. 6). Monitoring of the dye transport with the outgoing tide took place in two manholes along the storm sewer and at the outfall to a tributary to Ballast Creek. A chlorophyll fluorometric sensor in manhole STS25 (fig. 7*A*) detected the arrival of the dye pulse.

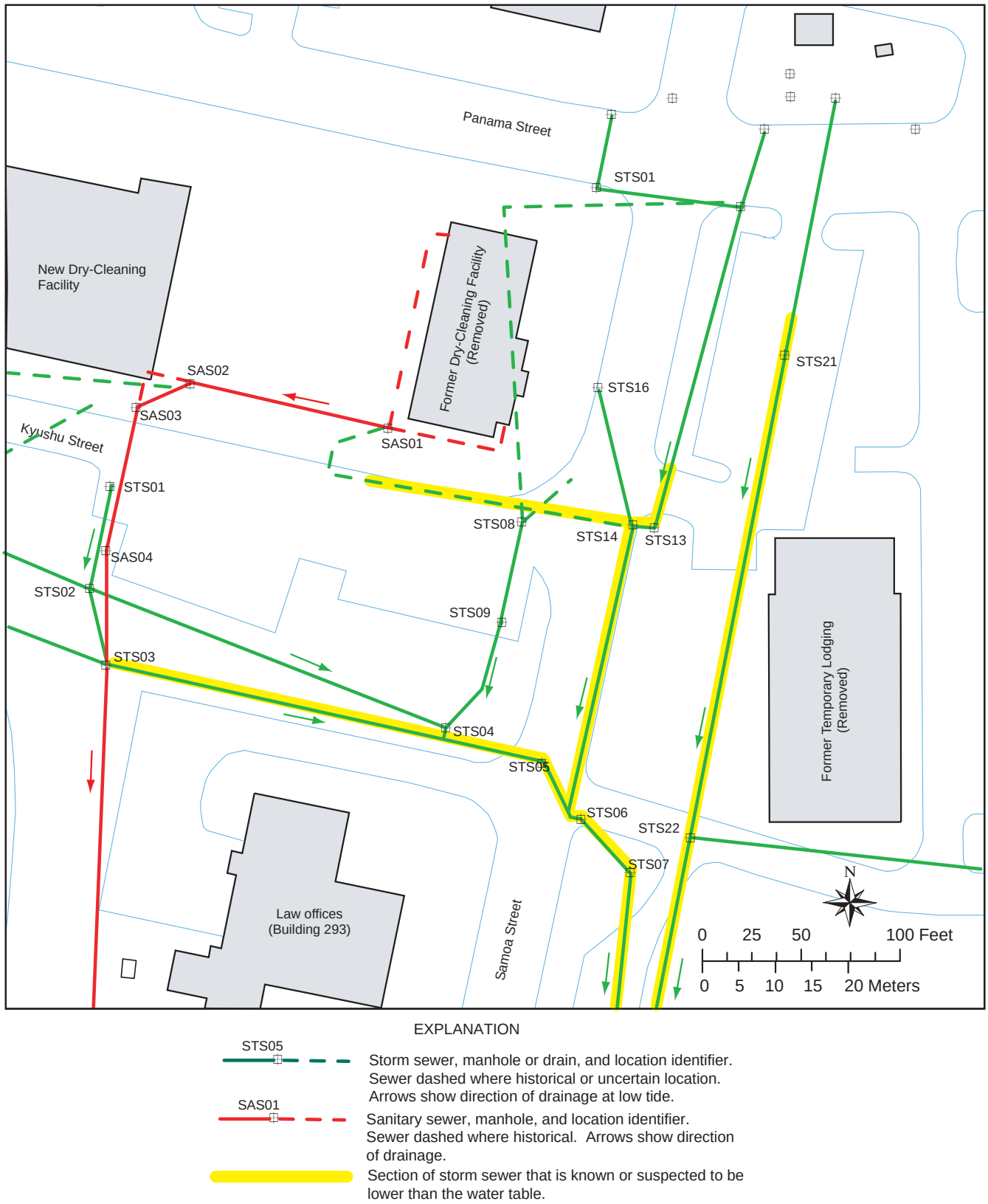
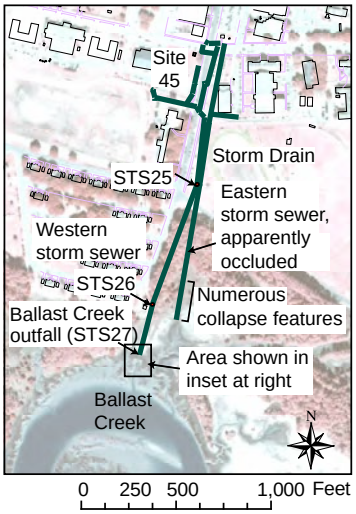


Figure 6. Storm sewers and sanitary sewers at Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina.

A. Storm sewers connecting Site 45 to Ballast Creek.



Water-sample location: June 16, 2008	Sediment samples colocated with water sample: June 17, 2008	Sediment-sample depths (feet below sediment-water interface): June 17, 2008
PAI-SW1	PAI-SWSED1	0.5 and 1.0
PAI-SW2	PAI-SWSED2	0.5 and 1.0
PAI-SW3	PAI-SWSED3	0.5 and 1.0
PAI-SW4	PAI-SWSED4	0.5 and 1.0

B. Sampling points near the storm-sewer outfall at the tributary to Ballast Creek.

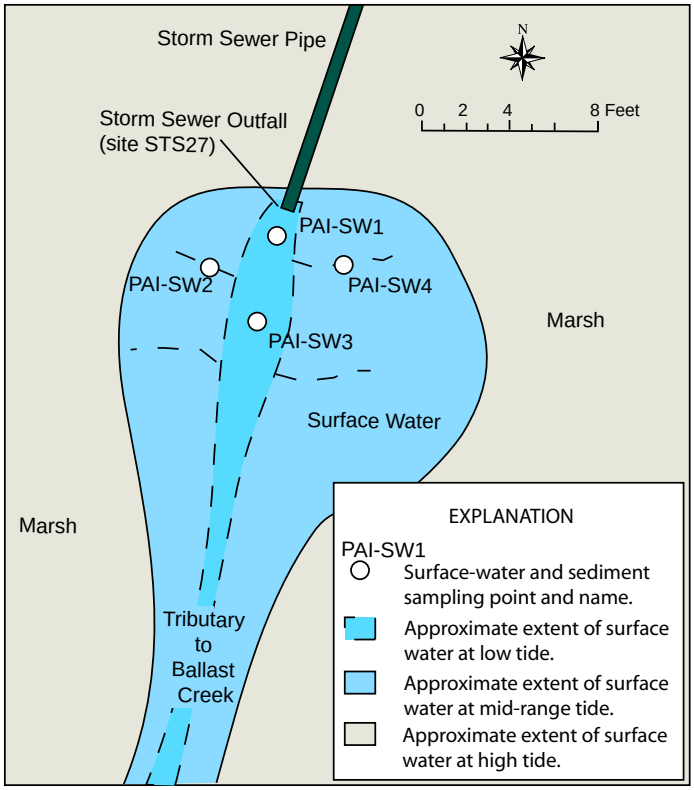


Figure 7. Locations of (*A*) storm sewers and (*B*) surface-water and sediment samples collected at the storm-sewer discharge from Site 45 to Ballast Creek, Marine Corps Recruit Depot, Parris Island, South Carolina, June 16–17, 2008.

Sediment Sampling

This investigation included collection of sediment samples from the tributary to Ballast Creek in the vicinity of the storm-sewer outfall at high tide using a 424-B40 hand corer (Wildlife Supply Company) (fig. 7*B*). Field personnel used the corer to collect the sediment in cellulose acetate liners, and then they extruded the sediment from the acetate liners into sampling syringes. The syringes were part of a U.S. Environmental Protection Agency (USEPA) Method 5035 O2SI Sample Smart Field Preservation Kit for sediment sampling (O2SI Smart Solutions, P.O. Box 30712, Charleston, SC). This kit consists of preserved syringes that allow a 14-day holding time for VOCs and analysis of moisture content. Sediment sample depths were 0.5 and 1 ft below the bed surface at each of four locations (fig. 7). Samples were analyzed for VOC content and percentage of moisture.

A limited number of sediment samples from the aquifer and confining material were analyzed for total organic carbon (TOC) content by method SW846-9060 (U.S. Environmental Protection Agency, 1999). A split-spoon sampler provided the core material from well PAI-45-MW28-D, and a direct-push technology method provided the core material from temporary well PAI-45-USGS-TW96. The sediment sample from well PAI-45-MW26-SL consisted of fine-grained sand that infiltrated the well screen after the well was completed, and, therefore, was skewed toward material fine enough to pass the well screen.

Selected core samples were analyzed onsite by the AQR Color-Tec® method (Kelso, 2005). This method consisted of collecting sediment by push technology and placing the sediment in a volatile organic analysis (VOA) vial with deionized water to make a slurry. The slurry was aerated by bubbling to collect the dissolved gas, which was passed through a colorimetric indicator tube. The colorimetric response is a relative response of total chlorinated VOC concentration.

Surface-Water and Storm-Drain Sampling

Water samples from surface water and storm drains were collected by means of a peristaltic pump attached to clean polyethylene tubing. The tubing was inserted through the center of a piece of rigid PVC pipe and extended to the sampling location. The tubing was then extended to beneath the water surface, and a water sample was collected by means of the peristaltic pump. Water samples were collected from the storm sewers at or soon after low tide while storm-sewer water was still moving toward Ballast Creek. An exception was on June 25, 2007, when a sample was collected during high tide from storm drain STS21 to measure pH, specific conductance, and temperature of incoming water (fig. 6).

Well Sampling

Water samples from the temporary wells were collected immediately after well installation by extending tubing to the screened interval and removing water with a peristaltic pump until the apparent turbidity diminished. Stabilization to field properties was not done because the wells were sampled immediately after opening the retractable well-screen cover, and, therefore, no stagnant casing water should have been in the borehole. The water samples were analyzed for VOCs.

Permanent wells at Site 45 were sampled by a variety of methods. The sampling approaches included low-flow methodology, diffusion-sampler methodology, and multiple casing-volume purges prior to sampling.

Prior to September 2007, all of the pumped water samples from wells were obtained by using low-flow methodology (Barcelona and others, 1994; Shanklin and others, 1995). Low-flow sampling, however, proved difficult and raised questions about sample quality because of tidal effects and the presence of vertically stratified specific conductance. The proximity of the well screens to specific-conductivity stratification sometimes resulted in continuous changes in specific conductance during low-flow stabilization that were more related to induced movement of low-conductivity or high-conductivity water toward the well rather than to well purging. For example, in July 2006, well PAI-45-MW20-SL was pumped by low-flow methodology for 2 hours and 17 minutes in an attempt to stabilize field properties so that low-flow samples could be collected. At that point, specific conductance was still slowly decreasing; however, the samples were collected because of concern that continued pumping would result in samples that no longer represented groundwater in the immediate vicinity of the well screen. In addition, recent work has shown that in-well convection cells can develop during the winter, resulting in a mixing of water during low-flow sampling that can substantially increase equilibration times, can cause false stabilization of indicator properties, can give false indications of the redox state, and can provide microbiological data that are not representative of the aquifer conditions (Vroblesky and others, 2007).

To reconcile these low-flow sampling issues, all of the wells except the deep well (PAI-45-MW-04D) were sampled in September 2007 by first evacuating three casing volumes of water from the top of the well casing and then lowering the sampling tubing to the screened interval and collecting the water samples. This was done to simplify the sampling process and to produce samples thought to be more representative of the immediate vicinity of the screened interval. The wells were purged by peristaltic pump from the top of the water column, and the intake tubing followed the water column down if drawdowns occurred. After three casing volumes were purged, the peristaltic tubing was lowered to the top of the screened interval, and approximately 0.5 to 1 gallon was purged, followed by field parameter measurement and sample collection. Stabilization to field properties was not done because the change in properties with continued pumping would reflect movement of conductivity interfaces in the aquifer rather than being related to the reliability of the well purge. In general, water levels were not allowed to drop into the screened interval during the three-casing-volume purge.

Low-flow sampling of wells continued to be used in wells where the static water level was within the screened interval of the well. In those cases, it was advisable to limit the amount of drawdown during pumping so as to avoid contaminant volatilization as water cascaded down the well screen. During low-flow sampling, the wells were purged at 120–250 milliliters per minute (mL/min), until the temperature, pH, dissolved oxygen (DO), and specific conductuctivity stabilized and no additional water-level drawdowns were observed. Stabilization of temperature, pH, dissolved oxygen, and specific conductance was observed by passing the water through a flow-through cell containing field-calibrated sensors. The field properties were considered to be stabilized when the observed changes over three 3-minute intervals were within ±3 percent for temperature and specific conductance, within ±0.1 unit for pH, and within ±10 percent for dissolved oxygen. VOCs and dissolved gases were collected with no headspace in 40-mL vials preserved by hydrochloric acid, and were analyzed by USEPA method 8260B at General Engineering Lab in Charleston, SC. Samples for dissolved metals were preserved with nitric acid, samples for dissolved total organic carbon were preserved with sulfuric acid, and anions were preserved by chilling. Molecular hydrogen samples were collected by a bubble-strip method and analyzed by Microseeps, Inc. Samples for molecular analysis were obtained by filtering water and sending the filters to Microbial Insights for analysis.

A vertical profile of specific conductance was measured in well PFM02, which is fully screened across the saturated zone from about 4 to about 20 ft below land surface. The profile was accomplished by using a YSI XLM conductivity sonde on June 14, 2007. The sonde was lowered into the well to a depth of about 2.7 ft. The readings of temperature, specific conductance, dissolved oxygen, and pH were allowed to stabilize, which generally took about 7 or 8 minutes. Readings were recorded and the sonde was lowered to the next measurement depth. Measurements were made at depth intervals of 3.28 ft, moving from the shallowest to the deepest depth.

Compound-Specific Isotope Analysis

Selected water samples were collected for compound-specific isotope analysis (CSIA) using carbon in the chlorinated solvents. CSIA can be used to examine biodegradation of contaminants. The two stable isotopes of carbon are ^{12}C and ^{13}C, of which ^{12}C is the lighter, more abundant, and more readily biodegraded. The ratio of $^{13}C/^{12}C$ relative to a reference standard of the Vienna Pee Dee Belemnite ($\delta^{13}C$) usually is reported in units of parts per thousand, or per mil (‰). Because the lighter isotope is more readily biodegraded, the resulting fractionation, or change in the $\delta^{13}C$, can indicate biodegradation. As the reaction proceeds, the reactant that remains becomes enriched in the heavier isotope, and the $\delta^{13}C$ value becomes progressively less negative (Hunkeler and others, 1999). Carbon isotope fractionation is not significant (for example, <0.5 ‰) for non-degradative processes such as sorption, but can be on the order of tens of ‰ for degradative processes (Dempster and others, 1997; Harrington and others, 1999; Poulson and Drever, 1999; Slater and others, 1999, 2000). The use of isotope ratio measurements of carbon in both parent and daughter compounds, therefore, can complement the conventional approach to monitoring of chlorinated-solvent concentrations and site geochemistry (Hunkeler and others, 1999; Sherwood Lollar and others, 1999, 2001; Song and others, 2002; Vieth and others, 2003).

Investigation-Derived Waste

Investigation-dervived waste (IDW) generated during this investigation included waste sediment cuttings from drilling operations and wastewater from well development, purging, and sampling. All IDW was containerized. The drilling contractor removed all IDW associated with drilling operations. In 2007, removal of the IDW from the site was the responsibility of the Navy. In 2008, removal of IDW from USGS operations was the responsibility of the USGS. The USGS containerized all surplus water from well sampling during 2008 in 55-gallon drums, and Fenn Vac, Inc., removed the waste from the site on September 29, 2008.

Site Description

MCRD, Parris Island, is a military training site surrounded by the Broad River to the west, the Beaufort River to the east, the confluence of those two rivers to the south, and Archers Creek to the north (fig. 1). The island is interfingered by several tidal creeks. Site 45 is relatively flat lying and is approximately 6 to 9 ft above North American Vertical Datum of 1988 (NAVD 88).

Movement of groundwater contamination at Site 45 is controlled by site hydrology. The site hydrology is influenced by a complex mixture of hydrogeologic aspects and by exchange of groundwater and surface water from leakage at storm sewers.

Hydrogeology

The surficial aquifer at Site 45 consists of sand interspersed with discontinuous beds of clay, silty clay, silty clayey sand, and clayey silt and extends to a depth of about 18 ft below land surface (BLS) (Tetra Tech NUS, Inc., 2004). Monitoring wells in this undifferentiated zone are referred to as SU wells if they are screened predominantly shallower than about 11 ft BLS and are referred to as SL wells if they are screened predominantly deeper than about 10 ft BLS.

A peat layer, which is a few feet thick, has been reported at depths of about 17 to 27 ft BLS overlying a clay layer that functions as a confining bed (Tetra Tech NUS, Inc., 2004). The part of the aquifer below this clay is considered to be the “D” horizon. Core samples collected during this investigation showed the peat layer to be a complex mixture of sand, silt, and clay with a substantial amount of black to brown organic material. The layer was encountered at a depth of 17.8 ft BLS in well PAI-45-MW28-D and 18.7 to 18.8 ft BLS at wells PAI-45-MW29-D and PAI-45-MW30-D. Sediment that probably was the top part of the layer was encountered at a depth of 15.2 ft BLS at well PAI-45-USGS-TW96.

The thickness of the clay at the base of the surficial aquifer was about 5 to 8 ft in wells drilled during a previous investigation (Tetra Tech NUS, Inc., 2004). During the present investigation, descriptions on the clay layer are based partly on split-spoon samples (top part of the clay) and partly on cuttings from mud-rotary drilling (bottom part of the clay). Thus, there is some uncertainty about the thickness of the clay. The clay layer at well PAI-45-MW28-D appeared to be about 3.5 ft thick at well PAI-45-MW28-D and between 2 and 3 ft thick at well PAI-45-MW30-D. At well PAI-45-MW29-D, an organic rich silt was encountered at a depth of 18.8 ft BLS. Mud-rotary cuttings below a depth of 19.6 ft BLS in well PAI-45-MW19-D showed a thin layer of sand, possibly at a depth of about 20–21 ft BLS, underlain by about 7.5 ft of clay.

The surficial aquifer at well PAI-45-MW28-D consists of silty sand with a zone of fine-grained very loose sand between about 6 and 11.4 ft BLS. The loose-sand zone probably constitutes the most permeable part of the surficial aquifer at well PAI-45-MW28-D. In the midpart of the plume at temporary well PAI-45-USGS-TW96 (near wells PAI-45-MW31-SL and PAI-45-MW31-SU), the sediment between depths of 4 and 16 ft BLS is sandiest between depths of 8 and 15.3 ft BLS, with fine-grained, loose sand at a depth of 8–10 ft BLS. The 8- to 10-ft zone probably constitutes the most permeable part of the surficial aquifer at well PAI-45-USGS-TW96. These findings are consistent with a previous passive-flux study showing a zone of relatively high Darcy flux between depths of about 9.5 and 11 ft BLS near the midpart of the southern plume at wells PFM-02 and PFM-03 (EnviroFlux, LLC, 2007). The lithologic and passive-flux data indicate that the most permeable part of the surficial aquifer in the southern plume beneath Kyushu Street probably is in the range of 6–11.4 ft BLS near the new dry-cleaning facility and about

8–10 ft BLS in the approximate midpart of the plume near wells PAI-45-MW31-SL and PAI-45-MW31-SU.

In the downgradient part of the plume near well clusters PAI-45-MW04 and PAI-45-MW20, passive-flux tests from the previous investigation showed a higher Darcy flux in the SU wells relative to the SL wells (EnviroFlux, LLC, 2007; Hackett and others, 2008). These findings are consistent with previously published slug-test data showing that the geometric mean of hydraulic conductivity (K) calculated from upper surficial aquifer wells [8 feet per day (ft/d)] was slightly greater than that calculated from the lower surficial aquifer wells (2 ft/d) (Tetra Tech, NUS, Inc., 2004).

A broad range of groundwater flow rates can be calculated from previously reported well tests at Site 45. Typical Darcy velocities estimated from passive-flux meter tests were about 0.027 ft/d [0.82 centimeter per day (cm/d)] at well MW10SL and about 0.020 to 0.095 ft/d (0.6 to 2.9 cm/d) at well PFM-01 (Enviroflux, LLC, 2007). At wells PFM-02 and PFM-03, the Darcy velocities ranged from about 0.033 to 0.164 ft/d (1 to 5 cm/d) at depths below 10 ft. Using a geologically reasonable porosity of 0.3 to 0.45, the calculated seepage velocity (Darcy velocity divided by porosity) ranges from about 16 to 199.5 feet per year (ft/yr).

Slug tests in the lower surficial aquifer by Tetra Tech NUS, Inc. (2004) showed a geometric mean K of about 2 ft/d. The hydraulic gradients between wells PAI-45-MW25-SL and PAI-45-MW31-SL and between wells PAI-45-MW31-SL and PAI-45-MW20-SL are about 0.0052 to 0.0053, based on the average of instantaneous gradients measured at 15-minute intervals between September 10 and September 29, 2008, during the present investigation. Using an assumed range of porosity of about 0.3–0.45, the seepage velocity [(K × hydraulic gradient)/porosity] can be calculated to be about 9–13 ft/yr.

Aquifer tests from a previous investigation gave an overall average K for the surficial aquifer of about 15.3 ft/d (Tetra Tech NUS, Inc., 2004). Using a hydraulic gradient of about 0.0052–0.0053 and a range of porosity of about 0.3–0.45, the calculated seepage velocity is about 65–97 ft/yr.

The variety of calculated seepage velocities in the previous discussion illustrates the uncertainty with calculations of groundwater velocity. The actual groundwater velocity almost certainly varies across the site with aquifer heterogeneity. Based strictly on aquifer tests (Tetra Tech NUS, Inc., 2004), the mean groundwater velocity in the southern plume is between the end values of about 9 and 97 ft/yr.

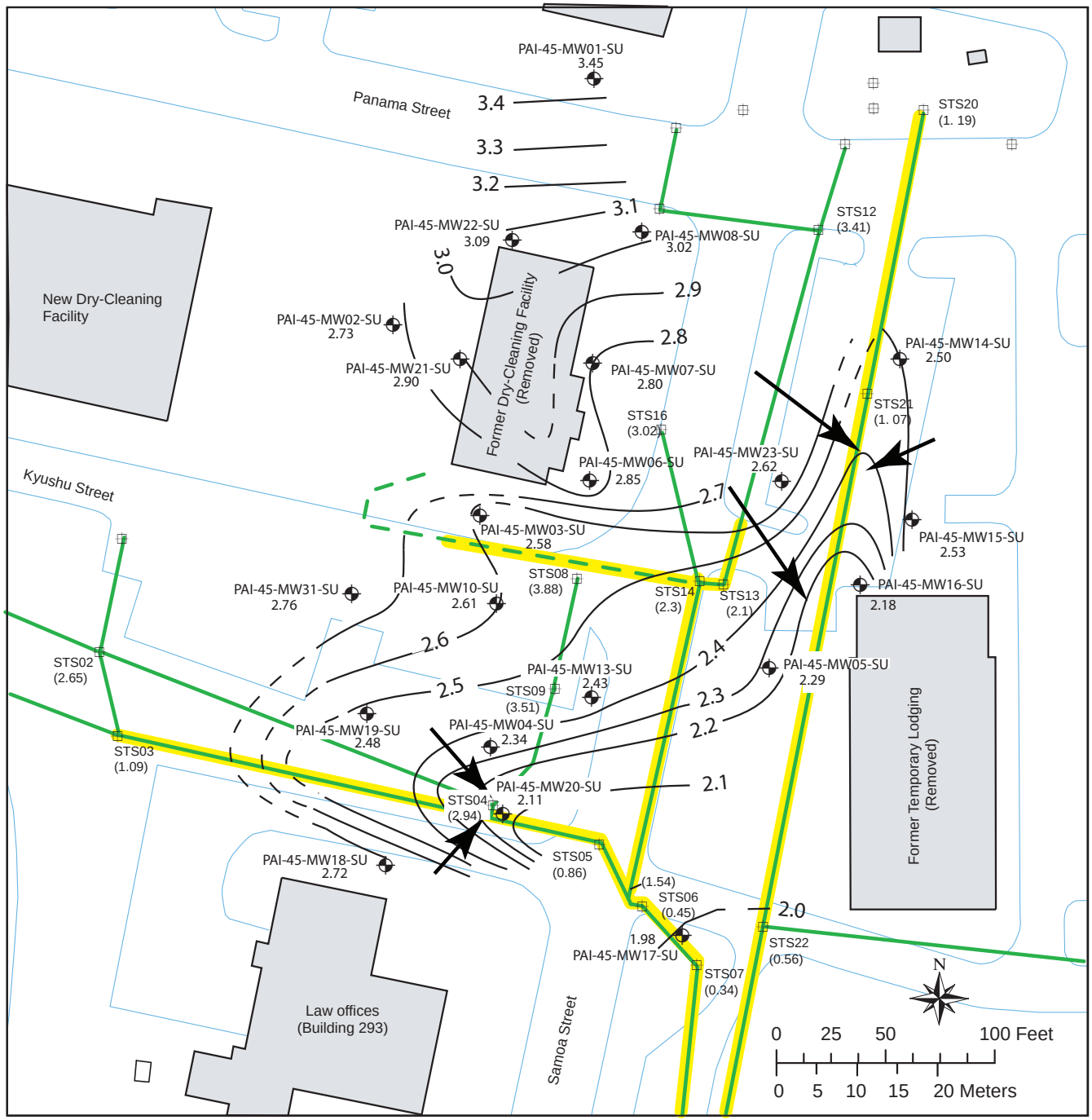
The surficial aquifer at Site 45 is unconfined. Depth to water is about 2–6 ft. Groundwater is recharged primarily from rainfall infiltration in non-paved areas. Some amount of recharge also may take place during rainfall events through partially collapsed storm sewers. For example, on June 4, 2008, repairs were done on partially collapsed storm sewer STS01 (fig. 6). Prior to the repairs, runoff from Kyushu Street south of the new dry cleaner collected and flowed into the asphalt cracks adjacent to the storm drain rather than into the storm drain. Thus, rainfall-derived runoff flowed into a focused part of the aquifer rather than being diverted offsite by the storm-sewer system. Because partially collapsed storm sewers are not always obvious from a casual surface inspection, there is the possibility that such localized rainfall infiltration is or has been influential in other parts of the site.

A primary discharge path for groundwater at Site 45 appears to be to storm sewers. The inverts (bottoms) of some sections of the storm-sewer system at Site 45 are below the high-tide level and below the groundwater levels (figs. 8 and 9). At the downgradient part of the southern plume, the bottoms of manholes STS05 and STS06 are at altitudes of 0.86 and 0.45 ft relative to NAVD 88 (about 5.5 and 5.4 ft BLS) and about 1.2 and 2.4 ft below the water table, respectively (fig. 8). At the downgradient part of the northern plume, the bottoms of manholes STS13 and STS21 are at altitudes of 2.1 and 1.07 ft relative to NAVD 88 (about 4.3 to 4.6 ft BLS) and about 0.3 to 1.3 ft below the water table, respectively (fig. 8).

Groundwater in both the SU and SL wells shows a general movement from the northwest to the southeast (figs. 8 and 9). The groundwater contours in the SU wells show strong curvature toward some of the storm sewers where the inverts of the sewers are deeper than the water table (fig. 8). These data indicate that groundwater discharges to the storm-sewer system in those areas. Curvature of the groundwater contours is less pronounced for the SL wells than for the SU wells, possibly reflecting a diminished hydraulic influence from the storm sewers on the deeper part of the surficial aquifer (fig. 9).

Infiltration of groundwater into sewers is not unusual when the sewers are below the water table, and in some municipal systems, infiltration of groundwater to sewer systems can be widespread and overwhelming (Wolf and others, 2003; Jamison, 2007). Discharge of groundwater to storm sewers at Navy bases may be more common than currently recognized considering the low altitude of many Navy bases and a previous report of groundwater discharge to storm sewers at U.S. Naval Air Station, Jacksonville, Florida (Davis, 2003).

Because the storm-sewer system connects to tidally influenced Ballast Creek, tidal water enters the storm drains through an open drain approximately 1,400 ft south of Site 45 during incoming tides. Incoming tidal water moves inland through the sewer system at least as far as to Site 45. A water-level logger recorded tidally induced water-level increases of more than 3 ft in the storm sewer at manhole STS06 (fig. 10). Surficial aquifer groundwater levels in the vicinity of the storm sewers also rise and fall in response to tidal cycles. In general, where the invert of the storm sewer is below the water table, groundwater levels tend to be higher than water levels in the storm sewer at low tide and lower than in the storm sewer about 1 to 2 hours preceding and following high tide. The higher water levels in the storm sewers than in the groundwater about 1 to 2 hours preceding and following high tide indicate a short-term potential for movement of tidal water from the storm sewers to the aquifer.



EXPLANATION

—2.3 — - Water-level contour, June 27, 2008. Interval is 0.1 foot. Datum is North American Vertical Datum of 1988 (NAVD 88). Dashed where inferred. Arrows show general direction of groundwater movement.

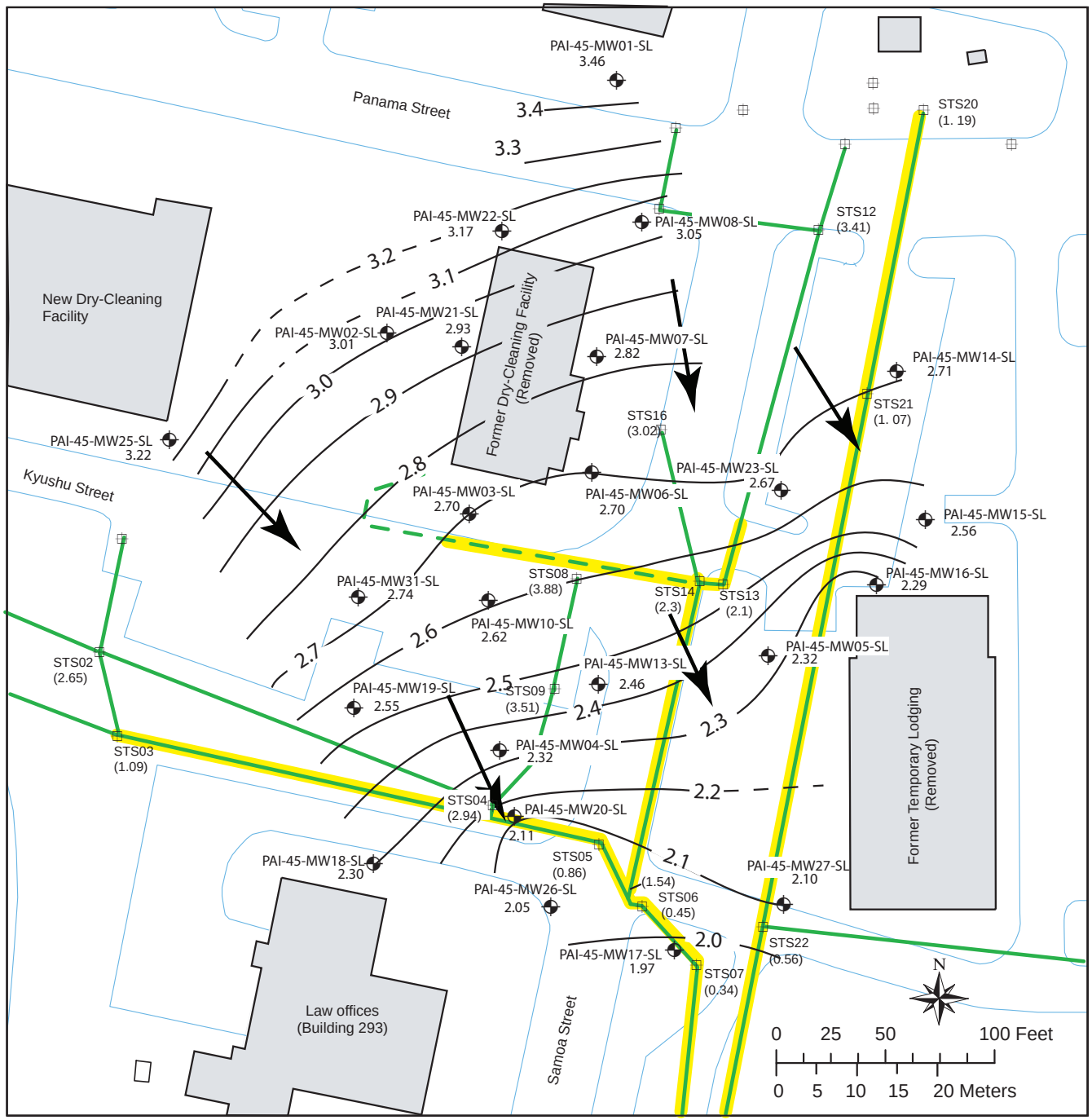
PAI-45-MW20-SU
2.61

Monitoring well, identifier, and water level, in feet above NAVD 88, June 27, 2008, low tide.

STS06
(0.45)

Storm sewer, manhole or drain, and location identifier. Line dashed where historical or uncertain location. Storm sewer is highlighted in yellow where it is known or suspected to be below the water table. Number in parentheses is estimated altitude of invert, in feet above NAVD 88.

Figure 8. Groundwater levels in the SU wells in the surficial aquifer, Marine Corps Recruit Depot, Parris Island, South Carolina, June 27, 2008.



EXPLANATION

2.3 — Water-level contour, June 27, 2008. Interval is 0.1 foot. Datum is North American Vertical Datum of 1988 (NAVD 88). Dashed where inferred. Arrows show approximate direction of groundwater movement.

PAI-45-MW20-SL 2.11 — Monitoring well, identifier, and water level, in feet above NAVD 88, June 27, 2008, low tide.

STS06 (0.45) — Storm sewer, manhole or drain, and location identifier. Line dashed where historical or uncertain location. Storm sewer is highlighted in yellow where it is known or suspected to be below the water table. Number in parentheses is estimated altitude of invert, in feet above NAVD 88.

Figure 9. Groundwater levels in the SL wells in the surficial aquifer, Marine Corps Recruit Depot, Parris Island, South Carolina, June 27, 2008.

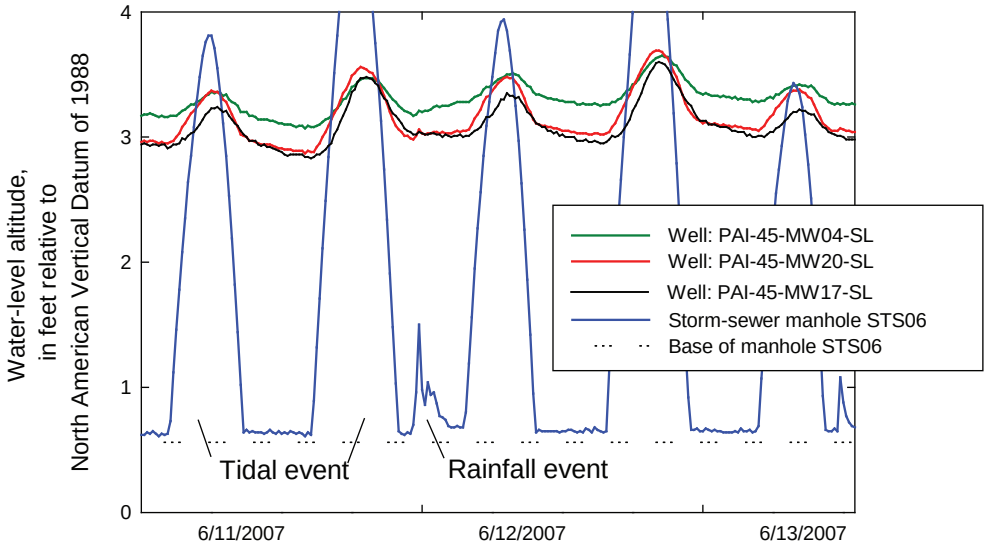


Figure 10. Water levels in selected monitoring wells and storm-sewer manhole STS06, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, June 11–13, 2007.

A groundwater map for the "D"-horizon wells is not shown because groundwater levels across the site on June 27, 2008, differed by only 0.16 ft or less, with the exception of well PAI-45-MW11-D. In general, the slight hydraulic gradient was from the northwest to the southeast. In contrast, the groundwater level in well PAI-45-MW11-D typically showed a marked dissimilarity from the other D-horizon wells. For example, on June 27, 2008, the groundwater level in well PAI-45-MW11-D was more than 1 ft lower than the groundwater level in any other D-horizon well and appeared to be more sensitive to tidal fluctuations than the remaining D-horizon wells. Water levels in well PAI-45-MW11-D were more than 2 ft lower than in wells in the overlying SL horizon. Releveling of the well measuring point revealed no significant datum error. The reason for the anomalous water levels in well PAI-45-MW11-D was not investigated further.

Groundwater Chemistry

The surfical aquifer at Site 45 is anaerobic at most locations, with DO concentrations less than 0.3 milligram per liter (mg/L) and sometimes less than 0.025 mg/L. Although aerobic groundwater conditions in the shallow part of the surficial aquifer were observed during two events at well PAI-45-MW-20-SU (September 29, 2006, and September 10, 2007) and during one event at well PAI-45-MW-05-SU (September 8, 2008), anaerobic conditions also prevailed in groundwater from these wells on other sampling dates. Thus, the dominant redox reactions in the contaminated aquifer are anaerobic.

The specific terminal electron accepting process (TEAP) probably varies spatially in the study area. The patchy brown coloring of the sand in some shallow parts of the surficial aquifer (less than about 6–8 ft BLS) indicates that iron reduction probably is an active electron accepting activity in the shallowest sediment (lithologic logs from wells PAI-45-MW28-D and PAI-45-USGS-TW96). The USEPA reported an increase in acid-extractable iron from sediment cores with depth from about 8.4 to 16 ft BLS in the upgradient part of the southern plume (Scott Huling, U.S. Environmental Protection Agency, written commun., 2009). These data may mean that iron reduction continues to be a predominant TEAP to a depth of at least 16 ft BLS; however, it also is possible that the acid-extractable iron does not represent bioavailable ferric iron. Data from the present investigation indicate that the dominant TEAP in groundwater from some of the SL wells is more reducing than iron reduction.

The sediment is predominantly gray at depths below about 8 ft in parts of the southern plume, indicating less of a potential for iron reduction at depth than in shallower sediment. When ferric iron is unavailable and sulfate is present in an anaerobic aquifer, sulfate reduction is commonly the predominant TEAP. Sulfate concentrations in groundwater in the vicinity of the southern-plume source area are about 40 to 50 mg/L (well PAI-45-MW25-SL). In the downgradient part of the southern plume at well PAI-45-MW20-SL, sulfate concentrations in the groundwater are about 112 to 130 mg/L. In anaerobic aquifers lacking more efficient electron acceptors, such as ferric iron, these concentrations are sufficient to allow sulfate reduction to outcompete methanogenesis (Vroblesky and others, 1996). If the gray sediment at depths below 8 ft indicates that there is insufficient bioavailable ferric iron to support iron reduction, then it is likely that sulfate reduction is the predominant TEAP in much of the contaminated

aquifer of the southern plume. Although sulfide typically was not detected in the wells, 0.28 to 0.47 mg/L of sulfide was detected in groundwater at well PAI-45-MW20-SU during 2008. In addition, molecular hydrogen (H_2) measurements ranged from 1.1 to 3.4 nanomoles per liter (nM) in six out of the seven tested wells in the surficial aquifer. H_2 concentrations in anaerobic systems can be classified as follows: less than 0.1 nM, characteristic of denitrification; 0.2–0.8 nM, characteristic of iron reduction; 1–4 nM, characteristic of sulfate reduction; and greater than 5 nM, characteristic of methanogenesis, with in-between ranges being not diagnostic (Chapelle and others, 1997). Thus, most of the measured H_2 concentrations were in the range of sulfate reduction. The H_2 concentration in one out of the seven tested wells was in the range characteristic of methanogenesis.

The methane concentrations in groundwater from the source-area well of the southern plume (PAI-45-MW25-SL) are relatively low [180–754 micrograms per liter (µg/L)]; however, methane concentrations in groundwater from a number of other wells in the southern plume are greater than 1,000 µg/L. The elevated methane concentrations may partly represent methane from probable methanogenic degradation in the organic-rich layer (peat zone) at the base of the surficial aquifer, below the screened intervals of the monitoring wells. The presence of paved areas has the potential to trap some methane otherwise released from groundwater to the atmosphere, possibly explaining why methane concentrations are higher in the shallower SU wells than in the deeper SL well beneath Kyushu Street at well clusters PAI-45-MW10 and PAI-45-MW31. Low concentrations of acetic acid (0.11–0.33 mg/L) are present in groundwater from a number of wells in the southern plume, however, indicating that part of the methane probably represents localized pockets of methanogenesis in the surficial aquifer at or near the screened intervals of wells. Support of this hypothesis is that the H_2 value of groundwater at well PAI-45-MW31-SL was 31 nM on September 9, 2008, which is in the range of methanogenic conditions.

Groundwater in the SL wells had a greater specific conductance and greater chloride concentration than groundwater in the SU wells. The contrast is most pronounced at well cluster PAI-45-MW17, where the specific conductance of water was 622–942 microsiemens per centimeter (µS/cm) from the SU well and 4,264–5,917 µS/cm from the SL well. Chloride concentrations ranged from about 68 to 162 mg/L in groundwater at the SU screen and from about 1,160 to 1,750 mg/L in groundwater at the SL screen. Because this well cluster is near a storm sewer that is more than 1 ft below the water table, the conductivity contrast may represent density stratification from leakage of saltwater from the storm sewer at high tide. Although not as pronounced as at well cluster PAI-45-MW17, the elevated specific conductance, chloride, and sodium concentrations in SL wells (compared with the SU wells) at other tested well clusters indicates some degree of vertical density stratification elsewhere in the surficial aquifer. Additional evidence for conductivity stratification can be seen at well PFM-02 (fig. 3) in the central part of the southern plume, where the specific conductance substantially increases with depths greater than 15 ft BLS (fig. 11).

In the three D-horizon wells tested below the surficial aquifer in this investigation (wells PAI-45-MW28-D, -MW29-D, and -MW30-D), the chloride and specific conductance were substantially greater than in the surficial aquifer. Chloride concentrations ranged from 1,940 to 5,520 mg/L, and specific conductance ranged from 7,050 to 17,714 µS/cm. Salinity measured in well PAI-45-MW29-D [8.1 milligrams per milliliter (mg/mL)] indicated that water in the D horizon is brackish.

Low levels of non-chlorinated-solvent constituents are present in groundwater in the surficial aquifer at concentrations exceeding USEPA maximum contaminant levels (MCLs). In September 2008, six wells in the surficial aquifer were sampled for dissolved arsenic. Of these six wells, two were SU wells, and neither contained arsenic at a detection limit of 0.005 mg/L. The four remaining wells were SL wells; three out of the four of these wells contained dissolved arsenic concentrations in the range of 0.13 to 0.22 mg/L, which is greater than the USEPA MCL of 0.01 mg/L (U.S. Environmental Protection Agency, 2002).

Finally, low concentrations of petroleum hydrocarbons were present in well PAI-45-MW27-SL near the former temporary lodging facility (table 1, fig. 3). The petroleum hydrocarbons were detected at similar concentrations in the sample and in a duplicate, and the anomalously low sulfate concentration (2.63–2.94 mg/L) and high methane concentration

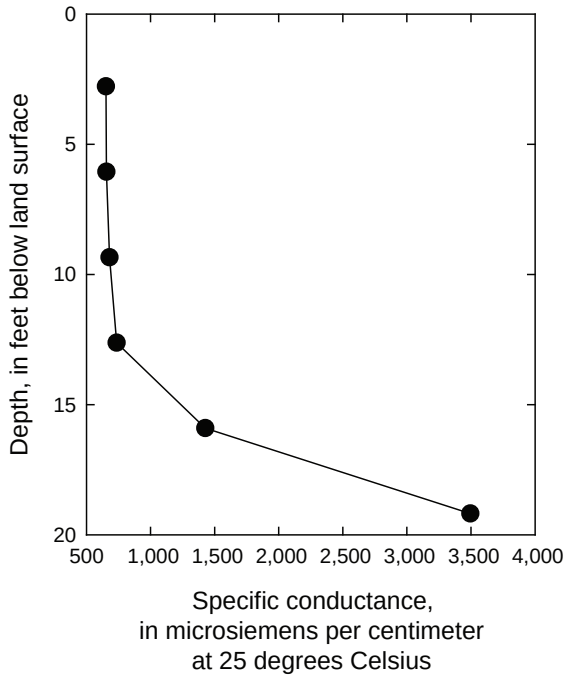


Figure 11. Vertical profile of specific conductance at well PFM-02, Marine Corps Recruit Depot, Parris Island, South Carolina, June 14, 2007.

(7,310–7,630 µg/L) are consistent with a shift from sulfate reduction to methanogenesis, as is common when petroleum hydrocarbons are present in an aquifer. Low concentrations of petroleum hydrocarbons also were detected in temporary wells drilled near the former temporary lodging facility in June and August 2007 (table 1, fig. 4). The source of the petroleum hydrocarbons is not known. Some of the benzene detections were slightly greater than the 5-µg/L MCL established by the USEPA (U.S. Environmental Protection Agency, 2008).

Distribution of Chlorinated-Solvent Groundwater Contamination

This investigation examined aspects related to areal and vertical distribution of the groundwater contamination. Data related to the areal distribution of groundwater contamination were collected for the southern plume and the downgradient part of the northern plume. Data related to the vertical distribution of groundwater contamination were collected only for the southern plume.

Areal Distribution of Groundwater Contamination

Groundwater contamination by chlorinated solvents at Site 45 is present in two lobes with some probable intermingling in downgradient parts (figs. 12–15). The northern plume extends southeastward from the northern part of the former dry-cleaning facility. The southern plume extends from the southeastern corner of the new dry-cleaning facility to approximately the intersection of Samoa Street and the entrance to the Building 293 driveway. Because the northern plume has been studied extensively in previous investigations (Tetra Tech NUS, Inc., 2004, 2005), the present investigation concentrated on the southern plume and the downgradient part of the northern plume. The distribution of groundwater contamination shown in figures 12–15 represents data from multiple sampling events during an approximate 2-year period. In the southern plume, the data include groundwater samples from temporary wells installed for this investigation on multiple dates, from temporary wells installed during a previous investigation in 2006 (Mark Sladic, Tetra Tech NUS, Inc., written commun., 2006), and from permanent wells that were sampled in 2008. Thus, the mapped configurations of individual constituents represent generalized distributions rather than snapshots in time. The data from the northern plume represent samples collected primarily during a single event (June 2007), but include data from a monitoring well sampled in June 2008.

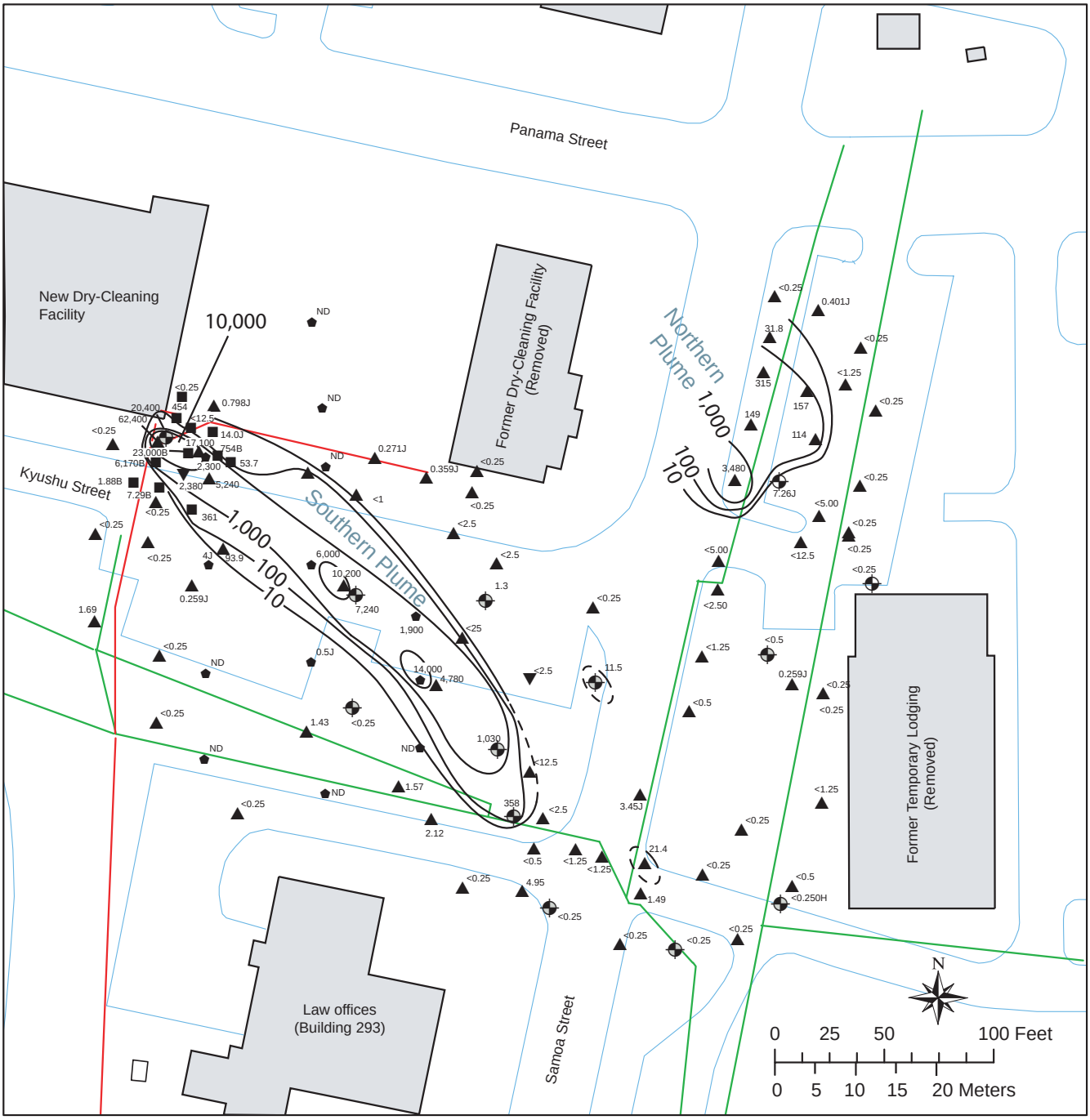
The downgradient part of the northern plume extends southeastward to the storm drain connected to storm drain STS21 (fig. 6). No detectable groundwater contamination was found in temporary or permanent wells east of that storm drain beneath the former temporary lodging parking lot (figs. 12–15).

The main part of groundwater contamination in the southern plume extends from the southeastern corner of the new dry-cleaning facility southeastward toward well PAI-45-MW20-SL (figs. 3 and 12). PCE concentrations in the southern plume were greatest in the source area at the southeastern corner of the new dry-cleaning facility (62,400 µg/L) and were greater than 10,000 µg/L in the middle part of the

Table 1. Concentrations of total organic carbon in sediment cores, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2008.

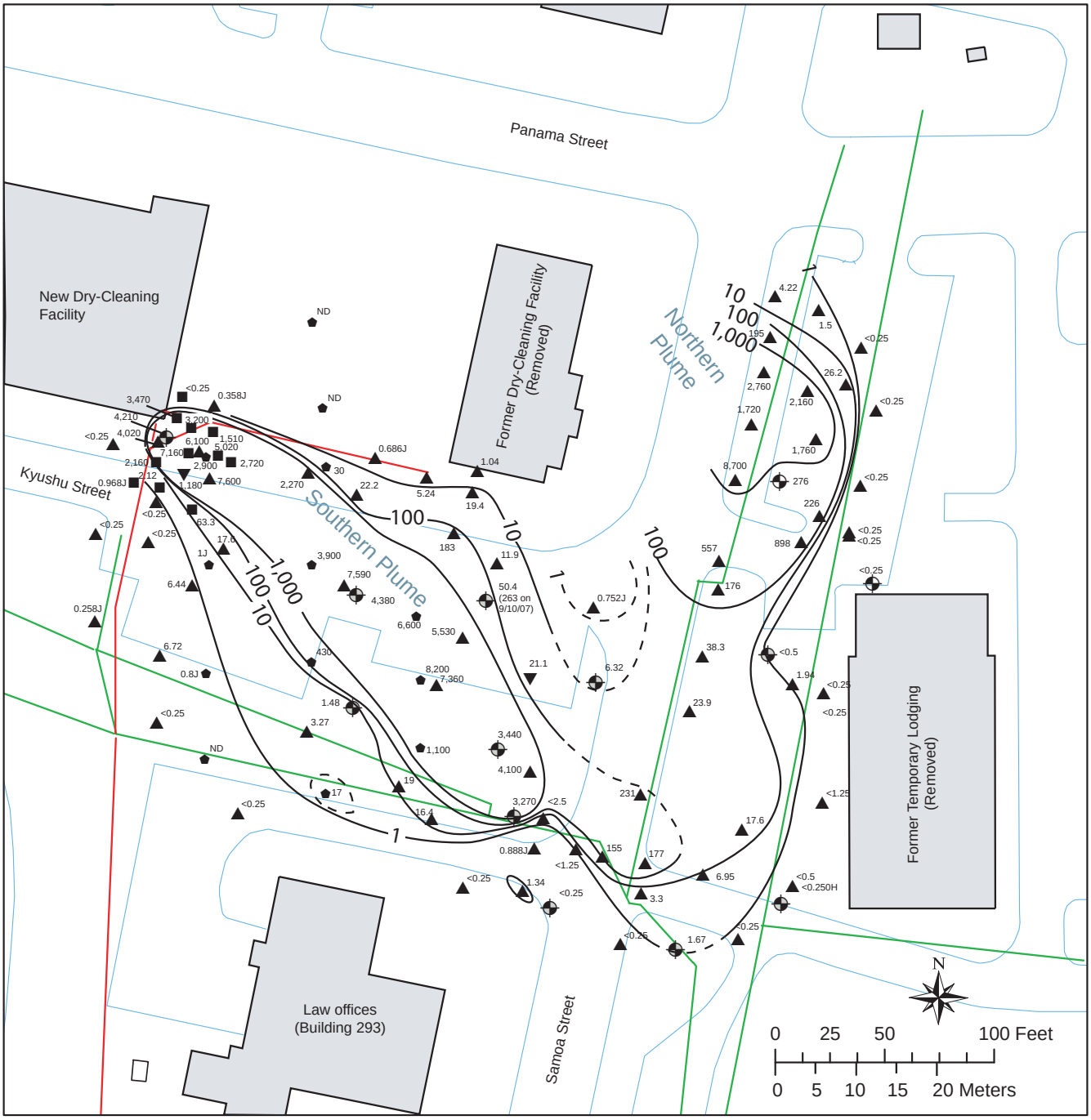
[J, estimated value; <, less than; MCL, maximum contaminant level for drinking water established by the U.S. Environmental Protection Agency, accessed on June 18, 2009, at http://www.epa.gov/safewater/contaminants/index.html#mcls]

Well identifier	Date	Concentration, in micrograms per liter				
		Benzene	Toluene	Ethylbenzene	Xylenes (total)	Naphthalene
PAI-45-MW27-SL	September 11, 2007	6.01	1.55J	5.14	8.44	606
PAI-45-MW27-SL duplicate	September 11, 2007	5.94	1.38J	4.94J	8.49	555
PAI-45-USGS-TW21	June 25, 2007	0.952J	<0.25	<0.25	<0.25	6.98
PAI-45-USGS-TW26	June 25, 2007	1.71	<0.25	<0.25	<0.25	<0.25
PAI-45-USGS-TW36	June 25, 2007	4.17	<0.5	1.21J	1.97J	81.9
PAI-45-USGS-TW65	June 28, 2007	5.36	<1.25	3.81J	6.55	397
PAI-45-USGS-TW71	August 29, 2007	2.66	0.759J	0.759J	0.773J	119
MCL	Not applicable	5	1,000	700	10,000	Not established



- Monitoring well sampled during June 2008
- USGS Temporary well sampled during March 2008
- USGS Temporary well sampled during August 2007
- USGS Temporary well sampled during June 2007
- Tetra Tech NUS, Inc., temporary well, 2006 (Mark Sladic, Tetra Tech NUS, Inc., written commun., 2007)
- <0.25 Concentration of tetrachloroethene, in micrograms per liter. [<, less than; J, estimated; H, analyzed out of holding time; ND, not detected at unstated detection limit]
- —10– – Line of equal tetrachloroethene concentration, in micrograms per liter. Interval variable as shown. Dashed where uncertain.
- Storm sewer
- Sanitary sewer

Figure 12. Generalized distribution of tetrachloroethene in groundwater at Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2006–2008.



Monitoring well sampled during June 2008, unless otherwise noted

USGS Temporary well sampled during March 2008

USGS Temporary well sampled during August 2007

USGS Temporary well sampled during June 2007

Tetra Tech NUS, Inc., temporary well, 2006 (Mark Sladic, Tetra Tech NUS, Inc., written commun., 2007)

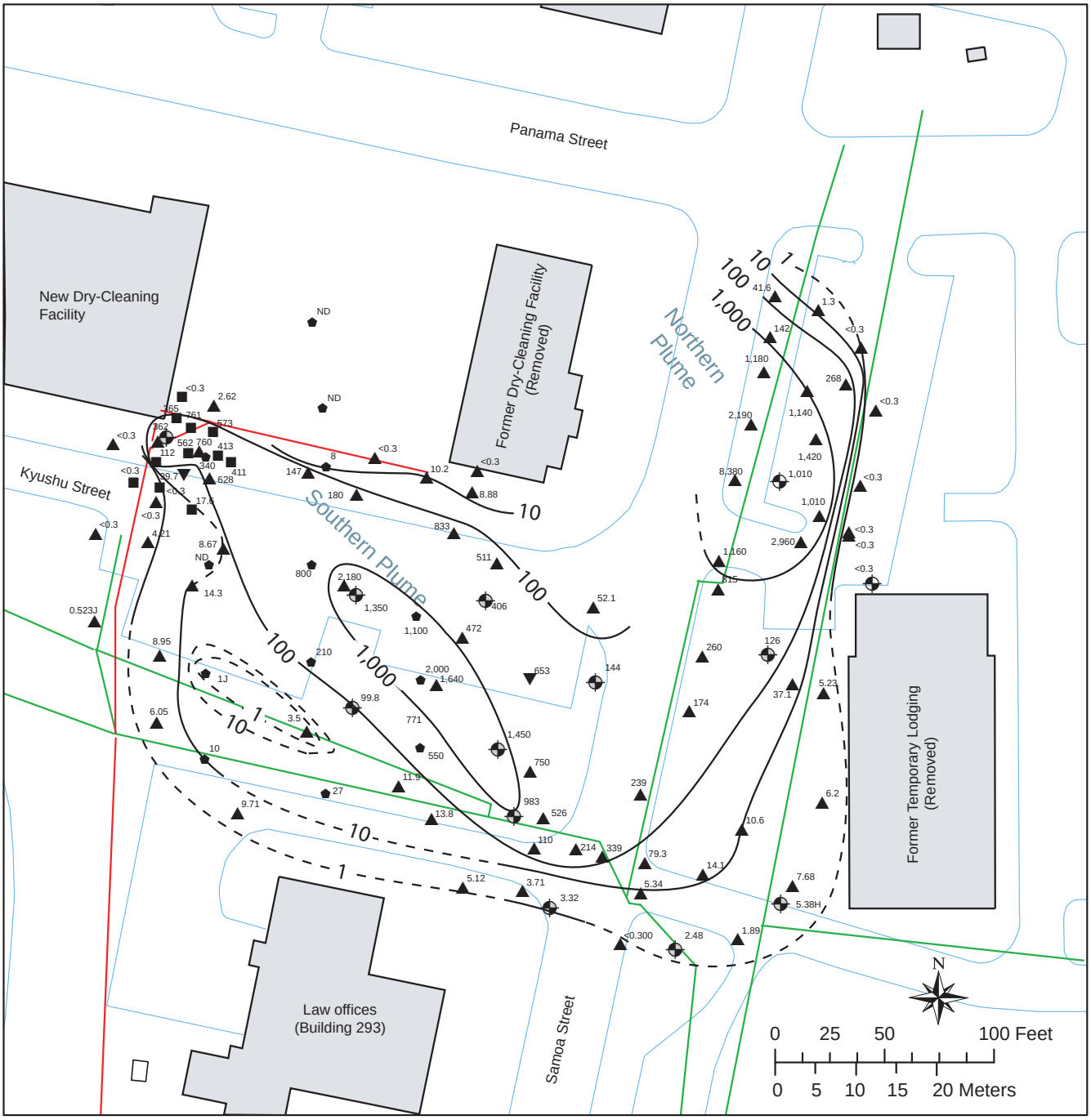
<0.25 Concentration of trichloroethene, in micrograms per liter. [<, less than; J, estimated; H, analyzed out of holding time; ND, not detected at unstated detection limit]

—10– – Line of equal trichloroethene concentration, in micrograms per liter. Interval variable as shown. Dashed where uncertain.

Storm sewer

Sanitary sewer

Figure 13. Generalized distribution of trichloroethene in groundwater at Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2006–2008.



Monitoring well sampled during June 2008

USGS Temporary well sampled during March 2008

USGS Temporary well sampled during August 2007

USGS Temporary well sampled during June 2007

Tetra Tech NUS, Inc., temporary well, 2006 (Mark Sladic, Tetra Tech NUS, Inc., written commun., 2007)

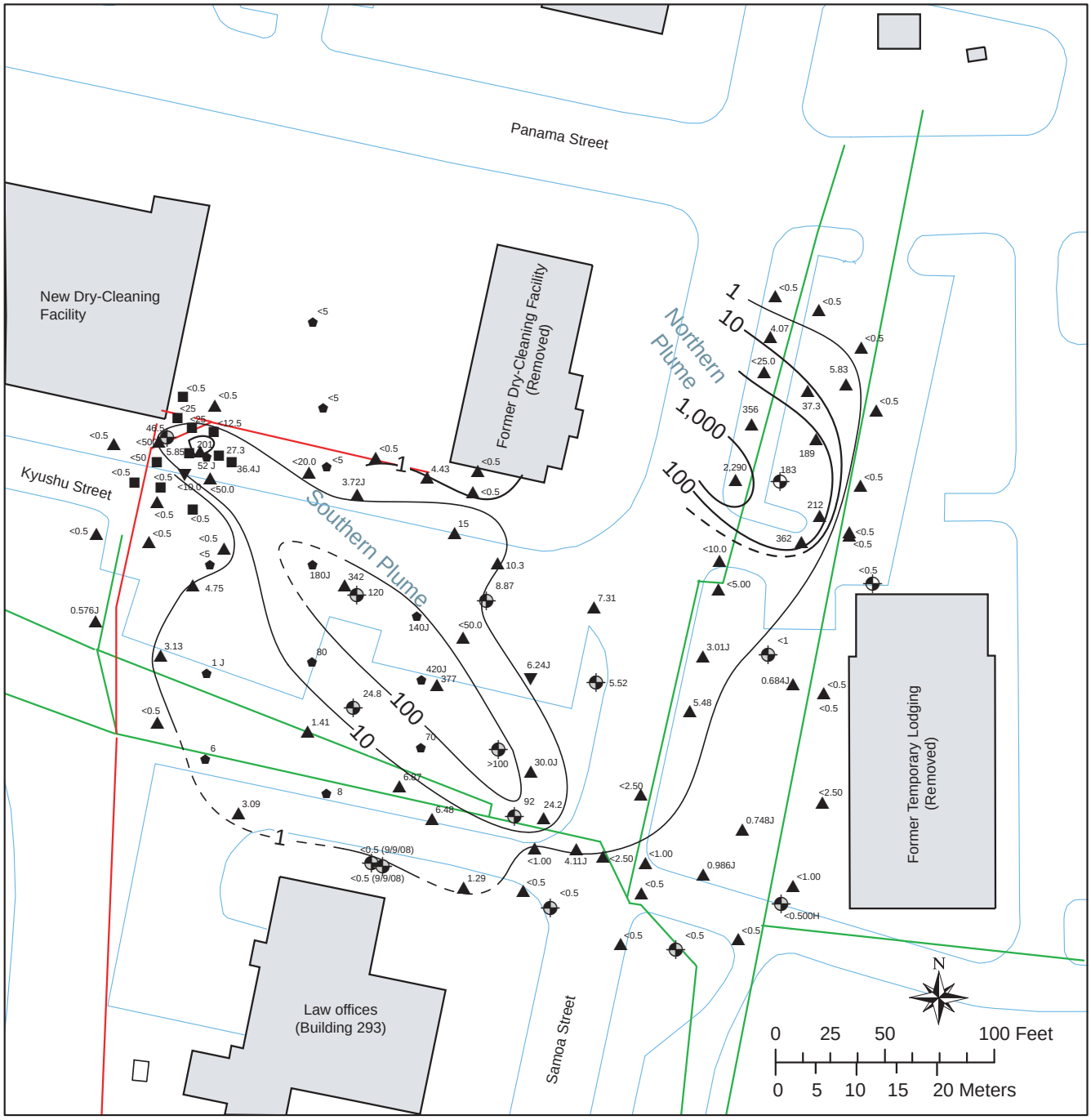
10 Concentration of *cis*-1,2-dichloroethene, in micrograms per liter. [<, less than; J, estimated; H, analyzed out of holding time; ND, not detected at unstated detection limit]

—10– – Line of equal *cis*-1,2-dichloroethene concentration, in micrograms per liter. Interval variable as shown. Dashed where uncertain.

Storm sewer

Sanitary sewer

Figure 14. Generalized distribution of *cis*-1,2-dichloroethene in groundwater at Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2006–2008.



Monitoring well sampled during June 2008

USGS Temporary well sampled during March 2008

USGS Temporary well sampled during August 2007

USGS Temporary well sampled during June 2007

Tetra Tech NUS, Inc., temporary well, 2006 (Mark Sladic, Tetra Tech NUS, Inc., written commun., 2007)

10 Concentration of vinyl chloride, in micrograms per liter. [<, less than; J, estimated; H, analyzed out of holding time; ND, not detected at unstated detection limit]

—10– – – Line of equal vinyl chloride concentration, in micrograms per liter. Interval variable as shown. Dashed where uncertain.

Storm sewer

Sanitary sewer

Figure 15. Generalized distribution of vinyl chloride in groundwater at Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2006–2008.

plume beneath Kyushu Street (fig. 12). Concentrations of TCE were relatively uniform along the axis of the southern plume (fig. 13). *c*DCE was most concentrated (1,100–2,180 µg/L) near the middle part of the plume between temporary wells PAI-45-USGS-TW48 and PAI-45-USGS-TW53 (figs. 4 and 14). In general, VC also was most concentrated in the central part of the plume (greater than 100 µg/L) (fig. 15). An exception, however, is a temporary well (PAI-USGS-TW44) near the new dry cleaner where a VC concentration of 201 µg/L was found in the groundwater (fig. 15).

Vertical Distribution of Groundwater Contamination

A variety of lines of evidence contribute to the interpretation of the vertical distribution of groundwater contamination at Site 45. The data include lithologic descriptions, ECD logs from MIP investigations, sediment analysis from core samples, and groundwater samples from temporary and permanent wells (fig. 16).

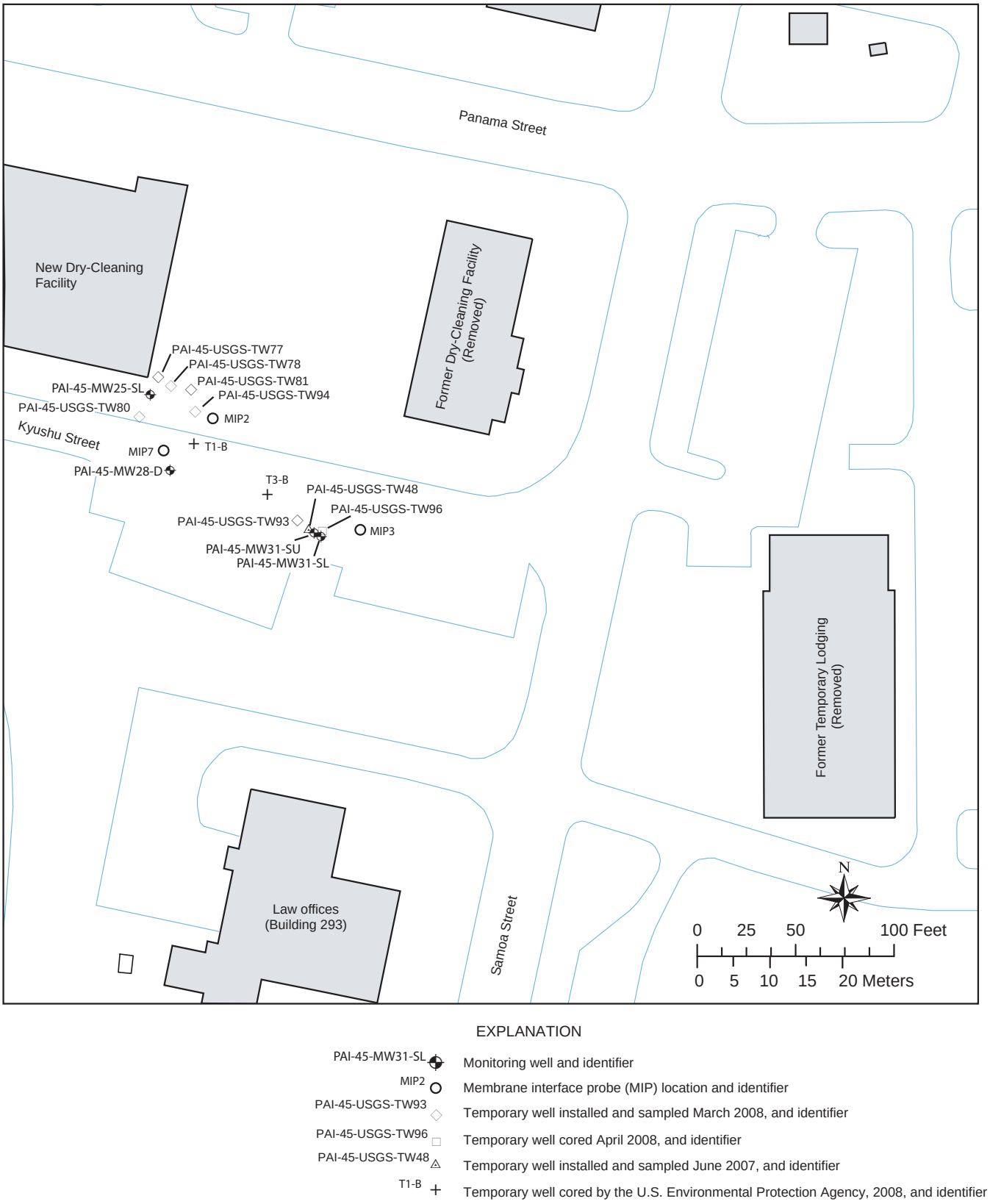
Although well PAI-45-MW28-D is screened below the surficial aquifer, lithologic data collected during the well installation provide information on the nature of the surficial aquifer at that well. Based only on lithologic considerations from drilling cores at well PAI-45-MW28-D, the most permeable part of the surficial aquifer near the new dry-cleaning facility probably is at a depth of about 6.5 to 11.4 ft BLS (altitude of about –1 to –5.9 ft relative to NAVD 88). That horizon consisted of loose, wet sand (fig. 17*A*). The zone beneath the sand was siltier and, therefore, less permeable, indicating that a depth of about 11.4 ft probably is the base of the zone transmitting most of the groundwater in the surficial aquifer at well PAI-45-MW28-D. This horizon probably is a few feet deeper at the southeastern corner of the new dry-cleaning facility because of the slight rise in altitude relative to Kyushu Street.

The ECD log indicates that at MIP7, near the new dry-cleaning facility, the VOC contamination begins at a depth of about 8 ft BLS (altitude of about –2.7 ft relative to NAVD 88), with a greater VOC concentration beginning at a depth of about 10–11 ft (altitude of –4.7 to –5.7 ft) below Kyushu Street (fig. 17*B*). At MIP2, also near the new dry-cleaning facility, but at a slightly higher altitude, a spike in the ECD log indicates a sharp increase in VOC contamination at a depth of about 12 ft BLS (altitude of about –5.3 ft relative to NAVD 88). The sharp increase in VOC contamination of MIP2 corresponds to the zone of increased VOC contamination at MIP7. The top of the zone of increased VOC contamination in MIP2 and MIP7 corresponds to the lowermost foot or so of loose sand at the probable base of the predominant flow regime in the surficial aquifer.

Temporary wells sampled near the new dry-cleaning facility at depths of 7–11 ft BLS had lower concentrations of VOCs than at 11–15-ft BLS (fig. 17*C*, table 2). Thus, VOC concentrations are greater near the base of the loose sand than near the top. Because the 11–15-ft temporary wells appear to be partly screened in the loose sand and partly screened in the underlying less permeable material, most of the water sampled from the 11–15-ft temporary wells likely was derived from the loose sand in the top part of the screened interval rather than from the underlying less permeable material. This interpretation is consistent with the soil-core data indicating a sharp decrease in contaminant concentrations at depths greater than 12 ft BLS relative to shallower depths (fig. 17*D*) (Scott Huling, U.S. Environmental Protection Agency, written commun, 2009). Thus, it is likely that contamination near the new dry-cleaning facility is present from a few feet depth to about 11.5 ft BLS, most of the contamination is at a depth of about 8 to 11.5 ft. BLS, and the greatest concentrations are at the base of the 8–11.5 ft interval.

Further support for this hypothesis is that while temporary wells PAI-45-USGS-TW39 (upgradient part of the southern plume) and PAI-45-USGS-TW48 (midpart of the southern plume) were screened at depths of 10–14 and 10.5–14.5 ft BLS, respectively, and contained about 5,000 to 10,000 µg/L of PCE, several temporary wells between these two wells were screened at depths of 11–15 ft BLS and contained relatively little contamination (less than 250 µg/L and in most cases less than 50 µg/L of PCE). These wells included PAI-45-USGS-TW73, -TW74, -TW83, -TW87, -TW88, -TW90, -TW91, -TW92, and -TW93 (fig. 4). The data are consistent with the interpretation that 11- to 15-ft-deep wells with comparatively little contamination were screened below the major contamination depth; therefore,wells PAI-45-USGS-TW73, -TW74, -TW83, -TW87, -TW88, -TW90, -TW91, -TW92, and -TW93 are not included in figures 12–15. The depths of these wells were selected based on the MIP-log response showing relatively high ECD indications at depths from about 10 or 12 ft to about 15 ft (fig. 17*B*). It is likely, however, that as the MIP probe progressed downward, the most reliable reading was at the first encounters with contamination and the deeper ECD responses reflect some level of carry-over. Thus, in the area between temporary wells PAI-45-USGS-TW39 and PAI-45-USGS-TW48, there appears to be comparatively little contamination at depths greater than 11 ft BLS.

In the midpart of the southern plume at temporary well PAI-45-USGS-TW96, the most permeable zone appears to be a loose sand layer from about 8 to 10 ft BLS (figs. 16 and 18*A*). The shallowest sharp increase in ECD-log response was just above the base of this layer (fig. 18*B*), and greatest concentrations of VOCs detected in field measurements from this well were in the same layer (figs. 18*C* and 18*E*). Relatively high VOC concentrations also were detected at depths below 11 ft (figs. 18*C* and 18*D*). The VOC concentrations at temporary well PAI-45-USGS-TW96 decreased with depth below about 13 ft BLS (figs. 18*C* and 18*E*) and were not detectable (less than 0.2 parts per million) at depths of 14–14.8 ft directly above the organic-rich silt layer and at 15.2–16 ft in the organic-rich silt layer (fig. 18*C*). The less porous nature of the organic-rich layer relative to the overlying sand and the downward decrease in VOC concentrations in sediment immediately above the organic-rich layer indicates



EXPLANATION

PAI-45-MW31-SL	Monitoring well and identifier
MIP2	Membrane interface probe (MIP) location and identifier
PAI-45-USGS-TW93	Temporary well installed and sampled March 2008, and identifier
PAI-45-USGS-TW96	Temporary well cored April 2008, and identifier
PAI-45-USGS-TW48	Temporary well installed and sampled June 2007, and identifier
T1-B	Temporary well cored by the U.S. Environmental Protection Agency, 2008, and identifier

Figure 16. Locations of sampling points shown in figures 17 and 18, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina.

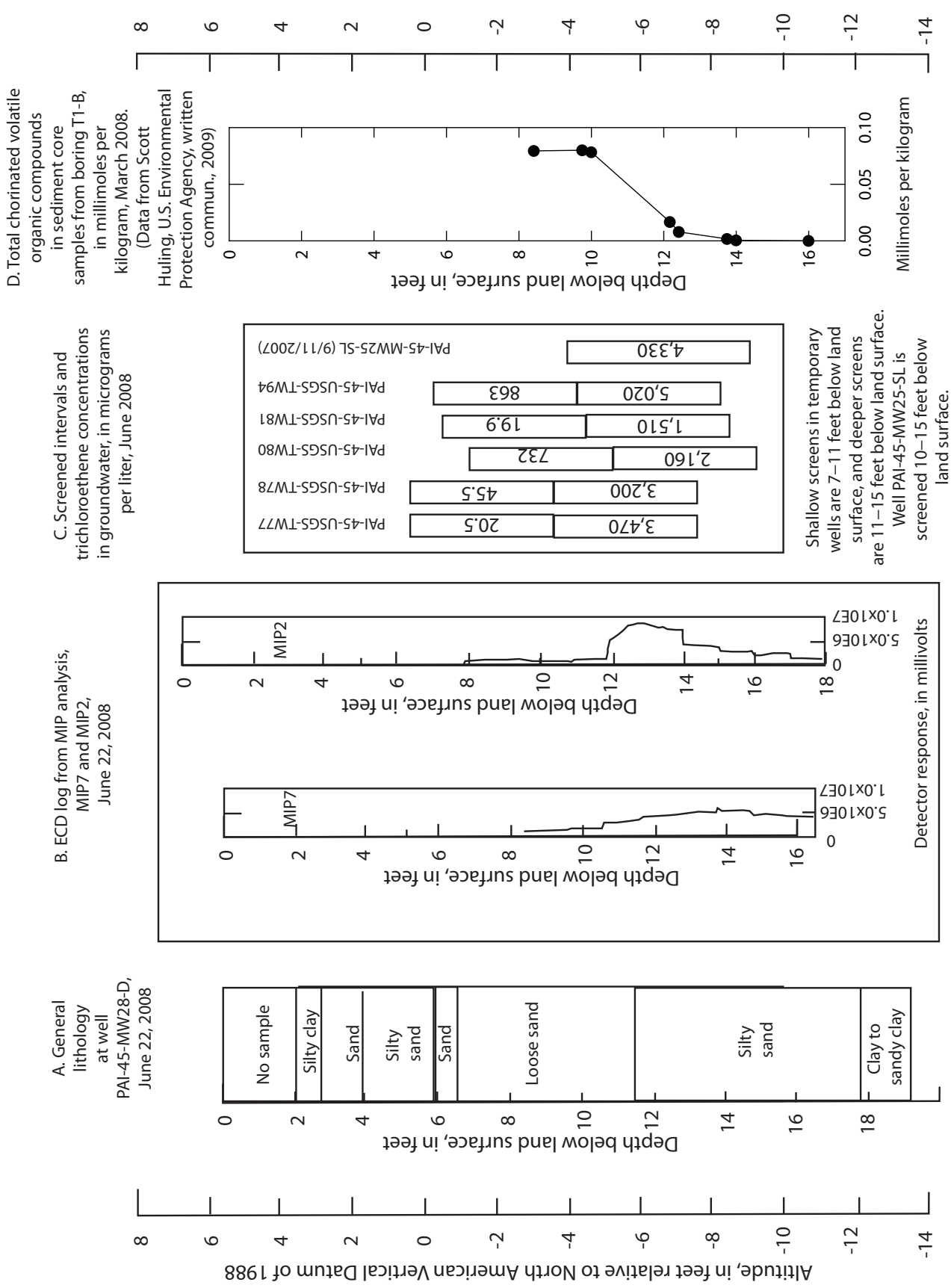


Figure 17. (*A*) Lithologic log, (*B*) electron-capture-detector (ECD) logs from Membrane Interface Probe (MIP) investigation, (*C*) trichloroethene concentrations in water from multiple depths in temporary wells, and (*D*) total chlorinated volatile organic compounds in sediment from cores near the southeastern corner of the new dry-cleaning facility, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2008.

Table 2. Concentrations of chlorinated volatile organic compounds in shallow and deeper temporary-well groundwater samples near the new dry cleaning facility, March 5, 2008.

[ft NAVD 88, feet relative to the North American Vertical Datum of 1988; ft BLS, feet below land surface; PCE, tetrachloroethene; TCE, trichloroethene; *c*DCE, *cis*-1,2-dichloroethene; VC, vinyl chloride; <, less than; J, estimated value; B, target analyte was detected in the associated blank]

Well identifier	Ground-surface altitude (ft NAVD 88)	Screen interval (ft NAVD 88)	Screen interval (ft BLS)	PCE	TCE	*c*DCE	VC
PAI-45-USGS-TW77	7.33	0.33	7–11	0.351J	20.5	47.9	<0.3
		–3.67	11–15	454	3,470	365	<15
PAI-45-USGS-TW78	7.34	0.34	7–11	10.1	45.5	117	<0.3
		–3.66	11–15	<12.5	3,200	761	<15
PAI-45-USGS-TW80	5.54	–1.46	7–11	366	732	82.6	<3
		–5.46	11–15	6,170	2,160	112	<30
PAI-45-USGS-TW81	7.67	0.67	7–11	<0.25	19.9	107	<0.3
		–3.33	11–15	14.0J	1,510	573	<7.5
PAI-45-USGS-TW94	6.6	0.67	7–11	331	863	213	<0.3
		–3.33	11–15	754B	5,020	323	2.07

that the organic-rich layer is not a major contaminant-transport pathway at well PAI-45-USGS-TW96. These data indicate that the probable depth of contamination in the midpart of the southern plume at well cluster PAI-45-MW31 is about 6–14 ft BLS, with most of the contamination between about 8 and 11 or 12 ft BLS and the largest potential for lateral transport between about 8 and 10 ft BLS.

Wells PAI-45-MW28-D, PAI-45-MW29-D, and PAI-45-MW30-D (fig. 3) were installed below the clay layer at the base of the surficial aquifer to gain further information on water levels and water quality below the surficial aquifer. It cannot be stated with certainty that no VOC contamination is in the D horizon underlying the clay that defines the base of the surficial unit because the wells in the D horizon near the new dry-cleaning facility were installed slightly offset from the main body of contamination in the surfical aquifer to avoid the risk of inadvertent downward transport of possible free product from the surficial to the deeper aquifer during drilling. Groundwater levels in the D-horizon wells are lower than levels in the surficial aquifer wells, indicating that if there were a discontinuity in the clay layer, it is likely that there would be downward flow from the surficial to the deeper aquifers. Contamination, however, is unlikely to be present in the brackish D-horizon aquifer for several reasons. No evidence of groundwater contamination by VOCs was found in groundwater samples collected from D-horizon wells PAI-45-MW28-D, -29-D, and -30-D on June 7, 2008, and well PAI-45-MW28-D was near the main body of contamination. Water samples from the wells contained less than 0.25 µg/L of PCE and TCE, less than 0.3 µg/L of *c*DCE, and less than 0.5 µg/L of VC. By virtue of its nearness to the main body of contamination in the southern plume and the probable slight hydraulic gradient to the southeast, it is likely that contamination would have been detected at well PAI-45-MW28-D if substantial contamination were present in the aquifer beneath the surficial aquifer. In addition, there are substantially lower VOC concentrations near the base of the surficial aquifer than in the vertical midpart of the surficial aquifer, indicating a low potential for downward transport through the base of the surficial aquifer. Finally, the organic-rich peat at the base of the surficial aquifer provides a substantial sorptive buffer for VOCs.

Source of Chlorinated-Solvent Groundwater Contamination in the Southern Plume

Although the southern plume spatially originates from the new dry-cleaning facility, it is unlikely that the new dry-cleaning facility is the source of the contamination. From the beginning of its operation, the new dry-cleaning facility used ExxonMobil DF-2000 fluid as the cleaning solvent; this is a petroleum-based solvent and would not be a viable source of chlorinated-solvent contamination in the aquifer.

Several lines of evidence indicate that the contaminant source in the southern plume was a leak from a sanitary sewer in the vicinity of the new dry-cleaning facility. In the initial stages of the present investigation, the USGS uncovered manhole SAS01 and determined it to be an abandoned sanitary sewer system shallower than the water table. When water was poured into the manhole, the water exited the manhole in the direction leading to the new dry-cleaning facility (fig. 6). Examination of engineering blueprints of historic and existing structures at Site 45 showed that the system was the sanitary

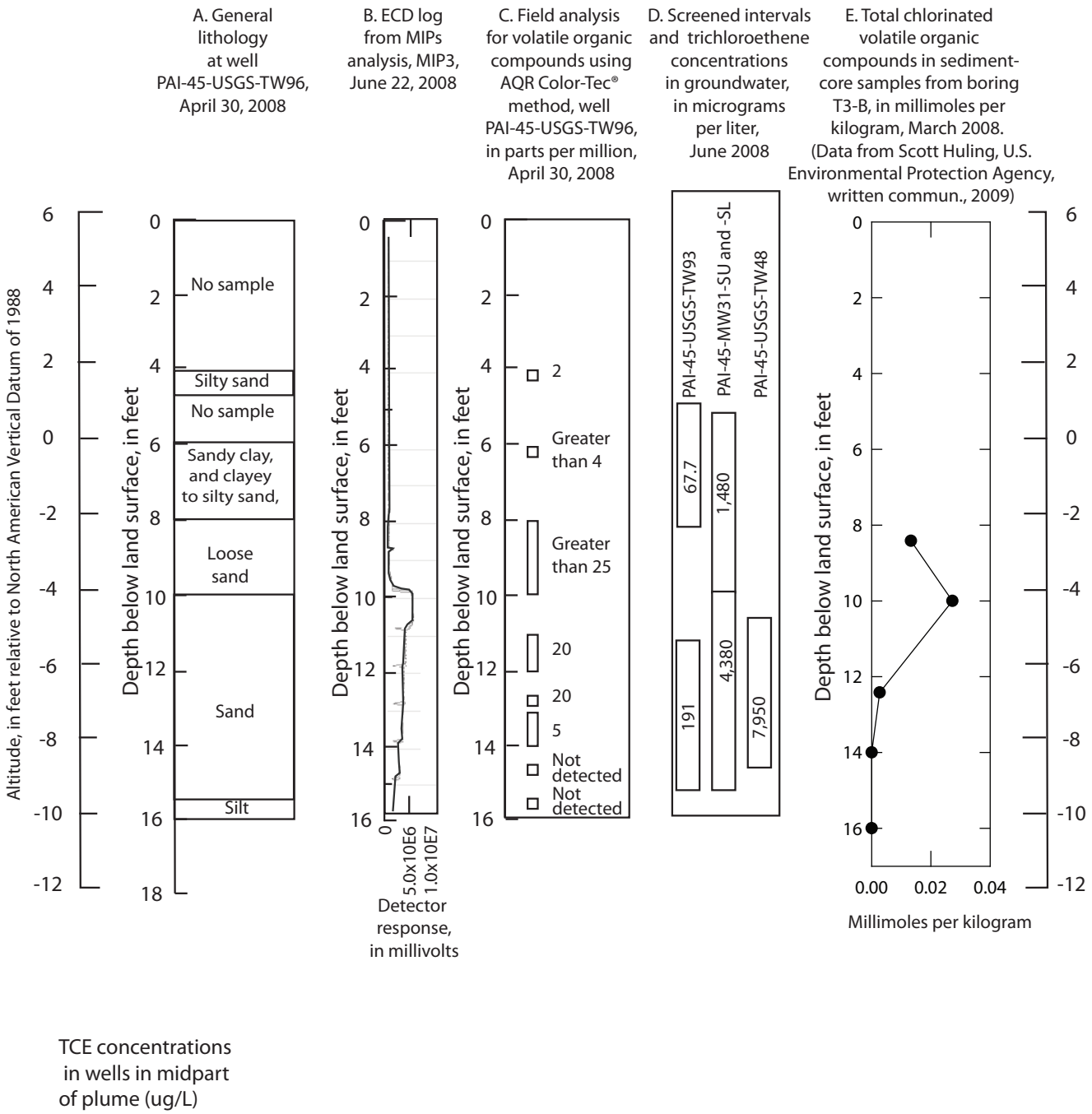


Figure 18. (*A*) Lithologic log, (*B*) electron-capture-detector (ECD) log from Membrane Interface Probe (MIP) investigation, (*C*) field analysis of volatile organic compounds in sediment cores, (*D*) trichloroethene concentrations in water from multiple depths in temporary wells, and (*E*) total chlorinated volatile organic compounds in sediment from cores near the southeastern corner of the new dry-cleaning facility, Site 45, Marine Corps Recruit Depot, Parris Island, 2008.

sewer for the former dry-cleaning facility. The original sanitary sewer line, in place since the mid-1950s, appears to have extended to beneath what is now the southeastern corner of the new dry-cleaning facility and then turned about 90 degrees southward. The corner of the former sanitary sewer line that extended beneath the new dry-cleaning facility was replaced by a diagonal section of pipe extending from manhole SAS02 to SAS03 sometime in the mid- to late-1990s.

The sanitary sewer line was constructed of vitrified clay. A sewer-inspection camera was used to examine the integrity of the sewer line in 2007. The camera revealed that although the existing pipe between the former and new dry-cleaning facilities contained no collapsed sections, it contained many cracks, and grass roots extended into the pipe. Thus, it is highly probable that the abandoned sanitary sewer is leaky.

The aquifer at the southeastern corner of the new dry-cleaning facility, where the section of the sanitary sewer was removed, contained the greatest PCE concentrations, the greatest PCE/daughter-product ratios, and the lightest PCE CSIA values in the southern plume. The direction of groundwater flow is to the southeast and the chemical data indicate that the area where the sanitary sewer was removed contains the most concentrated and least degraded parent compound in the southern plume. The southeastern corner of the new dry cleaning facility is, therefore, the likely source area for the southern plume.

The coincidence of the southern plume source area with a removed section of sanitary sewer that was part of a cracked sanitary sewer system, the existence of documented and potentially undocumented PCE spills in the former dry-cleaning facility connected to that sanitary sewer, and the lack of a viable source for the PCE spill at the new dry-cleaning facility indicate that the probable source of the contamination at that location was leakage from the sanitary sewer system. In general, sewer leaks (exfiltration) have been recognized as potential contamination sources for many years (Amick and Burgess, 2000; Wakida and Lerner, 2004; Wolf and others, 2004; Rutsch and others, 2005; Held and others, 2006; Reynolds and Barrett, 2007). Leaking sewer lines have produced groundwater VOC contamination elsewhere (Squillace and others, 2004), including PCE contamination from dry-cleaning operations (State of Wisconsin, 1996).

An additional underground pipe was encountered during this investigation in a boring near well PAI-45-MW31-SU. This unmarked and unused pipe was not found on site blueprints. Therefore, other unidentified subsurface utilities may influence groundwater or contaminant transport.

Transport and Fate of Chlorinated Solvents

Groundwater contamination at Site 45 is subject to a variety of influences. One of the most important influences is site hydraulics, which are affected by the storm sewers. Other important influences include biodegradation and sorption.

Storm-Sewer Influences on Transport

Data indicate that groundwater contamination in the northern plume discharges to the storm sewer containing storm grate STS21 and possibly to the section of storm sewer near manholes STS13 and STS14. These sections of storm drains are below the water table, and VOCs have been detected in the storm sewer at STS13, STS14, and STS21 (fig. 6 and table 3). In addition, the curvature of water-table contours around the storm sewer downgradient from storm grate STS21 indicates movement of groundwater to the storm drain from both sides (figs. 8 and 9).

Data from temporary wells sampled during this investigation at the downgradient edge of the northern plume provide further evidence indicating an influence from the storm-sewer system on the groundwater-contamination distribution. Groundwater from temporary wells PAI-45-USGS-TW4, -TW6, -TW8, and -TW10 immediately west of the storm sewer containing storm grate STS21 had more than 1,000 µg/L of *c*DCE at the 7–11 or 7.5–11.5 ft BLS (figs. 4, 6, and 14). In contrast, wells PAI-45-USGS-TW7 (screened at 7–11 ft BLS) and adjacent wells PAI-45-USGS-TW9 and PAI-45-USGS-TW18 (screened at 7.5–11.5 ft BLS and 12–14.5 ft BLS, respectively) on the eastern side of the storm drain did not contain detectable VOCs (figs. 4, 6, and 12–15). The depth to water in that area was 3.24 to 3.75 ft (based on wells PAI-45-MW14-SU and PAI-45-MW23-SU, respectively), and the depth of the storm drain containing manhole STS21 is about 4.6 ft or greater. Thus, it is unlikely that the wells east of the storm sewer vertically missed the contamination beneath the former temporary lodging parking lot. The hydraulic gradients and lack of detectable VOCs east of the storm drain indicate that the storm-sewer system probably is a main discharge zone for the northern plume and effectively limits further expansion of the main axis of contamination in the northern plume.

In the downgradient part of the northern plume near the entrance to the former temporary lodging parking lot, the storm sewer containing manholes STS13 and STS14 is shallower than the storm drain containing storm grate STS21 (fig. 8). Thus, much of the groundwater contamination in the northern plume appears to underflow the western storm drain (containing STS14) and move toward the deeper storm drain farther east (containing STS21) (figs. 12–15). It is clear that some groundwater contamination discharges to the western storm sewer because TCE and *c*DCE were found in water at manhole STS14 on most of the sampling dates (table 3). During three out of the four sampling events at manhole STS14, groundwater levels were relatively low, compared with measurements in nearby well PAI-45-MW23-SU (2.54 to 2.66 ft relative to NAVD 88). On those dates, TCE concentrations in water from manhole STS14 ranged from less than 0.25 to 3.86 µg/L, and *c*DCE concentrations ranged from an estimated value of 0.937 to 4.78 µg/L. On September 8, 2007, however, the measured water level in well PAI-45-MW23-SU was 3.54, about a foot higher than on the previous sampling dates. The following day (September 9, 2008) a water sample

Table 3. Concentrations of selected constituents in storm sewers, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2007–2008.

[1,1-DCE, 1,1-dichloroethene; 1,2-DCE, total 1,2-dichloroethene; CB, chlorobenzene; *c*DCE, *cis*-1,2-dichloroethene; EB, ethylbenzene; Napht, naphthalene; PCE, tetrachloroethene; TCE, trichloroethene; Tol, toluene; *t*DCE, *trans*-1,2-dichloroethene; VC, vinyl chloride; Xyl, total xylenes; SC, specific conductance; Temp, temperature; µg/L, micrograms per liter; S.U., standard units; µS/cm at 25 °C, microsiemens per centimeter at 25 degrees Celsius; °C, degrees Celsius; <, less than; —, not analyzed; J, estimated concentration; R, duplicate sample; Sample points PAI-SW1 and PAI-SW1R are within 1.5 feet of sample point STS26]

Site identifier	Date (month/day/year)	Time (hours after low tide)	1,1-DCE (µg/L)	1,2-DCE (µg/L)	Benzene (µg/L)	CB (µg/L)	*c*DCE (µg/L)	EB (µg/L)	Napht (µg/L)	PCE (µg/L)	TCE (µg/L)	Tol (µg/L)	*t*DCE (µg/L)	VC (µg/L)	Xyl (µg/L)	pH (S.U.)	SC (µS/cm at 25 °C)	Temp (°C)
STS05	5/31/2007	0.50	<0.3	35	<0.3	<0.25	34	<0.25	0.91BJ	20	77	<0.25	0.736J	2.6	<0.25	—	—	—
STS05	6/27/2007	0.18	<5	—	—	—	70	—	—	30	100	—	<5	7.0	—	—	—	—
STS13	4/30/2007	1.5	<0.3	3.0	<0.3	<0.25	2.7	<0.25	<0.25	<0.25	2.2	<0.25	<0.3	<0.50	<0.25	—	—	—
STS14	4/30/2007	1.5	<0.3	5.2	<0.3	<0.25	4.7	<0.25	<0.25	0.27J	2.4	<0.25	<0.3	<0.50	<0.25	—	—	—
STS14	5/14/2007	4.0	<0.3	4.8	<0.3	<0.25	4.8	<0.25	<0.25	<0.25	3.9	<0.25	<0.3	<0.50	<0.25	—	—	—
STS14	6/16/2008	2.9	<0.3	0.94J	<0.3	<0.25	0.94J	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.50	<0.25	—	—	—
STS14	9/9/2008	0.5	0.7J	410	<0.3	<0.25	390	<0.25	<0.25	30	180	<0.25	7.4	20	<0.25	—	—	—
STS21	4/30/2007	1.5	<0.3	7.4	<0.3	<0.25	6.7	<0.25	22	<0.25	2.4	<0.25	<0.3	<0.50	<0.25	—	—	—
STS21	5/14/2007	4.0	<0.3	<0.30	<0.3	<0.25	<0.30	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.50	<0.25	—	—	—
STS21	6/25/2007	high tide	—	—	—	—	—	—	—	—	—	—	—	—	—	5.44	50,047	30.01
STS22	6/16/2008	3.0	<0.3	41	<0.3	<0.25	40	<0.25	9.3	0.60J	13	<0.25	0.693J	4.5	<0.25	—	—	—
STS22	9/9/2008	0.5	<0.3	1.3	<0.3	<0.25	1.3	<0.25	0.58J	<0.25	0.77J	<0.25	<0.3	<0.50	<0.25	—	—	—
STS26	9/10/2007	0	<0.3	2.5	<0.3	<0.25	2.5	<0.25	0.75J	0.69J	4.3	<0.25	<0.3	<0.50	<0.25	—	—	—
STS26	9/10/2007	3.0	<0.3	3.5	<0.3	<0.25	3.5	<0.25	0.90J	1.1	5.6	<0.25	<0.3	<0.50	<0.25	—	—	—
STS26	6/16/2008	1.0	<0.3	2.9	<0.3	<0.25	2.9	<0.25	0.27J	0.77J	2.3	<0.25	<0.3	<0.50	<0.25	—	—	—
STS27	9/9/2008	0	<0.3	0.59J	<0.3	<0.25	0.59J	<0.25	<0.25	<0.25	0.43J	<0.25	<0.3	<0.50	<0.25	—	—	—
PAI-SW1	6/16/2008	0.3	<0.3	1.6	<0.3	<0.25	1.6	<0.25	0.33J	0.44J	1.3	<0.25	<0.3	<0.50	<0.25	—	—	—
PAI-SW1R	6/16/2008	0.3	<0.3	1.7	<0.3	<0.25	1.7	<0.25	<0.25	0.48J	1.3	<0.25	<0.3	<0.50	<0.25	—	—	—

from manhole STS14 contained substantially greater VOC concentrations than on previous dates (183 µg/L of TCE and 387 µg/L of *c*DCE). Most importantly, water from manhole STS14 contained 20.1 µg/L of VC. The western storm drain containing STS14 is a receptor of groundwater contamination from the northern plume and is more important as a receptor during periods of high groundwater levels than during periods of low groundwater levels. This is important because temporary well PAI-45-USGS-TW15 (fig. 4) had groundwater contamination containing 2,290 µg/L of VC (June 25, 2007) and is immediately adjacent to that storm sewer (figs. 4 and 15). Thus, at high groundwater levels, there is the potential for increased amounts of VC to enter the storm sewer. If such an event occurs at a time when tidal flushing is low, then increased concentrations of VC could discharge at the storm-sewer outfall. The MCL for VC in drinking water established by the USEPA is 2 µg/L, and VC has been associated with potential increased risk of cancer in adults (U.S. Environmental Protection Agency, 2008).

During times of low groundwater levels, relatively low concentrations of VOCs in the southernmost part of the northern plume may move southeastward beneath storm drain STS14. Based on this consideration and on groundwater flow directions (figs. 8 and 9), such movement may account for some of the low concentrations of TCE and *c*DCE detected in groundwater immediately west of the former temporary lodging (figs. 13 and 14).

Data indicate that storm sewers also intercept contamination in the southern plume. Chlorinated solvents were detected in water from STS05 (30 µg/L of PCE, 100 µg/L of trichloroethene [TCE], 70 µg/L of *c*DCE, and 7 µg/L of VC in June 2007) (table 3, fig. 6). Well PAI-45-MW20-SL, a few feet north of the storm drain containing manhole STS05, contained more than 1,000 µg/L of TCE, while TCE in most of the temporary wells on the opposite of the storm drain contained less than 5 µg/L of TCE (fig. 13). Thus, it appears that the storm drain below the water table near well PAI-45-MW20-SL is a discharge zone for groundwater contamination. Manholes STS05 and STS06 are near each other and are about the same depth (fig. 8); therefore, the hydrology of the two manholes probably is similar. Because the groundwater levels in SL wells near these manholes is usually more than 2 ft higher than the water levels in the manholes (fig. 10), there probably is movement of contaminated water from parts of the aquifer deeper than the manholes upward toward the manholes, storm sewer, and the granular base material below the storm sewer.

The presence of VOCs in water from manhole STS05 and the sharp decline in contaminant concentrations from one side of the storm sewer to the other side indicate that a substantial part of the southern plume is captured by the storm sewer. The presence of VOCs in some temporary wells on the downgradient side of the storm sewers, however, indicates that some of the contamination in the southern plume bypasses the storm sewers. For example, 110–339 µg/L of *c*DCE was detected in groundwater on the downgradient side of the storm drain at temporary wells PAI-45-USGS-TW27, PAI-45-USGS-TW28, and PAI-45-USGS-TW64, and 155 µg/L of TCE was detected in groundwater at well PAI-45-USGS-TW27 (figs. 4, 13, and 14).

Relatively low concentrations of groundwater contamination bypass the storm sewers at Site 45, as evidenced by concentrations of *c*DCE of about 5–7 µg/L in temporary wells between the storm sewer and the former temporary lodging (fig. 14). Based on site hydrology and the relatively leaky nature of the storm sewers, the groundwater contaminants probably are captured eventually by discharge to a deep storm sewer. Potential receptors include the storm sewers near manholes STS06, STS07, and STS22 (fig. 6).

Once in the storm-sewer system, VOCs are subject to a variety of contaminant-reduction influences. The largest influence is tidal action. The storm sewers at Site 45 range in diameter from 12 to 36 inches; thus, a tidal change of greater than 3 ft in some of the storm sewers at Site 45 represents a substantial amount of marsh water entering and exiting the pipes relative to the comparatively small amount of groundwater leaking into them. The tidal exchange dilutes the VOC concentrations in the storm sewers. Volatilization probably also removes some of the VOC contamination in the storm sewers.

During outgoing tides, the diluted contamination in the storm sewer is transported southward and discharges to Ballast Creek. Based on a dye test, the contaminant-transport time through approximately 1,400 ft of storm sewer from Site 45 to Ballast Creek during outgoing tides is a little more than 1 hour (fig. 19). A sample from manhole STS26 in the storm sewer approximately 320 ft from the Ballast Creek discharge contained PCE, TCE, and *c*DCE concentrations of 0.69 (estimated), 4.26, and 2.53 µg/L, respectively, at low tide and concentrations of 1.06, 5.63, and 3.48 µg/L, respectively, 1 hour after low tide. At 1 hour after low tide, water at manhole STS26 was moving in the storm sewer toward the creek. Because no additional storm-sewer pipes appear to enter the main storm sewer between STS26 and Ballast Creek, there is no additional dilution between STS26 and Ballast Creek, and the detected contaminant concentrations at STS26 represent VOC concentrations from Site 45 being discharged to Ballast Creek. Maximum detected VOC concentrations detected in storm-sewer water at STS26 during three sampling events (on two different dates) were 1.06 µg/L of PCE, 5.63 µg/L of TCE, 3.48 µg/L of *c*DCE, and less than 0.5 µg/L of VC (September 10, 2007, 1 hour after low tide) (table 3).

The above data indicate that the storm sewers function as discharge points for the major parts of both the northern and southern plumes. Part of the groundwater contamination may bypass some of the storm sewers below the water table; however, the bypassing concentrations are relatively low. Although substantial concentrations of VOCs are present in the groundwater near the storm sewers (more than 1,000 µg/L of TCE in the southern plume and more than 1,000 µg/L of *c*DCE in the northern plume), the groundwater that leaks into the storm sewers is subjected to dilution and volatilization effects that result in low concentrations of VOCs in water

from the sampled manholes (maximum detection of 387 µg/L of *c*DCE and 183 µg/L of TCE; table 3) and at the discharge point. Thus, the storm sewers appear to be preventing substantial additional expansion of the plumes and usually discharging relatively low concentrations of VOCs (less than about 10 µg/L of total VOCs to Ballast Creek).

Finally, in an interview during this investigation, the Parris Island environmental officer who investigated the 1994 solvent spill at the above-ground storage tanks stated that there was evidence that PCE may have entered the storm drains during this event (James Clark, Environmental Officer, Parris Island, oral commun., 2008). Because a substantial amount of PCE was released to the environment, PCE entering the storm drain would have been transported through the storm-sewer system. The most probable receptors would have been storm drains STS01 or STS16 (fig. 6). Both of these storm drains connect to the same storm sewer and ultimately discharge to the Ballast Creek tributary at STS27 (fig. 19). Few data are available on the nature of a historic storm sewer extending from beneath the former above-ground storage-tank area southeastward to storm grate STS08 (fig. 6) except that video imaging of that section of the sewer during this investigation showed it to be presently occluded by a concrete plug approximately 94 ft northeast of STS08. If the historic sewer line had been a receptor, then it would have connected to the same storm sewer that drains STS01 and STS16.

The potential historical presence of free-phase PCE in the storm sewer is important for several reasons. The previously discussed leaky nature of parts of the storm sewer means that the dense nonaqueous phase liquid (DNAPL) could have leaked from various parts of the storm sewer in route to the Ballast Creek discharge. If DNAPL was transported all the way to the Ballast Creek discharge point at STS27, then it likely would have sorbed to and sunk into the sediments not far from STS27. A reconnaissance survey of shallow sediment collected near the STS27 outfall during this investigation showed no detectable chlorinated-solvent contamination at depths of 0.5 and 1 ft below the sediment surface (fig. 7); however, due to a laboratory error, the sediment sample from 1-ft depth at the outfall (PAI-SWSED1, June 17, 2008) had unusually high detection limits [32 to 81 milligrams per kilogram (mg/kg)]. Low concentrations of toluene were detected in sediment from PAI-SWSED1, 0.5 ft depth (estimated 0.67 mg/kg), and at PAI-SWSED3, 1.0 ft depth (3.96 mg/kg). The lack of detectable chlorinated-solvent contamination in the sediment does not eliminate the possibility of deeper contamination because reworking of the shallow sediment could have destroyed the shallow signature. Examination of deeper sediment and a search for potential PCE leaks from the storm sewer outside of Site 45 were beyond the scope of the present investigation.

Historical contamination could have exited the storm sewer east of STS26 through the eastern storm sewer that now contains numerous collapse features (fig. 19). This eastern storm sewer and the storm sewer containing sewer-outfall point STS27 are now connected at manhole STS25. The connection at STS25 probably was made to facilitate drainage of the storm sewer that extended from approximately beneath the former temporary lodging parking lot to a tributary to Ballast Creek after the collapse features occluded the pipe near the outfall point. Evidence that the occlusions limit or prevent direct discharge from the eastern storm sewer to Ballast Creek can be seen in the directions of water flow in the sewers. During an outgoing tide, water drains into manhole STS25 (fig. 19) from both the northern and southern sections of the eastern storm sewer. Water then flows laterally to the western storm sewer and then moves southward toward Ballast Creek. The flow directions reverse during an incoming tide, with water moving from the western storm sewer through manhole STS25 and into both the northern and southern sections of the eastern storm sewer. Thus, it appears that there is no significant exit or entrance for the eastern storm sewer at Ballast Creek.

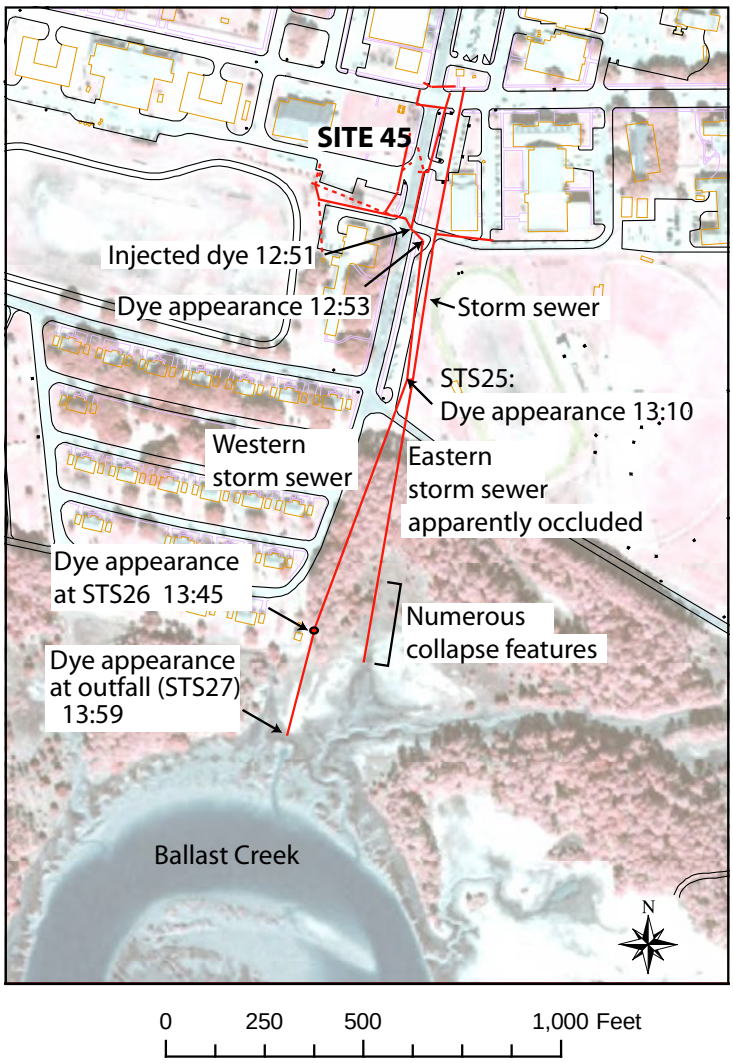


Figure 19. Movement of dye tracer and arrival times in the storm sewer from Site 45 to the Ballast Creek tributary, Marine Corps Recruit Depot, Parris Island, South Carolina, August 30, 2007.

If the spill occurred during a period when the eastern and western storm drains were connected, then some level of contaminant could have been transported in the eastern storm drain. Such transport, however, seems less likely than transport in the storm sewer containing discharge point STS27 because the storm sewer containing STS27 is more directly connected to the probable receptor drains for the spill and because of predominance of flow at the STS27 discharge point relative to the occluded sewers.

It is unlikely that substantial DNAPL from the original spill is still present in the storm sewers because of substantial flushing by daily tides and by rainfall events, including hurricanes. It also is unlikely that the VOCs detected during this investigation in the storm sewers are simply a measurement of remnant DNAPL because the presence of TCE, *c*DCE, and VC in the storm sewer indicates that the PCE has been degraded by reductive dechlorination (table 3), a process unlikely to occur in an aerobic storm sewer. In addition, the $\delta^{13}C$ of PCE in water from manhole STS05 (–20.51 ‰) reflected a substantial amount of degradation relative to manufactured PCE (–27.0 to –37.2 ‰: van Warmerdam and others, 1995; Jendrejewski and others, 2001), but was similar to the $\delta^{13}C$ of PCE in groundwater from nearby well PAI-45-MW20-SL (–20.8 ‰) (table 4). Thus, the chlorinated solvents presently in the storm-sewer water are from groundwater.

Biodegradation

Several lines of evidence indicate the presence of VOC biodegradation in the aquifer at the southern plume. These data include microbial considerations, chlorinated-solvent parent/daughter–product ratios, and stable carbon isotopes. Despite a substantial decrease in the total mass of chlorinated solvents from the upgradient source area near the new dry-cleaning facility to downgradient well PAI-45-MW20-SL, however, a substantial concentration of TCE (3,500–5,840 µg/L) is still present in the aquifer at well PAI-45-MW20-SL near a storm drain (STS05) known to be a recipient of groundwater contamination. Thus, biodegradation alone is not sufficient to decrease TCE concentrations to values less than milligram-per-liter levels prior to discharge to the storm sewers.

Molecular analysis as part of this investigation indicated the presence of *Dehalococcoides* sp. and *Dehalobacter* sp., which are microbes known to degrade chlorinated solvents (table 5). A variety of microorganisms are capable

Table 4. Concentrations of compound-specific stable carbon isotope analysis on water from wells and a storm sewer, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2007–2008.

[1,1-DCE, 1,1-dichloroethylene; PCE, tetrachloroethylene; TCE, trichloroethylene; *c*DCE, *cis*-1,2-dichloroethylene; *t*DCE, *trans*-1,2-dichloroethylene; VC, vinyl chloride; DIC, dissolved inorganic carbon as carbon dioxide; R, laboratory rerun of a sample at a later date than the original analysis; D, duplicate sample; —, not analyzed or not reliable due to low concentrations; all concentrations are per mil units of the $^{13}C/^{12}C$ ratio from a reference standard of the Vienna Pee Dee Belemnite]

Site identifier	Sample date (month/day/year)	1,1-DCE	PCE	TCE	*c*DCE	*t*DCE	VC	DIC
PAI-45-MW04-SL	8/25/2005	–36.60	–25.10	–29.20	–30.30	—	—	–12.0
PAI-45-MW20-SL	8/25/2005	–38.80	–20.80	–29.20	–30.30	—	—	–11.9
PAI-45-USGS-TW44	6/27/2007	–22.10	–26.01	–31.03	–30.76	–41.53	–22.57	—
PAI-45-USGS-TW39	6/27/2007	—	–29.49	–30.19	–31.61	—	–20.25	—
PAI-45-USGS-TW48	6/27/2007	–33.06	–27.22	–30.24	–29.79	–39.54	–19.21	—
PAI-45-USGS-TW48 R	6/27/2007	—	—	—	–29.71	–39.70	–18.76	—
PAI-45-USGS-TW53	6/27/2007	–32.70	–26.16	–30.43	–30.56	–38.56	–18.22	—
PAI-45-USGS-TW53 D	6/27/2007	—	–25.84	—	–30.42	–37.39	–17.91	—
PAI-45-USGS-TW63	6/28/2007	–35.88	–26.07	–26.61	–33.82	–50.92	–6.17	—
PAI-45-USGS-TW63 R	6/28/2007	–35.22	—	–26.52	–33.60	–50.65	–4.98	—
STS05 (storm sewer)	6/27/2007	—	–20.51	–27.99	–31.03	—	–20.25	—
PAI-45-USGS-TW3	6/25/2007	—	—	5.64	–27.81	—	–19.62	—
PAI-45-USGS-TW12	6/25/2007	—	–15.39	–21.69	–27.50	—	–23.37	—
PAI-45-USGS-TW12 R	6/25/2007	—	–14.98	–21.26	–27.25	—	–24.09	—
PAI-45-USGS-TW43	6/27/2007	—	—	–23.78	–28.60	—	–3.07	—
PAI-45-MW25-SL	6/19/2008	—	–29.16	–30.93	–32.71	—	–22.58	—
PAI-45-MW31-SL	6/18/2008	—	–25.51	–29.76	–30.35	—	–21.41	—
PAI-45-MW31-SU	6/18/2008	—	–25.55	–29.32	–29.76	—	–24.11	—

Table 5. Molecular analysis of phylogenic groups and functional genes in groundwater samples from the southern plume at Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2005–2006.

[DNA, deoxyribose nucleic acid; RNA, ribonucleic acid; 16s rRNA, 16S ribosomal RNA; mRNA, messenger RNA; BVC, vinyl chloride reductase associated with *Dehalococcoides* sp. Strain BAV1; DSR, sulfate-reducing bacteria; sMMO, methane monooxygenase; TceA, trichloroethene reductase; VcrA, vinyl chloride reductase; c/mL, cells per milliliter; <, less than; —, data not collected; gc/mL, gene copies per milliliter; E, scientific notation; J, estimated value]

Well identifier	Date (month/day/year)	DNA or RNA	Units	Phylogenic groups							Functional genes					Percent recovery
				DNA or 16s rRNA							DNA or mRNA					
				Eubacteria	*Dehalobacter* sp.	*Dehalococcoides* sp.	Methanogenic bacteria	*Desulfuromonas* sp.	Type 1 methanotrophic bacteria	Type 2 methanotrophic bacteria	BVC	DSR	sMMO	TceA	VcrA	
PAI-45-MW04-SL	8/25/2005	RNA	gc/mL	3.59E+07	5.38E+04	2.30E+03	<1.00E+00	<1.00E+00	1.05E+08	1.22E+05	<5E–01	9.69E+06	4.43E+06	<5E–01	<5E–01	—
PAI-45-MW04-SL	9/28/2006	RNA	gc/mL	5.66E+05	8.35E+00	4.07E+01	—	—	—	—	<5E–01	—	—	<5E–01	<5E–01	65.53
PAI-45-MW04-SL	9/28/2006	RNA	gc/mL	2.27E+04	—	6.64E+01	—	—	—	—	<5E–01	—	—	<5E–01	<5E–01	98.24
PAI-45-MW04-SL	10/10/2006	DNA	c/mL	8.29E+05	2.34E+03	1.14E+05	—	—	—	—	6.67E–03(J)	—	—	<5E–01	1.18E+05	98.72
PAI-45-MW04-SL	10/10/2006	RNA	gc/mL	3.97E+05	<1E+0	<5E–01	—	—	—	—	<5E–01	—	—	<5E–01	<5E–01	42.03
PAI-45-MW20-SL	8/25/2005	RNA	gc/mL	2.09E+07	3.68E+04	6.40E+02	<1.00E+00	4.16E+00	9.25E+07	3.73E+04	<5E–01	1.38E+07	3.08E+06	<5E–01	<5E–01	—
PAI-45-MW20-SL	9/26/2006	DNA	c/mL	1.85E+06	1.09E+02	2.88E+02	—	—	—	—	4.47E–02(J)	—	—	<5E–01	<5E–01	76.48
PAI-45-MW20-SL	9/26/2006	RNA	gc/mL	7.32E+02	—	<5E–01	—	—	—	—	<5E–01	—	—	<5E–01	<5E–01	38.18
PAI-45-MW20-SL	10/10/2006	DNA	c/mL	2.12E+06	2.18E+03	1.22E+02	—	—	—	—	2.23E–01(J)	—	—	<5E–01	<5E–01	71.99
PAI-45-MW20-SL	10/10/2006	RNA	gc/mL	2.89E+05	3.37E+00	<5E–01	—	—	—	—	<5E–01	—	—	<5E-01	<5E–01	36.38
PAI-45-MW20-SU	9/26/2006	DNA	c/mL	1.11E+06	1.23E+01	1.47E+04	—	—	—	—	2.53E+01	—	—	5.37E+00	7.36E–01	93.43
PAI-45-MW20-SU	9/26/2006	RNA	gc/mL	2.33E+04	—	1.61E+04	—	—	—	—	<5E–01	—	—	<5E–01	1.3E–02J	47.01
PAI-45-MW20-SU	10/10/2006	DNA	c/mL	2.15E+06	4.61E+03	7.01E+02	—	—	—	—	6.30E–1	—	—	2.05E–01	<5E–01	58.53
PAI-45-MW20-SU	10/10/2006	RNA	gc/mL	1.98E+05	4.78E+00	<5E–01	—	—	—	—	<5E–01	—	—	<5E–01	<5E–01	62.22

of dechlorinating PCE and TCE; however, only microorganisms associated with the genus *Dehalococcoides* are known to dehalorespire *c*DCE and VC to ethylene (Hendrickson and others, 2002; Cupples and others, 2003; He and others, 2003a, 2003b; Schmidt and de Vos, 2004). The species *Dehalococcoides etheneogenes* is capable of complete sequential dechlorination of PCE to ethylene (Maymo-Gatell and others, 1999). *Dehalobacter* sp. also has been identified as bacteria associated with dechlorination of chloroethenes (Holliger and others, 1998; Maymo-Gatell and others, 1997). In nature, anaerobic dechlorination typically is carried out by mixed cultures of dechlorinators (Bradley, 2003), and complete dechlorination of PCE to ethylene has been observed in a mixed culture that did not contain the *Dehalococcoides* sp. (Flynn and others, 2000). Thus, the absence of *Dehalococcoides* sp. and *Dehalobacter* sp. does not necessarily preclude complete dechlorination. Their presence in groundwater at Site 45, however, indicates a strong probability of microbial dechlorination of the contamination.

In areas where the dominant driver of biodegradation is *Dehalococcoides* sp., the rate of biodegradation appears to be related to the cell density. Dennis (2005) detected ethylene production from dechlorination in 78 percent of the groundwater samples where the density of *Dehalococcoides* sp. was between 1×10^4 and 9.9×10^5 cells per liter and in 83 percent of the samples where the density was between 1×10^6 and 9.9×10^7 cells per liter. In general, a density of 1×10^7 cells per liter is considered to be necessary to produce a useful rate of natural attenuation (Lu and others, 2006; Dennis, 2009). At Site 45, multiple groundwater samples contained *Dehalococcoides* sp. at greater than 10^4 cells per milliliter (10^7 cells per liter), indicating that sufficient quantities of *Dehalococcoides* sp. are present to produce robust biodegradation of chlorinated solvents to ethylene.

An additional way to examine microbial activity in groundwater is to examine enzymes. The enzymes responsible for reductive dehalogenation in *Dehalococcoides* are reductive dehalogenases, or reductases (Krajmalnik-Brown and others, 2004). Microbial analysis of enzymes in groundwater from the southern plume showed the presence of BVC, which is the functional gene of vinyl chloride reductase associated with *Dehalococcoides* sp. strain BAV1 (table 5). The reductase gene (bvcA) in *Dehalococcoides* strain BAV1 grows using all dichloroethene (DCE) isomers and VC as electron acceptors and cometabolizes PCE and TCE, efficiently converting these compounds to ethylene and inorganic chloride (He and others 2003b; Krajmalnik-Brown and others, 2004).

The reductase associated with VC degradation in *Dehalococcoides* strain VS and other strains is VcrA (Magnuson and others, 2000; Muller and others, 2004). VcrA was detected in groundwater from wells PAI-45-MW4-SL and PAI-45-MW20-SU in the southern plume during some sampling events (table 5). The reductase responsible for trichloroethene reduction is TceA in *Dehalococcoides* strain 195 and other strains. TceA was detected in DNA in groundwater in the southern plume at well PAI-45-MW20-SU during one sampling event. The presence of these enzymes supports the finding that microbial degradation of the chlorinated solvents is occurring in the southern plume.

The pH of water in the surficial aquifer containing greater than 1 micromole per liter of chlorinated solvents averaged 5.77 pH units (standard deviation of 0.32) in monitoring wells and 6.03 pH units (standard deviation of 0.25) in temporary wells. In general, maximum microbial reductive dechlorination has been observed between pH values of about 6.8 to 7.6 with diminished reduction at lower pH values (Hollinger and others, 1993; Zhuang and Pavlostathis, 1995; Wiedemeier and others, 1996; Cirpka and others, 1999; Fennell and Gossett, 2003). Although the pH in contaminated groundwater at Site 45 is slightly below the optimum level, the presence of chlorinated-solvent reductive dechlorination daughter products indicates that the pH is not low enough to prohibit reductive dechlorination. Reductive dechlorination of chlorinated solvents in a low-pH environment (2–4 range) has been reported elsewhere in a Fenton's reagent treatment area (Bradley and others, 2007).

Contaminant Concentration Changes in the Direction of Transport

Total chlorinated-solvent concentrations decrease in the southern plume along the transport path from the source area to well PAI-45-MW04-SL (fig. 20*A*). A variety of lines of evidence in addition to the previously discussed microbial consideration indicate that the decrease is partly due to contaminant biodegradation.

PCE is degrading to TCE in the southern plume. The PCE concentrations substantially decrease from upgradient to downgradient areas (fig. 20*B*). The PCE/TCE ratio decreases from PAI-45-MW25-SL to PAI-45-MW31-SL to PAI-45-MW04-SL, indicating a decrease of PCE relative to TCE (fig. 20*C*). In general, the upgradient parts of the southern plume tend to be dominated by PCE, while more downgradient parts of the plume tend to be dominated by TCE or *c*DCE reflecting dechlorination activity (fig. 21). In addition, the $\delta^{13}C$ of PCE in groundwater indicates a shift from isotopically light (negative) to isotopically heavier (more positive) from the source area to well PAI-45-MW20-SL (fig. 20*D*), indicating a depletion in the PCE mass of the more readily degradable, lighter isotopes.

Although PCE is the dominant VOC in the source area at the southeastern corner of the new dry-cleaning facility, the presence of TCE indicates some degree of near-source-area PCE degradation. Additional evidence indicating PCE degradation near the source area can be seen in the $\delta^{13}C$ data. The $\delta^{13}C$ of manufactured PCE can vary depending on the manufacturer and the timeframe of production, with values ranging from –27.0 to –37.2 ‰ (Jendrejewski and others, 2001; van Warmerdam and others, 1995). These values are consistent with the $\delta^{13}C$ of PCE in the source area at well PAI-45-MW-5-SL (–29.16 ‰) and in temporary well PAI-45-USGS-TW39 (–29.49 ‰), approximately 30 ft downgradient from the

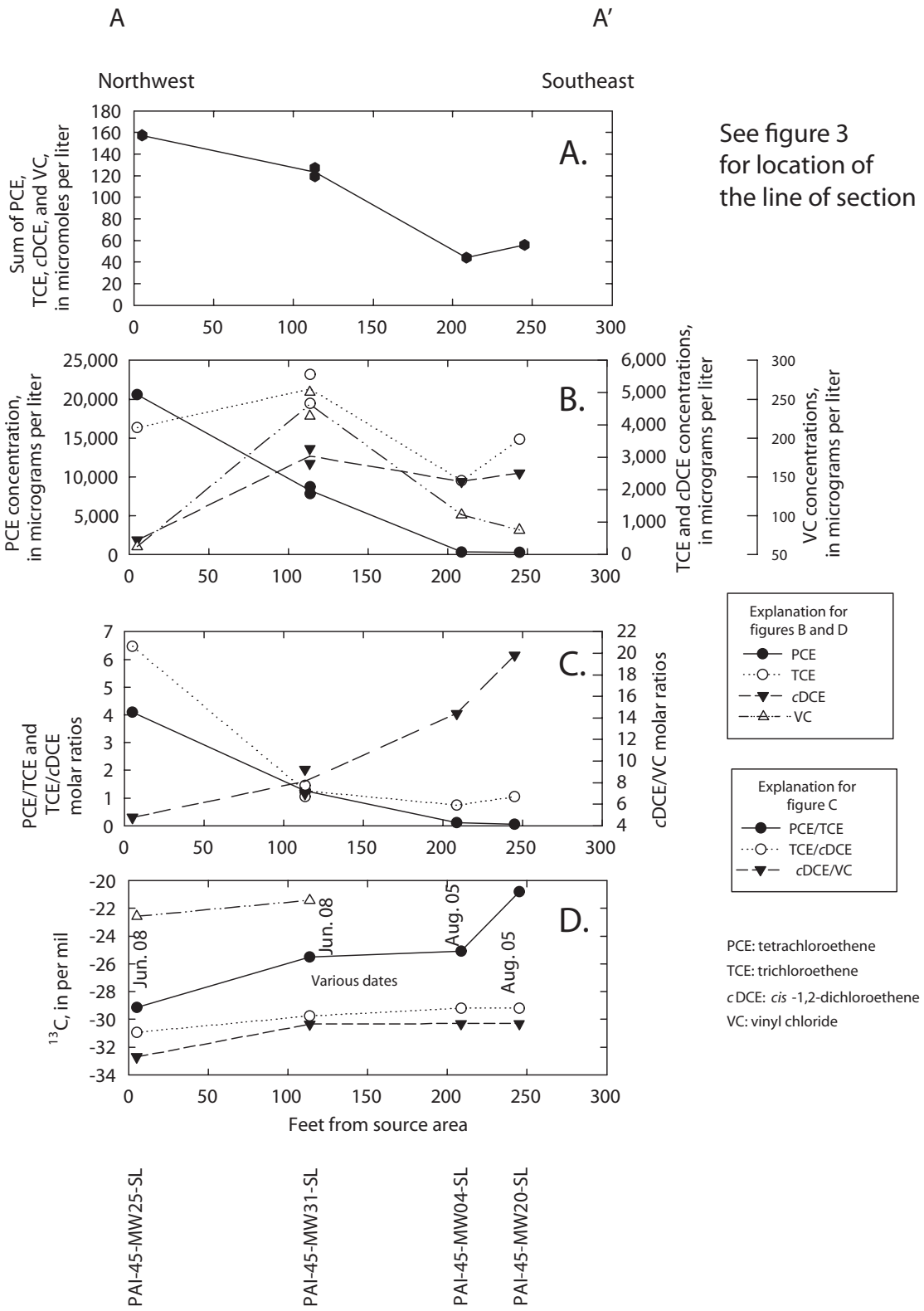


Figure 20. (*A*) Total chlorinated solvents, (*B*) individual chlorinated solvents, (*C*) parent/daughter ratios, and (*D*) compound-specific stable carbon isotopes ($\delta^{13}C$) in wells along the axis of contamination in the southern plume, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, September 2008, unless otherwise noted.

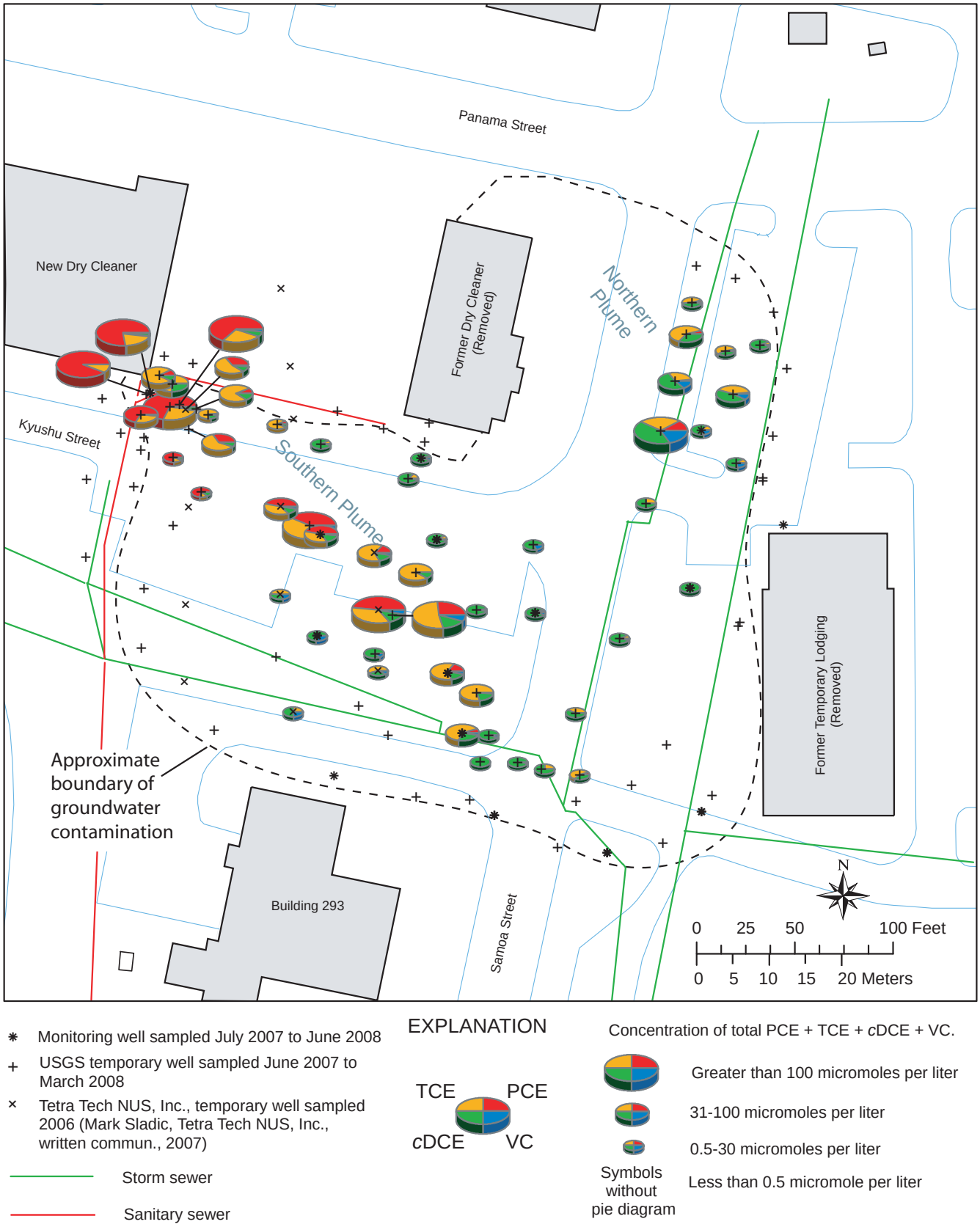


Figure 21. Relative molar percentage of tetrachloroethene (PCE), trichloroethene (TCE), *cis*-1,2-dichloroethene (*c*DCE), and vinyl chloride (VC) in groundwater from monitoring wells and selected temporary wells representing multiple sampling events, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2006–2008.

source area (table 4), possibly indicating little degradation or proximity to free product (Morrill and others, 2003). In temporary well PAI-45-USGS-TW44, which is nearer to the source area than PAI-45-USGS-TW30, the $\delta^{13}C$ of PCE in groundwater was substantially enriched (–26.01 ‰), indicating dechlorination of the PCE. This temporary well also contained a substantially higher VC concentration (201 µg/L; figs. 4 and 15) than in nearby wells, further attesting to dechlorination activity. Thus, there is sufficient dechlorination activity to produce VC in parts of the surficial aquifer near the source area at the southeastern corner of the new dry-cleaning facility.

There also is evidence that TCE is dechlorinating to *c*DCE in groundwater in the southern plume. The most compelling evidence is the sharp decrease in the TCE/*c*DCE ratio between the source area and mid-plume well PAI-45-MW31-SL (fig. 20*C*), despite the observation that the TCE concentration increased over that interval. The change in ratio indicates a gain of *c*DCE relative to TCE.

Direct evidence indicating TCE biodegradation between the midpart of the southern plume at well PAI-45-MW31-SL and the downgradient axis of the plume at well PAI-45-MW20-SL is limited because there is almost no change in the TCE/*c*DCE ratio or in the $\delta^{13}C$ of TCE in this part of the plume (figs. 20*C* and 20*D*), despite a slight decrease in TCE concentration (about 25–35 percent). TCE biodegradation, however, can occur under all anaerobic conditions; it occurs most efficiently under sulfate-reducing and methanogenic conditions (Yang and McCarty, 1998; Bradley, 2003). Because the aquifer is anaerobic and the most contaminated part probably is dominated by sulfate-reducing conditions with probable pockets of methanogenesis, the TEAP conditions are conducive to TCE degradation.

Because H_2 appears to be the most important donor for anaerobic dechlorination of chlorinated VOCs (Fennell and Gossett, 1998), the competition between sulfate-reducing bacteria (SRB) and chlorinated-VOC-degrading bacteria has the potential to limit dechlorination activity; however, in one laboratory study of microcosms containing *Dehalococcoides* sp., high sulfate concentrations (400 to 1,100 mg/L) under limiting electron donor conditions significantly inhibited TCE reduction, but had a negligible effect at 30 mg/L compared to the zero-sulfate case (Panagiotakis and others, 2008). At the comparatively low sulfate concentrations in the southern plume (about 23 to 143 mg/L), sulfate is not expected to inhibit dechlorination activity.

Thus, it is likely that TCE dechlorination to *c*DCE is taking place in the downgradient part of the southern plume. The relative lack of degradation signature in the TCE/*c*DCE ratio or in the $\delta^{13}C$ of TCE may be due to a combination of simultaneous production and degradation of TCE, the relatively small $\delta^{13}C$ fractionation factor associated with TCE to *c*DCE degradation (Song and others, 2002), and slow degradation rates associated with natural attenuation.

It is clear that some level of *c*DCE dechlorination takes place in the aquifer simply because of the presence of VC, a daughter product of *c*DCE reduction. VC is more concentrated in the central part of the southern plume near well PAI-45-MW31-SL (about 120 to 420 µg/L) than in most wells near the source area (about 5 to 50 µg/L) (figs. 15 and 20*B*). This indicates that production of VC by dechlorination of *c*DCE takes place as the contamination is transported, at least in the upgradient half of the plume. An exception is temporary well PAI-45-USGS-TW44 near the new dry cleaner that had 201 µg/L of VC in groundwater, indicating that substantial dechlorination has taken place in at least some parts of the aquifer in or near the source area.

Reduction of VOCs under the iron- and sulfate-reducing conditions that appear to prevail in the aquifer at Site 45 is substantially less favorable for VC than for PCE and TCE. VC dechlorination can take place under these conditions, however, and has taken place at Site 45, as evidenced by elevated ethylene concentrations (13–150 µg/L) in groundwater along the axis of the southern plume relative to groundwater in wells outside of the main axis of the plume (less than 10 µg/L at most wells). Oxidation of VC under iron- and sulfate-reducing conditions is more favorable than reduction and probably is taking place in the aquifer at Site 45. The increases in $\delta^{13}C$ for VC from –22.57 ‰ at temporary well PAI-45-USGS-TW44 to –18.76 to –19.21 ‰ at PAI-45-USGS-TW48 and –17.91 to –18.22 ‰ at PAI-45-USGS-TW53 indicate biodegradation of VC as it is transported along the flowpath (table 4). Further evidence for VC biodegradation can be seen at temporary well PAI-45-USGS-TW63, where only a small amount of VC was present (estimated 30 µg/L) and the $\delta^{13}C$ was enriched (–4.98 to –6.17 ‰). The isotopic fractionation of VC during biodegradation can be larger than the fractionation of its parent compounds because the fractionation factor for VC is larger than for the parent compounds (Hunkeler and others, 1999; Bloom and others, 2000; Slater and others, 2001) and because while TCE and *c*DCE are being biodegraded, they also may be produced by reductive dehalogenation of parent compounds.

Supporting evidence for VC degradation can be seen in the fact that *c*DCE/VC ratios substantially increase along the transport pathway in the southern plume (fig. 20*D*). Based on the isotopic evidence for VC degradation, the increase in *c*DCE/VC ratios probably reflects VC degradation.

Although this investigation mostly focused on the southern plume, part of the northern plume approximately 100 to 160 ft downgradient from the tank-spill area also was investigated using temporary wells. In some of those wells, VC constituted a larger percentage of the VOC contamination than in the southern plume, indicating a more advanced state of degradation. The difference between the chemistry in the northern and southern plumes may be partly because the northern plume has been the focus of a variety of treatment pilot studies. An air-sparging pilot study took place in the northern plume in December 1996 (Bechtel Environmental, Inc., 1997). A groundwater pump-and-treat system was in operation from 1998 to 2000, removing an estimated 1,056,410 gallons of water from the northern plume (Tetra Tech NUS, Inc., 2004). Emulsified zero-valent iron was injected into the aquifer as a treatment in the vicinity of the former above-ground storage

tanks in late 2006 (Suzanne O'Hara, Geosyntec Consultants, written commun., 2008). In contrast, the southern plume has not yet been subjected to engineered remediation. The larger amount of VC in the northern plume than in the southern plume also may be a consequence of probable historic releases of petroleum-based solvents at the former dry cleaning facility (S&ME, Inc., 1994), which could have produced highly reducing conditions conducive to enhanced VC production in parts of what is now the northern plume.

Other Influences

Some degree of sorption of the VOCs is expected to take place in the aquifer. In temporary well PAI-45-USGS-TW96, the total organic carbon (TOC) concentration in a composite sediment sample was 440 mg/kg (0.044 fraction organic carbon [f_{oc}] as percent) at a depth of 8–10 ft and was 2,120 mg/kg (0.212 f_{oc}) at a depth of 12–13 ft (table 6). These values are consistent with TOC analyses of sediment from the southern plume collected by the USEPA for a separate investigation (Scott Huling, U.S. Environmental Protection Agency, written commun., 2009).

The distribution coefficient between water and sediment (K_d) can be calculated from the equation $K_d = K_{oc} \times f_{oc}$, where K_{oc} is the organic carbon sorption coefficient. For PCE, which has a log K_{oc} of about 2.42 (Solutions IES, Inc., and others, 2007), these values produce distribution coefficient between water and sediment (K_d) of about 0.11–0.56. For TCE (log K_{oc} of about 2.03, Solutions IES, Inc., and others, 2007), the calculated K_d is 0.04–0.23. For *c*DCE (log K_{oc} of about 1.65, Solutions IES, Inc., and others, 2007), the calculated K_d is about 0.02–0.06. For VC (log K_{oc} of about 1.23, Solutions IES, Inc., and others, 2007), the calculated K_d is about 0.007–0.036.

The K_d values can be used to calculate a retardation coefficient {1+ [(bulk density)(K_d)]/porosity} for a range of porosities from 0.25 to 0.45 (Freeze and Cherry, 1979). Using an estimated bulk density of 1.65 grams per cubic centimeter (Mercer and others, 1982), the calculated retardation factors are about 1.4–4.7 for PCE, 1.2–2.5 for TCE, 1.1–1.6 for *c*DCE, and 1.0–1.2 for VC. Thus, PCE has the potential to travel 1.4–4.7 times more slowly than water in the aquifer due to sorption, whereas VC is subject to little or no sorption.

Dispersion is an additional factor affecting contaminant concentrations. Dispersion of contamination in the southern plume may be somewhat enhanced by tidal fluctuations and diversion of flow paths toward multiple leaking storm drains.

Summary and Conclusions

Site 45 is a former dry-cleaning facility and the surrounding area near the intersections of Panama Street, Samoa Street, and Kyushu Street. The area includes a new dry-cleaning facility. Groundwater contamination is present at the site, consisting primarily of PCE, TCE, *c*DCE, and VC. Two plumes of groundwater contamination are present, probably with some degree of intermingling in downgradient areas. The northern plume consists of groundwater contamination in the vicinity of and downgradient (southeast) from an area of former aboveground storage tanks north of the former dry-cleaning facility. The southern plume consists of groundwater contamination extending southeastward from the southeastern corner of the new dry-cleaning facility to about the intersection of Samoa Street and the driveway into the parking lot for Building 293. The USGS, in cooperation with the Naval Facilities Engineering Command Southeast, began investigations at the site to (1) examine the role that sewer lines play in contaminant source, distribution, attenuation, and transport in both the northern and southern plumes; (2) further delineate contamination in the southern plume; and (3) examine natural attenuation aspects of groundwater contamination in the southern plume. The investigation involved examination of historical records and engineering drawings of buildings, video imaging of storm sewers, water-level monitoring by synoptic measurements in wells and by use of continuous data loggers, installation and sampling of temporary wells, sampling of wells, storm sewers, surface water, and sediment, and the use of an MIP.

The northern plume appears to have originated from releases of PCE from the former dry-cleaning facility operation, including a documented spill on March 11, 1994. This spill also resulted in discharge of free-phase PCE into the storm-sewer system. Once in the storm-sewer system, the free-phase PCE probably was transported to a discharge point

Table 6. Concentrations of total organic carbon in soil borings, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2008.

[ft BLS, feet below land surface; mg/kg, milligrams per kilogram]

Site identifier	Date (month/day/year)	Depth (ft BLS)	Total organic carbon (mg/kg)	Lithology
PAI-45-MW26-SL	6/27/2008	10–15	128	Sand, fine-grained
PAI-45-MW28-D	8/26/2008	18	155,000	Clay, organic-rich
PAI-45-USGS-TW96	4/30/2008	8–10	440	Sand, grayish-tan, fine-grained, loose
PAI-45-USGS-TW96	4/30/2008	12–13	2,120	Sand, black fine-grained

near Ballast Creek. Some PCE also may have leaked from the storm sewer along the way.

In late 1997, the dry-cleaning operations were moved to a nearby new facility, and the new operation used a hydrocarbon-based cleaner that did not contain chlorinated solvents. Nevertheless, investigations identified a southern plume, which appeared to originate in the vicinity of the new dry-cleaning facility. The present investigation, however, indicates that the southern plume was associated with activities at the former dry-cleaning facility.

The unconfined surficial aquifer at Site 45 consists of sand interspersed with discontinuous beds of clay, silty clay, silty clayey sand, and clayey silt and extends to a depth of about 18 ft BLS. Monitoring wells in this undifferentiated zone are referred to as SU wells if they are screened predominantly shallower than about 11 ft BLS and are referred to as SL wells if they are screened predominantly deeper than about 10 ft BLS. A peat layer, which is a few feet thick, has been reported at depths of about 17 to 27 ft BLS overlying a clay layer of variable thickness (possibly about 2 to 8 ft) that functions as a confining bed. The part of the aquifer below this clay is considered to be the D horizon.

Groundwater in the surficial aquifer moves in a generally southeastward direction with strong curvature of flow lines toward some of the storm sewers that are deeper than the water table. The groundwater surface in the D-horizon wells was comparatively flat-lying, with an overall trend toward the southeast. The most permeable part of the surficial aquifer near the new dry-cleaning facility and the midpart of the southern plume probably is the loose sand unit, which is at a depth of about 6–11.4 ft BLS at well PAI-45-MW28-D and at a depth of about 8–10 ft BLS at temporary well PAI-45-USGS-TW96.

The surfical aquifer at Site 45 is anaerobic at most locations, with the predominant TEAP being iron reduction in the shallowest sediment. In deeper sediment containing the main body of contamination, the predominant TEAP appears to be sulfate or iron reduction; however, the presence of methane, the high degree of contaminant dechlorination, and an H_2 value (31 nM) in the range of methanogenesis at one well indicates that methanogenic zones probably also are present. In the deepest part of the surficial aquifer, near the peat layer, the predominant TEAP probably is methanogenesis, by virtue of the abundant available natural organic matter.

Storm sewers that are below the water table appear to have an important influence on groundwater and contaminant movement. The curvature of groundwater flow lines toward the storm sewers and the presence of chlorinated solvents in water from the storm sewers indicate some level of leakage from the contaminated aquifer into the storm sewers. Although there is some contaminant underflow past the storm sewers in the southern plume and possibly in the southernmost part of the northern plume, leakage into the storm sewers appears to intercept and contain the main body of groundwater contamination in both plumes. Thus, the storm sewers are collection points for the dissolved groundwater contamination.

Most of the groundwater contamination near the new dry-cleaning facility is present from a few feet BLS to about 11.5 ft BLS. Within that interval, most of the contamination is at a depth of about 8 to 11.5 ft BLS, with the greatest concentrations near the bottom of that interval. In the middle part of the southern plume at temporary well PAI-45-USGS-TW96, the most contaminated zone appears to be in a loose sand layer about 8 to 11 ft BLS, although relatively high VOC concentrations also were found to a depth of about 14 ft BLS. The VOC concentrations at temporary well PAI-45-USGS-TW96 decreased with depth below about 13 ft BLS and were not detectable (less than 0.2 parts per million) at depths of 14–14.8 ft directly above the organic-rich layer and at 15.2–16 ft in the organic-rich layer. The less porous nature of the organic-rich silt layer relative to the overlying sand and the downward decrease in VOC concentrations in sediment immediately above the organic-rich silt layer indicates that the organic-rich layer is not a major contaminant-transport pathway at well PAI-45-USGS-TW96.

Although it cannot be stated with certainty that no VOC contamination is in the brackish-water D horizon underlying the clay that defines the base of the surficial unit, such contamination is unlikely for several reasons. The uncertainty arises because the wells in the D horizon were installed slightly offset from the main body of contamination in the surfical aquifer so as to avoid the risk of inadvertent transport of possible free product from the surficial to the deeper aquifer during drilling and because groundwater levels in the D-horizon wells are lower than the levels in the surficial aquifer. Thus, if there were a discontinuity in the clay layer, it is likely that there would be downward flow from the surficial to the deeper aquifers. It seems unlikely that there is contamination in the D-horizon aquifer also because (1) no VOCs were detected in any of the D wells despite the fact that at least well PAI-45-MW28-D was near the main body of contamination; (2) substantially lower VOC concentrations were detected near the base of the surficial aquifer than in the vertical midpart of the surficial aquifer, indicating a low potential for downward transport through the base of the surficial aquifer; and (3) the organic-rich peat at the base of the surficial aquifer provides a substantial sorptive buffer for VOCs.

Although the southern plume spatially originates from the new dry-cleaning facility, the new dry-cleaning facility is not likely the source of the contamination. Engineering blueprints, flow testing, and video imaging of sanitary sewers at the site, as well as the lack of a viable contaminant source at the new dry-cleaning facility, indicate that the contaminant source in the southern plume was a leak from a sanitary sewer in the vicinity of the new dry-cleaning facility.

Once in the aquifer, contamination in both the northern and southern plumes is transported southeastward, where most of the dissolved contamination is intercepted by leaky storm sewers. Because the storm sewers at Site 45 range in diameter from 12 to 36 inches and a tidal change of greater than 3 ft takes place in some of the storm sewers at Site 45, the VOCs entering the storm sewers are substantially diluted upon

entry. Volatilization probably also removes some of the VOC contamination in the storm sewers. During outgoing tides, the diluted contamination in the storm sewer is transported southward and discharges to Ballast Creek. A sample from a manhole STS26 in the storm sewer approximately 320 ft from the Ballast Creek discharge contained PCE, TCE, and *c*DCE concentrations of 0.69 (estimated), 4.26, and 2.53 µg/L, respectively, at low tide and concentrations of 1.06, 5.63, and 3.48 µg/L, respectively, 1 hour after low tide. No chlorinated-solvent contamination was detected in shallow sediment samples in the vicinity of the outfall to Ballast Creek; however, due to a laboratory error, the sediment sample from 1-ft depth at the outfall (PAI-SWSED1, June 17, 2008) had unusually high detection limits (32 to 81 mg/kg).

Despite the low VOC concentrations discharging to Ballast Creek, increases in VOC concentrations potentially are possible in the storm sewers during a time of relatively high groundwater levels and low amounts of tidal flushing. Water from manhole STS14 contained 20 µg/L of VC at a time of relatively high groundwater levels (September 9, 2008). Because manhole STS14 is downstream from the contaminant source along a storm-sewer line that is adjacent to part of the aquifer where 2,290 µg/L of VC was detected (June 25, 2007), there is a potential for substantially increased concentrations of VC to discharge at the storm-sewer outfall under conditions of high groundwater levels and low tidal flushing. In addition, the observation that free-phase PCE may have entered the storm-sewer system during the 1994 overflow means that DNAPL PCE could have leaked from various parts of the storm sewer in route to the Ballast Creek discharge. If the DNAPL was transported all the way to the Ballast Creek discharge point at STS27, then it likely would have sorbed to and sunk into the sediments not far from STS27.

Contaminant concentrations in the aquifer are subject to several influences. Microbes known to degrade chlorinated solvents and enzymes associated with dechlorination are present in the aquifer. The total mass of chlorinated solvents decreases from upgradient to downgradient parts of the southern plume. Parent/daughter–product ratios, stable carbon isotopes, the presence of VC, and higher ethylene concentrations in groundwater along the axis of the southern plume relative to nearby wells indicate extensive dechlorination activity. Oxidation of VC likely is taking place in the aquifer along the southern plume, based on the probable presence of sulfate reduction. Some degree of sorption of the VOCs is expected to take place in the aquifer, with the largest influence being on PCE. Dispersion also may decrease concentrations along the transport pathway. Although biodegradation and other attenuation processes are active in the southern plume, the processes are not sufficient to lower TCE concentrations to less than milligram-per-liter levels prior to intercepting the storm-sewer system.

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Appendix 1. Monitoring-well information, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina.

[NAVD 88, North American Vertical Datum of 1988]

Site identifier	Well diameter (inches)	Depth to top of screen (feet below land surface)	Depth to bottom of screen (feet below land surface)	Northing	Easting	Top of riser datum NAVD 88 (Surveyed by Andrews and Burgess, Inc., in 2008)	Surveyor and date (month/day/year) of survey for Northing and Easting
PAI-45-MW01-D	2	30	40	187465.456	2099311.961	6.60	Andrews & Burgess, Inc. 6/11/08
PAI-45-MW01-SL	2	11.6	14	187466.139	2099316.097	6.52	Doolan, Inc., 2005 (month and day unavailable)
PAI-45-MW01-SU	2	3	7	187467.026	2099306.621	6.54	Doolan, Inc., 2005 (month and day unavailable)
PAI-45-MW02-SL	2	9	14	187351.015	2099211.018	6.22	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW02-SU	2	3	7	187354.829	2099212.934	6.12	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW03-SL	2	9	14	187268.683	2099249.515	6.54	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW03-SU	2	3	7	187267.674	2099253.593	6.59	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW04-D	2	31	41	187166.810	2099265.215	5.78	Andrews & Burgess, Inc. 6/11/08
PAI-45-MW04-SL	2	9	14	187159.374	2099262.953	5.91	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW04-SU	2	3	7	187160.950	2099259.013	5.93	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW05-D	2	34	44	187197.820	2099386.421	7.63	Andrews & Burgess, Inc. 6/11/08
PAI-45-MW05-SL	2	9	14	187202.721	2099386.456	7.24	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW05-SU	2	3	7	187197.962	2099386.971	7.59	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW06-D	2	30	40	187282.019	2099309.350	6.44	Andrews & Burgess, Inc. 6/11/08
PAI-45-MW06-SL	2	9	14	187287.357	2099305.627	6.48	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW06-SU	2	3	7	187283.229	2099304.531	6.52	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW07-D	2	30	40	187339.823	2099306.986	6.63	Andrews & Burgess, Inc. 6/11/08
PAI-45-MW07-SL	2	9	14	187338.979	2099302.924	6.68	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW07-SU	2	3	7	187336.809	2099304.945	6.63	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW08-SL	2	9	14	187401.386	2099328.184	6.50	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW08-SU	2	3	7	187397.064	2099327.899	6.57	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW09-D	2	31	41	187100.747	2099353.889	6.24	Andrews & Burgess, Inc. 6/11/08
PAI-45-MW10-D	2	31	41	187415.892	2099229.520	6.25	Data from Mark Sladic, Tetra Tech NUS, Inc., written commun., 2008
PAI-45-MW10-SL	2	11	16	187227.568	2099257.425	5.85	Andrews & Burgess, Inc. 3/26/08
PAI-45-MW10-SU	2	3	8	187226.768	2099261.530	5.90	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW11-D	2	31	41	187188.732	2099166.370	5.43	Andrews & Burgess, Inc. 6/16/08
PAI-45-MW13-SL	2	11	16	187190.163	2099307.653	6.39	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW13-SU	2	4	9	187184.776	2099306.465	6.48	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW14-SL	2	10	15	187334.096	2099445.045	5.76	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW14-SU	2	4	9	187338.682	2099445.653	5.84	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW15-SL	2	13	18	187265.544	2099457.147	8.13	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW15-SU	2	4	9	187266.012	2099452.700	8.32	Andrews & Burgess, Inc. 4/2/08

Appendix 1. Monitoring-well information, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina.—Continued

[NAVD 88, North American Vertical Datum of 1988]

Site identifier	Well diameter (inches)	Depth to top of screen (feet below land surface)	Depth to bottom of screen (feet below land surface)	Northing	Easting	Top of riser datum NAVD 88 (Surveyed by Andrews and Burgess, Inc., in 2008)	Surveyor and date (month/day/year) of survey for Northing and Easting
PAI-45-MW16-SL	2	13	18	187234.892	2099433.936	9.17	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW16-SU	2	4	9	187234.935	2099429.243	9.14	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW17-SL	2	10	15	187067.734	2099344.179	5.96	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW17-SU	2	4	9	187075.099	2099346.330	6.17	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW18-SL	2	11	16	187107.267	2099205.285	6.98	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW18-SU	2	4	9	187105.786	2099210.709	6.99	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW19-SL	2	11	16	187178.241	2099196.676	5.64	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW19-SU	2	3	8	187176.220	2099201.993	5.64	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW20-SL	2	11	16	187129.003	2099270.471	6.67	Andrews & Burgess, Inc. 3/26/08
PAI-45-MW20-SU	2	4	9	187129.327	2099264.864	6.72	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW21-SL	2	10	15	187345.345	2099245.914	6.27	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW21-SU	2	3	8	187339.024	2099245.269	6.37	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW21-D	2	27	37	187340.975	2099246.902	6.27	Andrews & Burgess, Inc. 9/16/08
PAI-45-MW22-SL	2	10	15	187397.664	2099263.094	6.43	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW22-SU	2	3	8	187392.941	2099266.426	6.51	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW23-SL	2	10	15	187278.133	2099390.679	6.28	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW23-SU	2	3	10	187283.155	2099392.057	6.37	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW24-SU	2	3	8	187373.509	2099284.908	6.62	Andrews & Burgess, Inc. 4/2/08
PAI-45-MW25-SL	2	10	15	187302.168	2099111.404	6.64	Andrews & Burgess, Inc. 3/26/08
PAI-45-MW26-SL	1	10	15	187087.084	2099286.783	5.61	Andrews & Burgess, Inc. 9/16/08
PAI-45-MW27-SL	1	10	15	187088.779	2099392.332	6.58	Andrews & Burgess, Inc. 9/16/08
PAI-45-MW28-D	2	23.7	33.7	187263.583	2099121.183	5.48	Andrews & Burgess, Inc. 6/17/08
PAI-45-MW29-D	2	23.1	33.1	187284.392	2099087.798	5.18	Andrews & Burgess, Inc. 6/11/08
PAI-45-MW30-D	2	25	35	187323.614	2099133.512	8.05	Andrews & Burgess, Inc. 6/11/08
PAI-45-MW31-SL	2	10	15	187230.214	2099198.181	5.49	Andrews & Burgess, Inc. 6/11/08
PAI-45-MW31-SU	2	5	10	187232.003	2099195.065	5.57	Andrews & Burgess, Inc. 6/11/08

Appendix 2. Temporary-well information, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina.

[NAVD 88, North American Vertical Datum of 1988; —, data not available]

Well name	Installation date (month/day/year)	Sample depth (feet below land surface)	Northing	Easting	Land surface datum NAVD 88 (Surveyed by Andrews and Burgess, Inc., in 2008)
PAI-45-USGS-TW1	6/25/2007	8–11	187360.27	2099409.50	6.59
PAI-45-USGS-TW2	6/25/2007	7–11	187343.36	2099429.00	6.13
PAI-45-USGS-TW3	6/25/2007	7–11	187326.55	2099422.00	6.03
PAI-45-USGS-TW4	6/25/2007	7–11	187323.50	2099404.50	6.54
PAI-45-USGS-TW5	6/25/2007	6–10.5	187314.65	2099435.85	5.88
PAI-45-USGS-TW6	6/25/2007	7–11	187301.52	2099408.25	6.33
PAI-45-USGS-TW7	6/25/2007	7–11	187279.92	2099428.61	6.35
PAI-45-USGS-TW8	6/25/2007	7.5–11.5	187266.28	2099410.01	6.85
PAI-45-USGS-TW9	6/25/2007	7.5–11.5	187257.22	2099423.55	7.55
PAI-45-USGS-TW10	6/25/2007	0–10	187254.39	2099401.62	7.18
PAI-45-USGS-TW11	6/25/2007	7.75–11.75	187366.61	2099389.75	6.77
PAI-45-USGS-TW12	6/25/2007	7.5–10.5	187348.06	2099387.50	6.93
PAI-45-USGS-TW13	6/25/2007	6–10	187331.98	2099384.50	6.84
PAI-45-USGS-TW14	6/25/2007	6–10	187308.06	2099378.75	6.94
PAI-45-USGS-TW15	6/25/2007	6–10	187282.89	2099371.50	6.93
PAI-45-USGS-TW16	6/25/2007	6–10	187245.86	2099364.08	6.15
PAI-45-USGS-TW17	6/25/2007	6.5–10.5	187232.94	2099363.75	6.54
PAI-45-USGS-TW18	6/25/2007	12–14.5	187258.84	2099423.52	7.43
PAI-45-USGS-TW19	6/25/2007	8–12	187189.27	2099397.75	7.83
PAI-45-USGS-TW20	6/25/2007	8–12	187183.31	2099411.00	8.39
PAI-45-USGS-TW21	6/25/2007	11–15	187185.06	2099411.75	8.49
PAI-45-USGS-TW22	6/25/2007	6–10	187201.98	2099356.50	6.9
PAI-45-USGS-TW23	6/25/2007	6–10	187176.92	2099350.50	6.69
PAI-45-USGS-TW24	6/25/2007	11.5–15.5	187122.83	2099374.50	6.95
PAI-45-USGS-TW25	6/25/2007	11.5–15.5	187139.01	2099328.13	6.14
PAI-45-USGS-TW26	6/25/2007	11.5–15.5	187072.66	2099372.77	5.96
PAI-45-USGS-TW27	6/25/2007	11.5–15.5	187110.40	2099310.81	6.33
PAI-45-USGS-TW28	6/25/2007	11.5–15.5	187113.94	2099298.75	5.94
PAI-45-USGS-TW29	6/27/2007	11.5–15.5	187094.61	2099274.29	6.32
PAI-45-USGS-TW30	6/25/2007	11.5–15.5	187102.36	2099356.75	6.76
PAI-45-USGS-TW31	6/27/2007	11.5–15.5	187127.72	2099232.59	6.95
PAI-45-USGS-TW32	6/27/2007	11.5–15.5	187142.73	2099217.73	6.98
PAI-45-USGS-TW33	6/25/2007	11.5–15.5	187107.59	2099330.16	5.83
PAI-45-USGS-TW34	6/25/2007	11.5–15.5	187093.87	2099328.33	5.78

Appendix 2. Temporary-well information, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina.—Continued

[NAVD 88, North American Vertical Datum of 1988; —, data not available]

Well name	Installation date (month/day/year)	Sample depth (feet below land surface)	Northing	Easting	Land surface datum NAVD 88 (Surveyed by Andrews and Burgess, Inc., in 2008)
PAI-45-USGS-TW35	6/25/2007	11.5–15.5	187070.40	2099318.86	5.77
PAI-45-USGS-TW36	6/25/2007	11.5–15.5	187096.98	2099397.75	7.22
PAI-45-USGS-TW37	6/27/2007	11.5–15.5	187167.73	2099175.75	6.47
PAI-45-USGS-TW38	6/27/2007	10–14	187251.48	2099137.50	5.34
PAI-45-USGS-TW39	6/27/2007	10–14	187283.45	2099131.22	5.83
PAI-45-USGS-TW40	6/27/2007	10–14	187234.53	2099123.25	5.29
PAI-45-USGS-TW41	6/27/2007	10–14	187316.97	2099133.25	7.95
PAI-45-USGS-TW42	6/27/2007	10–14	187272.82	2099106.84	5.57
PAI-45-USGS-TW43	6/27/2007	10–14	187202.56	2099108.50	—
PAI-45-USGS-TW44	6/27/2007	10–14	187296.06	2099126.50	7.16
PAI-45-USGS-TW45	6/27/2007	10.5–14.5	187171.89	2099107.00	6.76
PAI-45-USGS-TW46	6/27/2007	10.5–14.5	187218.25	2099078.75	5.86
PAI-45-USGS-TW47	6/27/2007	10.5–14.5	187301.52	2099109.50	7.25
PAI-45-USGS-TW48	6/27/2007	10.5–14.5	187234.42	2099192.59	5.64
PAI-45-USGS-TW49	6/27/2007	10–14	187298.99	2099087.18	6.3
PAI-45-USGS-TW50	6/27/2007	11–15	187276.06	2099198.35	6.47
PAI-45-USGS-TW51	6/27/2007	10.5–14.5	187286.09	2099176.36	6.61
PAI-45-USGS-TW52	6/27/2007	11–15	187210.67	2099246.72	6
PAI-45-USGS-TW53	6/27/2007	11–15	187188.90	2099234.92	6.06
PAI-45-USGS-TW54	6/27/2007	11–15	187169.28	2099226.16	5.97
PAI-45-USGS-TW55	6/28/2007	11–15	187292.91	2099206.75	6.63
PAI-45-USGS-TW56	6/28/2007	11–15	187254.19	2099207.20	5.75
PAI-45-USGS-TW57	6/28/2007	11–15	187206.84	2099183.50	5.97
PAI-45-USGS-TW58	6/28/2007	11–15	187130.32	2099144.04	6.92
PAI-45-USGS-TW59	6/28/2007	11–15	187096.29	2099247.02	6.92
PAI-45-USGS-TW60	6/28/2007	10–14	187283.61	2099230.42	6.82
PAI-45-USGS-TW61	6/28/2007	11–15	187244.46	2099262.61	6.21
PAI-45-USGS-TW62	6/28/2007	11.5–15.5	187224.64	2099306.74	6.26
PAI-45-USGS-TW63	6/28/2007	11.5–15.5	187149.34	2099277.79	6.57
PAI-45-USGS-TW64	6/28/2007	11.5–15.5	187114.10	2099279.61	5.97
PAI-45-USGS-TW65	6/28/2007	11.5–15.5	187135.36	2099411.25	6.53
PAI-45-USGS-TW66	6/28/2007	11.5–15.5	187258.48	2099242.97	—
PAI-45-USGS-TW67	6/28/2007	11–15	187277.23	2099251.25	7
PAI-45-USGS-TW68	6/28/2007	11–15	187287.06	2099253.50	6.94

Appendix 2. Temporary-well information, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina.—Continued

[NAVD 88, North American Vertical Datum of 1988; —, data not available]

Well name	Installation date (month/day/year)	Sample depth (feet below land surface)	Northing	Easting	Land surface datum NAVD 88 (Surveyed by Andrews and Burgess, Inc., in 2008)
PAI-45-USGS-TW69	6/28/2007	11–15	187258.16	2099079.12	5.21
PAI-45-USGS-TW70	6/28/2007	11–15	187254.18	2099103.20	5.2
PAI-45-USGS-TW71	8/29/2007	8–12	187211.46	2099416.85	10.04
PAI-45-USGS-TW72	8/29/2007	11–15	187284.76	2099119.48	5.04
PAI-45-USGS-TW73	8/29/2007	11–15	187266.94	2099152.55	5.6
PAI-45-USGS-TW74	8/29/2007	11–15	187249.54	2099172.17	5.56
PAI-45-USGS-TW75	8/29/2007	1–14	187191.45	2099277.80	6.09
PAI-45-USGS-TW76	8/29/2007	11–15	187127.76	2099283.83	6.88
PAI-45-USGS-TW77	3/5/2008	7–11 and 11–15	187311.01	2099116.30	7.33
PAI-45-USGS-TW78	3/5/2008	7–11 and 11–15	187306.62	2099122.83	7.34
PAI-45-USGS-TW79	3/5/2008	11–15	187294.99	2099121.60	6.31
PAI-45-USGS-TW80	3/5/2008	7–11 and 11–15	187291.03	2099106.77	5.54
PAI-45-USGS-TW81	3/5/2008	7–11 and 11–15	187304.55	2099132.91	7.67
PAI-45-USGS-TW82	3/4/2008	11–15	187291.12	2099140.97	6.72
PAI-45-USGS-TW83	3/5/2008	11–15	187273.63	2099135.31	5.38
PAI-45-USGS-TW84	3/5/2008	11–15	187269.15	2099123.28	5.58
PAI-45-USGS-TW85	3/5/2008	11–15	187281.50	2099096.44	5.35
PAI-45-USGS-TW86	3/5/2008	11–15	187279.37	2099108.35	5.32
PAI-45-USGS-TW87	3/4/2008	11–15	187266.53	2099154.00	5.54
PAI-45-USGS-TW88	3/4/2008	11–15	187260.98	2099146.37	5.58
PAI-45-USGS-TW89	3/4/2008	11–15	187263.54	2099179.96	5.6
PAI-45-USGS-TW90	3/4/2008	11–15	187255.87	2099167.90	5.66
PAI-45-USGS-TW91	3/5/2008	11–15	187248.20	2099157.66	5.51
PAI-45-USGS-TW92	3/4/2008	11–15	187247.59	2099194.75	5.72
PAI-45-USGS-TW93	3/4/2008	7–11 and 11–15	187238.34	2099187.03	5.6
PAI-45-USGS-TW94	3/5/2008	7–11 and 11–15	187293.68	2099135.13	6.6
PAI-45-USGS-TW95	3/5/2008	11–15	187320.82	2099118.61	7.52
PAI-45-USGS-TW96	4/30/2008	Core 4–16	187232.55	2099193.41	5.67

Appendix 3. Concentrations of volatile organic compounds in monitoring wells, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2005–2008.

[1,1-DCE, 1,1-dichloroethene; 1,2-DCE, total 1,2-dichloroethene; CB, chlorobenzene; *c*DCE, *cis*-1,2-dichloroethene; EB, ethylbenzene; Napht, naphthalene; PCE, tetrachloroethene; TCE, trichloroethene; Tol, toluene; *t*DCE, *trans*-1,2-dichloroethene; VC, vinyl chloride; Xyl, total xylenes; <, less than; R, duplicate sample; —, not analyzed; H, sample out of holding time; J, estimated concentration; all concentrations are in micrograms per liter]

Site identifier	Date (month/day/year)	1,1-DCE	1,2-DCE	Benzene	CB	*c*DCE	EB	Napht	PCE	TCE	Tol	*t*DCE	VC	Xyl
PAI-45-MW03-SL	7/23/2007	<3	750	<3	<2.5	750	<2.5	<2.5	<2.5	54	<2.5	<3	31.5	<2.5
PAI-45-MW03-SL	9/10/2007	<3	1,080	<3	<2.5	1,070	<2.5	<2.5	<2.5	11	<2.5	<3	14.3	<2.5
PAI-45-MW04-D	9/10/2007	<0.3	<0.3	<0.3	<0.25	<0.3	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25
PAI-45-MW04-SL	8/25/2005	6.51	1,290	<0.3	0.52J	1,290	0.28J	<0.25	4,460	5,390	2.71	—	155J	—
PAI-45-MW04-SL	3/7/2006	<100	796	<100	<100	796	<100	26.6J	5,370	4,760	<100	<100	135	<100
PAI-45-MW04-SLR	3/7/2006	<100	787	<100	<100	787	<100	32.7J	5,270	4,770	<100	<100	137	<100
PAI-45-MW04-SL	9/26/2006	<6.8	—	<10	<11	830	<10	<16	3,700	5,100	<8.5	12J	200	—
PAI-45-MW04-SL	7/24/2007	<15	701	<15	<12.5	701	<12.5	<12.5	1,290	4,010	<12.5	<15	113	<12.5
PAI-45-MW04-SL	9/10/2007	3.45	808	<0.3	1.13	1,010H	<0.25	<0.25	1,840H	5,860H	1.41	13.2	145H	0.50J
PAI-45-MW04-SL	6/18/2008	3.97	1,070	<0.3	1.2	1,450H	<0.25	<0.25	1,030H	3,440H	1.16	15.4	>100	0.46J
PAI-45-MW04-SL	9/9/2008	<15	2,260	<15	<12.5	2,260	<12.5	<12.5	326	2,280	<12.5	<15	101	<12.5
PAI-45-MW04-SU	7/24/2007	<1.2	45.9	<1.2	<1	45.9	<1	<1	67.4	245	<1	<1.2	10.4	<1
PAI-45-MW04-SU	9/10/2007	<0.3	53.4	<0.3	<0.25	52.6	<0.25	<0.25	80.6	277	<0.25	0.82J	12.5	<0.25
PAI-45-MW05-SL	7/23/2007	<0.3	55	<0.3	<0.25	55	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25
PAI-45-MW05-SL	9/11/2007	<0.3	27.7	<0.3	<0.25	27.7	<0.25	<0.25	<0.25	<0.25	0.311J	<0.3	<0.5	<0.25
PAI-45-MW05-SL	6/19/2008	<0.6	126	<0.6	<0.5	126	<0.5	1.03J	<0.5	<0.5	<0.5	<0.6	<1	<0.5
PAI-45-MW05-SL	9/8/2008	<0.3	63.2	<0.3	<0.25	62.6	<0.25	<0.25	<0.25	0.94J	<0.25	0.6J	0.6J	<0.25
PAI-45-MW05-SU	7/23/2007	<0.3	23.7	<0.3	<0.25	23.7	<0.25	<0.25	<0.25	0.47J	<0.25	<0.3	<0.5	<0.25
PAI-45-MW05-SU	6/19/2008	<0.3	13	<0.3	<0.25	13	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25
PAI-45-MW05-SU	9/8/2008	<0.3	4.04	<0.3	<0.25	4.04	<0.25	<0.25	<0.25	1.44	<0.25	<0.3	<0.5	<0.25

Appendix 3. Concentrations of volatile organic compounds in monitoring wells, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2005–2008.—Continued

[1,1-DCE, 1,1-dichloroethene; 1,2-DCE, total 1,2-dichloroethene; CB, chlorobenzene; *c*DCE, *cis*-1,2-dichloroethene; EB, ethylbenzene; Napht, naphthalene; PCE, tetrachloroethene; TCE, trichloroethene; Tol, toluene; *t*DCE, *trans*-1,2-dichloroethene; VC, vinyl chloride; Xyl, total xylenes; <, less than; R, duplicate sample; —, not analyzed; H, sample out of holding time; J, estimated concentration; all concentrations are in micrograms per liter]

Site identifier	Date (month/day/year)	1,1-DCE	1,2-DCE	Benzene	CB	*c*DCE	EB	Napht	PCE	TCE	Tol	*t*DCE	VC	Xyl
PAI-45-MW10-SL	7/23/2007	<3	504	<3	<2.5	504	<2.5	<2.5	<2.5	153	<2.5	<3	<5	<2.5
PAI-45-MW10-SL	9/10/2007	<1.5	525	<1.5	<1.25	563	<1.25	<1.25	<1.25	263	<1.25	2.59J	4.53J	<1.25
PAI-45-MW10-SL	6/18/2008	<0.3	417	<0.3	0.81J	406	<0.25	<0.25	1.3	50.4	<0.25	3.54	8.87	<0.25
PAI-45-MW10-SL	9/9/2008	0.51J	457	<0.3	<0.25	454	<0.25	<0.25	<0.45	13.7	<0.25	2.91	8.32	<0.6
PAI-45-MW10-SU	7/23/2007	0.5J	123	<0.3	<0.25	120	<0.25	<0.25	<0.25	<0.25	<0.25	1.84	9.03	<0.25
PAI-45-MW10-SU	9/10/2007	0.7J	147	<0.3	0.387J	168	<0.25	<0.25	<0.25	<0.25	<0.25	2.07	9.79	<0.25
PAI-45-MW10-SU	6/18/2008	<0.3	59.8	<0.3	<0.25	58.4	<0.25	<0.25	<0.25	<0.25	<0.25	1.34	9.65	<0.25
PAI-45-MW10-SU	9/9/2008	<0.3	66	<0.3	<0.25	64.7	<0.25	0.49J	8.98	2.4	<0.25	1.26	18.3	<0.6
PAI-45-MW13-SL	7/23/2007	<0.6	201	<0.6	3.43	189	<0.5	<0.5	<0.5	<0.5	<0.5	<0.6	4.03	<0.5
PAI-45-MW13-SL	9/11/2007	<1.5	334	<1.5	3.22J	334	<1.25	<1.25	<1.25	<1.25	<1.25	<1.5	<2.5	1.38J
PAI-45-MW13-SL	6/17/2008	<0.3	171	<0.3	3.61	144	<0.25	<0.25	11.5	6.32	<0.25	0.7J	5.52	<0.25
PAI-45-MW13-SL	9/9/2008	<0.6	154	<0.6	4.04	153	<0.5	<0.5	<0.5	<0.5	<0.5	0.7J	3.34	<0.5
PAI-45-MW16-SL	7/24/2007	<0.3	<0.3	<0.3	<0.25	<0.3	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25
PAI-45-MW16-SU	7/24/2007	<0.3	<0.3	<0.3	<0.25	<0.3	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25
PAI-45-MW17-SL	7/24/2007	<0.3	1.04	<0.3	<0.25	1.04	<0.25	<0.25	<0.25	0.27J	<0.25	<0.3	<0.5	<0.25
PAI-45-MW17-SL	9/11/2007	<0.3	0.61J	<0.3	<0.25	0.61J	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25
PAI-45-MW17-SL	6/17/2008	<0.3	2.48	<0.3	<0.25	2.48	<0.25	<0.25	<0.25	1.67	<0.25	<0.3	<0.5	<0.25
PAI-45-MW17-SL	9/8/2008	<0.3	0.35J	<0.3	<0.25	0.35J	<0.25	<0.25	<0.25	0.25J	<0.25	<0.3	<0.5	<0.25
PAI-45-MW17SU	6/17/2008	<0.3	9.71	<0.3	<0.25	9.71	<0.25	<0.25	<0.25	8.83	<0.25	<0.3	1.41	<0.25
PAI-45-MW17-SU	7/24/2007	<0.3	5.34	<0.3	<0.25	5.34	<0.25	<0.25	<0.25	5.74	<0.25	<0.3	<0.5	<0.25
PAI-45-MW17-SU	9/11/2007	<0.3	7.9	<0.3	<0.25	7.9	<0.25	<0.25	<0.25	9.04	<0.25	<0.3	0.87J	<0.25
PAI-45-MW17-SU	9/8/2008	<0.3	7.62	<0.3	<0.25	7.62	<0.25	<0.25	<0.25	4.69	<0.25	<0.3	<0.5	<0.25

Appendix 3. Concentrations of volatile organic compounds in monitoring wells, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2005–2008.—Continued

[1,1-DCE, 1,1-dichloroethene; 1,2-DCE, total 1,2-dichloroethene; CB, chlorobenzene; *c*DCE, *cis*-1,2-dichloroethene; EB, ethylbenzene; Napht, naphthalene; PCE, tetrachloroethene; TCE, trichloroethene; Tol, toluene; *t*DCE, *trans*-1,2-dichloroethene; VC, vinyl chloride; Xyl, total xylenes; <, less than; R, duplicate sample; —, not analyzed; H, sample out of holding time; J, estimated concentration; all concentrations are in micrograms per liter]

Site identifier	Date (month/day/year)	1,1-DCE	1,2-DCE	Benzene	CB	*c*DCE	EB	Napht	PCE	TCE	Tol	*t*DCE	VC	Xyl
PAI-45-MW18-SL	9/9/2008	<0.3	3.75	<0.3	<0.25	3.75	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25
PAI-45-MW18-SU	9/9/2008	<0.3	<0.3	<0.3	<0.25	<0.3	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25
PAI-45-MW19-SL	7/24/2007	<0.6	141	<0.6	<0.5	141	<0.5	<0.5	<0.5	7.63	<0.5	<0.6	31.7	<0.5
PAI-45-MW19-SLR	7/24/2007	<0.6	136	<0.6	<0.5	135	<0.5	<0.5	<0.5	6.55	<0.5	0.84J	30.2	<0.5
PAI-45-MW19-SL	9/11/2007	<0.3	107	<0.3	<0.25	127	<0.25	<0.25	<0.25	5.46	<0.25	0.97J	23.5	<0.25
PAI-45-MW19-SL	6/19/2008	<0.3	100	<0.3	<0.25	99.8	<0.25	<0.25	<0.25	1.48	<0.25	0.68J	24.8	<0.25
PAI-45-MW19-SL	9/10/2008	<0.3	127	<0.3	<0.25	111	<0.25	<0.25	6.87	2.27	<0.25	1.05	30.3	<0.6
PAI-45-MW20-SL	8/25/2005	3.85	900	<0.3	<0.25	900	<0.25	<0.25	1,100	3,950	1.47	—	<100	—
PAI-45-MW20-SL	3/7/2006	<100	905	<100	<100	905	<100	<100	782	5,840	<100	<100	117	<100
PAI-45-MW20-SL	9/26/2006	<6.8	—	<10	<11	920	<10	<16	430	5,600	<8.5	15J	120	—
PAI-45-MW20-SL	7/24/2007	<15	904	<15	<12.5	904	<12.5	<12.5	731	4,940	<12.5	<15	94.6	<12.5
PAI-45-MW20-SLR	7/24/2007	<15	896	<15	<12.5	896	<12.5	<12.5	740	4,840	<12.5	<15	99.6	<12.5
PAI-45-MW20-SL	9/10/2007	3.2	779	<0.3	0.58J	955H	<0.25	<0.25	661H	5,460H	1.36	12.6	97.7	0.48J
PAI-45-MW20-SL	6/19/2008	2.64	926	<0.3	0.67J	983	<0.25	<0.25	358	3,270	1.11	15.1	92	0.4J
PAI-45-MW20-SL	9/8/2008	4.16	1,700	<0.3	<0.25	2510	<0.25	<0.25	265	3,560	1.06	23.3	81.7	<0.6
PAI-45-MW20-SU	9/26/2006	<6.8	—	<10	<11	340	<10	<16	700	1,500	<8.5	<10	84	—
PAI-45-MW20-SU	7/24/2007	<7.5	993	<7.5	<6.25	993	<6.25	<6.25	1,260	2,350	<6.25	<7.5	188	<6.25
PAI-45-MW20-SU	9/10/2007	<0.3	66.4	<0.3	<0.25	65.5	<0.25	<0.25	32.6B	287H	0.26J	0.95J	19.1	<0.25
PAI-45-MW20-SU	9/8/2008	0.75J	295	<0.3	<0.25	283	<0.25	<0.25	43.3	233	<0.25	2.84	38	<0.25
PAI-45-MW23-SL	7/23/2007	<0.3	26.2	<0.3	<0.25	25.9	<0.25	<0.25	<0.25	0.32J	<0.25	0.37J	2.3	<0.25
PAI-45-MW23-SL	9/11/2007	<0.3	15.1	<0.3	<0.25	15.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	0.95J	<0.25

Appendix 3. Concentrations of volatile organic compounds in monitoring wells, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2005–2008.—Continued

[1,1-DCE, 1,1-dichloroethene; 1,2-DCE, total 1,2-dichloroethene; CB, chlorobenzene; *c*DCE, *cis*-1,2-dichloroethene; EB, ethylbenzene; Napht, naphthalene; PCE, tetrachloroethene; TCE, trichloroethene; Tol, toluene; *t*DCE, *trans*-1,2-dichloroethene; VC, vinyl chloride; Xyl, total xylenes; <, less than; R, duplicate sample; —, not analyzed; H, sample out of holding time; J, estimated concentration; all concentrations are in micrograms per liter]

Site identifier	Date (month/day/year)	1,1-DCE	1,2-DCE	Benzene	CB	*c*DCE	EB	Napht	PCE	TCE	Tol	*t*DCE	VC	Xyl
PAI-45-MW23-SU	7/23/2007	<6	1,030	<6	<5	1,010	<5	<5	7.26J	276	<5	23.1	183	<5
PAI-45-MW25-SL	9/11/2007	<75	796	<75	<62.5	796	<62.5	<62.5	17,200	4,330	<62.5	<75	<125	<62.5
PAI-45-MW25-SLR	9/11/2007	<75	746	<75	<62.5	746	<62.5	<62.5	17,200	3,960	<62.5	<75	<125	<62.5
PAI-45-MW25-SL	6/19/2008	3.53	413	<0.3	2.22	362	0.72J	<0.25	20,400	4,210	2.02	6.69	46.5	3.14
PAI-45-MW25-SL	9/9/2008	1.51	447	<0.3	2.06	447	0.44J	<0.25	20,600	3,920	1.1	5.93	60.3	2.04
PAI-45-MW26-SL	9/11/2007	<0.3	11.8	<0.3	<0.25	11.8	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25
PAI-45-MW26-SL	6/19/2008	<0.3	3.32	<0.3	<0.25	3.32	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25
PAI-45-MW26-SL	9/9/2008	<0.3	17.5	<0.3	<0.25	17.5	<0.25	<0.25	<0.45	0.501J	<0.25	<0.3	1.62	<0.6
PAI-45-MW27-SL	9/11/2007	<1.5	5.85	6.01	<1.25	5.85	5.14	606	<1.25	<1.25	1.55J	<1.5	<2.5	8.44
PAI-45-MW27-SLR	9/11/2007	<1.5	5.83	5.94	<1.25	5.83	4.94J	555	<1.25	<1.25	1.38J	<1.5	<2.5	8.49
PAI-45-MW27-SL	6/19/2008	<0.3H	5.38H	3.35H	<0.25H	5.38H	2.05H	281	<0.25H	<0.25H	0.34HJ	<0.3H	<0.5H	2.84H
PAI-45-MW27-SL	9/9/2008	<0.3	7.61	4.59	<0.25	7.61	3.27	219	<0.45	<0.25	0.420J	<0.3	<0.5	4.92
PAI-45-MW28D	6/17/2008	<0.3	<0.3	<0.3	<0.25	<0.3	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25
PAI-45-MW29D	6/17/2008	<0.3	<0.3	<0.3	<0.25	<0.3	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25
PAI-45-MW30D	6/17/2008	<0.3	<0.3	<0.3	<0.25	<0.3	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25
PAI-45-MW31-SL	6/18/2008	4.96	1,180	<0.3	1.11	1,350	0.46J	<0.25	7,240	4,380	2.57	20	120	1.98
PAI-45-MW31-SLR	6/18/2008	5.9	1,220	<0.3	1.12	1,310	0.45J	<0.25	7,450	4,560	2.72	22	170	1.99
PAI-45-MW31-SL	9/9/2008	<30	3,270	<30	<25	3,270	<25	<25	7,840	4,670	<25	<30	228	<60
PAI-45-MW31-SLR	9/9/2008	<30	2,810	<30	<25	2,810	<25	<25	8,720	5,560	<25	<30	259	<60
PAI-45-MW31-SU	6/18/2008	2.83	925	<0.3	<0.25	945	<0.25	<0.25	2,060	1,480	1.26	19.5	144	<0.25
PAI-45-MW31-SUR	6/18/2008	3.23	920	<0.3	<0.25	1,010	<0.25	<0.25	2,160	1,550	1.13	18	148	<0.25
PAI-45-MW31-SU	9/9/2008	<7.5	1,150	<7.5	<6.25	1,140	<6.25	<6.25	2,770	1,860	<6.25	12.0J	205	<15
PAI-45-MW31-SUR	9/9/2008	3.69	1,050	<0.3	<0.25	1,230	<0.25	<0.25	3,000	2,090	1.45	13.7	263	<0.6

Appendix 4. Concentrations of inorganic constituents, dissolved gases, and total organic carbon in monitoring wells, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2005–2008.

[H_2, molecular hydrogen; HIBA, 2-hydroxyisobutyric acid; TOC, total organic carbon; Mg, magnesium; Mn, manganese; mg/L, milligrams per liter; nM, nanomoles per liter; µg/L, micrograms per liter; mg/mL, milligrams per milliliter; <, less than; R, duplicate sample; —, not analyzed; J, estimated concentration; B, target analyte was detected in the associated blank]

Site identifier	Date (month/day/year)	Acetic acid (mg/L)	Arsenic (mg/L)	Calcium (µg/L)	Chloride (mg/L)	Ethane (µg/L)	Ethene (µg/L)	H_2 (nM)	Lactic acid and HIBA (mg/L)	Mg (µg/L)	Mn (µg/L)	Methane (µg/L)	Nitrate (mg/L)	Salinity (mg/mL)	Sodium (µg/L)	Sulfate (mg/L)	TOC (mg/L)
PAI-45-MW03-SL	7/23/2007	0.11	—	—	143	<2	4.6J	1.1	—	—	—	423	—	—	—	110	34
PAI-45-MW03-SL	9/10/2007	0.19	—	—	241	<10	20J	—	<0.1	—	—	1,970	—	—	—	111	17
PAI-45-MW04-SL	8/25/2005	—	—	—	185	<2	97	—	—	—	—	1,510	—	—	—	53	—
PAI-45-MW04-SL	9/26/2006	—	—	—	—	<0.4	25	—	—	—	—	440	—	—	—	—	24
PAI-45-MW04-SL	7/24/2007	<0.07	—	—	146	<10	55J	1.1	0.15	—	—	1,410	—	—	—	51	21
PAI-45-MW04-SL	9/10/2007	0.12	—	—	260	<20	84J	—	<0.1	—	—	2,740	—	—	—	64	17
PAI-45-MW04-SL	6/18/2008	—	—	7,550	153	28BJ	45J	—	—	7,920	18.4	2,390B	<0.033	—	122,000	52	20
PAI-45-MW04-SL	9/9/2008	—	—	8,020	157	0.56	43	1.6	—	7,870	16.4	1,800	—	—	124,000	54	21
PAI-45-MW04-SU	7/24/2007	—	—	—	17.9	<4	6.1J	—	—	—	—	358	—	—	—	38	—
PAI-45-MW04-SU	9/10/2007	—	—	—	19.5	<10	10J	—	—	—	—	588	—	—	—	34	—
PAI-45-MW05-SL	7/23/2007	—	—	—	371	<20	<20	—	—	—	—	3,640	—	—	—	13	—
PAI-45-MW05-SL	9/11/2007	—	—	—	379	<40	<40	—	—	—	—	5,170	—	—	—	2.9	—
PAI-45-MW05-SL	6/19/2008	—	—	52,000	418	21J	<20	—	—	22,800	394	685B	—	—	226,000	65	9.8
PAI-45-MW05-SL	9/8/2008	—	< 0.0050	56,000	369	0.06	0.25	—	—	19,700	413	3,300	—	—	178,000	14	7
PAI-45-MW05-SU	7/23/2007	—	—	—	91.3	<2	<2	—	—	—	—	93.6	—	—	—	14	—
PAI-45-MW05-SU	6/19/2008	—	—	—	46.6	3BJ	<2	—	—	—	—	155B	—	—	—	19	12
PAI-45-MW05-SU	9/8/2008	—	< 0.0050	—	16.4	< 0.03	< 0.02	—	—	—	—	11	—	—	—	28	15
PAI-45-MW10-SL	7/23/2007	—	—	—	259	<2	4.J	2.2	—	—	—	190	—	—	—	140	16
PAI-45-MW10-SL	9/10/2007	—	—	—	243	<4	8.2J	—	—	—	—	363	—	—	—	110	—
PAI-45-MW10-SL	6/18/2008	—	—	23,300	223	3BJ	3.7J		—	14,000	65.9	164B	—	—	183,000	120	17
PAI-45-MW10-SL	9/9/2008	—	—	24,100	222	0.04	5.3	2.1	—	15,900	63.5	170	—	—	190,000	120	16
PAI-45-MW10-SU	7/23/2007	—	—	—	109	<20	<20	—	—	—	—	942	—	—	—	54	—
PAI-45-MW10-SU	9/10/2007	—	—	—	114	<10	<10	—	—	—	—	958	—	—	—	74	13
PAI-45-MW10-SU	6/18/2008	—	—	—	99.6	<10	<10	—	—	—	—	679B	—	—	—	47	50
PAI-45-MW10-SU	9/9/2008	—	—	—	103	0.1	9.3	—	—	—	—	1100	—	—	—	49	33

Appendix 4. Concentrations of inorganic constituents, dissolved gases, and total organic carbon in monitoring wells, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2005–2008.—Continued

[H_2, molecular hydrogen; HIBA, 2-hydroxyisobutyric acid; TOC, total organic carbon; Mg, magnesium; Mn, manganese; mg/L, milligrams per liter; nM, nanomoles per liter; µg/L, micrograms per liter; mg/mL, milligrams per milliliter; <, less than; R, duplicate sample; —, not analyzed; J, estimated concentration; B, target analyte was detected in the associated blank]

Site identifier	Date (month/day/year)	Acetic acid (mg/L)	Arsenic (mg/L)	Calcium (µg/L)	Chloride (mg/L)	Ethane (µg/L)	Ethene (µg/L)	H_2 (nM)	Lactic acid and HIBA (mg/L)	Mg (µg/L)	Mn (µg/L)	Methane (µg/L)	Nitrate (mg/L)	Salinity (mg/mL)	Sodium (µg/L)	Sulfate (mg/L)	TOC (mg/L)
PAI-45-MW13-SL	7/23/2007	0.14	—	—	153	<4	<4	—	0.15	—	—	425	—	—	—	120	15
PAI-45-MW13-SL	9/11/2007	<0.07	—	—	203	<4	<4	—	<0.1	—	—	600	—	—	—	130	14
PAI-45-MW13-SL	6/17/2008	—	—	24,700	140	—	—	—	—	13,700	69.6	—	—	—	143,000	87	16
PAI-45-MW13-SL	9/9/2008	—	—	28,300	131	0.19	1	—	—	15,100	73.9	870	—	—	131,000	100	15
PAI-45-MW16-SL	7/24/2007	—	—	—	24.3	<20	<20	—	—	—	—	3,840	—	—	—	0.7	—
PAI-45-MW16-SU	7/24/2007	—	—	—	4.5	<2	<2	—	—	—	—	36.5	—	—	—	9.4	—
PAI-45-MW17-SL	7/24/2007	—	—	—	1,480	<4	<4	—	—	—	—	294	—	—	—	200	—
PAI-45-MW17-SL	9/11/2007	—	—	—	1,500	<4	<4	—	—	—	—	385	—	—	—	200	—
PAI-45-MW17-SL	6/17/2008	—	—	72,200	1,750	2.8BJ	<2	—	—	128,000	172	269B	—	—	890,000	250	9
PAI-45-MW17-SL	9/8/2008	—	—	46,600	1,160	—		—	—	80,900	152	—	—	—	646,000	130	8
PAI-45-MW17SU	6/17/2008	—	—	19,400	86	3.BJ	<2	—	—	7,750	23.2	250B	—	—	87,500	10	54
PAI-45-MW17-SU	7/24/2007	—	—	—	162	<4	<4	—	—	—	—	476	—	—	—	15	—
PAI-45-MW17-SU	9/11/2007	—	—	—	141	<4	<4	—	—	—	—	876	—	—	—	14	—
PAI-45-MW17-SU	9/8/2008	—	—	21,500	68.5	—	—	—	—	8,570	23.8	—	—	—	60,700	7.8	19
PAI-45-MW18-SL	9/9/2008	—	0.013	—		—	—	—	—	—	—	—	—	—	—	—	—
PAI-45-MW18-SU	9/9/2008	—	< 0.0050	—		—	—	—	—	—	—	—	—	—	—	—	—
PAI-45-MW19-SL	7/24/2007	—	—	—	332	5.1J	<4	—	—	—	—	614	—	—	—	36	31
PAI-45-MW19-SLR	7/24/2007	—	—	—	357	<4	<4	—	—	—	—	569	—	—	—	36	—
PAI-45-MW19-SL	9/11/2007	0.33	—	—	303	<4	<4	—	<0.1	—	—	742	—	—	—	29	33
PAI-45-MW19-SL	6/19/2008	—	—	—	311	<10	<10	—	—	—	—	203B	—	<1	—	32	30
PAI-45-MW19-SL	9/10/2008	—	—	—	334	1.8	1.4	—	—	—	—	510	—	—	—	33	33

Appendix 4. Concentrations of inorganic constituents, dissolved gases, and total organic carbon in monitoring wells, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2005–2008.—Continued

[H_2, molecular hydrogen; HIBA, 2-hydroxyisobutyric acid; TOC, total organic carbon; Mg, magnesium; Mn, manganese; mg/L, milligrams per liter; nM, nanomoles per liter; µg/L, micrograms per liter; mg/mL, milligrams per milliliter; <, less than; R, duplicate sample; —, not analyzed; J, estimated concentration; B, target analyte was detected in the associated blank]

Site identifier	Date (month/day/year)	Acetic acid (mg/L)	Arsenic (mg/L)	Calcium (µg/L)	Chloride (mg/L)	Ethane (µg/L)	Ethene (µg/L)	H_2 (nM)	Lactic acid and HIBA (mg/L)	Mg (µg/L)	Mn (µg/L)	Methane (µg/L)	Nitrate (mg/L)	Salinity (mg/mL)	Sodium (µg/L)	Sulfate (mg/L)	TOC (mg/L)
PAI-45-MW20-SL	8/25/2005	—	—	—	678	<2	35	—	—	—	—	1,060	—	—	—	130	—
PAI-45-MW20-SL	9/26/2006	—	—	—	—	<0.4	13	—	—	—	—	200	—	—	—	—	—
PAI-45-MW20-SL	7/24/2007	0.26	—	—	478	<40	74J	2.9	0.42	—	—	1,680	—	—	—	110	19
PAI-45-MW20-SLR	7/24/2007	0.21	—	—	476	<40	66J	—	0.29	—	—	1,820	—	—	—	120	19
PAI-45-MW20-SL	9/10/2007	0.13	—	—	587	<20	64J	—	<0.1	—	—	1,970	—	—	—	130	16
PAI-45-MW20-SL	6/19/2008	—	—	31,100	—	16BJ	36J	—	—	21,300	68.5	1230B	0.132	—	267,000	—	16
PAI-45-MW20-SL	9/8/2008	—	—	43,700	473	0.51	35	2	—	27,700	91.9	1400	—	—	318,000	110	16
PAI-45-MW20-SU	9/26/2006	—	—	—	—	<0.4	7.7	—	—	—	—	190	—	—	—	—	—
PAI-45-MW20-SU	7/24/2007	—	—	—	85	<10	45J	—	—	—	—	1,350	—	—	—	38	14
PAI-45-MW20-SU	9/10/2007	0.08	—	—	261	<4	9.3J	—	0.18	—	—	865	—	—	—	53	12
PAI-45-MW20-SU	6/19/2008	—	—	4,800	99.2	<10	22J	—	—	8,570	22.2	709B	—	—	91,600	44	22
PAI-45-MW20-SU	9/8/2008	—	—	4,250	101	0.14	8.2	—	—	7,310	9.89J	870	—	—	85,500	38	12
PAI-45-MW23-SL	7/23/2007	0.23	—	—	161	<40	<40	—	0.23	—	—	5,440	—	—	—	0.6	7
PAI-45-MW23-SL	9/11/2007	<0.07	—	—	174	<100	<100	—	0.7	—	—	11,500	—	—	—	<0.1	<5
PAI-45-MW23-SU	7/23/2007	—	—	—	79.9	<10	95J	—	—	—	—	632	—	—	—	52	—
PAI-45-MW25-SL	9/11/2007	<0.07	—	—	90.4	<20	200J	—	1.4	—	—	754	—	—	—	45	8
PAI-45-MW25-SLR	9/11/2007	<0.07	—	—	82.7	<4	160	—	1.1	—	—	581	—	—	—	45	7
PAI-45-MW25-SL	6/19/2008	—	—	15,600	135	2.6BJ	28	—	—	7,340	38.6	203B	0.087J	—	106,000	50	10
PAI-45-MW25-SL	9/9/2008	—	0.018	8,310	62.4	0.53	45	1.8	—	4,840	18.2	180	—	—	62,200	43	11
PAI-45-MW26-SL	9/11/2007	0.28	—	—	341	<4	<4	—	<0.1	—	—	701	—	—	—	58	16
PAI-45-MW26-SL	6/19/2008	—	—	72,500	381	3.2BJ	<2	—	—	23,100	101	394B	—	—	286,000	65	18
PAI-45-MW26-SL	9/9/2008	—	—	69,500	574	0.21	0.67	—	—	30,600	108	390	—	—	432,000	68	19

Appendix 4. Concentrations of inorganic constituents, dissolved gases, and total organic carbon in monitoring wells, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2005–2008.—Continued

[H_2, molecular hydrogen; HIBA, 2-hydroxyisobutyric acid; TOC, total organic carbon; Mg, magnesium; Mn, manganese; mg/L, milligrams per liter; nM, nanomoles per liter; µg/L, micrograms per liter; mg/mL, milligrams per milliliter; <, less than; R, duplicate sample; —, not analyzed; J, estimated concentration; B, target analyte was detected in the associated blank]

Site identifier	Date (month/day/year)	Acetic acid (mg/L)	Arsenic (mg/L)	Calcium (µg/L)	Chloride (mg/L)	Ethane (µg/L)	Ethene (µg/L)	H_2 (nM)	Lactic acid and HIBA (mg/L)	Mg (µg/L)	Mn (µg/L)	Methane (µg/L)	Nitrate (mg/L)	Salinity (mg/mL)	Sodium (µg/L)	Sulfate (mg/L)	TOC (mg/L)
PAI-45-MW27-SL	9/11/2007	—	—	—	138	<40	<40	—	—	—	—	7,630	—	—	—	2.9	<5
PAI-45-MW27-SLR	9/11/2007	—	—	—	135	<40	<40	—	—	—	—	7,310	—	—	—	2.6	—
PAI-45-MW27-SL	6/19/2008	—	—	11,000	126	<40	<40	—	—	11,000	61.4	3210B	—	<1	76,200	0.6	6
PAI-45-MW27-SL	9/9/2008	—	—	9,610	120	0.23	0.18	—	—	10,100	57.2	7200	—	—	72,000	0.2J	5
PAI-45-MW28D	6/17/2008	—	—	—	5,520	<2	<2	—	—	—	—	17.3BJ	—	—	—	950	4
PAI-45-MW29D	6/17/2008	—	—	—	4,160	3.1BJ	<2	—	—	—	—	20.6BJ	—	8.1	—	660	4
PAI-45-MW30D	6/17/2008	—	—	—	1,940	3.2BJ	<2	—	—	—	—	29.8B	—	—	—	260	6
PAI-45-MW31-SL	6/18/2008	—	—	13,300	214	14BJ	130	—	—	10,400	54.5	1,650B	<0.033		144,000	62	14
PAI-45-MW31-SLR	6/18/2008	—	—	13,400	213	14BJ	140	—	—	10,400	56.1	2,140B	—	—	145,000	62	14
PAI-45-MW31-SL	9/9/2008	—	0.022	22,500	208	2.2	150	31	—	16,500	102	2,700	—	—	227,000	54	12
PAI-45-MW31-SLR	9/9/2008	—	—	18,500	208	2.3	140	—	—	14,200	79.5	2400	—	—	176,000	53	12
PAI-45-MW31-SU	6/18/2008	—	—	3,330	125	65BJ	77J		—	3,080	21.2	4,420B	<0.033H	—	122,000	76	29
PAI-45-MW31-SUR	6/18/2008	—	—	3,360	129	51BJ	49J	—	—	3,080	21.9	2,770B	—	—	125,000	72	26
PAI-45-MW31-SU	9/9/2008	—	—	3,270	121	0.59	87	3.4	—	3,190	16.2	4,400	—	—	113,000	63	34
PAI-45-MW31-SUR	9/9/2008	—	—	—	120	0.78	74	—	—	—	—	5,400	—	—	—	63	34

Appendix 5. Concentrations of field-measured constituents in groundwater from monitoring wells, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2005–2008.

[Alk, total alkalinity as calcium carbonate; CO_2, carbon dioxide; DO, dissolved oxygen; Fe, ferrous iron; SC, specific conductance; Temp., temperature; <, less than; —, not analyzed; mg/L, milligrams per liter; S.U., standard units; µS/cm at 25 °C, microsiemens per centimeter at 25 degrees Celsius; °C, degrees Celsius; >, greater than]

Site identifier	Date (month/day/year)	Alk (mg/L)	CO_2 (mg/L)	DO (mg/L)	Fe (mg/L)	pH (S.U.)	SC (µS/cm at 25 °C)	Sulfide (mg/L)	Temp. °C
PAI-45-MW03-SL	7/23/2007	—	—	—	—	6.01	1,030	—	23.92
PAI-45-MW03-SL	9/10/2007	55	50	<0.03	—	5.81	985	—	25.00
PAI-45-MW04-D	9/10/2007	200	50	0.05	—	6.35	12,700	<0.05	24.67
PAI-45-MW04-D	9/10/2007	200	50	0.05	—	6.35	12,700	<0.05	—
PAI-45-MW04-SL	8/25/2005	35	150	<0.03	17.5	5.71	1,040	<0.05	25.35
PAI-45-MW04-SL	3/7/2006	—	—	—	—	5.69	710	—	17.76
PAI-45-MW04-SL	9/26/2006	25	180	<0.03	5.55	5.55	784	<0.05	25.15
PAI-45-MW04-SL	7/24/2007	60	175	0.1	5.17	5.58	745	<0.05	24.18
PAI-45-MW04-SL	9/10/2007	35	100	0.05	—	5.83	632	—	25.40
PAI-45-MW04-SL	6/18/2008	20	170	0.15	5.32	5.58	773	<0.2	21.21
PAI-45-MW04-SL	9/9/2008	35	190	<0.03	5.36	5.63	785	<0.2	25.26
PAI-45-MW04-SU	7/24/2007	<10	100	0.1	1.55	4.99	191	<0.05	25.93
PAI-45-MW04-SU	9/10/2007	–10	125	0.02	—	5.16	211	<0.05	26.81
PAI-45-MW05-SL	7/23/2007	—	—	—	—	5.81	1,449	—	26.53
PAI-45-MW05-SL	9/11/2007	>1,000	50	<0.025	—	5.58	1,740	0.1	27.22
PAI-45-MW05-SL	6/19/2008	22	180	0.3	18.2	5.5	1,737	<0.2	25.02
PAI-45-MW05-SL	9/8/2008	45	30	0.1	27	5.76	1,464	0.18	27.57
PAI-45-MW05-SU	7/23/2007	100	70	0.7	2.8	6.31	568	<0.05	27.74
PAI-45-MW05-SU	6/19/2008	120	65	0.6	<0.2	6.41	480	<0.2	26.19
PAI-45-MW05-SU	9/8/2008	70	17	2	1.18	—	509	0.08	29.38
PAI-45-MW10-SL	7/23/2007	—	—	—	—	5.97	1,390	—	27.51
PAI-45-MW10-SL	9/10/2007	55	80	0.1	—	5.61	1,190	—	29.55
PAI-45-MW10-SL	6/18/2008	60	40	0.1	9.59	5.73	1,230	<0.2	25.54
PAI-45-MW10-SL	9/9/2008	70	45	<0.03	9.73	5.67	1,260	<0.2	30.08
PAI-45-MW10-SU	7/23/2007	—	—	—	—	6.3	975	—	29.52
PAI-45-MW10-SU	9/10/2007	150	70	<0.03	—	5.86	981	<0.05	30.80
PAI-45-MW10-SU	6/18/2008	170	35	0.05	13.7	6.23	960	<0.2	27.71
PAI-45-MW10-SU	9/9/2008	225	40	0.05	16.4	6.18	978	<0.2	30.76
PAI-45-MW13-SL	7/23/2007	—	—	—	—	6.08	1,030	—	28.43
PAI-45-MW13-SL	9/11/2007	110	40	0.05	—	—	1,000	<0.05	29.55
PAI-45-MW13-SL	6/17/2008	125	200	0.25	4.66	5.94	992	<0.2	25.11
PAI-45-MW13-SL	9/9/2008	100	200	0.05	4.97	5.96	1,010	<0.2	29.28
PAI-45-MW16-SL	7/24/2007	—	—	—	—	6.2	313	—	25.81
PAI-45-MW16-SU	7/24/2007	—	—	—	—	5.69	103	—	28.54
PAI-45-MW17-SL	7/24/2007	—	—	—	—	5.77	4,960	—	26.84
PAI-45-MW17-SL	9/11/2007	65	50	0.05	—	5.61	5,310	<.05	27.96
PAI-45-MW17-SL	6/17/2008	75	60	0.05	28.8	5.83	5,920	0.2	24.66
PAI-45-MW17-SL	9/8/2008	40	105	0.05	14.3	5.55	4,260	<0.2	27.82
PAI-45-MW17-SU	7/24/2007	—	—	—	—	6.63	942		28.15
PAI-45-MW17-SU	9/11/2007	150	35	0.05	—	6.43	874	<0.05	29.29

Appendix 5. Concentrations of field-measured constituents in groundwater from monitoring wells, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2005–2008.—Continued

[Alk, total alkalinity as calcium carbonate; CO_2, carbon dioxide; DO, dissolved oxygen; Fe, ferrous iron; SC, specific conductance; Temp., temperature; <, less than; —, not analyzed; mg/L, milligrams per liter; S.U., standard units; µS/cm at 25 °C, microsiemens per centimeter at 25 degrees Celsius; °C, degrees Celsius; >, greater than]

Site identifier	Date (month/day/year)	Alk (mg/L)	CO_2 (mg/L)	DO (mg/L)	Fe (mg/L)	pH (S.U.)	SC (µS/cm at 25 °C)	Sulfide (mg/L)	Temp. °C
PAI-45-MW17-SU	6/17/2008	140	25	<0.03	12.8	6.62	622	<0.2	26.81
PAI-45-MW17-SU	9/8/2008	110	80	<0.03	14.2	6.42	631	<0.2	28.51
PAI-45-MW18-SL	9/9/2008	180	25	0.1	2.27	6.67	3,030	<0.2	25.92
PAI-45-MW18-SU	9/9/2008	175	60	0.075	7.47	6.73	437	<0.2	28.01
PAI-45-MW19-SL	7/24/2007	—	—	—	—	5.72	1,560	—	23.02
PAI-45-MW19-SL	9/11/2007	65	45	0.05	—	5.75	1,350	<0.05	25.08
PAI-45-MW19-SL	6/19/2008	65	160	0.07	9.45	5.93	1,360	<0.2	20.87
PAI-45-MW19-SL	9/10/2008	60	170	<0.03	9.21	—	—	<0.2	—
PAI-45-MW20-SL	8/25/2005	50	70	0.15	12.5	5.92	—	<0.05	—
PAI-45-MW20-SL	3/7/2006	—	—	—	2.5	6.07	3,990	—	19.55
PAI-45-MW20-SL	9/26/2006	70	170	0.05	3.95	5.87	4,270	<0.05	25.90
PAI-45-MW20-SL	9/29/2006	—	—	—	—	—	—	—	—
PAI-45-MW20-SL	7/24/2007	90	165	0.1	6.01	5.8	2,250	<0.05	25.38
PAI-45-MW20-SL	9/10/2007	55	50	0.05	—	5.83	1,640	—	26.01
PAI-45-MW20-SL	6/19/2008	50	28	0.1	5.15	6.01	1,950	<0.2	23.10
PAI-45-MW20-SL	9/8/2008	45	155	<0.03	6.9	5.85	2,590	<0.2	26.12
PAI-45-MW20-SU	9/26/2006	37	180	0.1	3	5.5	579	<0.05	26.94
PAI-45-MW20-SU	9/29/2006	50	40	>1	—	6.44	1,540	<0.05	27.49
PAI-45-MW20-SU	7/24/2007	50	160	0.15	2.1	5.59	448	<0.05	27.54
PAI-45-MW20-SU	9/10/2007	50	40	>1	—	6.44	1,540	<0.05	27.49
PAI-45-MW20-SU	9/8/2008	40	160	0.25	2.72	—	—	0.28	—
PAI-45-MW20-SU	6/18/2008	35	50	0.6	4.43	5.58	591	0.47	26.20
PAI-45-MW23-SL	7/23/2007	250	105	<0.025	14.12	6.75	1,070	<0.05	28.23
PAI-45-MW23-SL	9/11/2007	100	40	0.1	—	6.48	1,040	—	28.66
PAI-45-MW25-SL	9/11/2007	35	25	0.2	—	5.58	427	—	—
PAI-45-MW25-SL	6/19/2008	30	30	0.05	—	5.6	751	<0.2	26.24
PAI-45-MW25-SL	9/9/2008	18	180	0.1	3.75	5.51	436	<0.2	29.18
PAI-45-MW26-SL	9/11/2007	200	40	0.1	—	6.35	1,770	—	28.97
PAI-45-MW26-SL	6/19/2008	200	35	0.2	10	6.56	2,010	<0.2	24.34
PAI-45-MW26-SL	9/9/2008	250	120	<0.025	12	6.54	2,790	<0.2	28.23
PAI-45-MW27-SL	9/11/2007	<10	45	0.05	—	5.68	613	—	27.96
PAI-45-MW27-SL	6/19/2008	40	135	<0.025	5.97	5.71	575	<0.2	25.40
PAI-45-MW27-SL	9/9/2008	40	145	<0.025	5.22	5.69	547	<0.2	27.49
PAI-45-MW28-D	6/17/2008	225	250	<0.025	92.2	6.21	17,700	<0.2	26.29
PAI-45-MW29-D	6/17/2008	240	35	0.1	0.94	7	13,900	0.14	26.72
PAI-45-MW30-D	6/17/2008	250	80	0.05	2.41	6.75	7,050	<0.2	25.07
PAI-45-MW31-SL	6/18/2008	18	140	0.075	5.52	5.66	1,000	<0.2	25.89
PAI-45-MW31-SL	9/9/2008	40	45	<0.025	11.8	5.73	1,110	<0.2	30.26
PAI-45-MW31-SU	6/18/2008	<10	200	0.075	4.14	5.1	708	<0.2	28.98
PAI-45-MW31-SU	9/9/2008	<10	70	0.1	5.77	5.27	679	<0.2	31.47

Appendix 6. Concentrations of groundwater constituents in temporary wells, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2006–2008.

[ft BLS, feet below land surface; 1,1-DCE, 1,1-dichloroethene; 1,2-DCE, total 1,2-dichloroethene; CB, chlorobenzene; *c*DCE, *cis*-1,2-dichloroethene; EB, ethylbenzene; Napht, naphthalene; PCE, tetrachloroethene; TCE, trichloroethene; Tol, toluene; *t*DCE, *trans*-1,2-dichloroethene; VC, vinyl chloride; Xyl, total xylenes; SC, specific conductance at 25 °C; TOC, total organic carbon; <, less than; R, duplicate sample; —, not analyzed; J, estimated concentration; µg/L, micrograms per liter; S.U., standard units; µS/cm at 25 °C, microsiemens per centimeter at 25 degrees Celsius; °C, Celsius; *, analysis was done by Microseeps, Inc, and is an approximation only. All other analyses were done by General Engineering Laboratory]

Well name	Date (month/ day/year)	Depth (ft BLS)	1,1-DCE (µg/L)	1,2-DCE (µg/L)	Benzene (µg/L)	CB (µg/L)	*c*DCE (µg/L)	EB (µg/L)	Napht (µg/L)	PCE (µg/L)	TCE (µg/L)	Tol (µg/L)	*t*DCE (µg/L)	VC (µg/L)	Xyl (µg/L)	pH (S.U.)	SC (µS/cm at 25 °C	Temp. (°C)
PAI-45-USGS-TW1	6/25/2007	8–11	<0.3	1.3	<0.3	<0.25	1.3	<0.25	<0.25	0.401J	1.5	<0.25	<0.3	<0.5	<0.25	5.73	1,470	29.8
PAI-45-USGS-TW2	6/25/2007	7–11	<0.3	<0.3	<0.3	<0.25	<0.3	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25	6.12	1,350	29.78
PAI-45-USGS-TW3	6/25/2007	7–11	<1.5	268	<1.5	<1.25	268	<1.25	<1.25	<1.25	26.2	<1.25	<1.5	5.83	<1.25	6.15	2,010	30.75
PAI-45-USGS-TW4	6/25/2007	7–11	<7.5	1,150	<7.5	<6.25	1,140	<6.25	<6.25	157	2,160	<6.25	13.2J	37.3	<6.25	6.05	823	31.22
PAI-45-USGS-TW5	6/25/2007	6–10.5	<0.3	<0.3	<0.3	<0.25	<0.3	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25	6.31	315	30.48
PAI-45-USGS-TW6	6/25/2007	7–11	<7.5	1,450	<7.5	<6.25	1,420	<6.25	<6.25	114	1,760	<6.25	28.1	189	<6.25	6.08	810	30.11
PAI-45-USGS-TW7	6/25/2007	7–11	<0.3	<0.3	<0.3	<0.25	<0.3	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25	6.31	284	29.56
PAI-45-USGS-TW8	6/25/2007	7.5–11.5	<6	1,030	<6	<5	1,010	<5	<5	<5	226	<5	23.4	212	<5	6.04	918	29.59
PAI-45-USGS-TW9	6/25/2007	7.5–11.5	<0.3	<0.3	<0.3	<0.25	<0.3	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25	6.38	303	29.16
PAI-45-USGS-TW10	6/25/2007	0–10	<15	3,000	<15	<12.5	2,960	<12.5	<12.5	<12.5	898	<12.5	41.6J	362	<12.5	6.29	822	30.87
PAI-45-USGS-TW11	6/25/2007	7.75–11.75	<0.3	41.6	<0.3	<0.25	41.6	<0.25	<0.25	<0.25	4.22	<0.25	<0.3	<0.5	<0.25	6.74	1,030	28.26
PAI-45-USGS-TW12	6/25/2007	7.5–10.5	<0.6	144	<0.6	<0.5	142	<0.5	<0.5	31.8	195	<0.5	2.25	4.07	<0.5	5.94	750	28.56
PAI-45-USGS-TW13	6/25/2007	6–10	<15	1,180	<15	<12.5	1,180	<12.5	<12.5	315	2,760	<12.5	<15	<25	<12.5	5.75	1,300	27.98
PAI-45-USGS-TW14	6/25/2007	6–10	<7.5	2,240	<7.5	<6.25	2,190	<6.25	<6.25	149	1,720	<6.25	53.7	356	<6.25	5.72	563	28.65
PAI-45-USGS-TW15	6/25/2007	6–10	<30	8,570	<30	<25	8,380	<25	<25	3,480	8,700	<25	196	2,290	<25	6.82	829	28.93
PAI-45-USGS-TW16	6/25/2007	6–10	<6	1,180	<6	<5	1,160	<5	<5	<5	557	<5	23.7	<10	<5	5.74	9,000	29.06
PAI-45-USGS-TW17	6/25/2007	6.5–10.5	<3	830	<3	<2.5	815	<2.5	<2.5	<2.5	176	<2.5	15.5	<5	<2.5	6.1	2,100	27.46
PAI-45-USGS-TW18	6/25/2007	12–14.5	<0.3	<0.3	<0.3	<0.25	<0.3	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25	6.59	460	27.45
PAI-45-USGS-TW19	6/25/2007	8–12	<0.3	37.5	<0.3	<0.25	37.1	<0.25	<0.25	0.26J	1.94	<0.25	0.42J	0.68J	<0.25	6.06	289	26.05
PAI-45-USGS-TW20	6/25/2007	8–12	<0.3	0.4J	<0.3	<0.25	0.4J	<0.25	0.404J	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25	5.92	232	24.8

Appendix 6. Concentrations of groundwater constituents in temporary wells, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2006–2008.—Continued

[ft BLS, feet below land surface; 1,1-DCE, 1,1-dichloroethene; 1,2-DCE, total 1,2-dichloroethene; CB, chlorobenzene; *c*DCE, *cis*-1,2-dichloroethene; EB, ethylbenzene; Napht, naphthalene; PCE, tetrachloroethene; TCE, trichloroethene; Tol, toluene; *t*DCE, *trans*-1,2-dichloroethene; VC, vinyl chloride; Xyl, total xylenes; SC, specific conductance at 25 °C; TOC, total organic carbon; <, less than; R, duplicate sample; —, not analyzed; J, estimated concentration; µg/L, micrograms per liter; S.U., standard units; µS/cm at 25 °C, microsiemens per centimeter at 25 degrees Celsius; °C, Celsius; *, analysis was done by Microseeps, Inc, and is an approximation only. All other analyses were done by General Engineering Laboratory]

Well name	Date (month/ day/year)	Depth (ft BLS)	1,1-DCE (µg/L)	1,2-DCE (µg/L)	Benzene (µg/L)	CB (µg/L)	*c*DCE (µg/L)	EB (µg/L)	Napht (µg/L)	PCE (µg/L)	TCE (µg/L)	Tol (µg/L)	*t*DCE (µg/L)	VC (µg/L)	Xyl (µg/L)	pH (S.U.)	SC (µS/cm at 25 °C	Temp. (°C)
PAI-45-USGS-TW21	6/25/2007	11–15	<0.3	5.23	0.95J	<0.25	5.23	<0.25	6.98	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25	5.83	357	24.79
PAI-45-USGS-TW22	6/25/2007	6–10	<1.5	262	<1.5	<1.25	260	<1.25	<1.25	<1.25	38.3	<1.25	2.36J	3.01J	<1.25	5.82	1,350	27.31
PAI-45-USGS-TW23	6/25/2007	6–10	<0.6	176	<0.6	<0.5	174	<0.5	<0.5	<0.5	23.9	<0.5	1.91J	5.48	<0.5	5.84	1,730	27.07
PAI-45-USGS-TW24	6/25/2007	11.5–15.5	<0.3	10.6	<0.3	<0.25	10.6	<0.25	<0.25	<0.25	17.6	<0.25	<0.3	0.75J	<0.25	6.42	777	25.53
PAI-45-USGS-TW25	6/25/2007	11.5–15.5	<1.5	241	<1.5	<1.25	239	<1.25	<1.25	3.45J	231	<1.25	2.17J	<2.5	<1.25	5.84	1,830	27.03
PAI-45-USGS-TW26	6/25/2007	11.5–15.5	<0.3	1.89	1.71	<0.25	1.89	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25	6.02	2,090	27.8
PAI-45-USGS-TW27	6/25/2007	11.5–15.5	<1.5	342	<1.5	<1.25	339	<1.25	<1.25	<1.25	155	<1.25	2.15J	<2.5	<1.25	5.91	1,820	29.35
PAI-45-USGS-TW28	6/25/2007	11.5–15.5	<1.5	214	<1.5	<1.25	214	<1.25	<1.25	<1.25	<1.25	<1.25	<1.5	4.11J	<1.25	—	—	—
PAI-45-USGS-TW29	6/27/2007	11.5–15.5	<0.3	3.71	<0.3	<0.25	3.71	<0.25	<0.25	4.95	1.34	<0.25	<0.3	<0.5	<0.25	6.4	2,490	24.22
PAI-45-USGS-TW30	6/25/2007	11.5–15.5	<0.3	14.1	<0.3	<0.25	14.1	<0.25	<0.25	<0.25	6.95	<0.25	<0.3	0.99J	<0.25	5.99	1,010	26.45
PAI-45-USGS-TW31	6/27/2007	11.5–15.5	<0.3	14.1	<0.3	<0.25	13.8	<0.25	<0.25	2.12	16.4	<0.25	0.36J	6.48	<0.25	6.16	2,540	25.91
PAI-45-USGS-TW32	6/27/2007	11.5–15.5	<0.3	11.9	<0.3	<0.25	11.9	<0.25	<0.25	1.57	19	<0.25	<0.3	6.87	<0.25	6.11	2,160	24.66
PAI-45-USGS-TW33	6/25/2007	11.5–15.5	<0.6	79.3	<0.6	<0.5	79.3	<0.5	1.32J	21.4	177	<0.5	<0.6	<1	<0.5	5.84	1,900	27.22
PAI-45-USGS-TW34	6/25/2007	11.5–15.5	<0.3	5.34	<0.3	<0.25	5.34	<0.25	<0.25	1.49	3.3	<0.25	<0.3	<0.5	<0.25	5.89	1,790	28.2
PAI-45-USGS-TW35	6/25/2007	11.5–15.5	<0.3	<0.3	<0.3	<0.25	<0.3	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25	6.14	2,810	29.49
PAI-45-USGS-TW36	6/25/2007	11.5–15.5	<0.6	7.68	4.17	<0.5	7.68	1.21J	81.9	<0.5	<0.5	<0.5	<0.6	<1	1.97J	6.02	857	27.24
PAI-45-USGS-TW37	6/27/2007	11.5–15.5	<0.3	3.5	<0.3	<0.25	3.5	<0.25	<0.25	1.43	3.27	<0.25	<0.3	1.41	<0.25	5.86	7,200	23.79
PAI-45-USGS-TW37R	6/27/2007	11.5–15.5	<0.3	3.26	<0.3	<0.25	3.26	<0.25	<0.25	1.33	3.17	<0.25	<0.3	1.18	<0.25	—	—	—
PAI-45-USGS-TW38	6/27/2007	10–14	<0.3	9.51	<0.3	<0.25	9.51	<0.25	<0.25	93.9	21.3	<0.25	<0.3	<0.5	<0.25	5.95	4,040	28.4
PAI-45-USGS-TW38R	6/27/2007	10–14	<0.3	10.5	<0.3	<0.25	10.5	<0.25	<0.25	105	23.2	<0.25	<0.3	0.51J	<0.25	—	—	—
PAI-45-USGS-TW39	6/27/2007	10–14	<30	628	<30	<25	628	<25	<25	5,240	7,600	<25	<30	<50 (200*)	<25	6.16	2,260	26.95
PAI-45-USGS-TW39R	6/27/2007	10–14	<30	604	<30	<25	604	<25	<25	5,050	7,210	<25	<30	<50	<25	—	—	—
PAI-45-USGS-TW40	6/27/2007	10–14	<0.3	14.3	<0.3	<0.25	14.3	<0.25	<0.25	0.26J	6.44	<0.25	<0.3	4.75	<0.25	5.91	3,370	28.84
PAI-45-USGS-TW41	6/27/2007	10–14	<0.3	2.62	<0.3	2.87	2.62	<0.25	<0.25	0.798J	0.36J	<0.25	<0.3	<0.5	<0.25	584	483	26.92

Appendix 6. Concentrations of groundwater constituents in temporary wells, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2006–2008.—Continued

[ft BLS, feet below land surface; 1,1-DCE, 1,1-dichloroethene; 1,2-DCE, total 1,2-dichloroethene; CB, chlorobenzene; *c*DCE, *cis*-1,2-dichloroethene; EB, ethylbenzene; Napht, naphthalene; PCE, tetrachloroethene; TCE, trichloroethene; Tol, toluene; *t*DCE, *trans*-1,2-dichloroethene; VC, vinyl chloride; Xyl, total xylenes; SC, specific conductance at 25 °C; TOC, total organic carbon; <, less than; R, duplicate sample; —, not analyzed; J, estimated concentration; µg/L, micrograms per liter; S.U., standard units; µS/cm at 25 °C, microsiemens per centimeter at 25 degrees Celsius; °C, Celsius; *, analysis was done by Microseeps, Inc, and is an approximation only. All other analyses were done by General Engineering Laboratory]

Well name	Date (month/ day/year)	Depth (ft BLS)	1,1-DCE (µg/L)	1,2-DCE (µg/L)	Benzene (µg/L)	CB (µg/L)	*c*DCE (µg/L)	EB (µg/L)	Napht (µg/L)	PCE (µg/L)	TCE (µg/L)	Tol (µg/L)	*t*DCE (µg/L)	VC (µg/L)	Xyl (µg/L)	pH (S.U.)	SC (µS/cm at 25 °C	Temp. (°C)
PAI-45-USGS-TW42	6/27/2007	10–14	<0.3	<0.3	<0.3	<0.25	<0.3	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25	5.7	7,410	28.84
PAI-45-USGS-TW43	6/27/2007	10–14	<0.3	9.28	<0.3	<0.25	8.95	<0.25	<0.25	<0.25	6.72	<0.25	0.32J	3.13	<0.25	5.94	8,240	25.71
PAI-45-USGS-TW44	6/27/2007	10–14	<30	760	<30	<25	760	<25	<25	17,100	6,100	<25	<30	201	<25	6.63	635	27.62
PAI-45-USGS-TW45	6/27/2007	10.5–14.5	<0.3	6.05	<0.3	<0.25	6.05	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25	6.44	3,540	25.59
PAI-45-USGS-TW46	6/27/2007	10.5–14.5	<0.3	0.52J	<0.3	<0.25	0.52J	<0.25	<0.25	1.69	0.26J	<0.25	<0.3	0.58J	<0.25	5.74	14,800	26.1
PAI-45-USGS-TW47	6/27/2007	10.5–14.5	<300	<300	<300	<250	<300	<250	<250	62,400	4,020	<250	<300	<500	<250	6.26	797	27.23
PAI-45-USGS-TW48	6/27/2007	10.5–14.5	<30	2,180	<30	<25	2,180	<25	<25	10,200	7,590	<25	<30	342	<25	6.08	1,330	28.74
PAI-45-USGS-TW49	6/27/2007	10–14	<0.3	<0.3	<0.3	<0.25	<0.3	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25	6.22	911	27.42
PAI-45-USGS-TW50	6/27/2007	11–15	<1.2	180	<1.2	1.26J	180	<1	<1	<1	22.2	<1	<1.2	3.72J	<1	5.74	1,040	25.24
PAI-45-USGS-TW51	6/27/2007	10.5–14.5	<12	147	<12	<10	147	<10	<10	315	2,270	<10	<12	<20	<10	5.71	916	24.21
PAI-45-USGS-TW52	6/27/2007	11–15	<30	472	<30	<25	472	<25	<25	<25	5,530	<25	<30	<50	<25	5.87	1,330	27.17
PAI-45-USGS-TW53	6/27/2007	11–15	<30	1,640	<30	<25	1,640	<25	<25	4,780	7,360	<25	<30	377	<25	6	1,890	24.68
PAI-45-USGS-TW54	6/27/2007	11–15	<3	776	<3	<2.5	771	<2.5	<2.5	<2.5	3.59J	<2.5	5.71J	70.8	<2.5	6.04	3,560	23.99
PAI-45-USGS-TW55	6/28/2007	11–15	<0.3	<0.3	<0.3	0.62J	<0.3	<0.25	<0.25	0.27J	0.69J	<0.25	<0.3	<0.5	<0.25	5.69	982	23.65
PAI-45-USGS-TW56	6/28/2007	11–15	<7.5	1,240	<7.5	<6.25	1,240	<6.25	<6.25	526	2,110	<6.25	<7.5	14.4J	<6.25	5.84	862	27.74
PAI-45-USGS-TW57	6/28/2007	11–15	<3	800	<3	<2.5	800	<2.5	<2.5	<2.5	<2.5	<2.5	<3	133	<2.5	6.03	1,170	26.12
PAI-45-USGS-TW58	6/28/2007	11–15	<0.3	9.71	<0.3	<0.25	9.71	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	3.09	<0.25	6.83	3,810	27.58
PAI-45-USGS-TW58R	6/28/2007	11–15	<0.3	9.14	<0.3	<0.25	9.14	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	2.77	<0.25	—	—	—
PAI-45-USGS-TW59	6/28/2007	11–15	<0.3	5.12	<0.3	<0.25	5.12	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	1.29	<0.25	6.61	2,090	24.61
PAI-45-USGS-TW60	6/28/2007	10–14	<0.3	10.2	<0.3	1.16	10.2	<0.25	<0.25	0.359J	5.24	<0.25	<0.3	4.43	0.29J	5.85	888	24.49
PAI-45-USGS-TW61	6/28/2007	11–15	<3	511	<3	<2.5	511	<2.5	<2.5	<2.5	11.9	<2.5	<3	10.3	<2.5	5.95	1,410	27.27
PAI-45-USGS-TW61R	6/28/2007	11.5–15.5	<3	511	<3	<2.5	511	<2.5	<2.5	<2.5	12.7	<2.5	<3	<5	<2.5	—	—	—
PAI-45-USGS-TW62	6/28/2007	11.5–15.5	<0.3	52.8	<0.3	0.82J	52.1	<0.25	<0.25	<0.25	0.75J	<0.25	0.72J	7.31	<0.25	6.36	5,310	29.22
PAI-45-USGS-TW63	6/28/2007	11.5–15.5	<15	783	<15	<12.5	750	<12.5	<12.5	<12.5	4,100	<12.5	32.4J	30J	<12.5	6.27	1,260	25.7
PAI-45-USGS-TW63R	6/28/2007	11.5–15.5	<15	769	<15	<12.5	738	<12.5	<12.5	<12.5	3,960	<12.5	30.5J	<25	<12.5	—	—	—

Appendix 6. Concentrations of groundwater constituents in temporary wells, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2006–2008.—Continued

[ft BLS, feet below land surface; 1,1-DCE, 1,1-dichloroethene; 1,2-DCE, total 1,2-dichloroethene; CB, chlorobenzene; *c*DCE, *cis*-1,2-dichloroethene; EB, ethylbenzene; Napht, naphthalene; PCE, tetrachloroethene; TCE, trichloroethene; Tol, toluene; *t*DCE, *trans*-1,2-dichloroethene; VC, vinyl chloride; Xyl, total xylenes; SC, specific conductance at 25 °C; TOC, total organic carbon; <, less than; R, duplicate sample; —, not analyzed; J, estimated concentration; µg/L, micrograms per liter; S.U., standard units; µS/cm at 25 °C, microsiemens per centimeter at 25 degrees Celsius; °C, Celsius; *, analysis was done by Microseeps, Inc, and is an approximation only. All other analyses were done by General Engineering Laboratory]

Well name	Date (month/day/year)	Depth (ft BLS)	1,1-DCE (µg/L)	1,2-DCE (µg/L)	Benzene (µg/L)	CB (µg/L)	*c*DCE (µg/L)	EB (µg/L)	Napht (µg/L)	PCE (µg/L)	TCE (µg/L)	Tol (µg/L)	*t*DCE (µg/L)	VC (µg/L)	Xyl (µg/L)	pH (S.U.)	SC (µS/cm at 25 °C	Temp. (°C)
PAI-45-USGS-TW64	6/28/2007	11.5–15.5	<0.6	110	<0.6	<0.5	110	<0.5	<0.5	<0.5	0.89J	<0.5	<0.6	<1	<0.5	6.38	2,840	28.78
PAI-45-USGS-TW65	6/28/2007	11.5–15.5	<1.5	6.2	5.36	<1.25	6.2	3.81J	397	<1.25	<1.25	<1.25	<1.5	<2.5	6.55	6.83	367	24.5
PAI-45-USGS-TW66	6/28/2007	11.5–15.5	<3	833	<3	<2.5	833	<2.5	<2.5	<2.5	183	<2.5	<3	15	<2.5	5.97	2,040	26.44
PAI-45-USGS-TW67	6/28/2007	11–15	<0.3	8.88	<0.3	2.62	8.88	<0.25	<0.25	<0.25	19.4	<0.25	<0.3	<0.5	<0.25	6	1,000	25.36
PAI-45-USGS-TW68	6/28/2007	11–15	<0.3	<0.3	<0.3	4.76	<0.3	<0.25	<0.25	<0.25	1.04	<0.25	<0.3	<0.5	<0.25	6.01	946	25.18
PAI-45-USGS-TW68R	6/28/2007	11–15	<0.3	<0.3	<0.3	4.76	<0.3	<0.25	<0.25	<0.25	1	<0.25	<0.3	<0.5	<0.25	—	—	—
PAI-45-USGS-TW69	6/28/2007	11–15	<0.3	<0.3	<0.3	<0.25	<0.3	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25	5.76	28,500	28.43
PAI-45-USGS-TW70	6/28/2007	11–15	<0.3	4.21	<0.3	<0.25	4.21	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25	5.82	10,600	28.66
PAI-45-USGS-TW71	8/29/2007	8–12	<0.3	0.5J	2.66	<0.25	0.5J	<0.25	119	<0.25	<0.25	0.759J	<0.3	<0.5	0.77J	—	—	—
PAI-45-USGS-TW72	8/29/2007	11–15	<6	39.7	<6	<5	39.7	<5	<5	2,380	1,180	<5	<6	<10	<5	—	—	—
PAI-45-USGS-TW74	8/29/2007	11–15	<0.3	16.7	<0.3	<0.25	16.7	<0.25	<0.25	7.73	35.3	<0.25	<0.3	1.35	<0.25	—	—	—
PAI-45-USGS-TW75	8/29/2007	1–14	<3	653	<3	<2.5	653	<2.5	5.94J	<2.5	21.1	<2.5	<3	6.24J	<2.5	—	—	—
PAI-45-USGS-TW76	8/29/2007	11–15	<3	526	<3	<2.5	526	<2.5	7.55J	<2.5	<2.5	<2.5	<3	24.2	<2.5	—	—	—
PAI-45-USGS-TW77	3/5/2008	7–11	<0.3	50.1	<0.3	1.55	47.9	<0.25	<0.25	0.35J	20.5	<12.5	<0.25	<0.3	<0.25	—	523	20.88
PAI-45-USGS-TW77	3/5/2008	11–15	<15	381	<15	<12.5	365	<12.5	<12.5	454	3,470	<0.25	<12.5	<15	<12.5	—	1,650	21.64
PAI-45-USGS-TW77R	3/5/2008	11–15	<15	460	<15	<12.5	440	<12.5	<12.5	408	3,530	<12.5	<12.5	<15	<12.5	—	—	—
PAI-45-USGS-TW78	3/5/2008	7–11	<0.3	118	<0.3	1.97	117	<0.25	<0.25	10.1	45.5	<12.5	<0.25	<0.3	<0.25	—	446	20.63
PAI-45-USGS-TW78	3/5/2008	11–15	<15	795	<15	<12.5	761	<12.5	<12.5	<12.5	3,200	<0.25	<12.5	<15	<12.5	—	1,970	21.48
PAI-45-USGS-TW79	3/5/2008	11–15	14.2	409	<0.3	<0.25	562	0.88J	<0.25	23,000B	7,160	3.63	3.63	2.56	1.34	—	4,910	22.71
PAI-45-USGS-TW80	3/5/2008	7–11	<3	82.6	<3	<2.5	82.6	<2.5	<2.5	366	732	<25	<2.5	<3	<2.5	—	444	20.4
PAI-45-USGS-TW80	3/5/2008	11–15	<30	112	<30	<25	112	<25	<25	6,170B	2,160	<2.5	<25	<30	<25	—	6,620	22.15
PAI-45-USGS-TW81	3/5/2008	7–11	<0.3	117	<0.3	2.43	107	<0.25	<0.25	<0.25	19.9	<6.25	<0.25	<0.3	<0.25	—	453	20.72
PAI-45-USGS-TW81	3/5/2008	11–15	<7.5	599	<7.5	<6.25	573	<6.25	<6.25	14.0J	1,510	<0.25	<6.25	<7.5	<6.25	—	1,710	21.15
PAI-45-USGS-TW81R	3/5/2008	11–15	<7.5	583	<7.5	<6.25	558	<6.25	<6.25	12.5J	1,510	<6.25	<6.25	<7.5	<6.25	—	—	—
PAI-45-USGS-TW82	3/4/2008	11–15	<15	411	<15	<12.5	411	<12.5	<12.5	53.7	2720	<12.5	<12.5	<15	<12.5	—	3,710	20.85

Appendix 6. Concentrations of groundwater constituents in temporary wells, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2006–2008.—Continued

[ft BLS, feet below land surface; 1,1-DCE, 1,1-dichloroethene; 1,2-DCE, total 1,2-dichloroethene; CB, chlorobenzene; *c*DCE, *cis*-1,2-dichloroethene; EB, ethylbenzene; Napht, naphthalene; PCE, tetrachloroethene; TCE, trichloroethene; Tol, toluene; *t*DCE, *trans*-1,2-dichloroethene; VC, vinyl chloride; Xyl, total xylenes; SC, specific conductance at 25 °C; TOC, total organic carbon; <, less than; R, duplicate sample; —, not analyzed; J, estimated concentration; µg/L, micrograms per liter; S.U., standard units; µS/cm at 25 °C, microsiemens per centimeter at 25 degrees Celsius; °C, Celsius; *, analysis was done by Microseeps, Inc, and is an approximation only. All other analyses were done by General Engineering Laboratory]

Well name	Date (month/ day/year)	Depth (ft BLS)	1,1-DCE (µg/L)	1,2-DCE (µg/L)	Benzene (µg/L)	CB (µg/L)	*c*DCE (µg/L)	EB (µg/L)	Napht (µg/L)	PCE (µg/L)	TCE (µg/L)	Tol (µg/L)	*t*DCE (µg/L)	VC (µg/L)	Xyl (µg/L)	pH (S.U.)	SC (µS/cm at 25 °C	Temp. (°C)
PAI-45-USGS-TW83	3/5/2008	11–15	<0.3	57.5	<0.3	<0.25	55	<0.25	<0.25	29.2	415	<0.25	<0.25	<0.3	<0.25	—	3,970	20.03
PAI-45-USGS-TW84	3/5/2008	11–15	<0.3	18.4	<0.3	<0.25	17.6	<0.25	<0.25	361	63.3	<0.25	<0.25	<0.3	<0.25	—	4,700	19.73
PAI-45-USGS-TW85	3/5/2008	11–15	<0.3	<0.3	<0.3	<0.25	<0.3	<0.25	<0.25	1.88B	0.97J	<0.25	<0.25	<0.3	<0.25	—	12,200	22.51
PAI-45-USGS-TW86	3/5/2008	11–15	<0.3	<0.3	<0.3	<0.25	<0.3	<0.25	<0.25	7.29B	2.12	<0.25	<0.25	<0.3	<0.25	—	9,040	21.8
PAI-45-USGS-TW87	3/4/2008	11–15	<0.3	146	<0.3	<0.25	158	<0.25	<0.25	17.2	420	<0.25	<0.25	1	<0.25	—	2,870	21.31
PAI-45-USGS-TW88	3/4/2008	11–15	<0.3	20.8	<0.3	<0.25	19.9	<0.25	<0.25	18.5	56.7	<0.25	<0.25	<0.3	<0.25	—	3,560	21.29
PAI-45-USGS-TW89	3/4/2008	11–15	<0.3	268	<0.3	<0.25	257	<0.25	<0.25	83.6	406	<0.25	<0.25	1.24	<0.25	—	2,180	21.42
PAI-45-USGS-TW90	3/4/2008	11–15	<0.3	154	<0.3	<0.25	164	<0.25	<0.25	37	342	<0.25	<0.25	0.72J	<0.25	—	2,860	21.85
PAI-45-USGS-TW91	3/5/2008	11–15	<0.3	20.2	<0.3	<0.25	19.3	<0.25	<0.25	24.7	47.4	<0.25	<0.25	<0.3	<0.25	—	3,630	18.9
PAI-45-USGS-TW92	3/4/2008	11–15	<6	1,330	<6	<5	1,270	<5	<5	201	796	<5	<5	<6	<5	—	2,340	22.64
PAI-45-USGS-TW93	3/4/2008	4.5–8	<0.3	88.3	<0.3	<0.25	83.3	<0.25	<0.25	34.7	67.7	<0.25	0.28J	1.29	<0.25	—	—	—
PAI-45-USGS-TW93	3/4/2008	11–15	<0.3	97.5	<0.3	<0.25	93.3	<0.25	<0.25	22.8	191	0.28J	<0.25	<0.3	<0.25	—	4,120	23.15
PAI-45-USGS-TW94	3/5/2008	7–11	<0.3	213	<0.3	1.69	254	<0.25	<0.25	331	863	1.05	<0.25	<0.3	<0.25	—	424	20.43
PAI-45-USGS-TW94	3/5/2008	11–15	3.51	323	<0.3	<0.25	413	<0.25	<0.25	754B	5,020	<0.25	1.05	2.07	<0.25	—	4,960	21.59
PAI-45-USGS-TW95	3/5/2008	11–15	<0.3	<0.3	<0.3	<0.25	<0.3	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.25	—	915	22.05

Appendix 7. Concentrations of selected volatile organic compounds in soil borings from temporary well PAI-45-USGS-TW7, Marine Corps Recruit Depot, Parris Island, South Carolina, 2008.

[ft BLS, feet below land surface; 1,1-DCE, 1,1-dichloroethene; 1,2-DCE, total 1,2-dichloroethene; CB, chlorobenzene; *c*DCE, *cis*-1,2-dichloroethene; EB, ethylbenzene; Napht, naphthalene; PCE, tetrachloroethene; TCE, trichloroethene; Tol, toluene; *t*DCE, *trans*-1,2-dichloroethene; VC, vinyl chloride; Xyl, total xylenes; <, less than; R, duplicate sample; J, estimated concentration; µg/kg, micrograms per kilogram; all data are dry-weight corrected]

Site identifier	Date (month/day/year)	Depth (ft BLS)	Percent moisture	1,1-DCE (µg/kg)	1,2-DCE (µg/kg)	Benzene (µg/kg)	CB (µg/kg)	*c*DCE (µg/kg)	EB (µg/kg)	Napht (µg/kg)	PCE (µg/kg)	TCE (µg/kg)	Tol (µg/kg)	*t*DCE (µg/kg)	VC (µg/kg)	Xyl (µg/kg)
PAI-45-USGS-TW96	4/30/2008	10–12	25.5	0.75J	211	<0.65	<0.39	411	<0.39	<0.39	1,990	4,640	0.59J	3.22	15.1	1.08J
PAI-45-USGS-TW96R	4/30/2008	10–12	24.3	1.1J	248	<0.38	<0.23	330	0.30J	<0.23	1,750	3,560	1.01J	4.09	22.3	1.14J
PAI-45-USGS-TW96	4/30/2008	15–16	27.6	<0.27	<0.27	<0.27	<0.18	<0.27	<0.18	<0.18	0.46J	<0.22	<0.26	<0.27	<0.45	0.5J

Appendix 8. Concentrations of total organic carbon in soil borings, Marine Corps Recruit Depot, Parris Island, South Carolina, 2008.

[ft BLS, feet below land surface; mg/kg, milligrams per kilogram]

Site identifier	Date (month/day/year)	Depth (ft BLS)	Total organic carbon (mg/kg)	Lithology
PAI-45-MW26-SL	6/27/2008	10–15	128	Fine-grained sand
PAI-45-MW28-D	8/26/2008	18	155,000	Organic-rich clay
PAI-45-USGS-TW96	4/30/2008	8–10	440	Grayish-tan, fine-grained heaving sand
PAI-45-USGS-TW96	4/30/2008	12–13	2,120	Black fine-grained sand

Appendix 9. Concentrations of selected volatile organic compounds in surface water near the outfall to Ballast Creek, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, June 17, 2008.

[1,1-DCE, 1,1-dichloroethene; 1,2-DCE, total 1,2-dichloroethene; CB, chlorobenzene; *c*DCE, *cis*-1,2-dichloroethene; EB, ethylbenzene; Napht, naphthalene; PCE, tetrachloroethene; TCE, trichloroethene; Tol, toluene; *t*DCE, *trans*-1,2-dichloroethene; VC, vinyl chloride; Xyl, total xylenes; <, less than; R, duplicate sample; J, estimated concentration; µg/L, micrograms per liter]

Site identifier	Date (month/day/year)	Time (minutes before low tide)	1,1-DCE (µg/L)	1,2-DCE (µg/L)	Benzene (µg/L)	CB (µg/L)	*c*DCE (µg/L)	EB (µg/L)	Napht (µg/L)	PCE (µg/L)	TCE (µg/L)	Tol (µg/L)	*t*DCE (µg/L)	VC (µg/L)	Xyl (µg/L)
PAI-SW1	6/16/2008	30	<0.3	1.6	<0.3	<0.25	1.6	<0.25	0.33J	0.44J	1.29	<0.25	<0.3	<0.5	<0.25
PAI-SW1-R	6/16/2008	30	<0.3	1.7	<0.3	<0.25	1.7	<0.25	<0.25	0.48J	1.34	<0.25	<0.3	<0.5	<0.25
PAI-SW2	6/16/2008	5	<0.3	<0.3	<0.3	<0.25	<0.3	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25
PAI-SW3	6/16/2008	6	<0.3	0.7J	<0.3	<0.25	0.73J	<0.25	<0.25	<0.25	0.6J	<0.25	<0.3	<0.5	<0.25
PAI-SW4	6/16/2008	22	<0.3	<0.3	<0.3	<0.25	<0.3	<0.25	<0.25	<0.25	<0.25	<0.25	<0.3	<0.5	<0.25

Appendix 10. Concentrations of selected volatile organic compounds in sediment near the outfall to Ballast Creek, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, June 17, 2008.

[1,1-DCE, 1,1-dichloroethene; 1,2-DCE, total 1,2-dichloroethene; CB, chlorobenzene; *c*DCE, *cis*-1,2-dichloroethene; EB, ethylbenzene; Napht, naphthalene; PCE, tetrachloroethene; TCE, trichloroethene; Tol, toluene; *t*DCE, *trans*-1,2-dichloroethene; VC, vinyl chloride; Xyl, total xylenes; mg/kg, milligrams per kilogram; <, less than; J, estimated concentration; all data are reported as dry-weight corrected]

Site identifier	Date (month/day/year)	Depth below sediment/water interface (feet)	Moisture (percent)	1,1-DCE (mg/kg)	Benzene (mg/kg)	CB (mg/kg)	*c*DCE (mg/kg)	EB (mg/kg)	PCE (mg/kg)	TCE (mg/kg)	Tol (mg/kg)	*t*DCE (mg/kg)	VC (mg/kg)	Xyl (mg/kg)
PAI-SWSED1	6/17/2008	0.5	68.5	<0.68	<0.75	<0.45	<0.68	<0.45	<0.45	<0.57	0.67J	<0.68	<1.13	<0.45
PAI-SWSED1	6/17/2008	1	57.2	<49	<54	<32	<49	<32	<32	<41	<47	<49	<81	<32
PAI-SWSED2	6/17/2008	0.5	57.7	<0.57	<0.63	<0.38	<0.57	<0.38	<0.38	<0.48	<0.55	<0.57	<0.95	<0.38
PAI-SWSED2	6/17/2008	1	58	<0.45	<0.5	<0.30	<0.45	<0.3	<0.30	<0.38	<0.44	<0.45	<0.75	<0.3
PA-ISWSED3	6/17/2008	0.5	73.3	<0.86	<0.95	<0.58	<0.86	<0.58	<0.58	<0.72	<0.83	<0.86	<1.44	<0.58
PAI-SWSED3	6/17/2008	1	71	<0.59	<0.65	<0.4	<0.59	0.75J	<0.4	<0.49	3.96	<0.59	<0.99	<0.4
PAI-SWSED4	6/17/2008	0.5	60.2	<0.74	<0.81	<0.49	<0.74	<0.49	<0.49	<0.62	<0.71	<0.74	<1.23	<0.49
PAI-SWSED4	6/17/2008	1	61.6	<0.54	<0.6	<0.36	<0.54	<0.36	<0.36	<0.45	<0.52	<0.54	<0.9	<0.36

Appendix 11. Synoptic water-level measurements at approximately low tide in monitoring wells, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2007–2008.

[MP, measuring point altitude in feet relative to North American Vertical Datum of 1988; —, data not collected; all top-of-casing altitudes were determined by Andrews and Burgess, Inc., in 2008; *, Datum was changed on these wells. Prior to July 3, 2008, the datum was 5.33 feet for well PAI-45-MW26-SL and 6.405 feet for well PAI-45-MW27-SL]

Well identifier	MP	Water-level altitude, in feet relative to North American Vertical Datum of 1988					
		April 30, 2007	August 7, 2007	August 29, 2007	June 16, 2008	June 27, 2008	July 25, 2008
PAI-45-MW01-D	6.60	1.72	—	2.03	1.31	1.20	1.83
PAI-45-MW01-SL	6.52	3.15	—	3.54	3.60	3.46	—
PAI-45-MW01-SU	6.54	3.12	—	3.57	3.57	3.45	—
PAI-45-MW02-SL	6.22	2.96	4.34	3.39	3.17	3.01	—
PAI-45-MW02-SU	6.12	2.67	4.31	3.12	2.66	2.73	—
PAI-45-MW03-SL	6.54	2.75	3.97	3.12	2.87	2.70	—
PAI-45-MW03-SU	6.59	2.52	4.39	3.12	2.57	2.58	—
PAI-45-MW04-D	5.78	1.59	—	1.92	1.21	1.09	1.71
PAI-45-MW04-SL	5.91	2.45	3.57	2.73	2.45	2.32	—
PAI-45-MW04-SU	5.93	2.45	3.59	2.74	2.47	2.34	—
PAI-45-MW05-D	7.63	1.61	—	1.93	1.19	1.07	1.69
PAI-45-MW05-SL	7.24	2.45	3.36	2.84	2.45	2.32	—
PAI-45-MW05-SU	7.59	2.42	3.33	2.71	2.42	2.29	—
PAI-45-MW06-D	6.44	1.64	—	1.96	1.23	1.09	1.74
PAI-45-MW06-SL	6.48	2.73	3.91	3.11	2.87	2.70	—
PAI-45-MW06-SU	6.52	2.87	3.44	3.12	2.90	2.85	—
PAI-45-MW07-D	6.63	1.66	—	1.97	1.25	1.12	1.75
PAI-45-MW07-SL	6.68	2.80	4.04	3.17	2.97	2.82	—
PAI-45-MW07-SU	6.63	2.79	4.04	3.15	2.95	2.80	—
PAI-45-MW08-SL	6.50	2.90	4.16	3.30	4.19	3.05	—
PAI-45-MW08-SU	6.57	2.81	4.15	3.29	3.17	3.02	—
PAI-45-MW09-D	6.24	1.60	—	1.89	1.15	1.04	1.67
PAI-45-MW10-D	6.25	—	—	—	—	1.18	1.81
PAI-45-MW10-SL	5.85	2.69	3.98	3.03	2.76	2.62	—
PAI-45-MW10-SU	5.90	2.67	3.86	3.02	2.78	2.61	—
PAI-45-MW11-D	5.43	1.36	—	1.37	1.67	-0.13	0.77
PAI-45-MW13-SL	6.39	2.57	3.68	2.87	2.61	2.46	—
PAI-45-MW13-SU	6.48	2.53	4.01	2.87	2.62	2.43	—
PAI-45-MW14-SL	5.76	2.73	3.67	3.08	2.84	2.71	—
PAI-45-MW14-SU	5.84	2.59	3.41	2.83	2.60	2.50	—

Appendix 11. Synoptic water-level measurements at approximately low tide in monitoring wells, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2007–2008.—Continued

[MP, measuring point altitude in feet relative to North American Vertical Datum of 1988; —, data not collected; all top-of-casing altitudes were determined by Andrews and Burgess, Inc., in 2008; *, Datum was changed on these wells. Prior to July 3, 2008, the datum was 5.33 feet for well PAI-45-MW26-SL and 6.405 feet for well PAI-45-MW27-SL]

Well identifier	MP	Water-level altitude, in feet relative to North American Vertical Datum of 1988					
		April 30, 2007	August 7, 2007	August 29, 2007	June 16, 2008	June 27, 2008	July 25, 2008
PAI-45-MW15-SL	8.13	2.72	3.72	3.03	2.68	2.56	—
PAI-45-MW15-SU	8.32	2.71	3.70	2.99	2.66	2.53	—
PAI-45-MW16-SL	9.17	2.44	3.35	2.75	2.38	2.29	—
PAI-45-MW16-SU	9.14	2.35	3.28	2.64	2.29	2.18	—
PAI-45-MW17-SL	5.96	2.68	3.11	2.32	2.10	1.97	—
PAI-45-MW17-SU	6.17	2.25	3.12	2.35	2.12	1.98	—
PAI-45-MW18-SL	6.98	2.53	3.53	2.71	2.43	2.30	—
PAI-45-MW18-SU	6.99	3.01	3.77	3.06	2.84	2.72	—
PAI-45-MW19-SL	5.64	2.68	3.82	2.98	2.71	2.55	—
PAI-45-MW19-SU	5.64	2.60	3.77	2.91	2.62	2.48	—
PAI-45-MW20-SL	6.67	2.23	3.29	2.49	2.21	2.11	—
PAI-45-MW20-SU	6.72	2.25	3.29	2.46	2.22	2.11	—
PAI-45-MW21-D	6.27	1.67	—	1.98	1.24	1.15	1.77
PAI-45-MW21-SL	6.27	2.88	—	3.28	3.06	2.93	—
PAI-45-MW21-SU	6.37	2.86	4.30	3.28	3.05	2.90	—
PAI-45-MW22-SL	6.43	2.99	4.37	3.42	3.30	3.17	—
PAI-45-MW22-SU	6.51	3.65	4.28	3.37	3.23	3.09	—
PAI-45-MW23-SL	6.28	2.64	3.43	3.05	2.64	2.67	—
PAI-45-MW23-SU	6.37	2.65	3.59	2.98	2.72	2.62	—
PAI-45-MW24-SU	6.62	2.93	3.91	3.30	3.11	2.97	—
PAI-45-MW25-SL	6.64	—	—	—	3.40	3.22	—
PAI-45-MW26-SL*	5.61	—	—	—	2.14	2.05	—
PAI-45-MW27-SL*	6.58	—	—	—	2.24	2.10	—
PAI-45-MW28-D	5.48	—	—	—	1.24	1.14	1.78
PAI-45-MW29-D	5.18	—	—	—	1.22	1.14	1.81
PAI-45-MW30-D	8.05	—	—	—	1.23	1.14	1.77
PAI-45-MW31-SL	5.49	—	—	—	2.91	2.74	—
PAI-45-MW31-SU	5.57	—	—	—	2.93	2.76	—

Appendix 12. Lithologic logs for permanent wells at site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2008.

[ft, feet; BLS, below land surface; USGS, U.S. Geological Survey]

Permanent well PAI-45-MW28-D

Date: June 2–4, 2008

Method: Hollow-stem auger to 19 ft BLS, Mud-rotary below 19 ft.
Driller: EarthCon
Core Description: Don Vroblesky, USGS
Split spoons
June 2, 2008

Core interval (ft BLS)	Recovery (ft)	Depth (ft BLS)	Description
2–4	2	2.0–2.6	Silty clay, black
		2.6–4.0	Sand, fine-grained, brown
4–6	2	4.0–5.3	Silty sand, fine-grained, gray with patches of brown silty sand, possibly burrow fills
		5.3–6.0	Silty sand, fine-grained, fewer brown patches than above
6–8	1.5	6.0–6.5	Sand, fine-grained, gray with patches of brown fine-grained sand
		6.5–7.5	Sand, fine-grained, gray, loose
		7.5–8.0	Missing
8–10	2	8.0–10.0	Sand, fine-grained, very loose, very wet, grayish-tan
10–12	2	10.0–11.4	Sand, fine-grained, very loose, very wet, grayish-tan
		11.4–12.0	Silty sand, fine-grained, dark gray
12–14	2	12.0–14.0	Silty sand, fine-grained, dark gray
16–18	2	16.0–17.8	Silty sand, fine-grained, dark gray
		17.8–18.0	Clay, organic-rich, dark gray
18–19	1	18.0–18.8	Clay, organic-rich, dark gray
		18.8–19.0	Sandy clay, dark gray

Stopped at 19 ft to set outer casing. Grouted from 18.6 ft BLS to land surface

General description from mud-rotary cuttings
June 4, 2008

Interval (ft BLS)	Description
19–21.5	Clay
21.5–32	Sand, fine-grained
32–33.5	Shelly material in fine-grained sand
33.5–34	Hard drilling, still looks like shelly material

Set screen 23.7 to 33.7 ft BLS. Grouted from 18.5 ft BLS to land surface.

Permanent well PAI-45-MW29-D

Date: June 3, 2008

Method: Hollow-stem auger to 19 ft BLS, Mud-rotary below 19 ft.
Driller: EarthCon
Core Description: Don Vroblesky, USGS
Split spoons
June 2, 2008

Core interval (ft BLS)	Recovery (ft)	Depth (ft BLS)	Description
15–17	2	15–17	Sand, very loose, fine-grained, gray, wet
17–18.8	1.8	17–18.8	Same as above
18.8–19	0.2	18.8–19	Silt, organic rich

Stopped at 19 ft BLS to set outer casing. Final casing set at 19.6 ft BLS. Grouted 19.6 ft to land surface.

Appendix 12. Lithologic logs for permanent wells at site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, 2008.—Continued

[ft, feet; BLS, below land surface; USGS, U.S. Geological Survey]

Permanent well PAI-45-MW29-D—Continued

General description from mud-rotary cuttings
June 4, 2008

Interval (ft BLS)	Description
20(?)–21	Sand, fine-grained, gray
21–28.5	Clay
28.5–29	Shelly material in fine-grained to silty sand
30–33	Sand, fine-grained to silty, with shells

Set screen 23.1 to 33.1 ft BLS. Grouted from 17 ft BLS to land surface.

Permanent well PAI-45-MW30-D

Date: June 4–5, 2008

Method: Hollow-stem auger to 20 ft BLS, Mud-rotary below 20 ft.
Driller: EarthCon
Core Description: Don Vroblesky, USGS
Split spoons
June 4, 2008

Core interval (ft BLS)	Recovery (ft)	Depth (ft BLS)	Description
0–15			No split spoons
15–17	2	15.0–17.0	Silty sand, fine-grained
17–19	2	17.0–17.8	Silty sand, fine-grained
		17.8–18.7	Clay, loose, with thin (0.05 inch) of fine-grained gray sand
		18.7–18.9	Clay, gray with abundant shell fragments
		18.9–19.0	Organic-rich clay, sharp upper contact
19–20	1	19.0–19.9	Organic-rich clay
		19.9–20.0	Organic-rich clay, very tight

Stopped at 20 ft BLS to set outer casing. Grouted from 20 ft BLS to land surface.

General description from mud-rotary cuttings
June 5, 2008

Interval (ft BLS)	Description
20.5–22	Sand
22–23	Hard drilling
23–23.5	Silty sand, wood that does not appear to be from the auger plug
23.5–27	Sand, fine-grained
27–30	Silty sand
30–34	Clay
34–35	Hard drilling, shelly material in silty sand

Set screen 25–35 ft BLS. Grouted from 20 ft BLS to land surface.

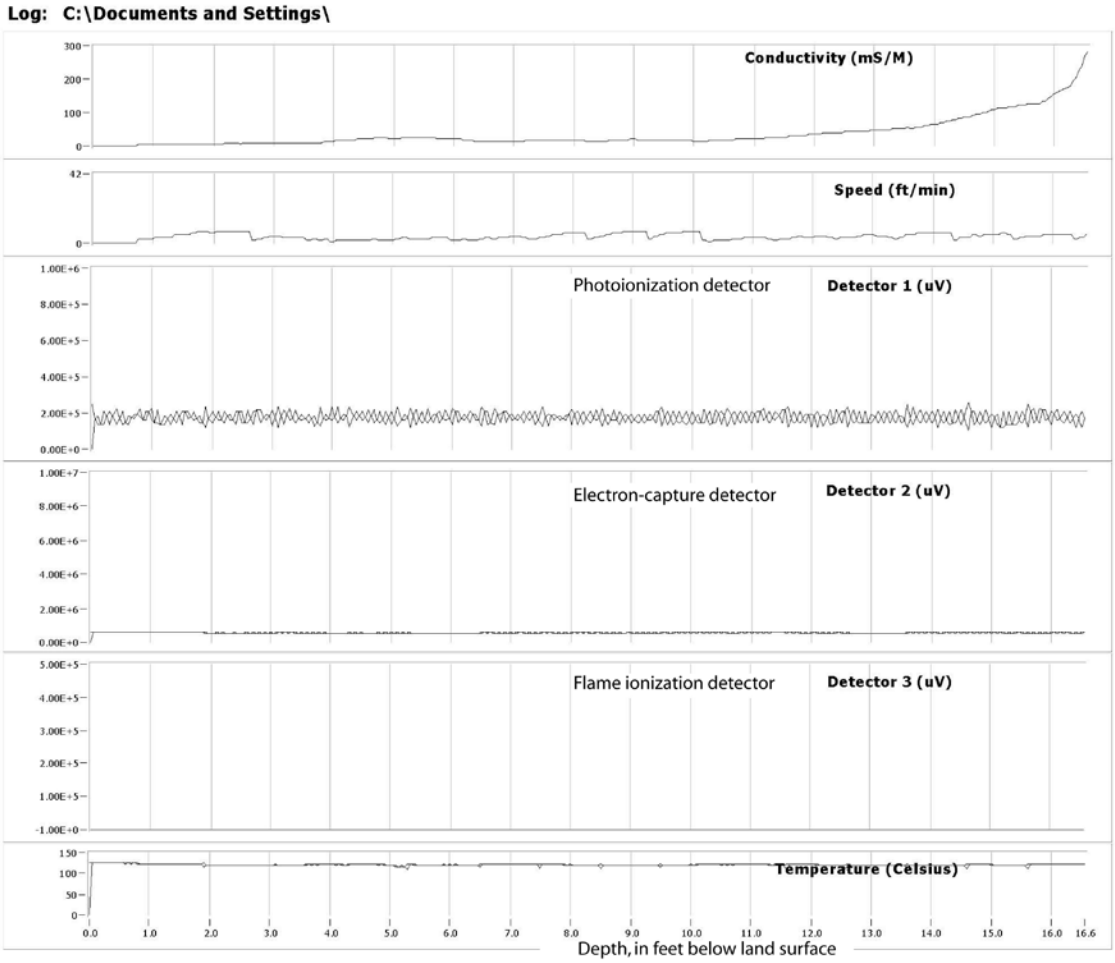
Appendix 13. Lithologic log for temporary well PAI-45-USGS-TW96, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, April 30, 2008.

[ft, feet; BLS, below land surface; USGS, U.S. Geological Survey; ppm, parts per million; <, less than; >, greater than]

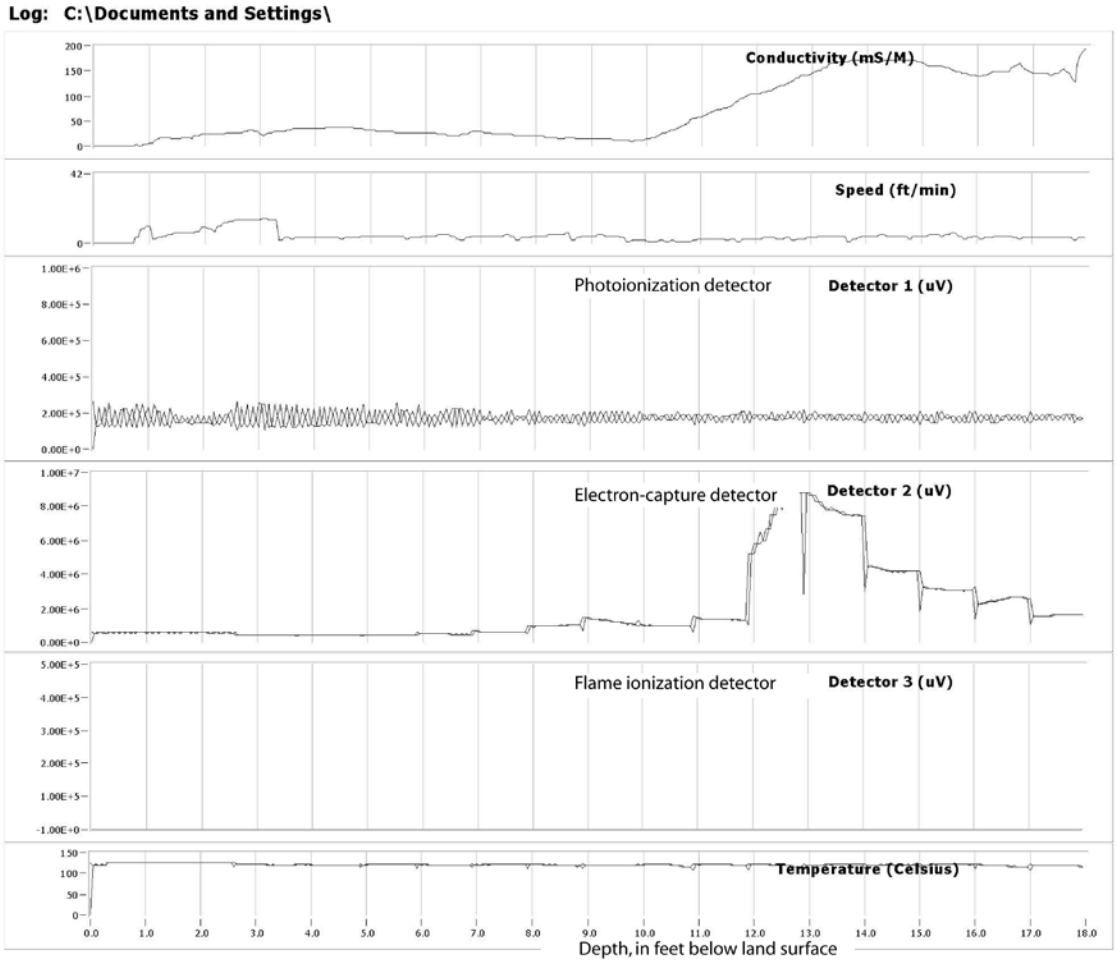
Date: April 30, 2008

Method: Geoprobe
Driller: James Landmeyer, USGS
Core Description: Don Vroblesky, USGS

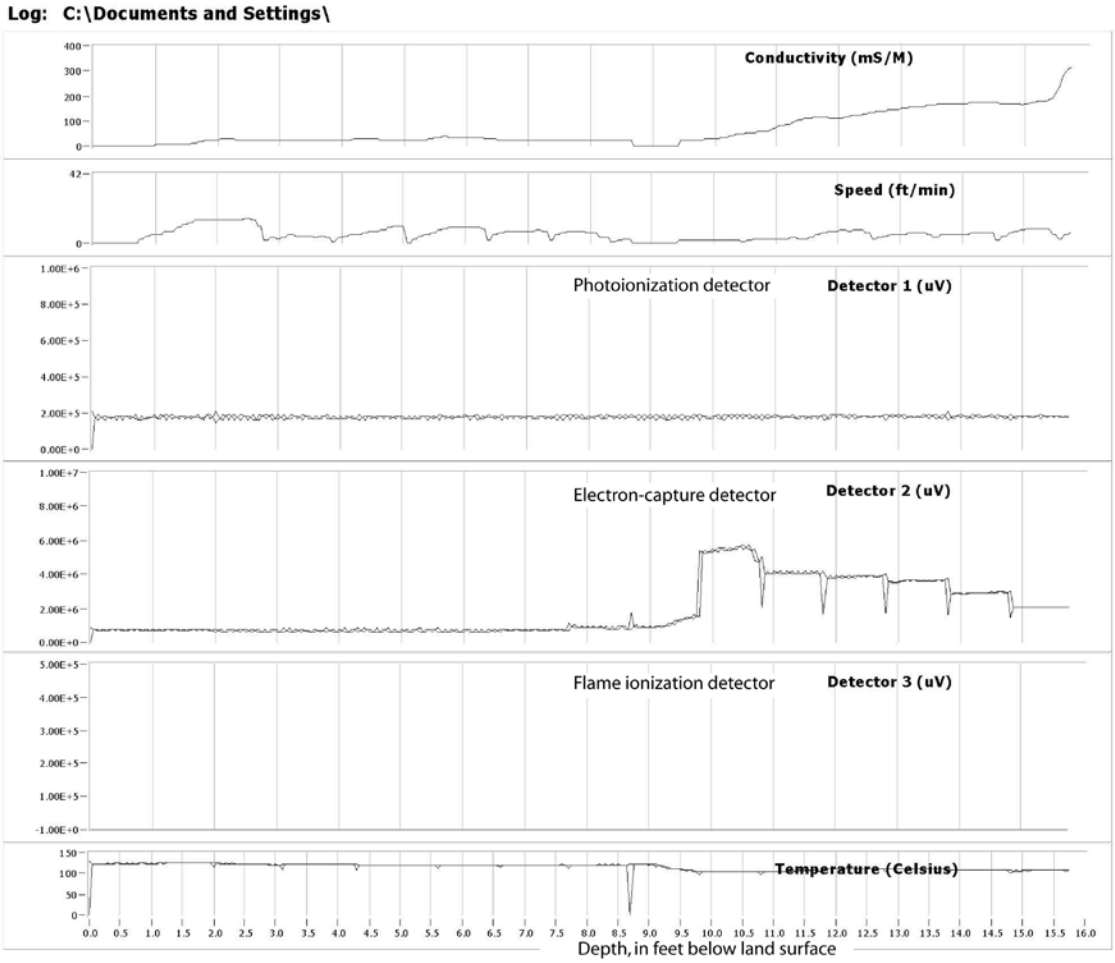
Core interval (ft BLS)	Recovery (ft)	Depth (ft BLS)	Description	Reading on ColorTek vapor analyzer (ppm)
4–5	0.85	4.0–4.8	Silty sand, fine-grained, gray. Exact depth uncertain.	<0.2
6–8	1.8	6.0–6.9	Sandy clay, gray	2
		6.9–7.2	Clayey sand, gray	
		7.2–7.8	Silty sand, fine-grained, brown	
		7.8–8.0	Silty sand, fine-grained, gray	>4
8–10	1.2	8.0–10.0	Sand, fine-grained, heaving, grayish tan	>25
10–12	1.6	10.4–10.8	Sand, fine-grained, grayish tan	
		10.8–12	Sand, fine-grained, black	30
12–14	1.7	12.3–12.8	Sand, fine-grained, black	40
		12.8–14.0	Sand, fine- to very fine-grained, grayish-brown	10
14–16	2	14.0–14.8	Sand, fine-grained, gray	<0.2
		14.8–15.2	Sand, medium-grained, gray	
		15.2–16.0	Silt, with brownish material that appears to be plant matter	<0.2



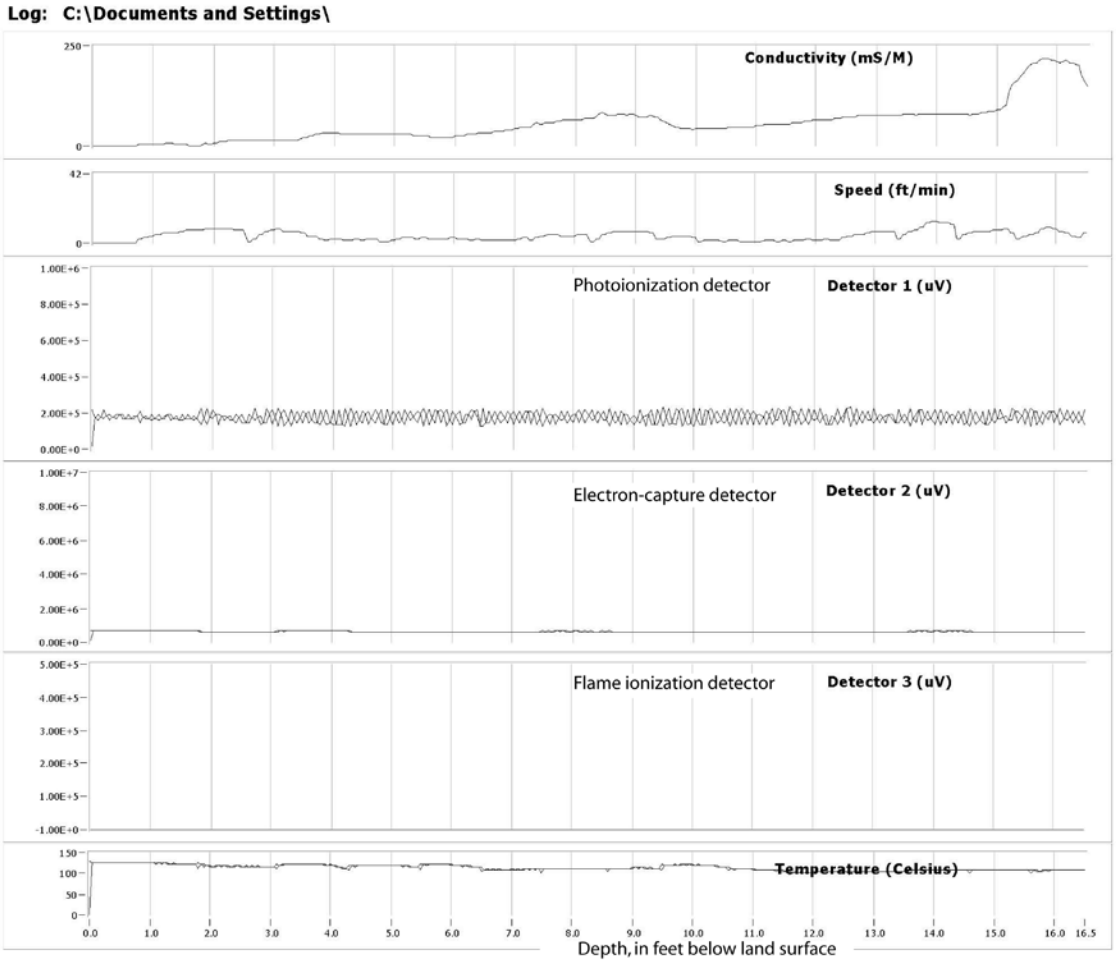
Appendix 14–1. Membrane Interface Probe (MIP) logs for boring MIP1, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, June 22, 2008.



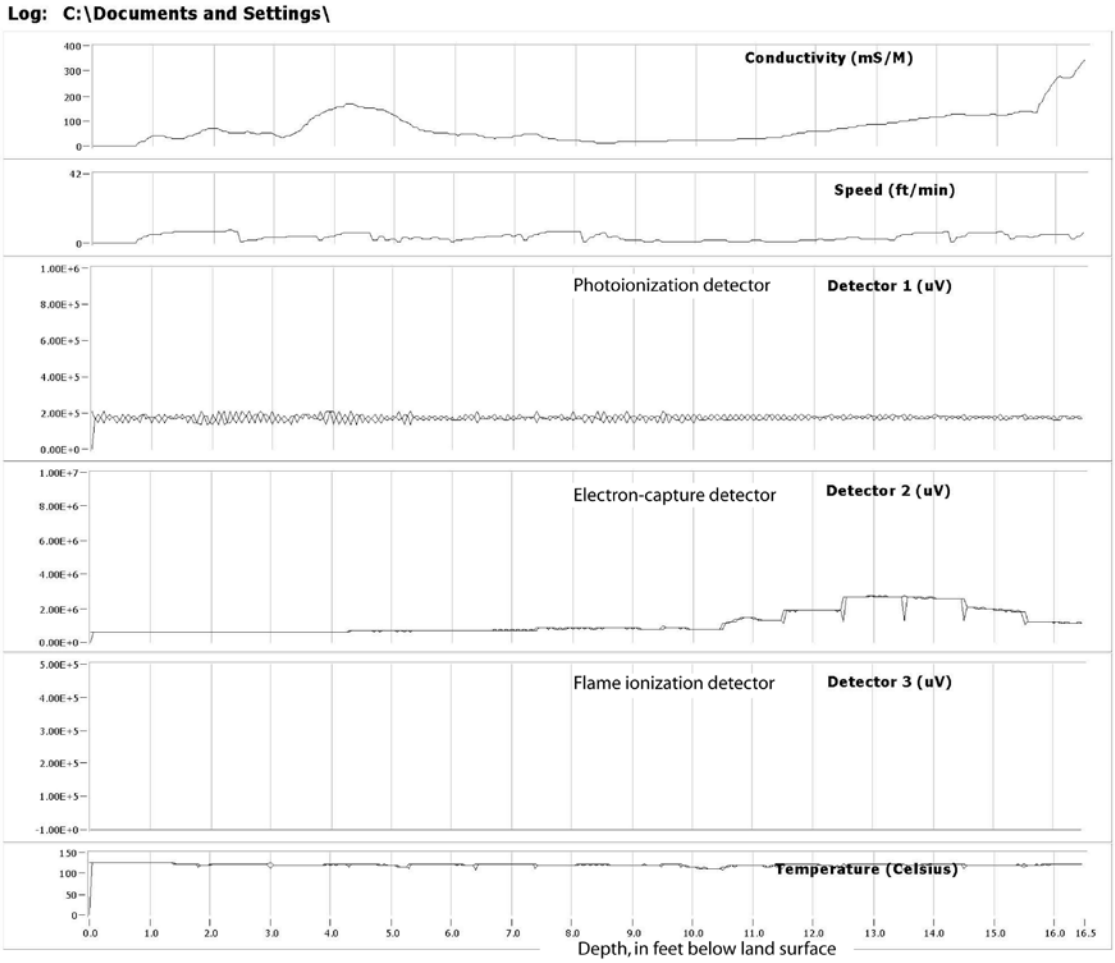
Appendix 14–2. Membrane Interface Probe (MIP) logs for boring MIP2, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, June 22, 2008.



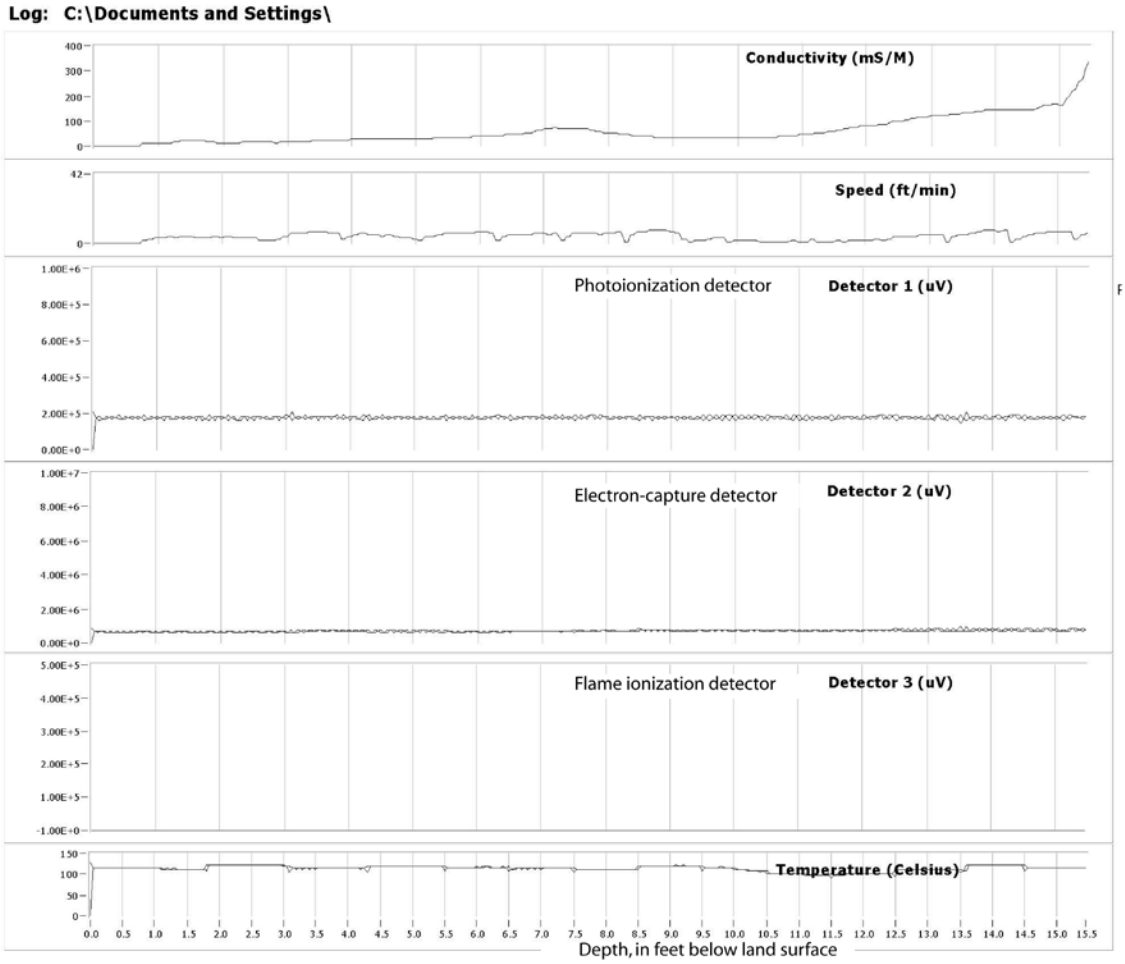
Appendix 14–3. Membrane Interface Probe (MIP) logs for boring MIP3, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, June 22, 2008.



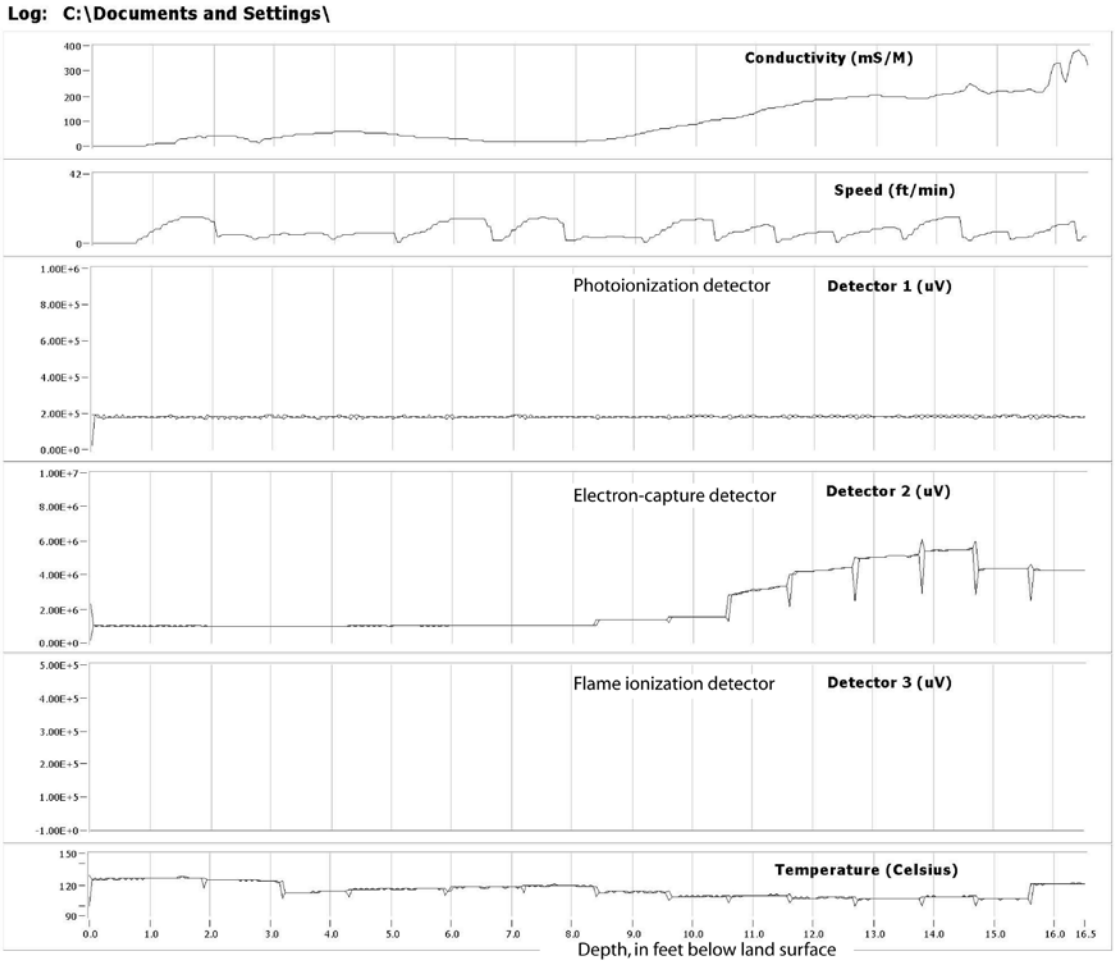
Appendix 14–4. Membrane Interface Probe (MIP) logs for boring MIP4, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, June 22, 2008.



Appendix 14–5. Membrane Interface Probe (MIP) logs for boring MIP5, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, June 22, 2008.



Appendix 14–6. Membrane Interface Probe (MIP) logs for boring MIP6, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, June 22, 2008.



Appendix 14–7. Membrane Interface Probe (MIP) logs for boring MIP7, Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina, June 22, 2008.

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Columbia, SC 29210
email: vroblesk@usgs.gov

Or visit the USGS South Carolina Water Science Center Web site at:
http://sc.water.usgs.gov/

APPENDIX B

GSI ENVIRONMENTAL DATA TABLES

GSI ENVIRONMENTAL

TABLE 1
Summary of Key Results of Sub-Slab Samples
ESTCP Tier 2 Vapor Screening Study
Site 45 - Marine Corps Recruit Depot, Parris Island, SC

				DUPLICATE					
SAMPLE LOCATION:	SUBSLAB-NP-1	SUBSLAB-NP-2	SUBSLAB-NP-3	SS-DUP-1	SG-2-2FT-NP	SUBSLAB-PP-1	SUBSLAB-PP-2	SUBSLAB-PP-3	SG-2-2FT-PP
PRESSURE CONDITION:	Negative	Negative	Negative	Negative	Negative	Positive	Positive	Positive	Positive
SAMPLE DEPTH (ft bgs):	0.8	0.8	0.8	0.8	2	0.8	0.8	0.8	2
SAMPLE DATE:	6/30/2009	6/30/2009	6/30/2009	6/30/2009	6/30/2009	7/1/2009	7/1/2009	7/1/2009	7/1/2009
COMPOUND	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
Volatile Organic Compounds (VOCs) by Method TO-15									
Benzene	**3.4**	**1**	**1.2**	**1.6**	**0.93**	**0.98**	**0.83**	< 0.45	< 0.46
Dichloroethane, 1,2-	**0.5**	< 0.45	< 0.47	**0.88**	< 0.45	< 0.46	< 0.46	< 0.45	< 0.46
Dichloroethene, cis-1,2-	< 0.44	< 0.45	< 0.47	< 0.49	< 0.45	< 0.46	< 0.46	< 0.45	< 0.46
Dichloroethene, trans-1,2-	< 0.44	< 0.45	< 0.47	< 0.49	< 0.45	< 0.46	< 0.46	< 0.45	< 0.46
Ethylbenzene	**6.1**	**13**	**3.7**	< 2.4	< 2.2	< 2.3	< 2.3	< 2.3	< 2.3
Tetrachloroethene	**190**	**240**	**89**	**120**	**190**	**74**	**160**	**91**	**170**
Toluene	**5.6**	< 2.3	< 2.3	**18**	< 2.2	**2.4**	< 2.3	< 2.3	< 2.3
Trichloroethane, 1,1,1-	< 0.44	< 0.45	< 0.47	< 0.49	< 0.45	< 0.46	< 0.46	< 0.45	< 0.46
Trichloroethene	**0.71**	**0.95**	< 0.47	< 0.49	< 0.45	< 0.46	< 0.46	< 0.45	< 0.46
Vinyl Chloride	< 0.44	< 0.45	< 0.47	< 0.49	< 0.45	< 0.46	< 0.46	< 0.45	< 0.46
Xylene, o-	**4.5**	**30**	**3.2**	< 2.4	< 2.2	< 2.3	< 2.3	< 2.3	< 2.3
Xylenes, m,p-	**21**	**66**	**14**	**2.9**	**7.5**	< 2.3	< 2.3	< 2.3	< 2.3

Notes:

1. Samples were analyzed by Columbia Analytical Services, Inc. in Simi Valley, California by Method TO-15.
2. Detected analytes are presented in **bold** type.

GSI ENVIRONMENTAL

TABLE 2
Summary of Key Results for Indoor and Ambient Air Samples
ESTCP Tier 2 Vapor Screening Study
Site 45 - Marine Corps Recruit Depot, Parris Island, SC

				DUPLICATE					
SAMPLE LOCATION:	Indoor-NP-1	Indoor-NP-2	Indoor-NP-3	Dup-1	Ambient-1	Indoor-PP-1	Indoor-PP-2	Indoor-PP-3	Ambient-2
PRESSURE CONDITION:	Negative	Negative	Negative	Negative	Negative	Positive	Positive	Positive	Positive
SAMPLE DATE:	6/30/2009	6/30/2009	6/30/2009	6/30/2009	6/30/2009	7/1/2009	7/1/2009	7/1/2009	7/1/2009
COMPOUND	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
Volatile Organic Compounds (VOCs) by Method TO-15 SIM									
Benzene	**0.41**	**0.49**	**0.43**	**0.42**	**0.46**	**0.71**	**0.68**	**0.69**	**0.84**
Dichloroethane, 1,2-	**0.13**	**0.19**	**0.17**	**0.19**	**0.059**	**0.15**	**0.12**	**0.095**	**0.058**
Dichloroethene, cis-1,2-	**0.49**	**2.2**	**1.8**	**2.5**	< 0.043	< 0.038	< 0.041	< 0.041	< 0.038
Dichloroethene, trans-1,2-	< 0.041	< 0.044	< 0.047	< 0.043	< 0.043	< 0.038	< 0.041	< 0.041	< 0.038
Ethylbenzene	**0.31**	**0.69**	**0.57**	**0.7**	**0.25**	**0.62**	**0.62**	**0.6**	**0.46**
Tetrachloroethene	**11**	**23**	**35**	**22**	**0.29**	**36**	**54**	**51**	**0.43**
Toluene	**5.1**	**13**	**13**	**13**	**1.6**	**5.3**	**5.6**	**5.1**	**2.7**
Trichloroethane, 1,1,1-	**0.055**	**0.054**	**0.056**	**0.54**	**0.054**	**0.054**	**0.053**	**0.054**	**0.054**
Trichloroethene	**0.15**	**0.65**	**0.54**	**0.73**	< 0.043	< 0.038	< 0.041	< 0.041	< 0.038
Vinyl Chloride	< 0.041	**0.11**	**0.09**	**0.12**	< 0.043	< 0.038	< 0.041	< 0.041	< 0.038
Xylenes, m,p-	**0.64**	**1.1**	**0.91**	**1.1**	**0.65**	**1.3**	**1.3**	**1.3**	**1.3**
Xylene, o-	**0.26**	**0.4**	**0.35**	**0.42**	**0.26**	**0.54**	**0.51**	**0.51**	**0.54**

Notes:
1. Samples were analyzed by Columbia Analytical Services, Inc. in Simi Valley, California by Method TO-15 SIM.
2. Detected analytes are presented in **bold** type.
3. ND = compound was analyzed for, but not detected above the laboratory reporting limit.

TABLE 3A
Analytical Results of Sulfur Hexafluoride Tracer Gas: Sub-slab gas samples
ESTCP Tier 2 Vapor Screening Study
Site 45 - Marine Corps Recruit Depot, Parris Island, SC

				DUPLICATE					
SAMPLE LOCATION:	SUBSLAB-NP-1	SUBSLAB-NP-2	SUBSLAB-NP-3	SS-DUP-1	SG-2-2FT-NP	SUBSLAB-PP-1	SUBSLAB-PP-2	SUBSLAB-PP-3	SG-2-2FT-PP
PRESSURE CONDITION:	Negative	Negative	Negative	Negative	Negative	Positive	Positive	Positive	Positive
SAMPLE DEPTH (ft bgs):	0.8	0.8	0.8	0.8	2	0.8	0.8	0.8	2
SAMPLE DATE:	6/30/2009	6/30/2009	6/30/2009	6/30/2009	6/30/2009	7/1/2009	7/1/2009	7/1/2009	7/1/2009
Units	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3
Compound of Interest									
Sulfur Hexafluoride (SF6)	< 6.5	< 6.6	< 6.6	**10**	< 7.3	< 6.4	< 6.4	< 6.4	< 6.5

TABLE 3B
Analytical Results of Sulfur Hexafluoride Tracer Gas: Indoor and Ambient Air Samples
ESTCP Tier 2 Vapor Screening Study
Site 45 - Marine Corps Recruit Depot, Parris Island, SC

				DUPLICATE					
SAMPLE LOCATION:	Indoor-NP-1	Indoor-NP-2	Indoor-NP-3	Dup-1	Ambient-1	Indoor-PP-1	Indoor-PP-2	Indoor-PP-3	Ambient-2
PRESSURE CONDITION:	Negative	Negative	Negative	Negative	Negative	Positive	Positive	Positive	Positive
SAMPLE DATE:	6/30/2009	6/30/2009	6/30/2009	6/30/2009	6/30/2009	7/1/2009	7/1/2009	7/1/2009	7/1/2009
Units	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3
Compound of Interest									
Sulfur Hexafluoride (SF6)	**42**	**150**	**110**	**160**	< 10	**190**	**110**	**58**	< 9.1

Notes:
1. Samples were analyzed by Columbia Analytical Services, Inc. in Simi Valley, California by NIOSH Method 6602 Modified.
2. Detected analytes are presented in **bold** type.
3. SF6 release start time: 29 June 2009 at 14:30; Average SF6 release rate: 120 mL/min.

GSI ENVIRONMENTAL

TABLE 4
Results of Radon Analysis
ESTCP Tier 2 Vapor Screening Study
Site 45 - Marine Corps Recruit Depot, Parris Island, SC

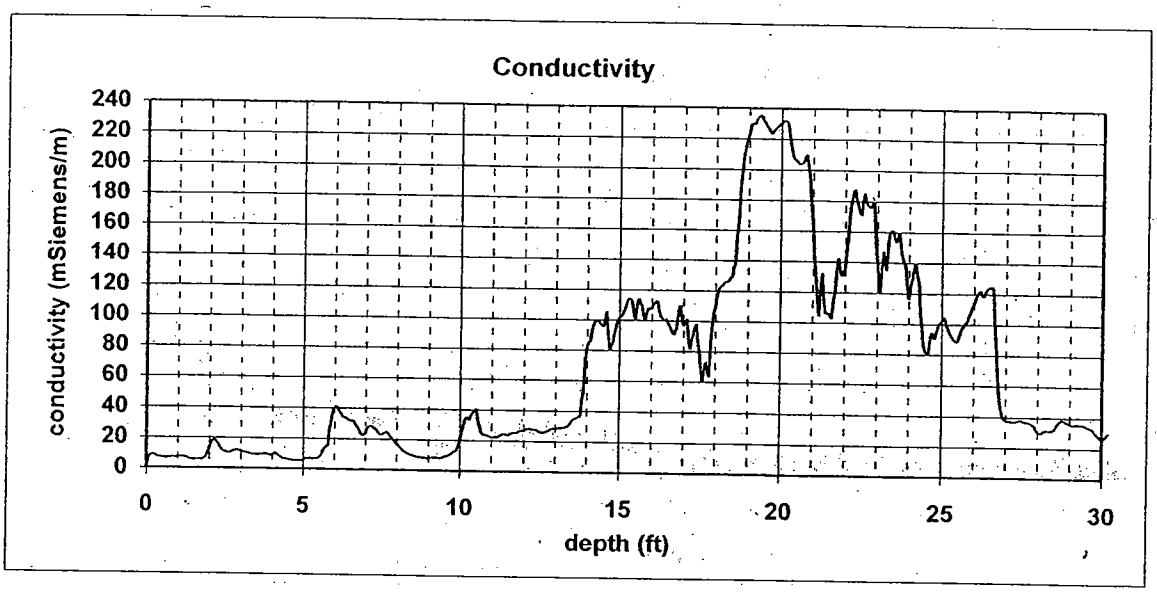
				DUPLICATE					
SAMPLE LOCATION:	SUBSLAB-NP-1	SUBSLAB-NP-2	SUBSLAB-NP-3	DUP-1	SG-2-2FT-NP	SUBSLAB-PP-1	SUBSLAB-PP-2	SUBSLAB-PP-3	SG-2-2FT-PP
PRESSURE CONDITION:	Negative	Negative	Negative	Negative	Negative	Positive	Positive	Positive	Positive
SAMPLE DATE:	6/30/2009	6/30/2009	6/30/2009	6/30/2009	6/30/2009	7/1/2009	7/1/2009	7/1/2009	7/1/2009
COMPOUND	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L
Compound of Interest									
Radon	**2405**	**2681**	**2372**	**2752**	**2728**	**2073**	**2471**	**2468**	**2737**

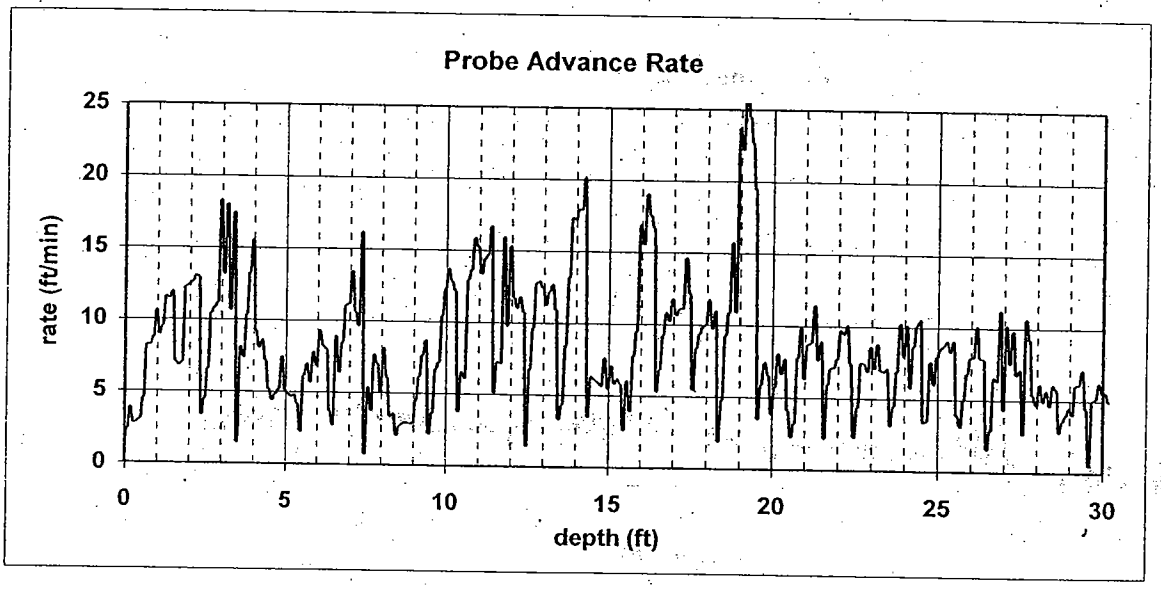
SAMPLE LOCATION:	Indoor-1-NP	Indoor-2-NP	Indoor-3-NP	Dup-1	Ambient-1-NP	Indoor-1-PP	Indoor-2-PP	Indoor-3-PP	Ambient-2
PRESSURE CONDITION:	Negative	Negative	Negative	Negative	Negative	Positive	Positive	Positive	Positive
SAMPLE DATE:	6/30/2009	6/30/2009	6/30/2009	6/30/2009	6/30/2009	7/1/2009	7/1/2009	7/1/2009	7/1/2009
COMPOUND	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L
Compound of Interest									
Radon	**0.27**	**0.21**	**0.3**	**-**	**0.11**	**0.25**	**0.49**	**0.4**	**0.22**

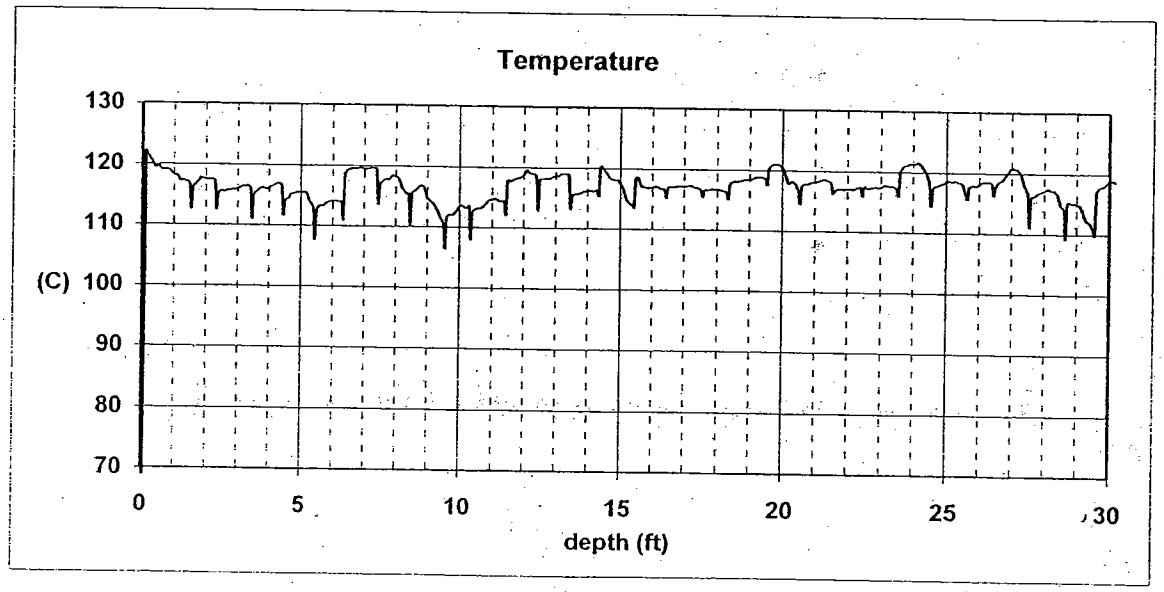
Notes:
1. Radon samples were analyzed by Dr. Douglas E. Hammond at the University of Southern California in Los Angeles, California.
2. Detected analytes are presented in **bold** type.
3. The lower detection limit for radon (95% confidence level as recommended by EPA 402-R-95-012, October 1997) is 0.14 pCi/L.
4. Results corrected to in-situ pressure of 1.00 atm based on assumed Parris Island elevation of 100 ft above sea level.

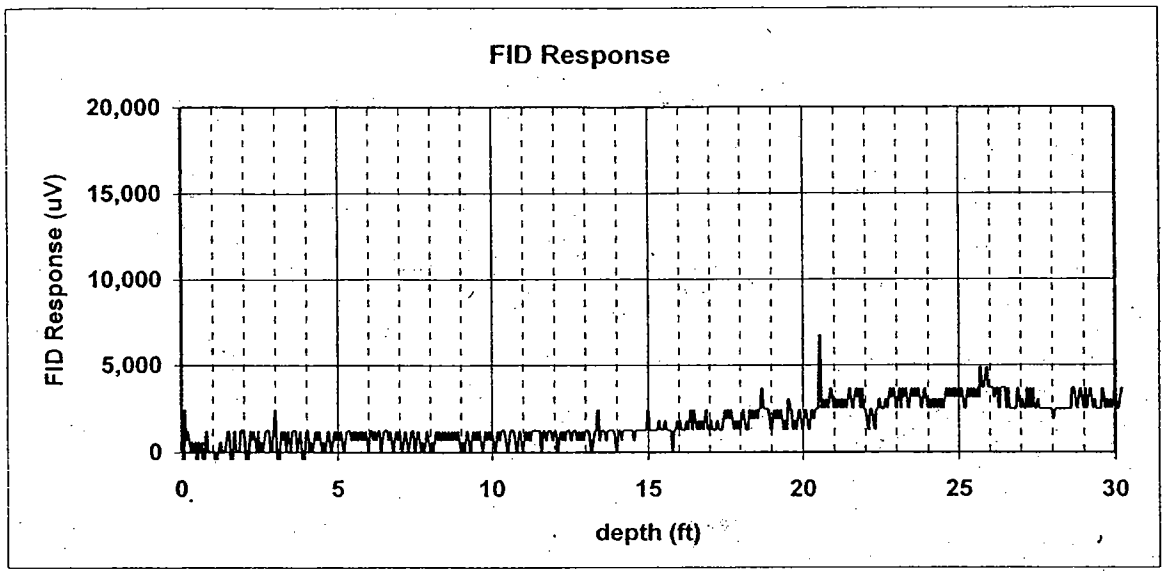
APPENDIX C

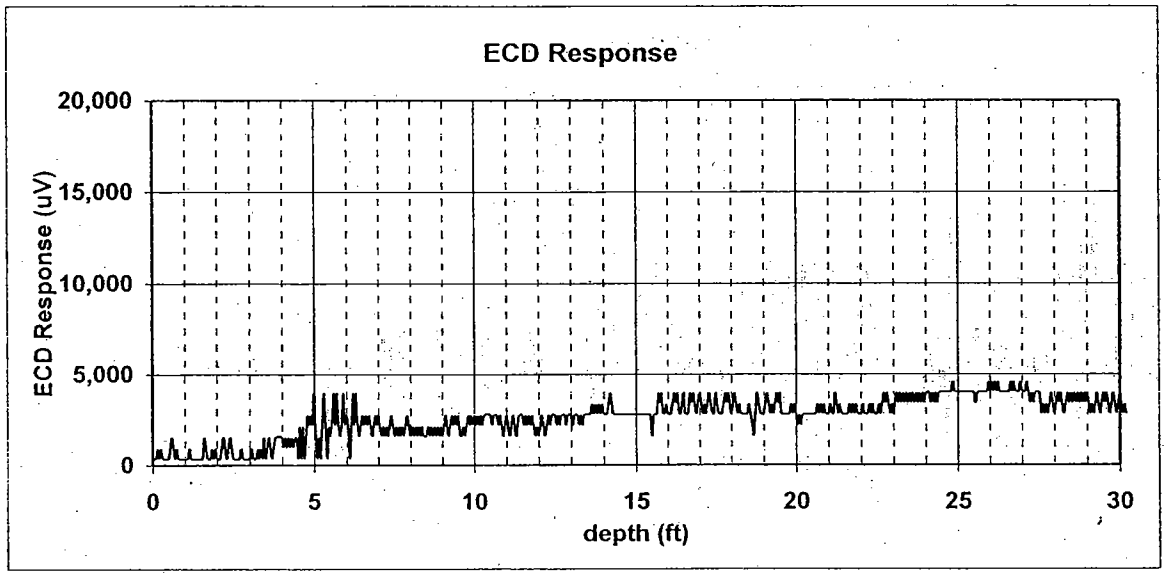
MEMBRANE INTERFACE PROBE DATA

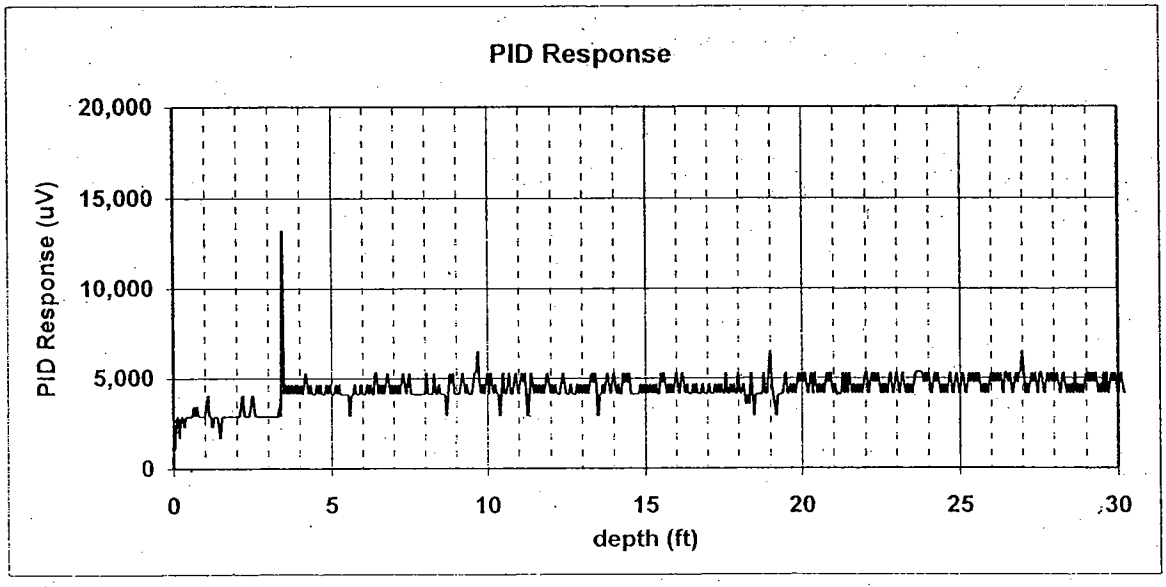

Conductivity
conductivity (mSiemens/m)
240
220
200
180
160
140
120
100
80
60
40
20
0
0
5
10
15
20
25
30
depth (ft)

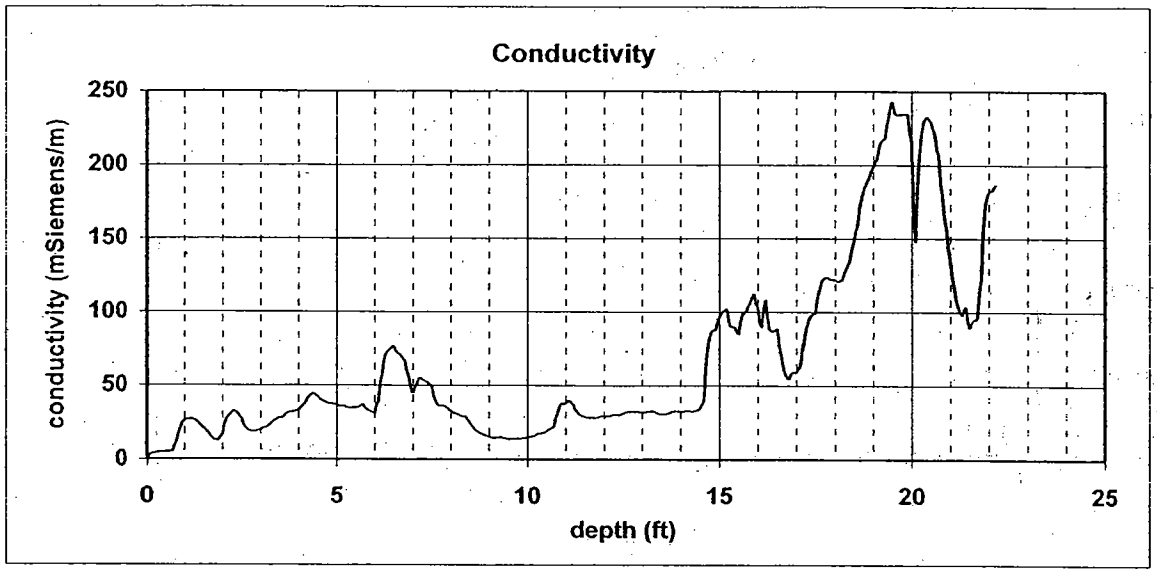

Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
30
depth (ft)

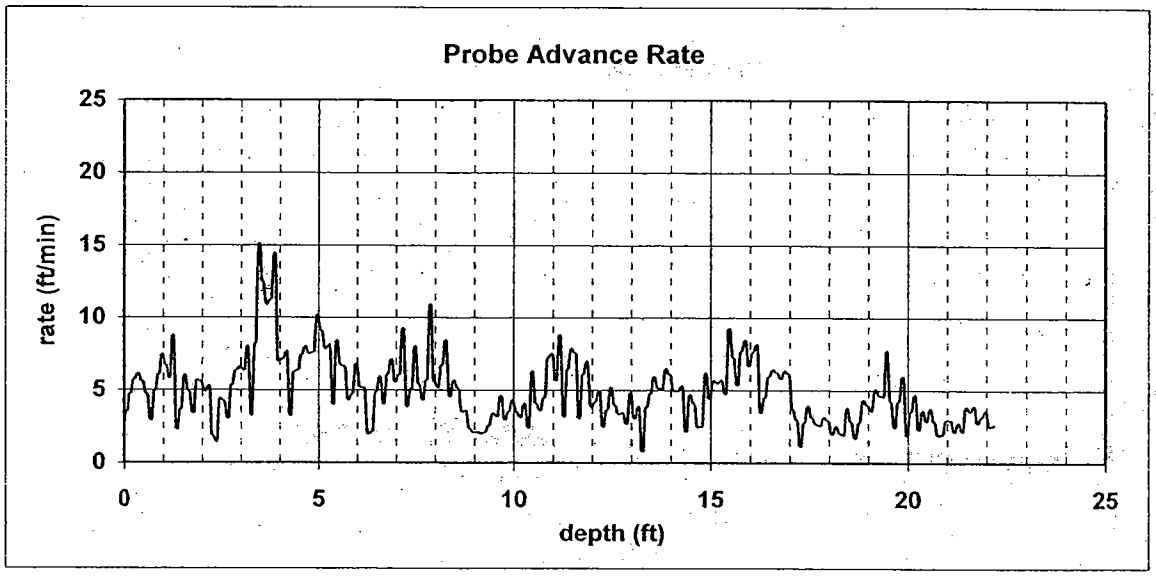

Temperature
(C)
130
120
110
100
90
80
70
0
5
10
15
20
25
30
depth (ft)

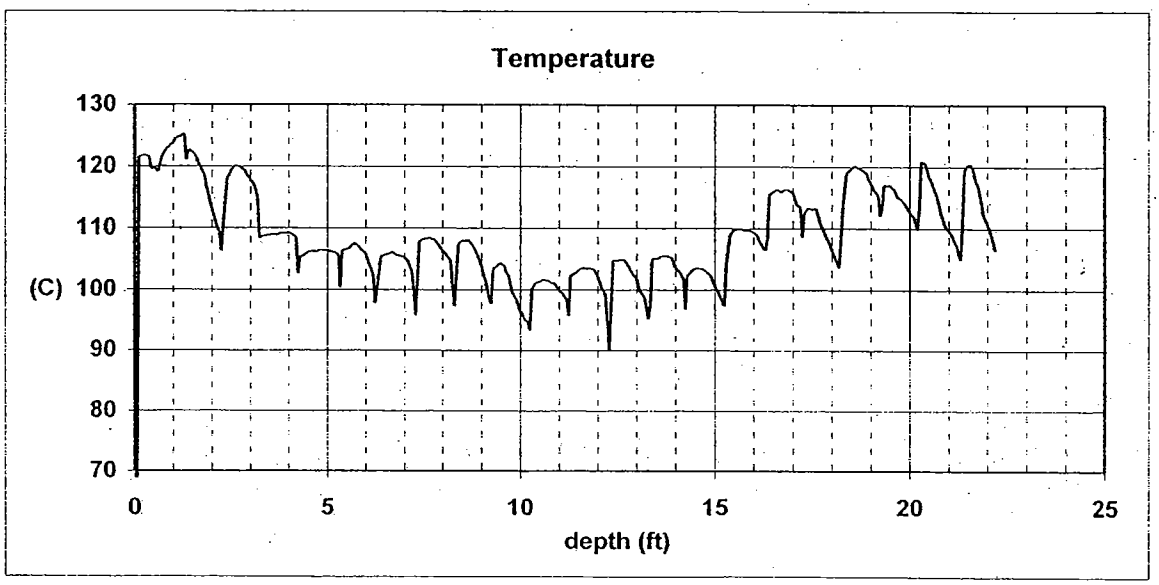

FID Response
FID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
30
depth (ft)

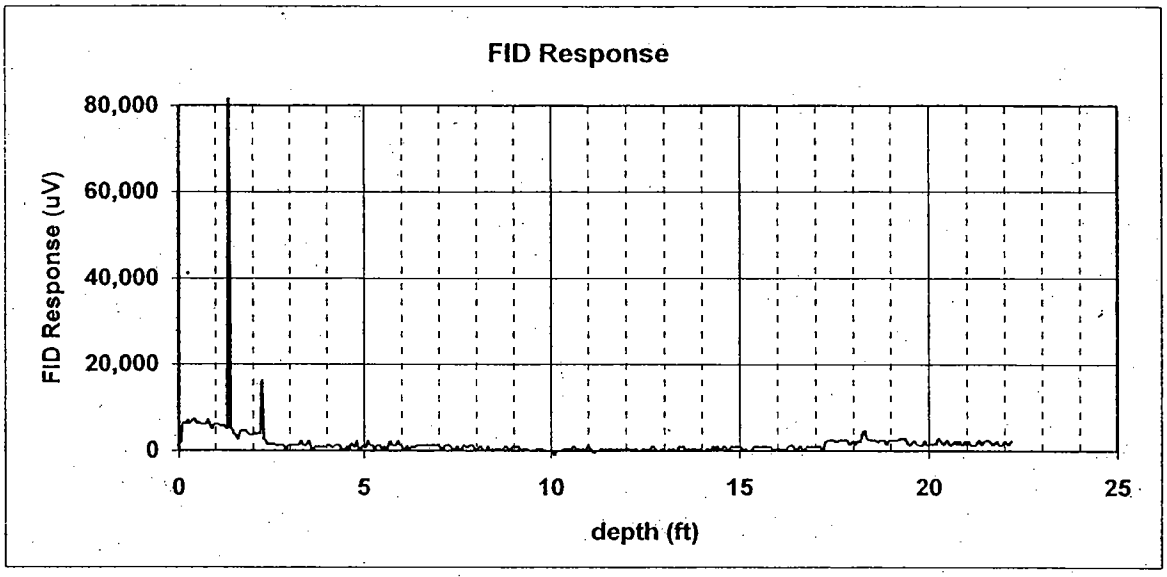

ECD Response
ECD Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
30
depth (ft)

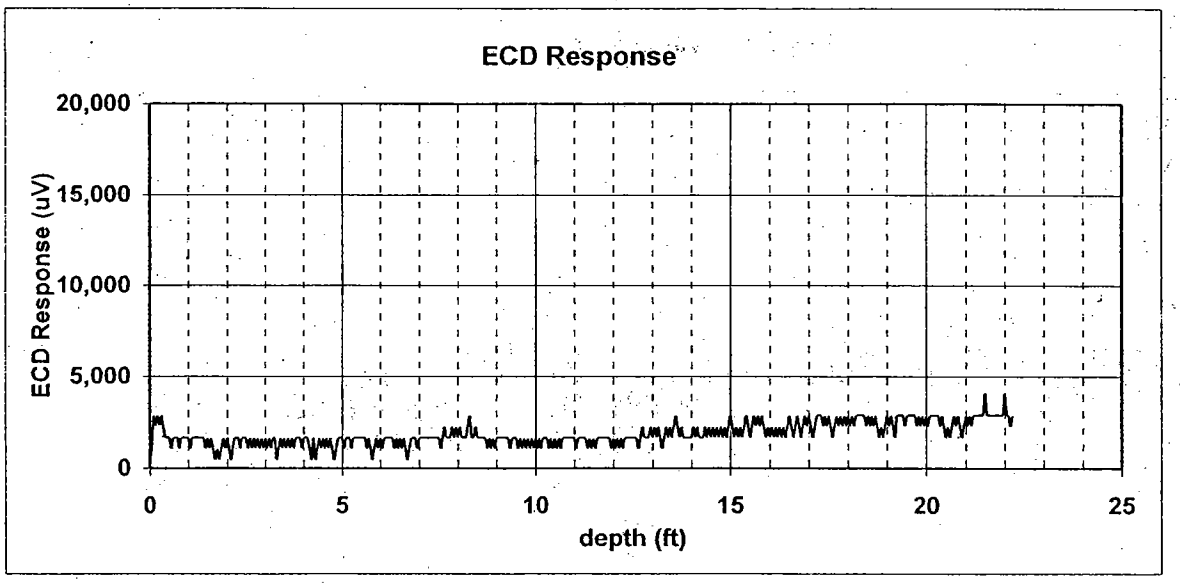

PID Response
PID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
30
depth (ft)

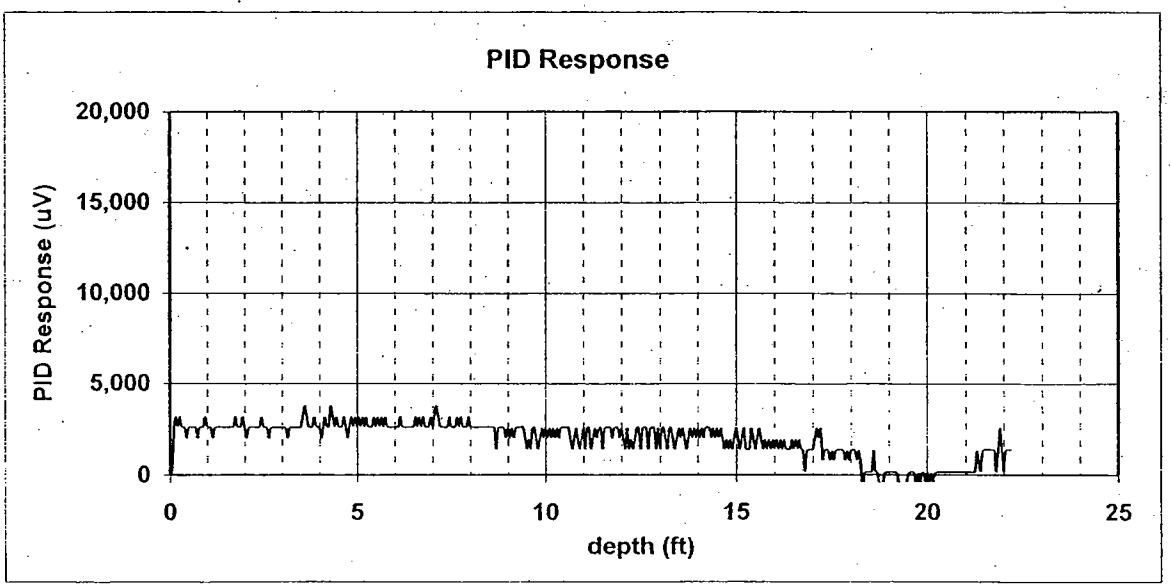

Conductivity
conductivity (mSiemens/m)
250
200
150
100
50
0
0
5
10
15
20
25
depth (ft)

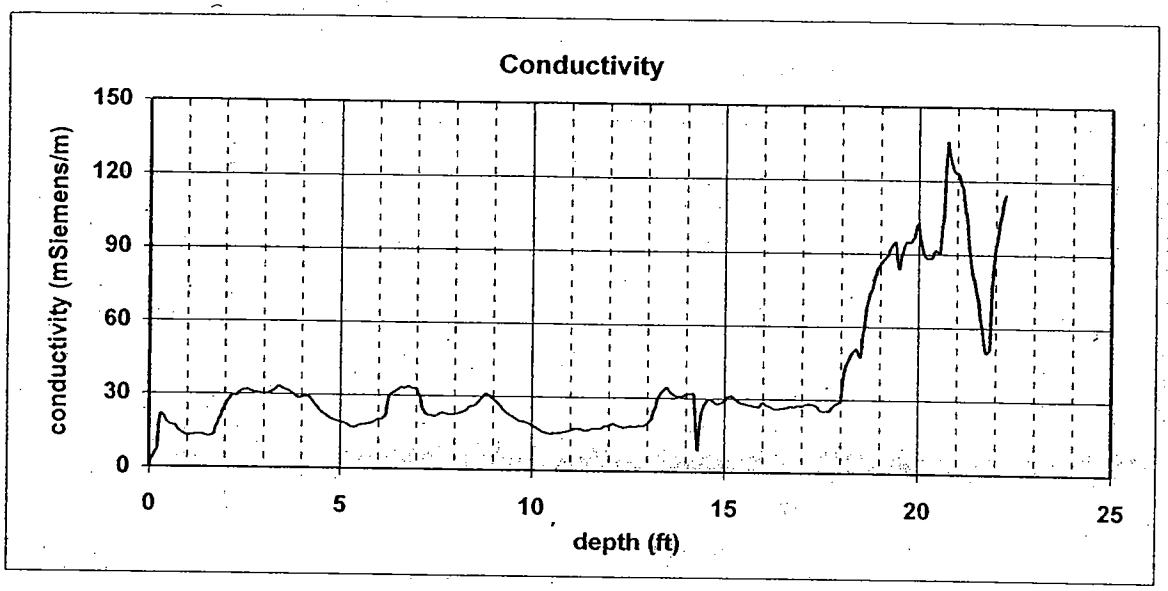

Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)

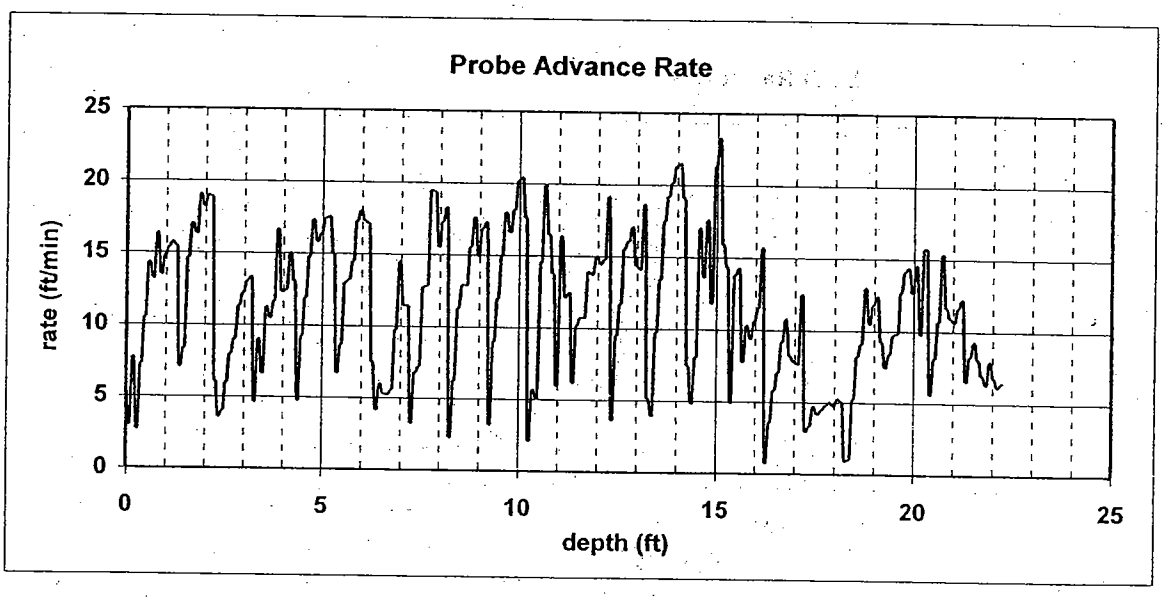

Temperature
(C)
130
120
110
100
90
80
70
0
5
10
15
20
25
depth (ft)

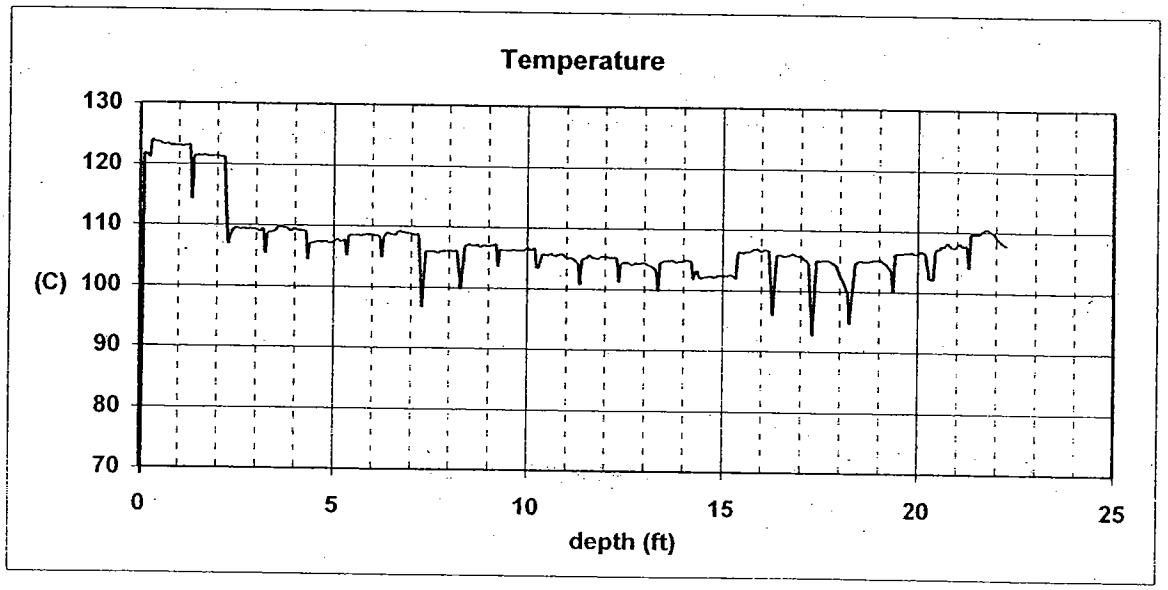

FID Response
FID Response (uV)
80,000
60,000
40,000
20,000
0
0
5
10
15
20
25
depth (ft)

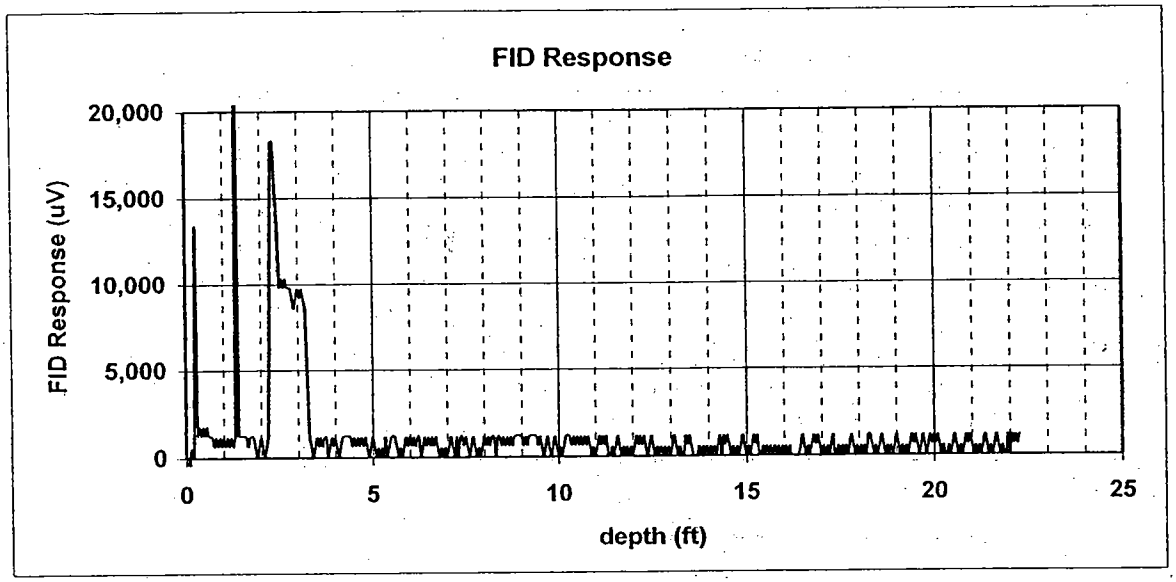

ECD Response
ECD Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

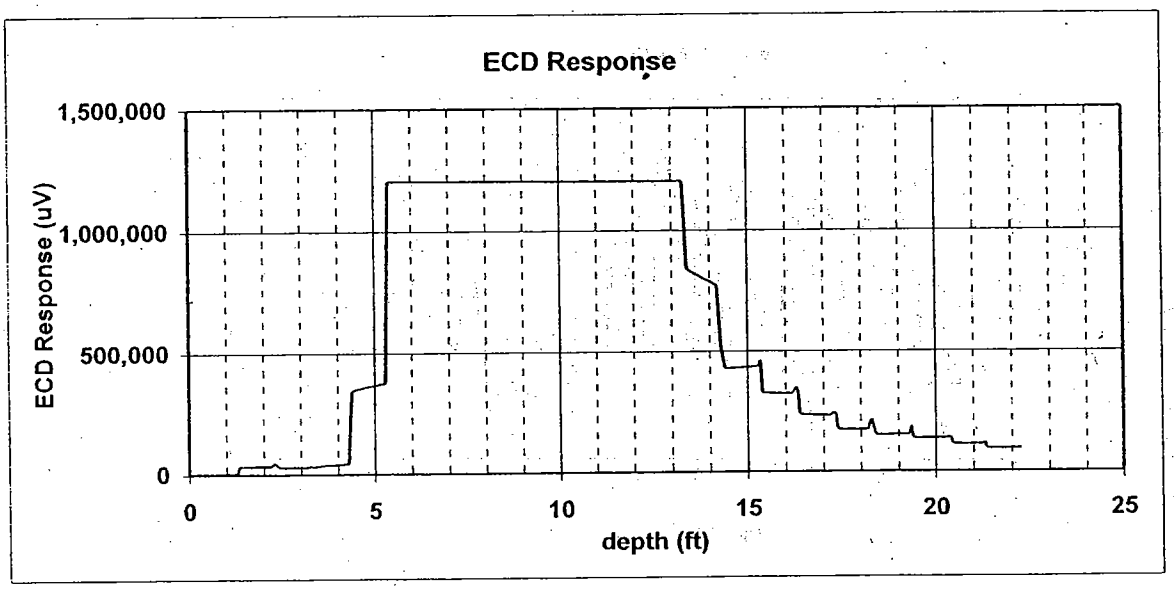

PID Response
PID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

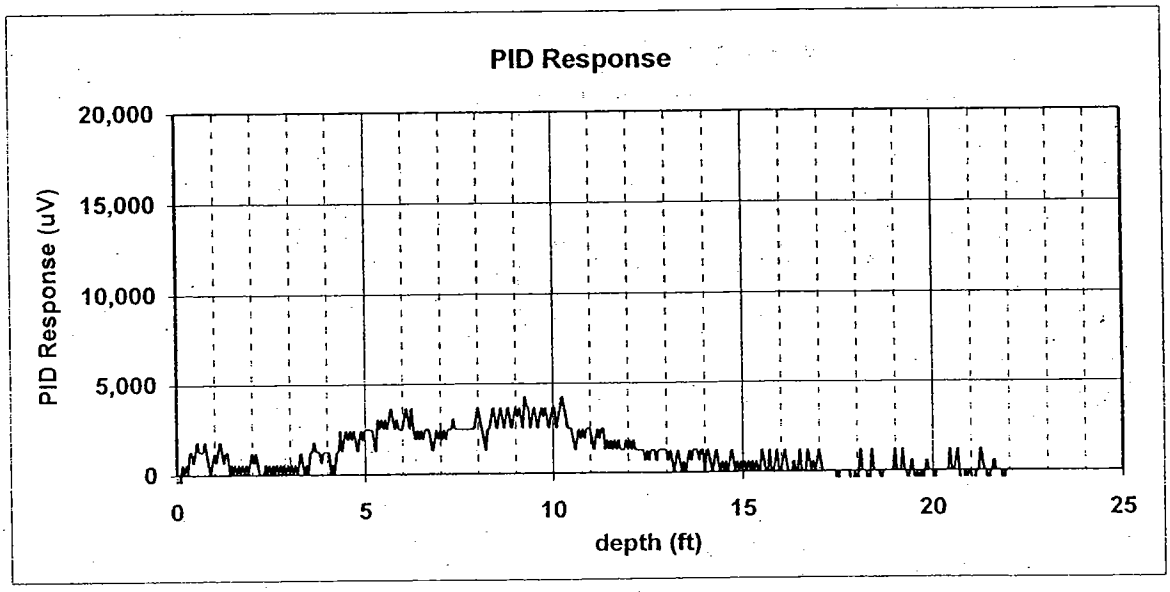

Conductivity
conductivity (mSiemens/m)
150
120
90
60
30
0
0
5
10
15
20
25
depth (ft)

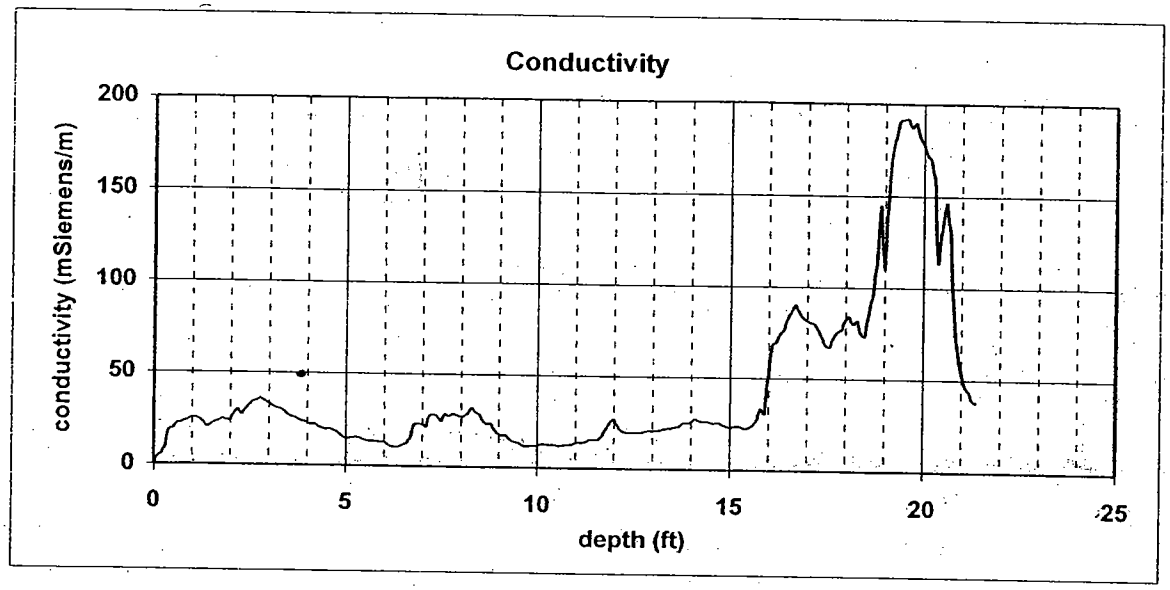

Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)

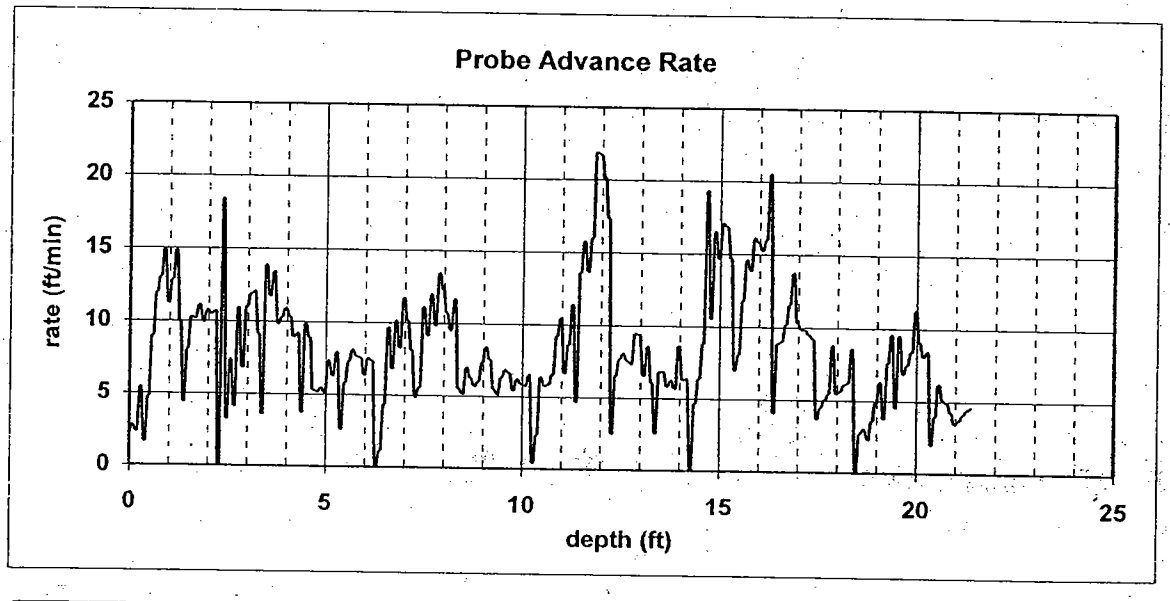

Temperature
(C)
130
120
110
100
90
80
70
0
5
10
15
20
25
depth (ft)

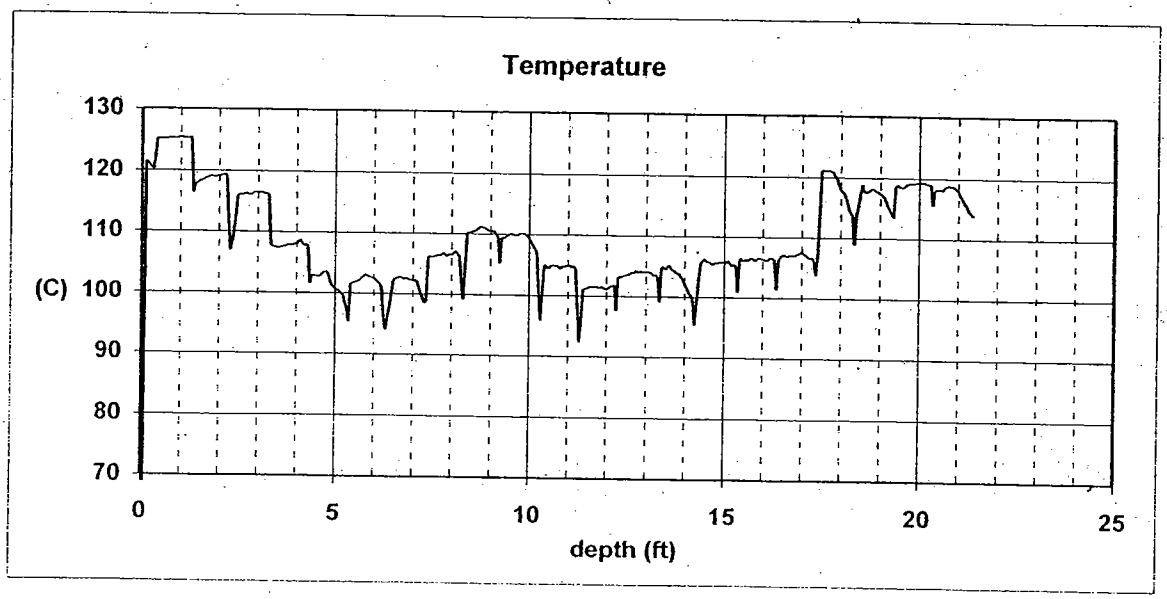

FID Response
FID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

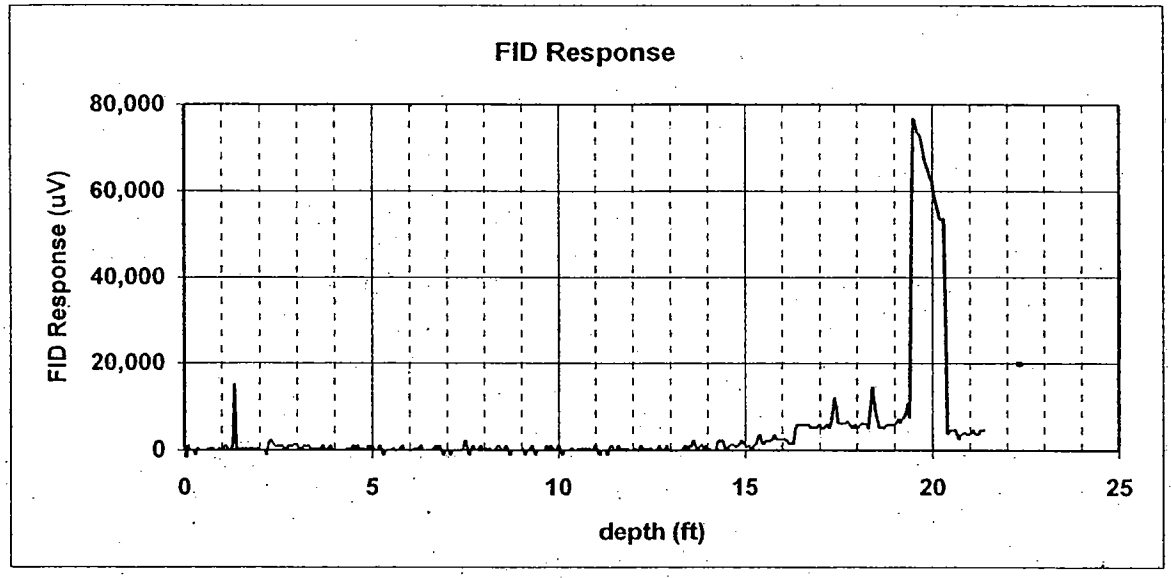

ECD Response
ECD Response (uV)
1,500,000
1,000,000
500,000
0
0
5
10
15
20
25
depth (ft)

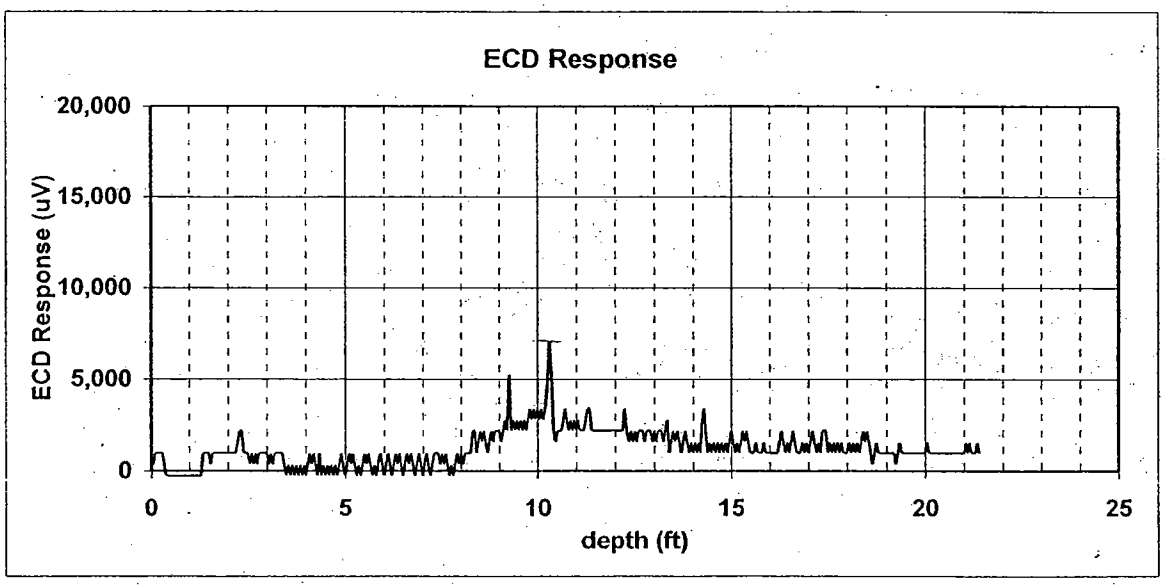

PID Response
PID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

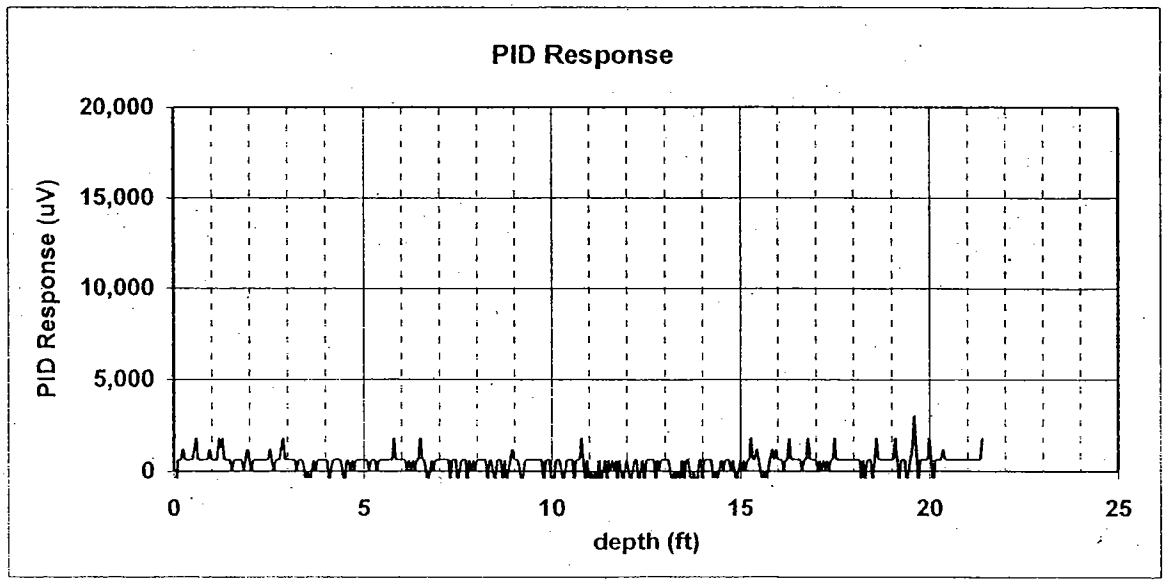

Conductivity
conductivity (mSiemens/m)
200
150
100
50
0
0
5
10
15
20
25
depth (ft)


Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)

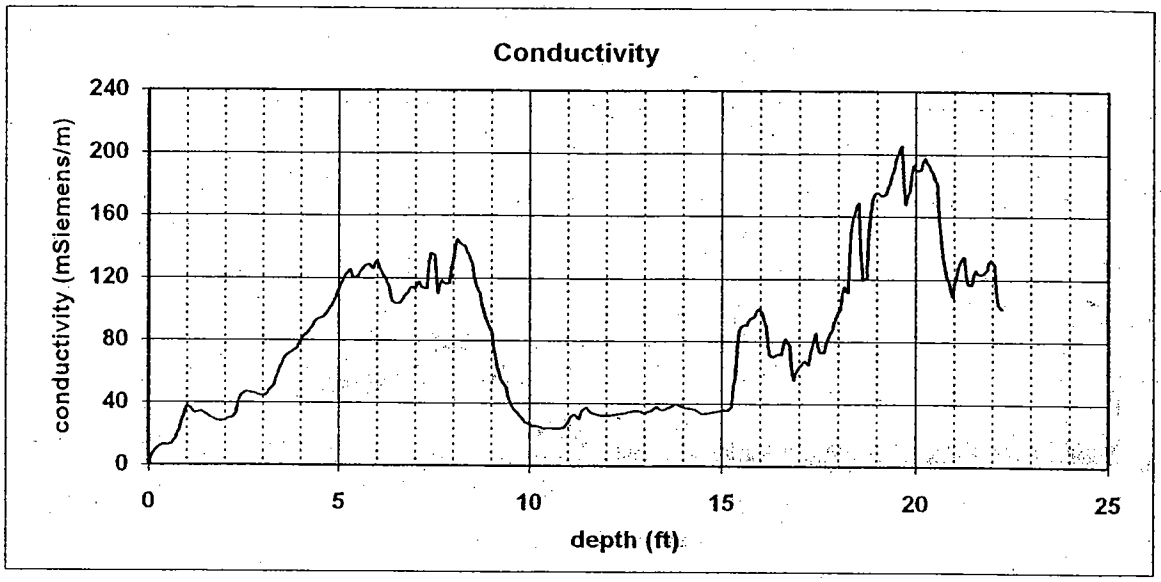

Temperature
(C)
130
120
110
100
90
80
70
0
5
10
15
20
25
depth (ft)

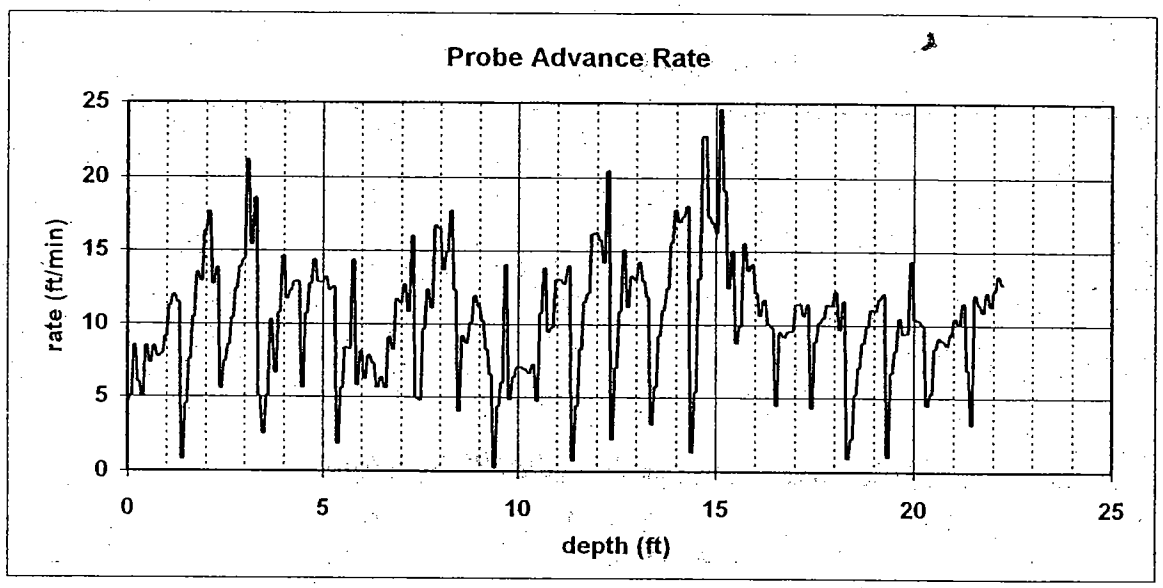

FID Response
FID Response (uV)
80,000
60,000
40,000
20,000
0
0
5
10
15
20
25
depth (ft)

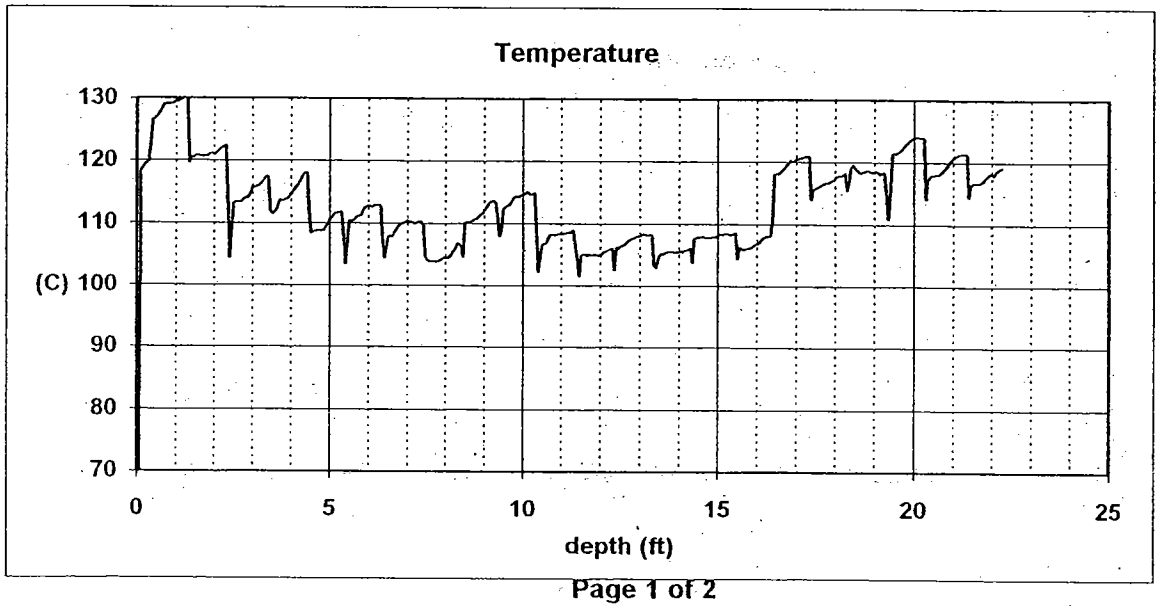

ECD Response
ECD Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)


PID Response
PID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

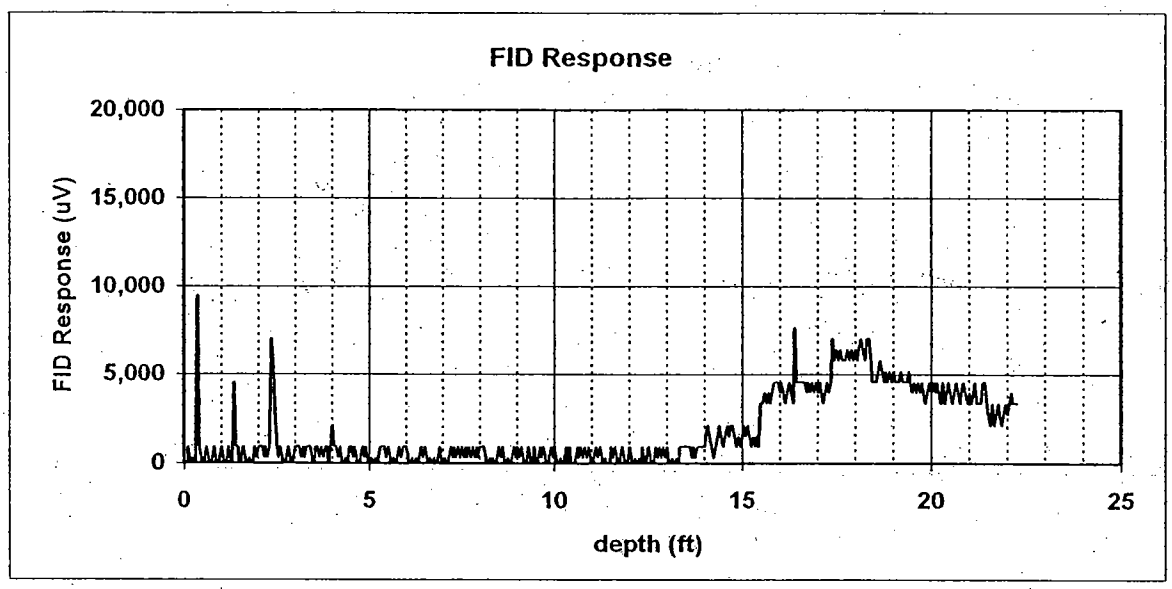
SB-105 (Field)

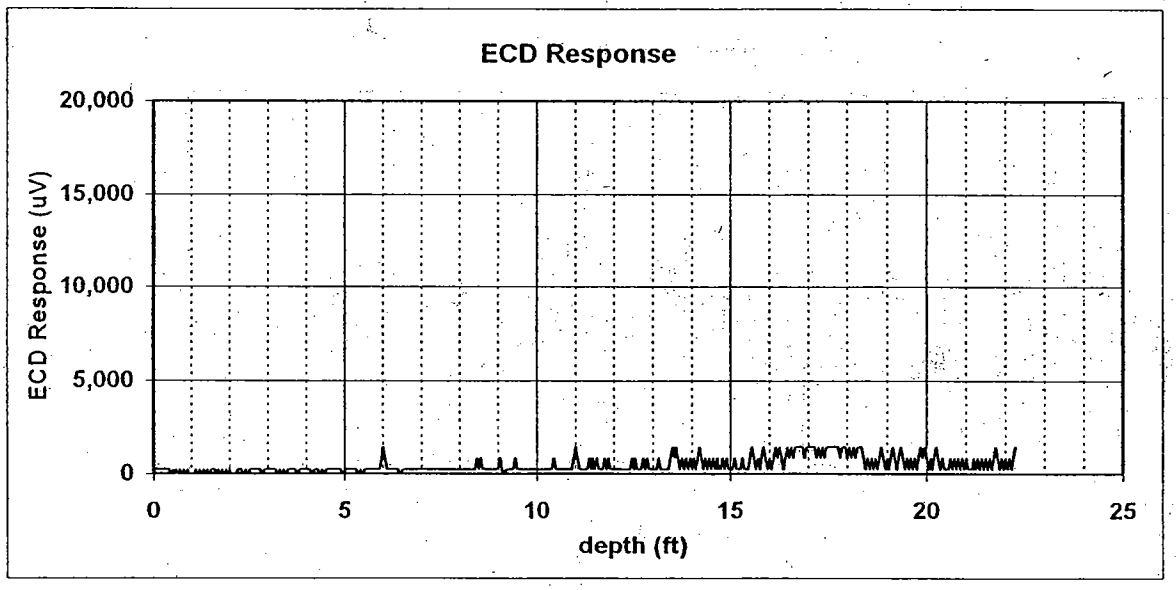

Conductivity
conductivity (mSiemens/m)
240
200
160
120
80
40
0
0
5
10
15
20
25
depth (ft)

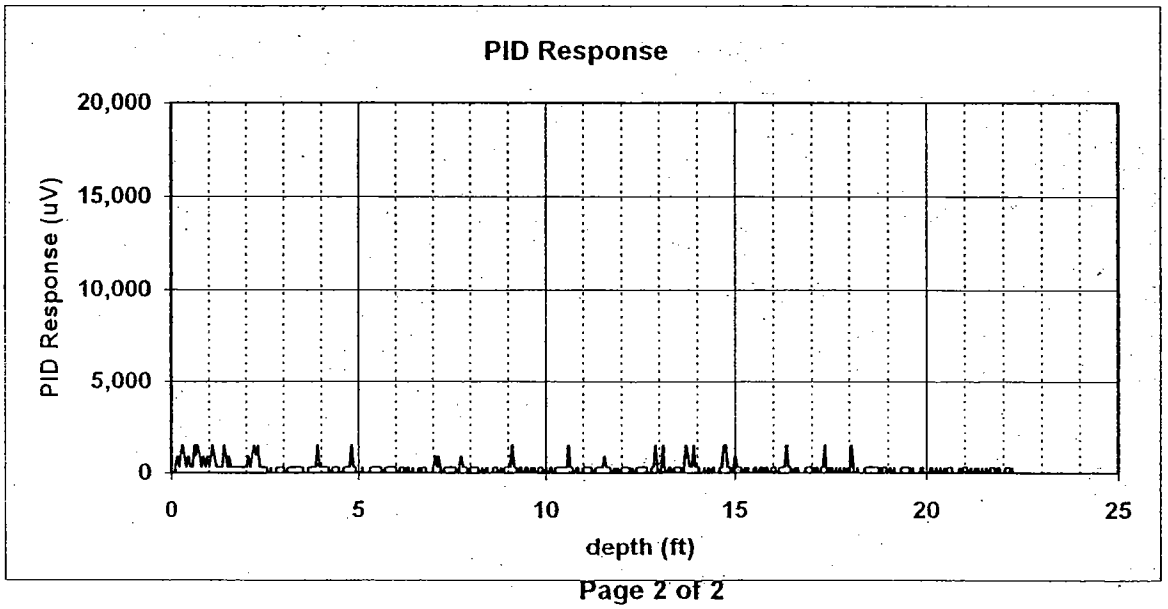

Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)


Temperature
(C)
130
120
110
100
90
80
70
0
5
10
15
20
25
depth (ft)

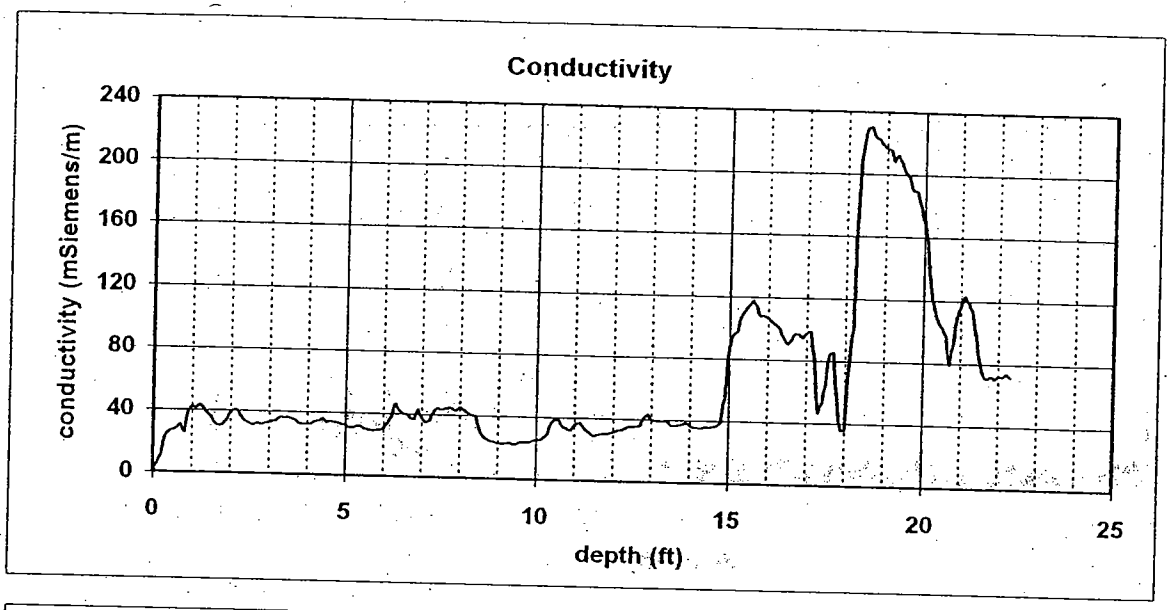
SB-105 (Field)

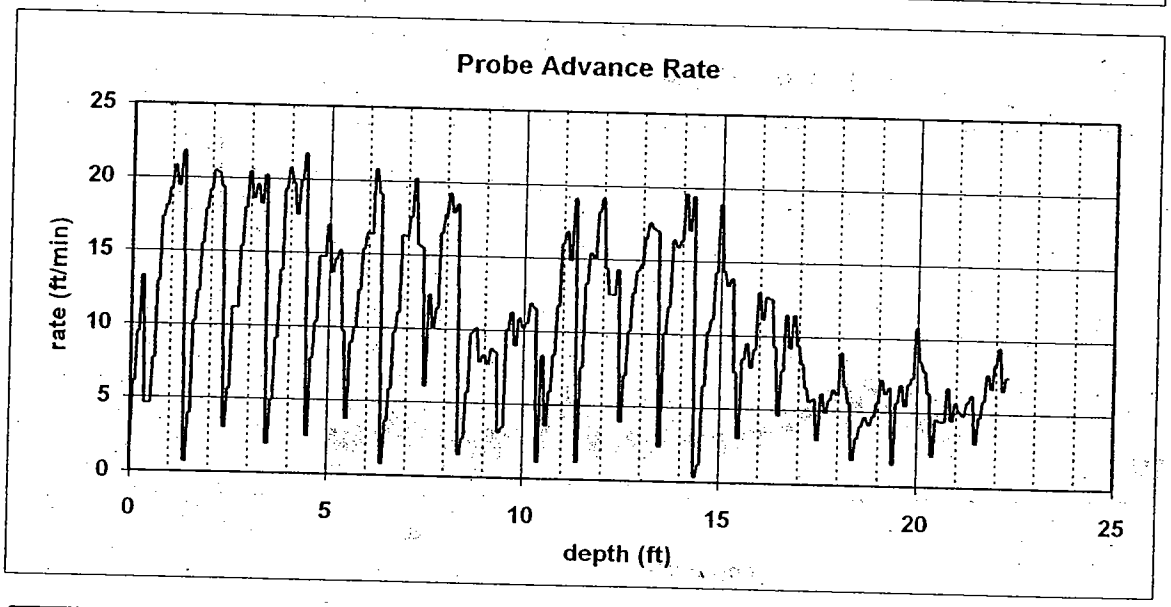

FID Response
FID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

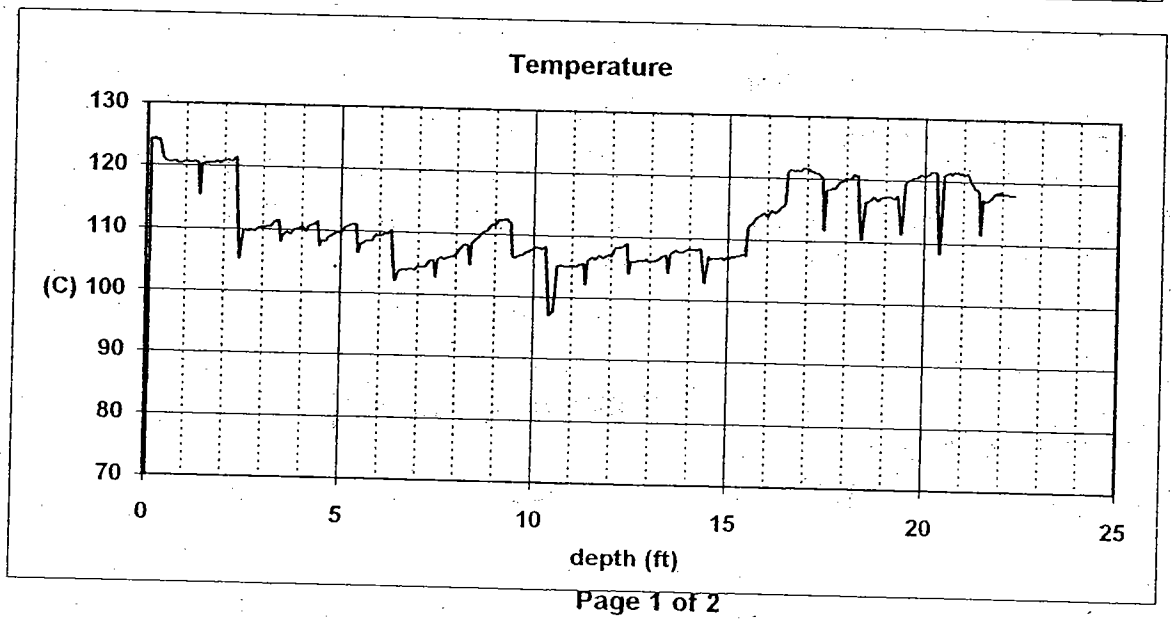

ECD Response
ECD Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)


PID Response
PID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

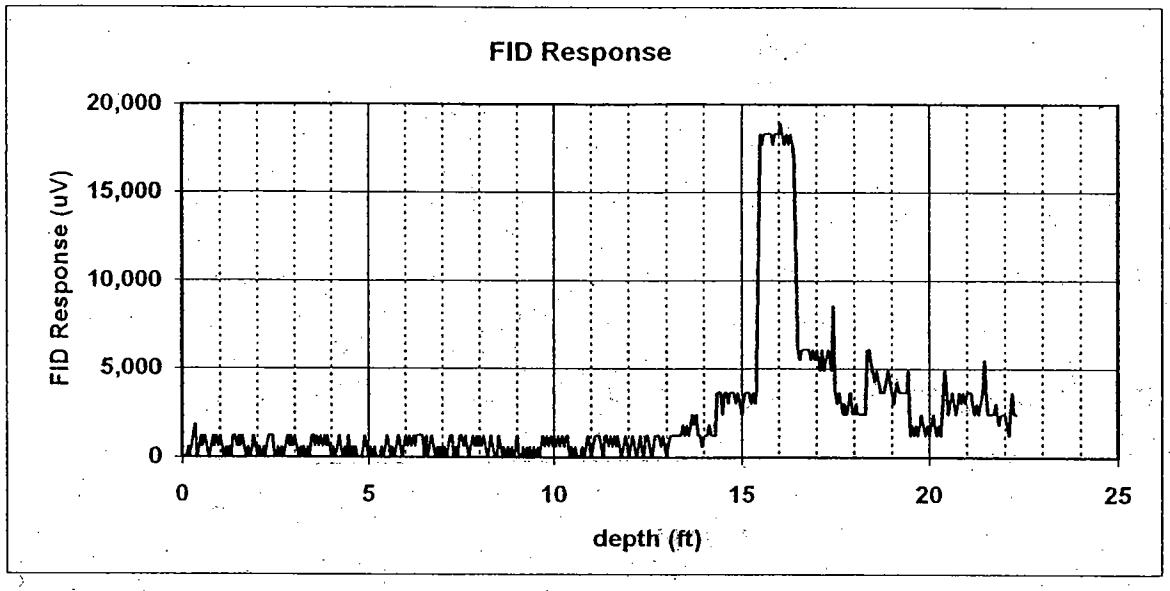
SB-106 (Field)

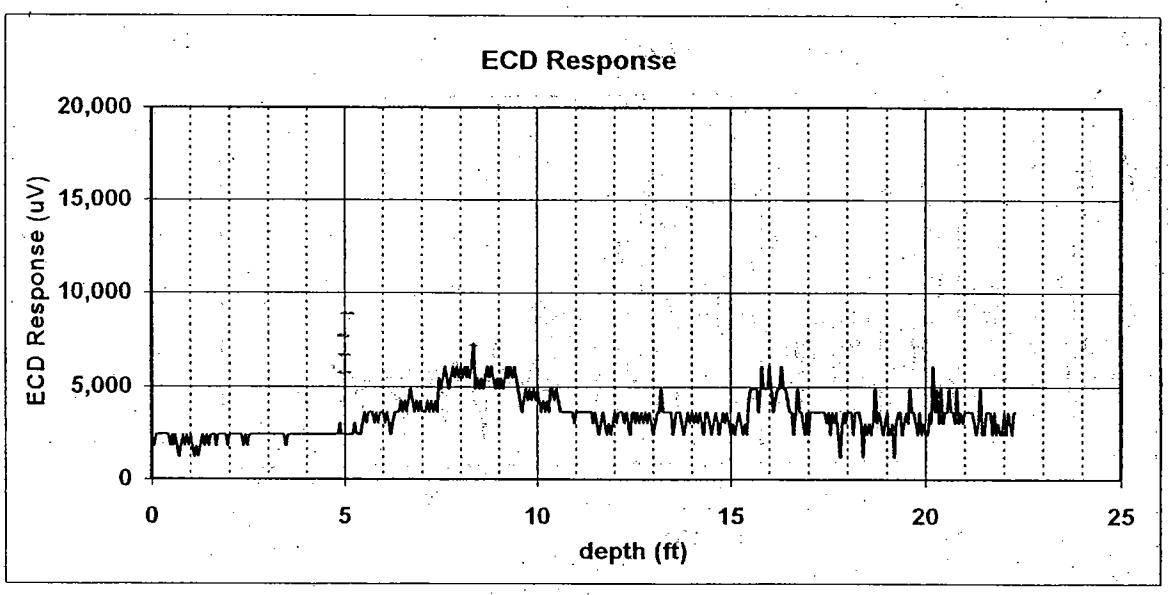

Conductivity
conductivity (mSiemens/m)
240
200
160
120
80
40
0
0
5
10
15
20
25
depth (ft)

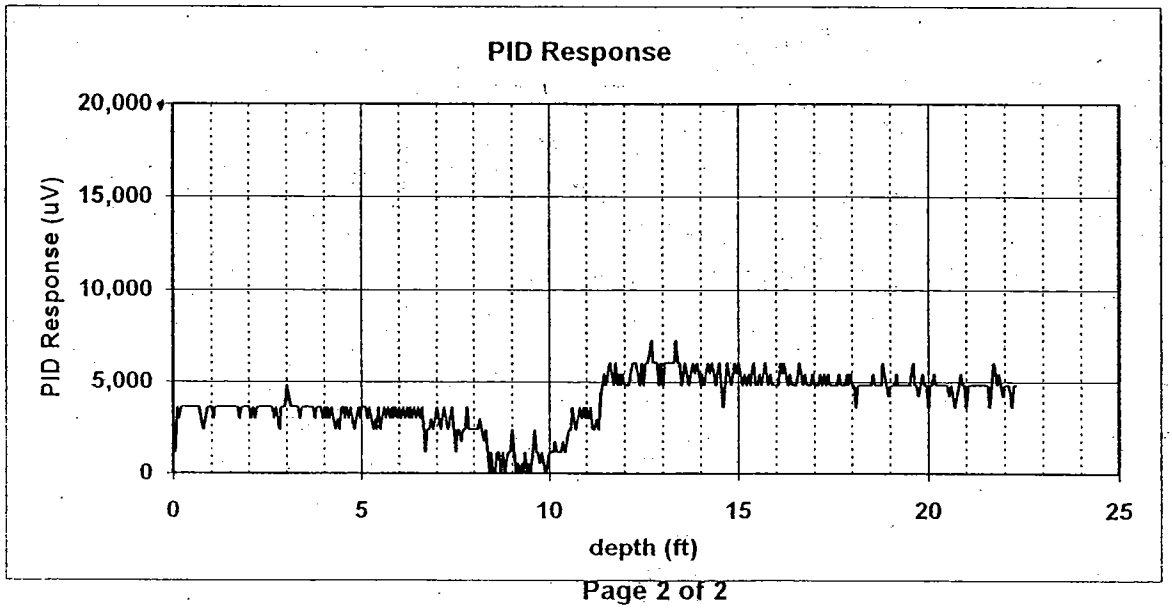

Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)


Temperature
(C)
130
120
110
100
90
80
70
0
5
10
15
20
25
depth (ft)

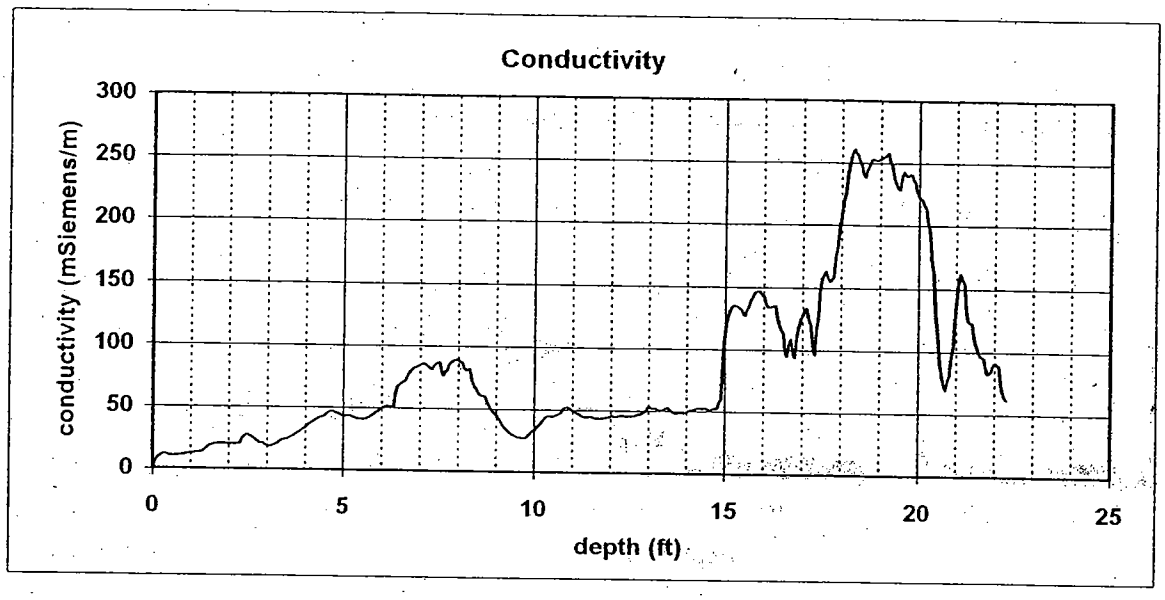
SB-106 (Field)

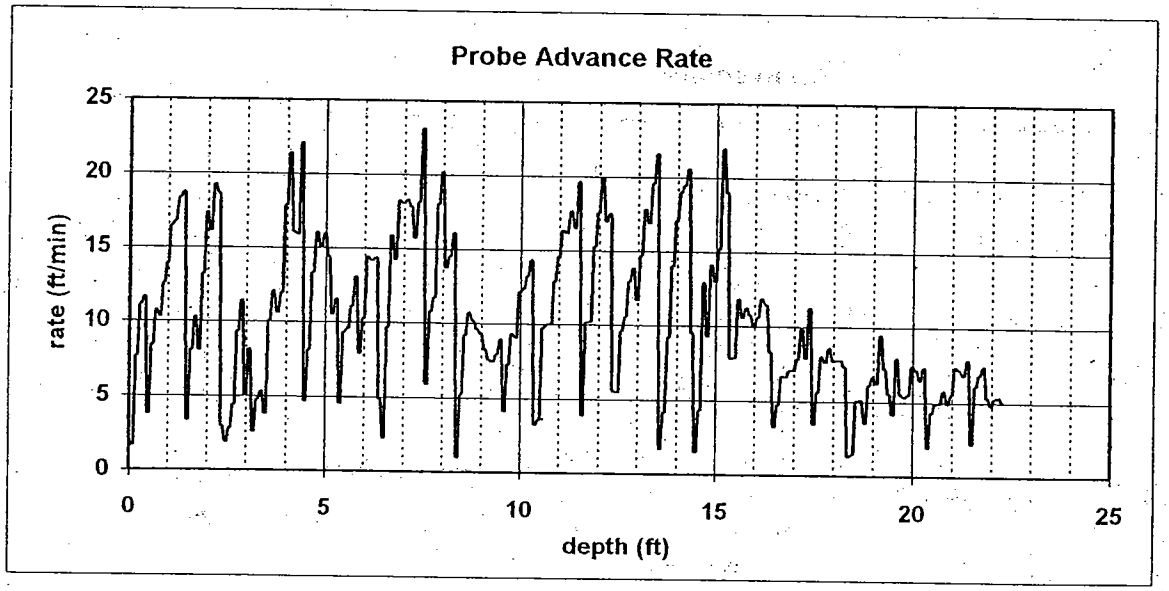

FID Response
FID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

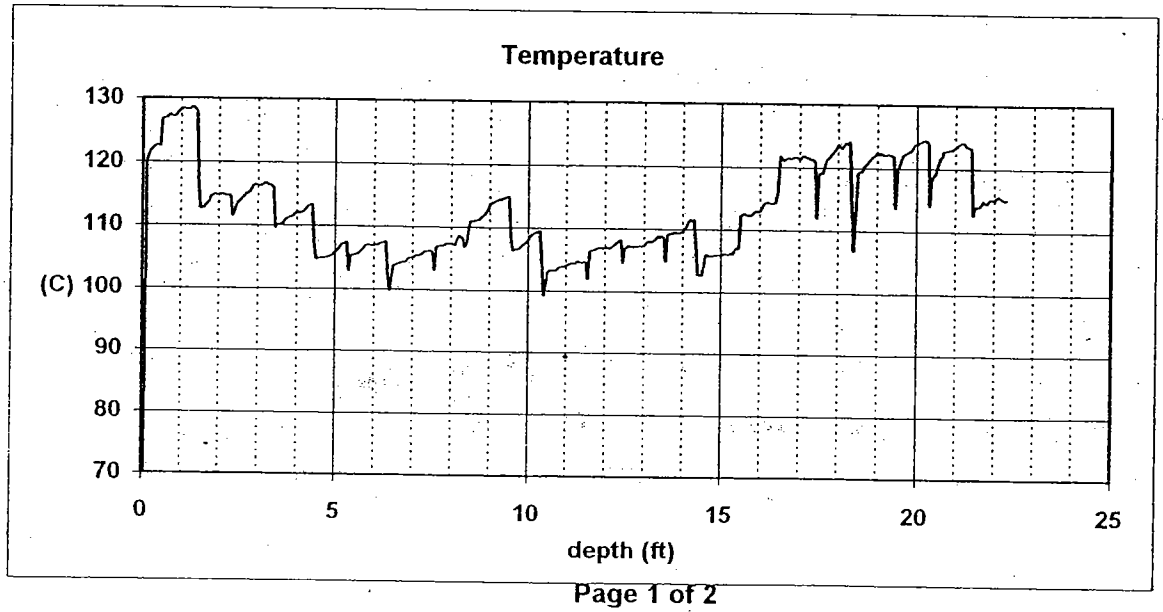

ECD Response
ECD Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)


PID Response
PID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

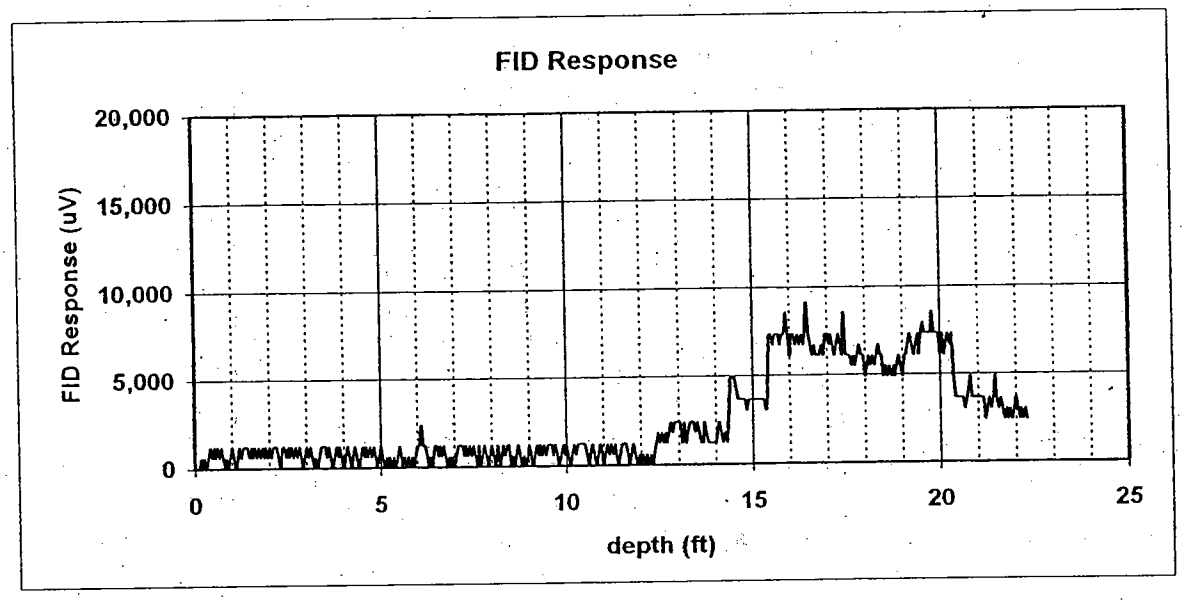
SB-107 (Field)

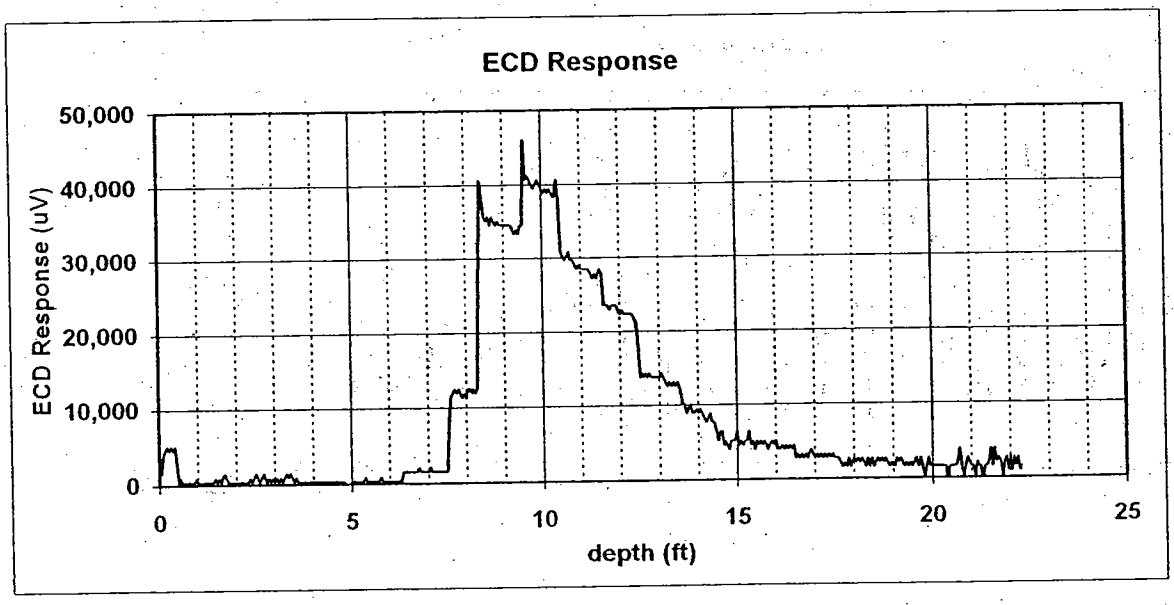

Conductivity
conductivity (mSiemens/m)
300
250
200
150
100
50
0
0
5
10
15
20
25
depth (ft)

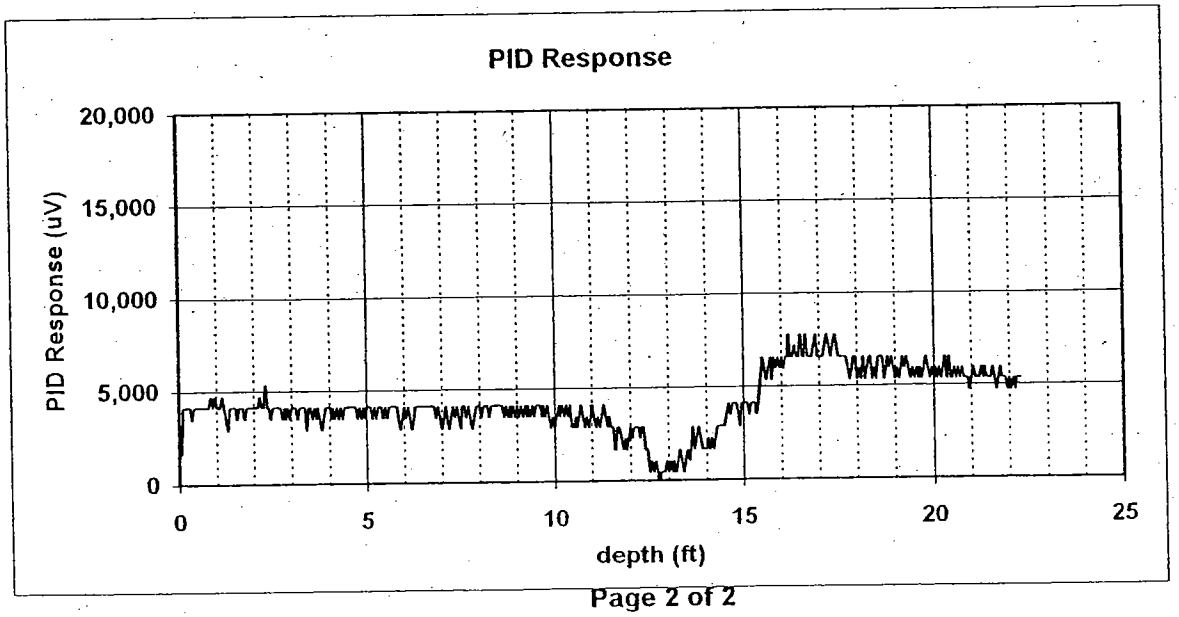

Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)

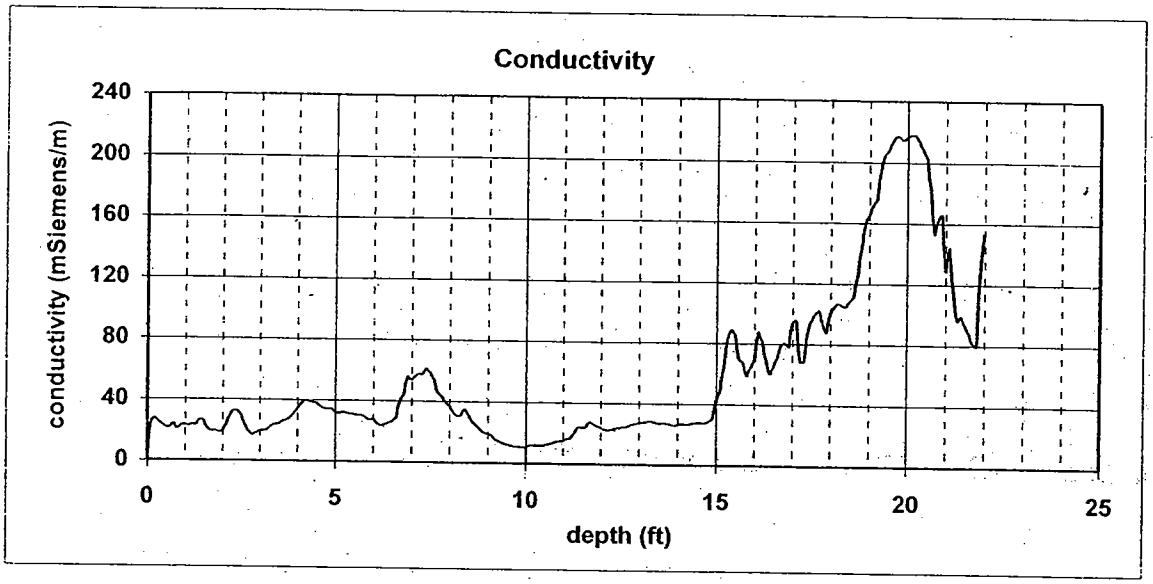

Temperature
(C)
130
120
110
100
90
80
70
0
5
10
15
20
25
depth (ft)

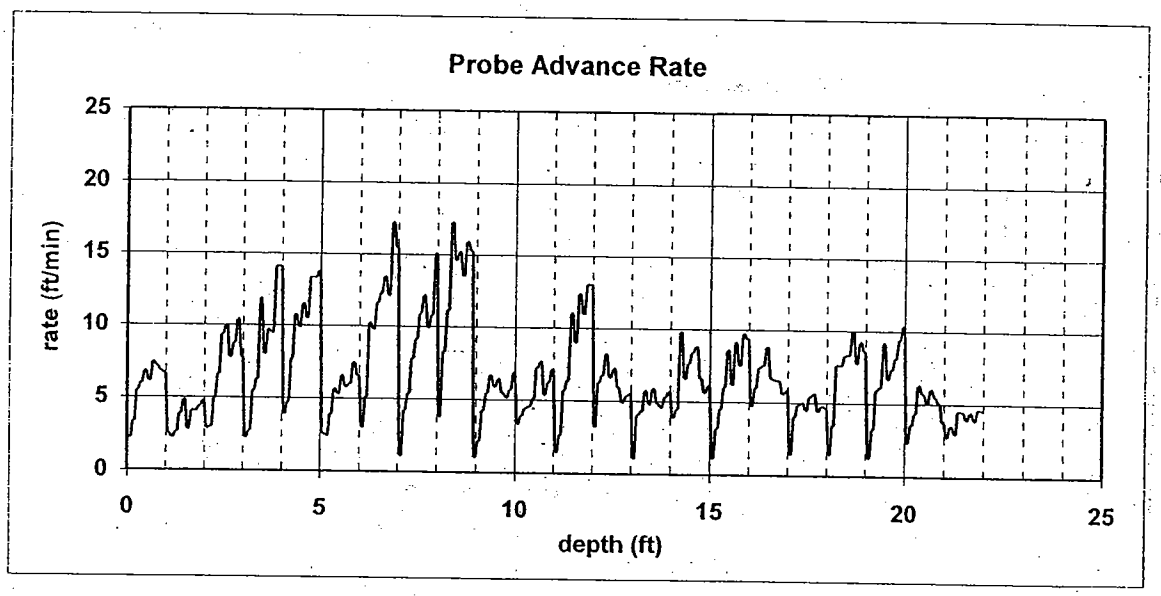
SB-107 (Field)

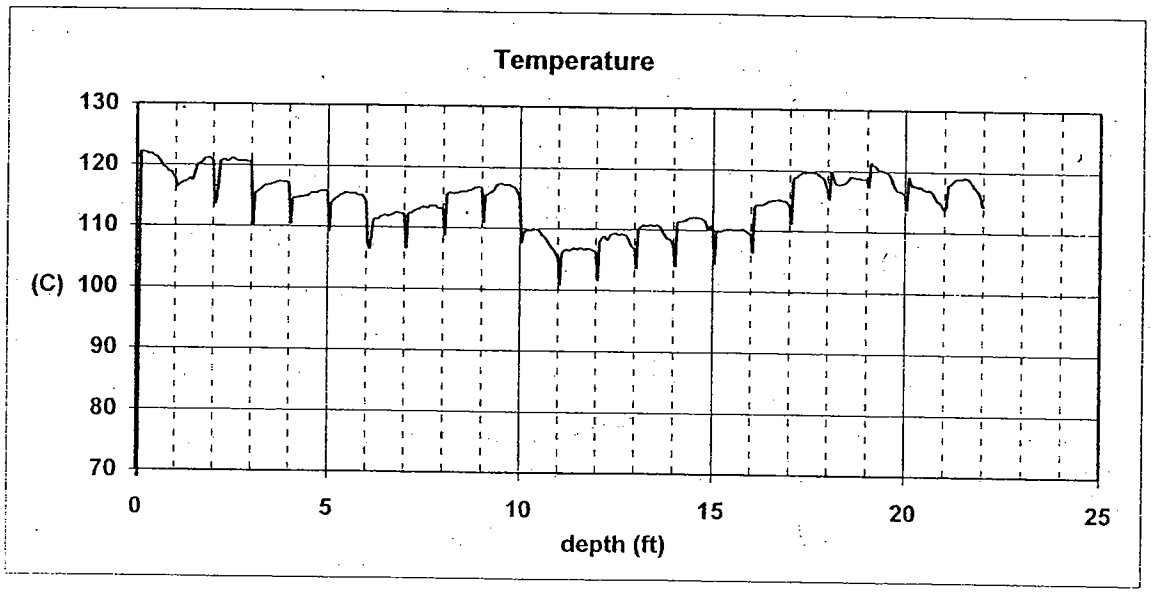

FID Response
FID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

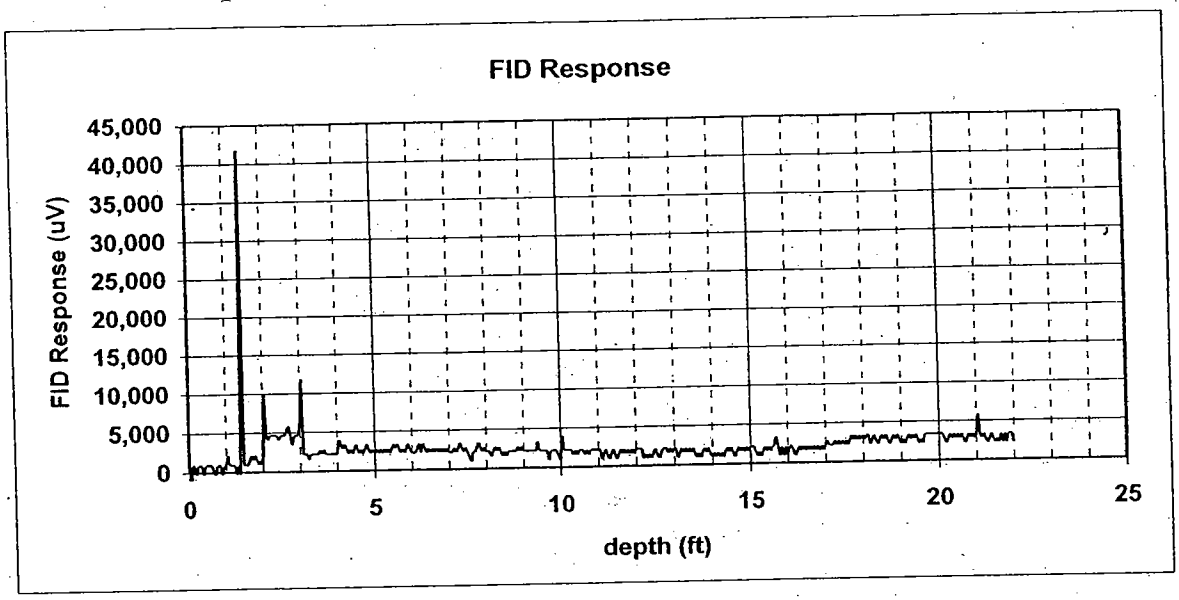

ECD Response
ECD Response (uV)
50,000
40,000
30,000
20,000
10,000
0
0
5
10
15
20
25
depth (ft)

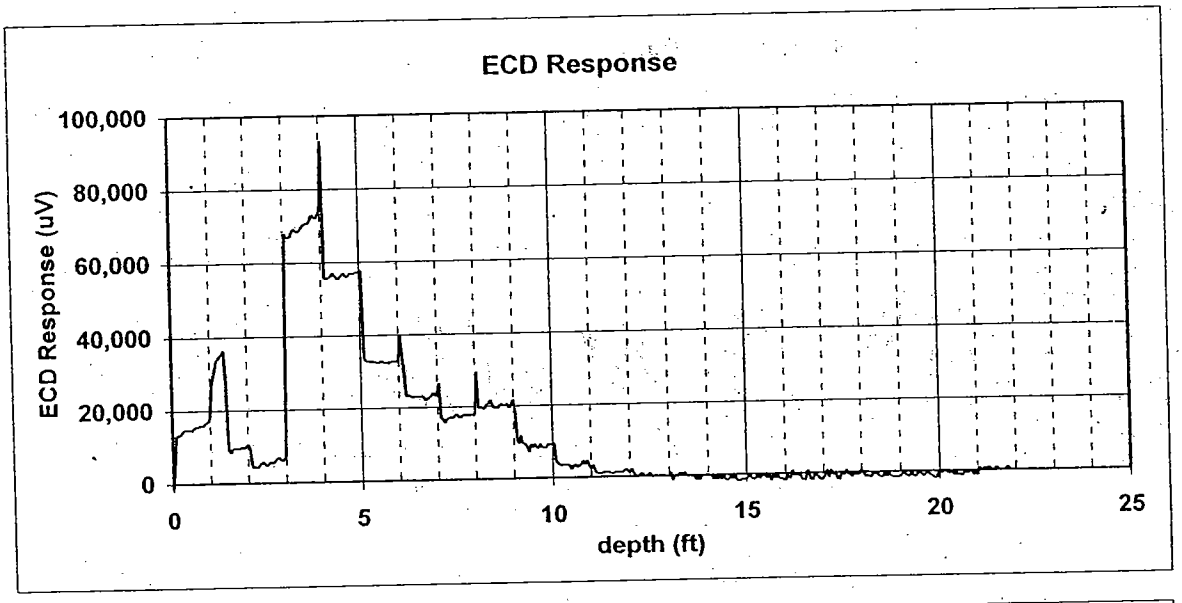

PID Response
PID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

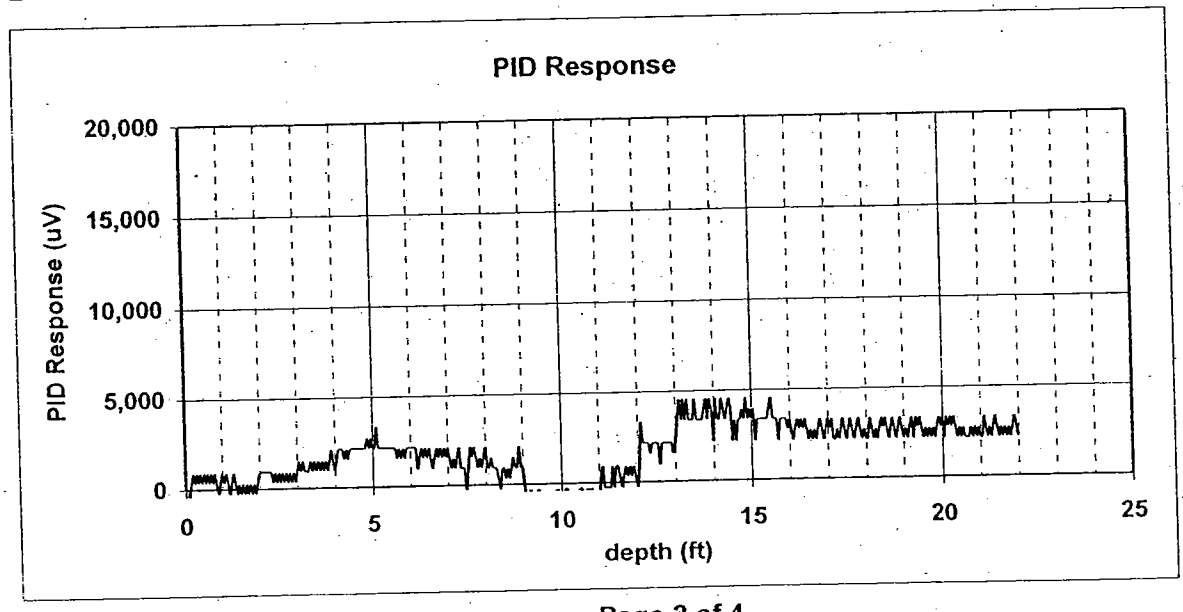

Conductivity
conductivity (mSiemens/m)
240
200
160
120
80
40
0
0
5
10
15
20
25
depth (ft)

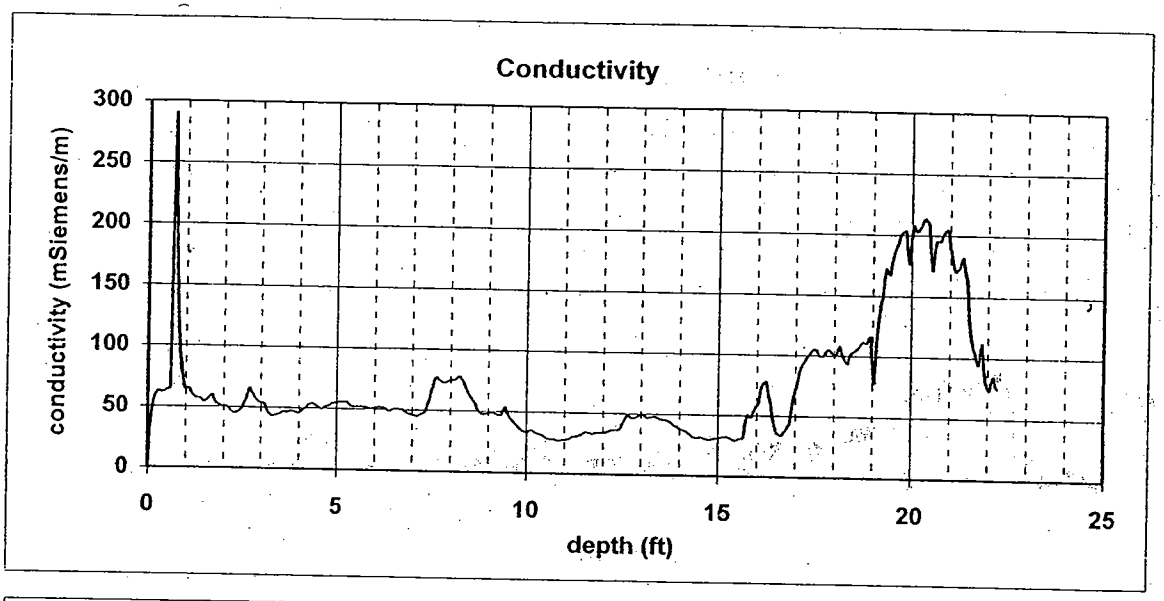

Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)

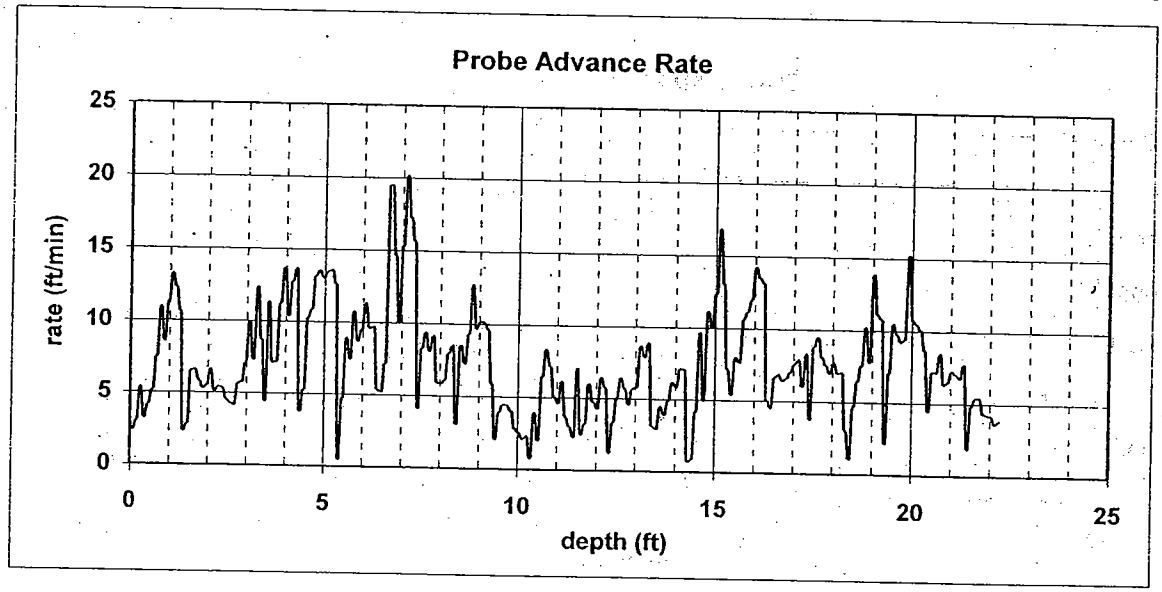

Temperature
(C)
130
120
110
100
90
80
70
0
5
10
15
20
25
depth (ft)

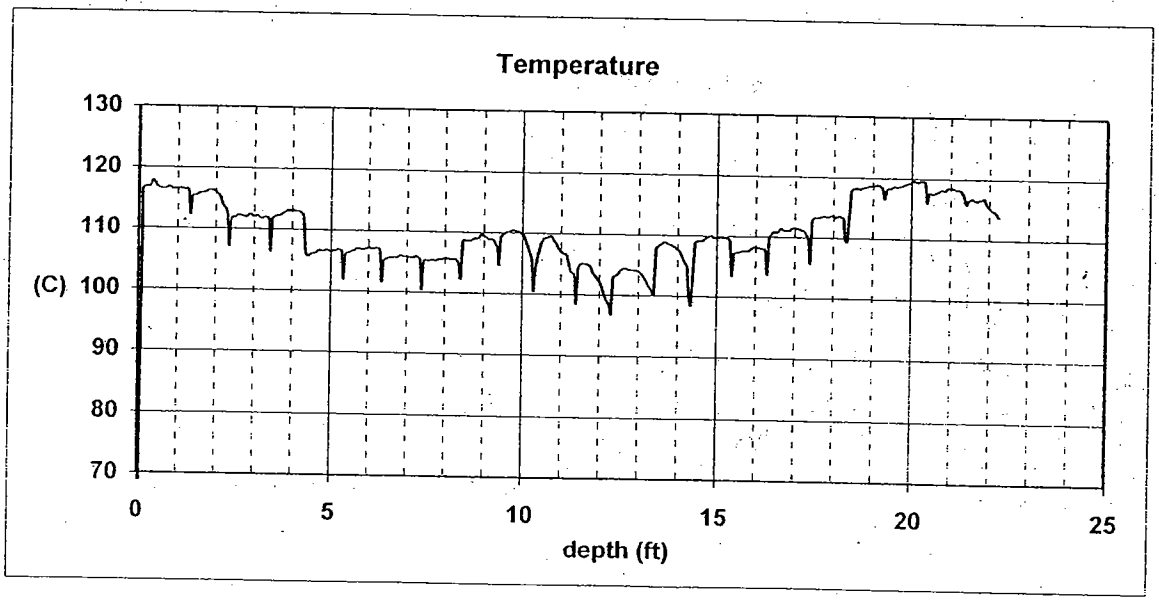

FID Response
FID Response (uV)
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

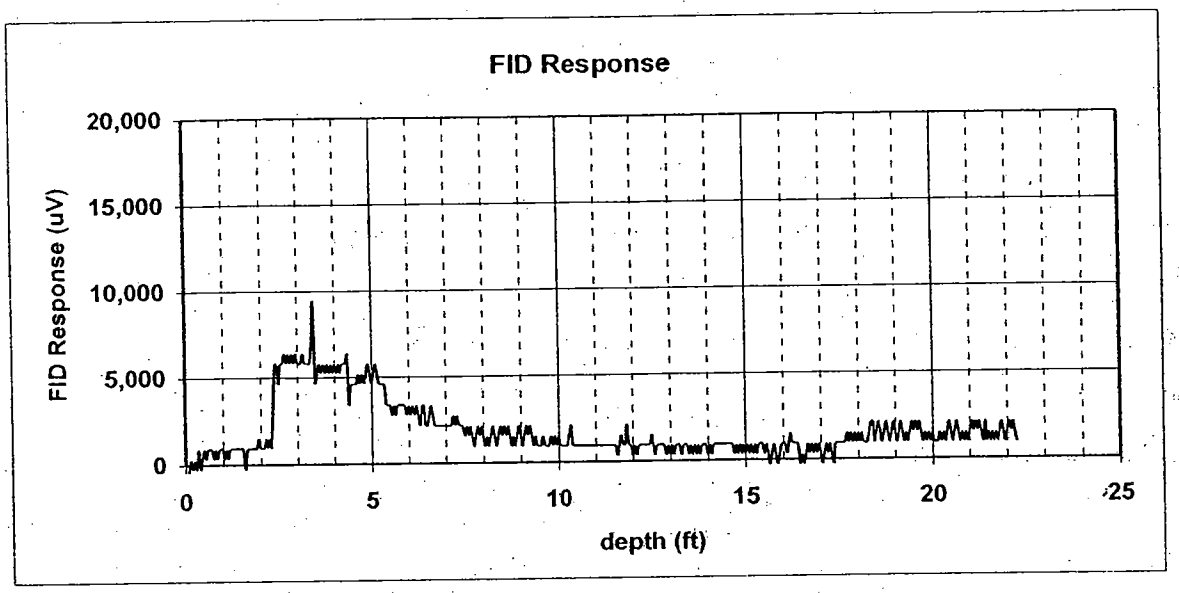

ECD Response
ECD Response (uV)
100,000
80,000
60,000
40,000
20,000
0
0
5
10
15
20
25
depth (ft)

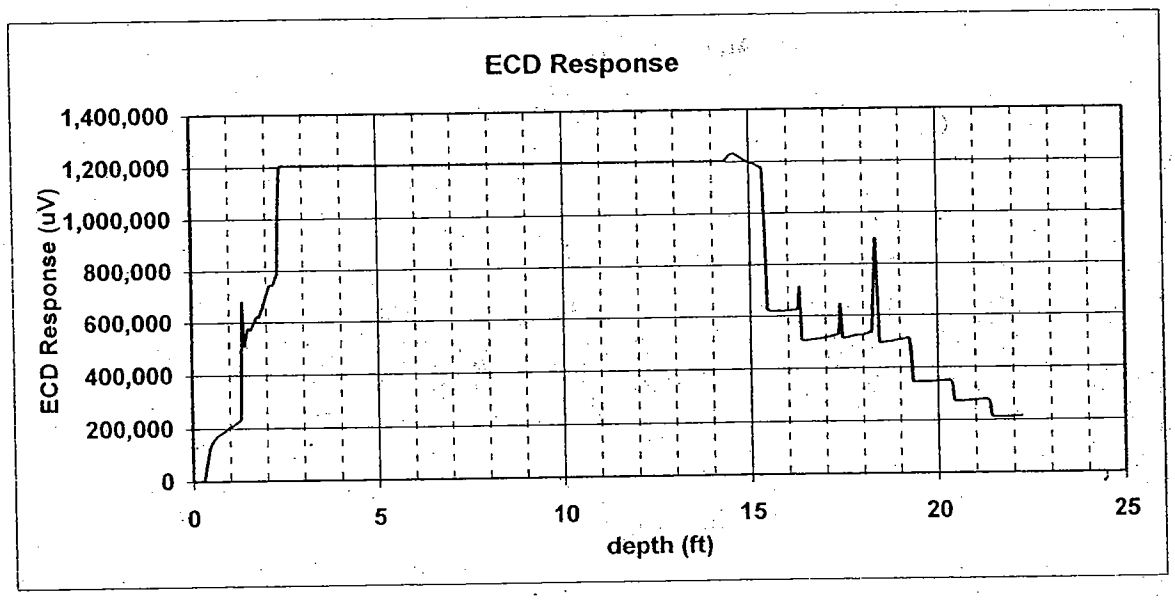

PID Response
PID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

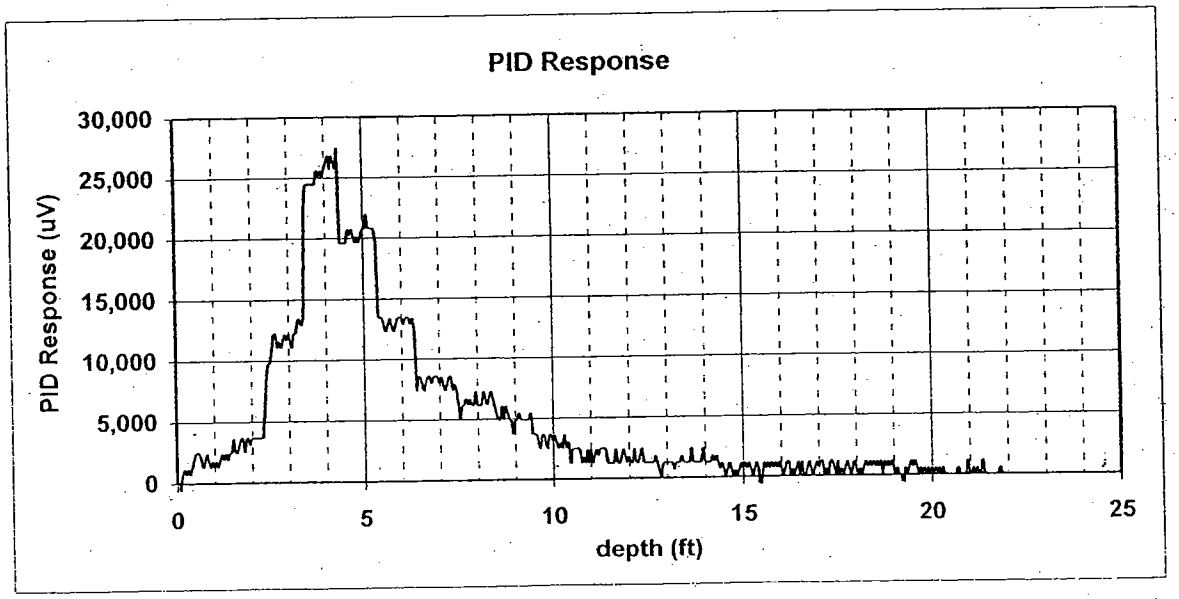

Conductivity
conductivity (mSiemens/m)
300
250
200
150
100
50
0
0
5
10
15
20
25
depth (ft)


Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)

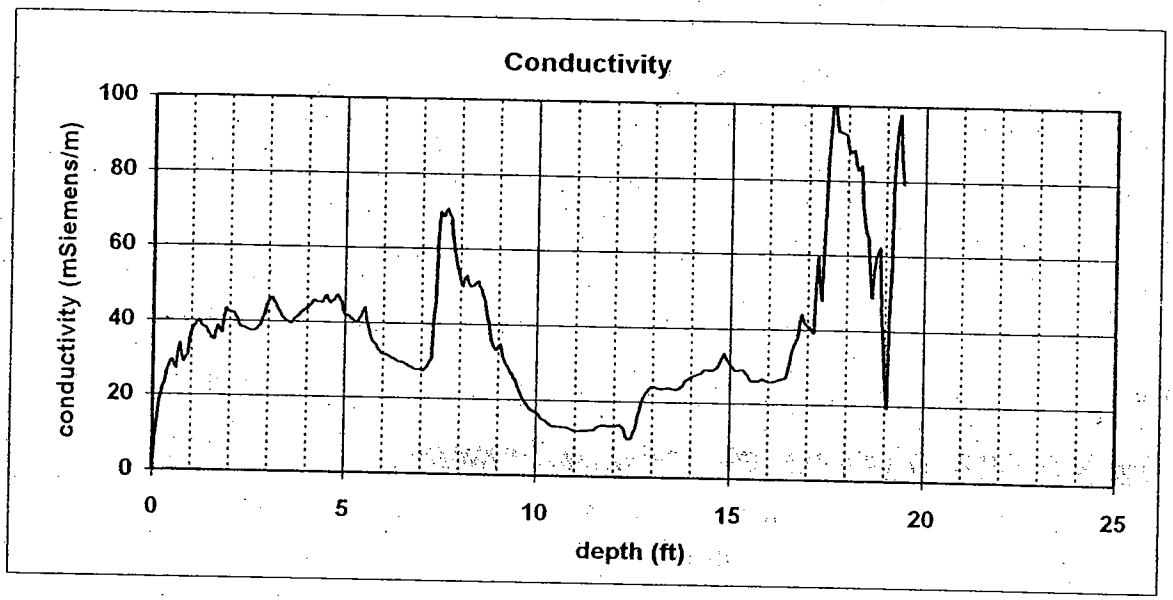

Temperature
(C)
130
120
110
100
90
80
70
0
5
10
15
20
25
depth (ft)

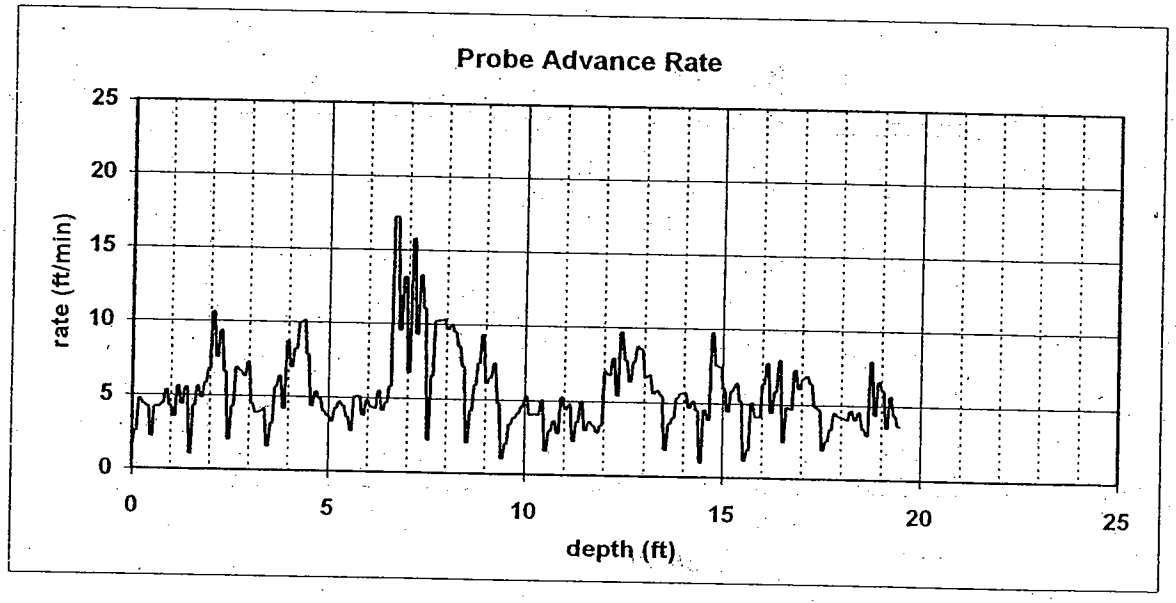

FID Response
FID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

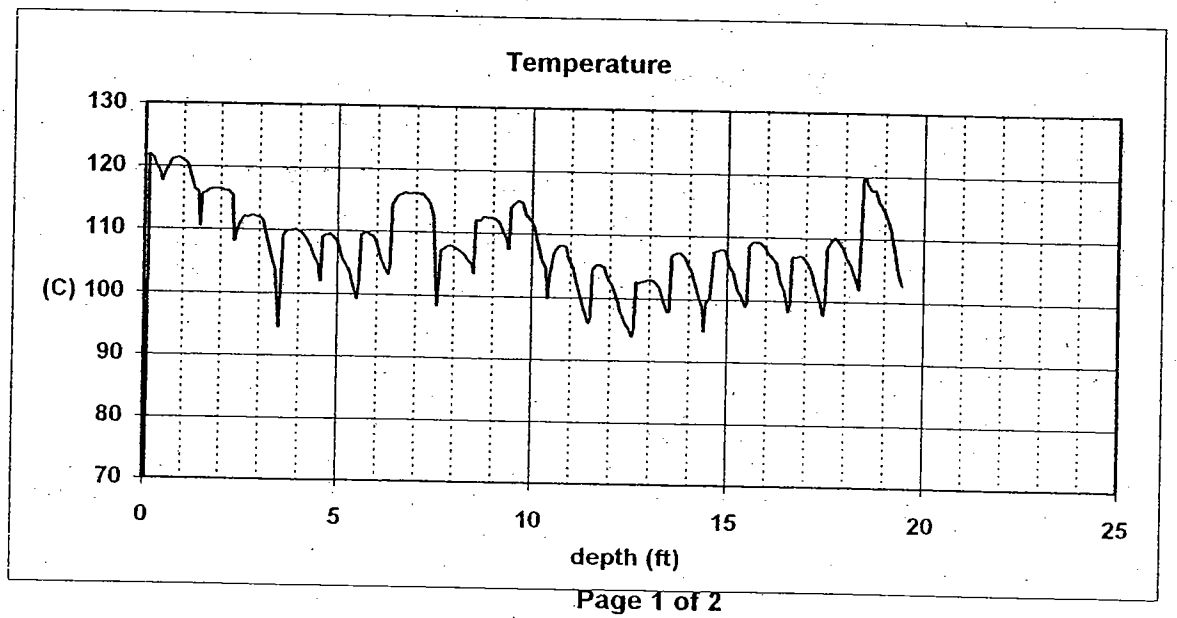

ECD Response
ECD Response (uV)
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
0
5
10
15
20
25
depth (ft)


PID Response
PID Response (uV)
30,000
25,000
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

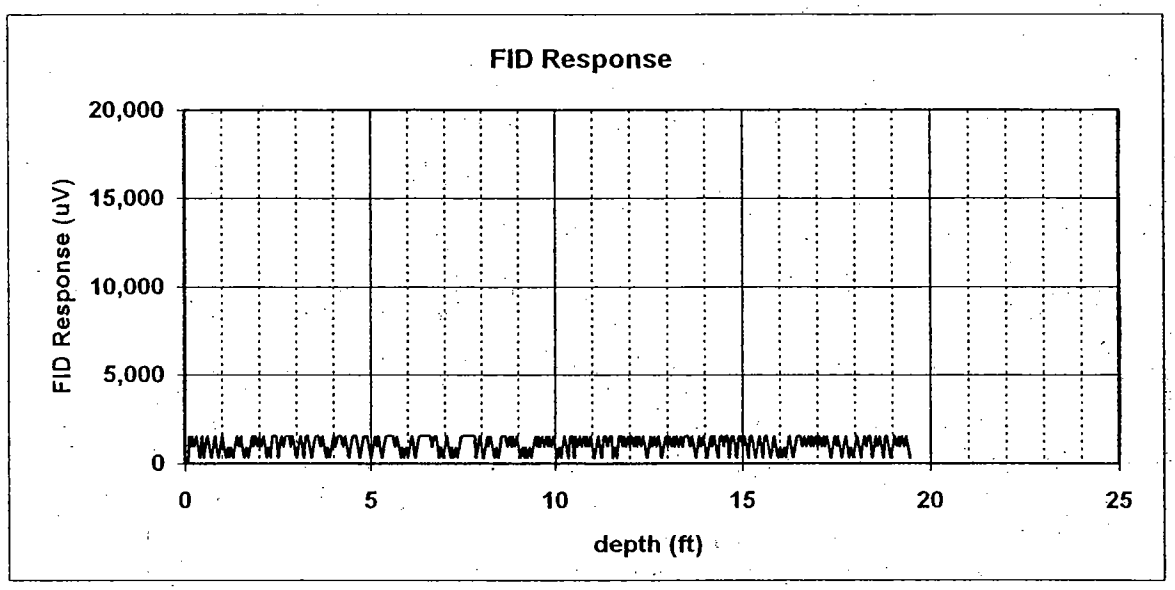
SB-111 (Field)

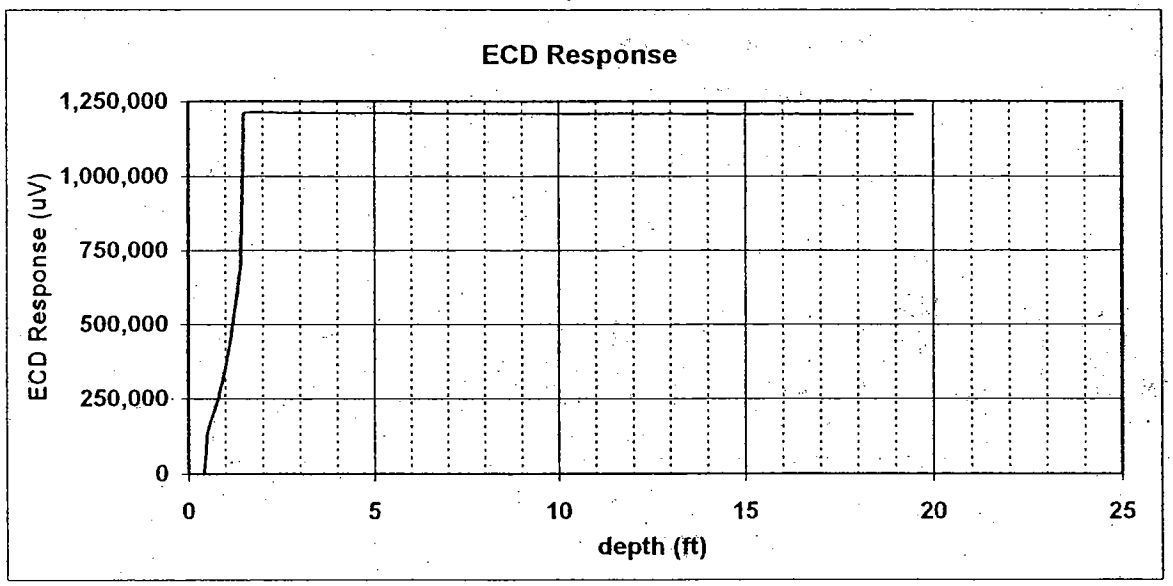

Conductivity
conductivity (mSiemens/m)
100
80
60
40
20
0
0
5
10
15
20
25
depth (ft)

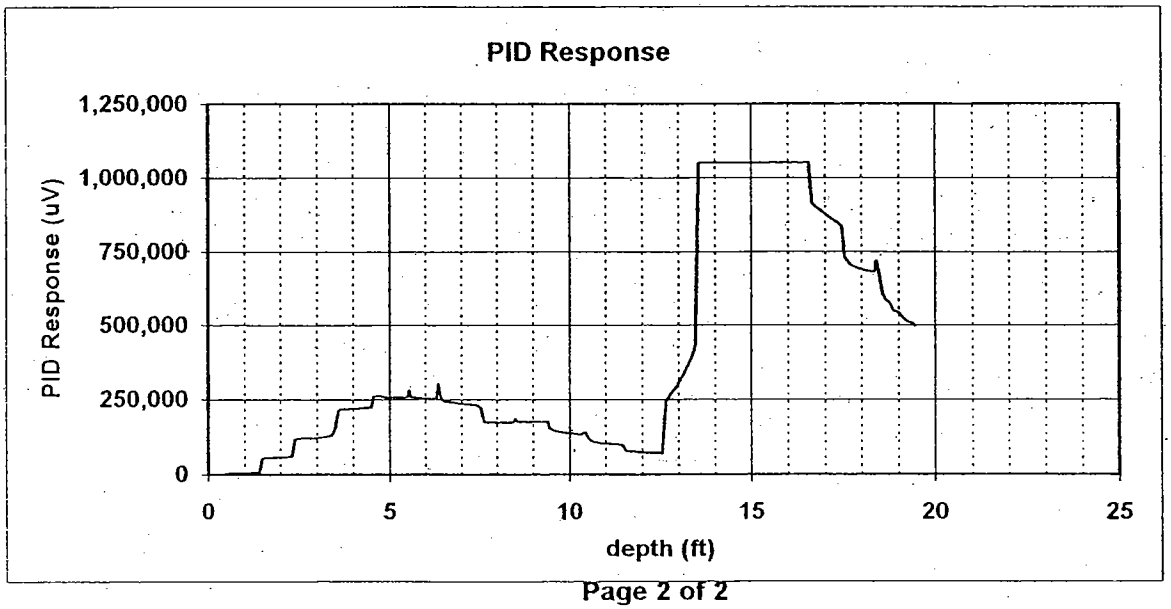

Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)

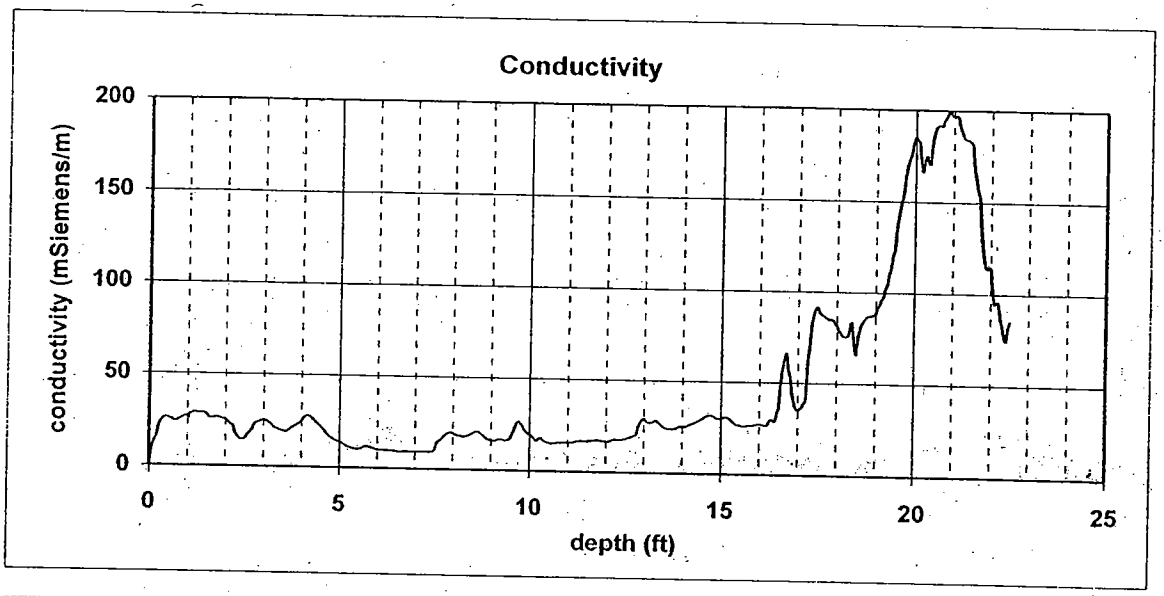

Temperature
130
120
110
(C) 100
90
80
70
0
5
10
15
20
25
depth (ft)

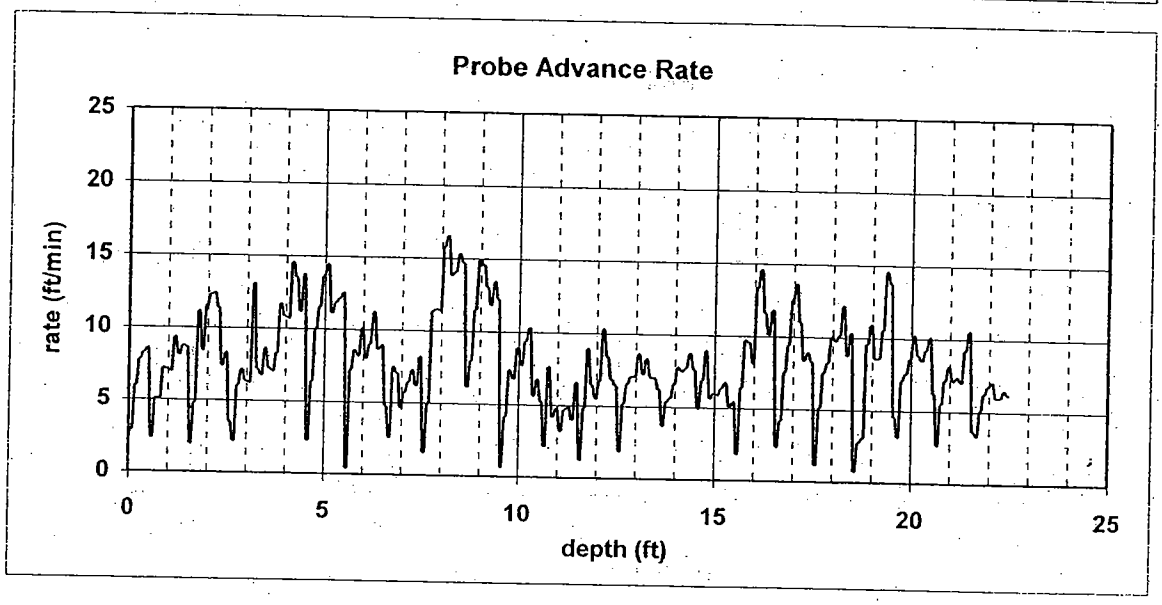
SB-111 (Field)

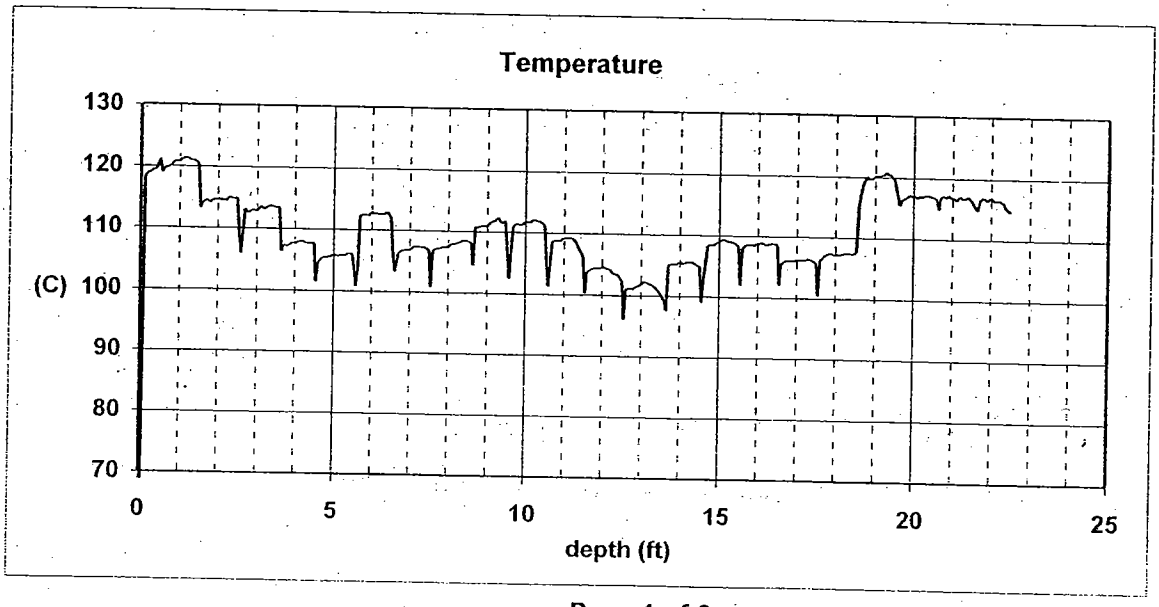

FID Response
FID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

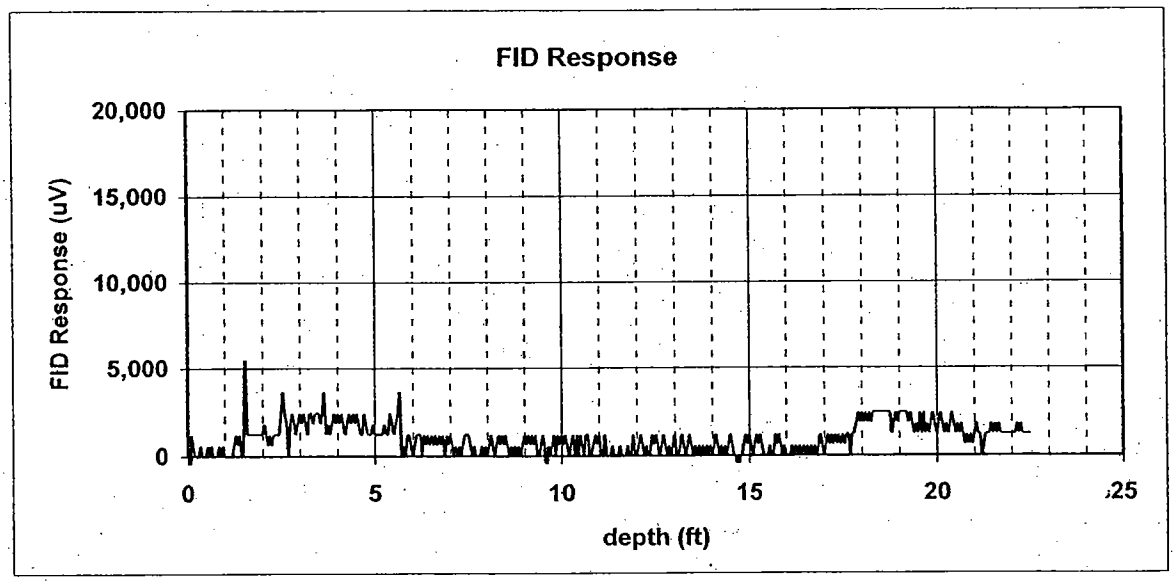

ECD Response
ECD Response (uV)
1,250,000
1,000,000
750,000
500,000
250,000
0
0
5
10
15
20
25
depth (ft)

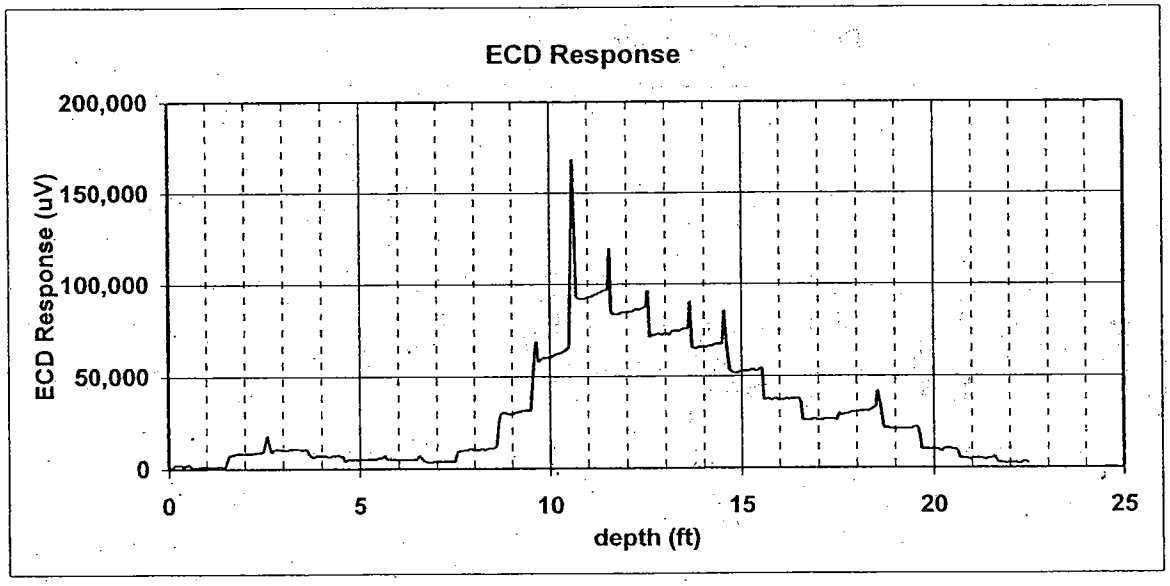

PID Response
PID Response (uV)
1,250,000
1,000,000
750,000
500,000
250,000
0
0
5
10
15
20
25
depth (ft)

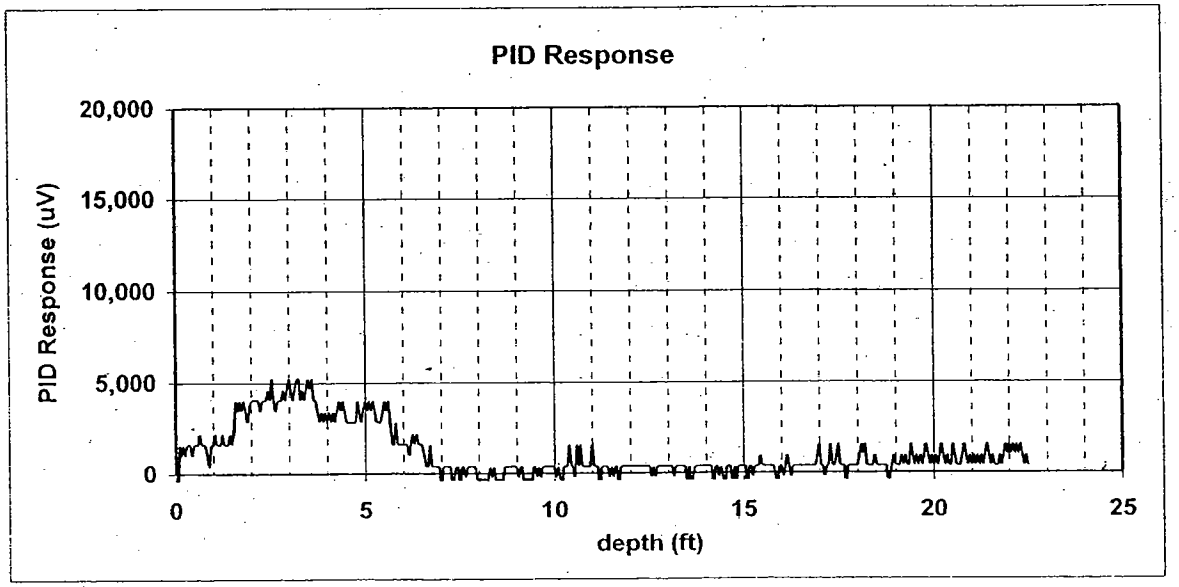

Conductivity
conductivity (mSiemens/m)
200
150
100
50
0
0
5
10
15
20
25
depth (ft)


Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)

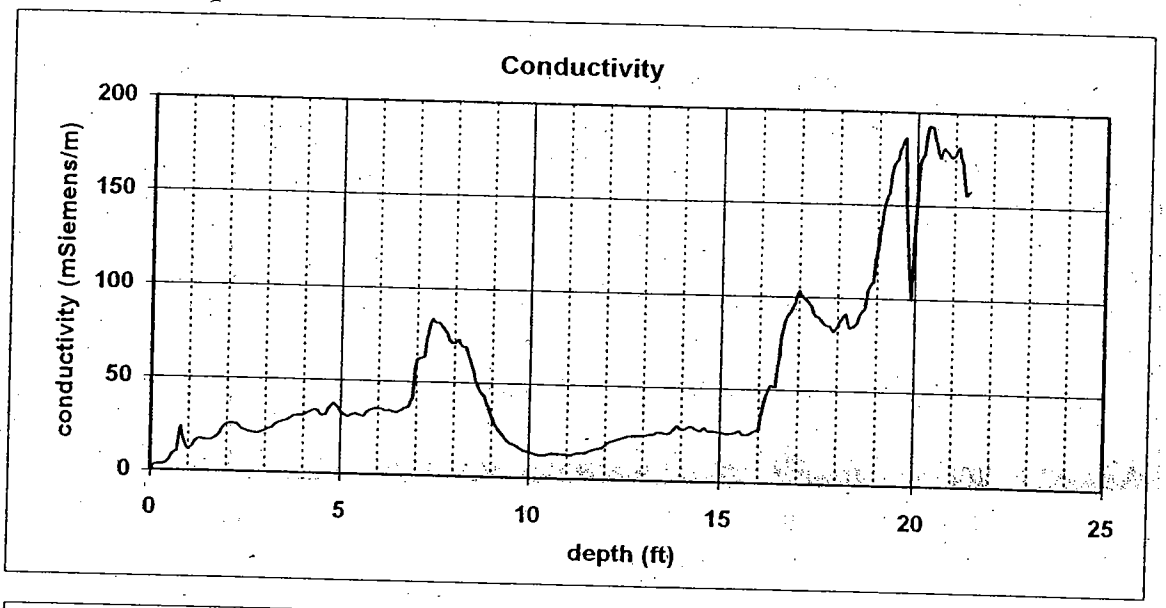

Temperature
(C)
130
120
110
100
90
80
70
0
5
10
15
20
25
depth (ft)

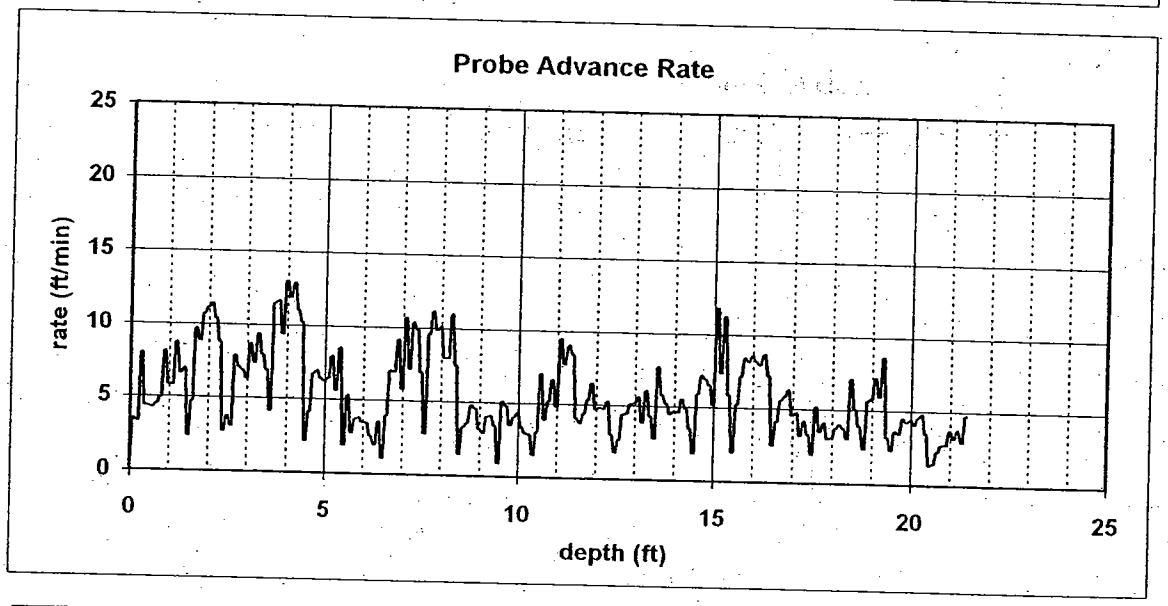

FID Response
FID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

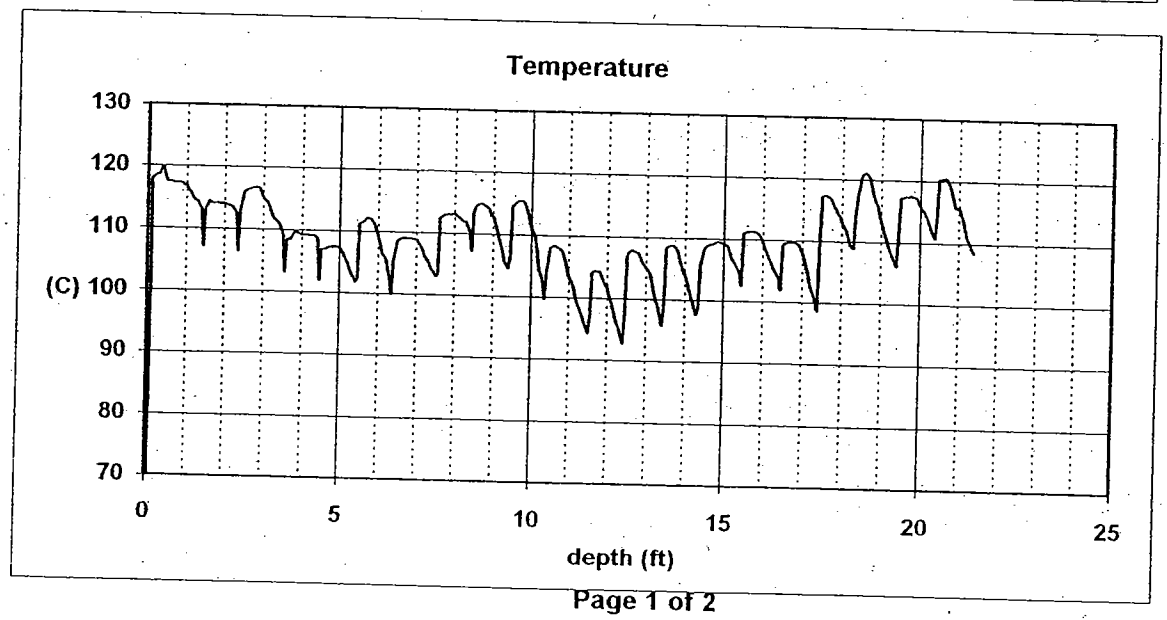

ECD Response
ECD Response (uV)
200,000
150,000
100,000
50,000
0
0
5
10
15
20
25
depth (ft)


PID Response
PID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

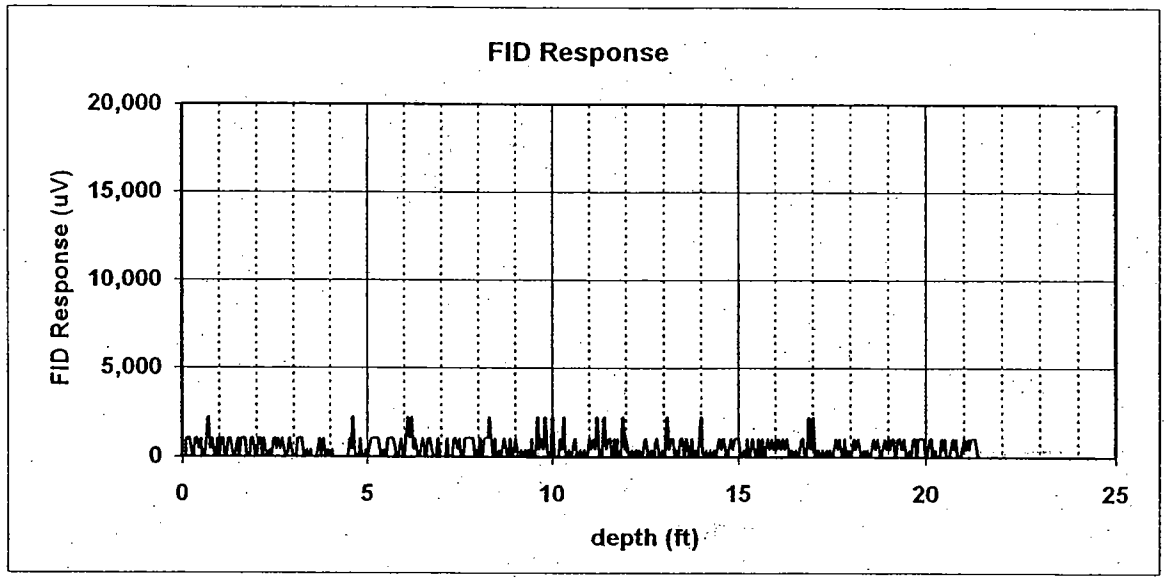
SB-114 (Field)

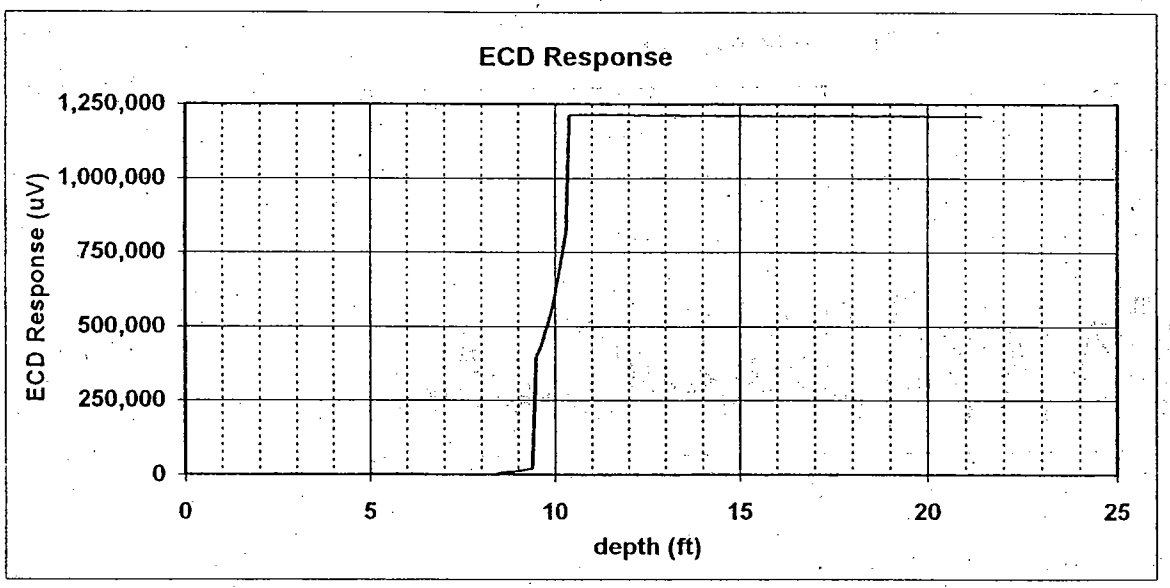

Conductivity
conductivity (mSiemens/m)
200
150
100
50
0
0
5
10
15
20
25
depth (ft)

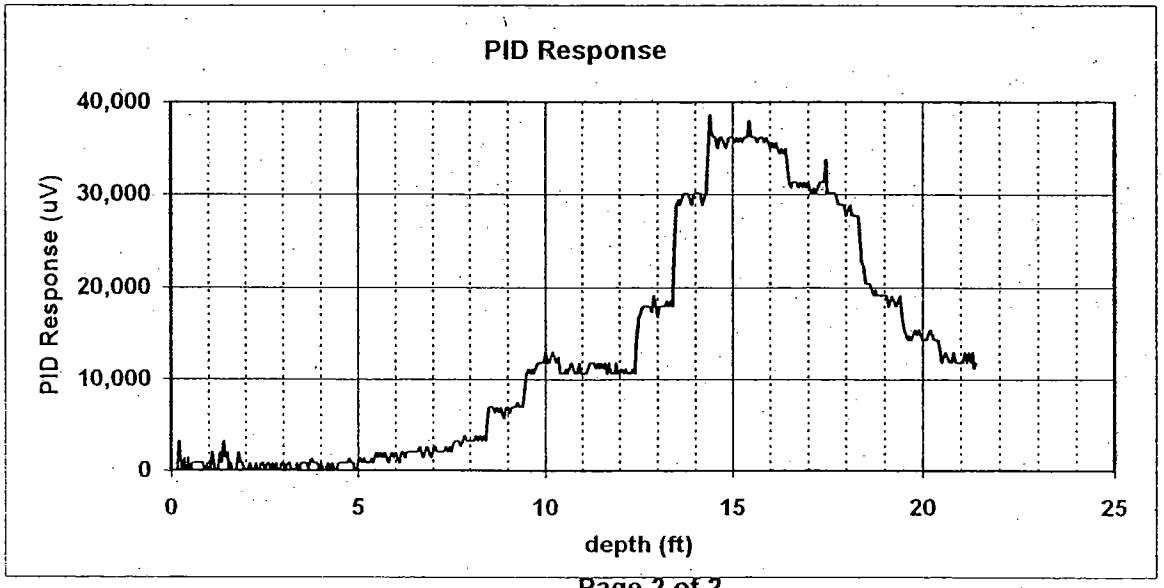

Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)


Temperature
(C)
130
120
110
100
90
80
70
0
5
10
15
20
25
depth (ft)

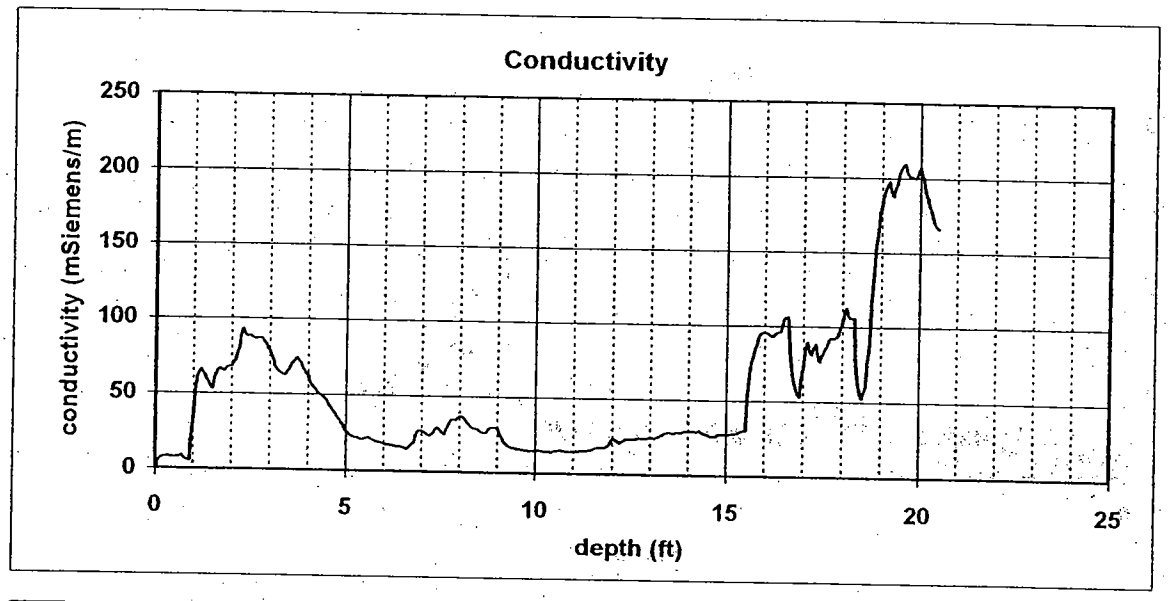
SB-114 (Field)

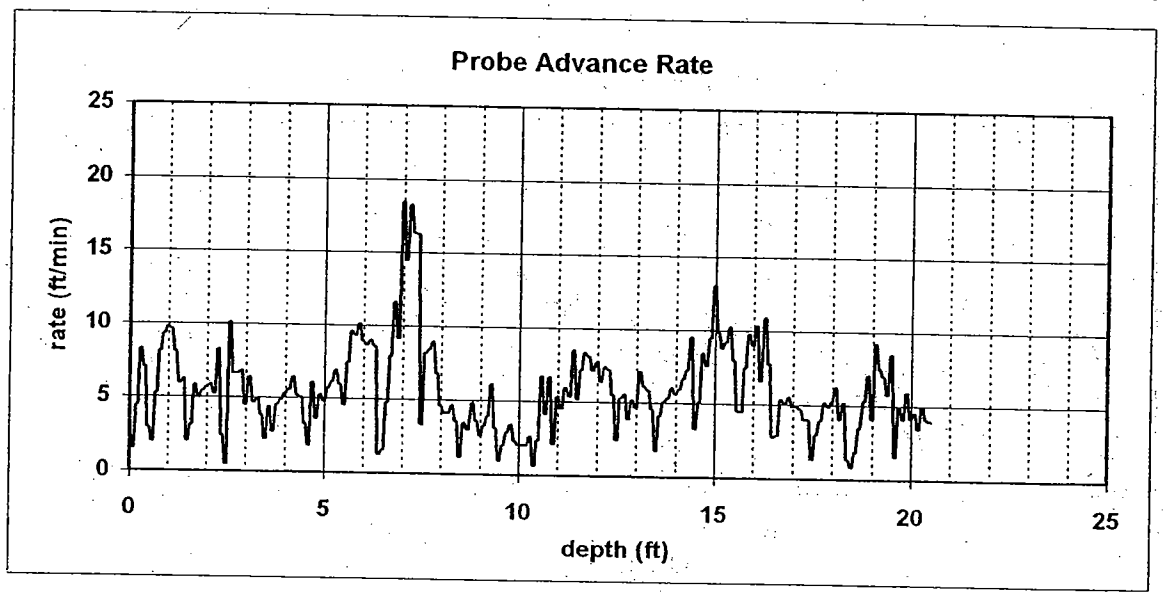

FID Response
FID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

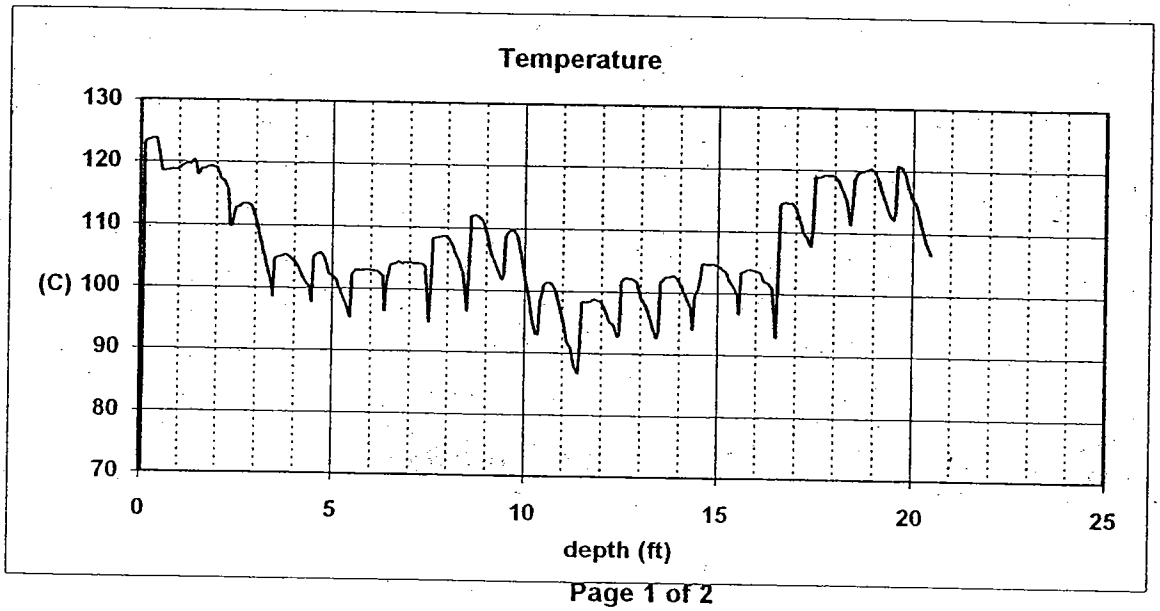

ECD Response
ECD Response (uV)
1,250,000
1,000,000
750,000
500,000
250,000
0
0
5
10
15
20
25
depth (ft)


PID Response
PID Response (uV)
40,000
30,000
20,000
10,000
0
0
5
10
15
20
25
depth (ft)

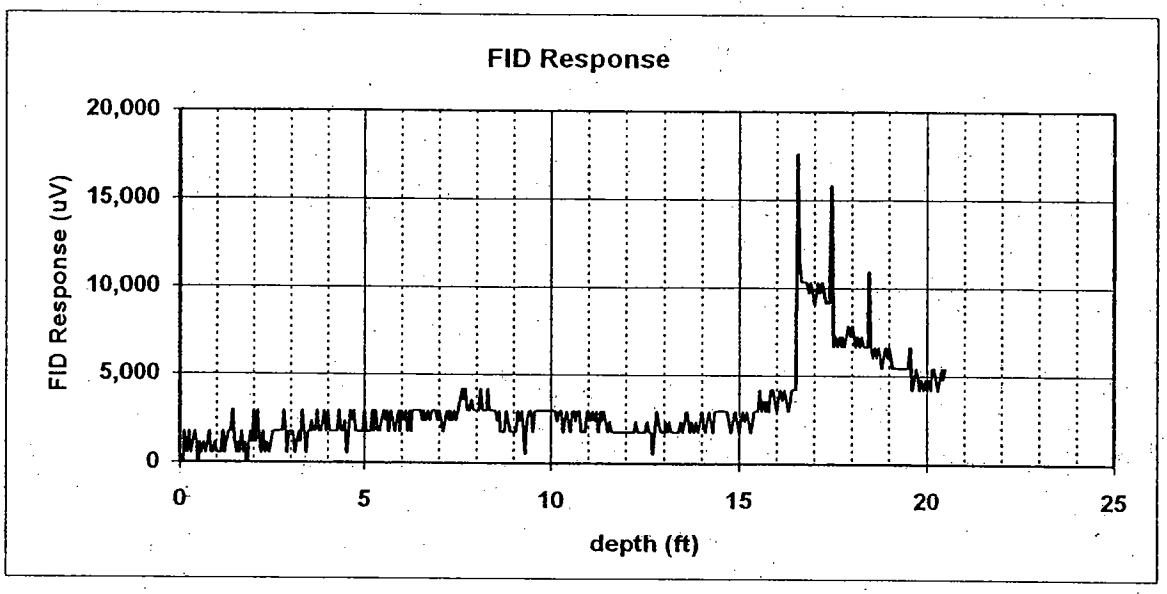
SB-116 (Field)

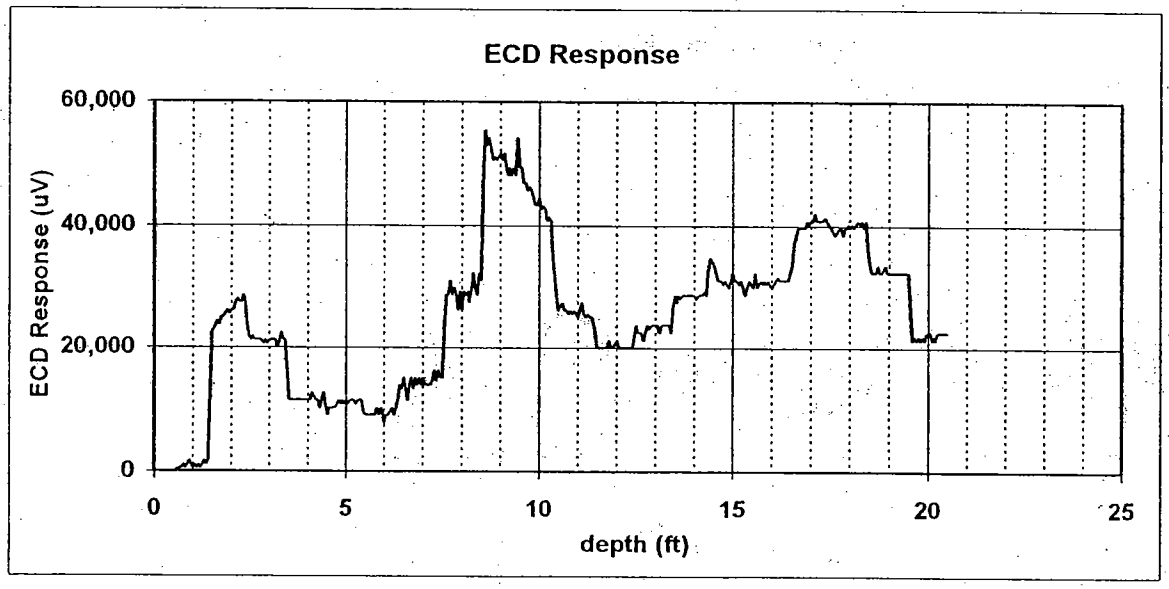

Conductivity
conductivity (mSiemens/m)
250
200
150
100
50
0
0
5
10
15
20
25
depth (ft)

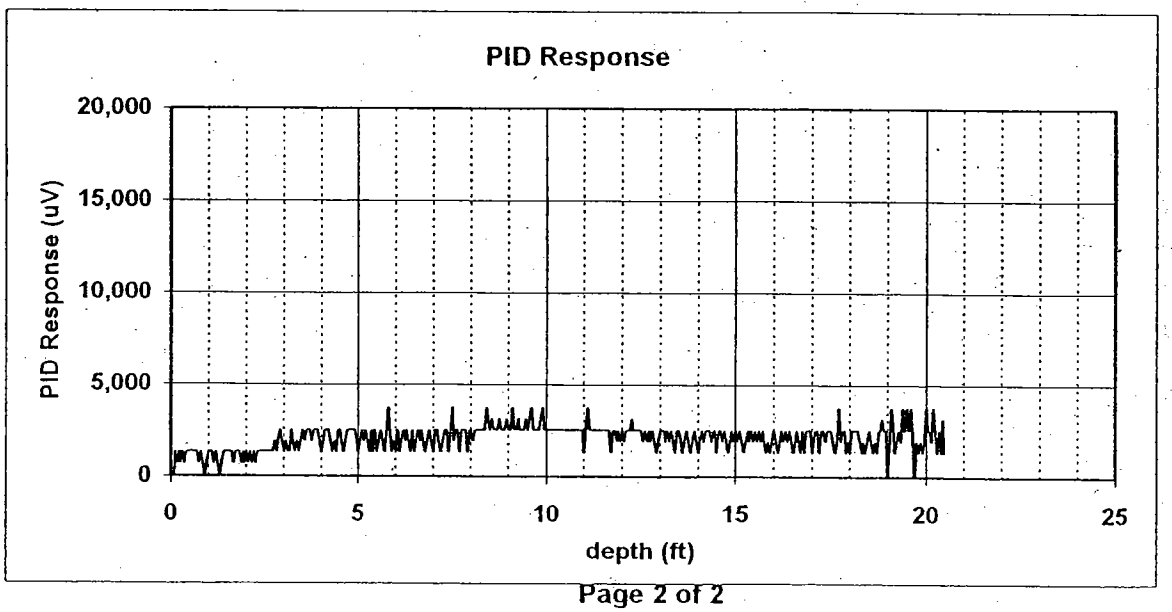

Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)


Temperature
130
120
110
(C) 100
90
80
70
0
5
10
15
20
25
depth (ft)

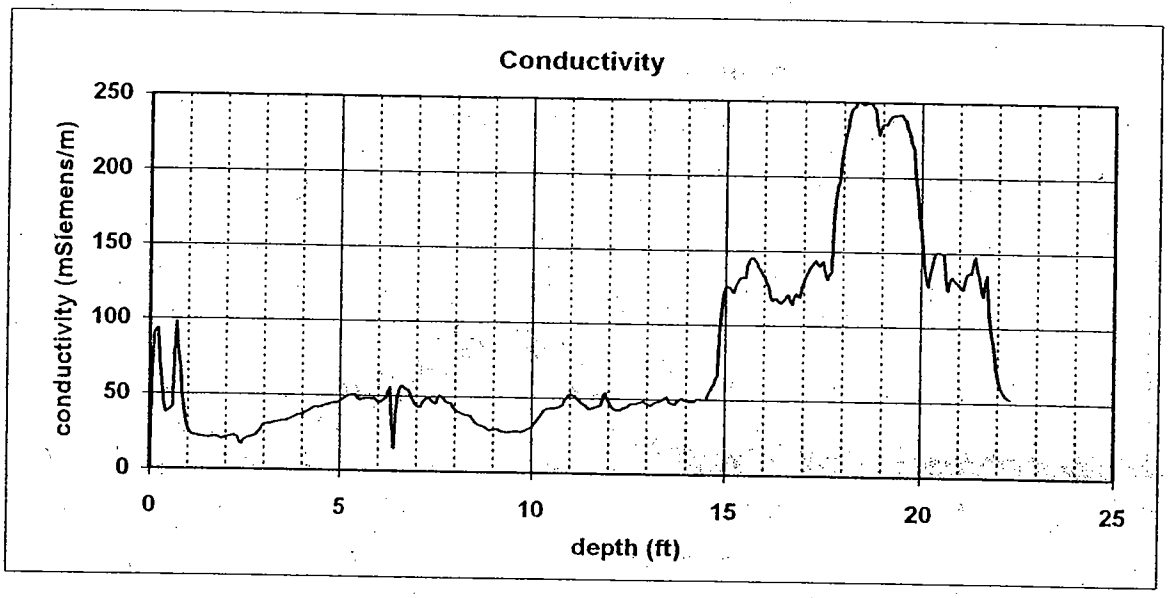
SB-116 (Field)

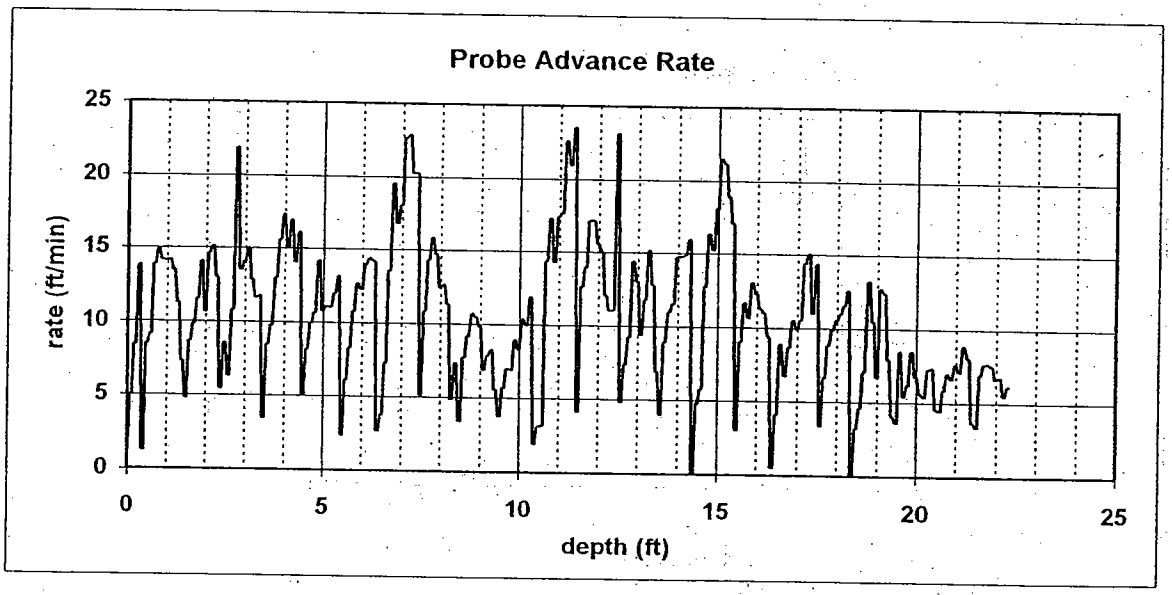

FID Response
FID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

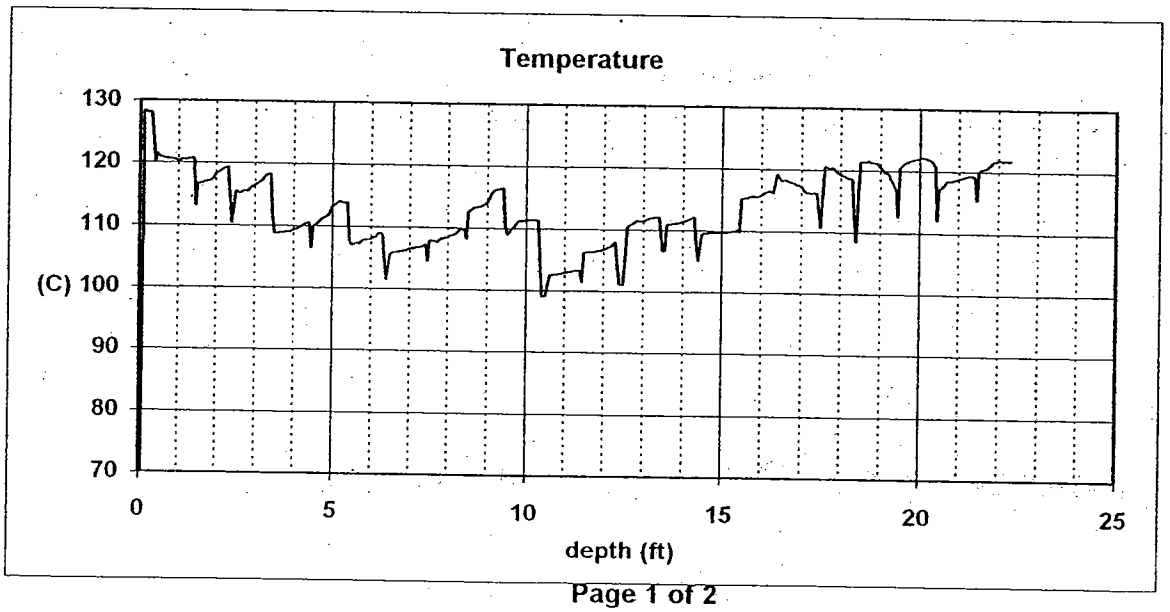

ECD Response
ECD Response (uV)
60,000
40,000
20,000
0
0
5
10
15
20
25
depth (ft)


PID Response
PID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

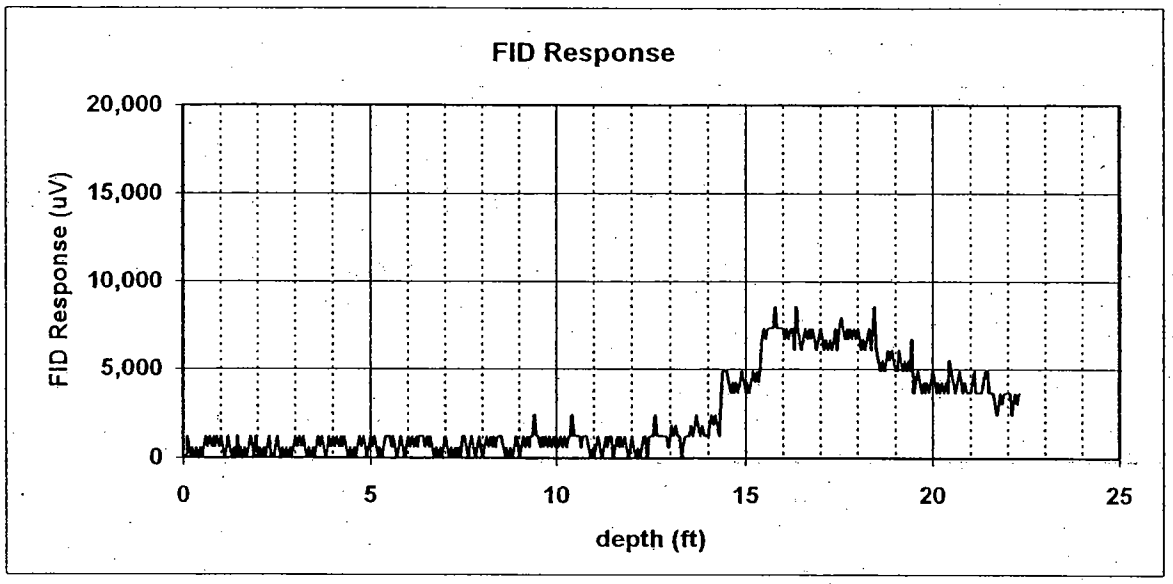
SB-117 (Field)

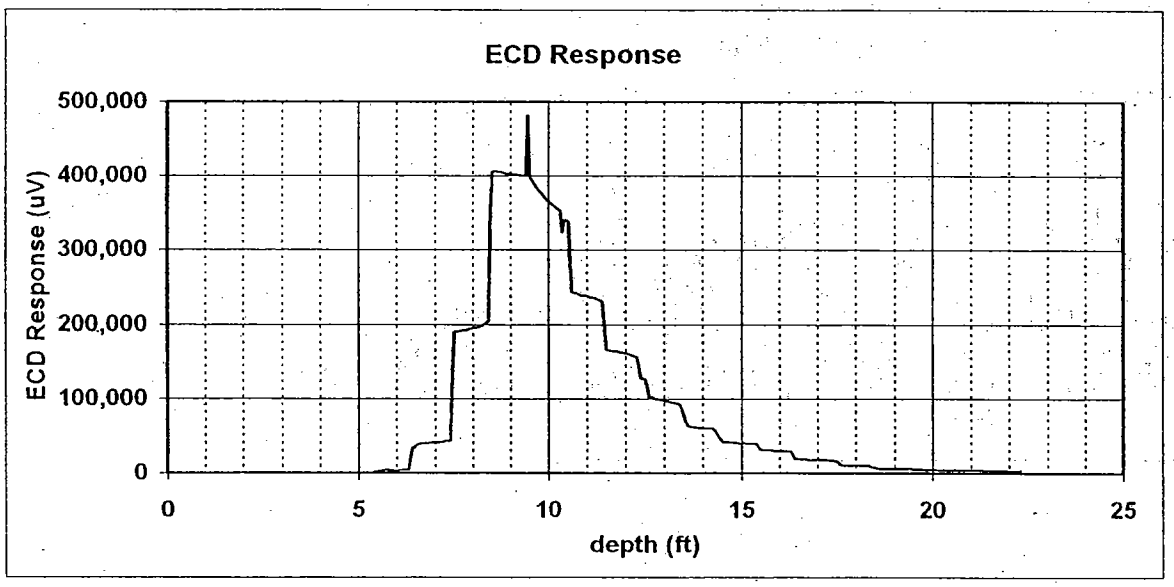

Conductivity
conductivity (mSiemens/m)
250
200
150
100
50
0
0
5
10
15
20
25
depth (ft)

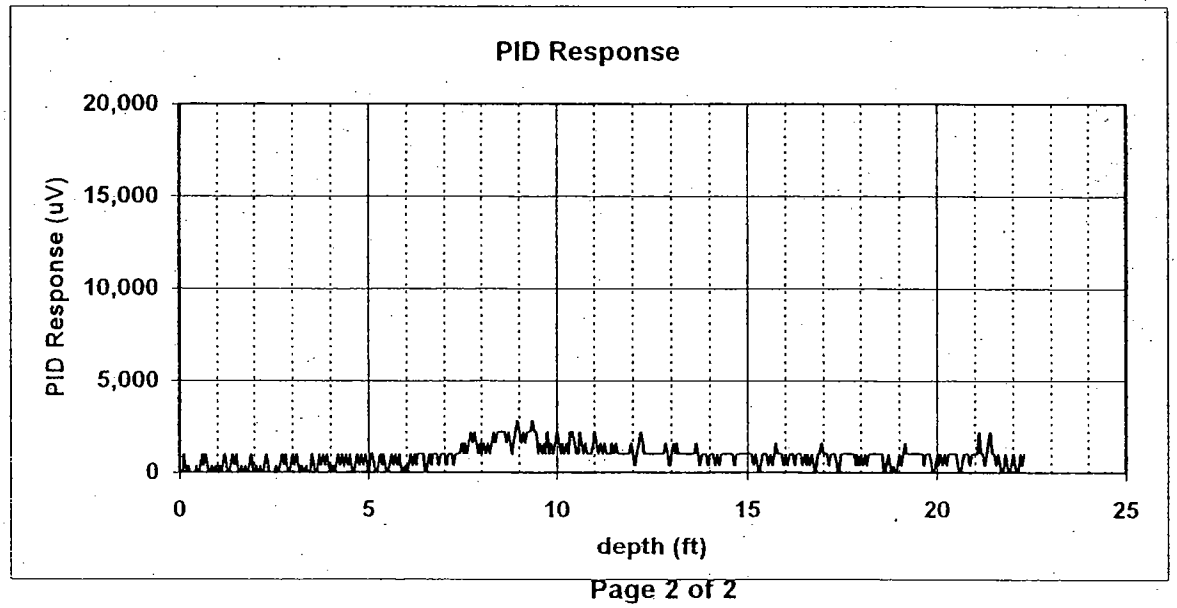

Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)

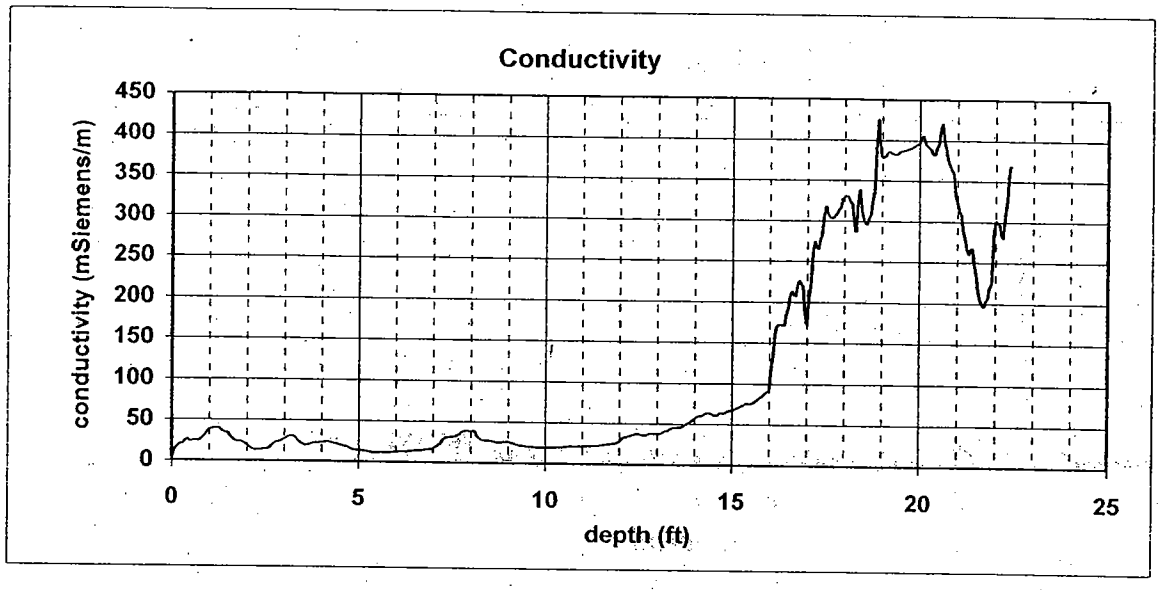

Temperature
130
120
110
(C) 100
90
80
70
0
5
10
15
20
25
depth (ft)

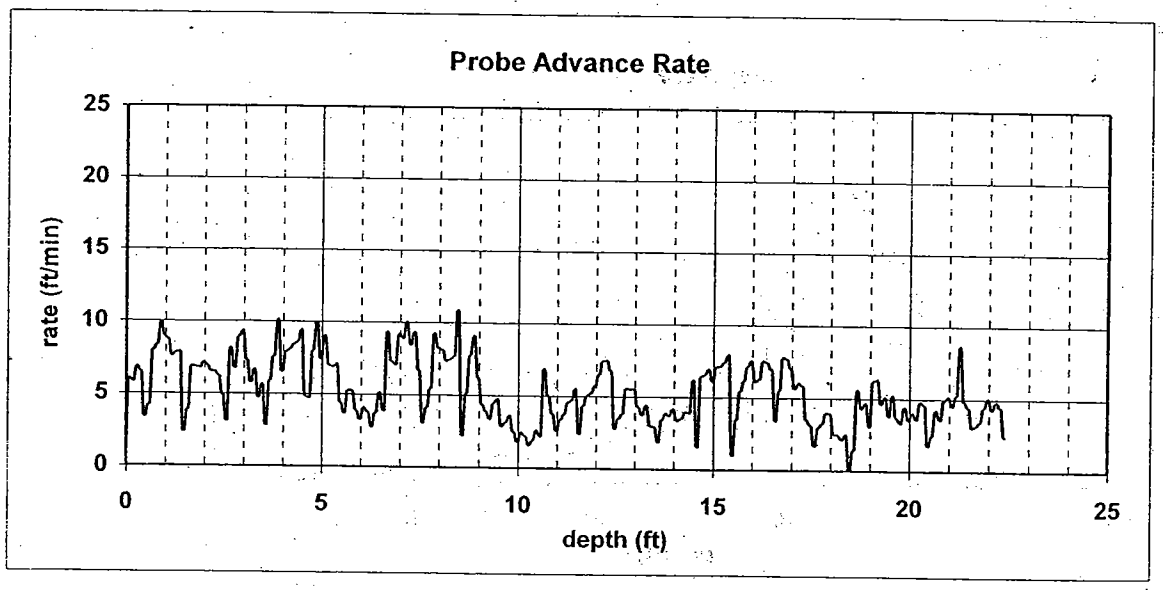
SB-117 (Field)

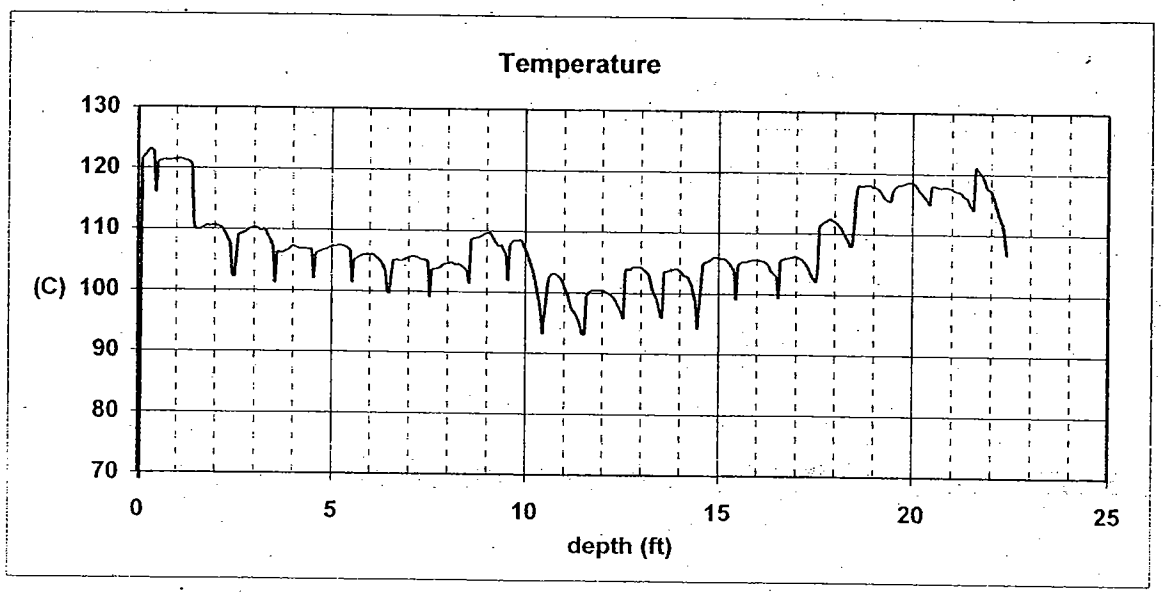

FID Response
FID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

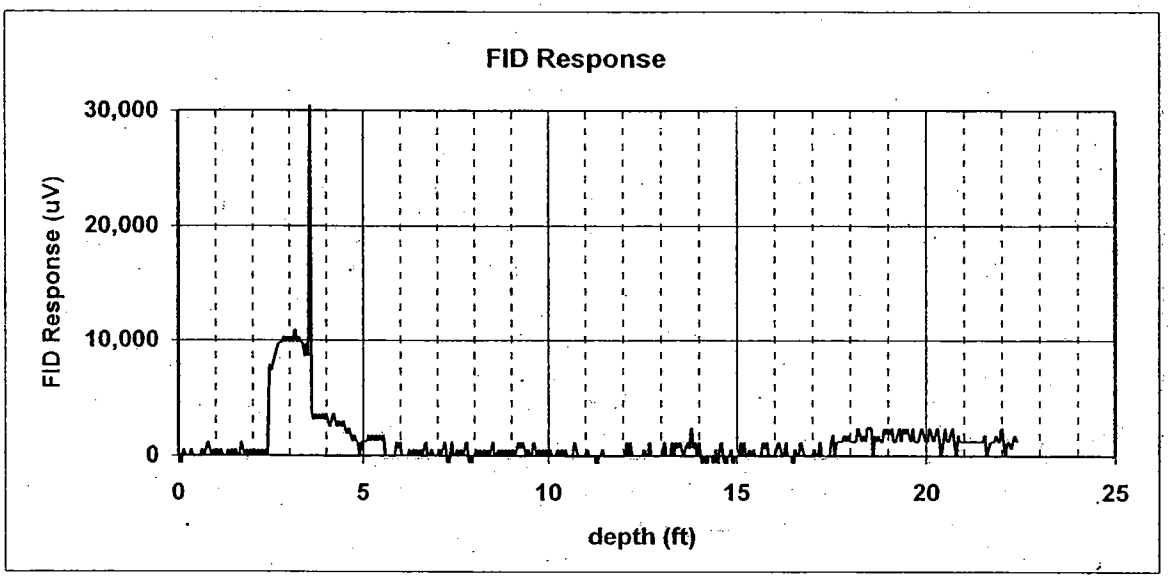

ECD Response
ECD Response (uV)
500,000
400,000
300,000
200,000
100,000
0
0
5
10
15
20
25
depth (ft)

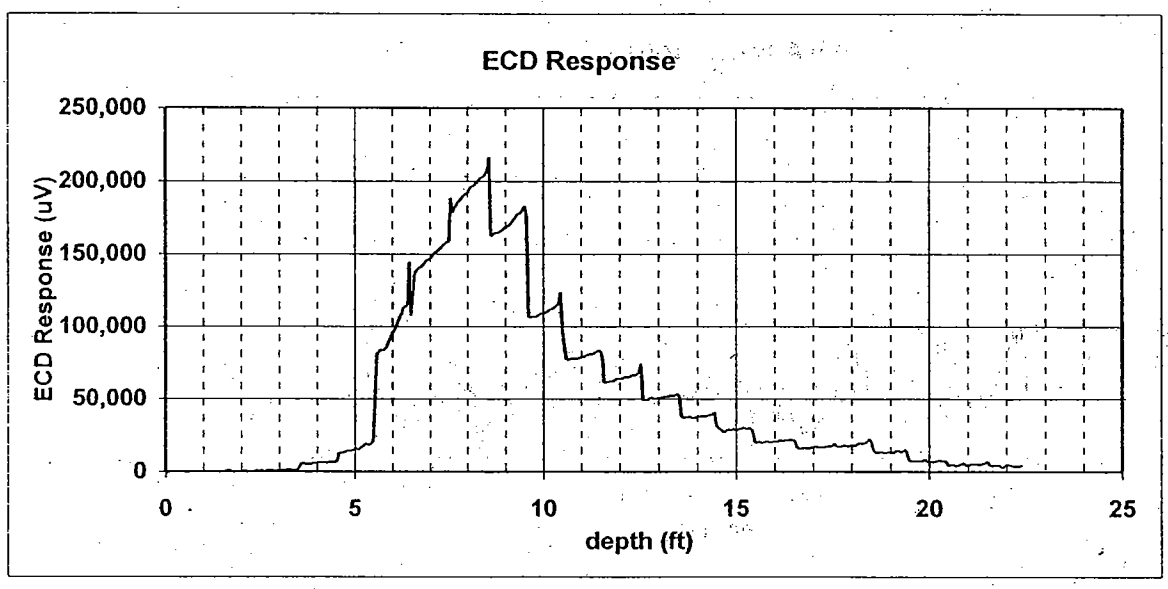

PID Response
PID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

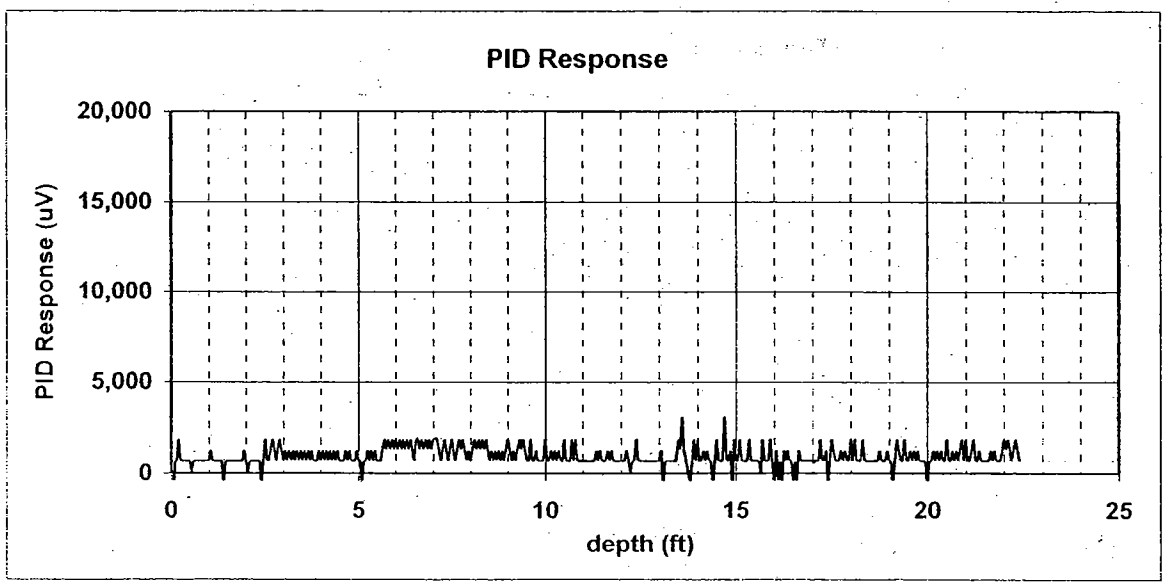

Conductivity
conductivity (mSiemens/m)
450
400
350
300
250
200
150
100
50
0
0
5
10
15
20
25
depth (ft)


Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)

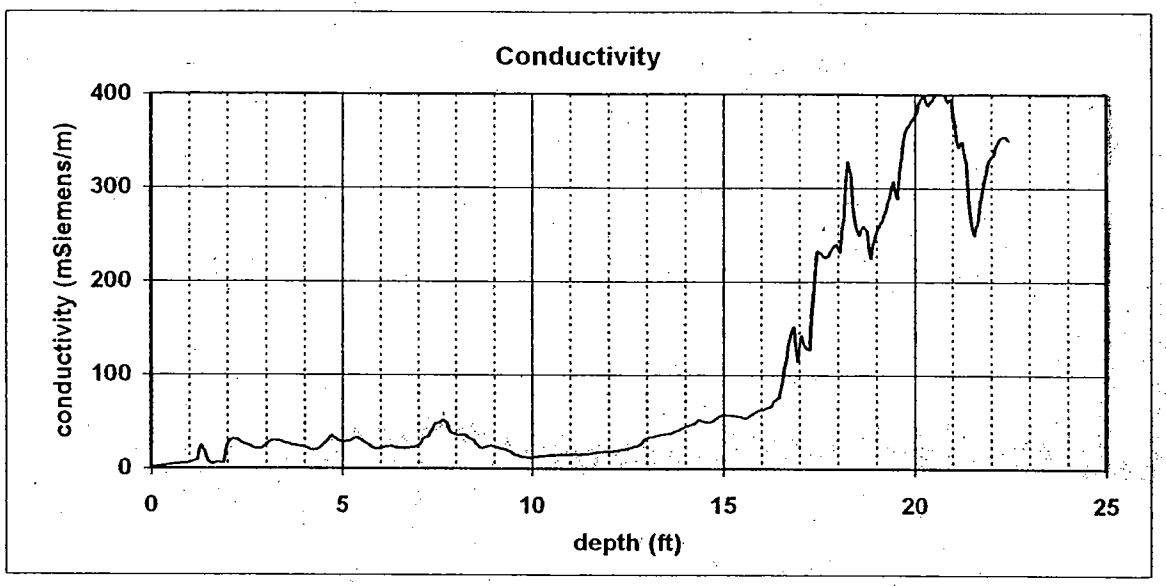

Temperature
(C)
130
120
110
100
90
80
70
0
5
10
15
20
25
depth (ft)

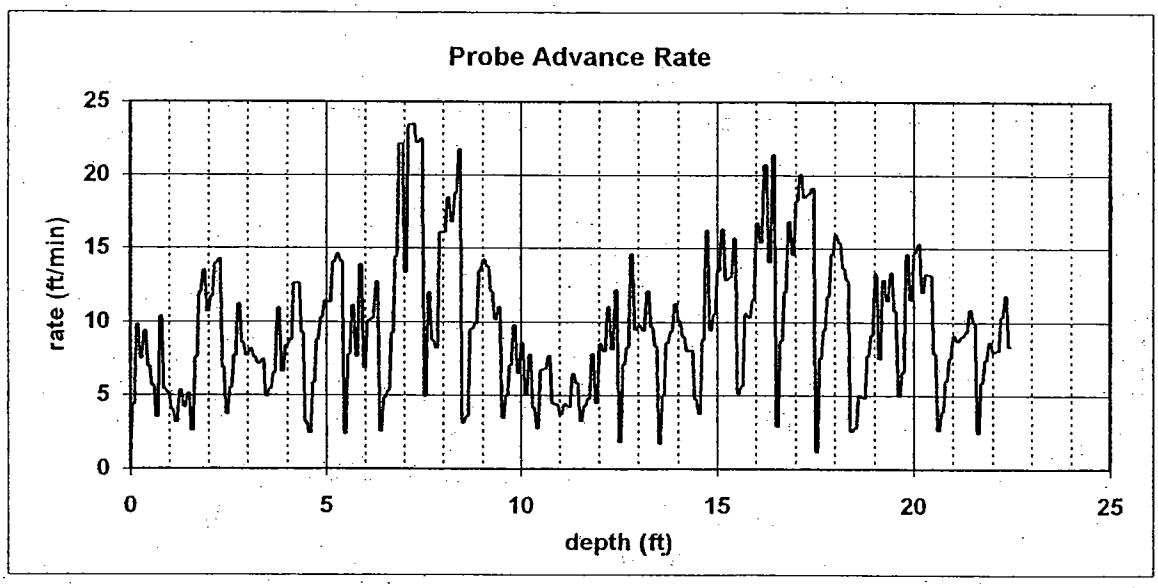

FID Response
FID Response (uV)
30,000
20,000
10,000
0
0
5
10
15
20
25
depth (ft)

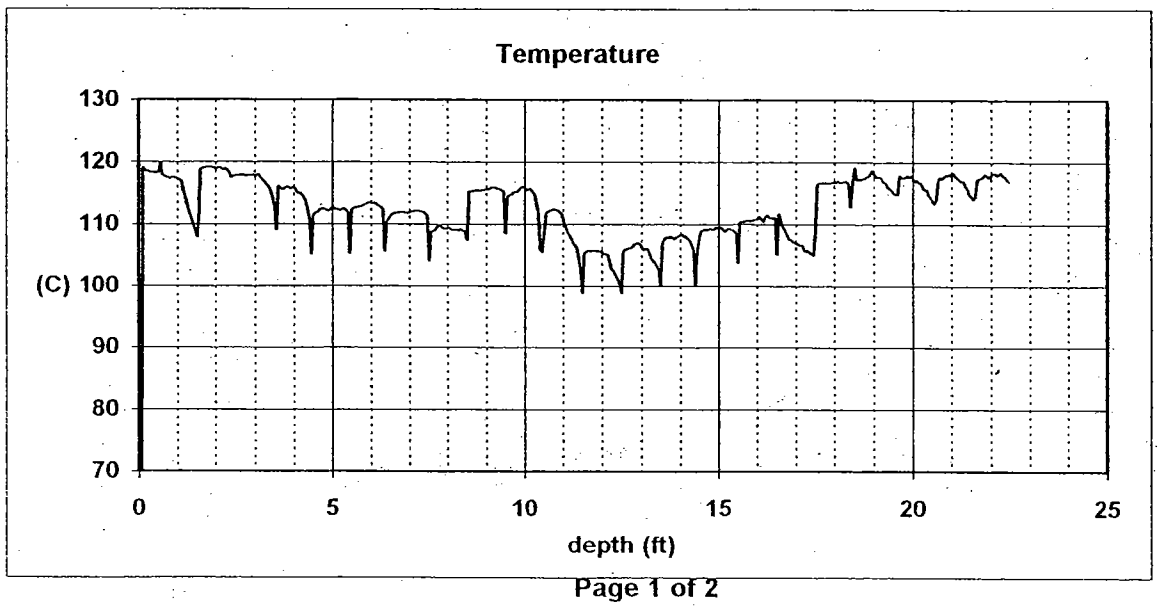

ECD Response
ECD Response (uV)
250,000
200,000
150,000
100,000
50,000
0
0
5
10
15
20
25
depth (ft)


PID Response
PID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

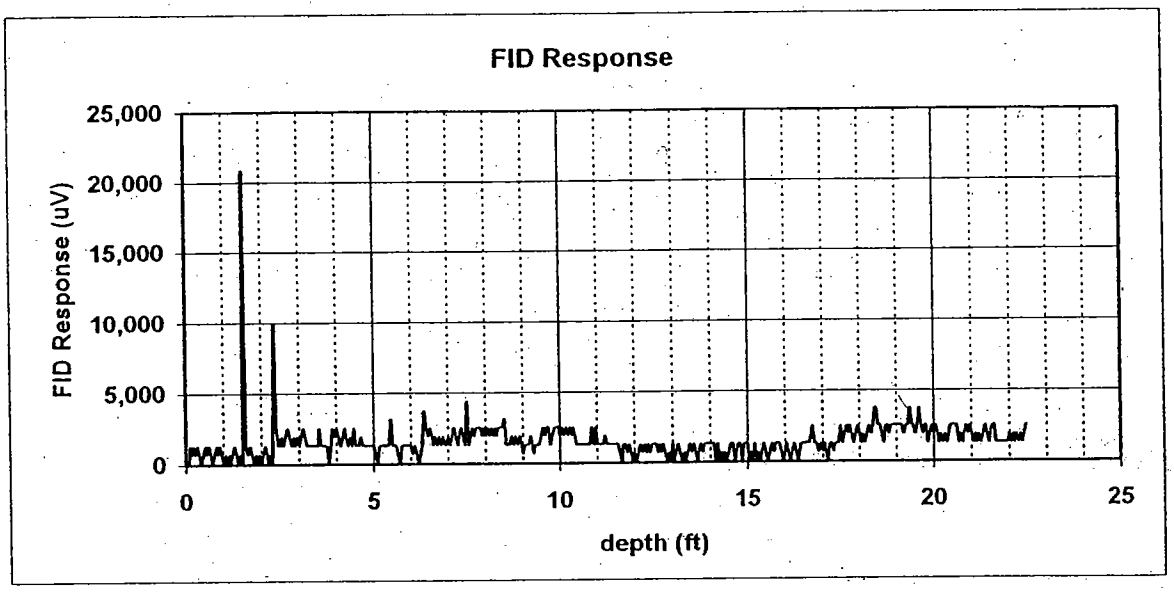
SB-119 (Field)

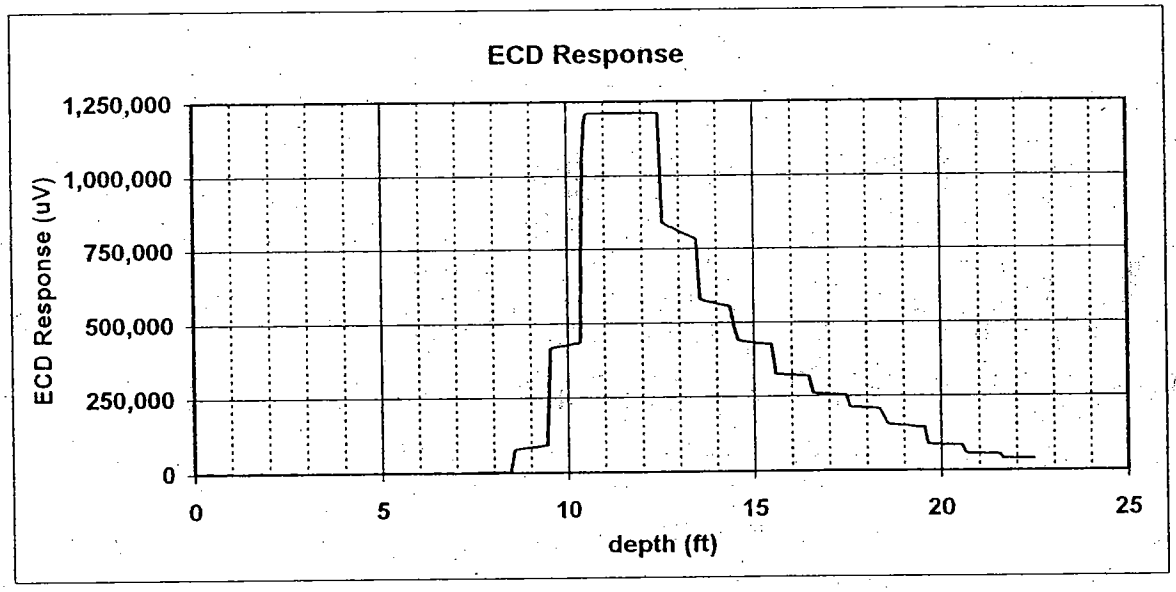

Conductivity
conductivity (mSiemens/m)
400
300
200
100
0
0
5
10
15
20
25
depth (ft)

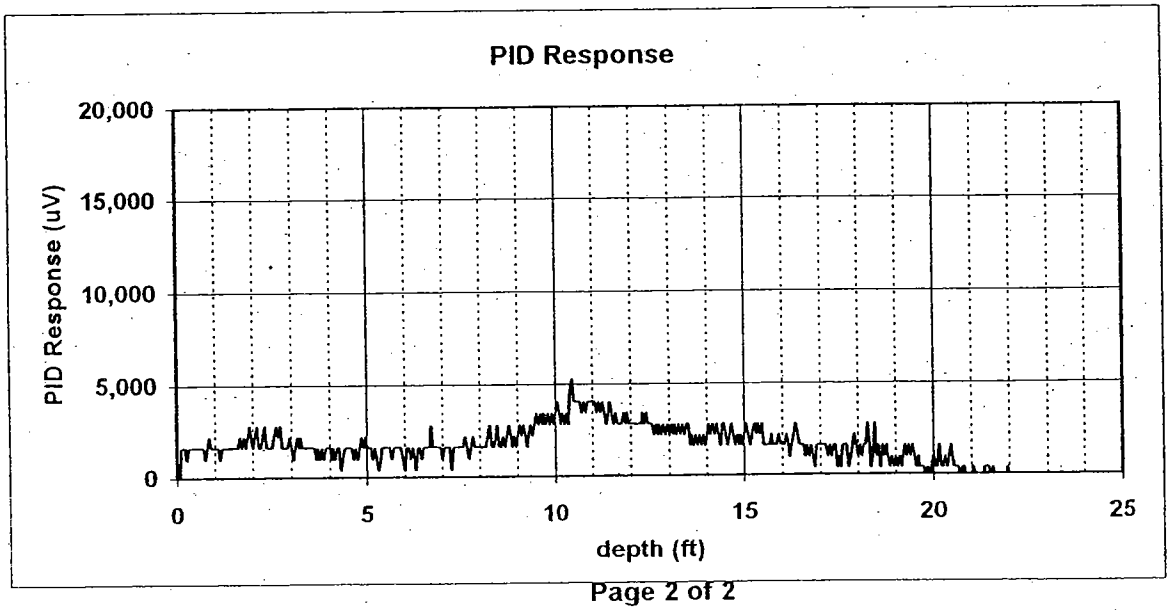

Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)


Temperature
(C)
130
120
110
100
90
80
70
0
5
10
15
20
25
depth (ft)

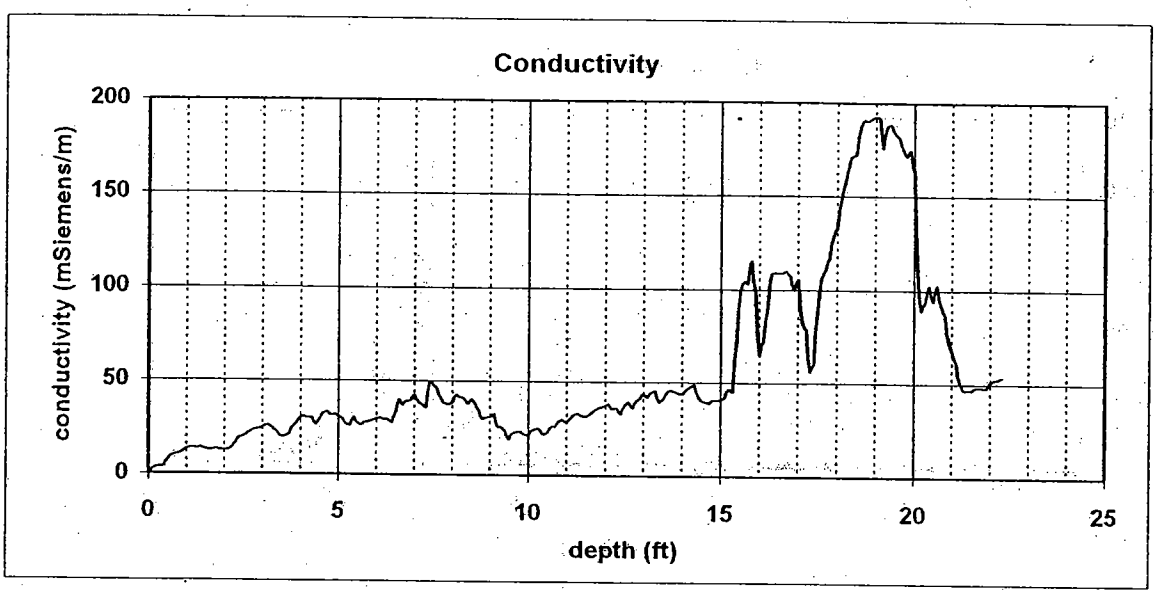
SB-119 (Field)

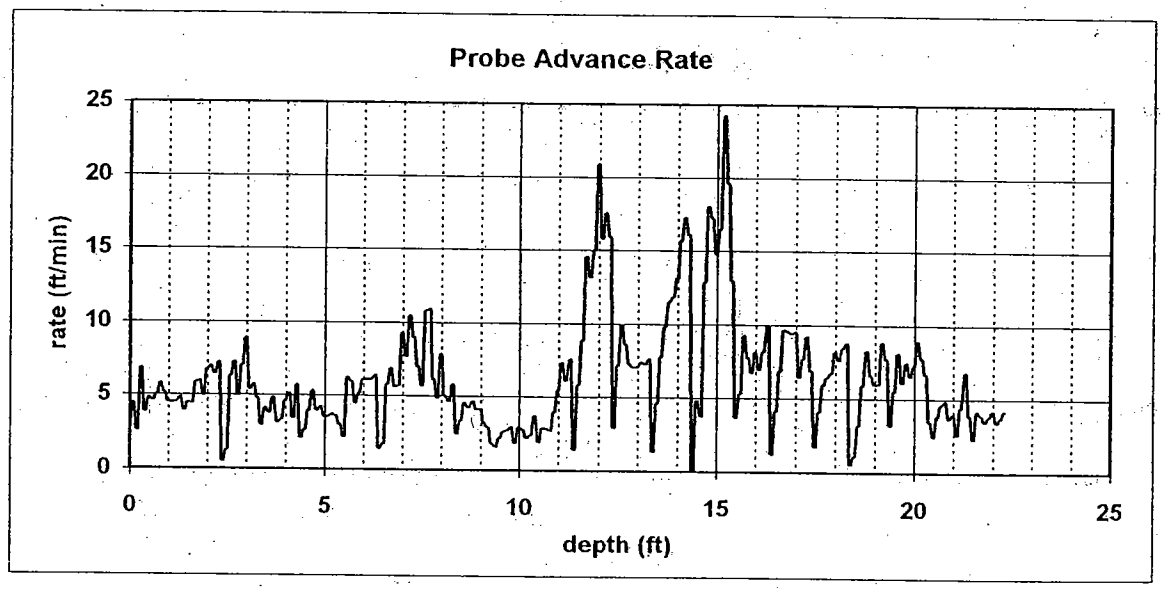

FID Response
FID Response (uV)
25,000
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

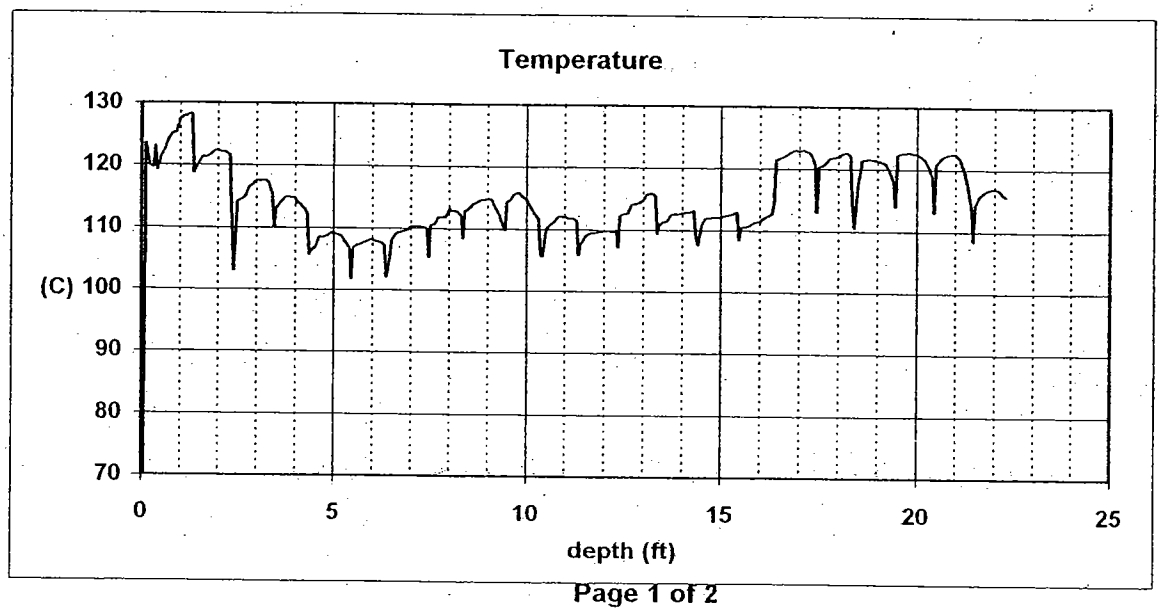

ECD Response
ECD Response (uV)
1,250,000
1,000,000
750,000
500,000
250,000
0
0
5
10
15
20
25
depth (ft)


PID Response
PID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

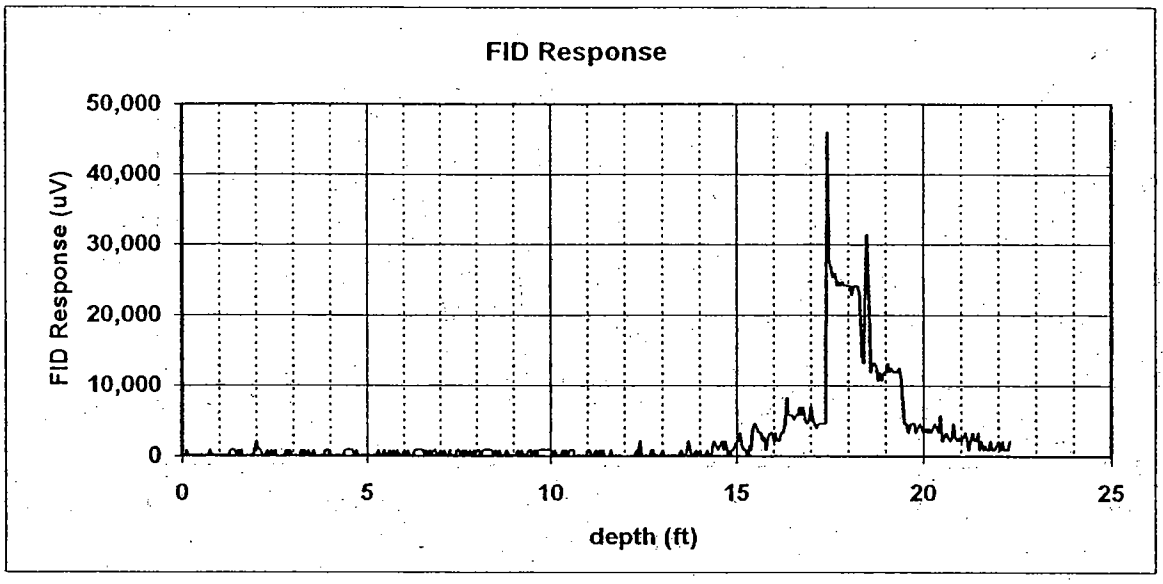
SB-122 (Field)

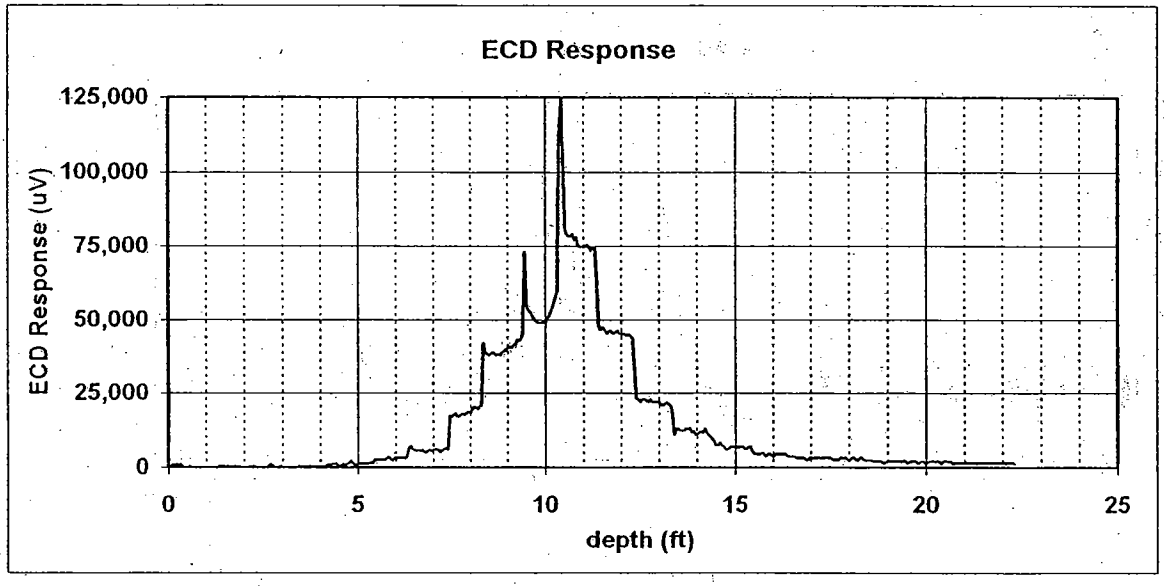

Conductivity
conductivity (mSiemens/m)
200
150
100
50
0
0
5
10
15
20
25
depth (ft)

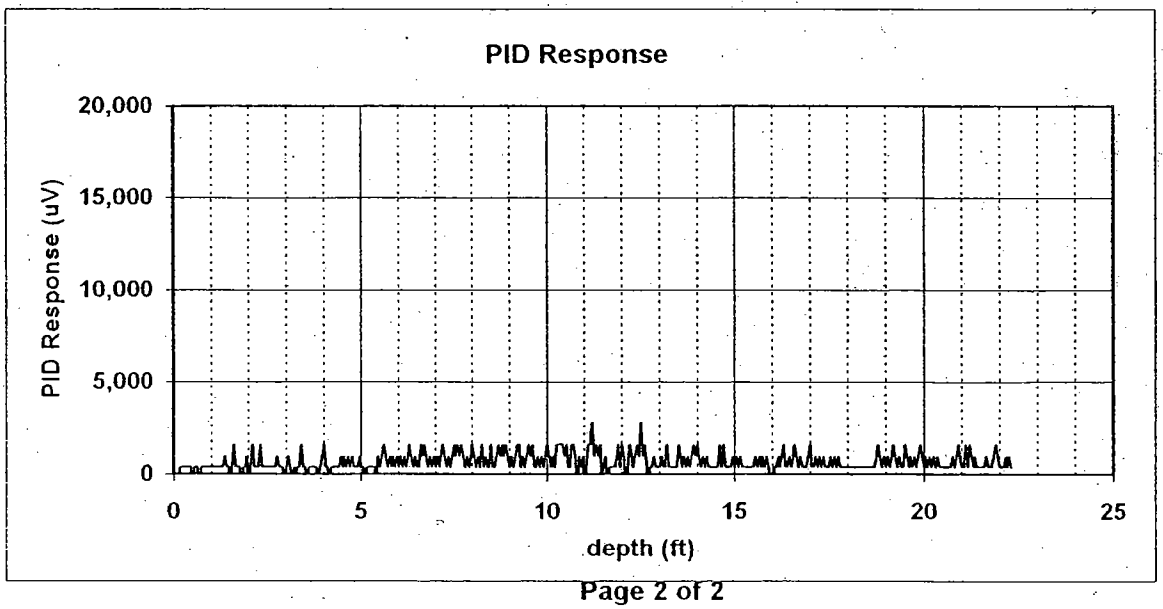

Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)


Temperature
130
120
110
(C) 100
90
80
70
0
5
10
15
20
25
depth (ft)

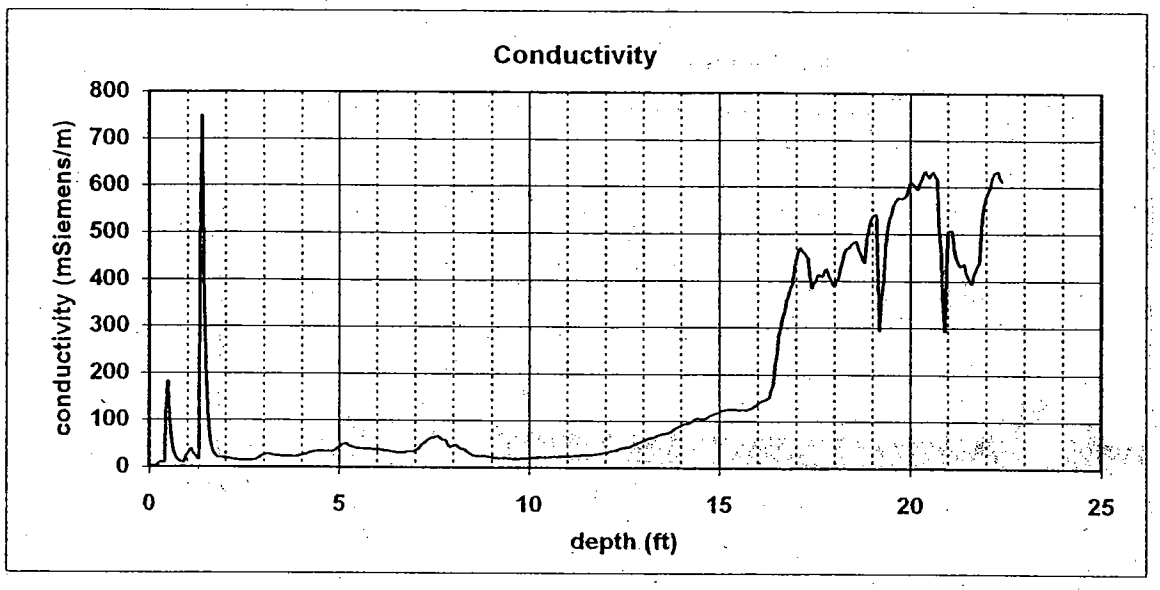
SB-122 (Field)

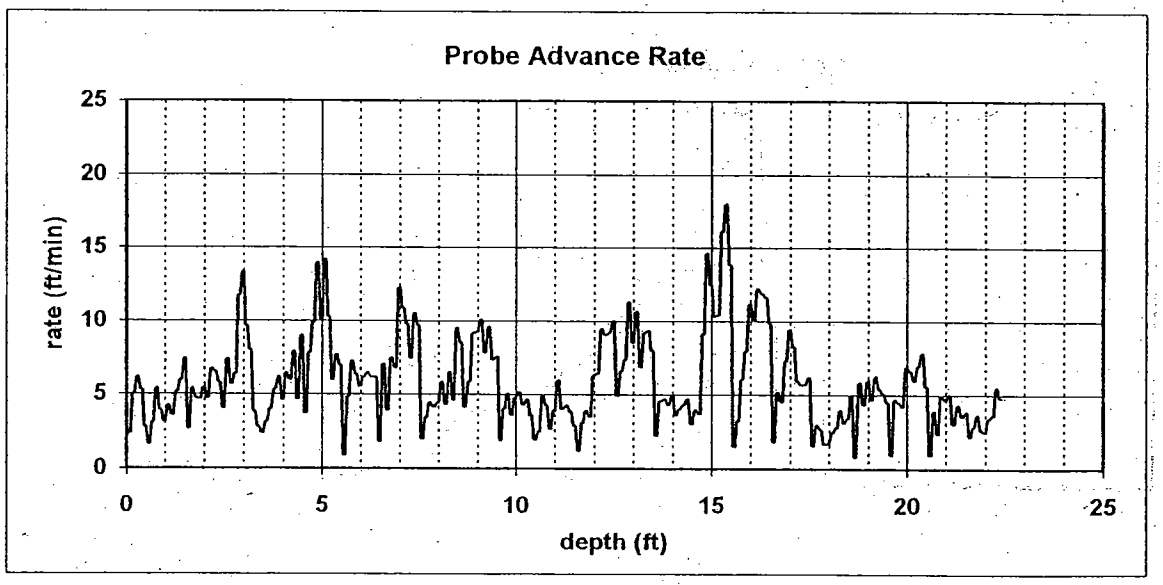

FID Response
FID Response (uV)
50,000
40,000
30,000
20,000
10,000
0
0
5
10
15
20
25
depth (ft)

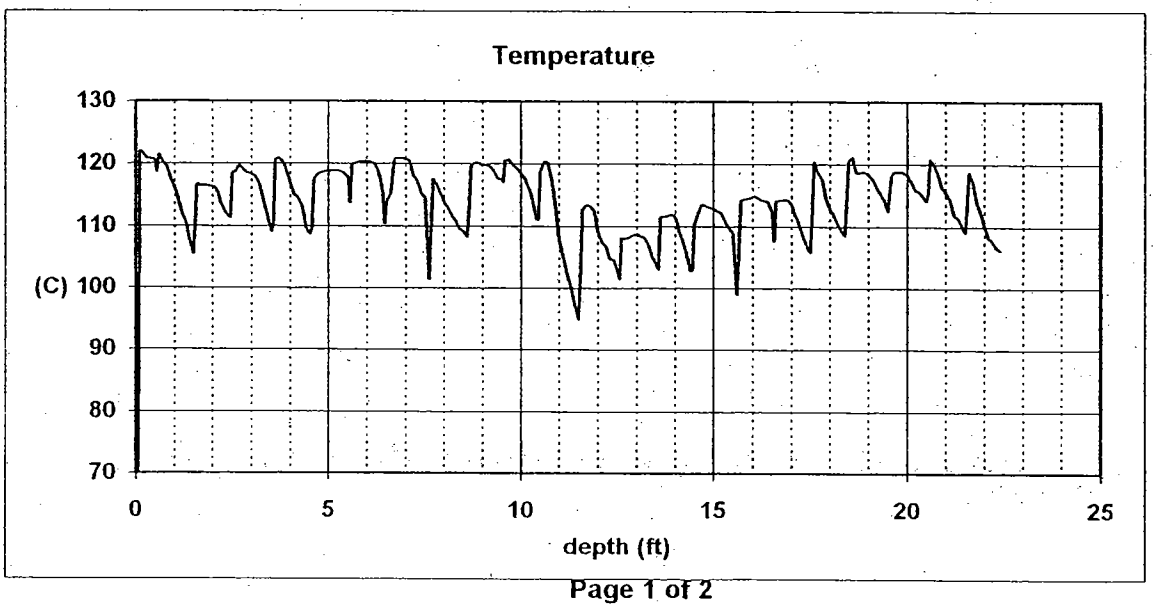

ECD Response
ECD Response (uV)
125,000
100,000
75,000
50,000
25,000
0
0
5
10
15
20
25
depth (ft)


PID Response
PID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

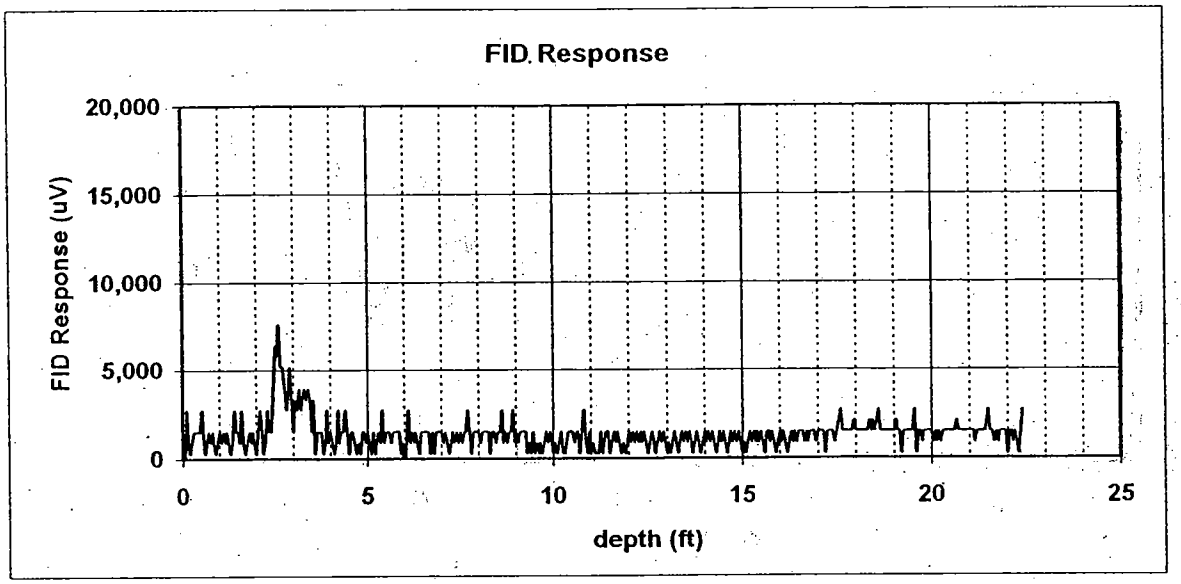
SB-123 (Field)

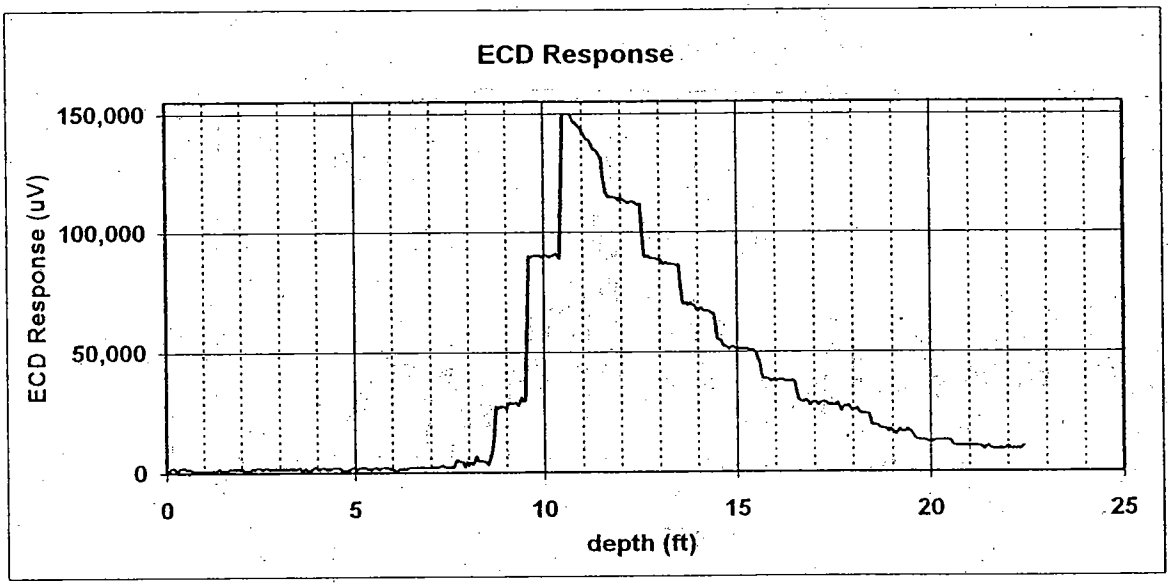

Conductivity
conductivity (mSiemens/m)
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
depth (ft)

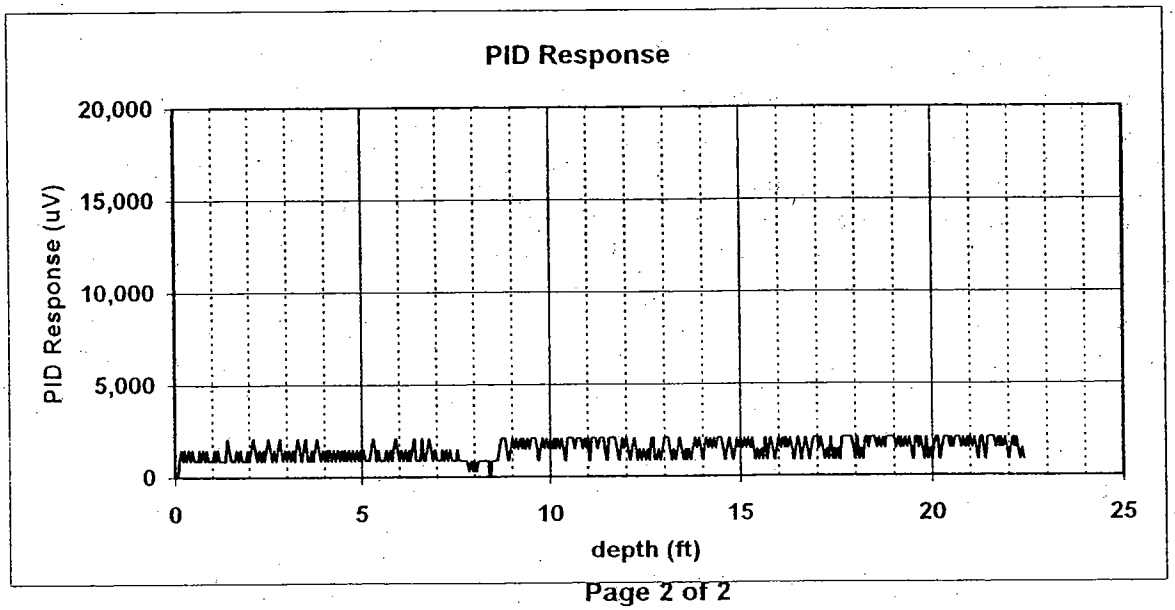

Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)


Temperature
(C)
130
120
110
100
90
80
70
0
5
10
15
20
25
depth (ft)

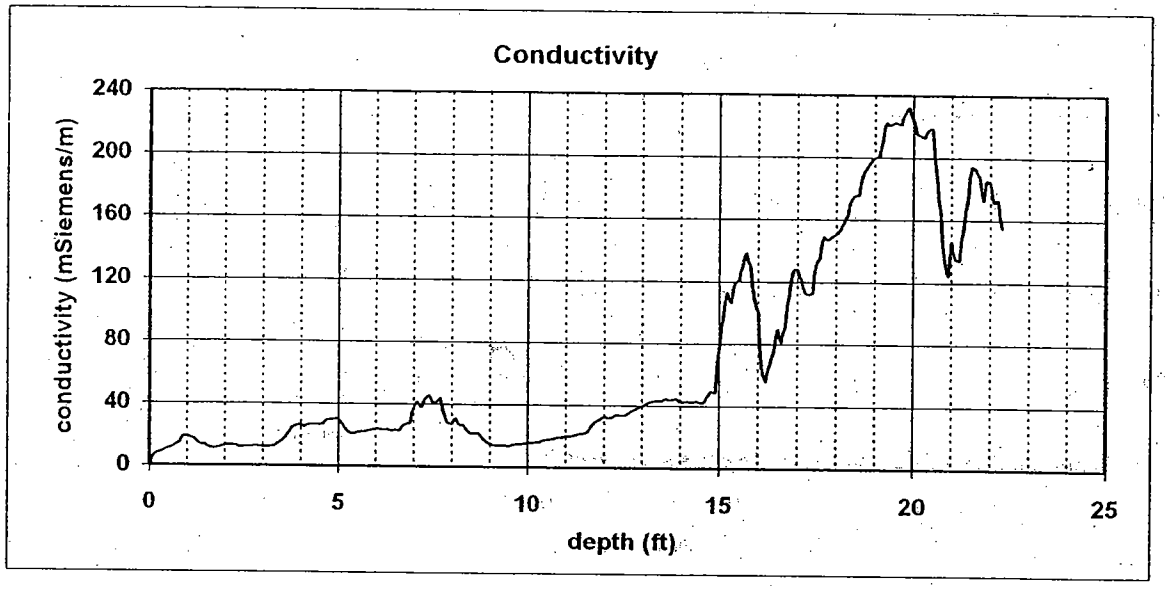
SB-123 (Field)

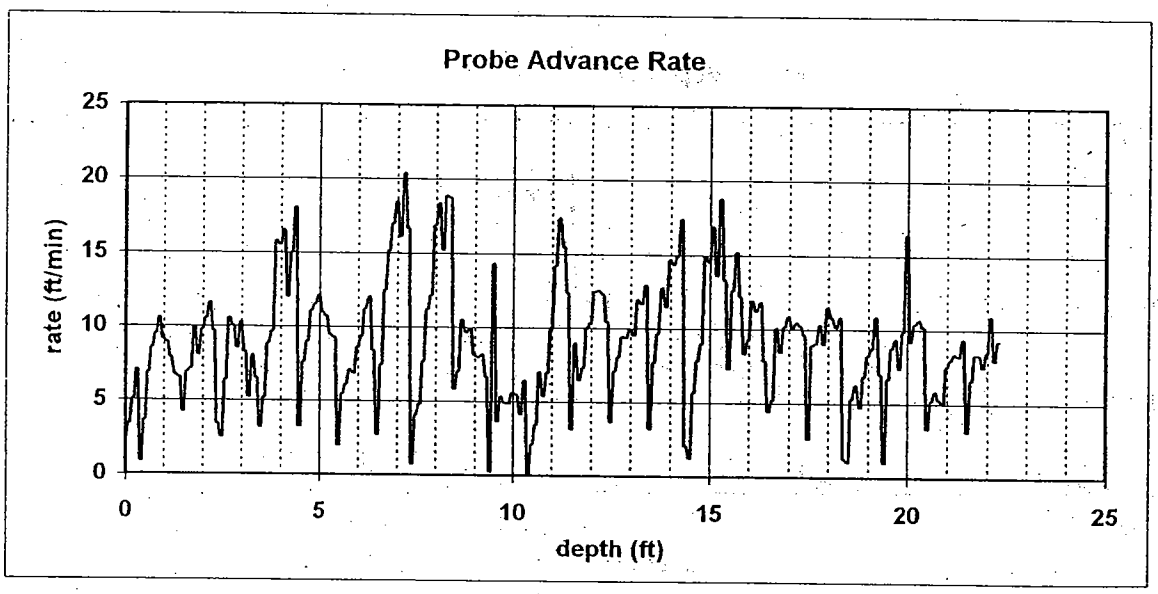

FID Response
FID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

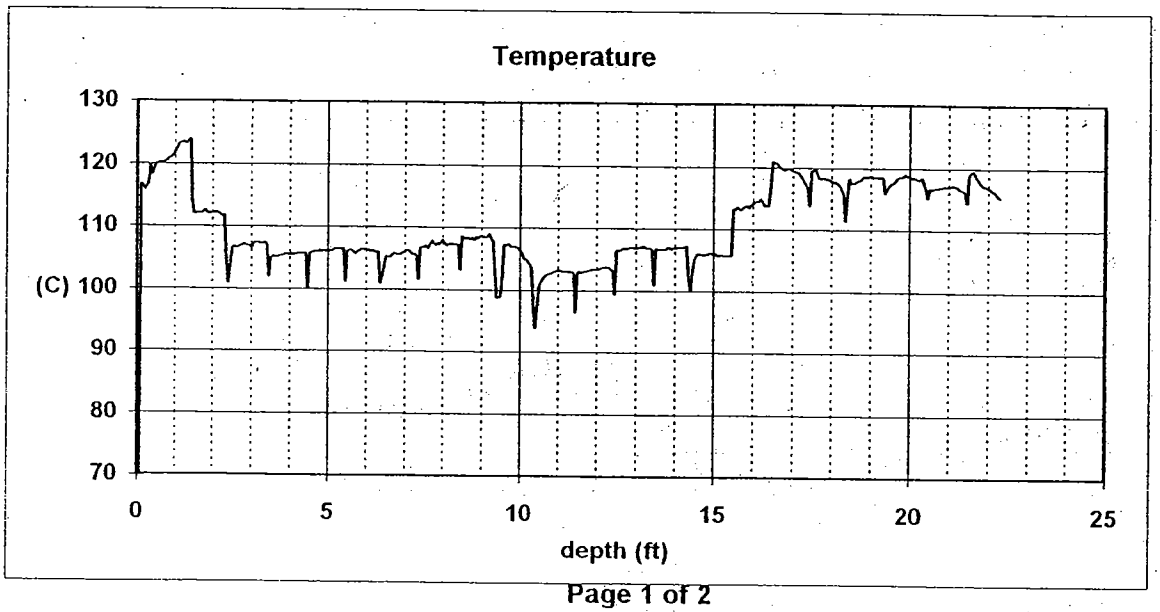

ECD Response
ECD Response (uV)
150,000
100,000
50,000
0
0
5
10
15
20
25
depth (ft)


PID Response
PID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

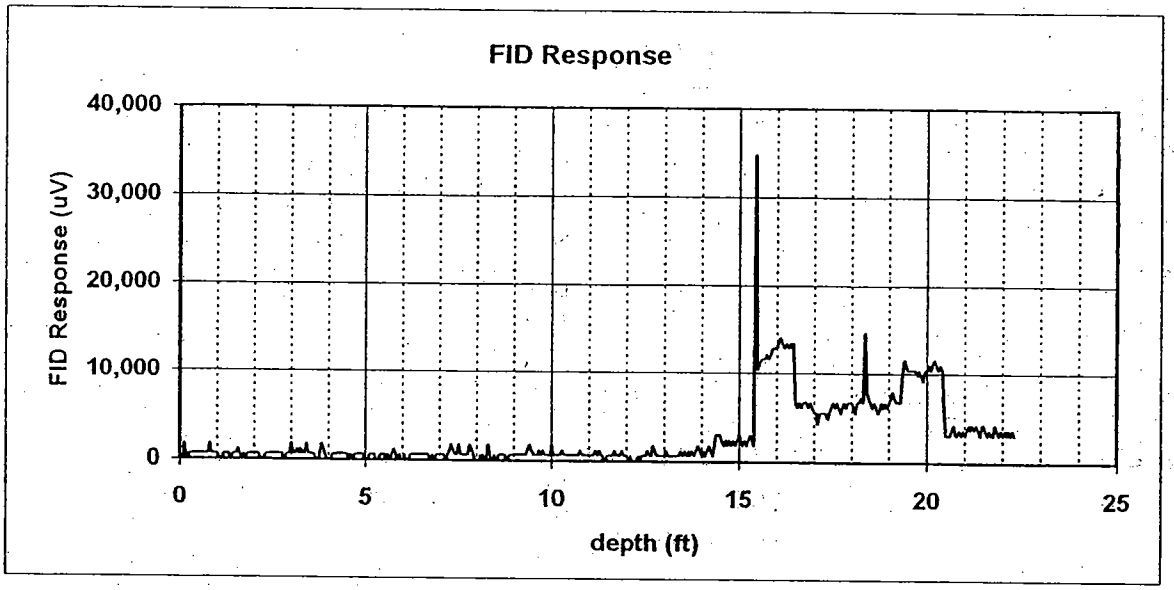
SB-124 (Field)

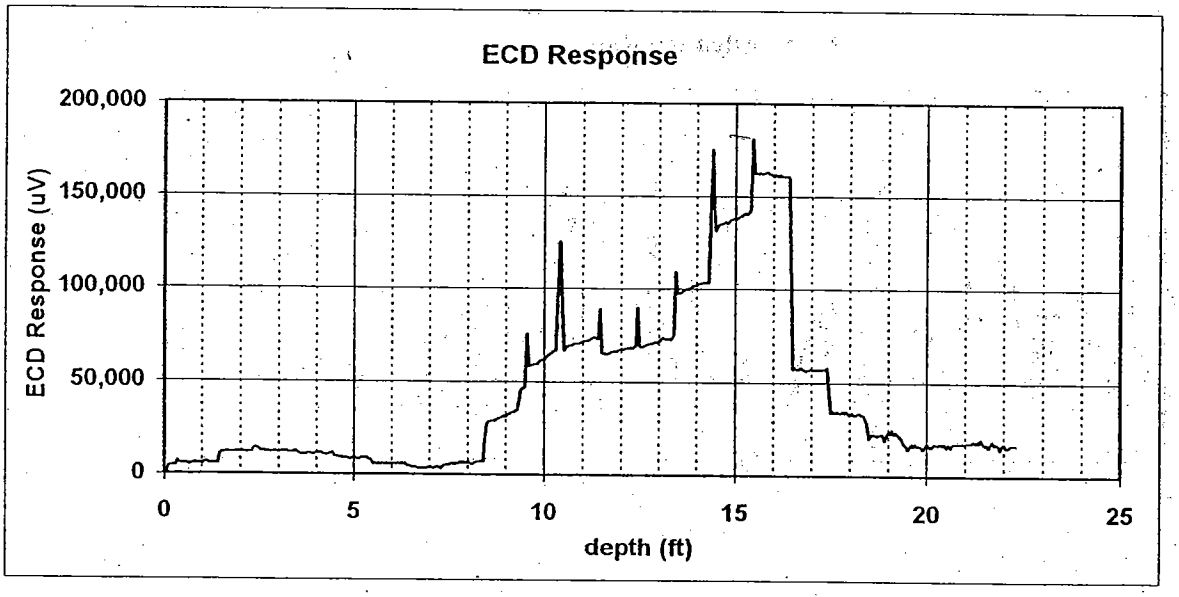

Conductivity
conductivity (mSiemens/m)
240
200
160
120
80
40
0
0
5
10
15
20
25
depth (ft)

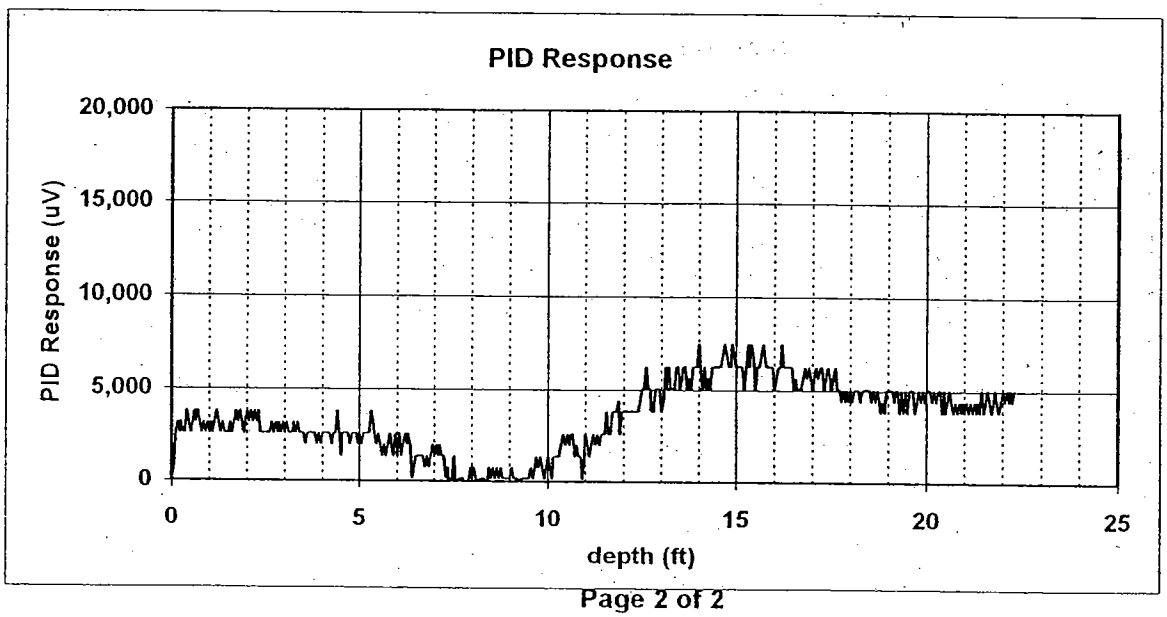

Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)


Temperature
(C)
130
120
110
100
90
80
70
0
5
10
15
20
25
depth (ft)

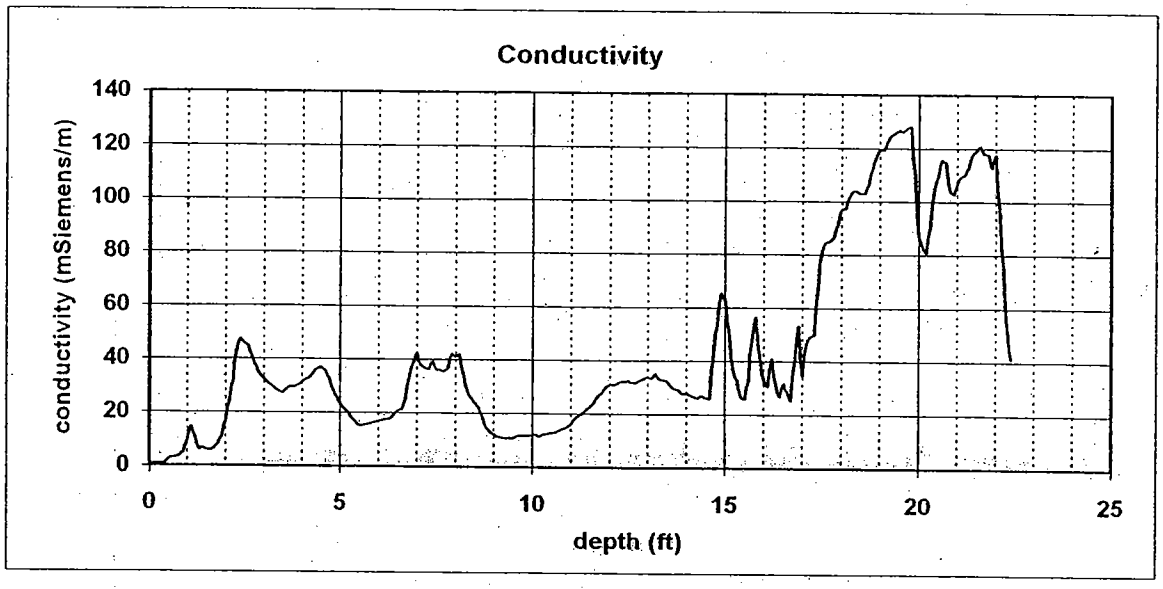
SB-124 (Field)

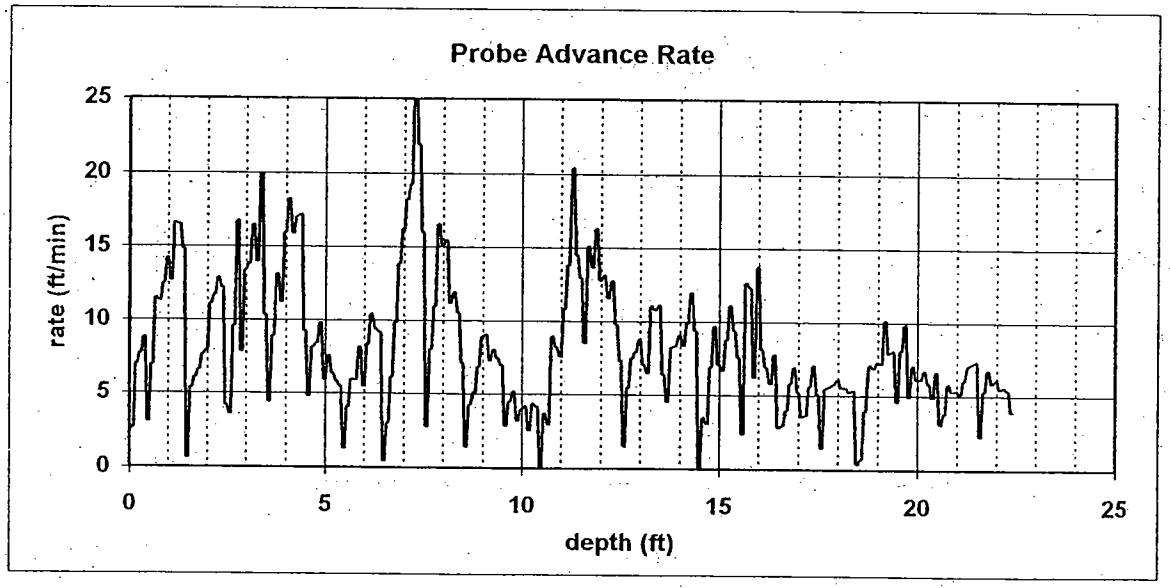

FID Response
FID Response (uV)
40,000
30,000
20,000
10,000
0
0
5
10
15
20
25
depth (ft)

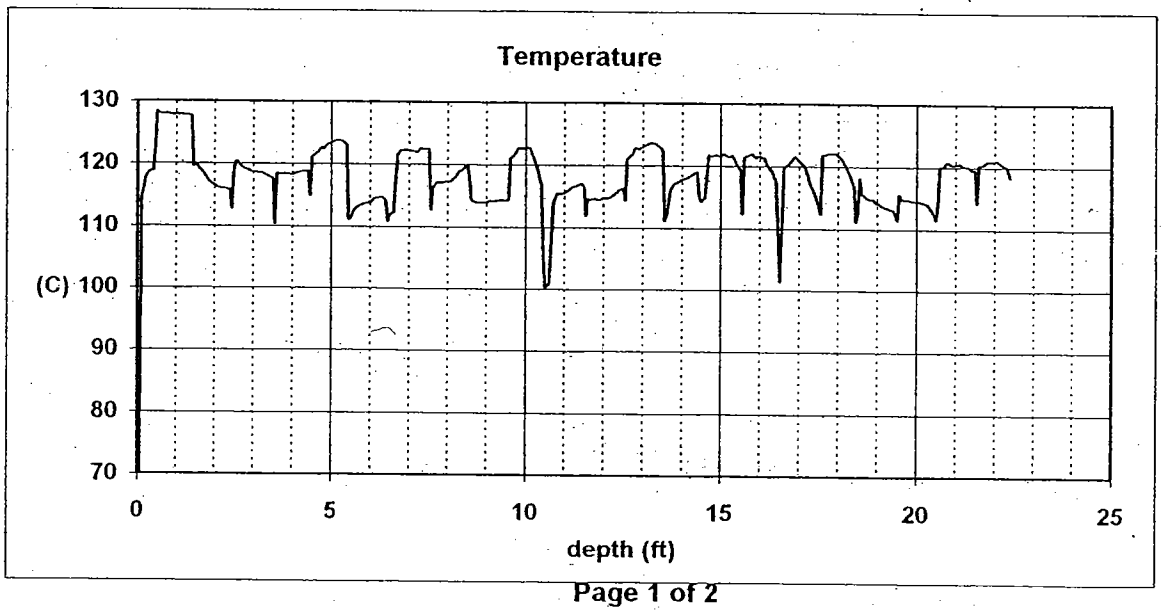

ECD Response
ECD Response (uV)
200,000
150,000
100,000
50,000
0
0
5
10
15
20
25
depth (ft)


PID Response
PID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

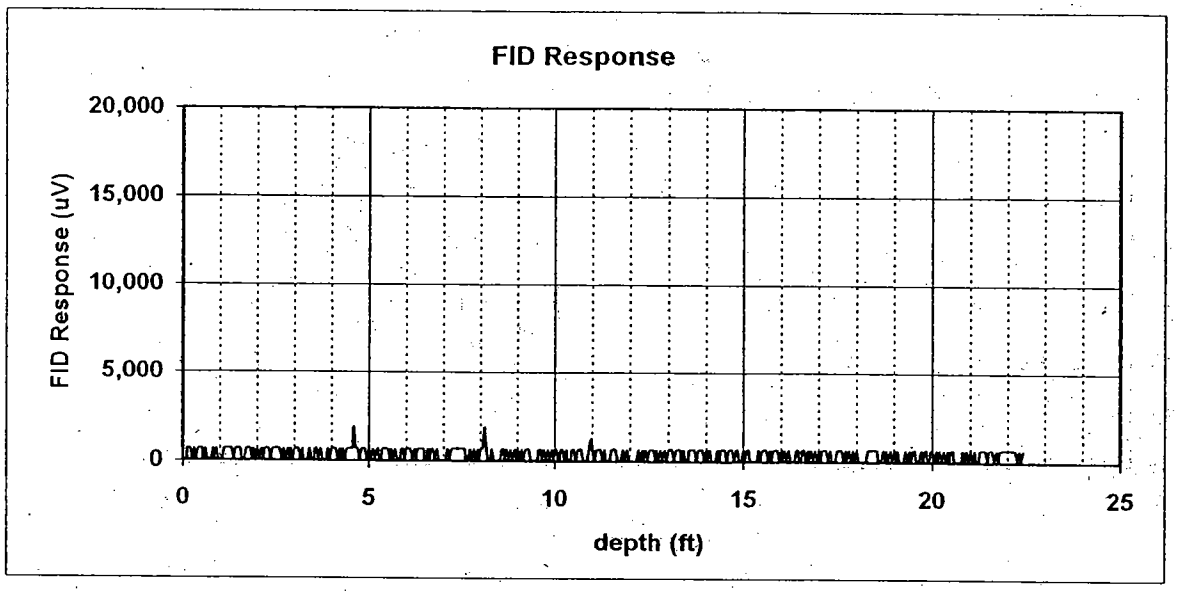
SB-125 (Field)

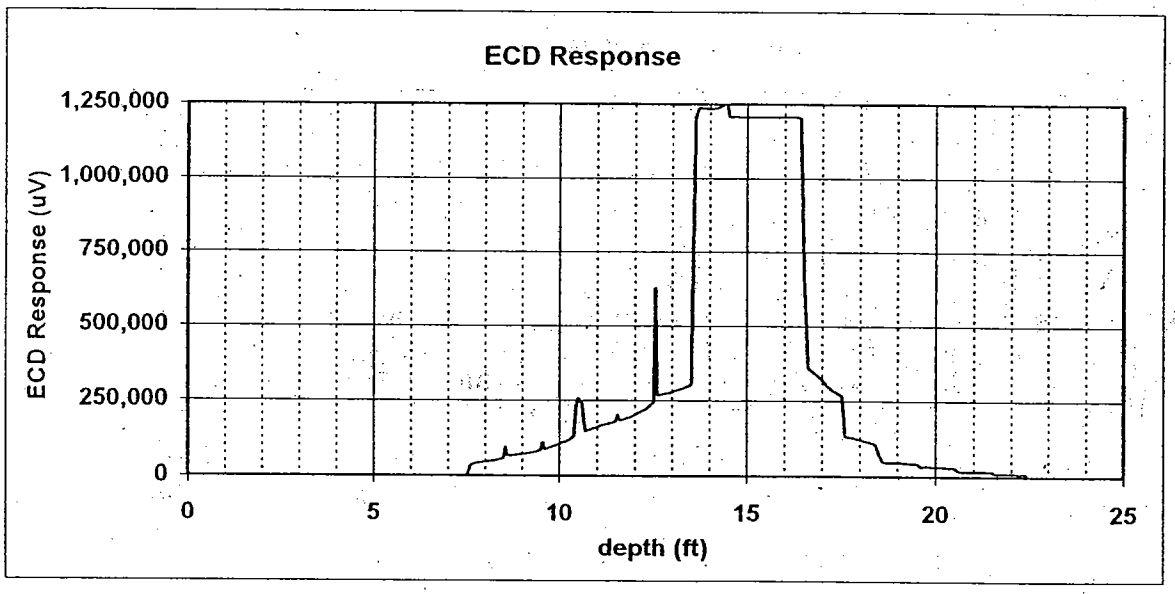

Conductivity
conductivity (mSiemens/m)
140
120
100
80
60
40
20
0
0
5
10
15
20
25
depth (ft)

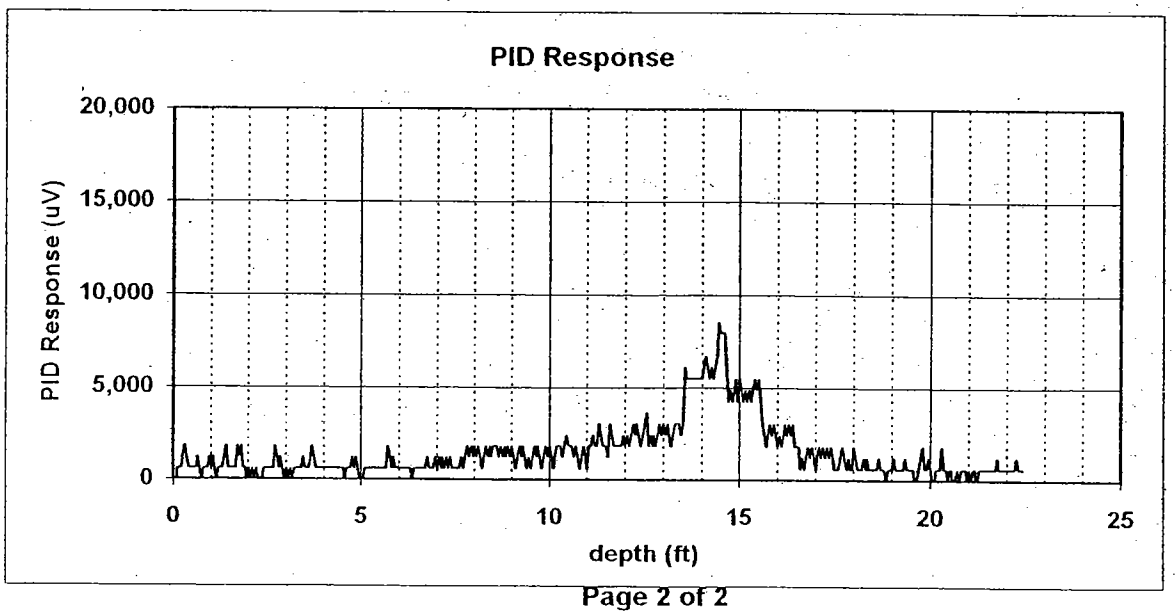

Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)

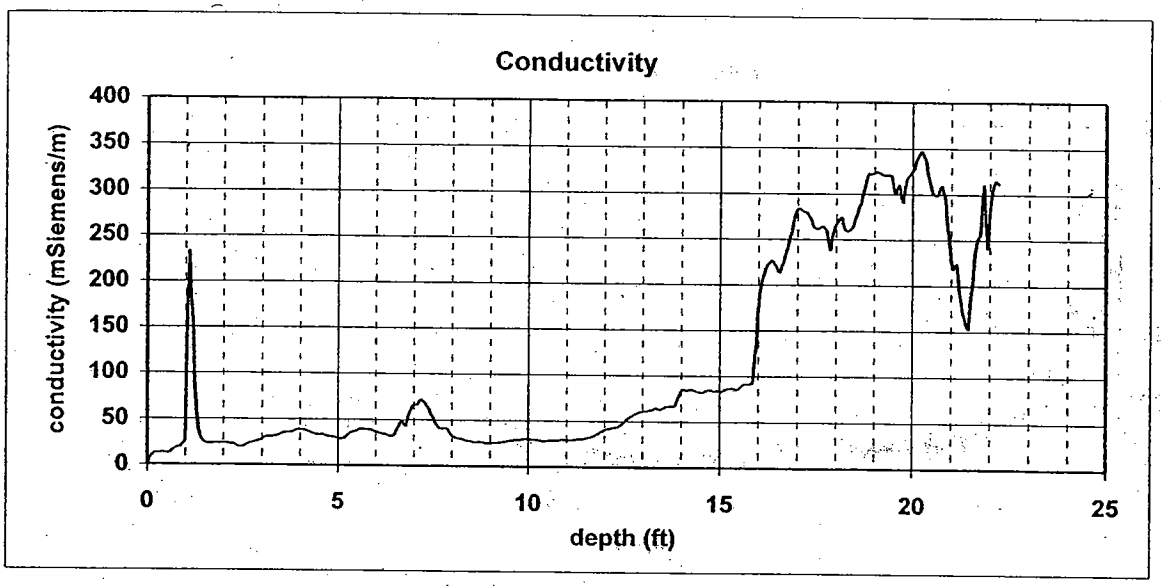

Temperature
(C)
130
120
110
100
90
80
70
0
5
10
15
20
25
depth (ft)

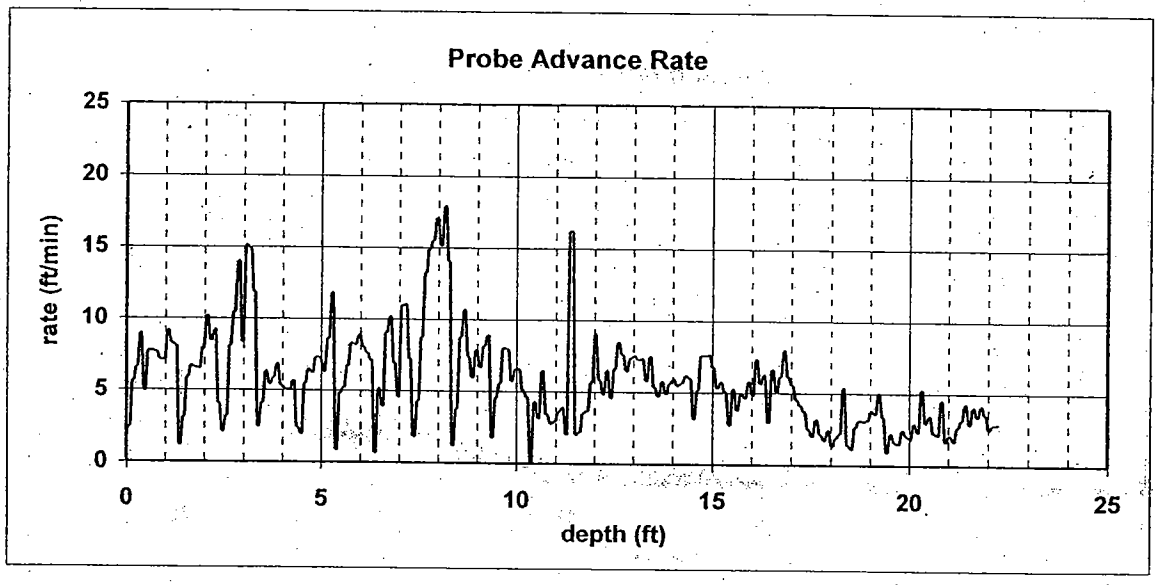
SB-125 (Field)

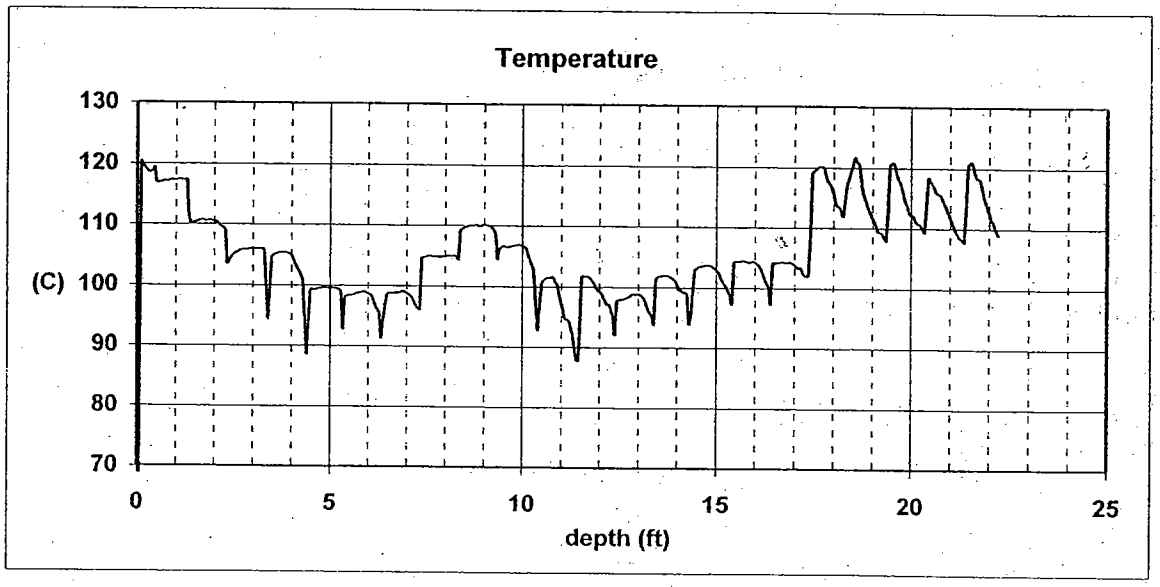

FID Response
FID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

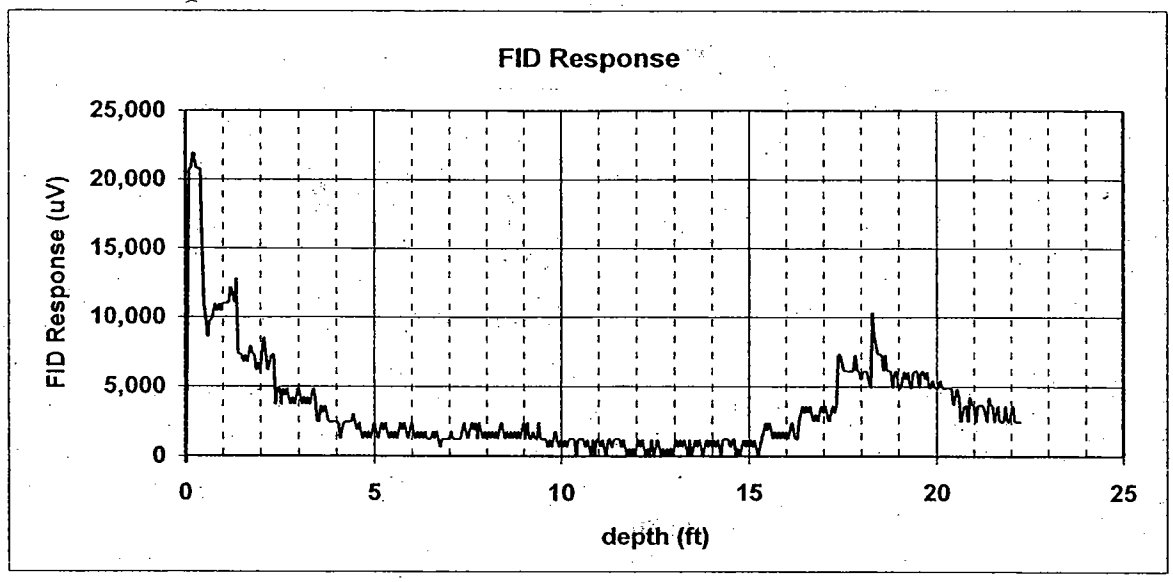

ECD Response
ECD Response (uV)
1,250,000
1,000,000
750,000
500,000
250,000
0
0
5
10
15
20
25
depth (ft)

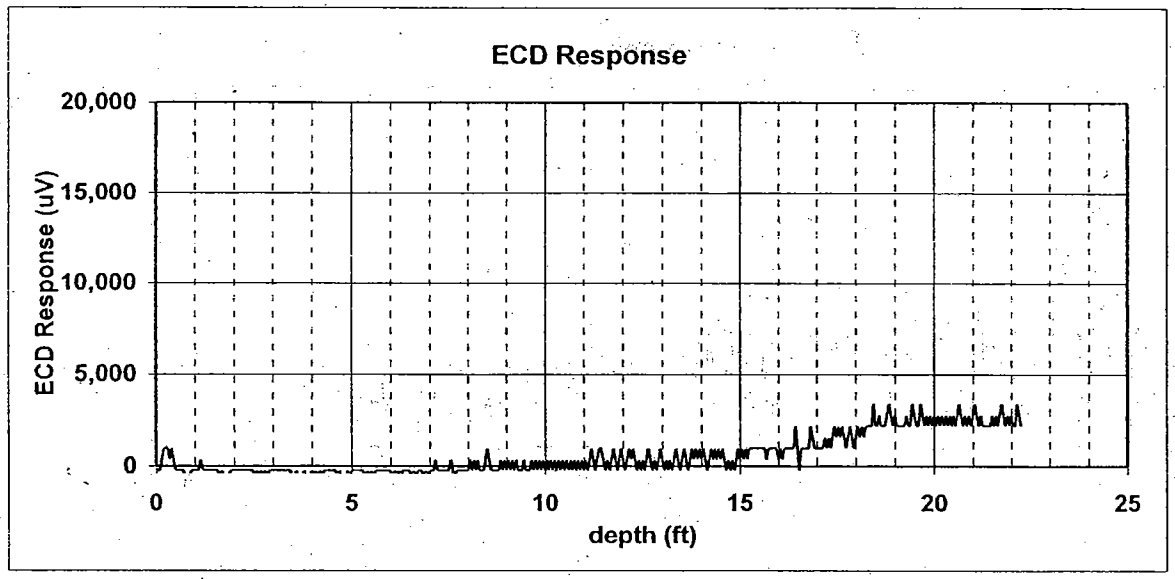

PID Response
PID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

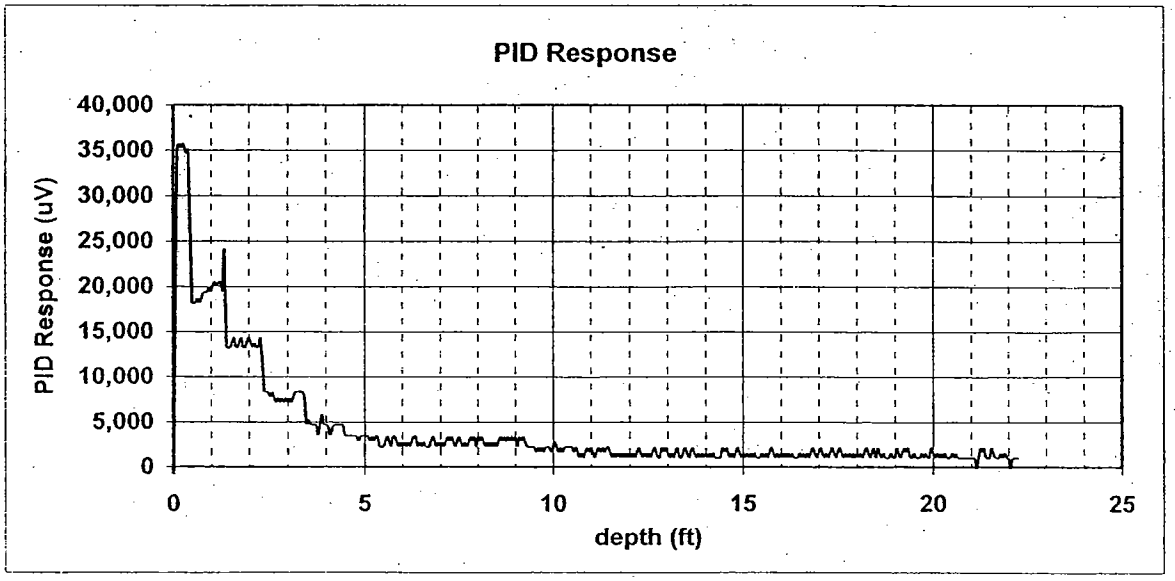

Conductivity
conductivity (mSiemens/m)
400
350
300
250
200
150
100
50
0
0
5
10
15
20
25
depth (ft)


Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)

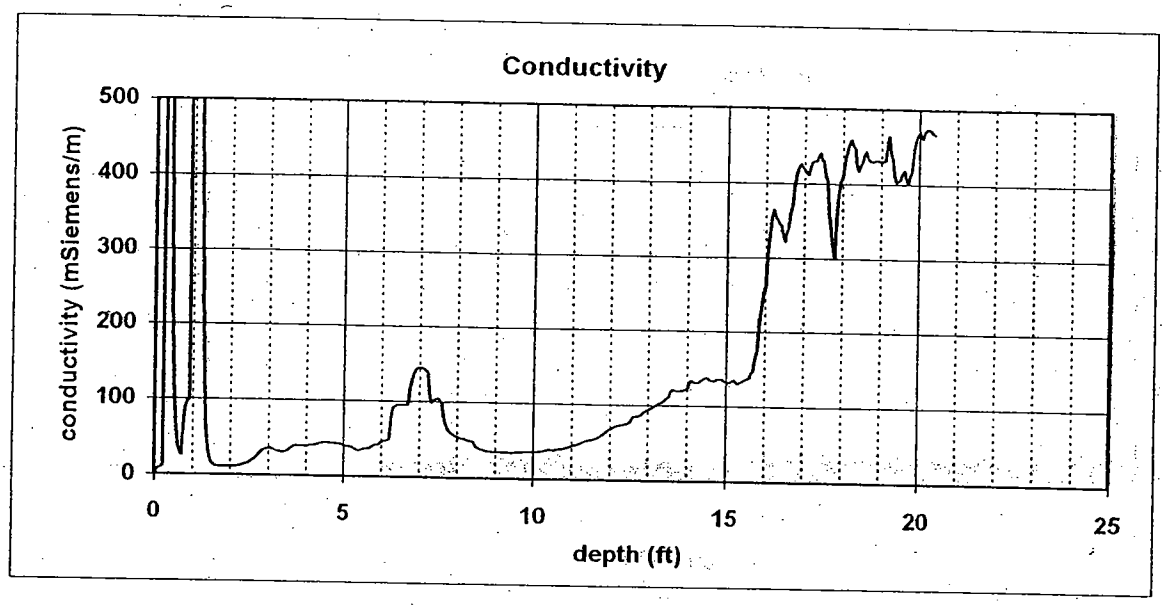

Temperature
(C)
130
120
110
100
90
80
70
0
5
10
15
20
25
depth (ft)

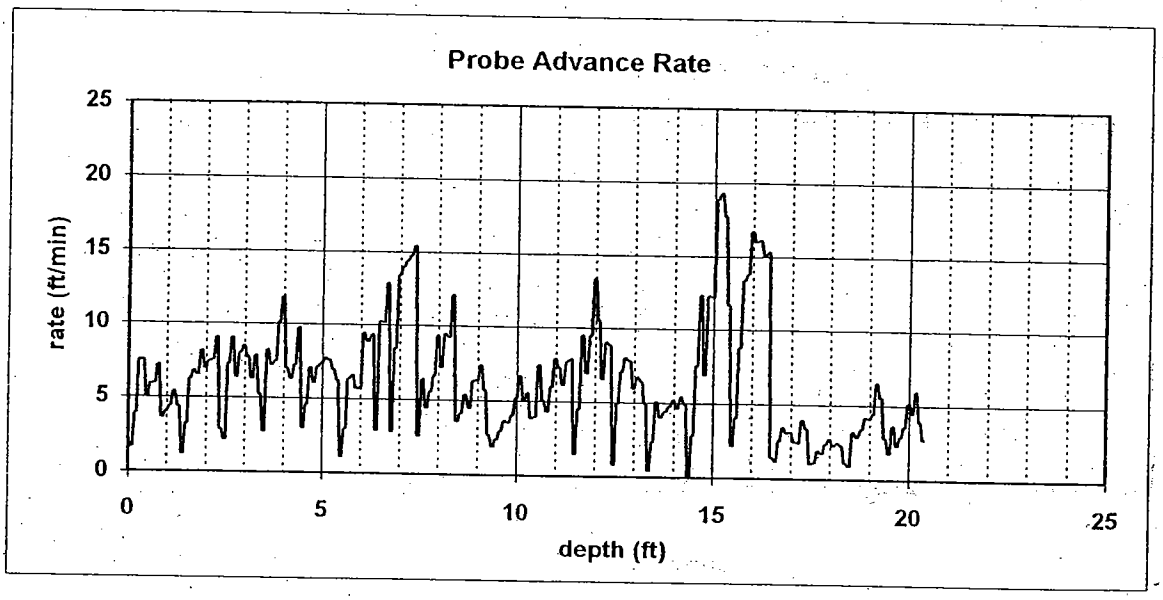

FID Response
FID Response (uV)
25,000
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

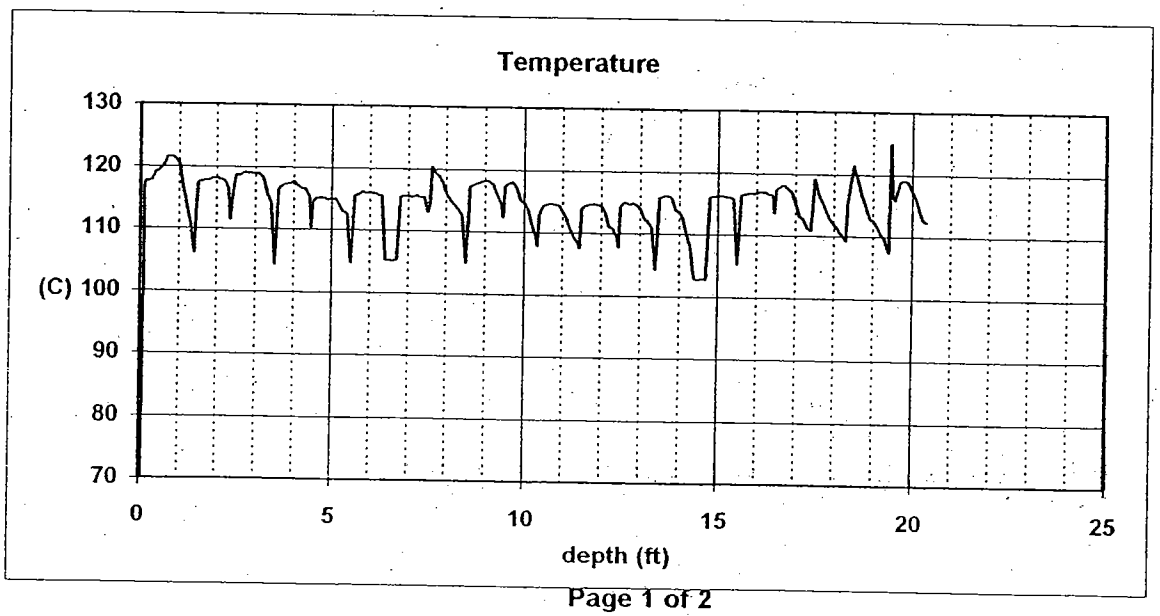

ECD Response
ECD Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)


PID Response
PID Response (uV)
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

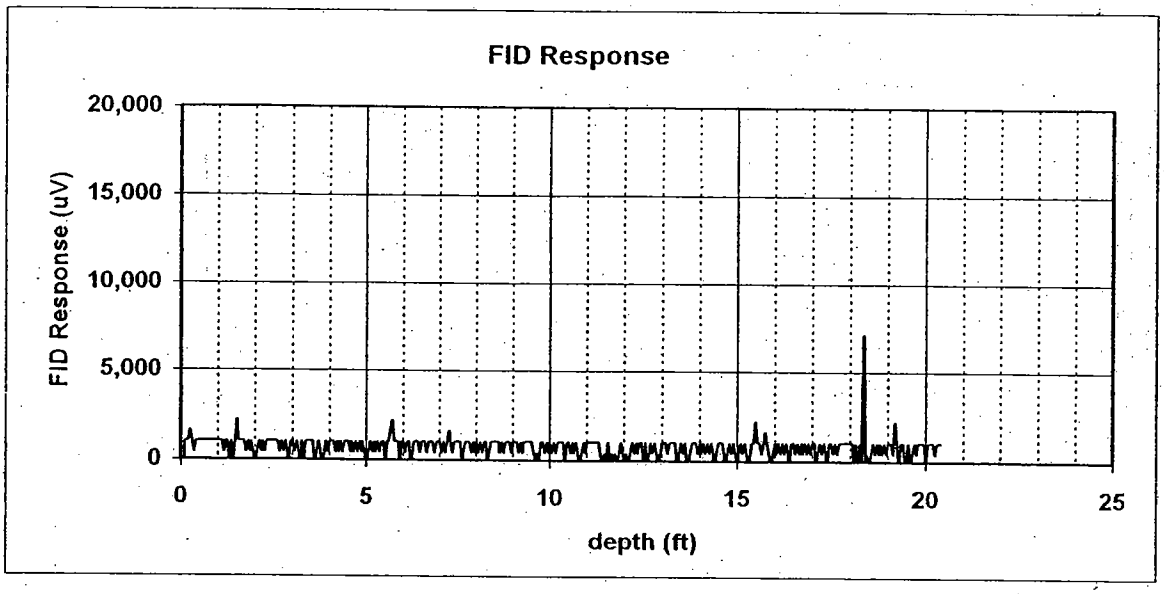
SB-128 (Field)

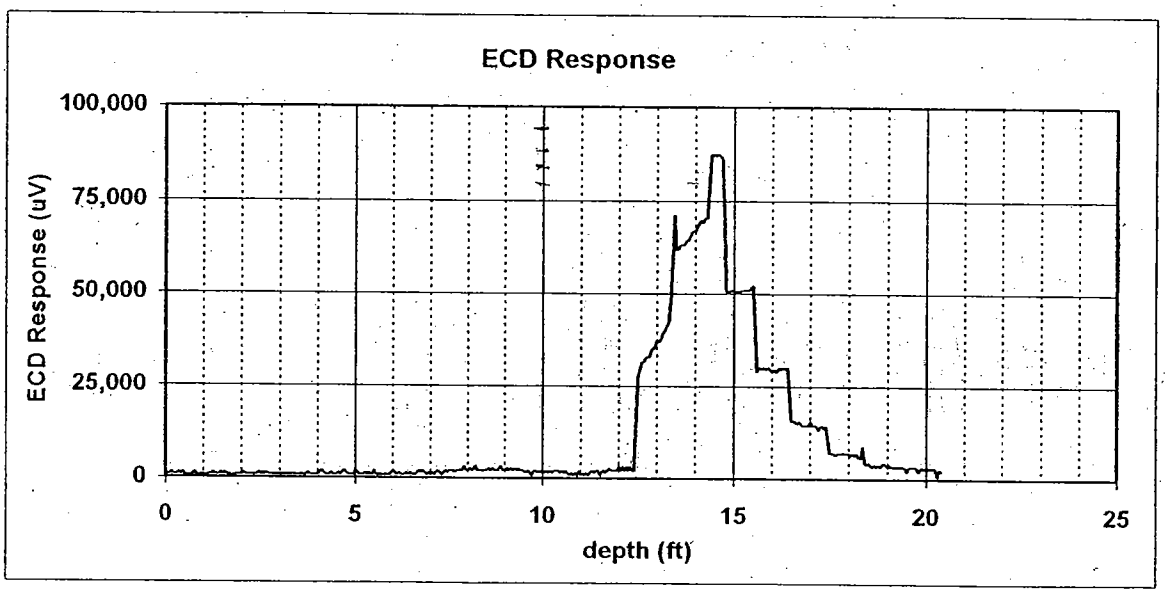

Conductivity
conductivity (mSiemens/m)
500
400
300
200
100
0
0
5
10
15
20
25
depth (ft)

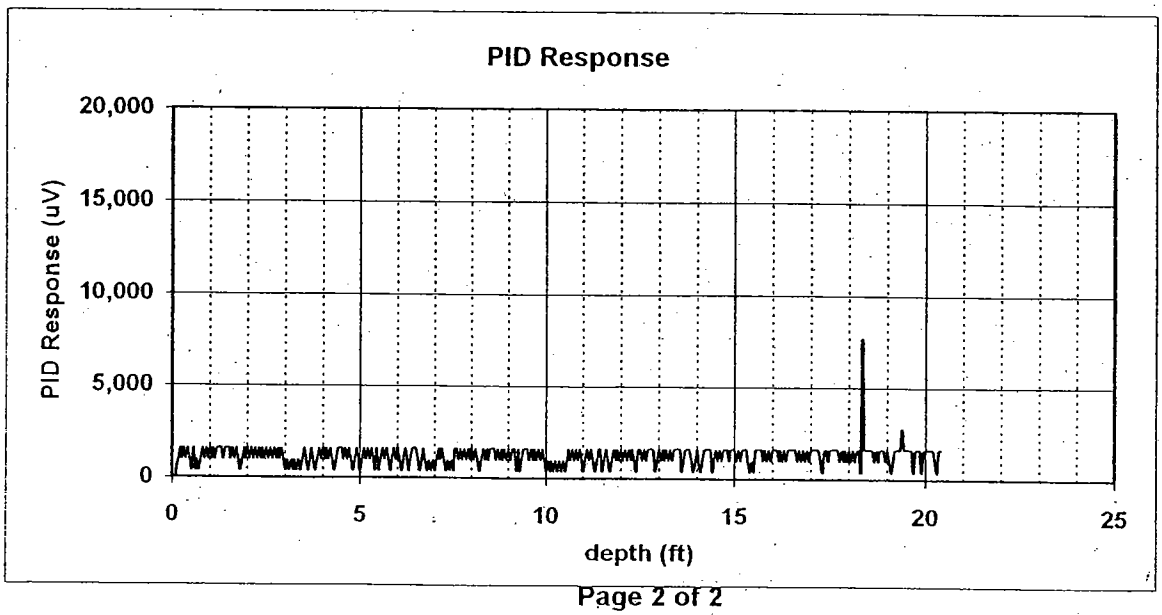

Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)


Temperature
(C)
130
120
110
100
90
80
70
0
5
10
15
20
25
depth (ft)

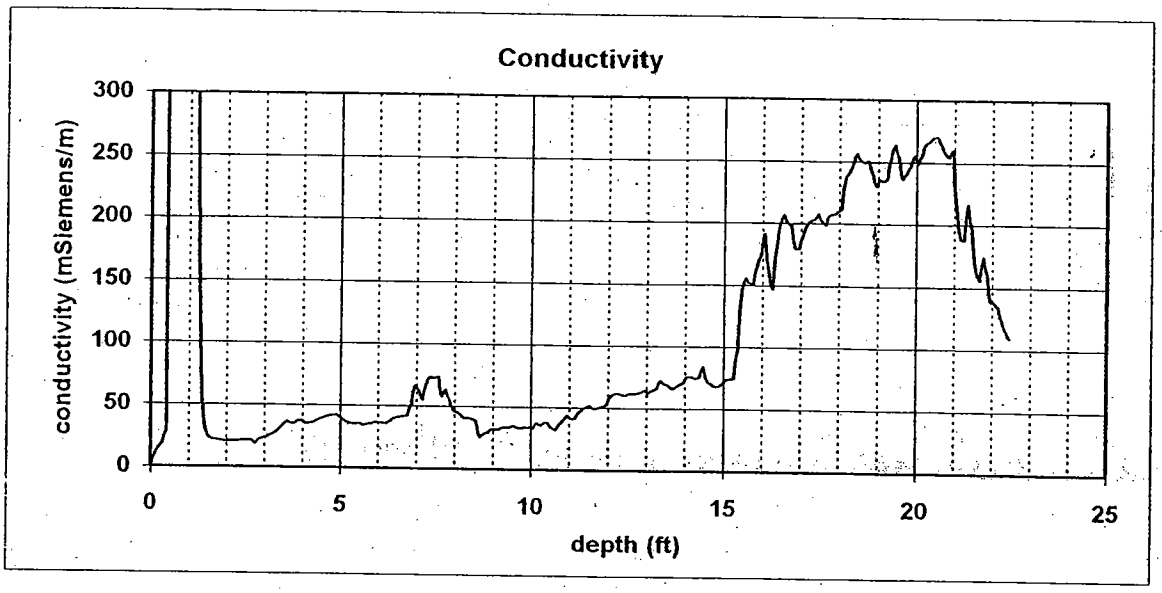
SB-128 (Field)

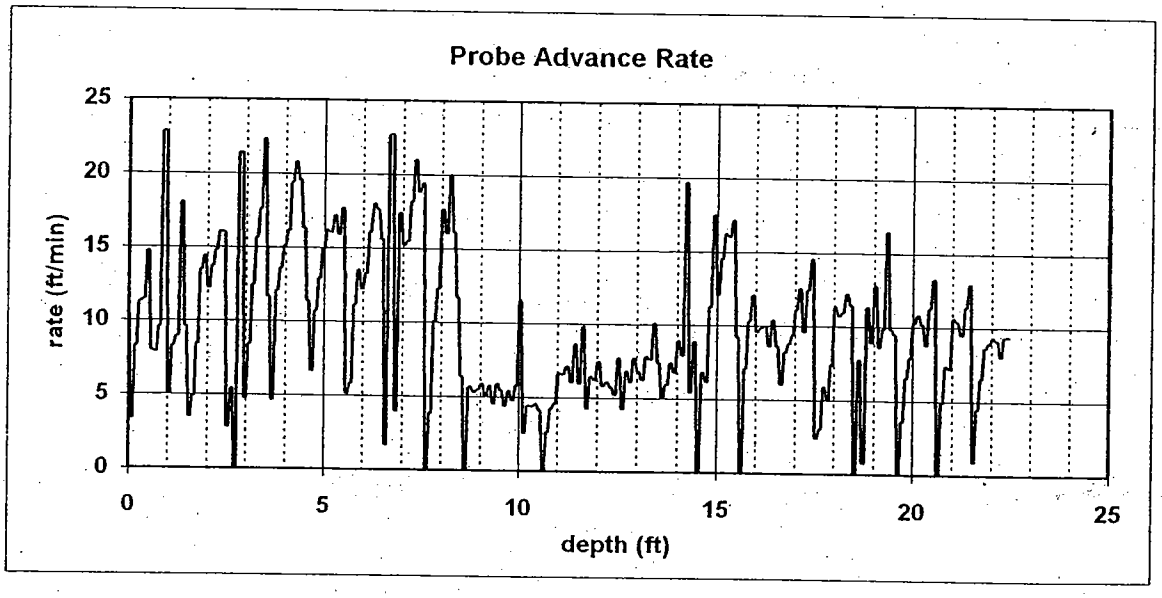

FID Response
FID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

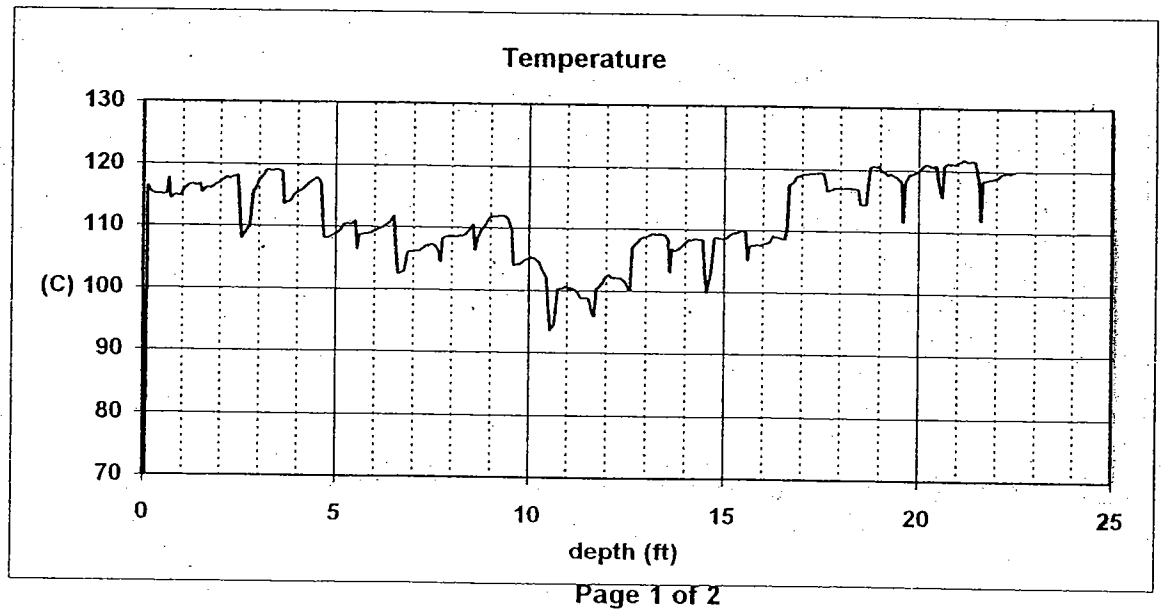

ECD Response
ECD Response (uV)
100,000
75,000
50,000
25,000
0
0
5
10
15
20
25
depth (ft)


PID Response
PID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

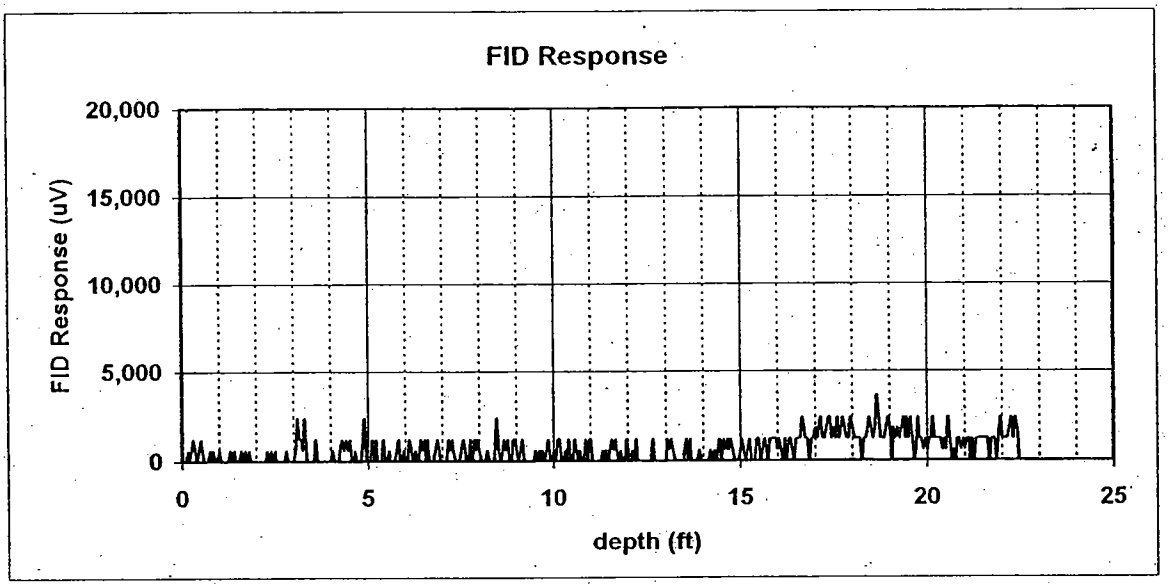
SB-129 (Field)

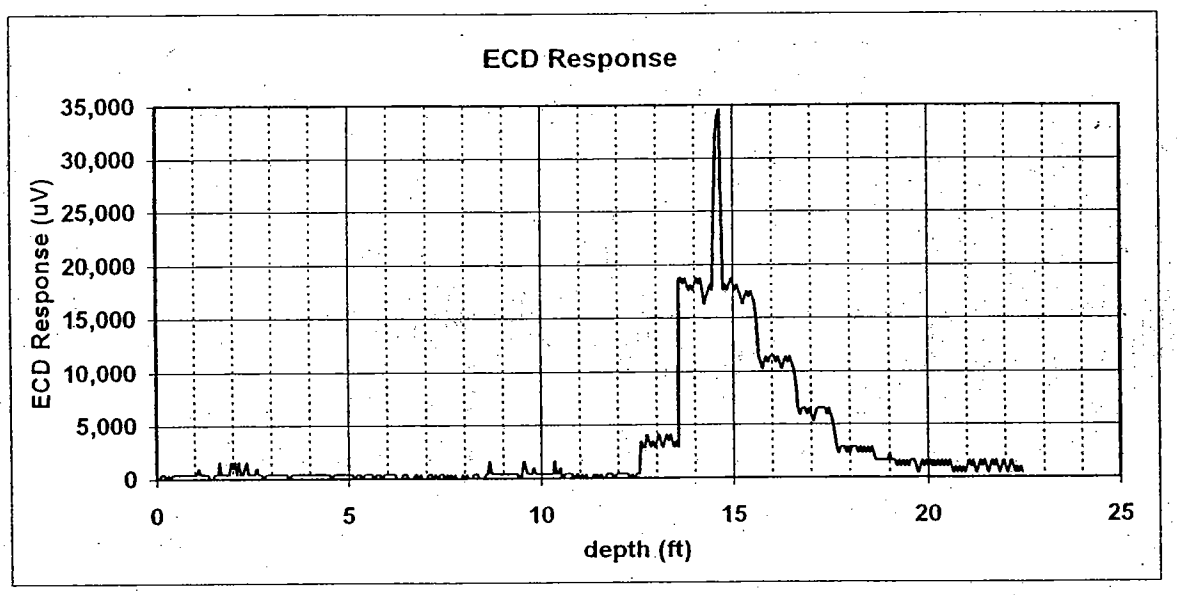

Conductivity
conductivity (mSiemens/m)
300
250
200
150
100
50
0
0
5
10
15
20
25
depth (ft)

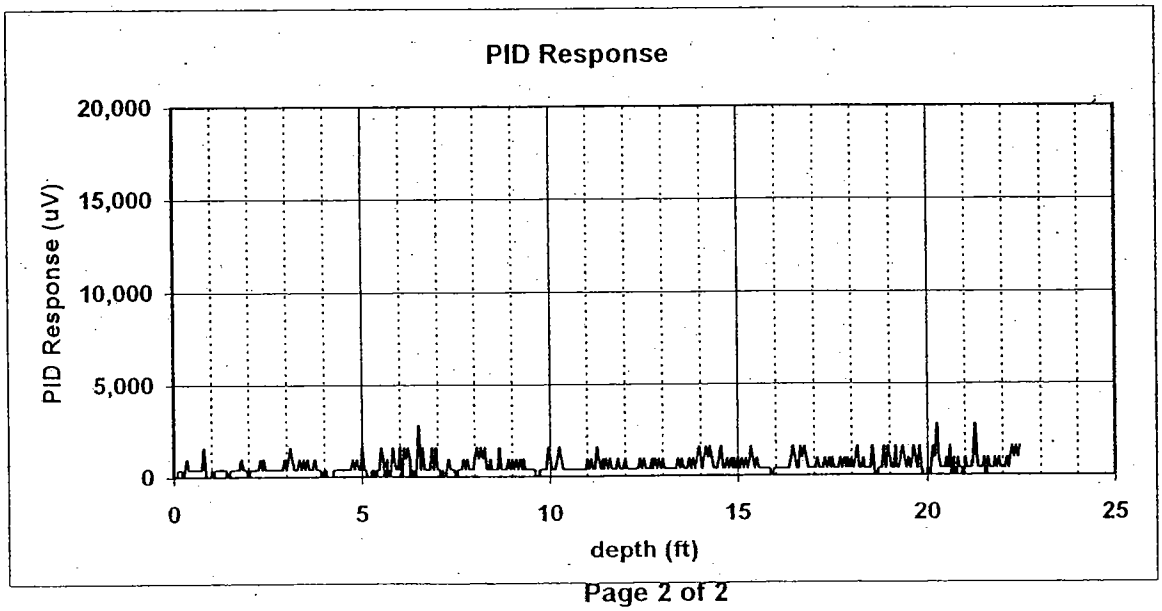

Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)


Temperature
130
120
110
(C) 100
90
80
70
0
5
10
15
20
25
depth (ft)

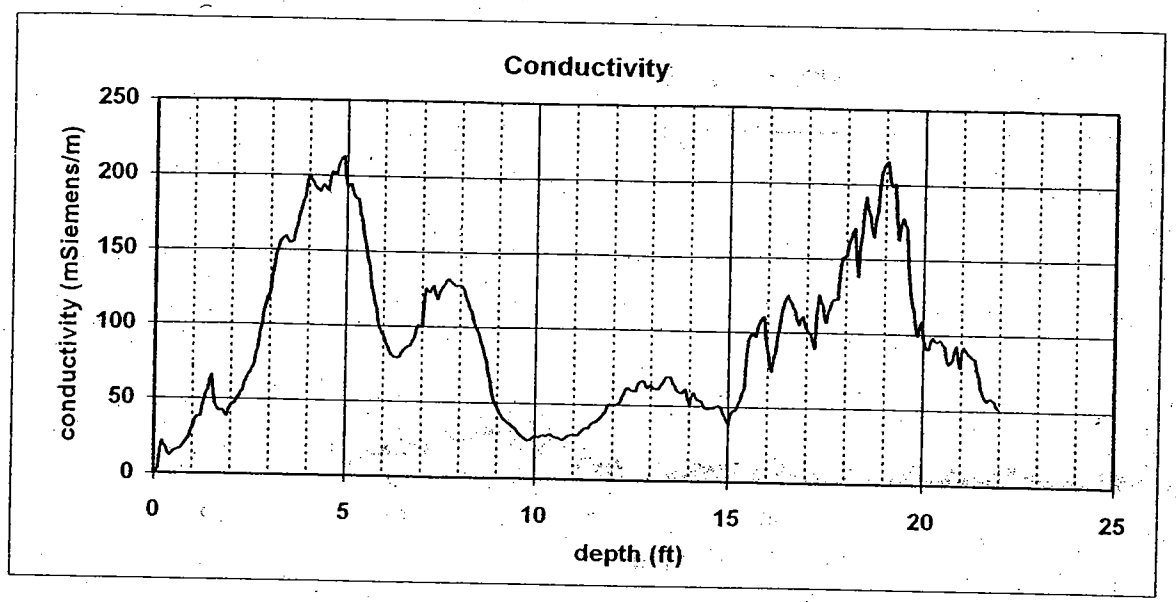
SB-129 (Field)

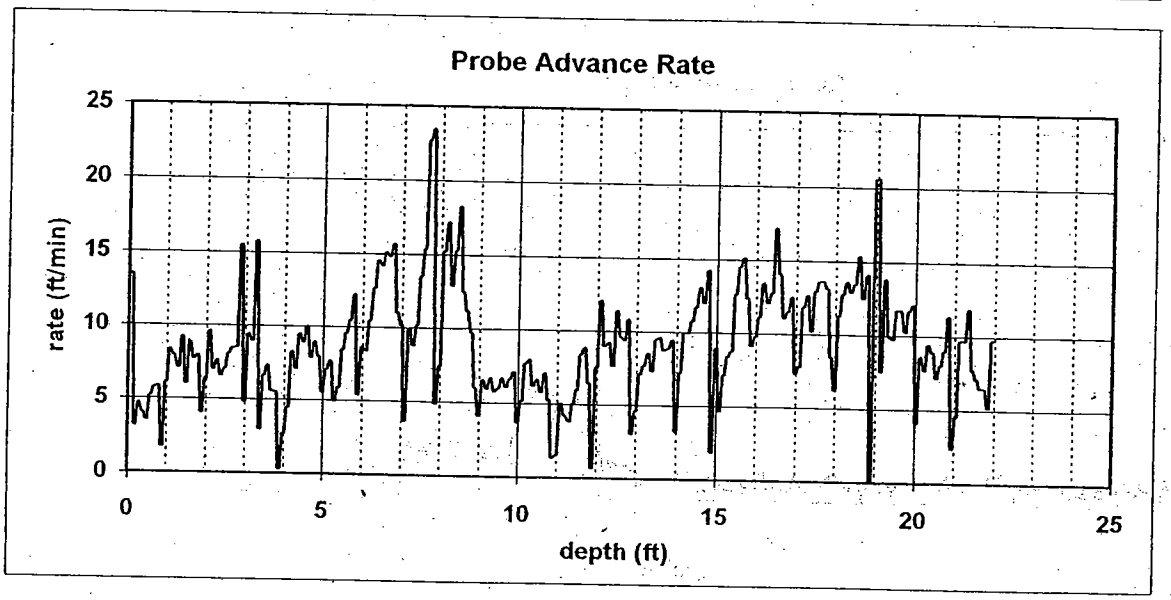

FID Response
FID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

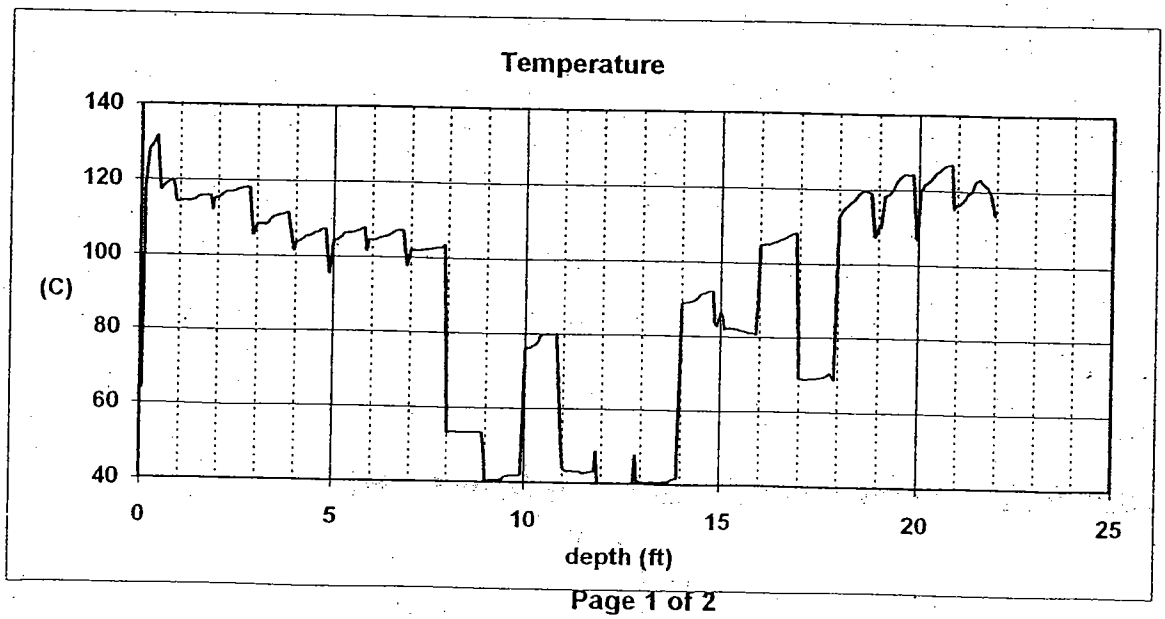

ECD Response
ECD Response (uV)
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)


PID Response
PID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

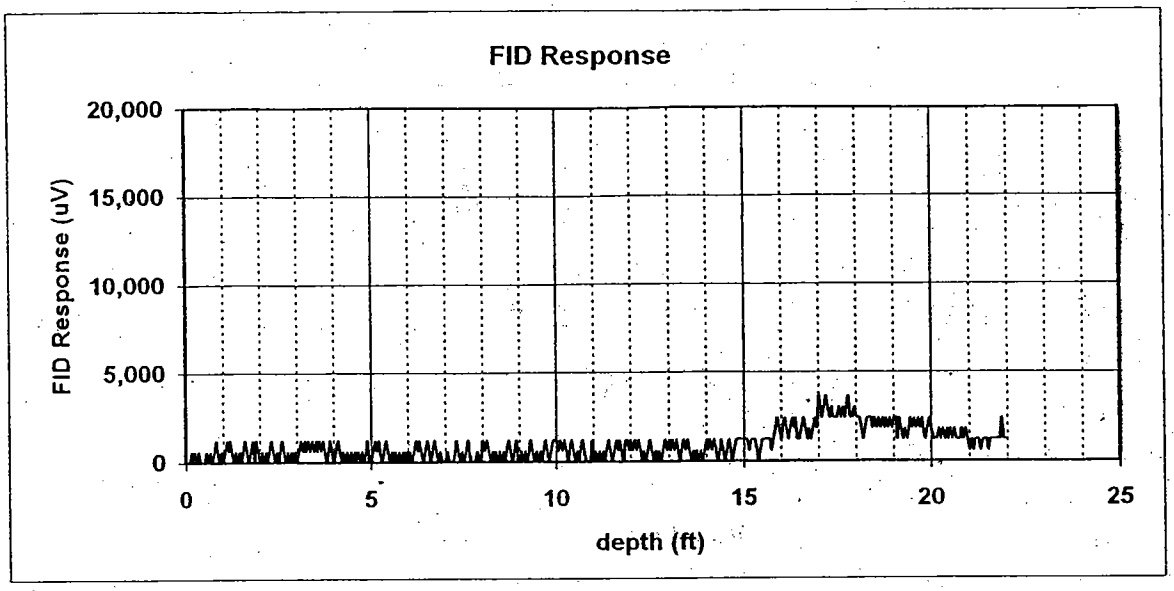
SB-130 (Field)

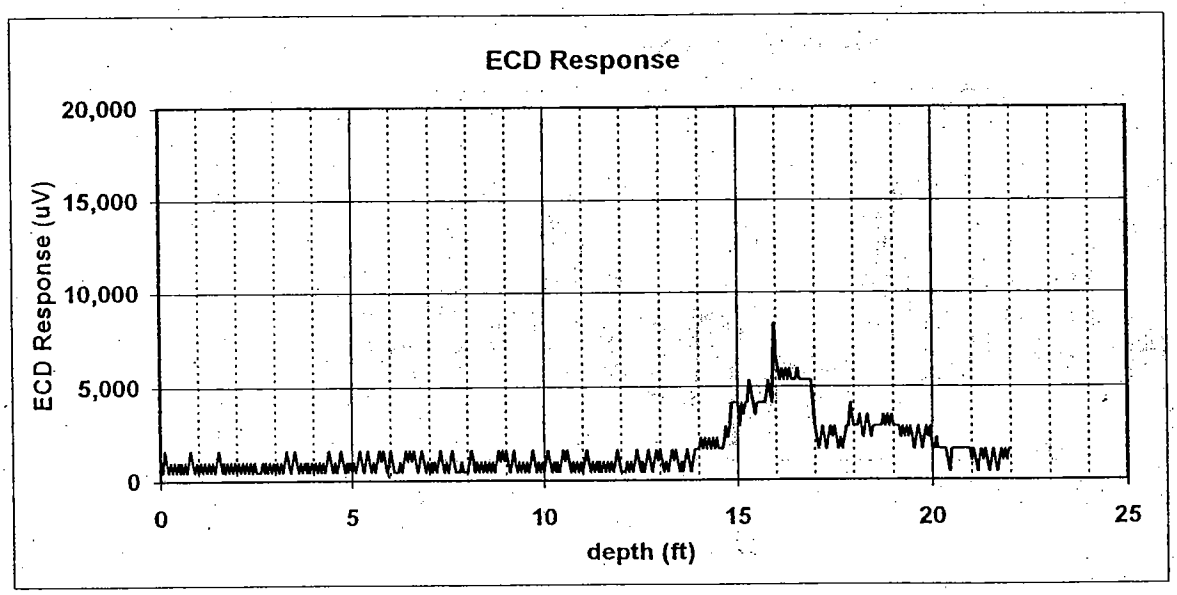

Conductivity
conductivity (mSiemens/m)
250
200
150
100
50
0
0
5
10
15
20
25
depth (ft)

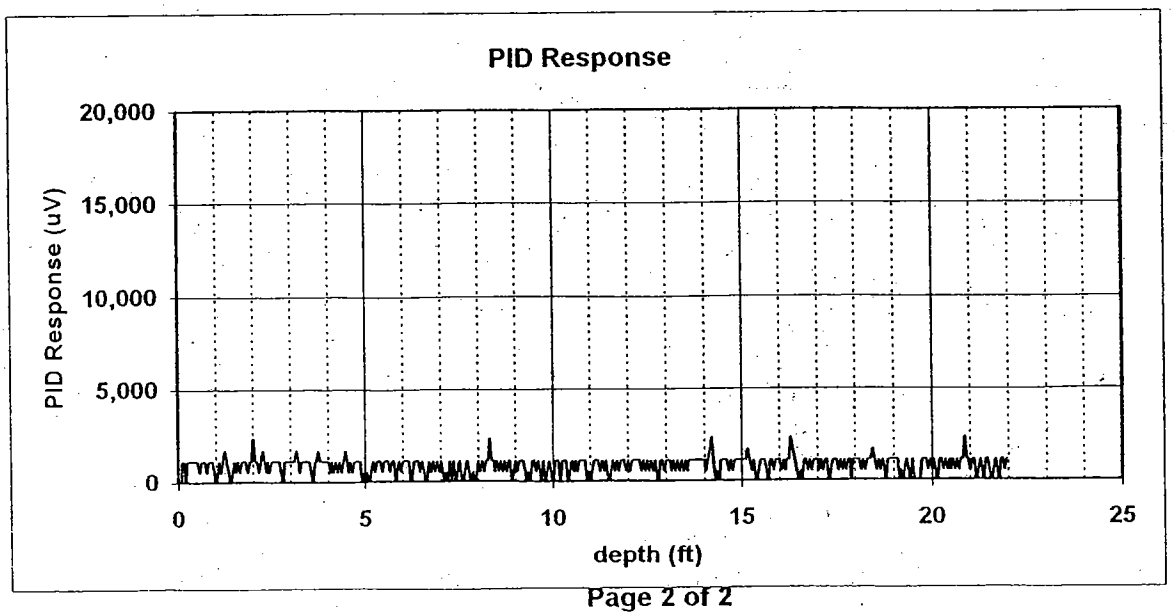

Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)


Temperature
(C)
140
120
100
80
60
40
0
5
10
15
20
25
depth (ft)

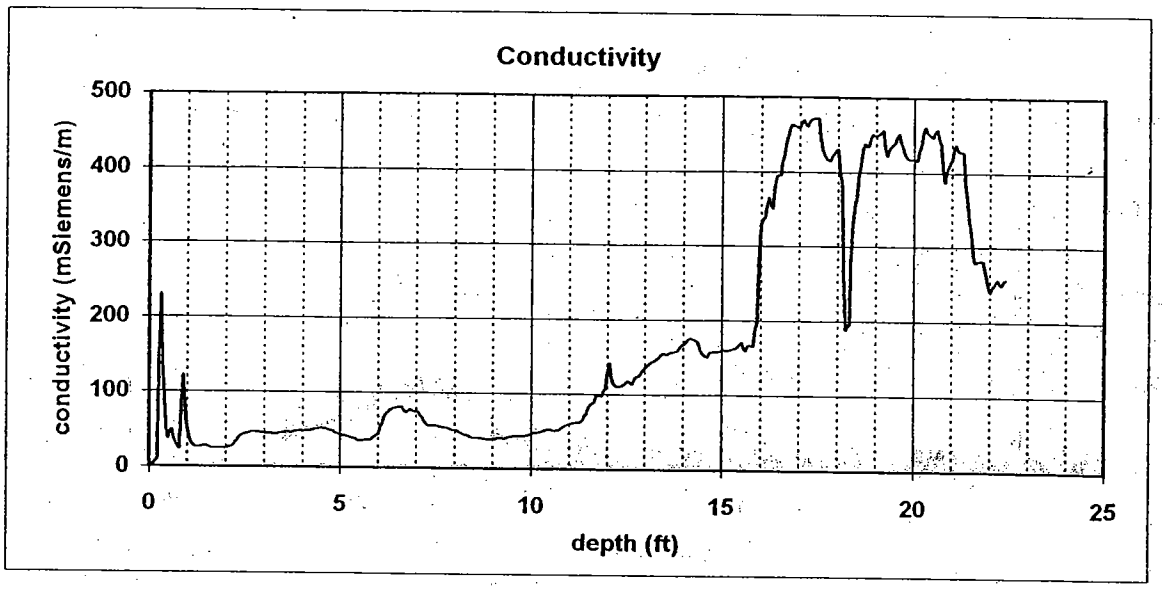
SB-130 (Field)

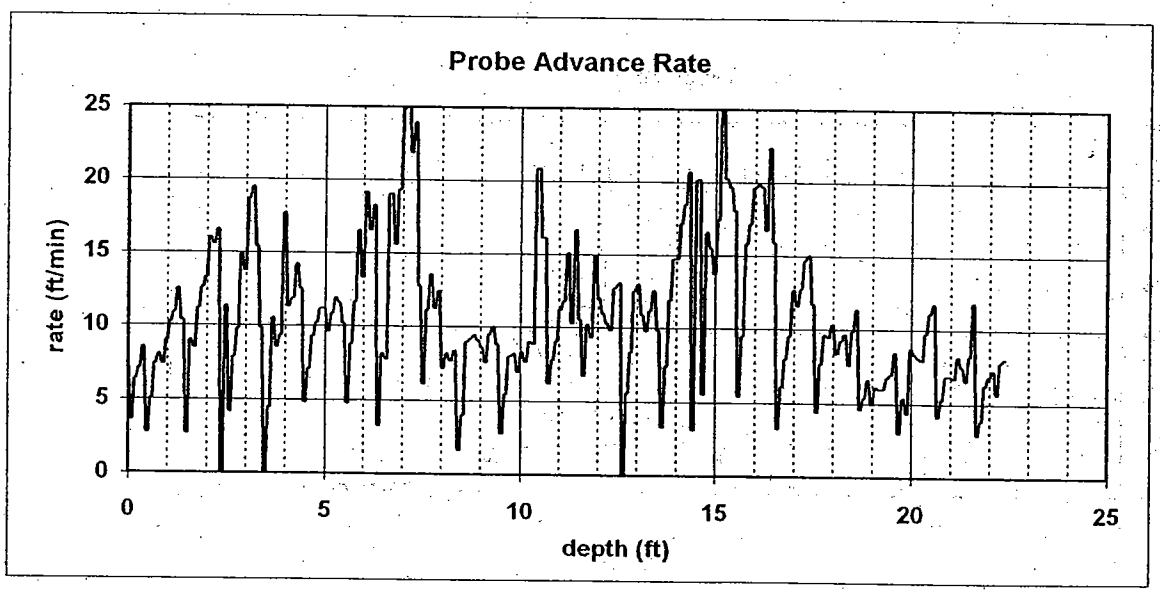

FID Response
FID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

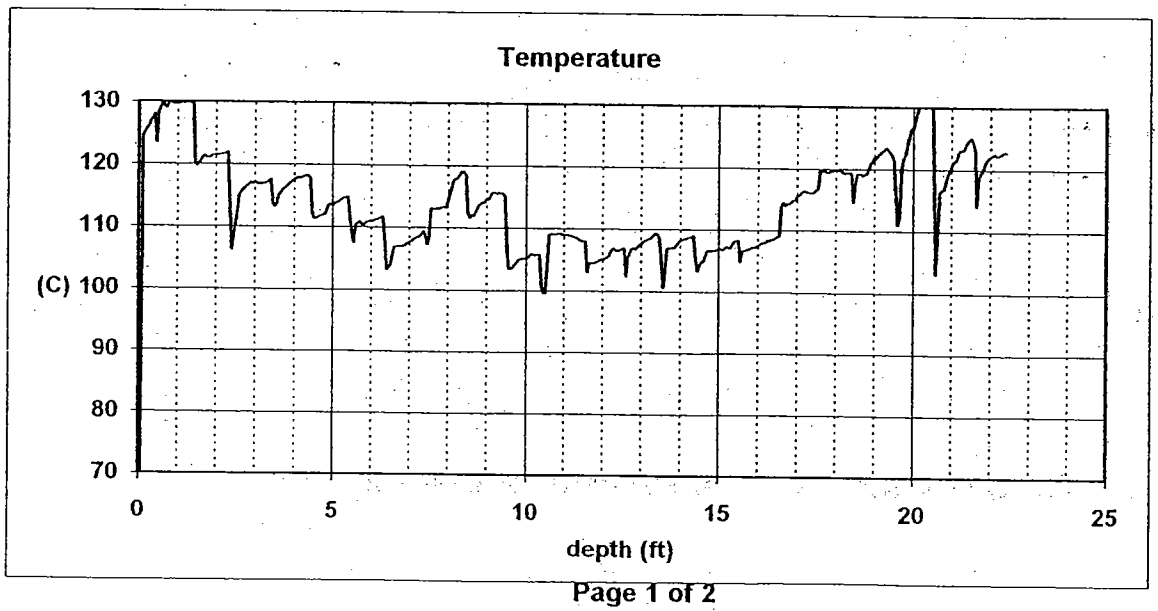

ECD Response
ECD Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)


PID Response
PID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

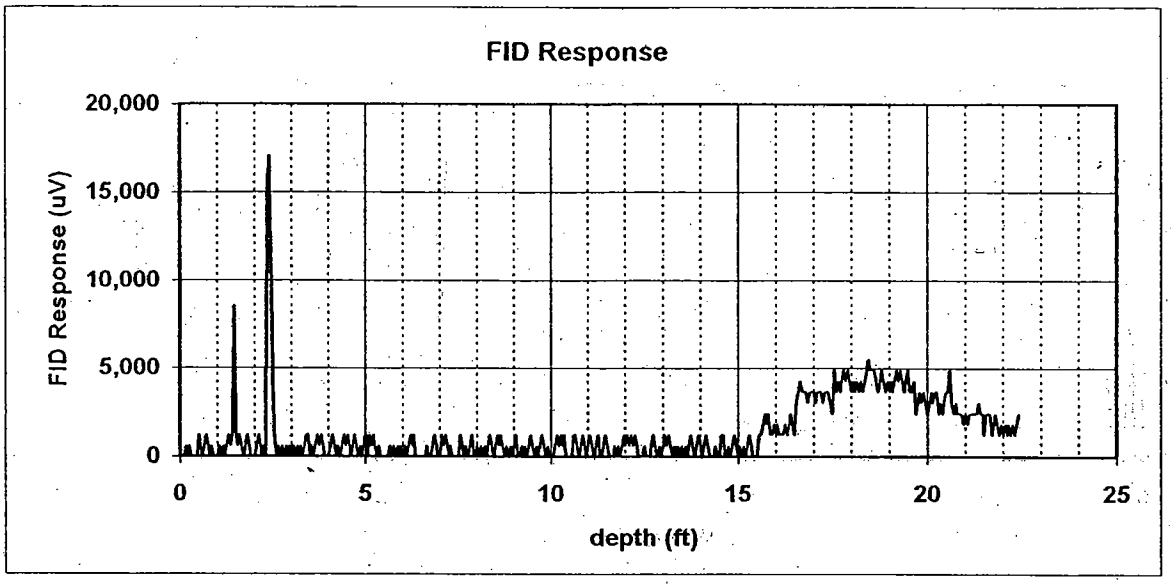
SB-131 (Field)

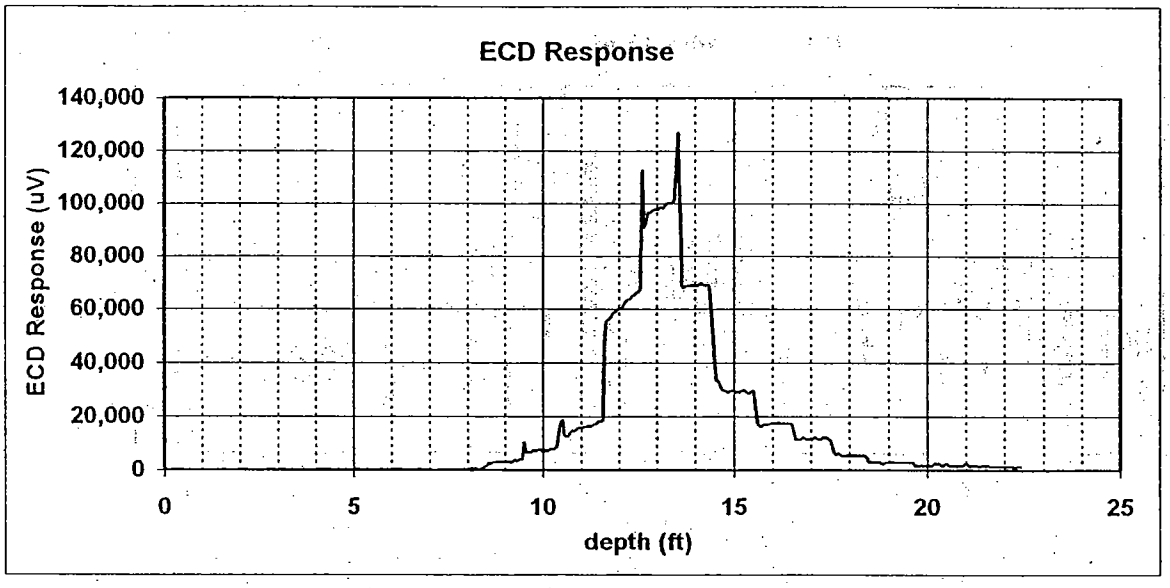

Conductivity
conductivity (mSiemens/m)
500
400
300
200
100
0
0
5
10
15
20
25
depth (ft)

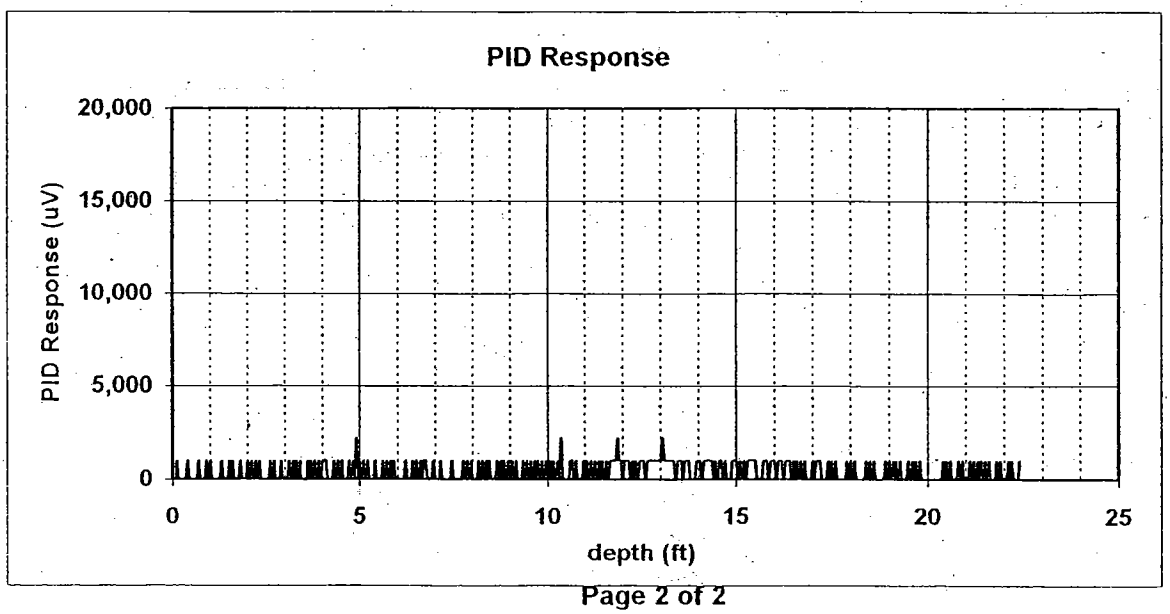

Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)


Temperature
(C)
130
120
110
100
90
80
70
0
5
10
15
20
25
depth (ft)

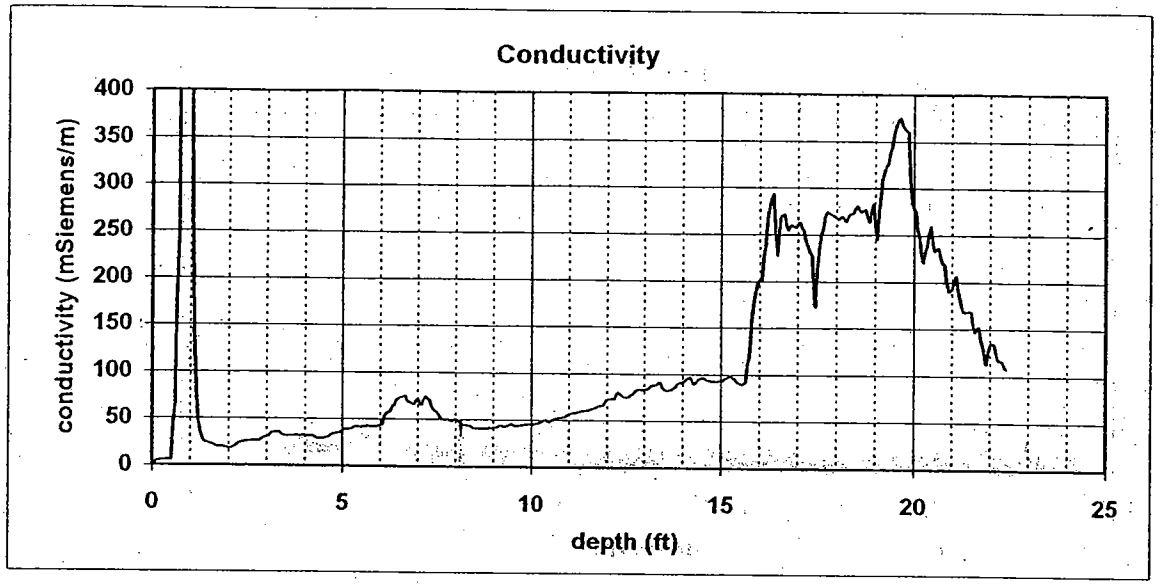
SB-131 (Field)

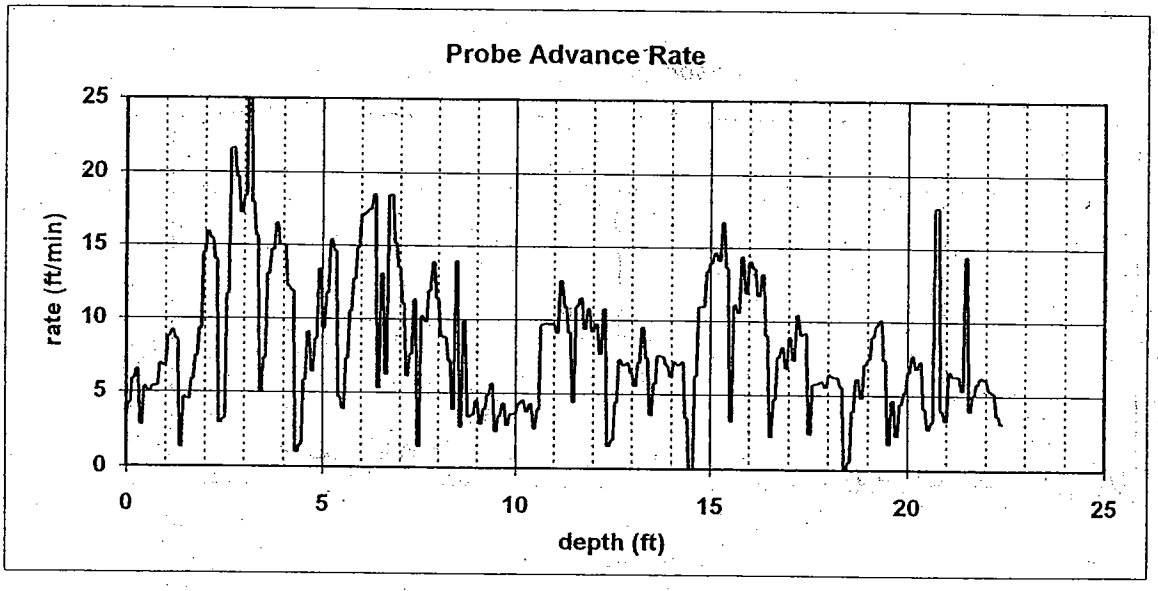

FID Response
FID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

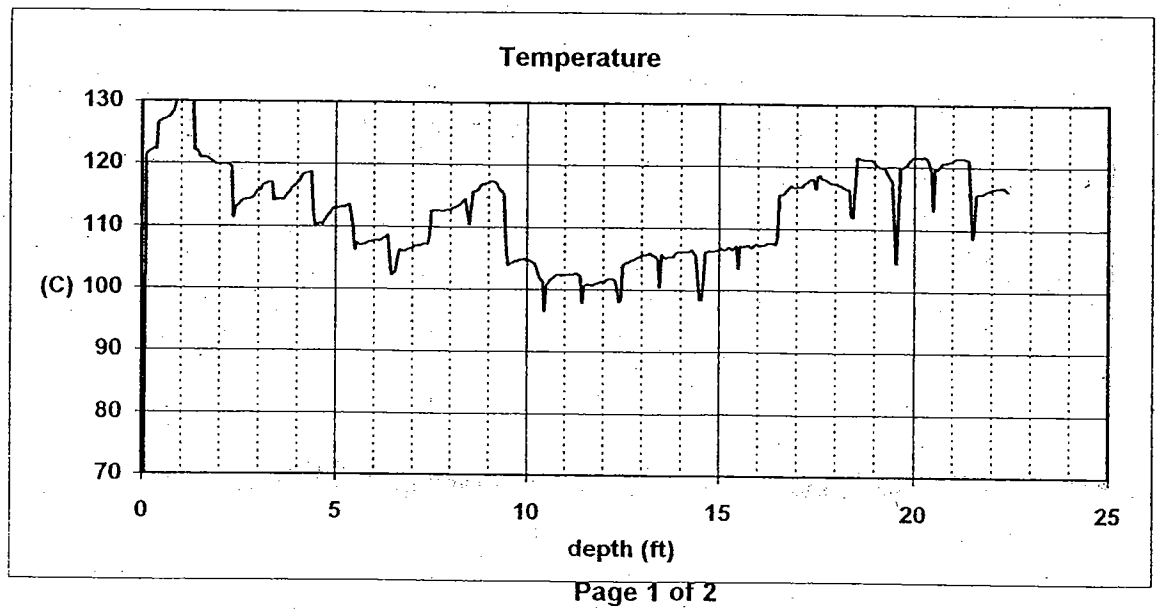

ECD Response
ECD Response (uV)
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
0
5
10
15
20
25
depth (ft)


PID Response
PID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

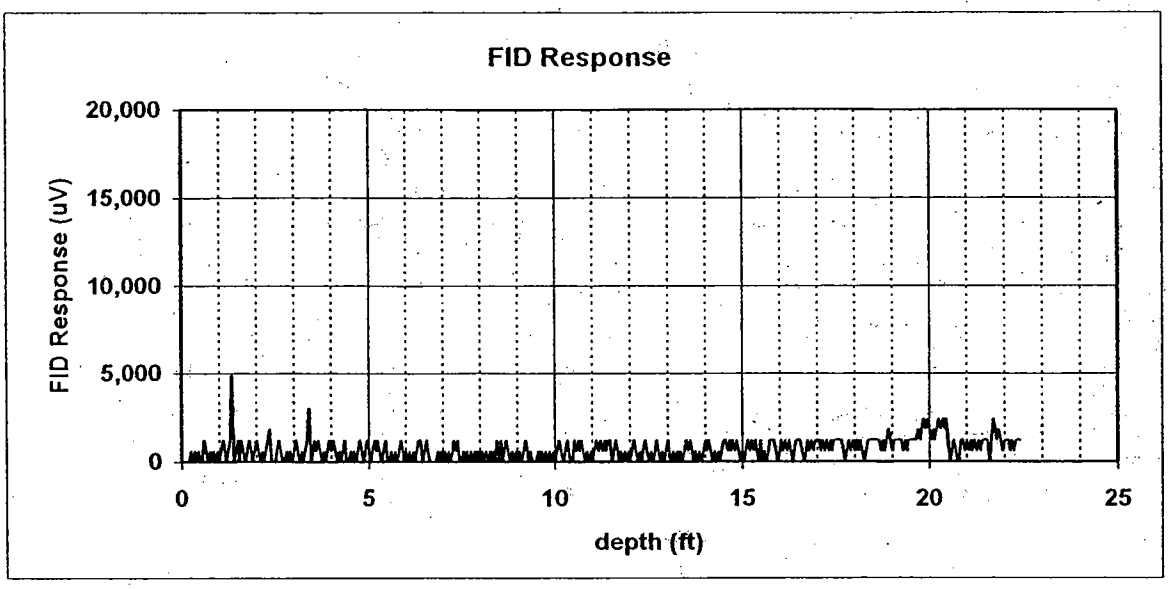
SB-132 (Field)

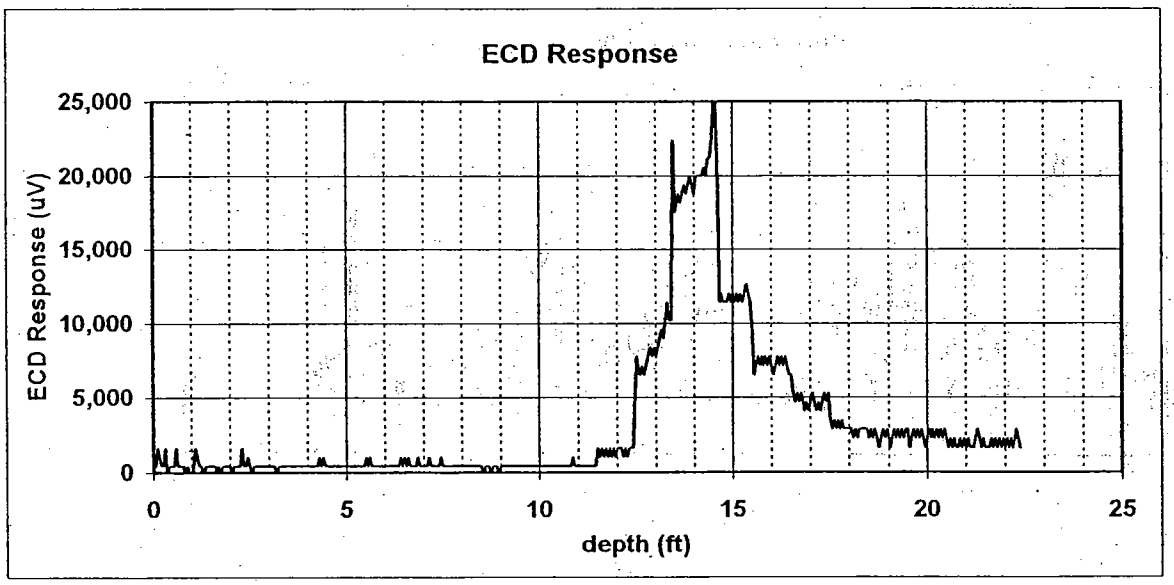

Conductivity
conductivity (mSiemens/m)
400
350
300
250
200
150
100
50
0
0
5
10
15
20
25
depth (ft)

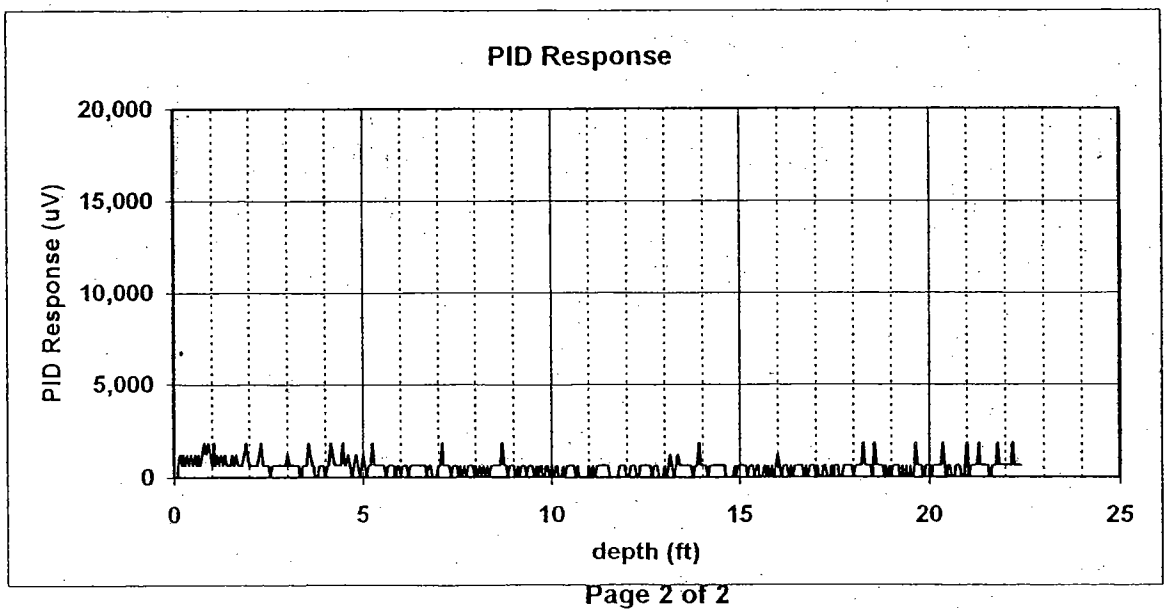

Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)


Temperature
(C)
130
120
110
100
90
80
70
0
5
10
15
20
25
depth (ft)

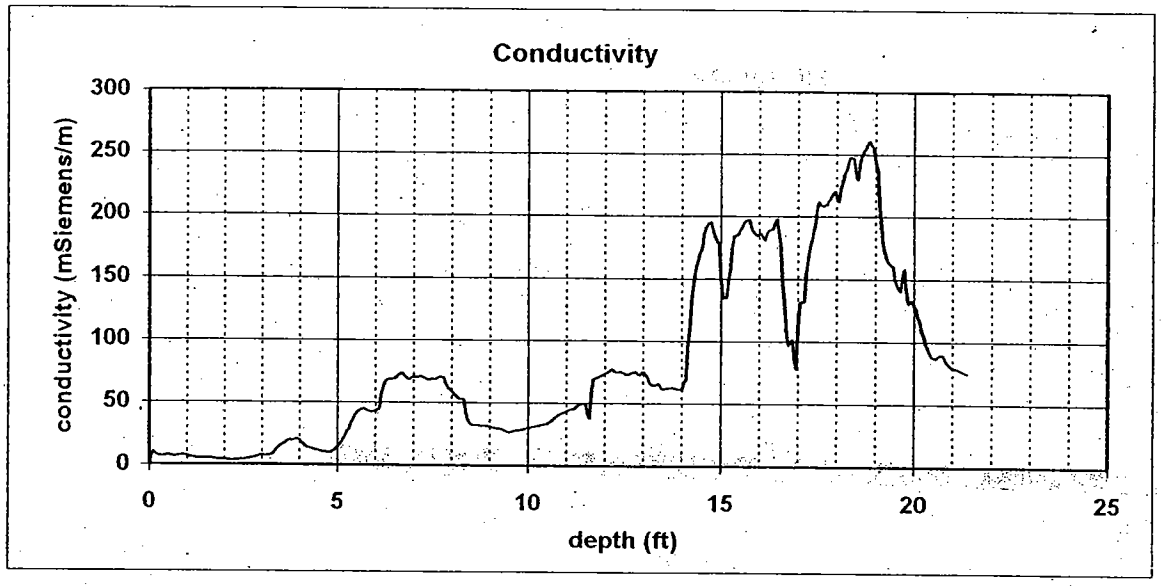
SB-132 (Field)

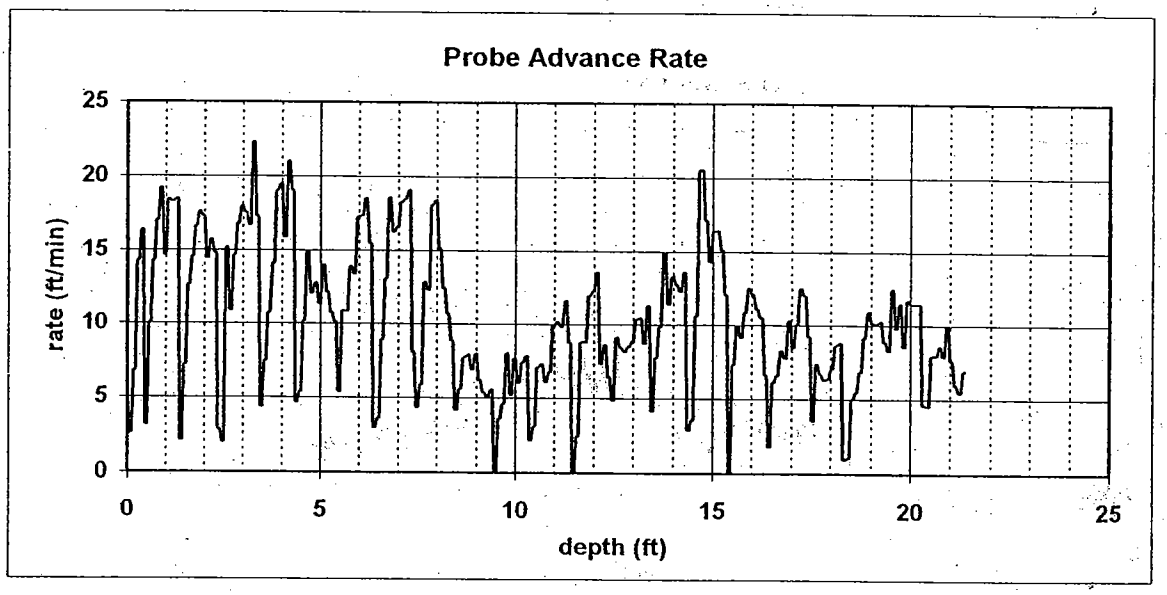

FID Response
FID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

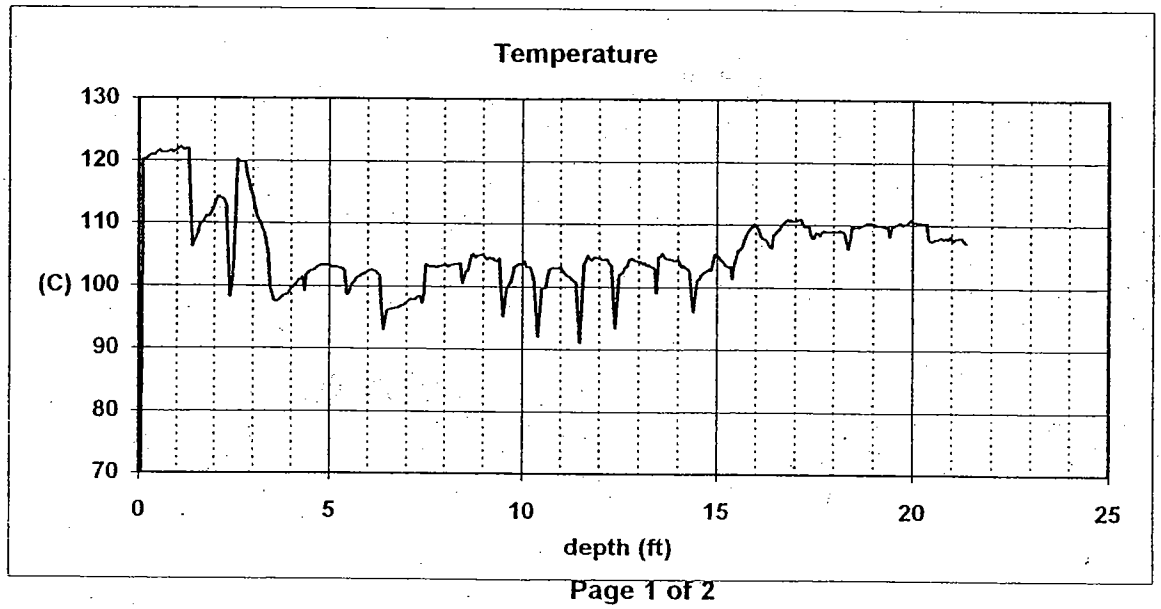

ECD Response
ECD Response (uV)
25,000
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)


PID Response
PID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

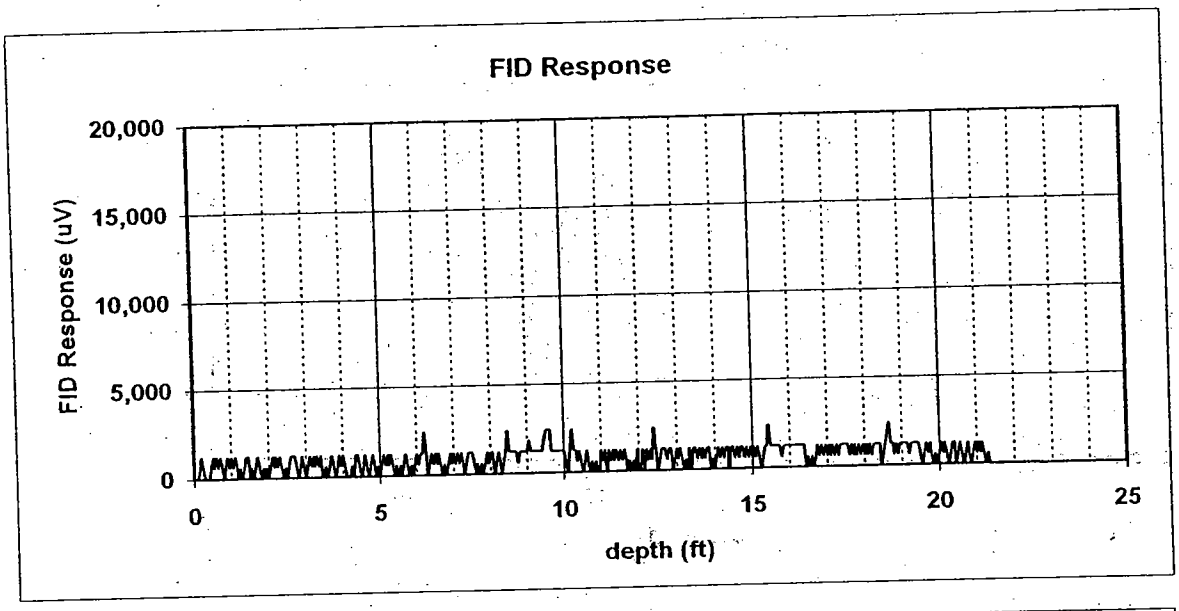
SB-133 (Field)

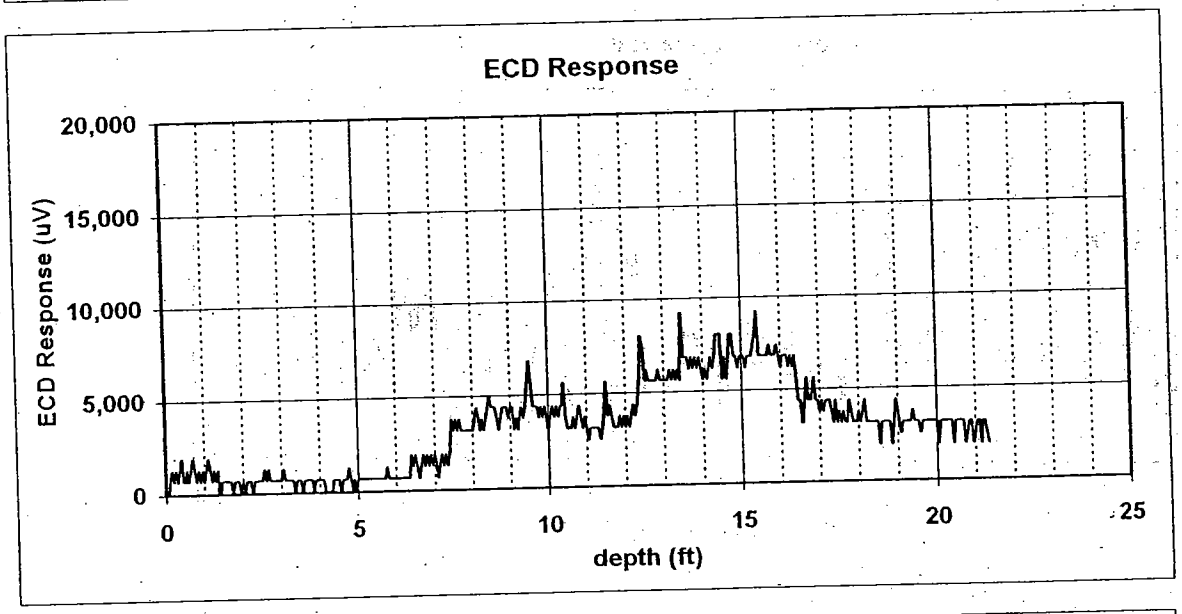

Conductivity
conductivity (mSiemens/m)
300
250
200
150
100
50
0
0
5
10
15
20
25
depth (ft)

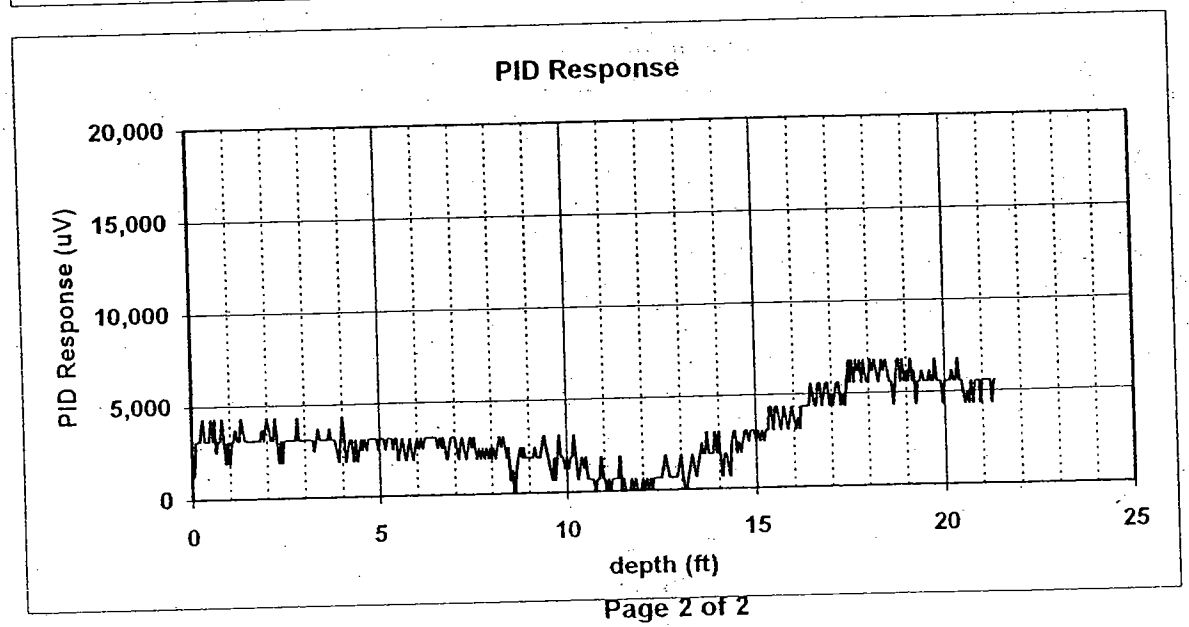

Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)


Temperature
(C)
130
120
110
100
90
80
70
0
5
10
15
20
25
depth (ft)

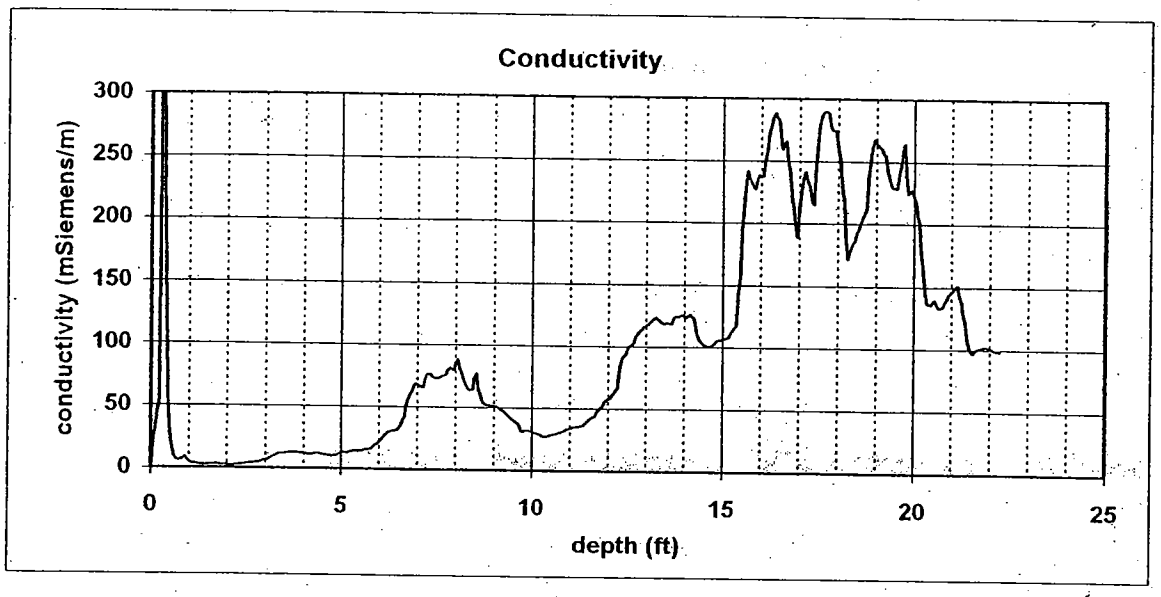
SB-133 (Field)

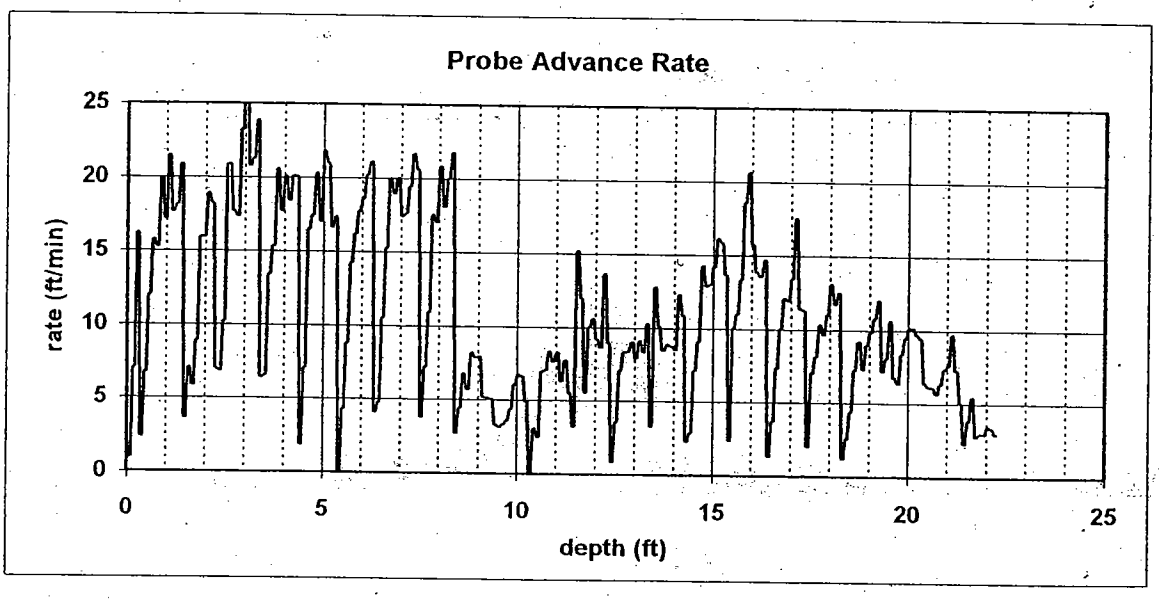

FID Response
FID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

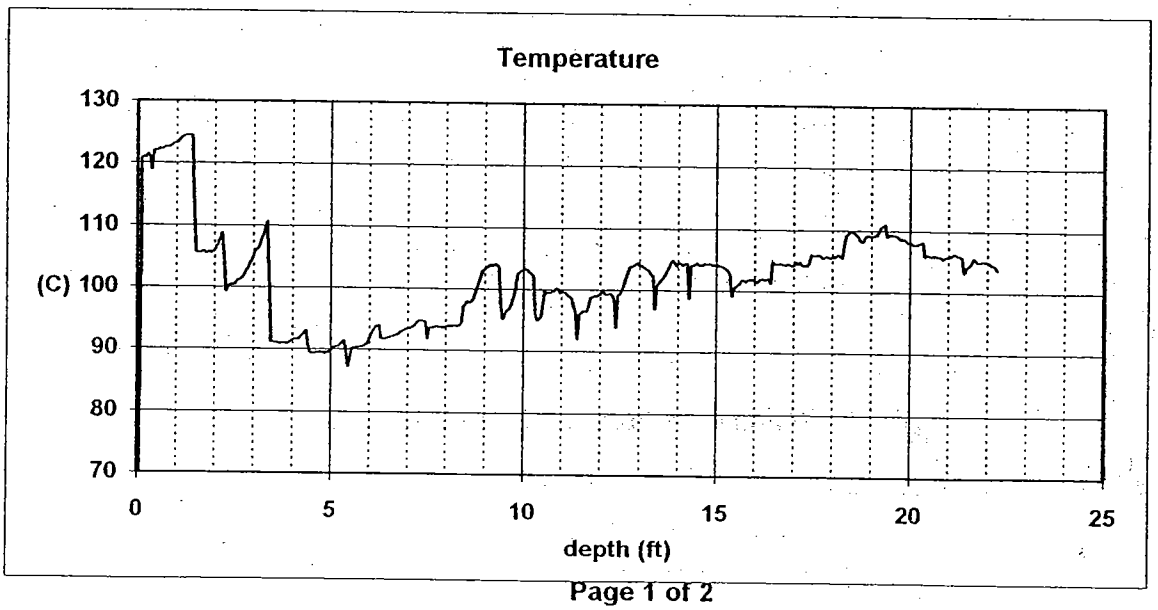

ECD Response
ECD Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)


PID Response
PID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

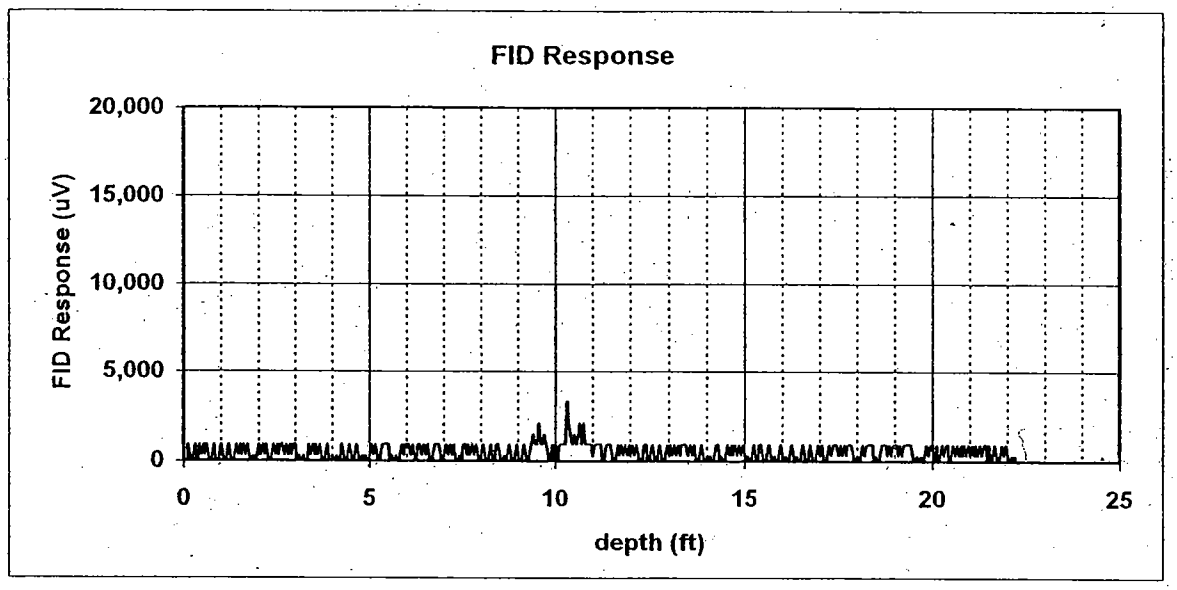
SB-136 (Field)

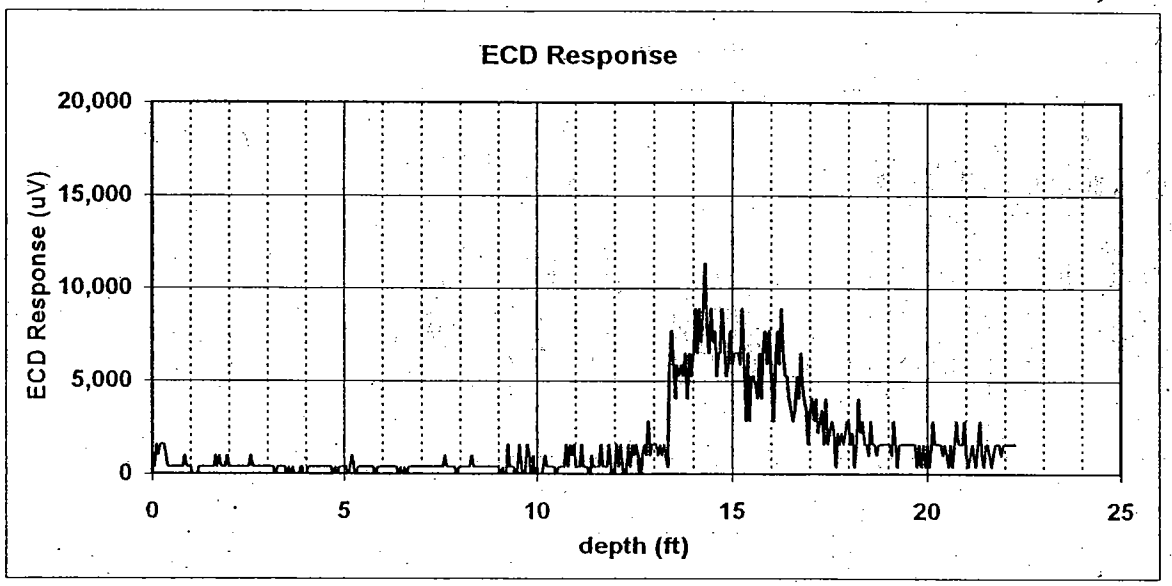

Conductivity
conductivity (mSiemens/m)
300
250
200
150
100
50
0
0
5
10
15
20
25
depth (ft)

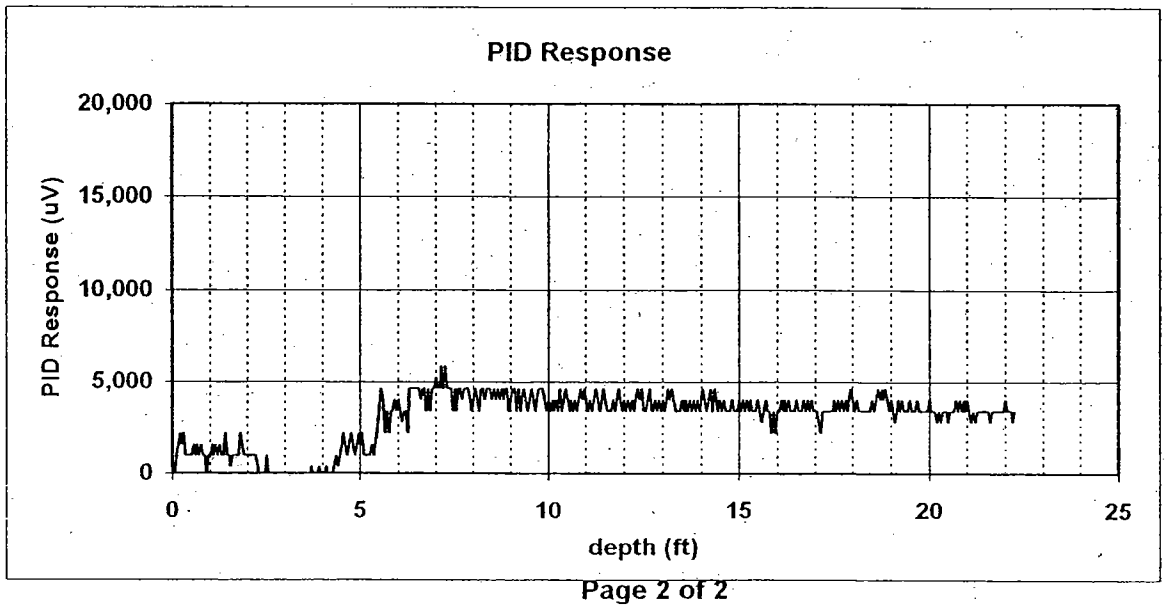

Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)


Temperature
(C)
130
120
110
100
90
80
70
0
5
10
15
20
25
depth (ft)

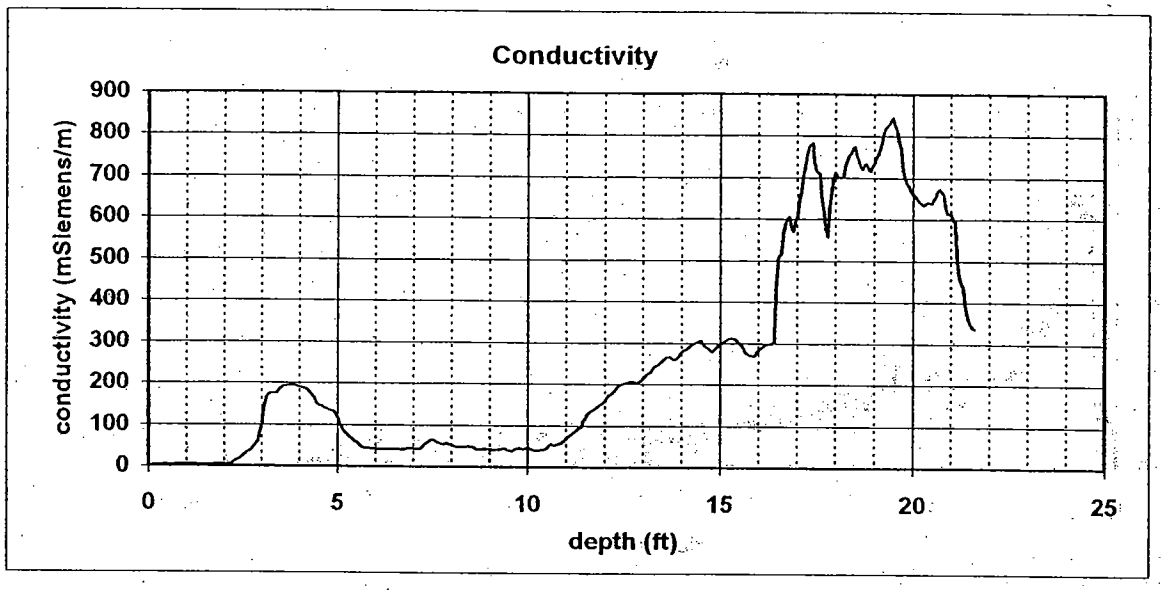
SB-136 (Field)

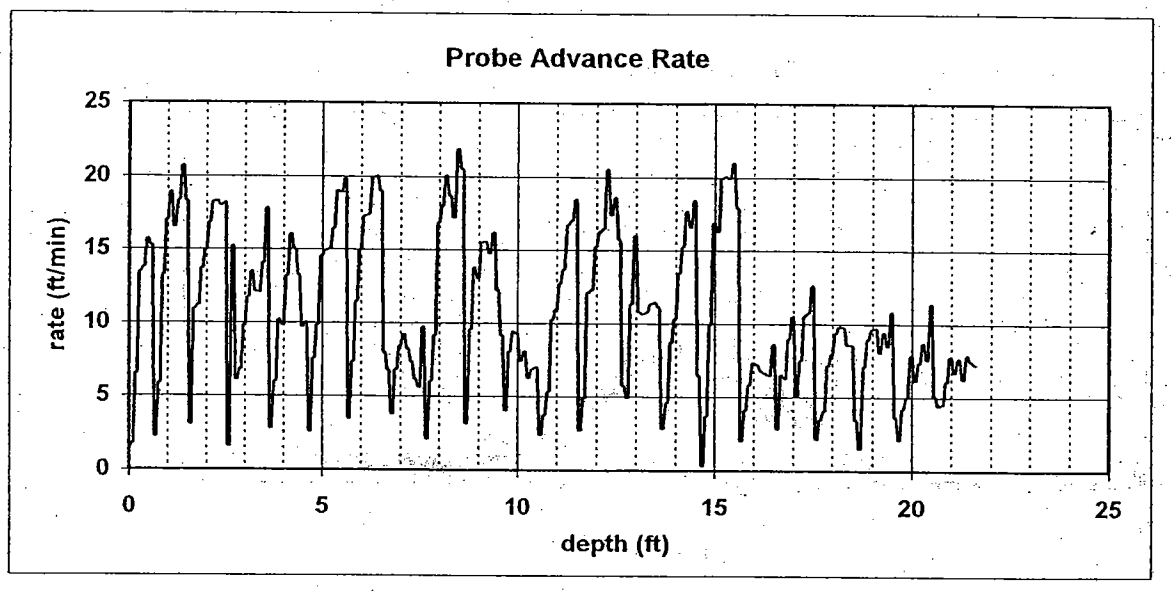

FID Response
FID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

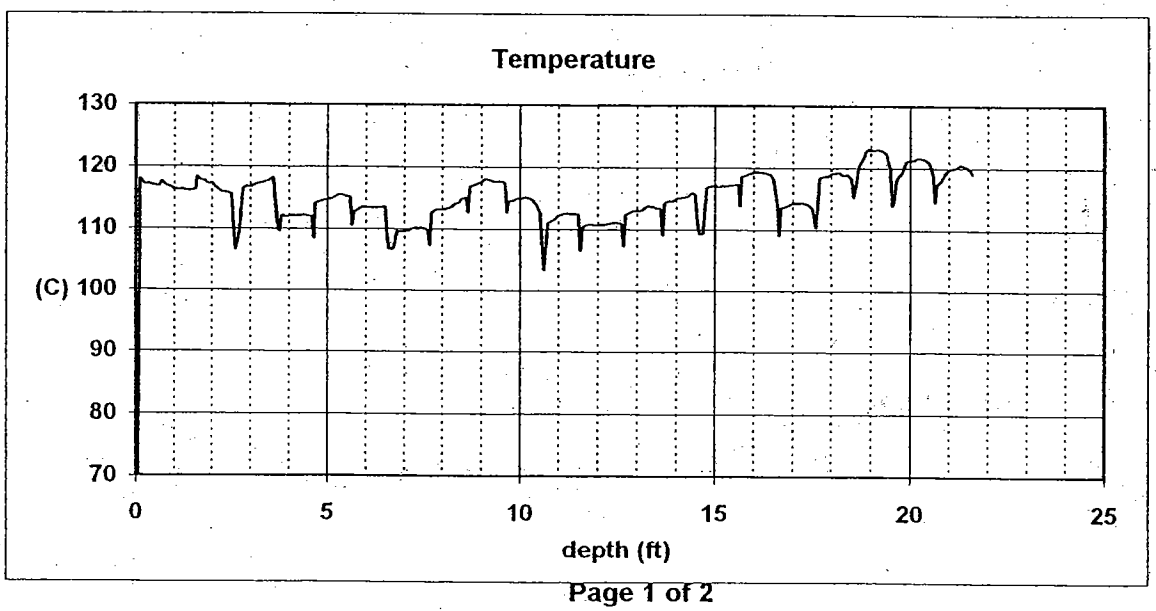

ECD Response
ECD Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)


PID Response
PID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

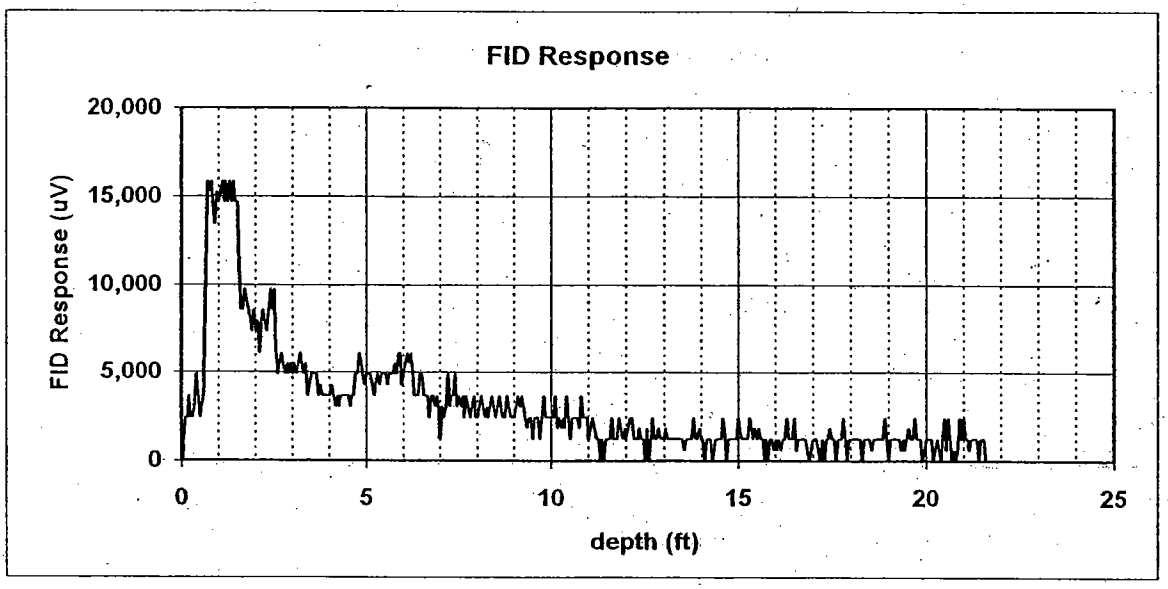
SB-137 (Field)

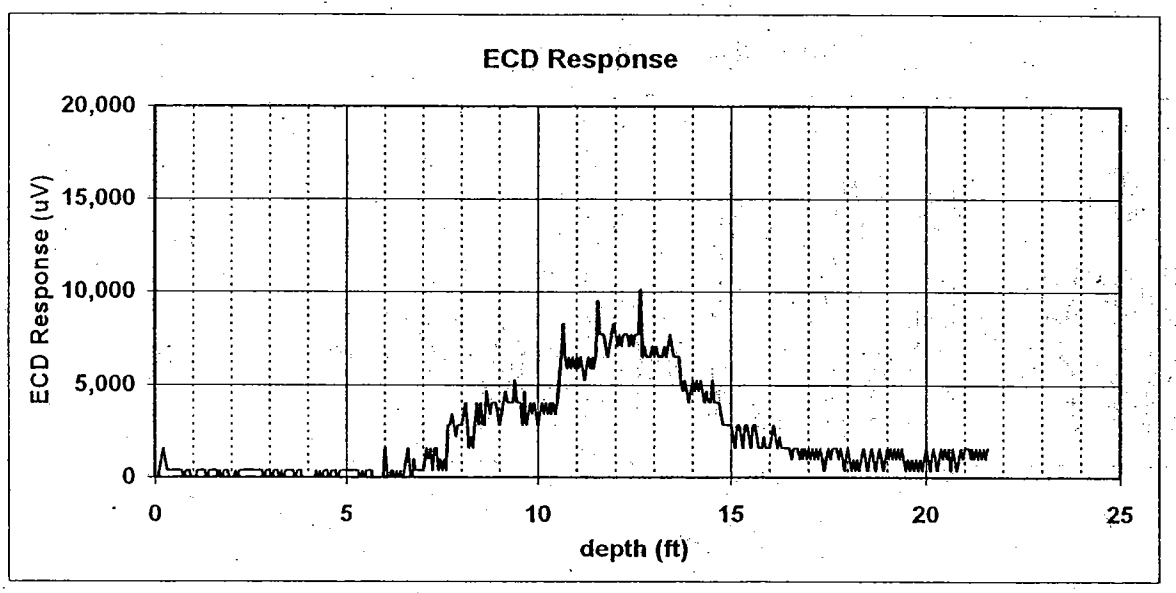

Conductivity
conductivity (mSiemens/m)
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
depth (ft)

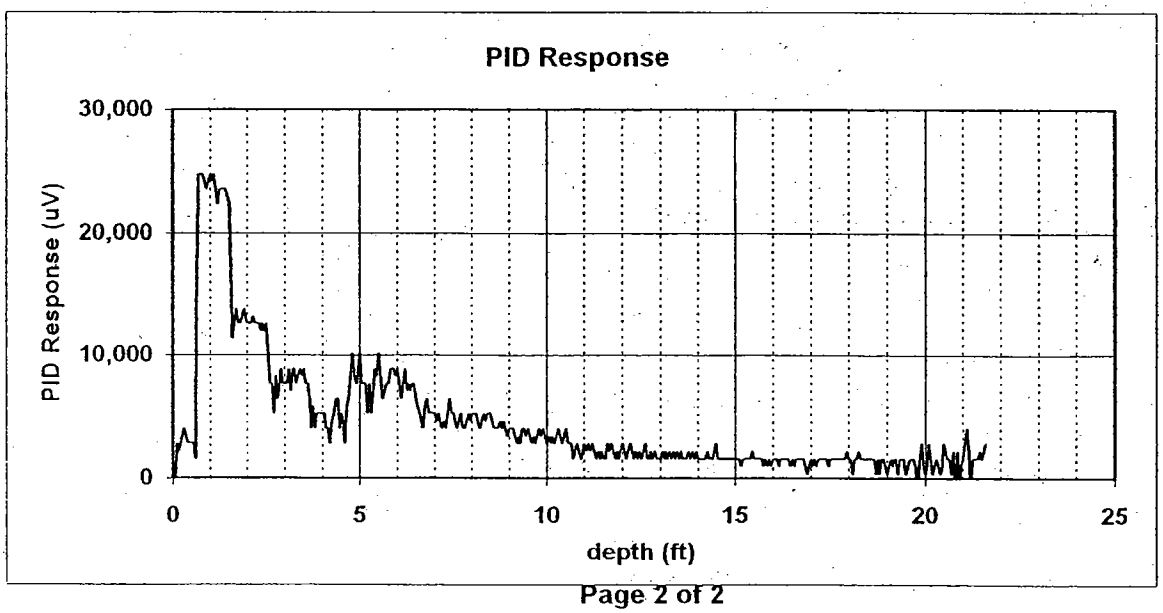

Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)


Temperature
(C)
130
120
110
100
90
80
70
0
5
10
15
20
25
depth (ft)

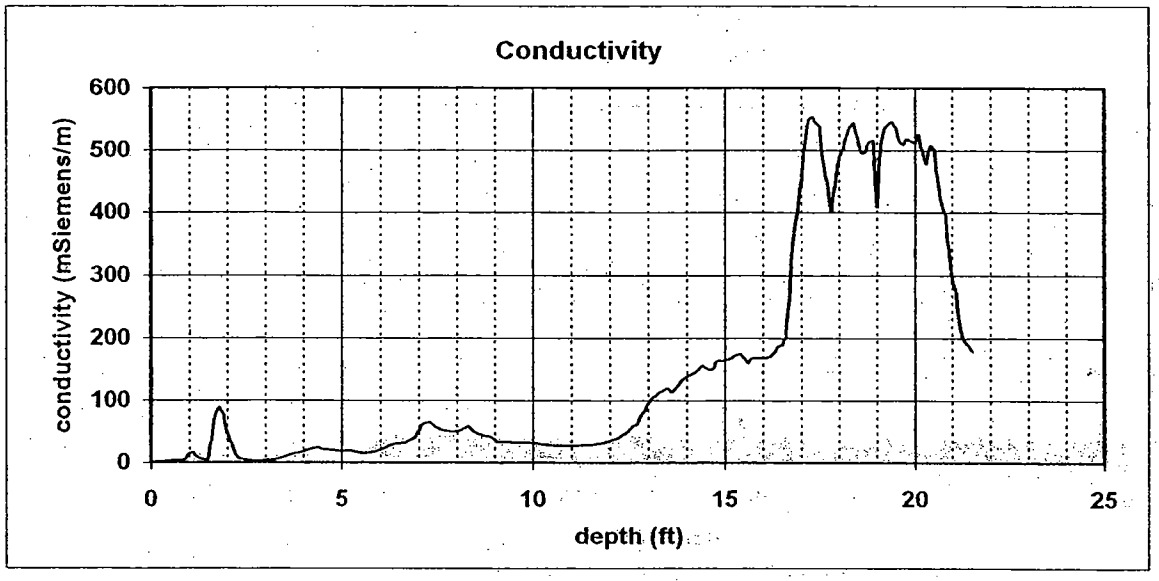
SB-137 (Field)

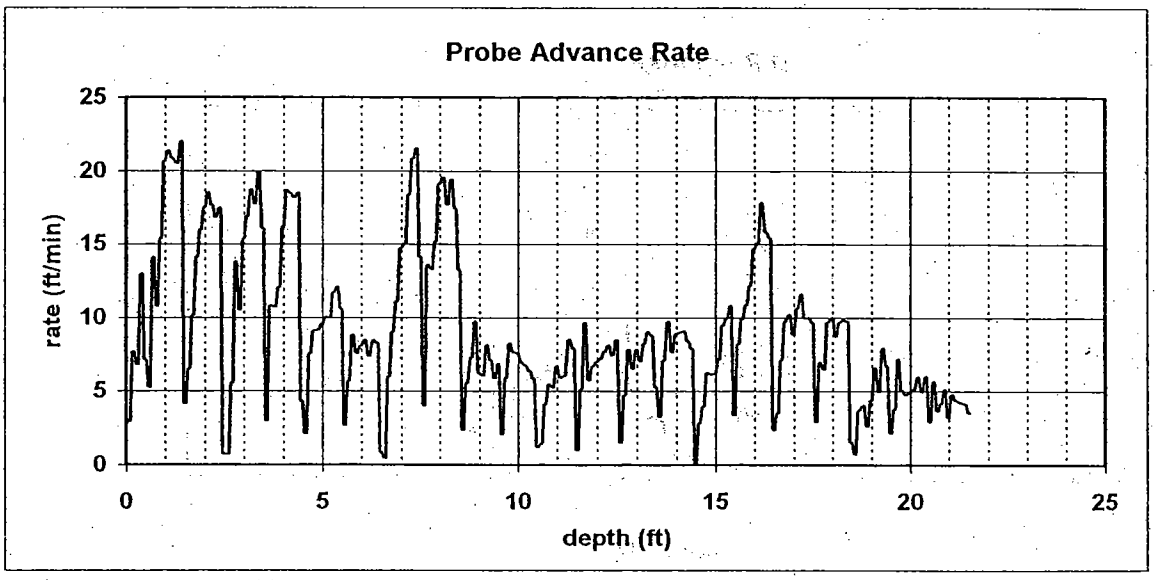

FID Response
FID Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)

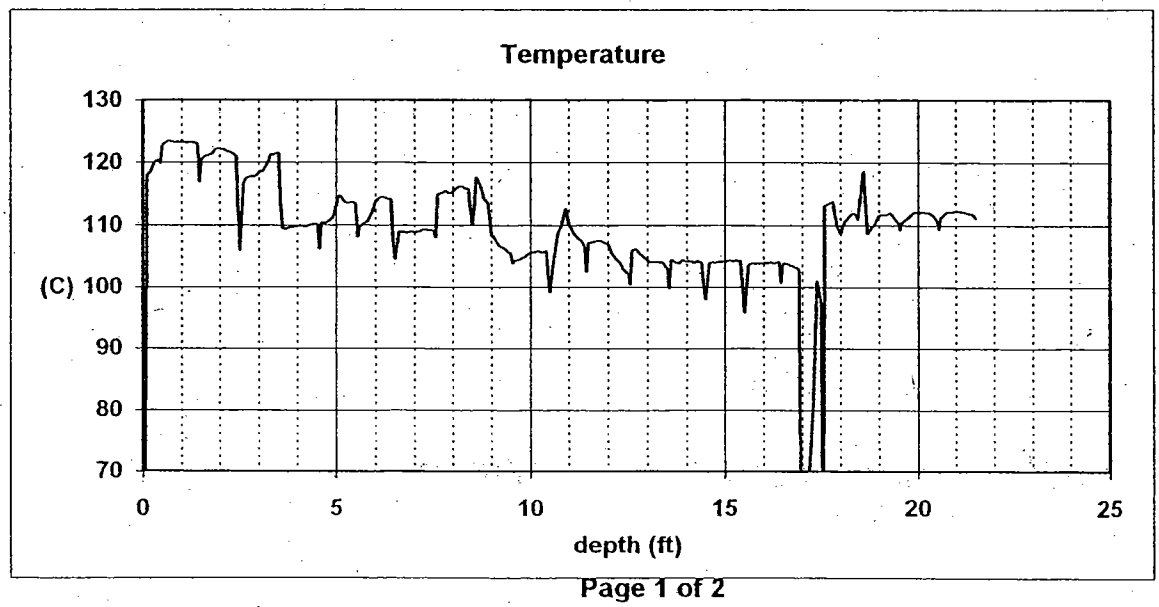

ECD Response
ECD Response (uV)
20,000
15,000
10,000
5,000
0
0
5
10
15
20
25
depth (ft)


PID Response
PID Response (uV)
30,000
20,000
10,000
0
0
5
10
15
20
25
depth (ft)

SB-139 (Field)


Conductivity
conductivity (mSiemens/m)
600
500
400
300
200
100
0
0
5
10
15
20
25
depth (ft)


Probe Advance Rate
rate (ft/min)
25
20
15
10
5
0
0
5
10
15
20
25
depth (ft)


Temperature
(C)
130
120
110
100
90
80
70
0
5
10
15
20
25
depth (ft)

APPENDIX D

TEMPORARY WELL BORING LOGS

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: DPT #5410

BORING No.: TW-107-SL
DATE: 3/9/05
GEOLOGIST: Conti
DRILLER: C. Gamwell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole **	Driller BZ **
	0												
				.5'	loose	lt. bro.	silty medium sand		fill, damp	82			
S-1 @ 0945			3/4		loose	orange brown	silty fine sand	SM	moist (fill?)	0			
						light to dark grey				0			
	4			4' ▼					wet	0			
									saturated zone	0			
S-2 @ 0950			3/4			olive grey				0			
										0			
	8			7'						0			
						olive grey	silty fine sand		wet	0			
S-3 @ 0955			1.5/4						poor recovery	0			
	12			12'						0			
				TD									
							Screen: 7' to 12'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: TW-107-SL

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: DPT #5410

BORING No.: TW-108-SU
DATE: 3/8/05
GEOLOGIST: Conti
DRILLER: C. Gamwell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sample BZ	Borehole**	Driller BZ**
	1									NA			
							See boring log TW-108-SL for details						
	4			3'									
	8			8' TD									
							BOTTOM 8'		USED DRIVE POINT TO SET WELL.				
							SCREEN 3-8'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: TW-108-SU

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: DPT #5410

BORING No.: TW-108-SL
DATE: 3/8/05
GEOLOGIST: Conti
DRILLER: C. Gamwell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	0												
					loose	grey brown	silty fine sand, moist	SM	2" of coarse sand at 2 ft.	0			
S-1			3/4						possible fill	0			
@ 1455										0			
	4			4 ft.						0			
						gray	silty sand, trace clay			0			
S-2			2.5/4							0			
@ 1500				7 ft.						0			
	8				Soft	gray	clayey sand, moist to wet	SC		0			
				9 ft.		brown				0			
S-3			4/4	9.5	V. soft	brown grey	clayey sand; wet	SC	2 ft saturated zone	0			
@ 1505				11 ft.						0			
	12					lt grey	silty sand, wet	SM		0			
					m. dense	to grey				0			
S-4 @ 1510			4/4							0			
				14.5						0			
	16			16'		dk. grey				0			
				TD.									
							BOTTOM 16'						
							SCREEN 9.5-14.5						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No ____ Well I.D. #: TW-108-SL

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: DPT #5410

BORING No.: TW-109-SU
DATE: 3/8/05
GEOLOGIST: Conti
DRILLER: C. Gamwell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ**	Borehole**	Driller BZ**
	0						See Boring Log			NA			
							TW-109-SL						
							for details						
	4			3'									
	8			8 Ft					Used Drive point well to set				
				TD									
							BOTM @ 8'						
							Screen 3'-8'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: TW-109-SU

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: DPT # 5410

BORING No.: TW-109-SL
DATE: 3/8/05
GEOLOGIST: Conti
DRILLER: C. Gamwell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	0												
					loose	brown	silty sand	SM	moist	0			
S-1 @			3/4	1.5 ft						700*			
1610										100			
	4			4 ft. 4 ft. ▼			some gravels		(probably fill) wet at 4 ft.				
					loose	brown grey	silty sand.	SM	wet	220	* 0		
S-2 @			3.5/4							225			
1615										102	*		
	8			8 ft.						67			
					Soft	grey	clayey sand	SC	wet to saturated				
S-3 @			2/4						liner was shattered		0		
1620										40			
	12			11.5 ft									
					medium dense	lt. grey	silty sand	SM	wet	32			
				13'						24			
S-4 @			4/4							3.4			
1625						dark grey				0			
	16			16'						0			
				TD									
							screened: 13'-16'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: * will check for fluorescence - was negative

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: TW-109-SL

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: DPT #5410

BORING No.: TW-118-SL
DATE: 3/9/05
GEOLOGIST: Conti
DRILLER: C. Gamwell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	0												
					loose to	dark brown	silty fine sand	SM	moist	130			
S-1 @			4/4	2'	med dense					34			
1120					med dense	v.dark brown	silty fine sand, trace clay	SM	very moist	7			
	4			4' ▼						35			
										27			
S-2 @			4/4	5.5'						11			
1125				6'	loose to	dark brown	silty fine sand	SM	very moist to wet	4			
	8				med dense	to gray				6			
						orange brown				10			
S-3 @			4/4	10'		dark gray			wet	0			
1130				11'	Soft	light yellow	clayey sand	SC	wet	0			
	12			12'	loose to med dense	light gray	silty fine sand	SM	wet	0			
				TD									
							screen: 6' - 11'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: TW-118-SL

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: DPT 5410

BORING No.: TW-119-SL
DATE: 3/10/05
GEOLOGIST: Conti
DRILLER: GAMWELL

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	0						SEE LOG FOR		ALSO SEE		0		
							TW-119 FOR		MIPS DATA				
							LITHOLOGY		FOR CONDUCTIVITY				
											0		
				10							0		
	15										0		
				15' TD									
							SCREEN 5-15						
									SCREEN INT BASED ON MIPS-ECD CURVE @SB-119				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: TW-119-SL

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: DPT #940

BORING No.: TW-125-SL
DATE: 3/9/05
GEOLOGIST: Conti
DRILLER: C. Gamwell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	0												
					loose	brown	silty fine sand, trace roots	SM	moist	47			
S-1 @			3/4							21			
1300							trace gravel at 2'			0			
	4					gray brown			wet at 3.5'	0			
				5.0'						0			
S-2 @			2.5/4						wet to saturated	0			
1305										0			
	8									0			
				9'						0			
S-3 @			4/4		very soft		clayey sand to sandy clay	SC	wet	0			
1310				11'						0			
	12				medium dense	gray brown	silty fine sand	SM	wet	2			
										0			
S-4 @			4/4							0			
1315						dark gray			color change @ 14.5'	12			
	16			16'						0			
				TD									
							screen: 11' - 16'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: TW-125-SL

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: DPT #5410

BORING No.: TW-134-SU
DATE: 3/9/05
GEOLOGIST: Conti
DRILLER: C. Gamwell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	0						see boring log			NA			
							TW-134-SL						
							for details						
	4			3'									
	8			8'									
				TD									
							Screen: 3'-8'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: TW-134-SU

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: DPT #5410

BORING No.: TW-134-SL
DATE: 3/9/05
GEOLOGIST: Conti
DRILLER: C. Gamwell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	0												
					loose	yellow brown	silty sand	SM	moist	24			
S-@1			3.5/4							15			
1400						grey			color change @ 2'	8			
	4									0			
				5'						9			
S-@2			3/4			gray with some orange brown	silty sand		wet	1.3			
1405										0			
	8			7.5'	soft	gray	sandy clay → mottled. w/ orange brown	SC	wet	0			
										0			
S-@3			4/4	10'						0			
1410						brown	grades to clayey sand			0			
	12			11.5'	v. soft	gray				0			
						gray	silty sand	SM		0			
S-@4			4/4							0			
1415										0			
	16			15						0			
				16'		dark gray			distinct color change	0			
				TD									
							Screen: 10'-15'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No ____ Well I.D. #: TW-134-SL

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: DPT # 5410

BORING No.: TW-138-SU
DATE: 3/9/05
GEOLOGIST: Conti
DRILLER: C. Gamwell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	0						see boring log			NA			
							TW- -SL						
							for details						
	4												
				6'									
	8												
				11'									
	12			12'									
				TD									
							Screen: 6'-11'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: TW-138-SU

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: DPT #5410

BORING No.: TW-138-SL
DATE: 3/9/05
GEOLOGIST: Conti
DRILLER: C. Gamwell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole **	Driller BZ **
	0												
					loose	brn	silty fine sand	SM		45			
S-@1			3/4						moist	24			
1540				3.5'									
				4' ▼		v. dark brn	silty sand, trace roots	SM	possible fill	0			
	4				medium dense	gray brown	silty fine sand	SM	wet to moist	0			
						to gray				0			
S-@2			3.5/4							0			
1545										0			
	8			7.5'					trace sandy clay	0			
					soft	gray	sandy clay	SC	wet	0			
S-@3			4/4							0			
1550				11'						0			
	12				medi dense	gray	silty fine sand	SM	wet to moist	0			
										0			
S-@4			3.5/4						wet	0			
1555										0			
	16			16'						0			
				TD									
							Screen: 11'-16'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: TW-138-SL

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: DPT 5410

BORING No.: TW-146-SL
DATE: 3/10/05
GEOLOGIST: Conti
DRILLER: GAMWELL

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness*	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	0						FOR LITHOLOGY		ALSO SEE		0		
							SEE TW-148		MIPS DATA				
							FOR DETAILS		CONDUCTIVITY FOR				
							0-7 - SILTY SAND		SB-146.				
	5										0		
				5			TR-CLAY 7-10'±						
	10			10							0		
				10' BOT.									
							SCREEN 5-10						
							BASED ON FOD						
							(MIPS)						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: TW-146-SL

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: DPT #5410

BORING No.: TW-148-SL
DATE: 3/9/05
GEOLOGIST: Conti
DRILLER: C. Gamwell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	0												
					loose	brown	silty fine sand, trace roots	SM	moist	43			
S-1 @ 1020			2.5/4										
										25			
	4			3.5'	loose	grey brown	silty sand	SM	moist				
					"				wet to saturated	0			
S-2 @ 1025			3/4		"	grey				0			
				7'		brown grey			trace roots	0			
	8					grey				0			
										0			
S-3 @ 1030			2.5/4							0			
										0			
	12			12						0			
				TD									
							Screen: 7'-12'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No ____ Well I.D. #: TW-148-SL

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: DPT #5410

BORING No.: TW-158-SL
DATE: 3/8/05
GEOLOGIST: Conti
DRILLER: C. Gamwell

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
	0												
	0			1.0	loose	brn.	silty fine sand - trace roots	SM	damp	4			
S-1			3/4	1.5	loose	blk	coal fragments		(fill) moist	1			
@ 1405				3ft. 3.0 ▼	loose	grey/brown	silty sand, trace clay	SM	wet	1			
	4									1			
	4									6			
S-2 @ 1410			2.5/4	6'						1			
						brn.	silty sand			12			
	8									1			
S-3 @ 1415	8		4/4	9.0	soft	grey	clayey sand	SC	wet	5			
										0			
				10.5	med. dense	lt grey	silty sand	SM	moist	0			
	12			11' 12' TD						0			
							screen: 6'-11'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 1" diameter PVC temp. well

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: TW-158-SL

APPENDIX E

TEMPORARY WELL CONSTRUCTION SHEETS

D H E C
PROMOTE PROTECT PROSPER
2600 Bull Street
Columbia, SC 29201-1708

February 18, 2005

FIRST CLASS MAIL

United States Marine Corps Air Station
Commanding Officer
Attention: NREAO (Mr. Tim Harrington)
P.O. Box 5028
Parris Island, SC 29905

RE: Marine Corps Recruit Depot (MCRD)
Parris Island, South Carolina
SC 6170022762

Monitoring Well Request (Sladic to Danielsen)
Dated February 17, 2005
SWMU 45

Dear Mr. Harrington:

The above referenced request has been reviewed with respect to R.61-71 of the South Carolina Well Standards and Regulations and other appropriate regulation/guidance. This request is for the installation of 15 shallow temporary monitoring wells, and 58 membrane interface wells (MIP) to evaluate groundwater quality in order to place 24 shallow/deep nested permanent monitoring wells and 5 deep permanent monitoring wells at various locations at SWMU 45.

In addition, the request is for the abandonment of a one-pump drinking water well located at SWMU 12.

The Division of Hydrogeology will approve the monitoring well request. Please find the monitoring well approval attached. The Department should be kept apprised of the ongoing fieldwork prior to the placement of the permanent monitoring wells.

The abandonment of the one-pump water well at SWMU 12 should be abandoned during the field effort at SWMU 45. Please note that a DHEC 1903 form must be completed for all abandoned wells

and abandonment should follow all applicable requirements of R.61-71.

All temporary monitoring wells/MIPs will be installed in the surficial aquifer and will be installed by direct push technology (DPT) drilling methods. The temporary wells are expected to be completed to a maximum depth of 15 feet below ground surface (bgs).

All temporary monitoring wells must be grouted upon termination of lithologic studies and/or sampling starting from the bottom of the boring and continuously pressure grouted to the ground surface with neat cement, bentonite-cement, or 20% high solids sodium bentonite grout through a tremie pipe.

All permanent monitoring wells will be installed in the surficial aquifer, will have 0.01 inch slotted screens and will be installed by hollow stem auger drilling methods. These permanent monitoring wells will be finished as flush mounted wells. The shallow permanent monitoring wells will be installed with 10-foot screens. The shallow screens will be placed across the top of the water table where possible. The shallow wells are anticipated to be completed to a maximum depth of approximately 15 feet bgs.

The deep permanent monitoring wells will be installed as double-cased wells with 10-foot screens below the confining unit. The deep screens will be placed approximately 30 to 40 feet below ground surface. The deep monitoring wells are anticipated to be completed to a maximum depth of approximately 42 feet bgs.

The boring and/or geologist logs for each permanent monitoring well should be submitted to the Department within two weeks of completion of the last bore hole.

All sampling should follow the methods described in the November 2001 EPA EISOPQAM.

The boring and/or geologist logs for each monitoring well/soil boring should be submitted to the Division of Hydrogeology, attention Michael Danielsen within 30 days of completion of the last bore hole.

All well construction and sampling derived wastes, including but not limited to, drill cuttings, drilling fluids, development and purge water, must be managed properly and in accordance with all applicable state and federal requirements. If containerized, each vessel shall be clearly labeled with regard to contents, source, and date of activity.

Field equipment (including sampling probes) must be decontaminated by steam cleaning, or other approved method, before use and between sampling locations. Well screens and casing must be decontaminated before installation or must be certified clean by the manufacturer.

Attached, please find a Monitoring Well Approval Form and a copy of the proposed monitoring well locations. A copy of this monitoring well approval form should be on site during drilling operations.

The April 26, 2002 South Carolina Well Standards Regulation R.61-71 apply to the monitoring well installations for the above referenced sites.

Please be advised, additional assessment may be required at this site. Should there be any questions, please contact me at (803) 896-4194 or danielmw@dhec.sc.gov .

Respectfully,

Michael W. Danielsen, Hydrogeologist
RCRA Hydrogeology I Section
Division of Hydrogeology
Bureau of Land and Waste Management

Enclosure
MWA: HW-05-005

CC: Russell Berry, Low-Country EQC
Leon Fulmer, Corrective Action Engineering Section
Art Sanford, Southern Division, Charleston
Mark Sladic, TetraTech Nus, Inc.
MCRD Bureau File #50492

D H E C
PROMOTE PROTECT PROSPER
2600 Bull Street
Columbia, SC 29201-1708

Monitoring Well Approval for
Temporary And Permanent Wells

Approval is hereby granted to: Tim Harrington
Marine Corps Recruit Depot
EPA ID # SC6170022762
Beaufort County

Facility: Marine Corps Recruit Depot
SWMU 45
Beaufort County

This approval is for the installation of 15 shallow temporary monitoring wells, 58 membrane interface wells (MIP), 24 shallow/deep permanent monitoring wells, and 5 deep permanent monitoring wells. The MIPs/temporary monitoring wells are to be installed in the locations as proposed in the construction details provided in the February 17, 2005 correspondence Sladic to Danielsen. The monitoring wells are to be installed following all of the applicable requirements of R.61-71.

Please note that R.61-71 requires the following:

1. All wells shall be drilled, constructed, and abandoned by a South Carolina certified well driller per R.61-71.D.1.

2. A Water Well Record Form or other form provided or approved by the Department shall be completed and submitted to the Department within 30 days after well completion or abandonment unless another schedule has been approved by the Department. The form should contain the "as-built" construction details and all other information required by R.61-71.H.1.f

3. All analytical data and water levels obtained from each monitoring well shall be submitted to the Department within 30 days of receipt of laboratory results unless another schedule has been approved by the Department as required by R.61-71.H.1.d.

4. All temporary monitoring wells shall be abandoned within 5 days of borehole completion using appropriate methods as required by R.61-71.H.4.c.

5. All permanent monitoring wells shall be labeled as required by R.61-71.H.2.c.

6. If any of the information provided to the Department changes, Michael W. Danielsen shall be notified a minimum of twenty-four hours prior to well construction as required by R.61-71.H.1.a.

This approval is pursuant to the provisions of Section 44-55-40 of the 1976 South Carolina Code of Laws and R.61-71 of the South Carolina Well Standards and Regulations, dated April 26, 2002.

Date of Issuance: 2-18-2005 **Approval #: HW-05-005**

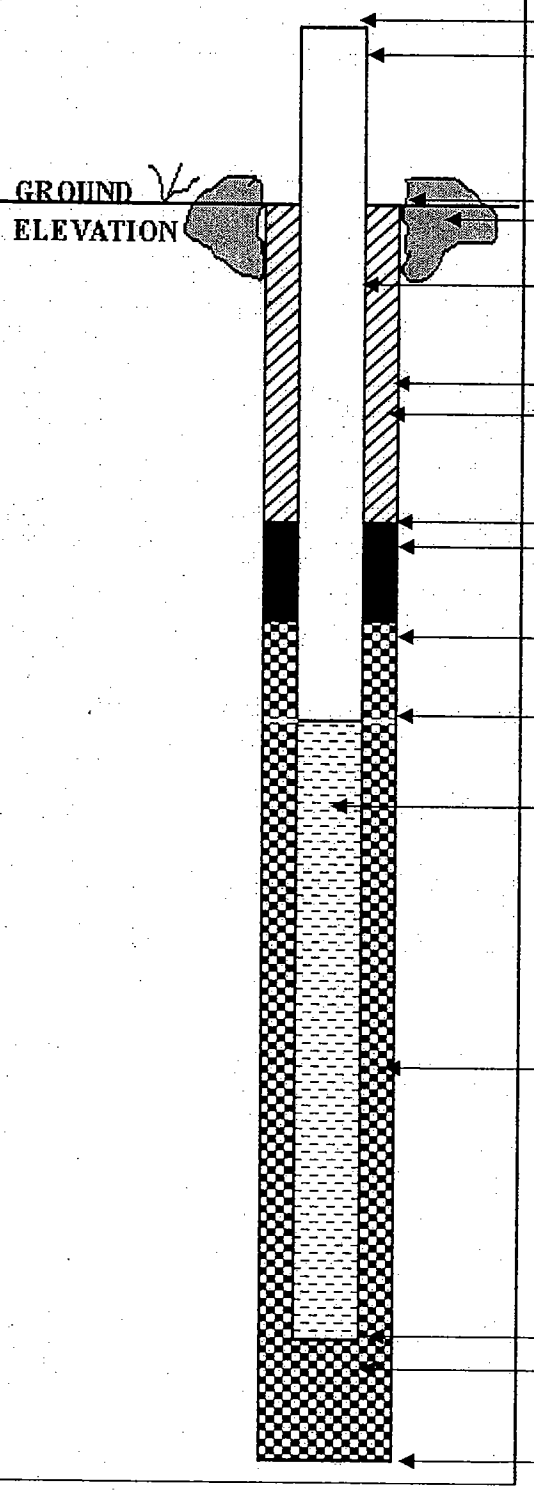
Michael W. Danielsen, Hydrogeologist
RCRA Hydrogeology I Section
Division of Hydrogeology
Bureau of Land & Waste Management

DD050083.MWD

BORING NO.: TW-107-SL

Tetra Tech NUS, Inc. **TEMPORARY MONITORING WELL SHEET**

PROJECT:	MCRD Parris Island	DRILLING Co.:	Miller	BORING No.:	TW-107-SL
PROJECT No.:	N5260	DRILLER:	C. Gamwell	DATE COMPLETED:	3/9/05
SITE:	Site 45	DRILLING METHOD:	DPT	NORTHING:	187334.4936
GEOLOGIST:	Conti	DEV. METHOD:	peristaltic	EASTING:	2099400.5726



ELEVATION OF TOP OF RISER PIPE: 7.65'

RISER STICK-UP ABOVE GROUND SURFACE: 0.95'

GROUND ELEVATION: 6.70'

TYPE OF SURFACE SEAL: NA

RISER PIPE I.D.: 1"

TYPE OF RISER PIPE: PVC

BOREHOLE DIAMETER: 3"

TYPE OF SEAL: NA

ELEVATION / DEPTH OF SEAL: NA / NA

TYPE OF SEAL: NA

ELEVATION / DEPTH TOP OF FILTER PACK: NA / NA

ELEVATION / DEPTH TOP OF SCREEN: -0.30' / 7'

TYPE OF SCREEN: PVC

SLOT SIZE X LENGTH: 10 sl. X 5'

I.D. OF SCREEN: 1"

TYPE OF FILTER PACK: NA

ELEVATION / DEPTH BOTTOM OF SCREEN: -5.30' / 12'

ELEVATION / DEPTH BOTTOM OF FILTER PACK: NA / NA

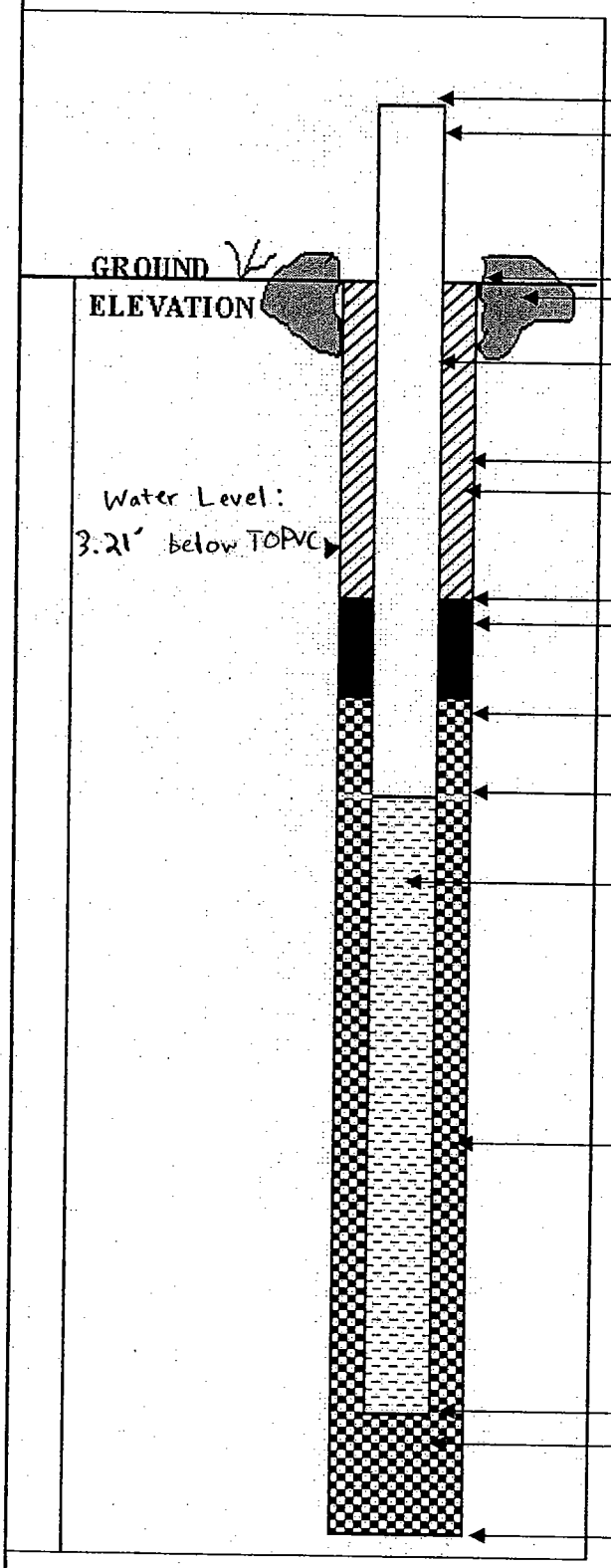
TYPE OF BACKFILL BELOW WELL: NA

ELEVATION / DEPTH OF BOREHOLE: -5.30' / 12'

BORING NO.: TW-108-SU

Tetra Tech NUS, Inc. **TEMPORARY MONITORING WELL SHEET**

PROJECT:	MCRD Parris Island	DRILLING Co.:	Miller	BORING No.:	TW-108-SU
PROJECT No.:	N5260	DRILLER:	C. Gamwell	DATE COMPLETED:	3/8/05
SITE:	Site 45	DRILLING METHOD:	DPT	NORTHING:	187394.1219
GEOLOGIST:	Conti	DEV. METHOD:	peristaltic	EASTING:	2099225.2791



ELEVATION OF TOP OF RISER PIPE: 7.94'

RISER STICK-UP ABOVE GROUND SURFACE: 1.37'

GROUND ELEVATION: 6.57'

TYPE OF SURFACE SEAL: NA

RISER PIPE I.D.: 1"

TYPE OF RISER PIPE: PVC

BOREHOLE DIAMETER: 3"

TYPE OF SEAL: NA

ELEVATION / DEPTH OF SEAL: NA/ NA

TYPE OF SEAL: NA

ELEVATION / DEPTH TOP OF FILTER PACK: NA/ NA

ELEVATION / DEPTH TOP OF SCREEN: 3.57'/ 3'

TYPE OF SCREEN: PVC

SLOT SIZE X LENGTH: 10 sl. X 5'

I.D. OF SCREEN: 1"

TYPE OF FILTER PACK: NA

ELEVATION / DEPTH BOTTOM OF SCREEN: -1.43'/ 8'

ELEVATION / DEPTH BOTTOM OF FILTER PACK: NA/ NA

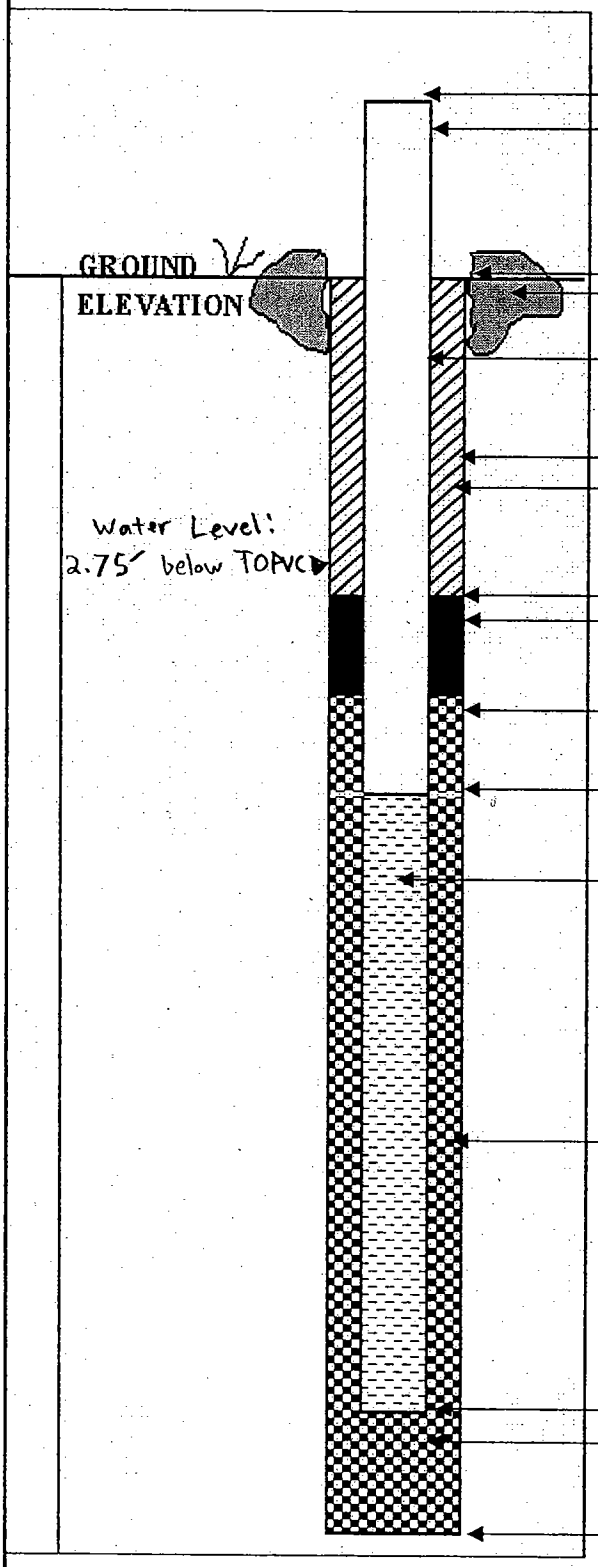
TYPE OF BACKFILL BELOW WELL: NA

ELEVATION / DEPTH OF BOREHOLE: -1.43/ 8'

BORING NO.: TW-108-SL

Tetra Tech NUS, Inc. **TEMPORARY MONITORING WELL SHEET**

PROJECT:	MCRD Parris Island	DRILLING Co.:	Miller	BORING No.:	TW-108-SL
PROJECT No.:	N5260	DRILLER:	C. Gamwell	DATE COMPLETED:	3/8/05
SITE:	Site 45	DRILLING METHOD:	DPT	NORTHING:	187396.1372
GEOLOGIST:	Conti	DEV. METHOD:	peristaltic	EASTING:	2099225.6770



ELEVATION OF TOP OF RISER PIPE: 7.16'

RISER STICK-UP ABOVE GROUND SURFACE: 0.70'

GROUND ELEVATION: 6.46'

TYPE OF SURFACE SEAL: NA

RISER PIPE I.D.: 1"

TYPE OF RISER PIPE: PVC

BOREHOLE DIAMETER: 3"

TYPE OF SEAL: NA

ELEVATION / DEPTH OF SEAL: NA / NA

TYPE OF SEAL: NA

ELEVATION / DEPTH TOP OF FILTER PACK: NA / NA

ELEVATION / DEPTH TOP OF SCREEN: -3.04' / 9.5'

TYPE OF SCREEN: PVC

SLOT SIZE X LENGTH: 10 sl. x 5'

I.D. OF SCREEN: 1"

TYPE OF FILTER PACK: NA

ELEVATION / DEPTH BOTTOM OF SCREEN: -8.04' / 14.5'

ELEVATION / DEPTH BOTTOM OF FILTER PACK: NA / NA

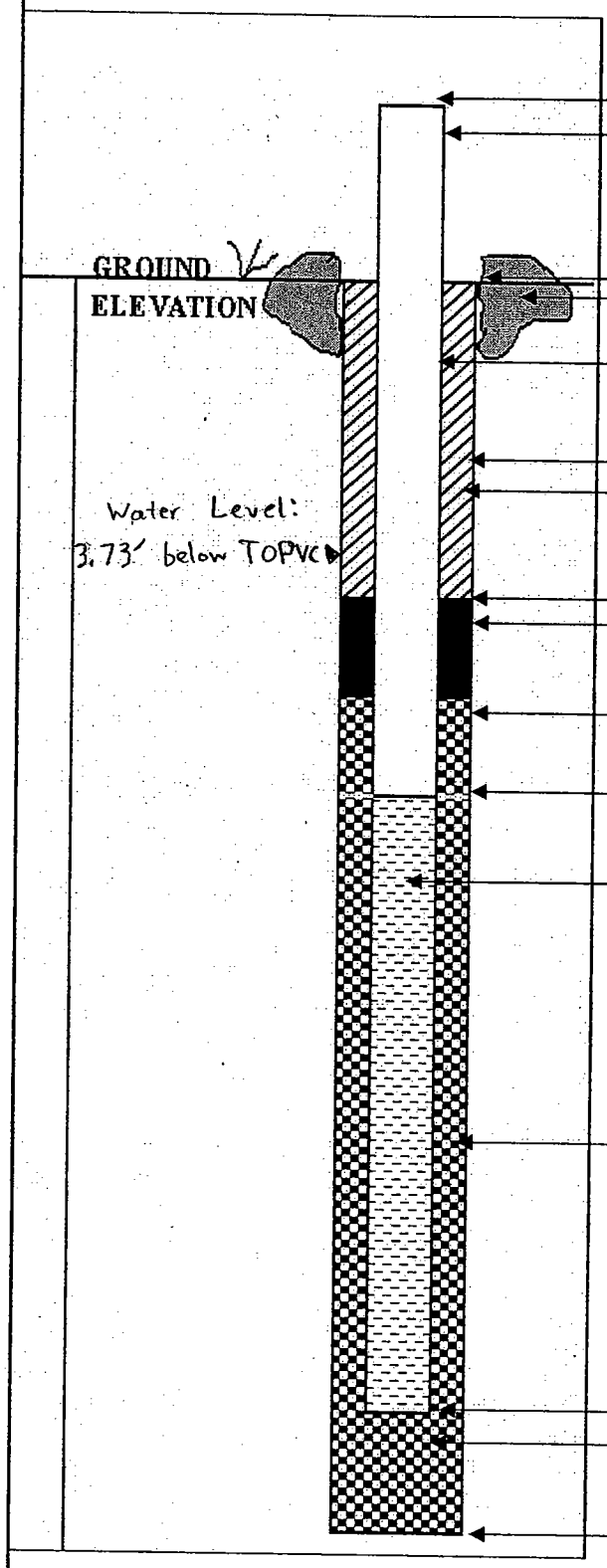
TYPE OF BACKFILL BELOW WELL: borehole cave in

ELEVATION / DEPTH OF BOREHOLE: -9.54' / 16'

BORING NO.: TW-109-SU

Tetra Tech NUS, Inc. **TEMPORARY MONITORING WELL SHEET**

PROJECT:	MCRD Parris Island	DRILLING Co.:	Miller	BORING No.:	TW-109-SU
PROJECT No.:	N5260	DRILLER:	C. Gamwell	DATE COMPLETED:	3/8/05
SITE:	Site 45	DRILLING METHOD:	DPT	NORTHING:	187384.3043
GEOLOGIST:	Conti	DEV. METHOD:	peristaltic	EASTING:	2099294.6007



ELEVATION OF TOP OF RISER PIPE: 8.34'

RISER STICK-UP ABOVE GROUND SURFACE: 1.32'

GROUND ELEVATION: 7.02'

TYPE OF SURFACE SEAL: NA

RISER PIPE I.D.: 1"

TYPE OF RISER PIPE: PVC

BOREHOLE DIAMETER: 3"

TYPE OF SEAL: NA

ELEVATION / DEPTH OF SEAL: NA / NA

TYPE OF SEAL: NA

ELEVATION / DEPTH TOP OF FILTER PACK: NA / NA

ELEVATION / DEPTH TOP OF SCREEN: 4.02' / 3'

TYPE OF SCREEN: PVC

SLOT SIZE X LENGTH: 10 sl. x 5'

I.D. OF SCREEN: 1"

TYPE OF FILTER PACK: NA

ELEVATION / DEPTH BOTTOM OF SCREEN: -0.98' / 8'

ELEVATION / DEPTH BOTTOM OF FILTER PACK: NA / NA

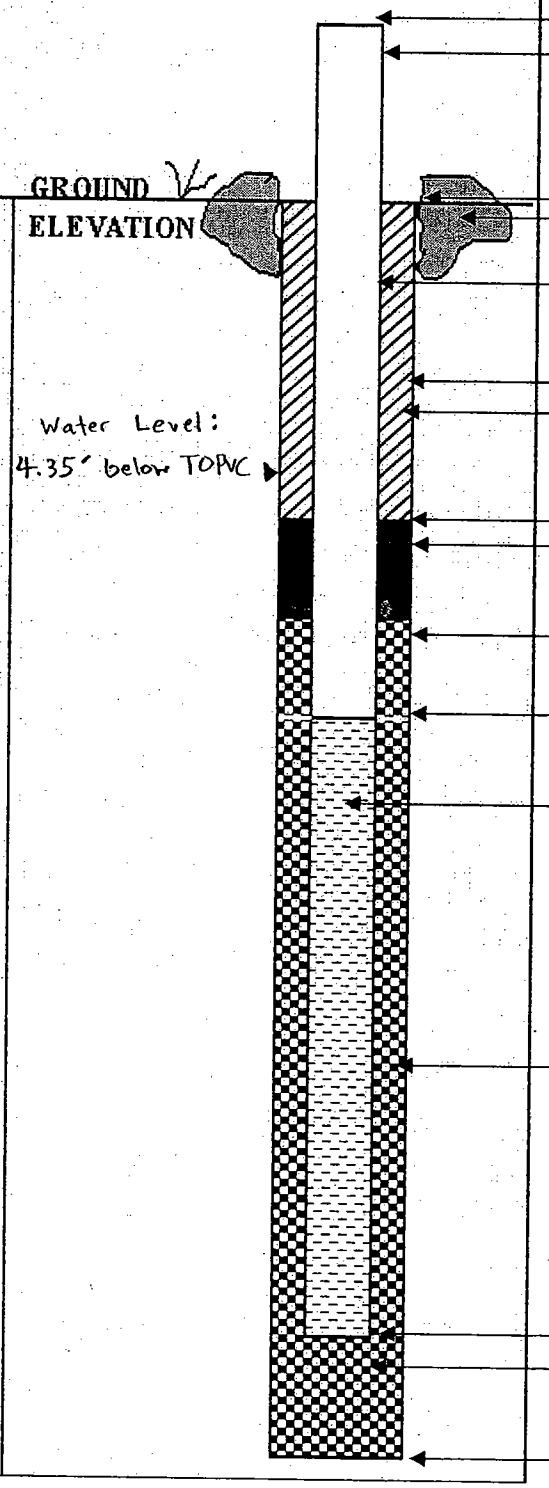
TYPE OF BACKFILL BELOW WELL: NA

ELEVATION / DEPTH OF BOREHOLE: -0.98' / 8'

BORING NO.: TW-109-SL

Tetra Tech NUS, Inc. **TEMPORARY MONITORING WELL SHEET**

PROJECT:	MCRD Parris Island	DRILLING Co.:	Miller	BORING No.:	TW-109-SL
PROJECT No.:	N5260	DRILLER:	C. Gamwell	DATE COMPLETED:	3/8/05
SITE:	Site 45	DRILLING METHOD:	DPT	NORTHING:	187381.3459
GEOLOGIST:	Conti	DEV. METHOD:	peristaltic	EASTING:	2099293.9976



ELEVATION OF TOP OF RISER PIPE: 8.51'

RISER STICK-UP ABOVE GROUND SURFACE: 1.45'

GROUND ELEVATION: 7.06'

TYPE OF SURFACE SEAL: NA

RISER PIPE I.D.: 1"

TYPE OF RISER PIPE: 1" PVC

BOREHOLE DIAMETER: 3"

TYPE OF SEAL: NA

ELEVATION / DEPTH OF SEAL: NA / NA

TYPE OF SEAL: NA

ELEVATION / DEPTH TOP OF FILTER PACK: NA / NA

ELEVATION / DEPTH TOP OF SCREEN: -5.94' / 13'

TYPE OF SCREEN: PVC

SLOT SIZE X LENGTH: 10 sl. X 3'

I.D. OF SCREEN: 1"

TYPE OF FILTER PACK: NA

ELEVATION / DEPTH BOTTOM OF SCREEN: -8.94' / 16'

ELEVATION / DEPTH BOTTOM OF FILTER PACK: NA / NA

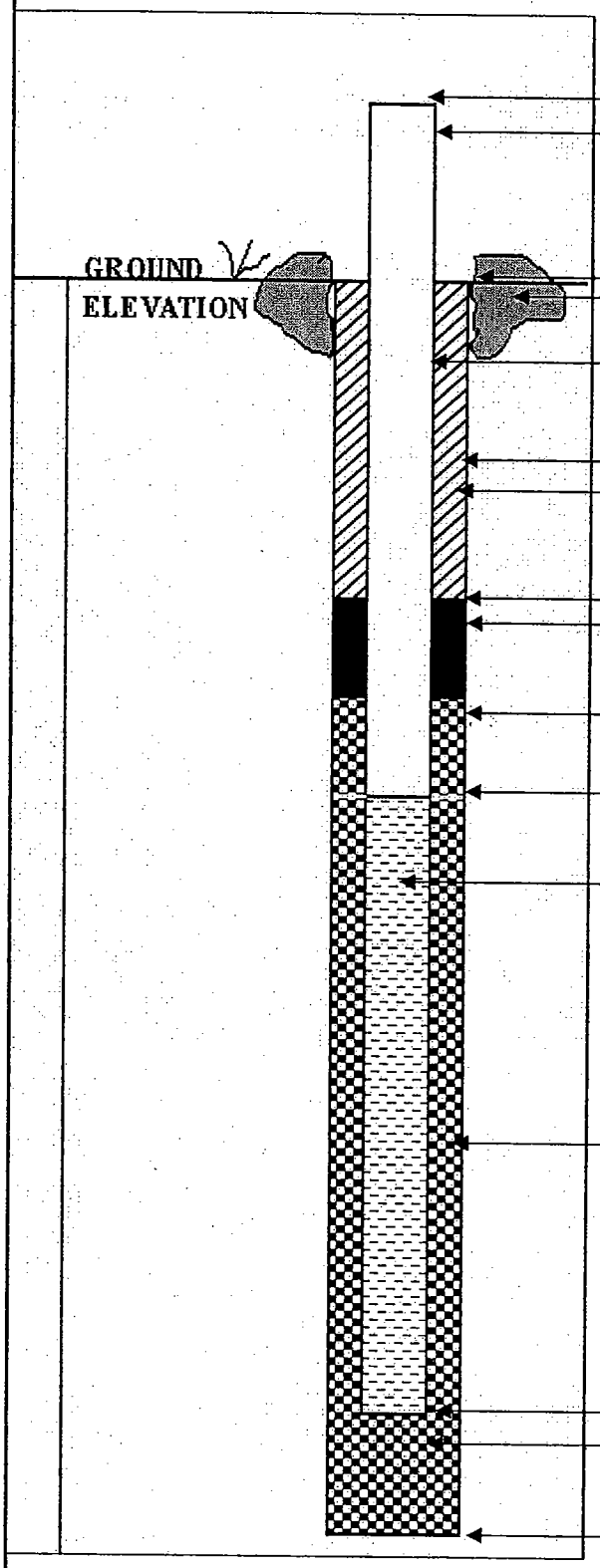
TYPE OF BACKFILL BELOW WELL: NA

ELEVATION / DEPTH OF BOREHOLE: -8.94' / 16'

BORING NO.: TW-118-SL

Tetra Tech NUS, Inc. **TEMPORARY MONITORING WELL SHEET**

PROJECT:	MCRD Parris Island	DRILLING Co.:	Miller	BORING No.:	TW-118-SL
PROJECT No.:	N5260	DRILLER:	C. Gamwell	DATE COMPLETED:	3/9/05
SITE:	site 45	DRILLING METHOD:	DPT	NORTHING:	187341.4293
GEOLOGIST:	Conti	DEV. METHOD:	peristaltic	EASTING:	2099247.9736



ELEVATION OF TOP OF RISER PIPE: 7.76'

RISER STICK-UP ABOVE GROUND SURFACE: 1.11'

GROUND ELEVATION: 6.65'

TYPE OF SURFACE SEAL: NA

RISER PIPE I.D.: 1"

TYPE OF RISER PIPE: PVC

BOREHOLE DIAMETER: 3"

TYPE OF SEAL: NA

ELEVATION / DEPTH OF SEAL: NA / NA

TYPE OF SEAL: NA

ELEVATION / DEPTH TOP OF FILTER PACK: NA / NA

ELEVATION / DEPTH TOP OF SCREEN: 0.65' / 6'

TYPE OF SCREEN: PVC

SLOT SIZE X LENGTH: 10 sl. X 5'

I.D. OF SCREEN: 1"

TYPE OF FILTER PACK: NA

ELEVATION / DEPTH BOTTOM OF SCREEN: -4.35' / 11'

ELEVATION / DEPTH BOTTOM OF FILTER PACK: NA / NA

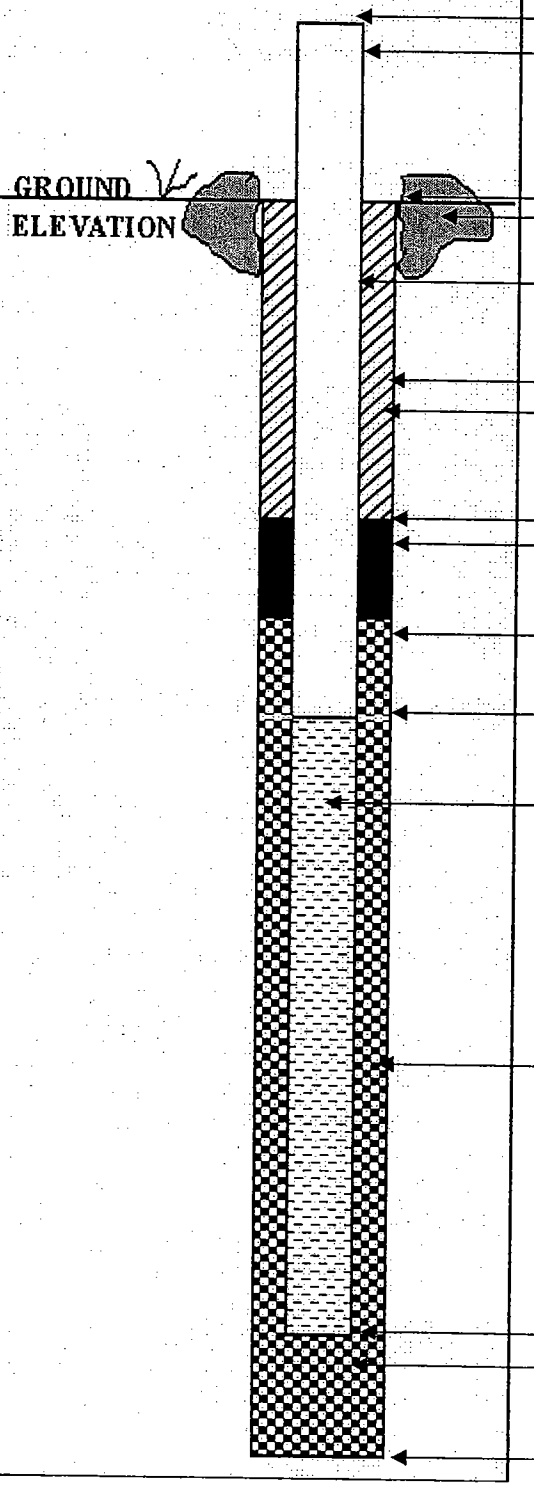
TYPE OF BACKFILL BELOW WELL: borehole cave in

ELEVATION / DEPTH OF BOREHOLE: -5.35' / 12'

Tetra Tech NUS, Inc. **TEMPORARY MONITORING WELL SHEET**

BORING NO.: TW-119-SL

PROJECT:	MCRD Parris Island	DRILLING Co.:	Miller	BORING No.:	TW-119-SL
PROJECT No.:	N5260	DRILLER:	GAMWELL	DATE COMPLETED:	3/10/05
SITE:	Site 45	DRILLING METHOD:	DPT	NORTHING:	187335.0999
GEOLOGIST:	Conti	DEV. METHOD:	PERISTALTIC	EASTING:	2099278.0544



ELEVATION OF TOP OF RISER PIPE: 7.89'

RISER STICK-UP ABOVE GROUND SURFACE: 1.00'

GROUND ELEVATION: 6.89'

TYPE OF SURFACE SEAL: NA

RISER PIPE I.D.: 1"Φ

TYPE OF RISER PIPE: PVC

BOREHOLE DIAMETER: 3"

TYPE OF SEAL: NA

ELEVATION / DEPTH OF SEAL: / NA

TYPE OF SEAL: NA

ELEVATION / DEPTH TOP OF FILTER PACK: / NA

ELEVATION / DEPTH TOP OF SCREEN: -3.11' / 10

TYPE OF SCREEN: PVC

SLOT SIZE X LENGTH: 10 SL x 5'

I.D. OF SCREEN: 2"

TYPE OF FILTER PACK: NA

ELEVATION / DEPTH BOTTOM OF SCREEN: -8.11' / 15

ELEVATION / DEPTH BOTTOM OF FILTER PACK: / NA

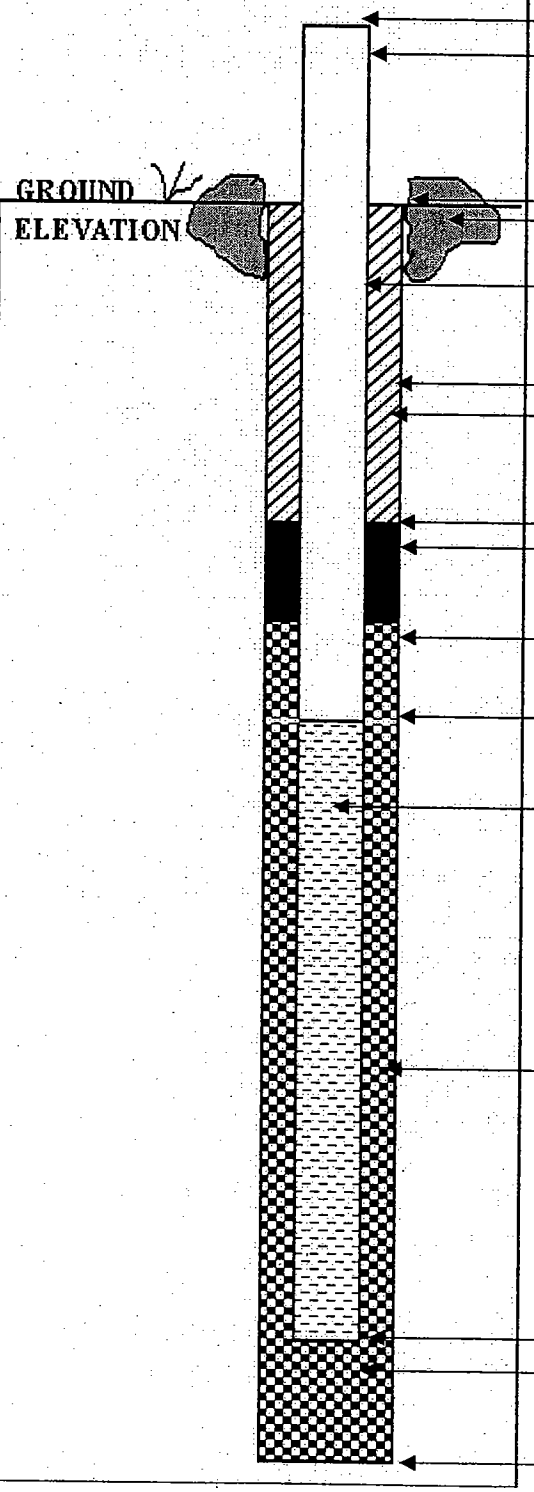
TYPE OF BACKFILL BELOW WELL: NA

ELEVATION / DEPTH OF BOREHOLE: -8.11' / 15

BORING NO.: TW-125-SL

Tetra Tech NUS, Inc. **TEMPORARY MONITORING WELL SHEET**

PROJECT:	MCRD Parris Island	DRILLING Co.:	Miller	BORING No.:	TW-125-SL
PROJECT No.:	N5260	DRILLER:	C. Gamwell	DATE COMPLETED:	3/9/05
SITE:	Site 45	DRILLING METHOD:	DPT	NORTHING:	187308.9564
GEOLOGIST:	Conti	DEV. METHOD:	peristaltic	EASTING:	2099326.3285



ELEVATION OF TOP OF RISER PIPE: 7.75'

RISER STICK-UP ABOVE GROUND SURFACE: 1.10'

GROUND ELEVATION: 6.65'

TYPE OF SURFACE SEAL: NA

RISER PIPE I.D.: 1"

TYPE OF RISER PIPE: PVC

BOREHOLE DIAMETER: 3"

TYPE OF SEAL: NA

ELEVATION / DEPTH OF SEAL: NA/ NA

TYPE OF SEAL: NA

ELEVATION / DEPTH TOP OF FILTER PACK: NA/NA

ELEVATION / DEPTH TOP OF SCREEN: -4.35' / 11'

TYPE OF SCREEN: PVC

SLOT SIZE X LENGTH: 10 sl. X 5'

I.D. OF SCREEN: 1"

TYPE OF FILTER PACK: NA

ELEVATION / DEPTH BOTTOM OF SCREEN: -9.35' / 16'

ELEVATION / DEPTH BOTTOM OF FILTER PACK: NA / NA

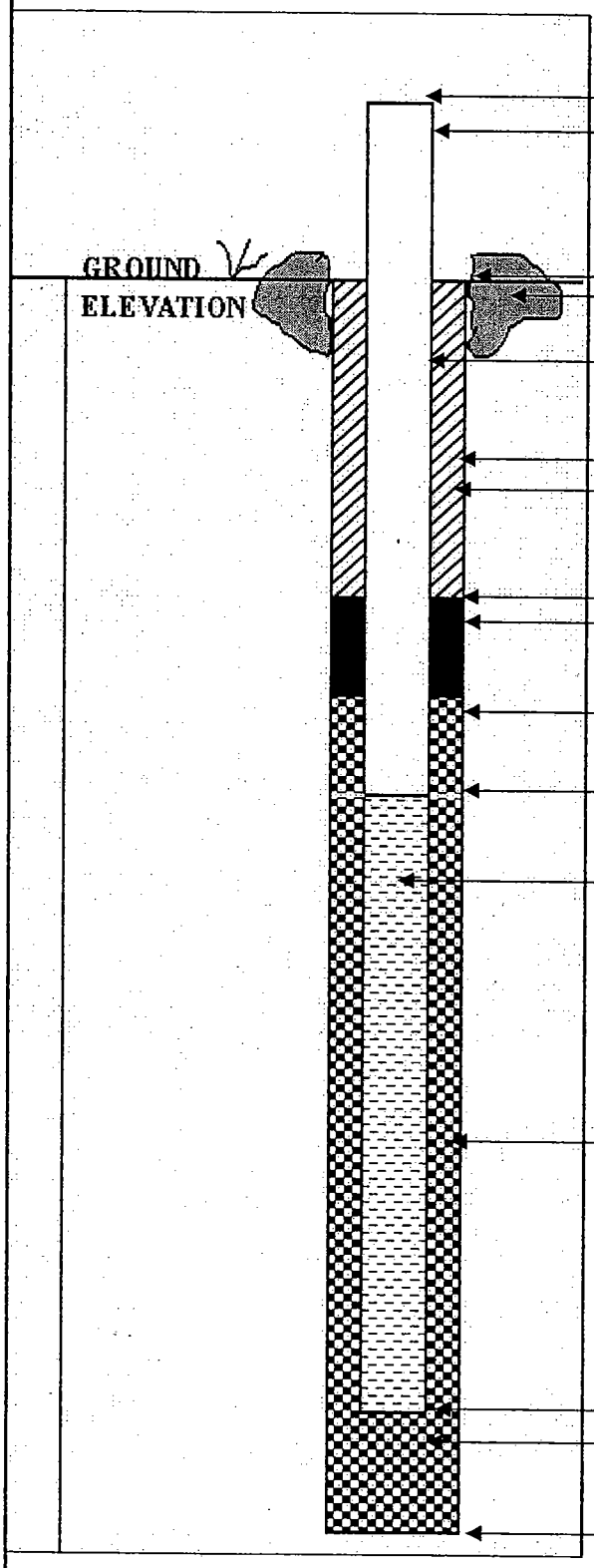
TYPE OF BACKFILL BELOW WELL: NA

ELEVATION / DEPTH OF BOREHOLE: -9.35' / 16'

BORING NO.: TW-134-SU

Tetra Tech NUS, Inc. **TEMPORARY MONITORING WELL SHEET**

PROJECT:	MCRD Parris Island	DRILLING Co.:	Miller	BORING No.:	TW-134-SU
PROJECT No.:	N5260	DRILLER:	C. Gamwell	DATE COMPLETED:	3/9/05
SITE:	Site 45	DRILLING METHOD:	DPT	NORTHING:	187176.0255
GEOLOGIST:	Conti	DEV. METHOD:	peristaltic	EASTING:	2099221.5269



ELEVATION OF TOP OF RISER PIPE: 6.77'

RISER STICK-UP ABOVE GROUND SURFACE: 0.97'

GROUND ELEVATION: 5.80'

TYPE OF SURFACE SEAL: NA

RISER PIPE I.D.: 1"

TYPE OF RISER PIPE: PVC

BOREHOLE DIAMETER: 3"

TYPE OF SEAL: NA

ELEVATION / DEPTH OF SEAL: NA/ NA

TYPE OF SEAL: NA

ELEVATION / DEPTH TOP OF FILTER PACK: NA/ NA

ELEVATION / DEPTH TOP OF SCREEN: 2.80', 3'

TYPE OF SCREEN: PVC

SLOT SIZE X LENGTH: 10 sl. X 5'

I.D. OF SCREEN: 1"

TYPE OF FILTER PACK: NA

ELEVATION / DEPTH BOTTOM OF SCREEN: -2.20', 8'

ELEVATION / DEPTH BOTTOM OF FILTER PACK: NA/ NA

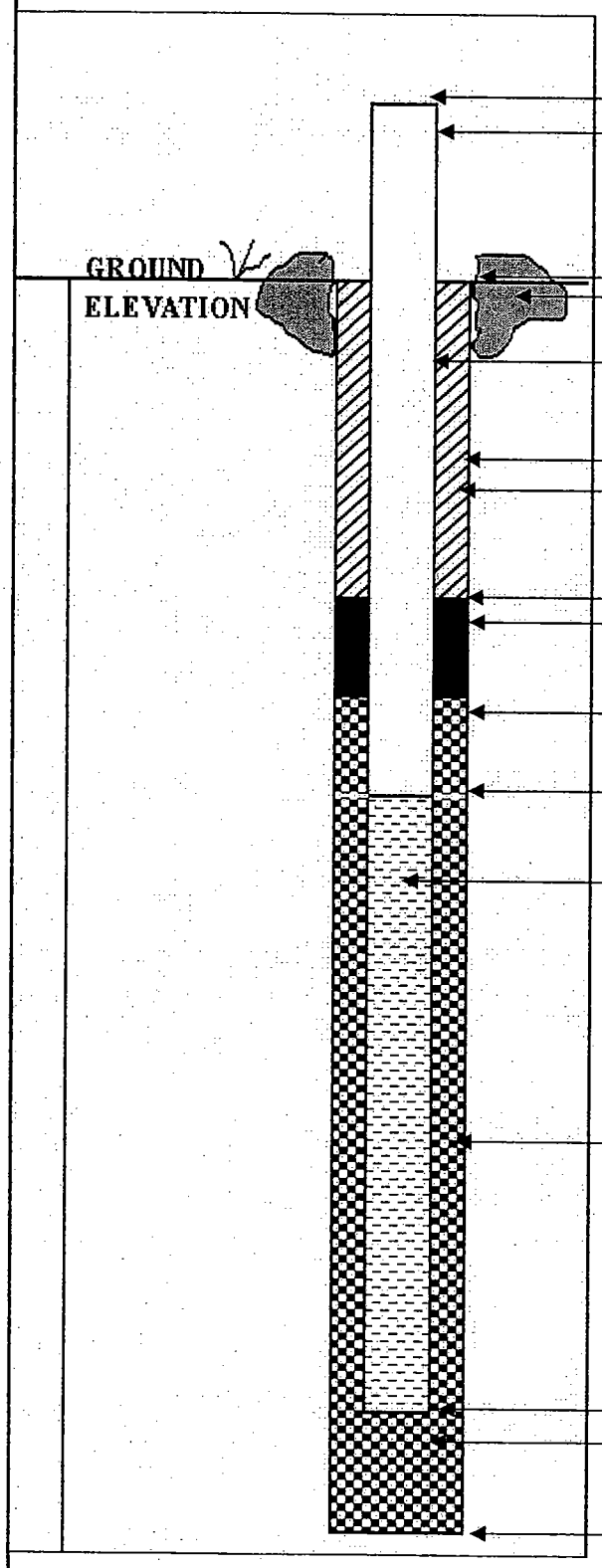
TYPE OF BACKFILL BELOW WELL: NA

ELEVATION / DEPTH OF BOREHOLE: -2.20', 8'

BORING NO.: TW-134-SL

Tetra Tech NUS, Inc. **TEMPORARY MONITORING WELL SHEET**

PROJECT:	MCRD Parris Island	DRILLING Co.:	Miller	BORING No.:	TW-134-SL
PROJECT No.:	N5260	DRILLER:	C. Gamwell	DATE COMPLETED:	3/9/05
SITE:	Site 45	DRILLING METHOD:	DPT	NORTHING:	187175.5213
GEOLOGIST:	Conti	DEV. METHOD:	peristaltic	EASTING:	2099224.5709



ELEVATION OF TOP OF RISER PIPE: 6.90'

RISER STICK-UP ABOVE GROUND SURFACE: 1.08'

GROUND ELEVATION: 5.82'

TYPE OF SURFACE SEAL: NA

RISER PIPE I.D.: 1"

TYPE OF RISER PIPE: PVC

BOREHOLE DIAMETER: 3"

TYPE OF SEAL: NA

ELEVATION / DEPTH OF SEAL: NA / NA

TYPE OF SEAL: NA

ELEVATION / DEPTH TOP OF FILTER PACK: NA / NA

ELEVATION / DEPTH TOP OF SCREEN: -4.18' / 10'

TYPE OF SCREEN: PVC

SLOT SIZE X LENGTH: 10 sl. X 5'

I.D. OF SCREEN: 1"

TYPE OF FILTER PACK: NA

ELEVATION / DEPTH BOTTOM OF SCREEN: -9.18' / 15'

ELEVATION / DEPTH BOTTOM OF FILTER PACK: NA / NA

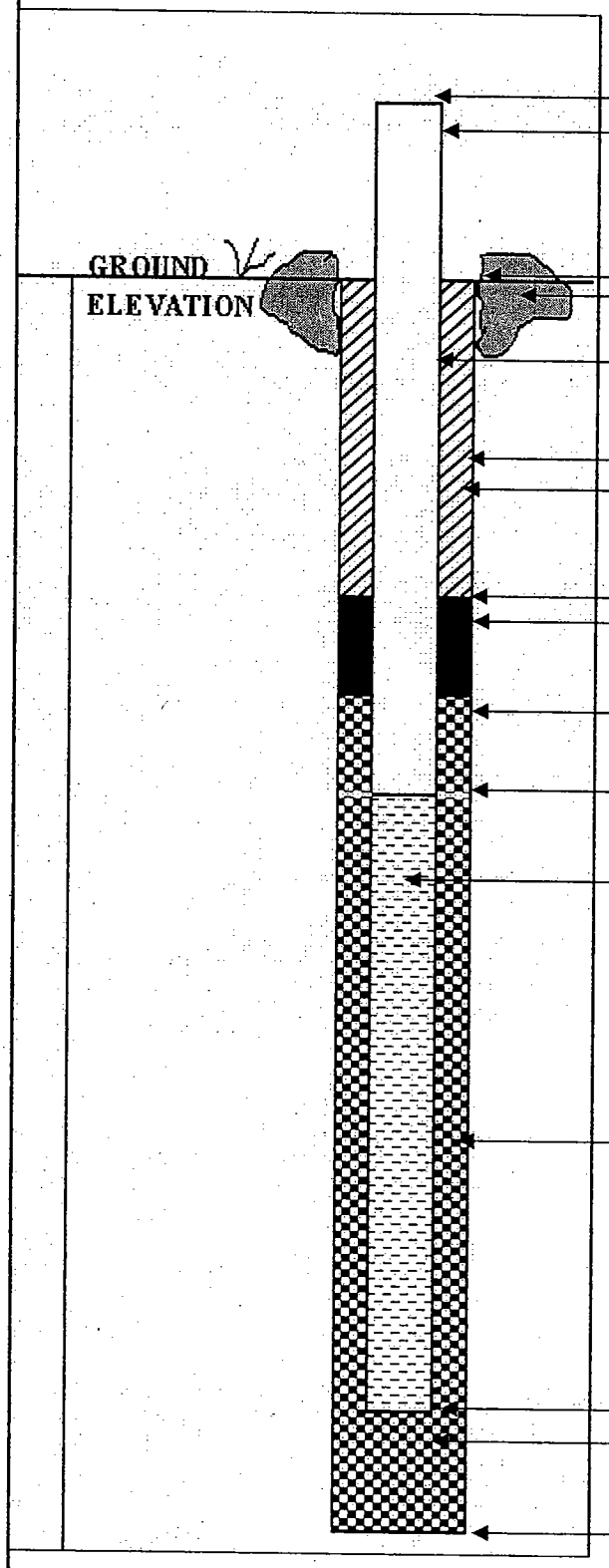
TYPE OF BACKFILL BELOW WELL: cave in

ELEVATION / DEPTH OF BOREHOLE: -10.18' / 16'

BORING NO.: TW-138-SU

Tetra Tech NUS, Inc. **TEMPORARY MONITORING WELL SHEET**

PROJECT:	MCRD Parris Island	DRILLING Co.:	Miller	BORING No.:	TW-138-SU
PROJECT No.:	N5260	DRILLER:	C. Gamwell	DATE COMPLETED:	3/9/05
SITE:	Site #45	DRILLING METHOD:	DPT	NORTHING:	187137.0083
GEOLOGIST:	Conti	DEV. METHOD:	peristaltic	EASTING:	2099271.0962



ELEVATION OF TOP OF RISER PIPE: 8.08'

RISER STICK-UP ABOVE GROUND SURFACE: 1.06'

GROUND ELEVATION: 7.02'

TYPE OF SURFACE SEAL: NA

RISER PIPE I.D.: 1"

TYPE OF RISER PIPE: PVC

BOREHOLE DIAMETER: 3"

TYPE OF SEAL: NA

ELEVATION / DEPTH OF SEAL: NA / NA

TYPE OF SEAL: NA

ELEVATION / DEPTH TOP OF FILTER PACK: NA / NA

ELEVATION / DEPTH TOP OF SCREEN: 1.02' / 6'

TYPE OF SCREEN: PVC

SLOT SIZE X LENGTH: 10 sl X 5'

I.D. OF SCREEN: 1"

TYPE OF FILTER PACK: NA

ELEVATION / DEPTH BOTTOM OF SCREEN: -3.98' / 11'

ELEVATION / DEPTH BOTTOM OF FILTER PACK: NA / NA

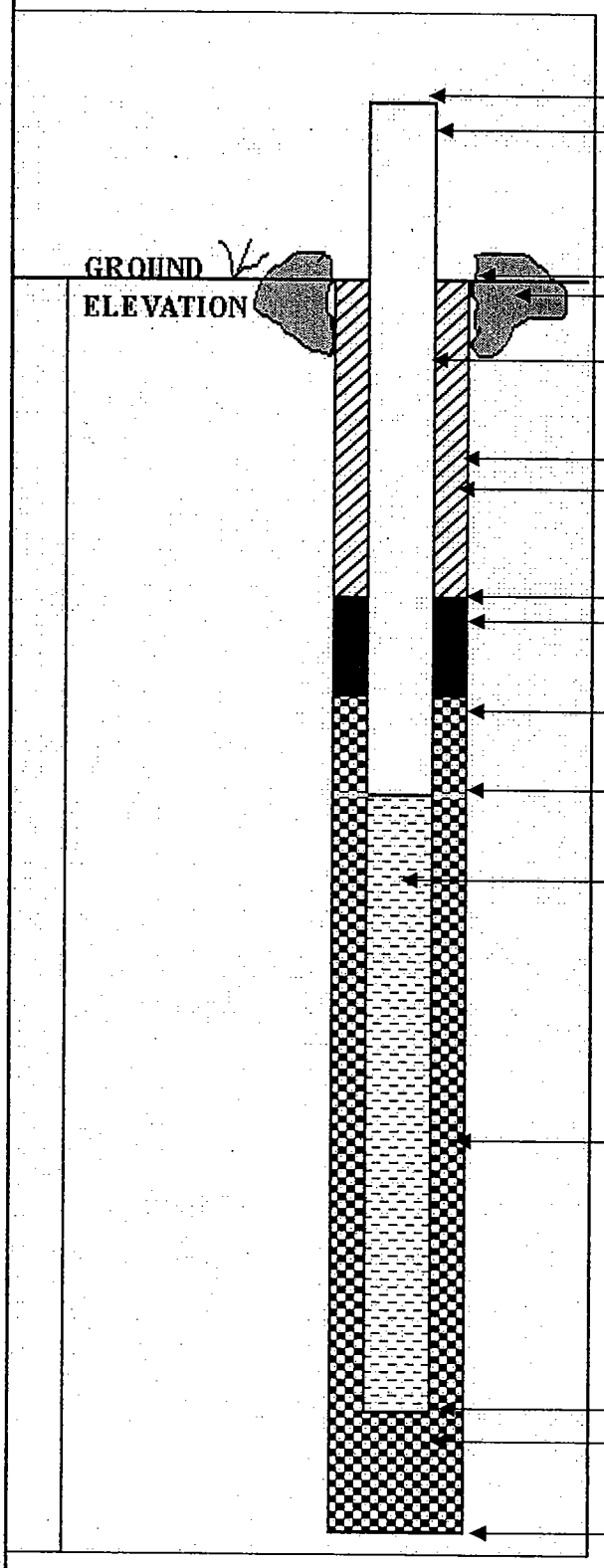
TYPE OF BACKFILL BELOW WELL: cave in

ELEVATION / DEPTH OF BOREHOLE: -4.98' / 12'

BORING NO.: TW-138-SL

Tetra Tech NUS, Inc. **TEMPORARY MONITORING WELL SHEET**

PROJECT:	MCRD Parris Island	DRILLING Co.:	Miller	BORING No.:	TW-138-SL
PROJECT No.:	N5260	DRILLER:	C. Gamwell	DATE COMPLETED:	3/9/05
SITE:	Site 45	DRILLING METHOD:	DPT	NORTHING:	187136.9447
GEOLOGIST:	Conti	DEV. METHOD:	peristaltic	EASTING:	2099269.5857



ELEVATION OF TOP OF RISER PIPE: 7.97'

RISER STICK-UP ABOVE GROUND SURFACE: 0.98'

GROUND ELEVATION: 6.99'

TYPE OF SURFACE SEAL: NA

RISER PIPE I.D.: 1"

TYPE OF RISER PIPE: PVC

BOREHOLE DIAMETER: 3"

TYPE OF SEAL: NA

ELEVATION / DEPTH OF SEAL: NA / NA

TYPE OF SEAL: NA

ELEVATION / DEPTH TOP OF FILTER PACK: NA / NA

ELEVATION / DEPTH TOP OF SCREEN: -4.01' / 11'

TYPE OF SCREEN: PVC

SLOT SIZE X LENGTH: 10 sl. x 5'

I.D. OF SCREEN: 1"

TYPE OF FILTER PACK: NA

ELEVATION / DEPTH BOTTOM OF SCREEN: -9.01' / 16'

ELEVATION / DEPTH BOTTOM OF FILTER PACK: NA / NA

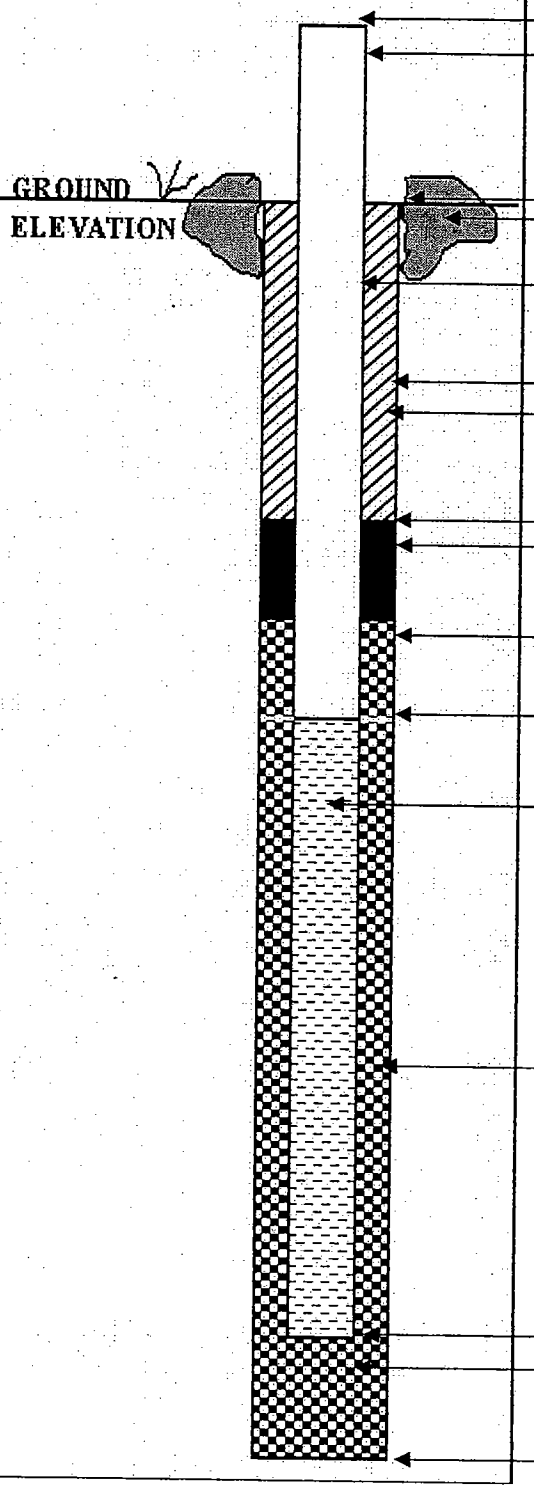
TYPE OF BACKFILL BELOW WELL: NA

ELEVATION / DEPTH OF BOREHOLE: -9.01' / 16'

Tetra Tech NUS, Inc. **TEMPORARY MONITORING WELL SHEET**

BORING NO.: TW-146-SL

PROJECT:	MCRD Parris Island	DRILLING Co.:	Miller	BORING No.:	TW-146-SL
PROJECT No.:	N5260	DRILLER:	GAMWELL	DATE COMPLETED:	3/10/05
SITE:	45	DRILLING METHOD:	DPT	NORTHING:	187277.6463
GEOLOGIST:	Conti	DEV. METHOD:	Peristaltic	EASTING:	2099388.5523



ELEVATION OF TOP OF RISER PIPE: 7.76'

RISER STICK-UP ABOVE GROUND SURFACE: 1.00'

GROUND ELEVATION: 6.76'

TYPE OF SURFACE SEAL: NA

RISER PIPE I.D.: 1"

TYPE OF RISER PIPE: PVC

BOREHOLE DIAMETER: 3"

TYPE OF SEAL: NA

ELEVATION / DEPTH OF SEAL: / NA

TYPE OF SEAL: NA

ELEVATION / DEPTH TOP OF FILTER PACK: / NA

ELEVATION / DEPTH TOP OF SCREEN: 1.76' / 5'

TYPE OF SCREEN: PVC

SLOT SIZE X LENGTH: 10 SL X 5'

I.D. OF SCREEN: 1"

TYPE OF FILTER PACK: NA

ELEVATION / DEPTH BOTTOM OF SCREEN: -3.24' / 10'

ELEVATION / DEPTH BOTTOM OF FILTER PACK: / NA

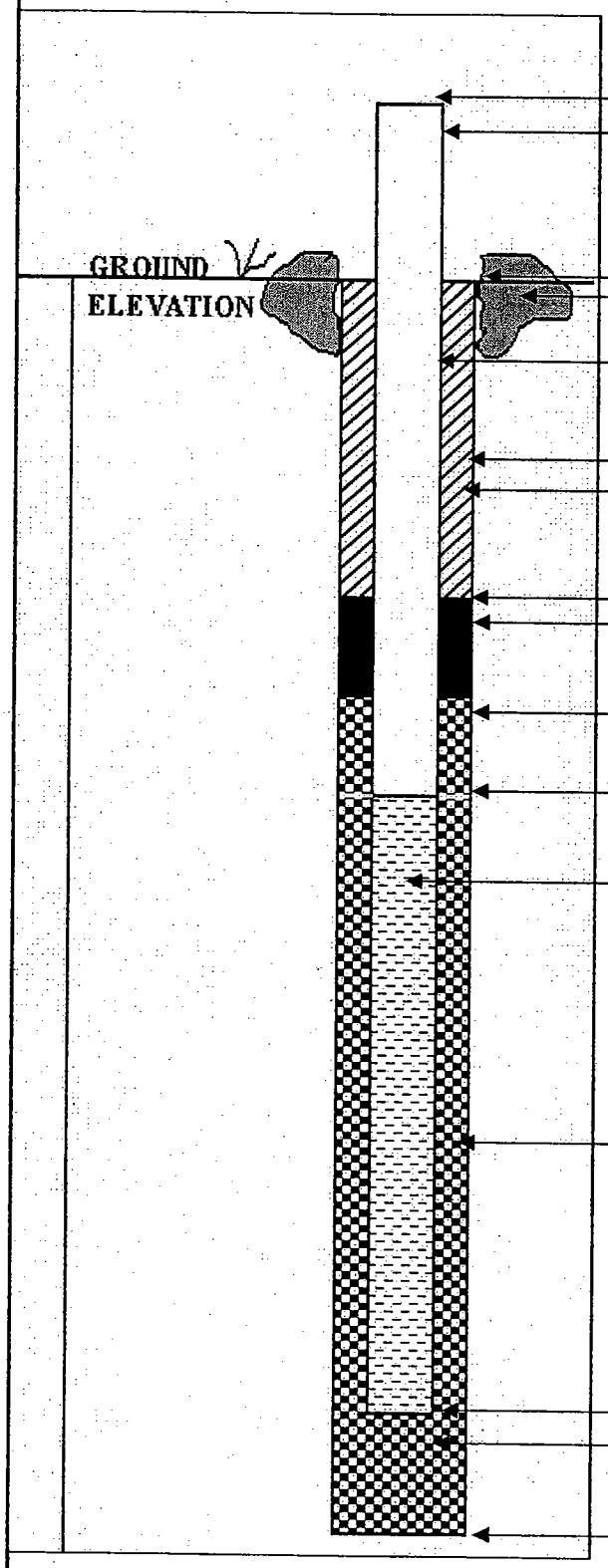
TYPE OF BACKFILL BELOW WELL: NA

ELEVATION / DEPTH OF BOREHOLE: -3.24' / 10'

BORING NO.: TW-148-SL

Tetra Tech NUS, Inc. **TEMPORARY MONITORING WELL SHEET**

PROJECT:	MCRD Parris Island	DRILLING Co.:	Miller	BORING No.:	TW-148-SL
PROJECT No.:	N5260	DRILLER:	C. Gamwell	DATE COMPLETED:	3/9/05
SITE:	Site 45	DRILLING METHOD:	DPT	NORTHING:	187229.0698
GEOLOGIST:	Conti	DEV. METHOD:	peristaltic	EASTING:	2099377.1766



ELEVATION OF TOP OF RISER PIPE: 8.25'

RISER STICK-UP ABOVE GROUND SURFACE: 1.06'

GROUND ELEVATION: 7.19'

TYPE OF SURFACE SEAL: NA

RISER PIPE I.D.: 1"

TYPE OF RISER PIPE: PVC

BOREHOLE DIAMETER: 3"

TYPE OF SEAL: NA

ELEVATION / DEPTH OF SEAL: NA / NA

TYPE OF SEAL: NA

ELEVATION / DEPTH TOP OF FILTER PACK: NA / NA

ELEVATION / DEPTH TOP OF SCREEN: 0.19' / 7'

TYPE OF SCREEN: PVC

SLOT SIZE X LENGTH: 10 sl. x 5'

I.D. OF SCREEN: 1"

TYPE OF FILTER PACK: NA

ELEVATION / DEPTH BOTTOM OF SCREEN: -4.81' / 12'

ELEVATION / DEPTH BOTTOM OF FILTER PACK: NA / NA

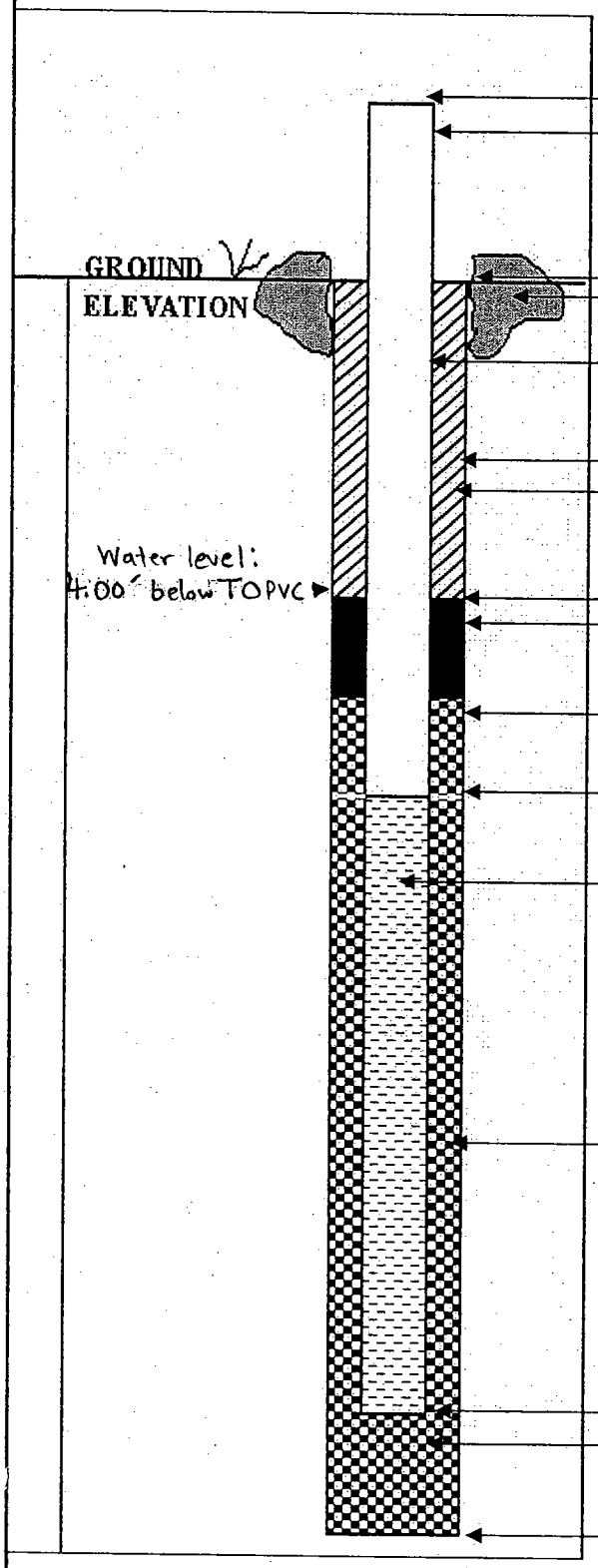
TYPE OF BACKFILL BELOW WELL: NA

ELEVATION / DEPTH OF BOREHOLE: -4.81' / 12'

BORING NO.: TW-158-SL

Tetra Tech NUS, Inc. **TEMPORARY MONITORING WELL SHEET**

PROJECT:	MCRD Parris Island	DRILLING Co.:	Miller	BORING No.:	TW-158-SL
PROJECT No.:	N5260	DRILLER:	C. Gamwell	DATE COMPLETED:	3/8/05
SITE:	Site 45	DRILLING METHOD:	DPT	NORTHING:	187284.5024
GEOLOGIST:	Conti	DEV. METHOD:	peristaltic	EASTING:	2099221.1610



ELEVATION OF TOP OF RISER PIPE: 8.14'

RISER STICK-UP ABOVE GROUND SURFACE: 1.53'

GROUND ELEVATION: 6.61'

TYPE OF SURFACE SEAL: NA

RISER PIPE I.D.: 1"

TYPE OF RISER PIPE: PVC

BOREHOLE DIAMETER: 3"

TYPE OF SEAL: NA

ELEVATION / DEPTH OF SEAL: NA / NA

TYPE OF SEAL: NA

ELEVATION / DEPTH TOP OF FILTER PACK: NA / NA

ELEVATION / DEPTH TOP OF SCREEN: 0.61' / 6'

TYPE OF SCREEN: PVC

SLOT SIZE X LENGTH: 10 sl. x 5'

I.D. OF SCREEN: 1"

TYPE OF FILTER PACK: NA

ELEVATION / DEPTH BOTTOM OF SCREEN: -4.39' / 11'

ELEVATION / DEPTH BOTTOM OF FILTER PACK: NA / NA

TYPE OF BACKFILL BELOW WELL: borehole cave in

ELEVATION / DEPTH OF BOREHOLE: -5.39' / 12'

APPENDIX F

CHAIN OF CUSTODY RECORDS

TETRA TECH NUS, INC. CHAIN OF CUSTODY NUMBER

PAGE 1 OF _

PROJECT NO: CTO 335 N5260	SITE NAME: MCRD PARRIS IS.	PROJECT MANAGER AND PHONE NUMBER: MARK SLADIC 412 921 7090	LABORATORY NAME AND CONTACT: KATAHDIN ANDREA COLBY
SAMPLERS (SIGNATURE): [signature]		FIELD OPERATIONS LEADER AND PHONE NUMBER: STAN CONTI 412 921 7090	ADDRESS
		CARRIER/WAYBILL NUMBER: FEDEX 8455 4237 5530	CITY, STATE: WESTBROOK, ME

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G

PRESERVATIVE USED: HCL

TYPE OF ANALYSIS: TCL VOCs

DATE YEAR 2005	TIME	SAMPLE ID (SWMU 45)	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TCL VOCs								COMMENTS
2/14	0700	TB 021405-01	AQ	G	2	2								
2/14	1010	PAI-45-GW-06-SL-02	↓	↓	3	3								
2/14	1155	PAI-45-GW-06-SL-02			9	9								RUN MS/MSD
2/14	1410	PAI-45-GW-07-SL-02			3	3								
2/14	1550	PAI-45-GW-07-SL-02			3	3								
2/14	0000	~~PA~~ FD 021405-01			3	3								DUP OF PAI-45-GW07SL-02
2/15	0915	PAI-45-GW-03SL-02			3	3								
	1105	PAI-45-GW-03SL-02			3	3								
↓	1425	PAI-45-GW-AMW 5-02	↓	↓	3	3								

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY [signature]	2-15-05	1625	1. RECEIVED BY FEDEX	2-15-05	1625
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

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FORM NO. TtNUS-001

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER | PAGE 1 OF 1

PROJECT NO:	SITE NAME:	PROJECT MANAGER AND PHONE NUMBER	LABORATORY NAME AND CONTACT:
CTO N5260 335	MCRD PARRIS IS	MARK SLADIC 412 921 7090	KATAHDIN / A. COLBY
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER AND PHONE NUMBER	ADDRESS
Dall / Weff		SJ CONTI 412 921 7090	340 COUNTRY RD # 5
		CARRIER/WAYBILL NUMBER	CITY, STATE
		FED EX AB # 845542375173	WESTBROOK ME. 04092

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G
PRESERVATIVE USED: 4°C HCL

TYPE OF ANALYSIS: TCL VOAs (VOCs)

DATE YEAR 2005	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TCL VOAs (VOCs)							COMMENTS
		SWMU 45											
2/23	0800	TB022305-01	H_2O	G	2	2							
"	1130	PAJ-45-GW04-SU-02	"	"	3	3							
"	1320	PAJ-45-GW04-SL-02	"	"	3	3							
"	1535	PAJ-45-GW04-D-02	"	"	3	3							
2/24	1000	PAJ-45-GW08-SU-02	"	"	3	3							
"	0000	FD022405-01	"	"	3	3							DUP OF PAJ-45-GW08SL-02
"	1145	PAJ-45-GW08SL-02	"	"	3	3							

1. RELINQUISHED BY	DATE	TIME	1. RECEIVED BY	DATE	TIME
D. WESTERHOFF	2/24/05	1600	FED EX	2/24/05	1600
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

TETRA TECH NUS, INC. CHAIN OF CUSTODY NUMBER PAGE 1 OF

PROJECT NO:	SITE NAME:	PROJECT MANAGER AND PHONE NUMBER	LABORATORY NAME AND CONTACT:
CTO 335 / N5260	MCRD PARRIS IS.	MARK SLADIC 412 921-7090	KATAHDIN - ANDREA COLBY
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER AND PHONE NUMBER: STAN CONTI 412 921-7090	ADDRESS
		CARRIER/WAYBILL NUMBER: FED EX 8455 4237 5184	CITY, STATE: WESTBROOK, ME

STANDARD TAT ☑
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G

PRESERVATIVE USED: HCL/4C

TYPE OF ANALYSIS: TCL VOCs

DATE YEAR 2005	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TCL VOCs							COMMENTS
		SWMU 45											
2/24	1530	PAJ-45-GW09-D-02	AQ	G	3	3							
2/25	0800	TB022505-01	"	"	2	2							
	1010	PAJ-45-GW05-SL-02	"	"	3	3							
	1300	PAJ-45-GW-AMW-2-02	"	"	3	3							
	1330	RB022505-01	"	"	3	3							RINSATE BLANK DI TUBING & SILICONE

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY: D WESTERHOFF	2/25/05	1600	1. RECEIVED BY: FED EX	2/25/05	1600
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER 31105-1 | PAGE 1 OF 1

PROJECT NO:	SITE NAME:	PROJECT MANAGER AND PHONE NUMBER	LABORATORY NAME AND CONTACT:
N5260 CTO 335	MCRD PARRIS IS	MARK SLADIC 412 921 7090	KATAHDIN / A. COLBY
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER AND PHONE NUMBER	ADDRESS
SJ Conti		SJ CONTI 412 921 7090	
		CARRIER/WAYBILL NUMBER	CITY, STATE
		FED EX AB# 8455 4237 5210	WESTBROOK, ME

CALL MARK SLADIC

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☒ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G

PRESERVATIVE USED: 4°C HCl

TYPE OF ANALYSIS: TCL VOCs

DATE YEAR 2005	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TCL VOCs								COMMENTS
3/10	0900	TB031005-01	AQ	G	2	2								
3/10	1035	PAI-45-TW158-SL-11	GW	G	3	3								
3/10	1250	PAI-45-TW108-SL-15	GW	G	3	3								
3/10	1410	PAI-45-TW108-SU-08	GW	G	3	3								
3/10	1635	PAI-45-TW109-SL-16	GW	G	3	3								
3/10	1710	PAI-45-TW109-SU-08	GW	G	3	3								
3/11	0935	PAI-45-TW125-SL-16	GW	G	3	3								
3/11	1115	PAI-45-TW134-SL-15	GW	G	9	9								DO MS/MSD
3/11	0000	FD031105-01	GW	G	3	3								DUP OF TW-134-SL-15
3/11	1215	PAI-45-TW134-SU-08	GW	G	3	3								
3/11	1345	PAI-45-TW138-SL-16	GW	G	3	3								
3/11	1525	PAI-45-TW138-SU-11	GW	G	3	3								

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY SJ Conti	3/11/05	1630	1. RECEIVED BY FED EX		
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS: HOLD FOR SAT PICK UP (KATAHDIN) Samples were sched for 48hr Turn, but can be exten

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

TETRA TECH NUS, INC. CHAIN OF CUSTODY NUMBER 3/1205-1 PAGE 1 OF

PROJECT NO:	SITE NAME:	PROJECT MANAGER AND PHONE NUMBER	LABORATORY NAME AND CONTACT:
N5260 CTO 335	MCRD PARRIS IS	M. SLADIC 412 921 7090	KATAHDIN / A COLBY
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER AND PHONE NUMBER	ADDRESS
SJ Conti *		SJ CONTI 412 921 7090	
		CARRIER/WAYBILL NUMBER	CITY, STATE
		FED EX # 8455 4237 5200	WESTBROOK, ME.

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☒ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G
PRESERVATIVE USED: 4°C HCL

DATE YEAR 2005	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS: TCL VOCS								COMMENTS
3/12	0810	TB031205-01	AQ	G	2	2								
3/12	0945	PAI-45-TW-107-SL-12	GW	G	3	3								
3/12	1105	PAI-45-TW-146-SL-10	GW	G	3	3								
3/12	1325	PAI-45-TW-148-SL-12	GW	G	3	3								
3/12	1450	PAI-45-TW-119-SL-15	GW	G	3	3								
3/11	1655	PAI-45-TW-118-SL-11	GW	G	3	3								

1. RELINQUISHED BY SJ Conti	DATE 3/14/05	TIME 1630	1. RECEIVED BY FED EX	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS * Were scheduled for 48hr - Call Mark Sladic for extension of QT

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

TETRA TECH NUS, INC. CHAIN OF CUSTODY NUMBER 033005-1 PAGE 1 OF 1

PROJECT NO:	SITE NAME:	PROJECT MANAGER AND PHONE NUMBER	LABORATORY NAME AND CONTACT:
N5260	McRD PI - SITE 45	M. SLADIC 412 921 7090	CLIFF CASEY
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER AND PHONE NUMBER	ADDRESS
SJ Conti		SJ CONTI 412 921 7090	NAVFAC EFD SOUTH
		CARRIER/WAYBILL NUMBER	CITY, STATE
		FED EX AB# 8455 4237 5221	NORTH CHARLESTON SC

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G

PRESERVATIVE USED: NA

TYPE OF ANALYSIS: 1 QT GLASS (FOR NAVY)

DATE YEAR 2005	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	1 QT GLASS (FOR NAVY)							COMMENTS
3/30	0810	PAI-45-MW22-SU	SOIL	G	2	2							FROM SCREEN INT 3-8'
3/30	0845	PAI-45-MW22-SL	"	"	2	2							10-15'
3/31	0755	PAI-45-MW21-SU	"	"	2	2							3-8'
3/31	0635	PAI-45-MW21-SL	"	"	2	2							10-15'

1. RELINQUISHED BY SJ Conti	DATE 4/4/05	TIME 1630	1. RECEIVED BY FED EX	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS Samples from the screened interval at each of the above 4 wells. mc

DISTRIBUTION WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

A TECH NUS, INC. CHAIN OF CUSTODY UMBER 041505-1 | PAGE 1 OF _ _

PROJECT NO:	SITE NAME:	PROJECT MANAGER AND PHONE NUMBER	LABORATORY NAME AND CONTACT:
N5260	MCRD PI-Site45	M SLADIC 412 921 7090	KATAHDIN / A COLBY OR SHELLY
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER AND PHONE NUMBER	ADDRESS
		SJ CONTI 412 921 7090	
		CARRIER/WAYBILL NUMBER	CITY, STATE
		FED EX AB# 8455 4237 5060	WESTBROOK, ME

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G
PRESERVATIVE USED: 4oC HCl

DATE YEAR 2005	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS: TCL VOCs								COMMENTS
4/13	0830	TB041305-01	~~GW~~ AQ	G	2	2								
4/13	1005	PAI-45-MW02-SU-02	GW	G	3	3								
4/13	1220	PAI-45-MW02-SL-02	GW	G	3	3								
4/13	1445	PAI-45-MW05-SU-02	GW	G	3	3								
4/14	0925	PAI-45-MW22-SU-02	GW	G	3	3								
4/14	1045	PAI-45-MW22-SL-02	GW	G	3	3								
4/14	1305	PAI-45-MW21-SU-02	GW	G	3	3								
4/14	1420	PAI-45-MW21-SL-02	GW	G	3	3								
4/14	1535	PAI-45-MW21-D-02	GW	G	3	3								
4/15	0955	PAI-45-MW23-SU-02	GW	G	3	3								
4/15	1135	PAI-45-MW23-SL-02	GW	G	3	3								
4/15	0000	FD041505-01	GW	G	3	3								DUP OF MW23 SL

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY SJ Conti	4/15/05	1700	1. RECEIVED BY FED EX	4/15/05	
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS # MW SHOULD BE GW — SJC 4/15/05

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

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FORM NO. TtNUS-001

TETRA TECH NUS, INC. CHAIN OF CUSTODY NUMBER 041805-1 PAGE 1 OF 2

PROJECT NO:	SITE NAME:	PROJECT MANAGER AND PHONE NUMBER	LABORATORY NAME AND CONTACT:
N5260	MCRD PI-Site 45	M SLADIC 412 921 7090	KATAHDIN / A COLBY or SHELLY

SAMPLERS (SIGNATURE): Clin Jooden

FIELD OPERATIONS LEADER AND PHONE NUMBER: SJ CONTI 412 921 7090

ADDRESS:

CARRIER/WAYBILL NUMBER: FED EX AB # 8455 4237 5195

CITY, STATE: WESTBROOK, ME

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G

PRESERVATIVE USED: 4oC HCl

TYPE OF ANALYSIS: TCL VOCS

DATE YEAR 2005	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TCL VOCS								COMMENTS
4/15	1405	PA1-45-GW16-SU-02	GW	G	9	9								do MS/MSD
4/15	1535	PA1-45-GW16-SL-02	GW	G	3	3								
4/16	0930	PA1-45-GW15-SU-02	GW	G	3	3								
4/16	1035	PA1-45-GW15-SL-02	GW	G	3	3								
4/16	1220	PA1-45-GW01-D-02	GW	G	3	3								
4/16	1425	PA1-45-GW19-SU-02	GW	G	3	3								
4/16	1535	PA1-45-GW19-SL-02	GW	G	3	3								
4/16	0000	FD 041605-01	GW	G	3	3								DUP OF MW01D
4/17	0950	PA1-45-GW10-SU-02	GW	G	3	3								
4/17	1050	PA1-45-GW10-SL-02	GW	G	9	9								do MS/MSD
4/17	1255	PA1-45-GW20-SU-02	GW	G	3	3								
4/17	1400	PA1-45-GW20-SL-02	GW	G	3	3								
4/17	1550	PA1-45-GW14-SU-02	GW	G	3	3								

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY SJ Conti	4/18/05	1630	1. RECEIVED BY FED EX		
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBU: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIE COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

TtRA TECH NUS, INC. CHAIN OF CUSTODY NUMBER 041805-1 PAGE 2 OF _

PROJECT NO:	SITE NAME:	PROJECT MANAGER AND PHONE NUMBER	LABORATORY NAME AND CONTACT:
N5260	MCRD PI-site 45	M SLADIC 412 921 7090	KATAHDIN/A COLBY or SHELLY

SAMPLERS (SIGNATURE): Clin Jodin

FIELD OPERATIONS LEADER AND PHONE NUMBER: SJ CONTI 412 921 7090

ADDRESS:

CARRIER/WAYBILL NUMBER: FED EX AB # 8455 4237 5195

CITY, STATE: WESTBROOK, ME

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G

PRESERVATIVE USED: 4°C HCl

TYPE OF ANALYSIS: TCL VOCs

DATE YEAR 2005	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TCL VOCs								COMMENTS
4/17	1650	PAI-45-GW14-SL-02	GW	G	3	3								
4/18	0945	PAI-45-GW18-SU-02	GW	G	3	3								
4/18	1050	PAI-45-GW18-SL-02	GW	G	3	3								
4/15	1330	TB 041505-01	AQ	G	2	2								
4/18	0830	PAI-45-WB-041805-01	AQ	G	3	3								SOURCE WATER

1. RELINQUISHED BY: SJ Conti	DATE 4/18/05	TIME 1630	1. RECEIVED BY: FED EX	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

TETRA TECH NUS, INC. CHAIN OF CUSTODY NUMBER 041905-1 PAGE 1 OF 1

PROJECT NO.	SITE NAME:	PROJECT MANAGER AND PHONE NUMBER	LABORATORY NAME AND CONTACT:
N5260	MCRD PI-SITE 45	M SLADIC 412 921 7090	KATAHDIN / A. COLBY
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER AND PHONE NUMBER	ADDRESS
		S CONTI 412 921 7090	
		CARRIER/WAYBILL NUMBER	CITY, STATE
		FED EX AB# 8455 4237 5092	WESTBROOKE, ME.

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G
PRESERVATIVE USED: 4°C HCL

DATE YEAR 2005	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS: VOCs (40 ml)								COMMENTS
4/18	1130	TB041805-01	AQ	G	2	2								
4/18	1205	PAI-45-GW17-SU-02	GW	G	3	3								
4/18	1300	PAT-45-GW17-SL-02	GW	G	3	3								
4/18	1425	PAI-45-GW06-D-02	GW	G	3	3								
4/18	1535	PAI-45-GW07-D-02	GW	G	3	3								
4/19	0925	PAI-45-GW13-SU-02	GW	G	3	3								
4/19	1025	PAI-45-GW13-SL-02	GW	G	3	3								
4/19	1230	PAI-45-GW24-SU-02	GW	G	3*	3*								* POTENTIAL HIGH CONCENTRATION
4/19	0000	FD041905-01	GW	G	3	3								(DUP OF MW24SU or GW24-SU-02)

1. RELINQUISHED BY	DATE 4/19/05	TIME 1630	1. RECEIVED BY FED EX	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBU WHITE (ACCOMPANIES SAMPLE) YELLOW (FIL OPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

APPENDIX G

PERMANENT MONITORING WELL CONSTRUCTION SHEETS

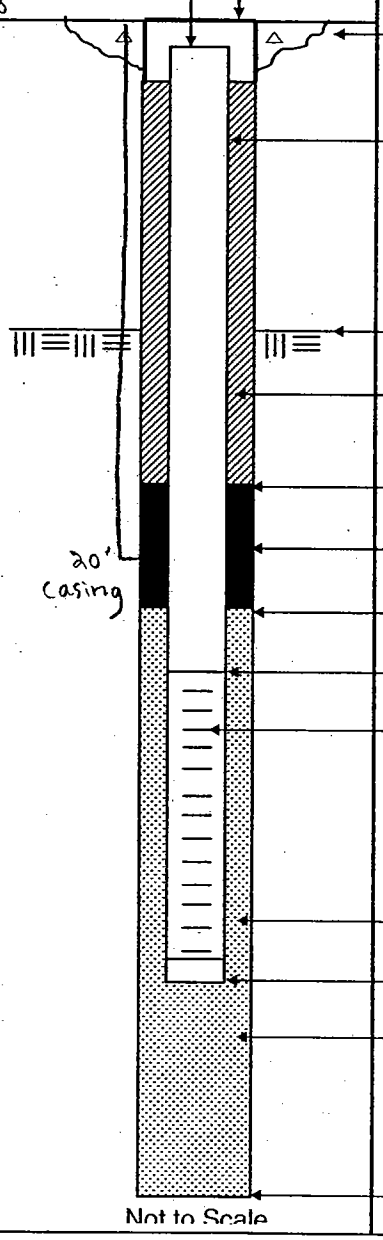
Tetra Tech NUS, Inc.

WELL No.: PA1-45-MW01-D

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	PA1-45-MW01-D
PROJECT No.:	N5260	DRILLER:	Bilbrey	DATE COMPLETED:	4/2/05
SITE:	Site 45	DRILLING METHOD:	HSA/mud rotary	NORTHING:	187466.4933
GEOLOGIST:	Conti	DEV. METHOD:	whale pump	EASTING:	2099311.3517

Ground Elevation = 7.02'
Datum: NAVD88



Elevation / Depth of Top of Riser: 6.71', 0.31'

Elevation / Height of Top of Surface Casing: 7.02', 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: steel

Type of Surface Seal: concrete 2' x 2' x 6" pad

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 12" to 20' / 5 7/8" below casing

Elevation / Depth Top of ~~Rock~~ confining layer: -8.98', ~16'

Type of Backfill: cement / bentonite grout

Elevation / Depth of Seal: -15.98', 23'

Type of Seal: DSI Shur-Pel 3/8" bentonite pellets

Elevation / Depth of Top of Filter Pack: -19.98', 27'

Elevation / Depth of Top of Screen: -22.98', 30'

Type of Screen: PVC

Slot Size x Length: 10 sl. - 10'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI filter sand

Elevation / Depth of Bottom of Screen: -32.98', 40'

Elevation / Depth of Bottom of Filter Pack: -33.48', 40.5'

Type of Backfill Below Well: #1 DSI filter sand

Elevation / Total Depth of Borehole: -33.98', 41'

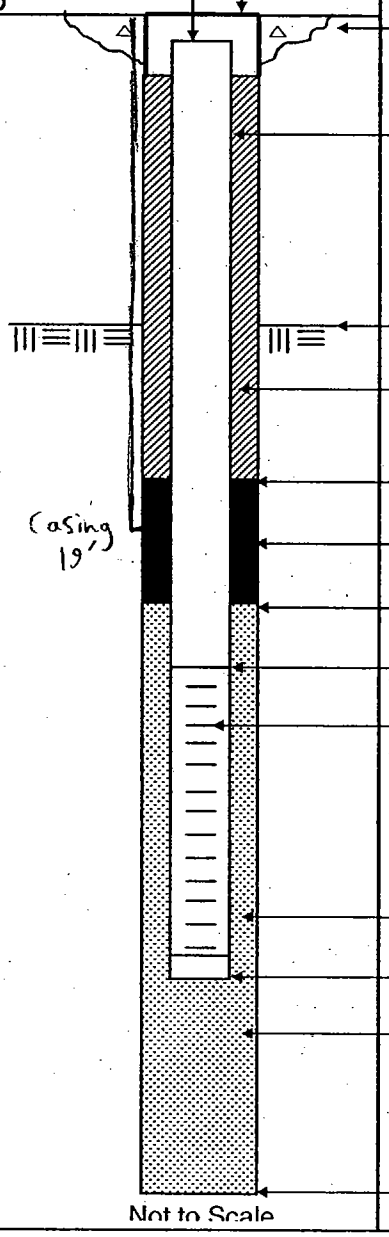
Tetra Tech NUS, Inc.

WELL No.: PA1-45-MW06-D

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	PA1-45-MW06-D
PROJECT No.:	N5260	DRILLER:	Bilbrey	DATE COMPLETED:	3/31/05
SITE:	Site 45	DRILLING METHOD:	HSA / mud rotary	NORTHING:	187283.0718
GEOLOGIST:	Conti	DEV. METHOD:	whale pump	EASTING:	2099308.8271

Ground Elevation = 6.82'
Datum: NAVD88



Elevation / Depth of Top of Riser: 6.44', 0.38'

Elevation / Height of Top of Surface Casing: 6.82', 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: steel

Type of Surface Seal: Concrete 2' x 2' x 6" pad

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 12" to 20' / 5 3/8" below casing

Elevation / Depth Top of ~~Rock~~ confining layer: -9.18', ~16'

Type of Backfill: cement/bentonite grout

Elevation / Depth of Seal: -17.18', 24'

Type of Seal: DSI Shur-Pel 3/8" bentonite pellets

Elevation / Depth of Top of Filter Pack: -20.18', 27'

Elevation / Depth of Top of Screen: -23.18', 30'

Type of Screen: PVC

Slot Size x Length: 10 sl. - 10'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI filter sand

Elevation / Depth of Bottom of Screen: -33.18', 40'

Elevation / Depth of Bottom of Filter Pack: -33.68', 40.5'

Type of Backfill Below Well: #1 DSI filter sand

Elevation / Total Depth of Borehole: -34.18', 41'

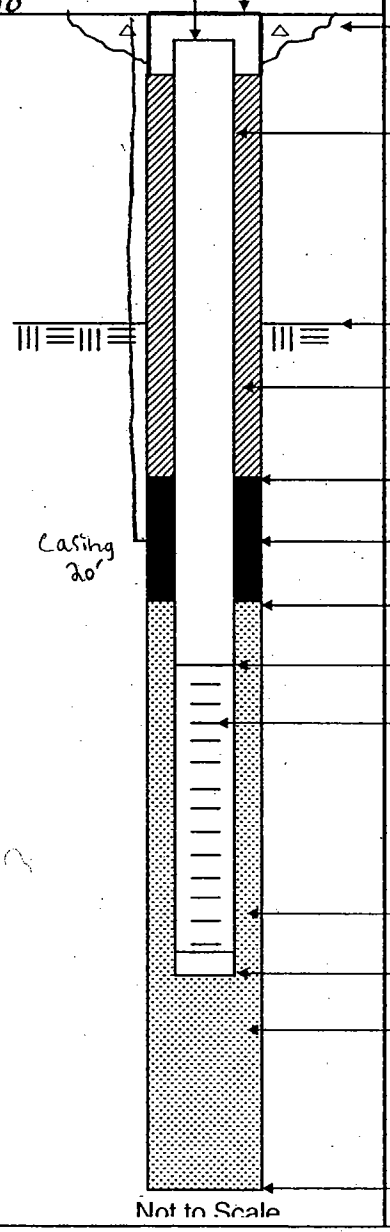
Tetra Tech NUS, Inc.

WELL No.: PAI-45-MW07-D

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	PAI-45-MW07-D
PROJECT No.:	N5260	DRILLER:	Bilbrey	DATE COMPLETED:	4/1/05
SITE:	Site 45	DRILLING METHOD:	HSA/mud rotary	NORTHING:	187340.8135
GEOLOGIST:	Conti	DEV. METHOD:	whale pump	EASTING:	2099306.4135

Ground Elevation = 7.06'
Datum: NAVD88



Elevation / Depth of Top of Riser: 6.75' / 0.31'

Elevation / Height of Top of Surface Casing: 7.06' / 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: steel

Type of Surface Seal: concrete 2' x 2' x 6" pad

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 12" to 20' / 5 7/8" below casing

Elevation / Depth Top of ~~Rock~~ confining layer: -9.94' / ~17'

Type of Backfill: cement / bentonite grout

Elevation / Depth of Seal: -15.44' / 22.5'

Type of Seal: DSI Shur-Pel 3/8" bentonite pellets

Elevation / Depth of Top of Filter Pack: -19.44' / 28.5'

Elevation / Depth of Top of Screen: -22.94' / 30'

Type of Screen: PVC

Slot Size x Length: 10 sl. - 10'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI filter sand

Elevation / Depth of Bottom of Screen: -32.94' / 40'

Elevation / Depth of Bottom of Filter Pack: -33.44' / 40.5'

Type of Backfill Below Well: #1 DSI filter sand

Elevation / Total Depth of Borehole: -33.94' / 41'

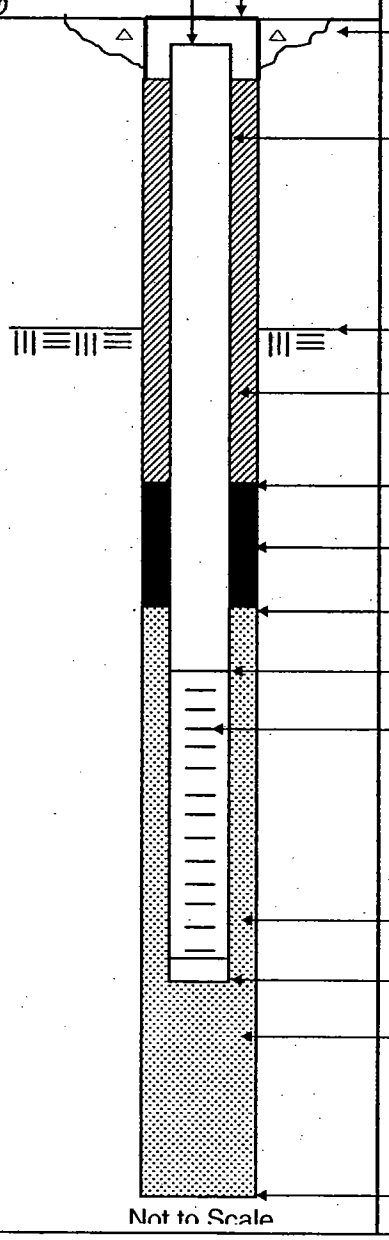
Tetra Tech NUS, Inc.

WELL No.: PAI-45-MW10-SU

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	—
PROJECT No.:	N5260	DRILLER:	BISHOP	DATE COMPLETED:	4/12/05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187227.7997
GEOLOGIST:	Conti	DEV. METHOD:	PURGE PUMP	EASTING:	2099260.9518

Ground Elevation = 6.28'
Datum: NAVD88



Elevation / Depth of Top of Riser: 5.92' / 0.36'

Elevation / Height of Top of Surface Casing: 6.28' / 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: STEEL

Type of Surface Seal: 2'x2'x6" CONCRETE PAD

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: / NA

Type of Backfill: PART OF CONCRETE PAD

Elevation / Depth of Seal: 5.28' / 1

Type of Seal: 3/8" ϕ DSI SHUR PEL Bentonite Pellets

Elevation / Depth of Top of Filter Pack: 4.28' / 2

Elevation / Depth of Top of Screen: 3.28' / 3

Type of Screen: PVC

Slot Size x Length: 10 SL x 5'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI Filter Sand

Elevation / Depth of Bottom of Screen: -1.72' / 8

Elevation / Depth of Bottom of Filter Pack: -2.22' / 8.5

Type of Backfill Below Well: #1 DSI Filter Sand

Elevation / Total Depth of Borehole: -2.72' / 9

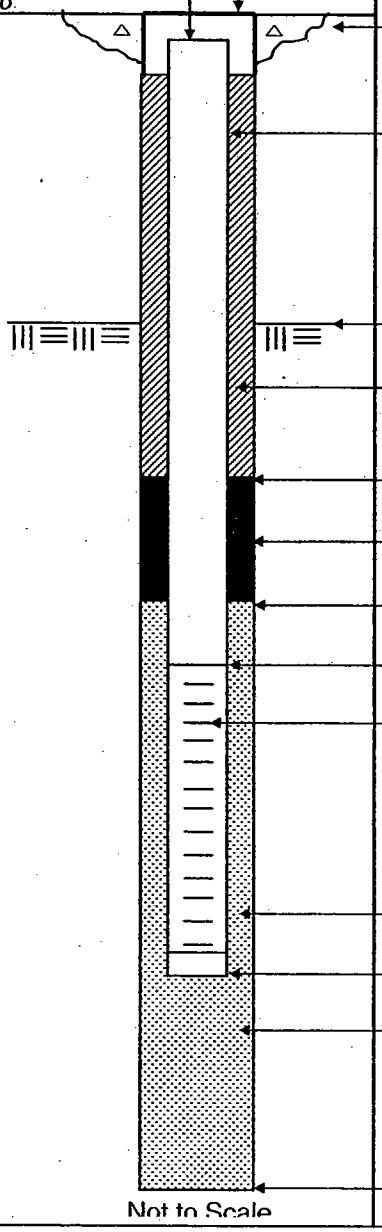
Tetra Tech NUS, Inc.

WELL No.: PAI- 45-MW10-SL

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	—
PROJECT No.:	N5260	DRILLER:	BISHOP	DATE COMPLETED:	4-12-05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187228.5239
GEOLOGIST:	Conti	DEV. METHOD:	PURGE PUMP	EASTING:	2099256.8740

Ground Elevation = 6.23'
Datum: NAVD88



Not to Scale

Elevation / Depth of Top of Riser: 5.89' / 0.34'

Elevation / Height of Top of Surface Casing: 6.23' / 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: STEEL

Type of Surface Seal: 2'x2'x6" CONCRETE PAD

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: / NA

Type of Backfill: CEMENT/BENTONITE GROUT

Elevation / Depth of Seal: 0.23' / 6

Type of Seal: 3/8"Φ DSI SHURPEL Bentonite Pellets - 1 Bucket

Elevation / Depth of Top of Filter Pack: -2.77' / 9

Elevation / Depth of Top of Screen: -4.77' / 11

Type of Screen: PVC

Slot Size x Length: 10 SL x 5'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI Filter Sand 3.5 Bags

Elevation / Depth of Bottom of Screen: -9.77' / 16

Elevation / Depth of Bottom of Filter Pack: -10.27' / 16.5

Type of Backfill Below Well: #1 DSI Filter Sand.

Elevation / Total Depth of Borehole: -10.77' / 17

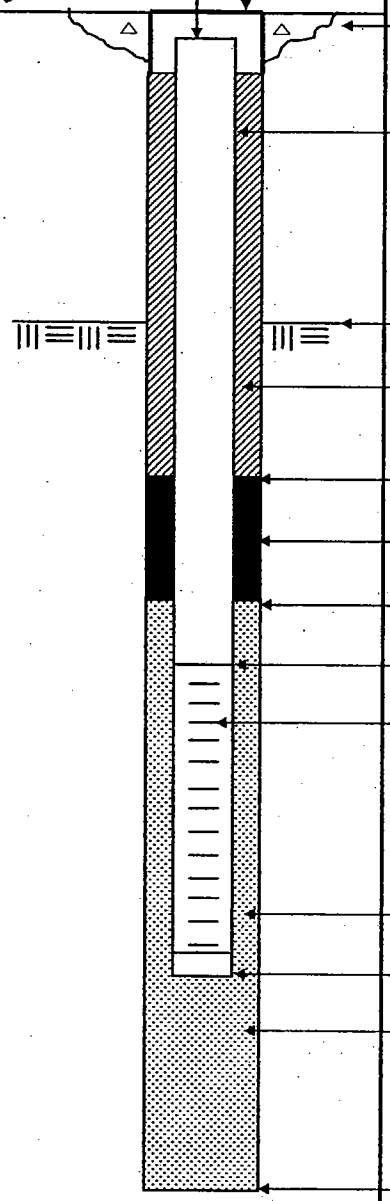
Tetra Tech NUS, Inc.

WELL No.: PAI-45-MW13SU

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	—
PROJECT No.:	N5260	DRILLER:	BISHOP	DATE COMPLETED:	4/13/05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187228.8092
GEOLOGIST:	Conti	DEV. METHOD:	PURGE PUMP	EASTING:	2099305.9101

Ground Elevation = 6.80'
Datum: NAVD88



Not to Scale

Elevation / Depth of Top of Riser: 6.27' / 0.53'

Elevation / Height of Top of Surface Casing: 6.80' / 0.00

I.D. of Surface Casing: 8"

Type of Surface Casing: STEEL

Type of Surface Seal: 2'x2'x6" CONCRETE PAD

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: / NA

Type of Backfill: CONC PAD AND CEMENT/BENTONITE GROUT

Elevation / Depth of Seal: 5.80' / 1

Type of Seal: 3/8"Φ DSI SHUR PEL Bentonite Pellets

Elevation / Depth of Top of Filter Pack: 4.80' / 2

Elevation / Depth of Top of Screen: 2.80' / 4

Type of Screen: PVC

Slot Size x Length: 10SL x 5'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI Filter Sand

Elevation / Depth of Bottom of Screen: -2.20' / 9

Elevation / Depth of Bottom of Filter Pack: -2.70' / 9.5

Type of Backfill Below Well: #1 DSI Filter Sand

Elevation / Total Depth of Borehole: -3.20' / 10

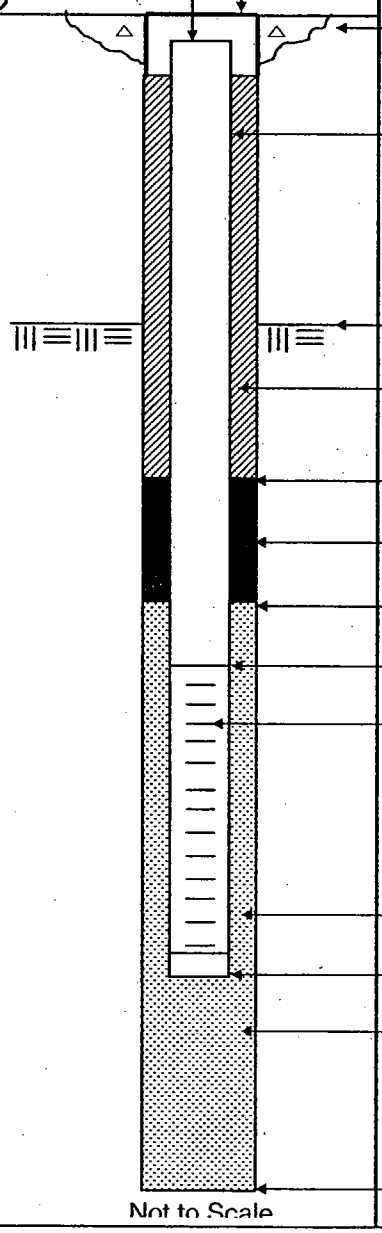
Tetra Tech NUS, Inc.

WELL No.: PAI-45-MW13-SL

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	—
PROJECT No.:	N5260	DRILLER:	BISHOP	DATE COMPLETED:	4/13/05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187191.0517
GEOLOGIST:	Conti	DEV. METHOD:	PURGE PUMP	EASTING:	2099307.1594

Ground Elevation = 6.75'
Datum: NAVD88



Not to Scale

Elevation / Depth of Top of Riser: 6.41' / 0.34'

Elevation / Height of Top of Surface Casing: 6.75' / 0.00

I.D. of Surface Casing: 8"

Type of Surface Casing: STEEL

Type of Surface Seal: 2'x2'x6" CONCRETE PAD

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: / NA

Type of Backfill: CEMENT / BENTONITE GROUT

Elevation / Depth of Seal: 0.75' / 6

Type of Seal: 3/8"Ø DSI SHUR PEL Bentonite Pellets

Elevation / Depth of Top of Filter Pack: -2.25' / 9

Elevation / Depth of Top of Screen: -4.25' / 11

Type of Screen: PVC

Slot Size x Length: 10 SL x 5'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI Filter Sand

Elevation / Depth of Bottom of Screen: -9.25' / 16

Elevation / Depth of Bottom of Filter Pack: -9.75' / 16.5

Type of Backfill Below Well: #1 DSI Filter Sand

Elevation / Total Depth of Borehole: -10.25' / 17

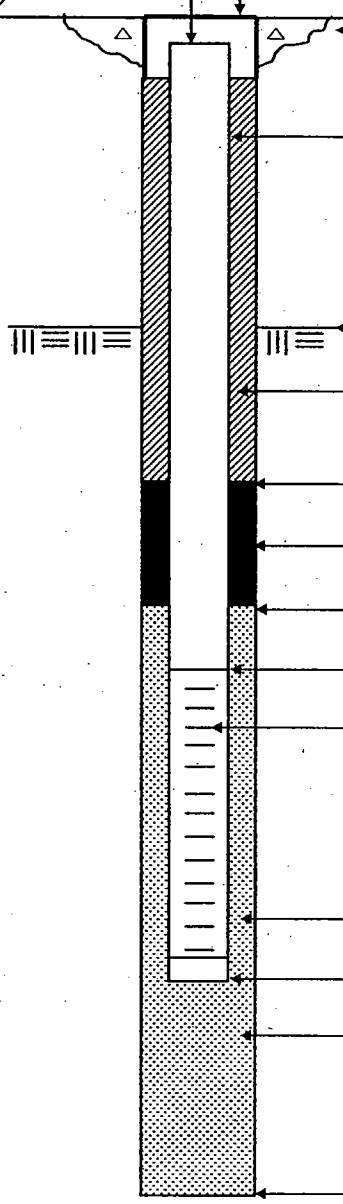
Tetra Tech NUS, Inc.

WELL No.: PAI-45-MW14-SU

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	—
PROJECT No.:	N5260	DRILLER:	BISHOP	DATE COMPLETED:	4-12-05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187339.5910
GEOLOGIST:	Conti	DEV. METHOD:	PURGE PUMP	EASTING:	2099445.0504

Ground Elevation = 6.24'
Datum: NAVD88



Not to Scale

Elevation / Depth of Top of Riser: 5.96' / 0.28'

Elevation / Height of Top of Surface Casing: 6.24' / 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: STEEL

Type of Surface Seal: 2'x2'x6" CONCRETE PAD

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: / NA

Type of Backfill: PART OF CONC PAD AND CEMENT BENTONITE GROUT

Elevation / Depth of Seal: 5.24' / 1

Type of Seal: 3/8"Φ DSI Shur Pel Bentonite Pellets 1/2 Bucket

Elevation / Depth of Top of Filter Pack: 4.24' / 2

Elevation / Depth of Top of Screen: 2.24' / 4

Type of Screen: PVC

Slot Size x Length: 10 SL x 5'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI Filter Sand (3 Bags)

Elevation / Depth of Bottom of Screen: -2.76' / 9

Elevation / Depth of Bottom of Filter Pack: -3.26' / 9.5

Type of Backfill Below Well: #1 DSI Filter Sand

Elevation / Total Depth of Borehole: -3.76' / 10

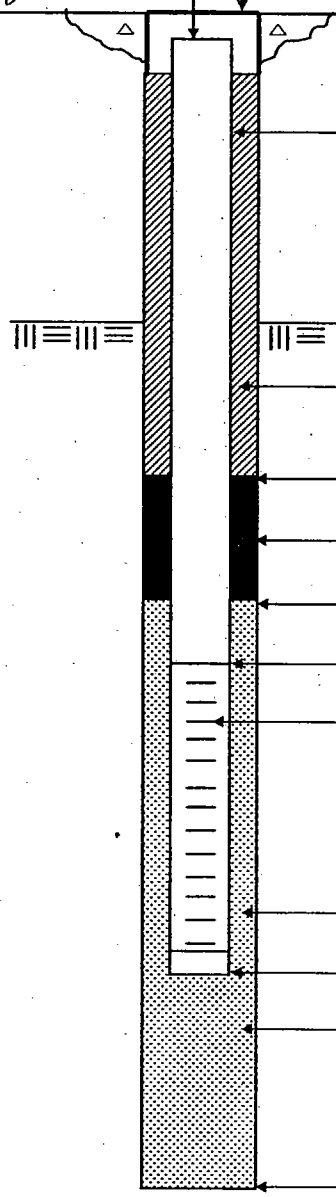
Tetra Tech NUS, Inc.

WELL No.: PAI-45-MW14-SL

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	PAI-45-MW14-SL
PROJECT No.:	N5260	DRILLER:	STURDEVANT	DATE COMPLETED:	4/12/05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187335.0293
GEOLOGIST:	Conti	DEV. METHOD:	PURGE PUMP	EASTING:	2099444.4475

Ground Elevation = 6.19'
Datum: NAVD88



Not to Scale

Elevation / Depth of Top of Riser: 5.89' / 0.30'

Elevation / Height of Top of Surface Casing: 6.19' / 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: STEEL

Type of Surface Seal: 2x2x6" CONCRETE PAD

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: / NA

Type of Backfill: CEMENT BENTONITE GROUT

Elevation / Depth of Seal: 0.19' / 6

Type of Seal: DSI- SHUR PEL 3/8"Φ BENTONITE PELLETS - 1 5gal Bucket

Elevation / Depth of Top of Filter Pack: -1.81' / 8

Elevation / Depth of Top of Screen: -3.81' / 10

Type of Screen: PVC

Slot Size x Length: 10 SL x 5'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI FILTER SAND - 3 Bags

Elevation / Depth of Bottom of Screen: -8.81' / 15

Elevation / Depth of Bottom of Filter Pack: -9.31' / 15.5

Type of Backfill Below Well: #1 DSI FILTER SAND

Elevation / Total Depth of Borehole: -9.81' / 16

Tetra Tech NUS, Inc.

WELL No.: PA1-45-MW15-SU

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	PA1-45-MW15-SU
PROJECT No.:	N5260	DRILLER:	Pilbrey	DATE COMPLETED:	4-3-05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187266.9908
GEOLOGIST:	Conti	DEV. METHOD:	whale pump	EASTING:	2099452.2144

Ground Elevation = 8.61'
Datum: NAVD88

Not to Scale

Elevation / Depth of Top of Riser: 8.34' / 0.27'

Elevation / Height of Top of Surface Casing: 8.61' / 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: steel

Type of Surface Seal: concrete 2' x 2' x 6" pad

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: NA / NA

Type of Backfill: Cement / bentonite Part of Concrete Pad. grout

Elevation / Depth of Seal: 7.61' / 1

Type of Seal: DSI Sure-Pel 3/8" bentonite pellets

Elevation / Depth of Top of Filter Pack: 6.61' / 2

Elevation / Depth of Top of Screen: 4.61' / 4

Type of Screen: PVC

Slot Size x Length: 10sl. x 5'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI filter sand

Elevation / Depth of Bottom of Screen: -0.39' / 9

Elevation / Depth of Bottom of Filter Pack: -0.89' / 9.5

Type of Backfill Below Well: #1 DSI filter sand

Elevation / Total Depth of Borehole: -1.39' / 10

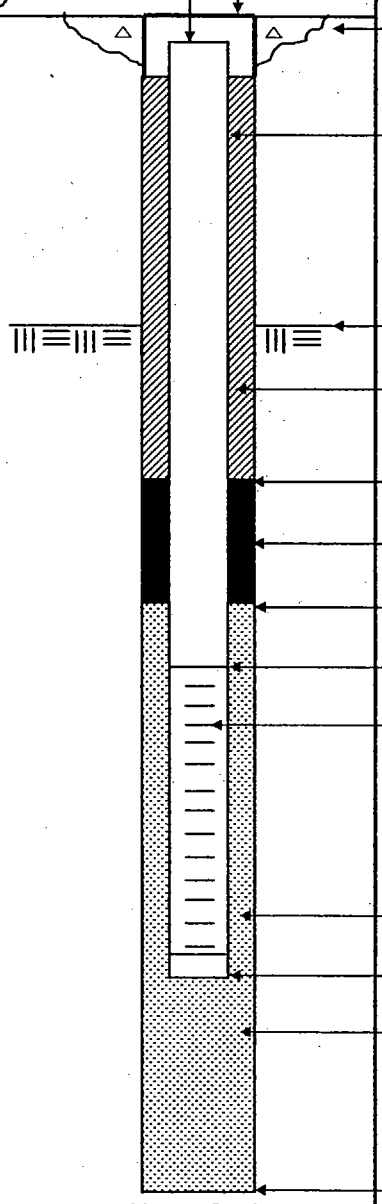
Tetra Tech NUS, Inc.

WELL No.: PA1-45-MW15-SL

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	PA1-45-MW15-SL
PROJECT No.:	N5260	DRILLER:	Bilbrey	DATE COMPLETED:	4-3-05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187266.5443
GEOLOGIST:	Conti	DEV. METHOD:	whale pump	EASTING:	2099456.6725

Ground Elevation = 8.47'
Datum: NAVD88



Not to Scale

Elevation / Depth of Top of Riser: 8.15' / 0.32'

Elevation / Height of Top of Surface Casing: 8.47' / 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: steel

Type of Surface Seal: concrete 2' x 2' x 6" pad

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: NA / NA

Type of Backfill: cement / bentonite grout

Elevation / Depth of Seal: 1.47' / 7

Type of Seal: DSI Sure-Pel 3/8" bentonite pellets

Elevation / Depth of Top of Filter Pack: -1.53' / 10

Elevation / Depth of Top of Screen: -4.53' / 13

Type of Screen: PVC

Slot Size x Length: 10sl. x 5'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI filter sand ≈ 3.0 BAGS

Elevation / Depth of Bottom of Screen: -9.53 / 18

Elevation / Depth of Bottom of Filter Pack: -10.03' / 18.5

Type of Backfill Below Well: #1 DSI filter sand

Elevation / Total Depth of Borehole: -10.53' / 19

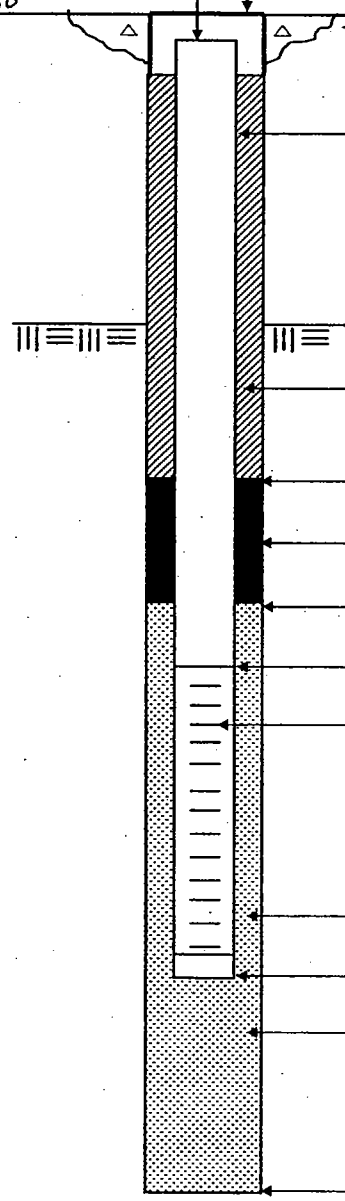
Tetra Tech NUS, Inc.

WELL No.: PAI-45-MW16-SU

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	PAI-45-MW16-SU
PROJECT No.:	N5260	DRILLER:	Bilbrey	DATE COMPLETED:	4/3/05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187235.8851
GEOLOGIST:	Conti	DEV. METHOD:	whale pump	EASTING:	2099428.7718

Ground Elevation = 9.58'
Datum: NAVD88



Not to Scale

Elevation / Depth of Top of Riser: 9.25' / 0.33'

Elevation / Height of Top of Surface Casing: 9.58' / 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: steel

Type of Surface Seal: Concrete 2' x 2' x 6" pad

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: NA / NA

Type of Backfill: cement / bentonite grout

Elevation / Depth of Seal: 8.58' / 1

Type of Seal: DSI Sure-Pel 3/8" bentonite pellets

Elevation / Depth of Top of Filter Pack: 7.58' / 2

Elevation / Depth of Top of Screen: 5.58' / 4

Type of Screen: PVC

Slot Size x Length: 10sl. x 5'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI filter sand ≈ 3.5 bags

Elevation / Depth of Bottom of Screen: 0.58' / 9

Elevation / Depth of Bottom of Filter Pack: 0.08' / 9.5

Type of Backfill Below Well: #1 DSI filter sand

Elevation / Total Depth of Borehole: -0.42' / 10

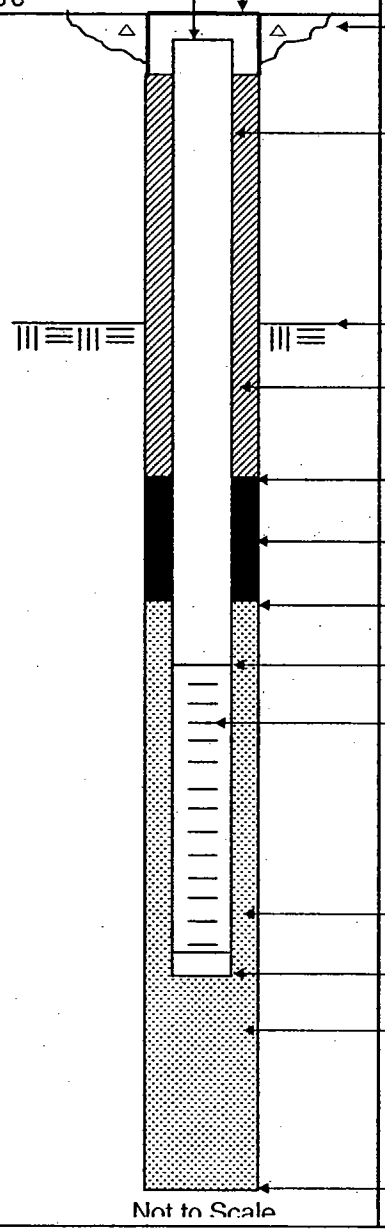
Tetra Tech NUS, Inc.

WELL No.: PAI-45-MW16-SL

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	PAI-45-MW16-SL
PROJECT No.:	N5260	DRILLER:	Bilbrey	DATE COMPLETED:	4/3/05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187235.8635
GEOLOGIST:	Conti	DEV. METHOD:	whale pump	EASTING:	2099433.3638

Ground Elevation = 9.63'
Datum: NAVD88



Not to Scale

Elevation / Depth of Top of Riser: 9.27' / 0.36'

Elevation / Height of Top of Surface Casing: 9.63' / 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: steel

Type of Surface Seal: concrete 2' x 2' x 6" pad

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: NA / NA

Type of Backfill: cement / bentonite grout

Elevation / Depth of Seal: 2.63' / 7'

Type of Seal: DSI Sure-Pel 3/8" bentonite pellets

Elevation / Depth of Top of Filter Pack: -0.37' / 10'

Elevation / Depth of Top of Screen: -3.37' / 13'

Type of Screen: PVC

Slot Size x Length: 10sl. x 5'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI filter sand ~3.5 bags

Elevation / Depth of Bottom of Screen: -8.37' / 18'

Elevation / Depth of Bottom of Filter Pack: -8.87' / 18.5'

Type of Backfill Below Well: #1 DSI filter sand

Elevation / Total Depth of Borehole: -9.37' / 19'

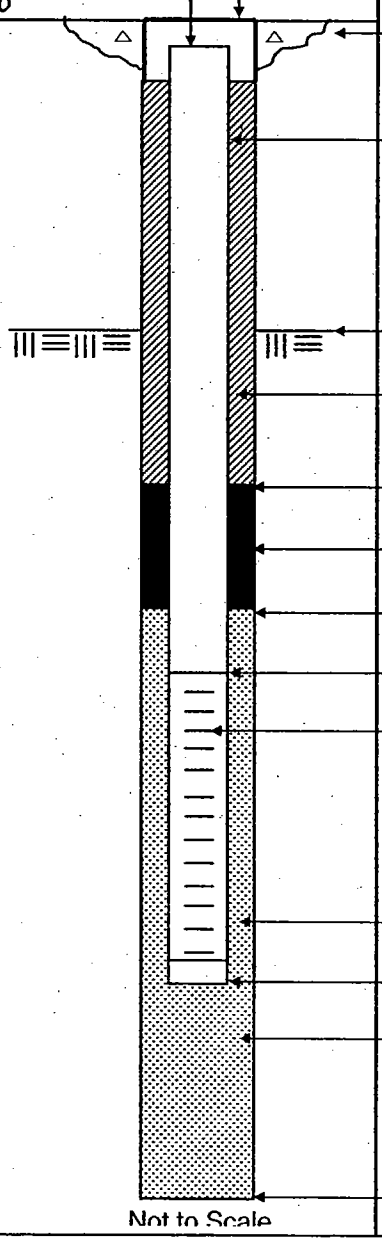
Tetra Tech NUS, Inc.

WELL No.: PAI-45-MW17-SU

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	—
PROJECT No.:	N5260	DRILLER:	BISHOP	DATE COMPLETED:	4/13/05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187076.1206
GEOLOGIST:	Conti	DEV. METHOD:	PURGE PUMP	EASTING:	209 9345.8211

Ground Elevation = 6.53'
Datum: NAVD88



Elevation / Depth of Top of Riser: 6.15' / 0.38'

Elevation / Height of Top of Surface Casing: 6.53' / 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: STEEL

Type of Surface Seal: 2'x2'x6" CONCRETE PAD

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: / NA

Type of Backfill: CEMENT/BENTONITE GROUT

Elevation / Depth of Seal: 5.53' / 1

Type of Seal: 3/8"Ø SHUR PEL Bentonite Pellets

Elevation / Depth of Top of Filter Pack: 4.53' / 2

Elevation / Depth of Top of Screen: 2.53' / 4

Type of Screen: PVC

Slot Size x Length: 10 SL x 5'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI Filter Sand

Elevation / Depth of Bottom of Screen: -2.47' / 9

Elevation / Depth of Bottom of Filter Pack: -2.97' / 9.5

Type of Backfill Below Well: #1 DSI Filter Sand

Elevation / Total Depth of Borehole: -3.47' / 10

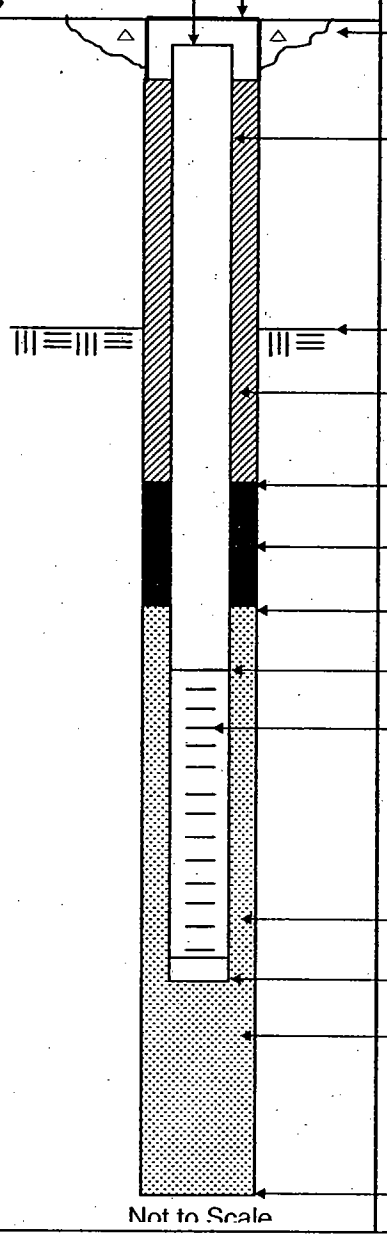
Tetra Tech NUS, Inc.

WELL No.: PAI-45-MW17-SL

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	—
PROJECT No.:	N5260	DRILLER:	BISHOP	DATE COMPLETED:	4-13-05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187068.7813
GEOLOGIST:	Conti	DEV. METHOD:	PURGE PUMP	EASTING:	2099343.8757

Ground Elevation = 6.42'
Datum: NAVD88



Not to Scale

Elevation / Depth of Top of Riser: 5.99' / 0.43'

Elevation / Height of Top of Surface Casing: 6.42' / 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: STEEL

Type of Surface Seal: 2'x2'x6" CONCRETE PAD

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: / NA

Type of Backfill: CEMENT/BENTONITE GROUT

Elevation / Depth of Seal: 1.42' / 5

Type of Seal: 3/8" Φ SHURPEL Bentonite Pellets

Elevation / Depth of Top of Filter Pack: -1.58' / 8

Elevation / Depth of Top of Screen: -3.58' / 10

Type of Screen: PVC

Slot Size x Length: 10 SL x 5'

I.D. of Screen: 2"

Type of Filter Pack: # DSI Filter Sand

Elevation / Depth of Bottom of Screen: -8.58' / 15

Elevation / Depth of Bottom of Filter Pack: -9.08' / 15.5

Type of Backfill Below Well: #1 DSI Filter Sand.

Elevation / Total Depth of Borehole: -9.58' / 16

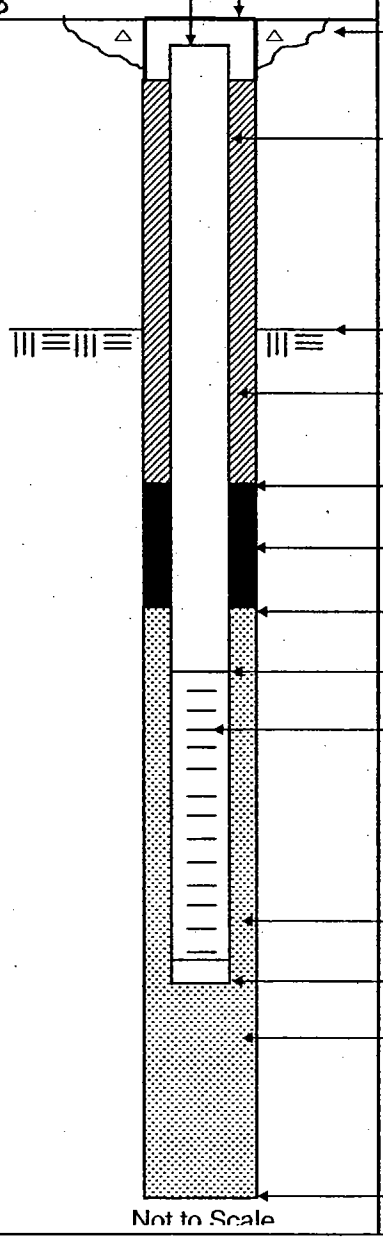
Tetra Tech NUS, Inc.

WELL No.: PAI-45-MW18-50

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	—
PROJECT No.:	N5260	DRILLER:	BISHOP	DATE COMPLETED:	4/13/05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187106.7279
GEOLOGIST:	Conti	DEV. METHOD:	Purge Pump	EASTING:	2099210.2550

Ground Elevation = 7.41'
Datum: NAVD 88



Not to Scale

Elevation / Depth of Top of Riser: 7.03' / 0.38'

Elevation / Height of Top of Surface Casing: 7.41' / 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: STEEL

Type of Surface Seal: 2'x2'x6" CONCRETE PAD

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: / NA

Type of Backfill: CEMENT BENTONITE GROUT

Elevation / Depth of Seal: 6.41' / 1

Type of Seal: 3/8"Ø DSI SHUR PEL Bentonite Pellets

Elevation / Depth of Top of Filter Pack: 5.41' / 2

Elevation / Depth of Top of Screen: 3.41' / 4

Type of Screen: PVC

Slot Size x Length: 10SL x 5'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI FILTER SAND

Elevation / Depth of Bottom of Screen: -1.59' / 9

Elevation / Depth of Bottom of Filter Pack: -2.09' / 9.5

Type of Backfill Below Well: #1 DSI FILTER SAND

Elevation / Total Depth of Borehole: -2.59' / 10

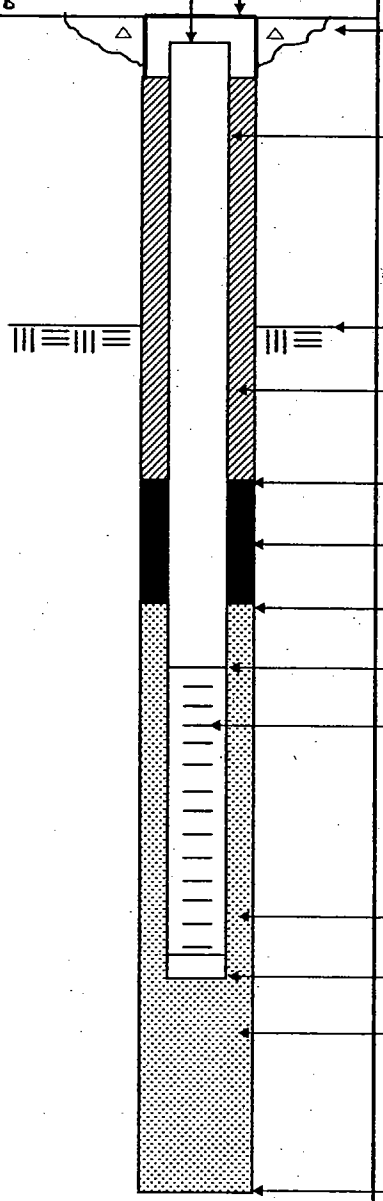
Tetra Tech NUS, Inc.

WELL No.: PAI-45-MW18-SL

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	—
PROJECT No.:	N5260	DRILLER:	BISHOP	DATE COMPLETED:	4/13/05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187108.1863
GEOLOGIST:	Conti	DEV. METHOD:	PURGE PUMP	EASTING:	2092204.8133

Ground Elevation = 7.38'
Datum: NAVD88



Not to Scale

Elevation / Depth of Top of Riser: 7.06' / 0.32'

Elevation / Height of Top of Surface Casing: 7.38' / 0.00

I.D. of Surface Casing: 8"

Type of Surface Casing: Steel

Type of Surface Seal: 2 x 2 x 6" CONCRETE PAD

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: / NA

Type of Backfill: CEMENT BENTONITE GROUT

Elevation / Depth of Seal: 1.38' / 6

Type of Seal: 3/8" Ø DSI SHUR PEL Bentonite Pellets (1 Bucket)

Elevation / Depth of Top of Filter Pack: -1.62' / 9

Elevation / Depth of Top of Screen: -3.62' / 11

Type of Screen: PVC

Slot Size x Length: 10 SL x 5'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI Filter Sand (3 Bgs.)

Elevation / Depth of Bottom of Screen: -8.62' / 16

Elevation / Depth of Bottom of Filter Pack: -9.12' / 16.5

Type of Backfill Below Well: #1 DSI Filter Sand

Elevation / Total Depth of Borehole: -9.62' / 17

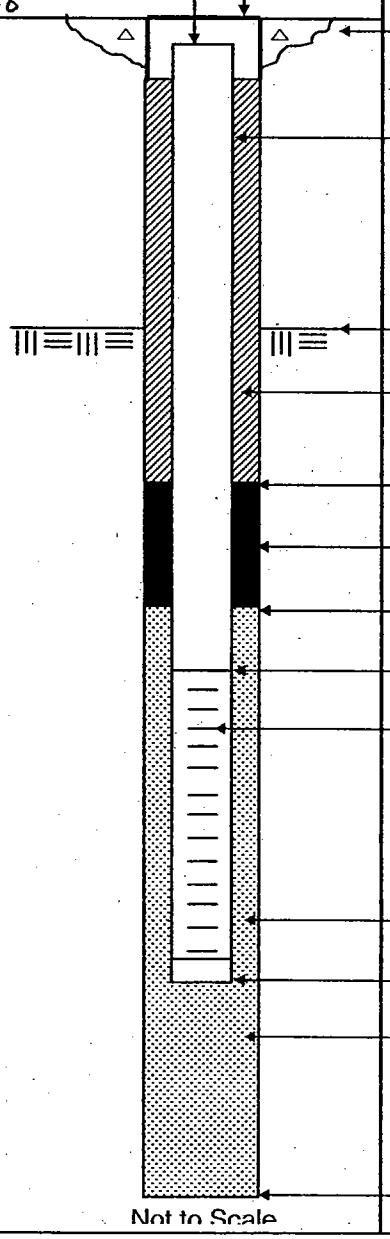
Tetra Tech NUS, Inc.

WELL No.: PA1-45-MW19-SU

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	PA1-45-MW19-SU
PROJECT No.:	N5260	DRILLER:	Bilbrey	DATE COMPLETED:	4/1/05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187177.1683
GEOLOGIST:	Conti	DEV. METHOD:	whale pump	EASTING:	2099201.5452

Ground Elevation = 6.01'
Datum: NAVD88



Elevation / Depth of Top of Riser: 5.71' / 0.30'

Elevation / Height of Top of Surface Casing: 6.01' / 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: steel

Type of Surface Seal: concrete 2' x 2' x 6" pad

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: NA / NA

Type of Backfill: cement / bentonite grout

Elevation / Depth of Seal: 5.01' / 1'

Type of Seal: DSI Sure-Pel 3/8" bentonite pellets

Elevation / Depth of Top of Filter Pack: 4.01' / 2'

Elevation / Depth of Top of Screen: 3.01' / 3'

Type of Screen: PVC

Slot Size x Length: 10 sl. x 5'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI filter sand

Elevation / Depth of Bottom of Screen: -1.99' / 8'

Elevation / Depth of Bottom of Filter Pack: -2.49' / 8.5'

Type of Backfill Below Well: #1 DSI filter sand

Elevation / Total Depth of Borehole: -2.99' / 9'

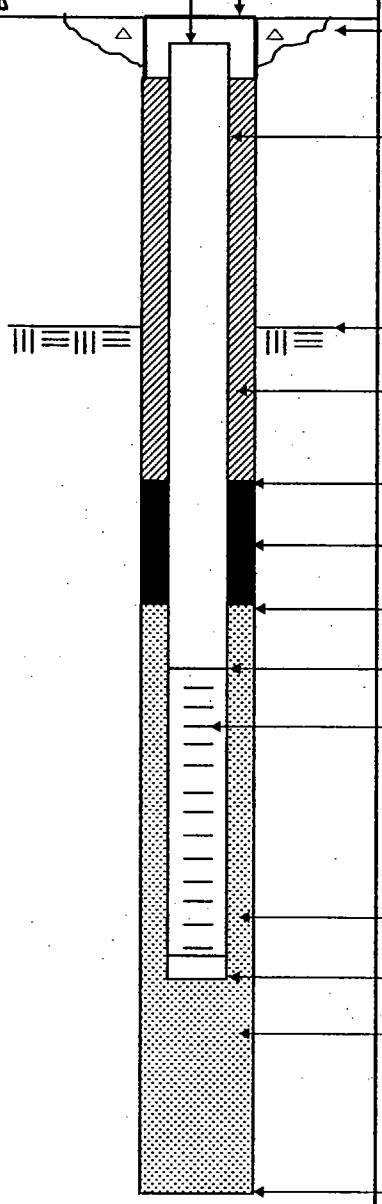
Tetra Tech NUS, Inc.

WELL No.: PAI-45-MW19-SL

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	PAI-45-MW19-SL
PROJECT No.:	N5260	DRILLER:	Bilbrey	DATE COMPLETED:	4/1/05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187179.1713
GEOLOGIST:	Conti	DEV. METHOD:	whale pump	EASTING:	2099186.1380

Ground Elevation = 6.05'
Datum: NAVD88



Not to Scale

Elevation / Depth of Top of Riser: 5.70' / 0.35'

Elevation / Height of Top of Surface Casing: 6.05' / 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: steel

Type of Surface Seal: concrete 2' x 2' x 6" pad

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: NA / NA

Type of Backfill: cement / bentonite grout

Elevation / Depth of Seal: -0.95' / 7'

Type of Seal: DSI Sure-Pel 3/8" bentonite pellets

Elevation / Depth of Top of Filter Pack: -2.95' / 9'

Elevation / Depth of Top of Screen: -4.95' / 11'

Type of Screen: PVC

Slot Size x Length: 10 sl. x 5'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI filter sand

Elevation / Depth of Bottom of Screen: -9.95' / 16'

Elevation / Depth of Bottom of Filter Pack: -10.45' / 16.5'

Type of Backfill Below Well: #1 DSI filter sand

Elevation / Total Depth of Borehole: -10.95' / 17'

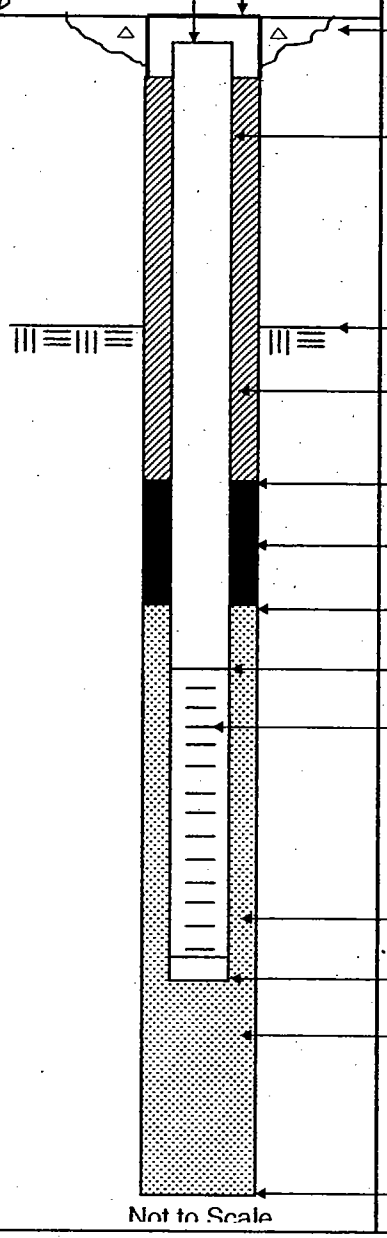
Tetra Tech NUS, Inc.

WELL No.: PAI-45-MW-20SU

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	—
PROJECT No.:	N5260	DRILLER:	BISHOP	DATE COMPLETED:	4-12-05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187130.3147
GEOLOGIST:	Conti	DEV. METHOD:	PURGE PUMP	EASTING:	209.9264.3546

Ground Elevation = 7.12'
Datum: NAVD88



Not to Scale

Elevation / Depth of Top of Riser: 6.79' / 0.33'

Elevation / Height of Top of Surface Casing: 7.12' / 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: STEEL

Type of Surface Seal: 2'x2'x6" CONCRETE PAD

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: / NA

Type of Backfill: CEMENT BENTONITE GROUT/CONCRETE PAD

Elevation / Depth of Seal: 6.12' / 1

Type of Seal: 3/8" DSI SHUR PEL Bentonite Pellets 1/2 Bucket

Elevation / Depth of Top of Filter Pack: 5.12' / 2

Elevation / Depth of Top of Screen: 3.12' / 4

Type of Screen: PVC

Slot Size x Length: 10 SL x 5'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI Filter Sand 3 Bags

Elevation / Depth of Bottom of Screen: -1.88' / 9

Elevation / Depth of Bottom of Filter Pack: -2.38' / 9.5

Type of Backfill Below Well: #1 DSI Filter Sand

Elevation / Total Depth of Borehole: -2.88' / 10

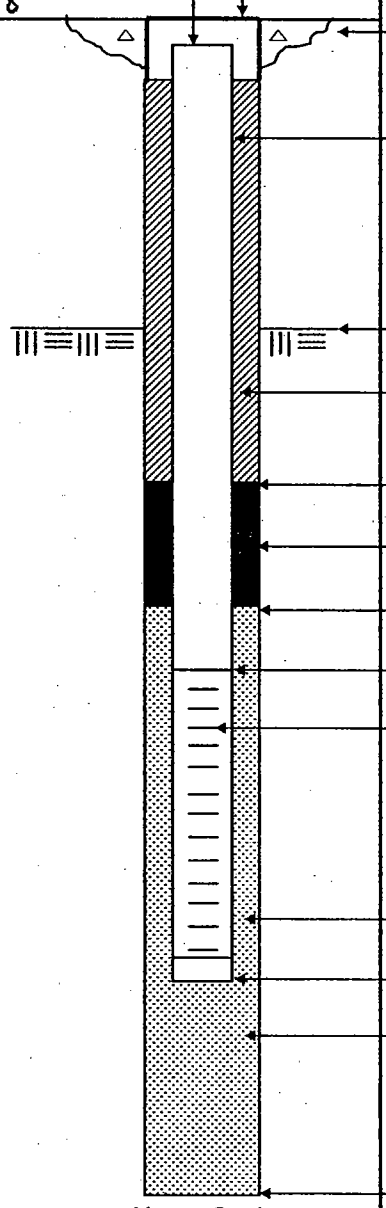
Tetra Tech NUS, Inc.

WELL No.: PAI-45-MW20-SL

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	—
PROJECT No.:	N5260	DRILLER:	BISHOP	DATE COMPLETED:	4/12/05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187129.9329
GEOLOGIST:	Conti	DEV. METHOD:	PURGE PUMP	EASTING:	2099269.9716

Ground Elevation = 7.15'
Datum: NAVD88



Not to Scale

Elevation / Depth of Top of Riser: 6.74' / 0.41'

Elevation / Height of Top of Surface Casing: 7.15' / 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: STEEL

Type of Surface Seal: 2'x2'x6" CONCRETE PAD

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: / NA

Type of Backfill: CEMENT BENTONITE GROUT

Elevation / Depth of Seal: 1.15' / 6

Type of Seal: 3/8" Ø DSI SHURPEL Bentonite Pellets – 1 Bucket (5gal)

Elevation / Depth of Top of Filter Pack: -1.85' / 9

Elevation / Depth of Top of Screen: -3.85' / 11

Type of Screen: PVC

Slot Size x Length: 10 SL x 5'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI Filter Sand 3 Bags.

Elevation / Depth of Bottom of Screen: -8.85' / 16

Elevation / Depth of Bottom of Filter Pack: -9.35' / 16.5

Type of Backfill Below Well: #1 DSI Filter Sand.

Elevation / Total Depth of Borehole: -9.85' / 17

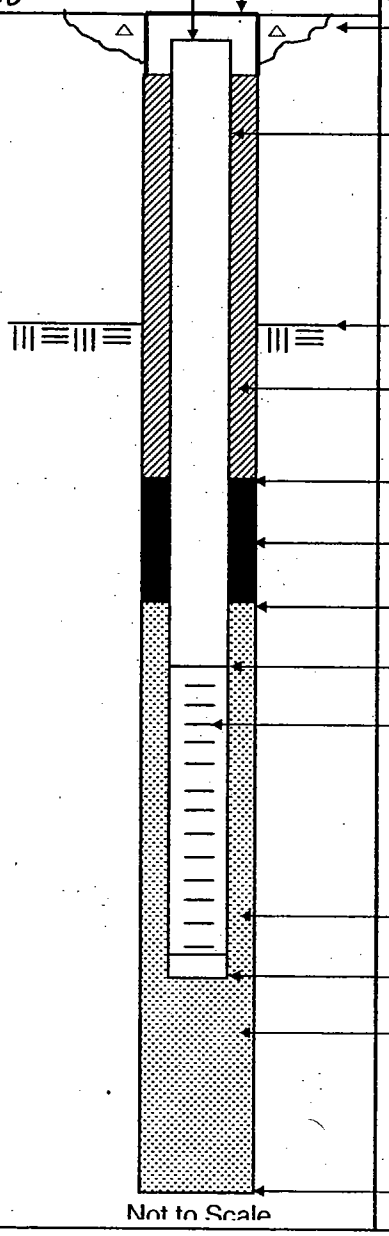
Tetra Tech NUS, Inc.

WELL No.: PA1-45-MW21-SU

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	PA1-45-MW21-SU
PROJECT No.:	N5260	DRILLER:	Bilbrey	DATE COMPLETED:	3/31/05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187339.9632
GEOLOGIST:	Conti	DEV. METHOD:	whale pump	EASTING:	2099244.6950

Ground Elevation = 6.81'
Datum: NAVD88



Not to Scale

Elevation / Depth of Top of Riser: 6.43' / 0.38'

Elevation / Height of Top of Surface Casing: 6.81' / 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: steel

Type of Surface Seal: concrete 2' x 2' x 6" pad

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: NA / NA

Type of Backfill: cement / bentonite grout

Elevation / Depth of Seal: 5.81' / 1'

Type of Seal: DSI Sure-Pel 3/8" bentonite pellets

Elevation / Depth of Top of Filter Pack: 4.81' / 2'

Elevation / Depth of Top of Screen: 3.81' / 3'

Type of Screen: PVC

Slot Size x Length: 10 sl. x 5'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI filter sand

Elevation / Depth of Bottom of Screen: -1.19' / 8'

Elevation / Depth of Bottom of Filter Pack: -1.69' / 8.5'

Type of Backfill Below Well: #1 DSI filter sand

Elevation / Total Depth of Borehole: -2.19' / 9'

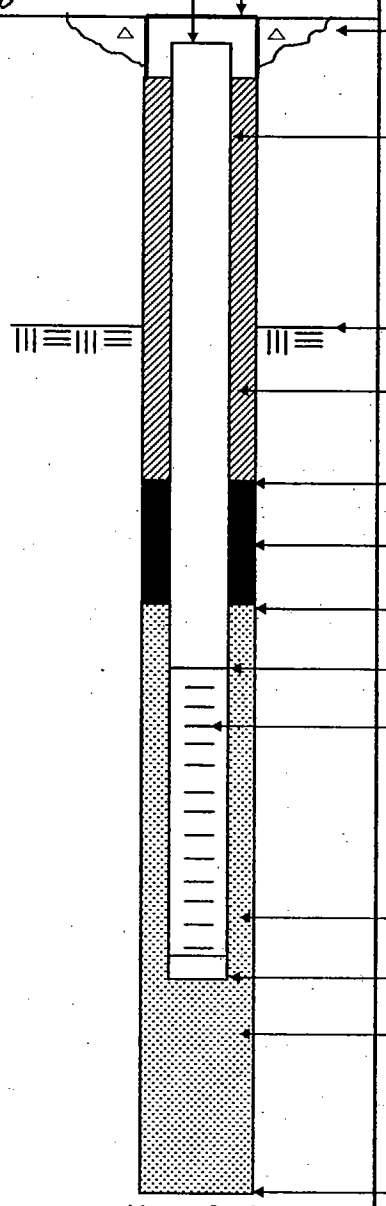
Tetra Tech NUS, Inc.

WELL No.: PA1-45-MW21-SL

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	PA1-45-MW21-SL
PROJECT No.:	N5260	DRILLER:	Bilbrey	DATE COMPLETED:	3/31/05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187346.2882
GEOLOGIST:	Conti	DEV. METHOD:	whale pump	EASTING:	2099245.3398

Ground Elevation = 6.73'
Datum: NAVD88



Not to Scale

Elevation / Depth of Top of Riser: 6.39' / 0.34'

Elevation / Height of Top of Surface Casing: 6.73' / 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: Steel

Type of Surface Seal: concrete 2' x 2' x 6" pad

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: NA / NA

Type of Backfill: cement / bentonite grout

Elevation / Depth of Seal: 1.73' / 5'

Type of Seal: DSI Sure-Pel 3/8" bentonite pellets

Elevation / Depth of Top of Filter Pack: -1.27' / 8'

Elevation / Depth of Top of Screen: -3.27' / 10'

Type of Screen: PVC

Slot Size x Length: 10sl. x 5'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI filter sand

Elevation / Depth of Bottom of Screen: -8.27' / 15'

Elevation / Depth of Bottom of Filter Pack: -8.77' / 15.5'

Type of Backfill Below Well: #1 DSI filter sand

Elevation / Total Depth of Borehole: -9.27' / 16'

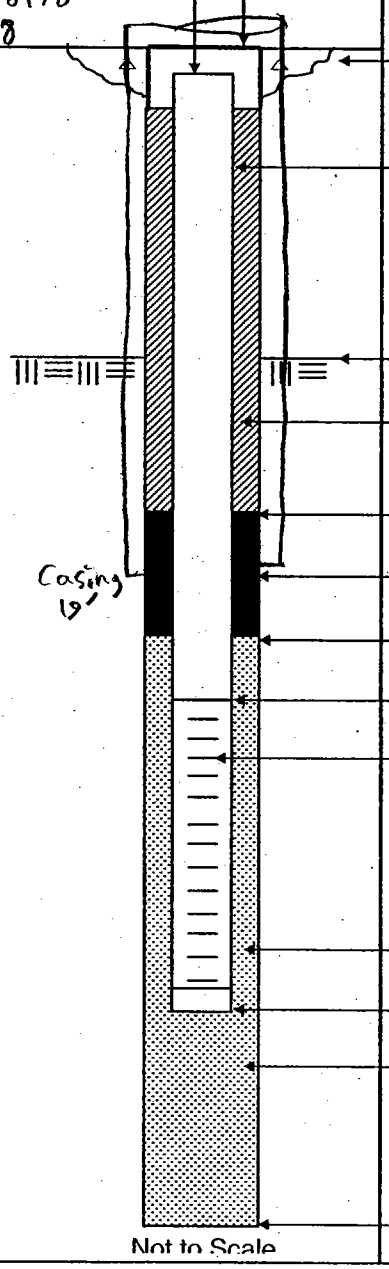
Tetra Tech NUS, Inc.

WELL No.: PA1-4S-MW21-D

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	PA1-4S-MW21-D
PROJECT No.:	N5260	DRILLER:	Bilbrey	DATE COMPLETED:	4/4/05
SITE:	Site 45	DRILLING METHOD:	HSA / mud rotary	NORTHING:	187342.2046
GEOLOGIST:	Conti	DEV. METHOD:	whale pump	EASTING:	2099250.6134

Ground Elevation = 6.76'
Datum: NAVD88



Not to Scale

Elevation / Depth of Top of Riser: 6.36' / 0.40'

Elevation / Height of Top of Surface Casing: 6.76' / 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: steel

Type of Surface Seal: concrete 2' x 2' x 6" pad

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 12" to 20' / 5 7/8" below casing

Elevation / Depth Top of ~~Rock~~ confining layer: -9.24' / ~16'

Type of Backfill: cement / bentonite grout

Elevation / Depth of Seal: -15.24' / 22

Type of Seal: DSI Shur-Pel 3/8" bentonite pellets

Elevation / Depth of Top of Filter Pack: -18.24' / 25

Elevation / Depth of Top of Screen: -20.24' / 27

Type of Screen: PVC

Slot Size x Length: 10 sl. - 10'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI filter sand

Elevation / Depth of Bottom of Screen: -30.24' / 37

Elevation / Depth of Bottom of Filter Pack: -30.74' / 37.5

Type of Backfill Below Well: #1 DSI filter sand

Elevation / Total Depth of Borehole: -31.24' / 38

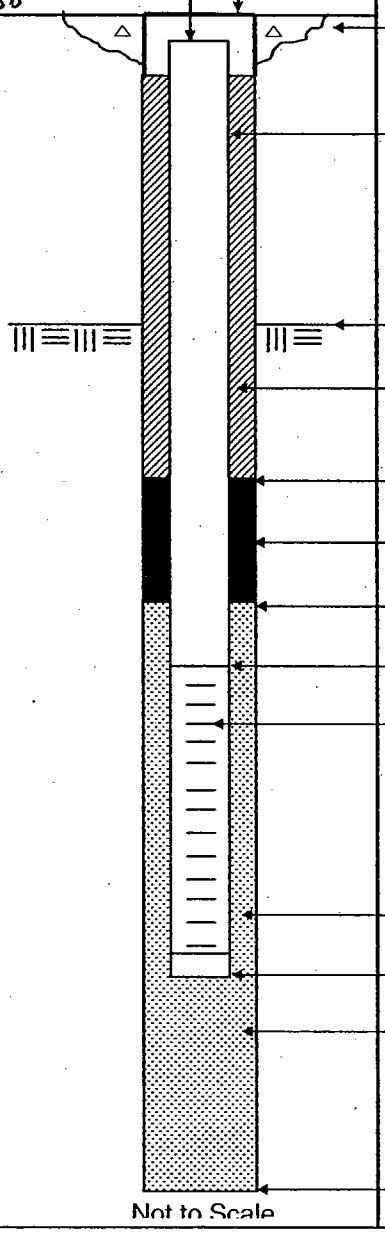
Tetra Tech NUS, Inc.

WELL No.: PA1-45-MW22-SU

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	PA1-45-MW22-SU
PROJECT No.:	N5260	DRILLER:	Bilbrey	DATE COMPLETED:	3/30/05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187393.8912
GEOLOGIST:	Conti	DEV. METHOD:	whale pump	EASTING:	2099265.8432

Ground Elevation = 6.90'
Datum: NAVD88



Not to Scale

Elevation / Depth of Top of Riser: 6.61' / 0.29'

Elevation / Height of Top of Surface Casing: 6.90' / 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: steel

Type of Surface Seal: concrete 2' x 2' x 6" pad

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: NA / NA

Type of Backfill: cement / bentonite grout

Elevation / Depth of Seal: 5.90' / 1'

Type of Seal: DSI Shur-Pel 3/8" bentonite pellets

Elevation / Depth of Top of Filter Pack: 4.90' / 2'

Elevation / Depth of Top of Screen: 3.90' / 3'

Type of Screen: PVC

Slot Size x Length: 10sl. x 5'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI filter sand

Elevation / Depth of Bottom of Screen: -1.10' / 8'

Elevation / Depth of Bottom of Filter Pack: -1.60' / 8.5'

Type of Backfill Below Well: #1 DSI filter sand

Elevation / Total Depth of Borehole: -2.10' / 9'

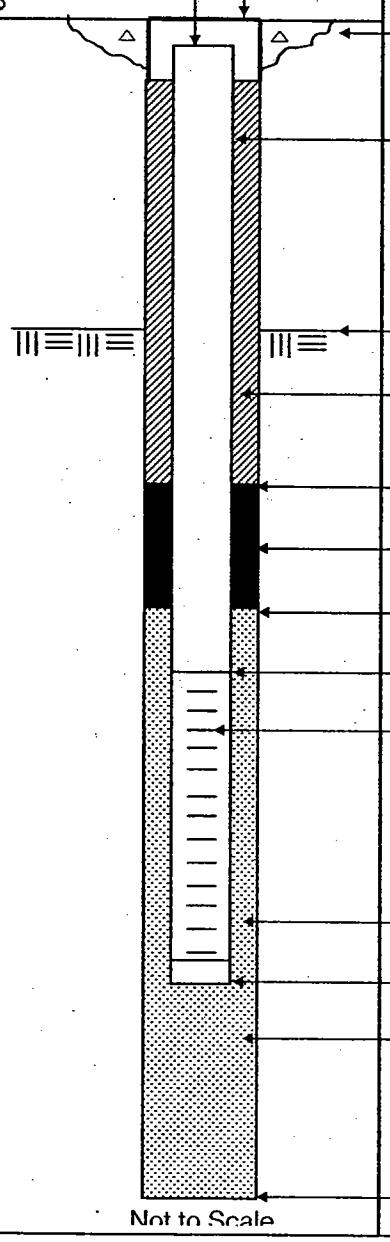
Tetra Tech NUS, Inc.

WELL No.: PA1-45-MW22-SL

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	PA1-45-MW22-SL
PROJECT No.:	N5260	DRILLER:	Bilbrey	DATE COMPLETED:	3/30/05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187398.6082
GEOLOGIST:	Conti/CD	DEV. METHOD:	whale pump	EASTING:	2099262.4690

Ground Elevation = 6.89'
Datum: NAVD88



Elevation / Depth of Top of Riser: 6.56' / 0.33'

Elevation / Height of Top of Surface Casing: 6.89' / 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: steel

Type of Surface Seal: concrete 2'x2'x6" pad

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: NA / NA

Type of Backfill: cement / bentonite grout

Elevation / Depth of Seal: 1.89' / 5'

Type of Seal: DSI Shur-Pel - 3/8" bentonite pellets

Elevation / Depth of Top of Filter Pack: -1.11' / 8'

Elevation / Depth of Top of Screen: -3.11' / 10'

Type of Screen: PVC

Slot Size x Length: 10 sl. - 5'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI filter sand

Elevation / Depth of Bottom of Screen: -8.11' / 15'

Elevation / Depth of Bottom of Filter Pack: -8.61' / 15.5'

Type of Backfill Below Well: #1 DSI filter sand

Elevation / Total Depth of Borehole: -9.11' / 16'

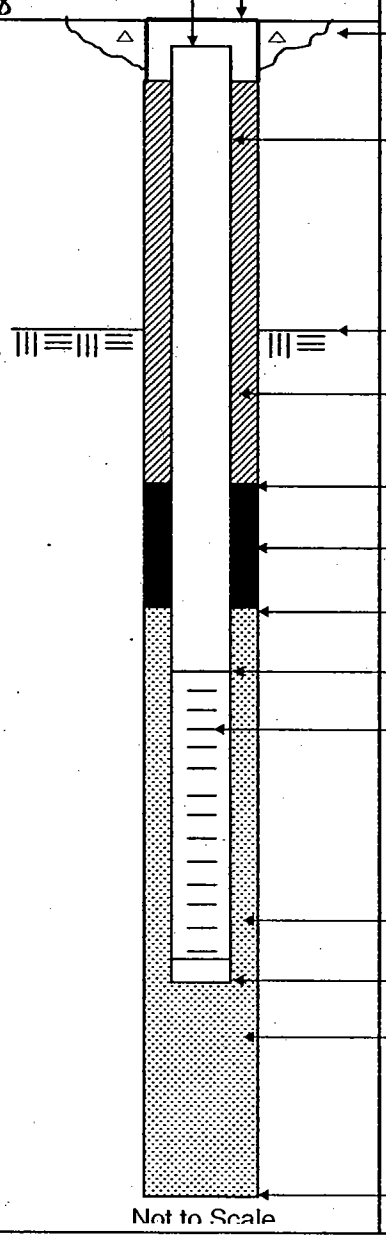
Tetra Tech NUS, Inc.

WELL No.: PA1-45-MW23-50

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	PA1-45-MW23-50
PROJECT No.:	N5260	DRILLER:	Bilbrey	DATE COMPLETED:	4/2/05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187283.8965
GEOLOGIST:	Conti	DEV. METHOD:	whale pump	EASTING:	2099391.4879

Ground Elevation = 6.78'
Datum: NAVD88



Not to Scale

Elevation / Depth of Top of Riser: 6.50', 0.28'

Elevation / Height of Top of Surface Casing: 6.78', 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: steel

Type of Surface Seal: concrete 2' x 2' x 6" pad

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: NA, NA

Type of Backfill: cement/bentonite grout

Elevation / Depth of Seal: 5.78', 1'

Type of Seal: DSI Sure-Pel 3/8" bentonite pellets

Elevation / Depth of Top of Filter Pack: 4.78', 2'

Elevation / Depth of Top of Screen: 3.78', 3'

Type of Screen: PVC

Slot Size x Length: 10sl. x 5'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI filter sand

Elevation / Depth of Bottom of Screen: -3.22', 10'

Elevation / Depth of Bottom of Filter Pack: -3.72', 10.5'

Type of Backfill Below Well: #1 DSI filter sand

Elevation / Total Depth of Borehole: -4.22', 11'

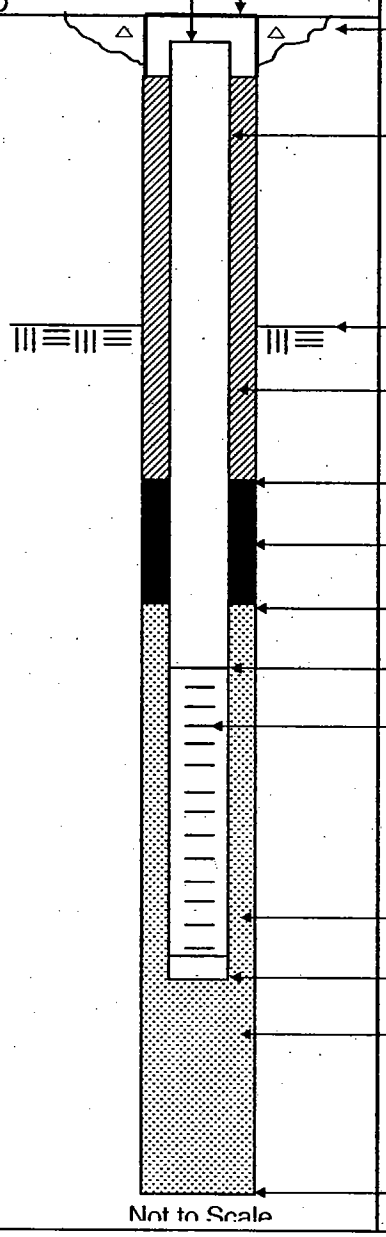
Tetra Tech NUS, Inc.

WELL No.: PAI-45-MW23-SL

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	PAI-45-MW23-SL
PROJECT No.:	N5260	DRILLER:	Bilbrey	DATE COMPLETED:	4/2/05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187279.0976
GEOLOGIST:	Conti	DEV. METHOD:	whale pump	EASTING:	2099390.1054

Ground Elevation = 6.78'
Datum: NAVD88



Not to Scale

Elevation / Depth of Top of Riser: 6.39' / 0.39'

Elevation / Height of Top of Surface Casing: 6.78' / 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: steel

Type of Surface Seal: concrete 2' x 2' x 6" pad

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: NA / NA

Type of Backfill: cement / bentonite grout

Elevation / Depth of Seal: 3.78' / 3'

Type of Seal: DSI Sure-Pel 3/8" bentonite pellets

Elevation / Depth of Top of Filter Pack: 0.28' / 6.5'

Elevation / Depth of Top of Screen: -3.22' / 10'

Type of Screen: PVC

Slot Size x Length: 10 sl. x 5'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI filter sand

Elevation / Depth of Bottom of Screen: -8.22' / 15'

Elevation / Depth of Bottom of Filter Pack: -8.72' / 15.5'

Type of Backfill Below Well: #1 DSI filter sand

Elevation / Total Depth of Borehole: -9.22' / 16'

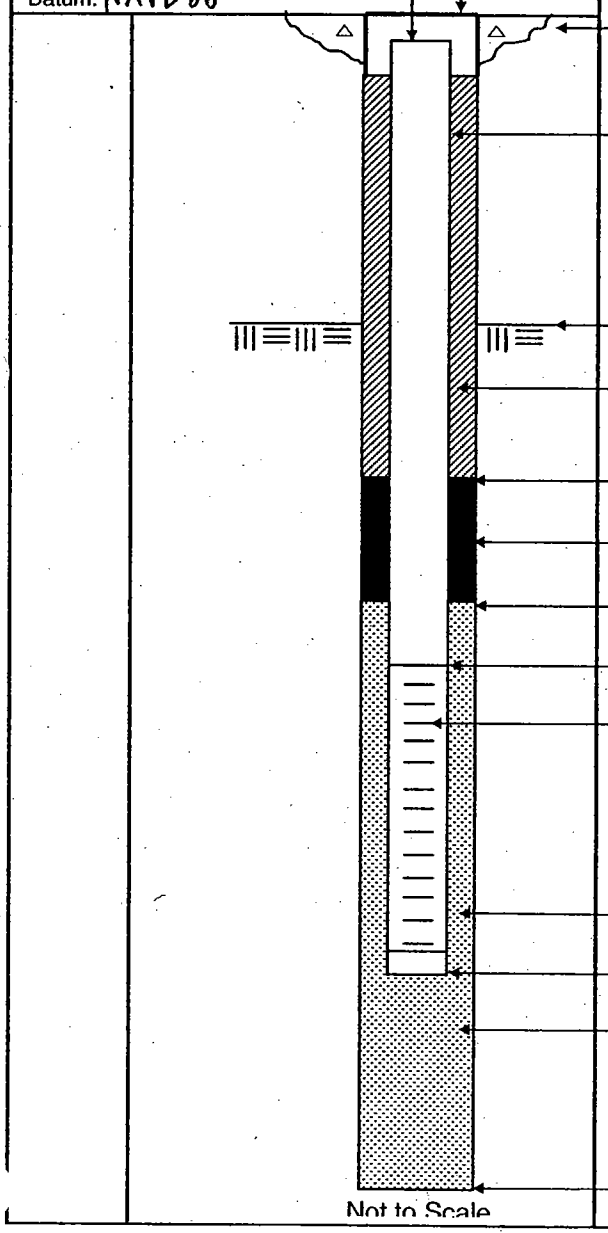
Tetra Tech NUS, Inc.

WELL No.: PAI-45-MW24SU

MONITORING WELL SHEET

PROJECT:	MCRD Parris Is.	DRILLING Co.:	Miller	BORING No.:	—
PROJECT No.:	N5260	DRILLER:	BISHOP	DATE COMPLETED:	4/13/05
SITE:	Site 45	DRILLING METHOD:	HSA	NORTHING:	187374.2764
GEOLOGIST:	Conti	DEV. METHOD:	Purge Pump	EASTING:	209 9284.2981

Ground Elevation = 7.06'
Datum: NAVD88



Elevation / Depth of Top of Riser: 6.63' / 0.43'

Elevation / Height of Top of Surface Casing: 7.06' / 0.00'

I.D. of Surface Casing: 8"

Type of Surface Casing: STEEL

Type of Surface Seal: 2'x2'x6" CONCRETE PAD

I.D. of Riser: 2"

Type of Riser: PVC

Borehole Diameter: 8"

Elevation / Depth Top of Rock: / NA

Type of Backfill: CEMENT/BENTONITE GROUT/ CONC PAD

Elevation / Depth of Seal: 6.06' / 1

Type of Seal: 3/8" Φ SHUR PEL Bentonite Pellets

Elevation / Depth of Top of Filter Pack: 5.06' / 2

Elevation / Depth of Top of Screen: 4.06' / 3

Type of Screen: PVC

Slot Size x Length: 10 SL x 5'

I.D. of Screen: 2"

Type of Filter Pack: #1 DSI Filter Sand

Elevation / Depth of Bottom of Screen: -0.94' / 8

Elevation / Depth of Bottom of Filter Pack: -1.44' / 8.5

Type of Backfill Below Well: #1 DSI Filter Sand.

Elevation / Total Depth of Borehole: -1.94' / 9

Deep Well #1 PA1-45 MW01-D

DHEC
PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 898-4300

1. WELL OWNER INFORMATION:
Name: USMC (last) (first)
Address: PARRIS Island S.C.
City: PARRIS Island S.C. State: Zip:
Telephone: Work: Home:

2. LOCATION OF WELL: COUNTY: Beaufort
Name: SWMU #5
Street Address:
City: Zip:
Latitude: Longitude:

3. PUBLIC SYSTEM NAME: **PUBLIC SYSTEM NUMBER:**

4. ABANDONMENT: ☐ Yes ☒ No
Grouted Depth: from _____ ft. to _____ ft.

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Gray Sand	2	9
Dark Brown silty sand	9	16
Black silt ~~+ shells~~ brown sand	16	19
Black silt + Brown	19	41
Sand with Sea Shells		

*Indicate Water Bearing Zones
(Use a 2nd sheet if needed)

5. REMARKS: 6" Steel Casing installed + grouted 12" Below Surface to 19'

6. PERMIT NUMBER: HW-05-005

7. USE: ☐ Residential ☐ Public Supply ☐ Process ☐ Irrigation ☐ Air Conditioning ☐ Emergency ☐ Test Well ☒ Monitor Well ☐ Replacement

8. WELL DEPTH (completed) Date Started: 3-29-05
40 ft. Date Completed: 4-2-05

9. TYPE ☒ Mud Rotary ☐ Jetted ☐ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

10. CASING: ☒ Threaded ☐ Welded
Diam.: 2" & 6"
Type: ☒ PVC ☐ Galvanized ☒ Steel ☐ Other
2" in. to 30 ft. depth
12" in. to 19 ft. depth
Height: Above/Below Surface 19' ft.
Weight 18 lb./ft.
Drive Shoe? ☐ Yes ☒ No

11. SCREEN
Type: PVC Diam.: 2"
Slot/Gauge: .010 Length: 10'
Set Between: 40 ft. and 30 ft.
_____ ft. and _____ ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☒ No

12. STATIC WATER LEVEL NA ft. below land surface after 24 hours

13. PUMPING LEVEL Below Land Surface.
_____ ft. after _____ hrs. Pumping NA G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield: _____

14. WATER QUALITY NA
Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

15. ARTIFICIAL FILTER (filter pack) ☒ Yes ☐ No
Installed from 40 ft. to 28 ft.
Effective size 20/30 Uniformity Coefficient yes

16. WELL GROUTED? ☒ Yes ☐ No
☐ Neat Cement ☐ Bentonite ☒ Bentonite/Cement ☐ Other _____
Depth: From 28 ft. to 0 ft.

17. NEAREST SOURCE OF POSSIBLE CONTAMINATION: ____ ft. ____ direction
Type _____ NA
Well Disinfected ☐ Yes ☐ No Type: _____ Amount: _____

18. PUMP: Date installed: _____ Not installed ☐
Mfr. Name: _____ Model No.: NA
H.P. _____ Volts _____ Length of drop pipe ___ ft. Capacity ___ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

19. WELL DRILLER: Rick Bilbrey CERT. NO.: B.01797
Address: 310 Sunset Dr.
Livingston, TN 38570
Telephone No. (931) 823-0755 Fax No.:

20. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

Signed: Rick Bilbrey Date: 4/26/05
Authorized Representative

DEEP well #2 PAI45.MW06-D

DHEC
PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 898-4300

1. WELL OWNER INFORMATION:
Name: USMC (last) (first)
Address: Parris Island SC.
City: Parris Island SC. State: Zip:
Telephone: Work: Home:

2. LOCATION OF WELL: COUNTY: Beaufort
Name: SWMU 45
Street Address:
City: Zip:
Latitude: Longitude:

3. PUBLIC SYSTEM NAME: **PUBLIC SYSTEM NUMBER:**

4. ABANDONMENT: ☐ Yes ☒ No
Grouted Depth: from _____ ft. to _____ ft.

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Topsoil	0	2
Ray Sand	2	9
Dark Brown Sand		
+ Silts	9	16
Black Silt +		
Brown Sand + Sea Shells	16	41
*ate Water Bearing Zones		
(Use a 2nd sheet if needed)		

5. REMARKS: 6" Steel Casing installed & grouted. 12" Below surface to depth 20'

6. PERMIT NUMBER: HW-05-005

7. USE:
☐ Residential ☐ Public Supply ☐ Process
☐ Irrigation ☐ Air Conditioning ☐ Emergency
☐ Test Well ☒ Monitor Well ☐ Replacement

8. WELL DEPTH (completed) Date Started: 3-29-05
40 ft. Date Completed: 3-31-05

9. TYPE ☒ Mud Rotary ☐ Jetted ☐ Bored
☐ Dug ☐ Air Rotary ☐ Driven
☐ Cable tool ☐ Other

10. CASING: ☒ Threaded ☐ Welded
Diam.: 2" & 6"
Type: ☒ PVC ☐ Galvanized
☒ Steel ☐ Other
2" in. to 30 ft. depth
12" in. to 20 ft. depth
Height: Above/Below
Surface 6" 6" Steel 20 ft.
Weight 18 lb./ft.
Drive Shoe? ☐ Yes ☒ No

11. SCREEN
Type: PVC Diam.: 2"
Slot/Gauge: .010 Length: 10'
Set Between: 30 ft. and 40 ft.
_____ ft. and _____ ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☒ No

12. STATIC WATER LEVEL N/A ft. below land surface after 24 hours

13. PUMPING LEVEL Below Land Surface. NA
_____ ft. after _____ hrs. Pumping _____ G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield: _____

14. WATER QUALITY NA
Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

15. ARTIFICIAL FILTER (filter pack) ☒ Yes ☐ No
Installed from 40 ft. to 28 ft.
Effective size 20/30 Uniformity Coefficient 4<5

16. WELL GROUTED? ☒ Yes ☐ No
☐ Neat Cement ☐ Bentonite ☒ Bentonite/Cement ☐ Other _____
Depth: From 28 ft. to 0 ft.

17. NEAREST SOURCE OF POSSIBLE CONTAMINATION: NA ft. ____ direction
Type _____
Well Disinfected ☐ Yes ☐ No Type: _____ Amount: _____

18. PUMP: Date installed: N/A Not installed ☐
Mfr. Name: _____ Model No.: _____
H.P. _____ Volts _____ Length of drop pipe ___ ft. Capacity ___ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine
☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

19. WELL DRILLER: RICK BILBREY CERT. NO.: B01797
Address: 310 SUNSET DR.
LIVINGSTON, TN, 38570
Telephone No. (931) 823-0755 Fax No.:

20. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

Signed: Rick Bilbrey Date: 4/26/05
Authorized Representative

DHEC 1903 (03/2002) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

Deep well #3 PAI-45-MW07-D

DHEC
PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 898-4300

1. WELL OWNER INFORMATION:
Name: USMC (last) (first)
Address: PARRIS Island S.C.
City: PARRIS Island State: S.C. Zip:
Telephone: Work: Home:

2. LOCATION OF WELL: COUNTY: Beaufort
Name: SWM245
Street Address:
City: Zip:
Latitude: Longitude:

3. PUBLIC SYSTEM NAME: **PUBLIC SYSTEM NUMBER:**

4. ABANDONMENT: ☐ Yes ☒ No
Grouted Depth: from _____ ft. to _____ ft.

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2'
Gray Sand	2'	9'
Brown Sand+Silt	9	19'
Black Silt + Sea Shells	19'	41
*Indicate Water Bearing Zones (Use a 2nd sheet if needed)		

5. REMARKS: 6" Steel Casing Installed + grouted in place 12" Below ground to 19' Depth

6. PERMIT NUMBER: Hw-05-005

7. USE: ☐ Residential ☐ Irrigation ☐ Test Well ☐ Public Supply ☐ Air Conditioning ☒ Monitor Well ☐ Process ☐ Emergency ☐ Replacement

8. WELL DEPTH (completed) 40 ft. Date Started: 3-29-05 Date Completed: 4-1-05

9. TYPE ☒ Mud Rotary ☐ Dug ☐ Cable tool ☐ Jetted ☐ Air Rotary ☐ Other ☐ Bored ☐ Driven

10. CASING: ☒ Threaded ☐ Welded
Diam.: 2" & 6"
Type: ☒ PVC ☐ Galvanized ☒ Steel ☐ Other
2" in. to 30 ft. depth
12" in. to 19 ft. depth
Height: Above/Below Surface 19 ft.
Weight 18 lb./ft.
Drive Shoe? ☐ Yes ☒ No

11. SCREEN
Type: PVC Diam.: 2"
Slot/Gauge: .010 Length: 10'
Set Between: 30 ft. and 40 ft.
ft. and ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☒ No

12. STATIC WATER LEVEL _____ ft. below land surface after 24 hours

13. PUMPING LEVEL Below Land Surface. NA
_____ ft. after _____ hrs. Pumping _____ G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield: _____

14. WATER QUALITY NA
Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

15. ARTIFICIAL FILTER (filter pack) ☒ Yes ☐ No
Installed from 40 ft. to 28 ft.
Effective size 20/30 Uniformity Coefficient yes

16. WELL GROUTED? ☒ Yes ☐ No
☐ Neat Cement ☐ Bentonite ☒ Bentonite/Cement ☐ Other _____
Depth: From 28 ft. to 0 ft.

17. NEAREST SOURCE OF POSSIBLE CONTAMINATION: ____ ft. ____ direction
Type _____ NA
Well Disinfected ☐ Yes ☐ No Type: _____ Amount: _____

18. PUMP: Date installed: NA Not installed ☐
Mfr. Name: _____ Model No.: _____
H.P. _____ Volts _____ Length of drop pipe ____ ft. Capacity ____ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

19. WELL DRILLER: Rick Bilbrey CERT. NO.: B 01797
Address: 310 Sunset Dr. Livingston TN 38570
Telephone No. (931) 823-0755 Fax No.:

20. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

Signed: Rick Bilbrey Date: 4/26/05
Authorized Representative

DHEC 1003 (03/2002) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

Deepwell # 4 PA1-45 MW21-D

DHEC
PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 898-4300

WELL OWNER INFORMATION:
Name: USMC (last) (first)
Address: Parris Island S.C.
City: Parris Island State: S.C. Zip:
Telephone: Work: Home:

2. LOCATION OF WELL: COUNTY: Beaufort
Name: SWMU-45
Street Address:
City: Zip:
Latitude: Longitude:

3. PUBLIC SYSTEM NAME: **PUBLIC SYSTEM NUMBER:**

4. ABANDONMENT: ☐ Yes ☒ No
Grouted Depth: from _____ ft. to _____ ft.

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Ray Sand	2	9
Brown Sand		
+ Silts	9	20'
Black Silts + Brown	@20	37'
Sand + Sea Shells		
*Indicate Water Bearing Zones (Use a 2nd sheet if needed)		

5. REMARKS: 6" Steel casing installed + Grouted in place 12" Below surface to 20' Depth

6. PERMIT NUMBER: HW-05-005

7. USE: ☐ Residential ☐ Public Supply ☐ Process ☐ Irrigation ☐ Air Conditioning ☐ Emergency ☐ Test Well ☒ Monitor Well ☐ Replacement

8. WELL DEPTH (completed) 37 ft. Date Started: 4-1-05 Date Completed: 4-4-05

9. TYPE ☒ Mud Rotary ☐ Jetted ☐ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

10. CASING: ☒ Threaded ☐ Welded
Diam.: 2" x 6"
Type: ☒ PVC ☐ Galvanized ☒ Steel ☐ Other
2" in. to 27 ft. depth
12" in. to 20 ft. depth
Height: Above (Below)
Surface 6" Steel to 20 ft.
Weight 18 lb./ft.
Drive Shoe? ☐ Yes ☒ No

11. SCREEN
Type: PVC Diam.: 2"
Slot/Gauge: .010 Length: 10'
Set Between: 27 ft. and 37 ft. **NOTE: MULTIPLE SCREENS**
_____ ft. and _____ ft. **USE SECOND SHEET**
Sieve Analysis ☐ Yes (please enclose) ☒ No

12. STATIC WATER LEVEL NA ft. below land surface after 24 hours

13. PUMPING LEVEL Below Land Surface. NA
_____ ft. after _____ hrs. Pumping _____ G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield: _____

14. WATER QUALITY NA
Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

15. ARTIFICIAL FILTER (filter pack) ☒ Yes ☐ No
Installed from 37 ft. to 25 ft.
Effective size 20/30 Uniformity Coefficient yes

16. WELL GROUTED? ☒ Yes ☐ No
☐ Neat Cement ☐ Bentonite ☒ Bentonite/Cement ☐ Other _____
Depth: From 25 ft. to 0 ft.

17. NEAREST SOURCE OF POSSIBLE CONTAMINATION: ____ ft. ____ direction
Type _____ NA
Well Disinfected ☐ Yes ☐ No Type: _____ Amount: _____

18. PUMP: Date installed: NA Not installed ☐
Mfr. Name: _____ Model No.: _____
H.P. _____ Volts _____ Length of drop pipe ___ ft. Capacity ___ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

19. WELL DRILLER: Rick Bilbrey CERT. NO.: B-01797
Address: 310 Sunset DR. Livingston, TN 38570
Telephone No. (931) 823-0755 Fax No.:

20. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

Signed: Rick Bilbrey Date: 4/26/05
Authorized Representative

DHEC 1903 (03/2002) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

PA1-45 MW15SU

DHEC
PROMOTE PROTECT PROSPER

Water Well Record PAI45-MW15SU
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 898-4300

1. WELL OWNER INFORMATION:
Name: USMC (last) (first)
Address: Parris Island SC
City: Parris Island State: Zip:
Telephone: Work: Home:

2. LOCATION OF WELL: COUNTY:
Name: SWMU-45 Beaufort
Street Address:
City: Zip:
Latitude: Longitude:

3. PUBLIC SYSTEM NAME: **PUBLIC SYSTEM NUMBER:**

4. ABANDONMENT: ☐ Yes ☑ No
Grouted Depth: from _____ ft. to _____ ft.

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Gray Sand	2	10
*Indicate Water Bearing Zones (Use a 2nd sheet if needed)		

5. REMARKS:

6. PERMIT NUMBER: Itw-05-005

7. USE:
☐ Residential ☐ Public Supply ☐ Process
☐ Irrigation ☐ Air Conditioning ☐ Emergency
☐ Test Well ☑ Monitor Well ☐ Replacement

8. WELL DEPTH (completed) Date Started: 4-3-2005
9 ft. Date Completed: 4-3-05

9. TYPE ☐ Mud Rotary ☐ Jetted ☑ Bored
☐ Dug ☐ Air Rotary ☐ Driven
☐ Cable tool ☐ Other

10. CASING: ☑ Threaded ☐ Welded
Diam.: 2"
Type: ☑ PVC ☐ Galvanized
☐ Steel ☐ Other
2" in. to 4 ft. depth
_____ in. to _____ ft. depth
Height: Above/Below
Surface _____ ft.
Weight _____ lb./ft.
Drive Shoe? ☐ Yes ☐ No

11. SCREEN
Type: PVC Diam.: 2"
Slot/Gauge: .010 Length: 5
Set Between: 4 ft. and 9 ft.
_____ ft. and _____ ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☑ No

12. STATIC WATER LEVEL NA ft. below land surface after 24 hours

13. PUMPING LEVEL Below Land Surface.
_____ ft. after _____ hrs. Pumping NA G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield: _____

14. WATER QUALITY NA
Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

15. ARTIFICIAL FILTER (filter pack) ☑ Yes ☐ No
Installed from 9 ft. to 2 ft.
Effective size 20/30 Uniformity Coefficient yes

16. WELL GROUTED? ☑ Yes ☐ No
☐ Neat Cement ☐ Bentonite ☑ Bentonite/Cement ☐ Other _____
Depth: From 2 ft. to 0 ft.

17. NEAREST SOURCE OF POSSIBLE CONTAMINATION: _____ ft. _____ direction
Type _____ NA
Well Disinfected ☐ Yes ☐ No Type: _____ Amount: _____

18. PUMP: Date installed: NA Not installed ☐
Mfr. Name: _____ Model No.: _____
H.P. _____ Volts _____ Length of drop pipe ___ ft. Capacity ___ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine
☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

19. WELL DRILLER: Rick Billey CERT. NO.: B-01797
Address: 310 Sunset Dr.
Livingston, TN 38570
Telephone No.: 931-823-0755 Fax No.:

20. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

Signed: Rick Billey Date: 5-15-05
Authorized Representative

DHEC 1903 (03/2002) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

DHEC
PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 898-4300

PA1-45 MW15SL

WELL OWNER INFORMATION:
Name: USMC (last) (first)
Address: Parris Island SC.
City: Parris Island State: Zip:
Telephone: Work: Home:

2. LOCATION OF WELL: COUNTY: Beaufort
Name: SWMU-45
Street Address:
City: Zip:
Latitude: Longitude:

3. PUBLIC SYSTEM NAME: **PUBLIC SYSTEM NUMBER:**

4. ABANDONMENT: ☐ Yes ☑ No
Grouted Depth: from _____ ft. to _____ ft.

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Gray Sand	2	9
Brown Sand + Silt	9	19
cate Water Bearing Zones		
(Use a 2nd sheet if needed)		

5. REMARKS:

6. PERMIT NUMBER: HW-05-005

7. USE:
☐ Residential ☐ Public Supply ☐ Process
☐ Irrigation ☐ Air Conditioning ☐ Emergency
☐ Test Well ☑ Monitor Well ☐ Replacement

8. WELL DEPTH (completed) Date Started: 4-3-05
18 ft. Date Completed: 4-3-05

9. TYPE ☐ Mud Rotary ☐ Jetted ☑ Bored
☐ Dug ☐ Air Rotary ☐ Driven
☐ Cable tool ☐ Other

10. CASING: ☑ Threaded ☐ Welded
Diam.: 2"
Type: ☑ PVC ☐ Galvanized
☐ Steel ☐ Other
2" in. to 13 ft. depth
_____ in. to _____ ft. depth
Height: Above/Below
Surface _____ ft.
Weight _____ lb./ft.
Drive Shoe? ☐ Yes ☐ No

11. SCREEN
Type: PVC Diam.: 2"
Slot/Gauge: .010 Length: 5
Set Between: 13 ft. and 18 ft.
_____ ft. and _____ ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☑ No

12. STATIC WATER LEVEL NA ft. below land surface after 24 hours

13. PUMPING LEVEL Below Land Surface. NA
_____ ft. after _____ hrs. Pumping _____ G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield: _____

14. WATER QUALITY NA
Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

15. ARTIFICIAL FILTER (filter pack) ☑ Yes ☐ No
Installed from 18 ft. to 11 ft.
Effective size 20/30 Uniformity Coefficient ~~yes~~

16. WELL GROUTED? ☑ Yes ☐ No
☐ Neat Cement ☐ Bentonite ☑ Bentonite/Cement ☐ Other _____
Depth: From 11 ft. to 0 ft.

17. NEAREST SOURCE OF POSSIBLE CONTAMINATION: _____ ft. _____ direction
Type _____
Well Disinfected ☐ Yes ☐ No Type: NA Amount: _____

18. PUMP: Date installed: NA Not installed ☐
Mfr. Name: _____ Model No.: _____
H.P. _____ Volts _____ Length of drop pipe ___ ft. Capacity ___ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine
☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

19. WELL DRILLER: Rick Billing CERT. NO.: B-01799
Address: 310 Sunset Dr.
Lexington TN 38570
Telephone No.: 931-823-0755 Fax No.:

20. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

Signed: Rick Billing Date: 5-15-05
Authorized Representative

DHEC 1803 (03/2002) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

DHEC
PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water

PA1-45 MW16SL

2600 Bull Street, Columbia, SC 29201-1708; (803) 898-4300

1. WELL OWNER INFORMATION:
Name: USMC (last) (first)
Address: Parris Island SC
City: Parris Island State: Zip:
Telephone: Work: Home:

2. LOCATION OF WELL: **COUNTY:**
Name: SWMU-45
Street Address:
City: Zip:
Latitude: Longitude:

3. PUBLIC SYSTEM NAME: **PUBLIC SYSTEM NUMBER:**

4. ABANDONMENT: ☐ Yes ☑ No
Grouted Depth: from _____ ft. to _____ ft.

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Gray Sand	2	9
Brown Sand & Silt	9	19
*Indicate Water Bearing Zones (Use a 2nd sheet if needed)		

5. REMARKS:

6. PERMIT NUMBER: HW-05-005

7. USE:
☐ Residential ☐ Public Supply ☐ Process
☐ Irrigation ☐ Air Conditioning ☐ Emergency
☐ Test Well ☑ Monitor Well ☐ Replacement

8. WELL DEPTH (completed) Date Started: 4-3-05
18 ft. Date Completed: 4-3-05

9. TYPE ☐ Mud Rotary ☐ Jetted ☑ Bored
☐ Dug ☐ Air Rotary ☐ Driven
☐ Cable tool ☐ Other

10. CASING: ☑ Threaded ☐ Welded
Diam.: 2"
Type: ☑ PVC ☐ Galvanized
☐ Steel ☐ Other
2 in. to 13 ft. depth
_____ in. to _____ ft. depth
Height: Above/Below Surface _____ ft.
Weight _____ lb./ft.
Drive Shoe? ☐ Yes ☐ No

11. SCREEN
Type: PVC Diam.: 2"
Slot/Gauge: .010 Length: 5'
Set Between: 13 ft. and 18 ft.
_____ ft. and _____ ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☑ No

12. STATIC WATER LEVEL NA ft. below land surface after 24 hours

13. PUMPING LEVEL Below Land Surface.
_____ ft. after _____ hrs. Pumping _____ G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield: _____

14. WATER QUALITY
Chemical Analysis ☐ Yes ☐ No NA Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

15. ARTIFICIAL FILTER (filter pack) ☑ Yes ☐ No
Installed from 18 ft. to 11 ft.
Effective size 20/30 Uniformity Coefficient yes

16. WELL GROUTED? ☑ Yes ☐ No
☐ Neat Cement ☐ Bentonite ☑ Bentonite/Cement ☐ Other _____
Depth: From 11 ft. to 0 ft.

17. NEAREST SOURCE OF POSSIBLE CONTAMINATION: ____ ft. ____ direction
Type _____ NA
Well Disinfected ☐ Yes ☐ No Type: _____ Amount: _____

18. PUMP: Date installed: NA Not installed ☐
Mfr. Name: _____ Model No.: _____
H.P. _____ Volts _____ Length of drop pipe ___ ft. Capacity ___ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine
☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

19. WELL DRILLER: Rick Billing **CERT. NO.:** B-01797
Address: 310 Sunrail DR
Lewisburg TN 37570
Telephone No.: 931-823-0755 Fax No.:

20. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

Signed: Rick Billing Date: 5-15-05
Authorized Representative

D H E C
PROMOTE PROTECT PROSPER

Water Well Record PA1-45 MW16-SU
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 898-4300

1. WELL OWNER INFORMATION:
Name: USMC (last) (first)
Address: Parris Island SC
City: Parris Island State: Zip:
Telephone: Work: Home:

2. LOCATION OF WELL: **COUNTY:**
Name: SWMU-45
Street Address:
City: Zip:
Latitude: Longitude:

3. PUBLIC SYSTEM NAME: **PUBLIC SYSTEM NUMBER:**

4. ABANDONMENT: ☐ Yes ☐ No
Grouted Depth: from _____ ft. to _____ ft.

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Bay Sand	2	10
cate Water Bearing Zones		
(Use a 2nd sheet if needed)		

5. REMARKS:

6. PERMIT NUMBER: HW-05-005

7. USE: ☐ Residential ☐ Public Supply ☐ Process ☐ Irrigation ☐ Air Conditioning ☐ Emergency ☐ Test Well ☑ Monitor Well ☐ Replacement

8. WELL DEPTH (completed) Date Started: 4-3-05
9 ft. Date Completed: 4-3-05

9. TYPE ☐ Mud Rotary ☐ Jetted ☑ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

10. CASING: ☑ Threaded ☐ Welded
Diam.: 2"
Type: ☑ PVC ☐ Galvanized ☐ Steel ☐ Other
2" in. to 4 ft. depth
_____ in. to _____ ft. depth
Height: Above/Below Surface _____ ft.
Weight _____ lb./ft.
Drive Shoe? ☐ Yes ☐ No

11. SCREEN
Type: PVC Diam.: 2"
Slot/Gauge: .010 Length: 5
Set Between: 4 ft. and 9 ft.
_____ ft. and _____ ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☑ No

12. STATIC WATER LEVEL NA ft. below land surface after 24 hours

13. PUMPING LEVEL Below Land Surface. NA
_____ ft. after _____ hrs. Pumping _____ G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield: _____

14. WATER QUALITY NA
Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

15. ARTIFICIAL FILTER (filter pack) ☑ Yes ☐ No
Installed from 9 ft. to 2 ft.
Effective size 20/30 Uniformity Coefficient yes

16. WELL GROUTED? ☑ Yes ☐ No
☐ Neat Cement ☐ Bentonite ☑ Bentonite/Cement ☐ Other _____
Depth: From 2 ft. to 0 ft.

17. NEAREST SOURCE OF POSSIBLE CONTAMINATION: _____ ft. _____ direction
Type _____ NA
Well Disinfected ☐ Yes ☐ No Type: _____ Amount: _____

18. PUMP: Date installed: NA Not installed ☐
Mfr. Name: _____ Model No.: _____
H.P. _____ Volts _____ Length of drop pipe ___ ft. Capacity ___ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

19. WELL DRILLER: Rick Bellamy **CERT. NO.:** B-01797
Address: 310 Sunset Dr
Jamesville, TN 38570
Telephone No.: 931-823-0755 Fax No.:

20. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

Signed: Rick Bellamy Date: 5-15-05
Authorized Representative

DHEC 1000 (05/2000) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

D H E C

PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water

PA1-45MW19-SU

2600 Bull Street, Columbia, SC 29201-1708; (803) 898-4300

1. WELL OWNER INFORMATION:
Name: USMC (last) (first)
Address: Parris Island SC
City: Parris Island State: Zip:
Telephone: Work: Home:

2. LOCATION OF WELL: COUNTY: Beaufort
Name: SWMW-45
Street Address:
City: Zip:
Latitude: Longitude:

3. PUBLIC SYSTEM NAME: **PUBLIC SYSTEM NUMBER:**

4. ABANDONMENT: ☐ Yes ☑ No
Grouted Depth: from _____ ft. to _____ ft.

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Gray Sand	2	9
*Indicate Water Bearing Zones (Use a 2nd sheet if needed)		

5. REMARKS:

6. PERMIT NUMBER: HW-05-005

7. USE:
☐ Residential ☐ Public Supply ☐ Process
☐ Irrigation ☐ Air Conditioning ☐ Emergency
☐ Test Well ☑ Monitor Well ☐ Replacement

8. WELL DEPTH (completed) Date Started: 4-1-05
8 ft. Date Completed: 4-1-05

9. TYPE ☐ Mud Rotary ☐ Jetted ☑ Bored
☐ Dug ☐ Air Rotary ☐ Driven
☐ Cable tool ☐ Other

10. CASING: ☑ Threaded ☐ Welded
Diam.: 2"
Type: ☑ PVC ☐ Galvanized
☐ Steel ☐ Other
2" in. to 3 ft. depth
_____ in. to _____ ft. depth

Height: Above/Below
Surface _____ ft.
Weight _____ lb./ft.
Drive Shoe? ☐ Yes ☐ No

11. SCREEN
Type: PVC Diam.: 2"
Slot/Gauge: .010 Length: 5'
Set Between: 3 ft. and 8 ft.
_____ ft. and _____ ft.
Sieve Analysis ☐ Yes (please enclose) ☑ No

NOTE: MULTIPLE SCREENS USE SECOND SHEET

12. STATIC WATER LEVEL NA ft. below land surface after 24 hours

13. PUMPING LEVEL Below Land Surface. NA
_____ ft. after _____ hrs. Pumping _____ G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield: _____

14. WATER QUALITY NA
Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

15. ARTIFICIAL FILTER (filter pack) ☑ Yes ☐ No
Installed from 8 ft. to 1 ft.
Effective size 20/30 Uniformity Coefficient yes

16. WELL GROUTED? ☑ Yes ☐ No
☐ Neat Cement ☐ Bentonite ☑ Bentonite/Cement ☐ Other _____
Depth: From 1 ft. to 0 ft.

17. NEAREST SOURCE OF POSSIBLE CONTAMINATION: ____ ft. ____ direction
Type _____ NA
Well Disinfected ☐ Yes ☐ No Type: _____ Amount: _____

18. PUMP: Date installed: NA Not installed ☐
Mfr. Name: _____ Model No.: _____
H.P. _____ Volts _____ Length of drop pipe ___ ft. Capacity ___ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine
☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

19. WELL DRILLER: Rick Bailey CERT. NO.: B-01797
Address: 310 Sunset Dr.
Lewisburg TN 38570
Telephone No.: 931-823-0255 Fax No.:

20. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

Signed: Rick Bailey Date: 5-16-05
Authorized Representative

COPY MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

DHEC
PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 898-4300

PA1-45-MW19-SL

1. WELL OWNER INFORMATION:
Name: USMC
Address: Parris Island SC (last) (first)
City: Parris Island State: Zip:
Telephone: Work: Home:

2. LOCATION OF WELL: COUNTY:
Name: SW MW-45 Beaufort
Street Address:
City: Zip:
Latitude: Longitude:

3. PUBLIC SYSTEM NAME: **PUBLIC SYSTEM NUMBER:**

4. ABANDONMENT: ☐ Yes ☒ No
Grouted Depth: from _____ ft. to _____ ft.

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Gray Sand	2	9
Brown Sand &		
Silts	9	17
licate Water Bearing Zones		
(Use a 2nd sheet if needed)		

5. REMARKS:

6. PERMIT NUMBER: HW-05-005

7. USE:
☐ Residential ☐ Public Supply ☐ Process
☐ Irrigation ☐ Air Conditioning ☐ Emergency
☐ Test Well ☒ Monitor Well ☐ Replacement

8. WELL DEPTH (completed) Date Started: 4-1-05
16 ft. Date Completed: 4-1-05

9. TYPE ☐ Mud Rotary ☐ Jetted ☒ Bored
☐ Dug ☐ Air Rotary ☐ Driven
☐ Cable tool ☐ Other

10. CASING: ☒ Threaded ☐ Welded
Diam.: 2"
Type: ☒ PVC ☐ Galvanized
☐ Steel ☐ Other
2" in. to 11 ft. depth
_____ in. to _____ ft. depth
Height: Above/Below
Surface _____ ft.
Weight _____ lb./ft.
Drive Shoe? ☐ Yes ☐ No

11. SCREEN
Type: PVC Diam.: 2"
Slot/Gauge: .010 Length: 5
Set Between: 11 ft. and 16 ft.
_____ ft. and _____ ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☒ No

12. STATIC WATER LEVEL NA ft. below land surface after 24 hours

13. PUMPING LEVEL Below Land Surface.
NA
_____ ft. after _____ hrs. Pumping _____ G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield: _____

14. WATER QUALITY NA
Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

15. ARTIFICIAL FILTER (filter pack) ☒ Yes ☐ No
Installed from 9 ft. to 16 ft.
Effective size 20/30 Uniformity Coefficient yes

16. WELL GROUTED? ☒ Yes ☐ No
☐ Neat Cement ☐ Bentonite ☒ Bentonite/Cement ☐ Other _____
Depth: From 8 ft. to 0 ft.

17. NEAREST SOURCE OF POSSIBLE CONTAMINATION: ____ ft. ____ direction
Type _____
NA
Well Disinfected ☐ Yes ☐ No Type: _____ Amount: _____

18. PUMP: Date installed: NA Not installed ☐
Mfr. Name: _____ Model No.: _____
H.P. _____ Volts _____ Length of drop pipe ___ ft. Capacity ___ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine
☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

19. WELL DRILLER: Rick Bilbrey CERT. NO.: B-01797
Address: 310 Sunset Dr.
Jackson TN 38570
Telephone No.: 931-823-0755 Fax No.:

20. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

Signed: Rick Bilbrey Date: 5-16-05
Authorized Representative

DHEC 1903 (03/2002) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

DHEC
PROMOTE PROTECT PROSPER

Water Well Record PA1-45 MW21-SU
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 898-4300

1. WELL OWNER INFORMATION:
Name: US MC (last) (first)
Address: Parris Island SC
City: Parris Island State: Zip:
Telephone: Work: Home:

2. LOCATION OF WELL: COUNTY: Beaufort
Name: SW MU-45
Street Address:
City: Zip:
Latitude: Longitude:

3. PUBLIC SYSTEM NAME: **PUBLIC SYSTEM NUMBER:**

4. ABANDONMENT: ☐ Yes ☑ No
Grouted Depth: from _____ ft. to _____ ft.

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Gray Sand	2	9
*Indicate Water Bearing Zones (Use a 2nd sheet if needed)		

5. REMARKS:

6. PERMIT NUMBER: HW-05-005

7. USE: ☐ Residential ☐ Public Supply ☐ Process ☐ Irrigation ☐ Air Conditioning ☐ Emergency ☐ Test Well ☑ Monitor Well ☐ Replacement

8. WELL DEPTH (completed) 8 ft. Date Started: 3-31-05 Date Completed: 3-31-05

9. TYPE ☐ Mud Rotary ☐ Jetted ☑ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

10. CASING: ☑ Threaded ☐ Welded
Diam.: 2"
Type: ☑ PVC ☐ Galvanized ☐ Steel ☐ Other
2" in. to 3 ft. depth
_____ in. to _____ ft. depth
Height: Above/Below Surface _____ ft.
Weight _____ lb./ft.
Drive Shoe? ☐ Yes ☐ No

11. SCREEN
Type: PVC Diam.: 2"
Slot/Gauge: 0010 Length: 5
Set Between: 3 ft. and 8 ft.
_____ ft. and _____ ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☑ No

12. STATIC WATER LEVEL NA ft. below land surface after 24 hours

13. PUMPING LEVEL Below Land Surface. NA
_____ ft. after _____ hrs. Pumping _____ G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield: _____

14. WATER QUALITY NA
Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

15. ARTIFICIAL FILTER (filter pack) ☑ Yes ☐ No
Installed from 8 ft. to 1 ft.
Effective size 20/30 Uniformity Coefficient yes

16. WELL GROUTED? ☑ Yes ☐ No
☐ Neat Cement ☐ Bentonite ☑ Bentonite/Cement ☐ Other _____
Depth: From 1 ft. to 0 ft.

17. NEAREST SOURCE OF POSSIBLE CONTAMINATION: ____ ft. ____ direction
Type _____ NA
Well Disinfected ☐ Yes ☐ No Type: _____ Amount: _____

18. PUMP: Date installed: NA Not installed ☐
Mfr. Name: _____ Model No.: _____
H.P. _____ Volts _____ Length of drop pipe ___ ft. Capacity ___ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

19. WELL DRILLER: Rick Bellamy CERT. NO.: B-01797
Address: 310 Sunset Dr
W. Jefferson TN 38570
Telephone No.: 931-823-0755 Fax No.:

20. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

Signed: Rick Bellamy Date: 5-16-05
Authorized Representative

DHEC
PROMOTE PROTECT PROSPER

Water Well Record PA1-45-MW21-SL
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 898-4300

WELL OWNER INFORMATION:
Name: USMC (last) (first)
Address: Parris Island Sc
City: Parris Island State: Zip:
Telephone: Work: Home:

2. LOCATION OF WELL: COUNTY: Beaufort
Name: SWMW-45
Street Address:
City: Zip:
Latitude: Longitude:

3. PUBLIC SYSTEM NAME: **PUBLIC SYSTEM NUMBER:**

4. ABANDONMENT: ☐ Yes ☑ No
Grouted Depth: from _____ ft. to _____ ft.

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Gray Sand	2	9
Brown Sand & Silt	9	16
ate Water Bearing Zones (Use a 2nd sheet if needed)		

5. REMARKS:

6. PERMIT NUMBER: HW-05-005

7. USE:
☐ Residential ☐ Public Supply ☐ Process
☐ Irrigation ☐ Air Conditioning ☐ Emergency
☐ Test Well ☑ Monitor Well ☐ Replacement

8. WELL DEPTH (completed) Date Started: 3-31-05
15 ft. Date Completed: 3-31-05

9. TYPE ☐ Mud Rotary ☐ Jetted ☑ Bored
☐ Dug ☐ Air Rotary ☐ Driven
☐ Cable tool ☐ Other

10. CASING: ☑ Threaded ☐ Welded
Diam.: 2"
Type: ☑ PVC ☐ Galvanized
☐ Steel ☐ Other
2" in. to 10 ft. depth
_____ in. to _____ ft. depth
Height: Above/Below
Surface _____ ft.
Weight _____ lb./ft.
Drive Shoe? ☐ Yes ☐ No

11. SCREEN
Type: PVC Diam.: 2"
Slot/Gauge: 0.010 Length: 5
Set Between: 10 ft. and 15 ft.
_____ ft. and _____ ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☑ No

12. STATIC WATER LEVEL NA ft. below land surface after 24 hours

13. PUMPING LEVEL Below Land Surface.
NA
_____ ft. after _____ hrs. Pumping _____ G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield: _____

14. WATER QUALITY NA
Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

15. ARTIFICIAL FILTER (filter pack) ☑ Yes ☐ No
Installed from 8 ft. to 15 ft.
Effective size 20/30 Uniformity Coefficient yes

16. WELL GROUTED? ☑ Yes ☐ No
☐ Neat Cement ☐ Bentonite ☑ Bentonite/Cement ☐ Other _____
Depth: From 8 ft. to 0 ft.

17. NEAREST SOURCE OF POSSIBLE CONTAMINATION: ____ ft. ____ direction
Type _____
NA
Well Disinfected ☐ Yes ☐ No Type: _____ Amount: _____

18. PUMP: Date installed: NA Not installed ☐
Mfr. Name: _____ Model No.: _____
H.P. _____ Volts _____ Length of drop pipe ___ ft. Capacity ___ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine
☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

19. WELL DRILLER: Rick Bullery CERT. NO.: B-01797
Address: 310 Sunset Dr
Livingston TN 38570
Telephone No.: 931-823-0755 Fax No.:

20. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

Signed: Rick Bullery Date: 5-10-05
Authorized Representative

DHEC 1903 (03/2002) **COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)**

DHEC
PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water

PA1-45-MW22SU

2600 Bull Street, Columbia, SC 29201-1708; (803) 898-4300

1. WELL OWNER INFORMATION:
Name: USMC (last) (first)
Address: Parris Island SC
City: Parris Island State: Zip:
Telephone: Work: Home:

2. LOCATION OF WELL: COUNTY: Beaufort
Name: SWMU-45
Street Address:
City: Zip:
Latitude: Longitude:

3. PUBLIC SYSTEM NAME: **PUBLIC SYSTEM NUMBER:**

4. ABANDONMENT: ☐ Yes ☑ No
Grouted Depth: from ____ ft. to ____ ft.

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Gray Sand	2	9

*Indicate Water Bearing Zones
(Use a 2nd sheet if needed)

5. REMARKS:

6. PERMIT NUMBER: MW-05-005

7. USE: ☐ Residential ☐ Irrigation ☐ Test Well ☐ Public Supply ☐ Air Conditioning ☑ Monitor Well ☐ Process ☐ Emergency ☐ Replacement

8. WELL DEPTH (completed) 8 ft. Date Started: 3-30-05 Date Completed: 3-30-05

9. TYPE ☐ Mud Rotary ☐ Dug ☐ Cable tool ☐ Jetted ☐ Air Rotary ☐ Other ☑ Bored ☐ Driven

10. CASING: ☑ Threaded ☐ Welded
Diam.: 2"
Type: ☑ PVC ☐ Galvanized ☐ Steel ☐ Other
2" in. to 3 ft. depth
____ in. to ____ ft. depth
Height: Above/Below Surface ____ ft.
Weight ____ lb./ft.
Drive Shoe? ☐ Yes ☐ No

11. SCREEN
Type: PVC Diam.: 2"
Slot/Gauge: .010 Length: 5
Set Between: 3 ft. and 8 ft.
____ ft. and ____ ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☑ No

12. STATIC WATER LEVEL NA ft. below land surface after 24 hours

13. PUMPING LEVEL Below Land Surface. NA
____ ft. after ____ hrs. Pumping ____ G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield:

14. WATER QUALITY NA
Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

15. ARTIFICIAL FILTER (filter pack) ☑ Yes ☐ No
Installed from 1 ft. to 8 ft.
Effective size 20/30 Uniformity Coefficient 4.5

16. WELL GROUTED? ☑ Yes ☐ No
☐ Neat Cement ☐ Bentonite ☑ Bentonite/Cement ☐ Other
Depth: From 1 ft. to 0 ft.

17. NEAREST SOURCE OF POSSIBLE CONTAMINATION: ____ ft. ____ direction
Type ____ NA
Well Disinfected ☐ Yes ☐ No Type: ____ Amount: ____

18. PUMP: Date installed: NA Not installed ☐
Mfr. Name: Model No.:
H.P.____ Volts____ Length of drop pipe ____ ft. Capacity ____ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

19. WELL DRILLER: Rick Bulkley CERT. NO.: B-01797
Address: 310 Sunset Dr
Livingston TN 38570
Telephone No.: 931-823-0755 Fax No.:

20. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

Signed: Rick Bulkley
Authorized Representative
Date: 5-16-05

DHEC 1903 (02/2000) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

DHEC
PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water

PAI-45-MW22-SL

2600 Bull Street, Columbia, SC 29201-1708; (803) 898-4300

WELL OWNER INFORMATION:
Name: USMC (last) (first)
Address: Parris Island SC
City: Parris Island State: Zip:
Telephone: Work: Home:

2. LOCATION OF WELL: COUNTY: Beaufort
Name: SWMU-45
Street Address:
City: Zip:
Latitude: Longitude:

3. PUBLIC SYSTEM NAME: PUBLIC SYSTEM NUMBER:

4. ABANDONMENT: ☐ Yes ☑ No
Grouted Depth: from ____ ft. to ____ ft.

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Gray Sand	2	9
Brown Sand + Silt	9	16

*Indicate Water Bearing Zones
(Use a 2nd sheet if needed)

5. REMARKS:

6. PERMIT NUMBER: HW-05-005

7. USE:
☐ Residential ☐ Public Supply ☐ Process
☐ Irrigation ☐ Air Conditioning ☐ Emergency
☐ Test Well ☑ Monitor Well ☐ Replacement

8. WELL DEPTH (completed) 15 ft. Date Started: 3-30-05 Date Completed: 3-30-05

9. TYPE ☐ Mud Rotary ☐ Jetted ☐ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

10. CASING: ☑ Threaded ☐ Welded
Diam.: 2"
Type: ☑ PVC ☐ Galvanized ☐ Steel ☐ Other
2" in. to 8 ft. depth
____ in. to ____ ft. depth
Height: Above/Below Surface ____ ft.
Weight ____ lb./ft.
Drive Shoe? ☐ Yes ☐ No

11. SCREEN
Type: PVC Diam.: 2"
Slot/Gauge: .010 Length: 5
Set Between: 10 ft. and 15 ft.
____ ft. and ____ ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☑ No

12. STATIC WATER LEVEL NA ft. below land surface after 24 hours

13. PUMPING LEVEL Below Land Surface. NA
____ ft. after ____ hrs. Pumping ____ G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield:

14. WATER QUALITY NA
Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

15. ARTIFICIAL FILTER (filter pack) ☑ Yes ☐ No
Installed from 8 ft. to 15 ft.
Effective size 20/30 Uniformity Coefficient yes

16. WELL GROUTED? ☑ Yes ☐ No
☐ Neat Cement ☐ Bentonite ☑ Bentonite/Cement ☐ Other
Depth: From 8 ft. to 0 ft.

17. NEAREST SOURCE OF POSSIBLE CONTAMINATION: ____ ft. ____ direction
Type ____ NA
Well Disinfected ☐ Yes ☐ No Type: ____ Amount: ____

18. PUMP: Date installed: NA Not installed ☐
Mfr. Name: ____ Model No.: ____
H.P. ____ Volts ____ Length of drop pipe ____ ft. Capacity ____ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

19. WELL DRILLER: Rick Bilbrey **CERT. NO.:** B-01797
Address: 310 Sunset Dr. Livingston TN 38570
Telephone No.: 931-823-0755 Fax No.:

20. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

Signed: Rick Bilbrey Date: 5-16-05
Authorized Representative

DHEC 1903 (03/2002) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

DHEC
PROMOTE PROTECT PROSPER

Water Well Record PA1-45MW23-SL
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 898-4300

1. WELL OWNER INFORMATION:
Name: USMC (last) (first)
Address: Parris Island SC
City: Parris Island State: Zip:
Telephone: Work: Home:

2. LOCATION OF WELL: COUNTY: Beaufort
Name: SWMU-45
Street Address:
City: Zip:
Latitude: Longitude:

3. PUBLIC SYSTEM NAME: **PUBLIC SYSTEM NUMBER:**

4. ABANDONMENT: ☐ Yes ☒ No
Grouted Depth: from _____ ft. to _____ ft.

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Gray Sand	2	9
Brown Silt & Sand	9	16
*Indicate Water Bearing Zones (Use a 2nd sheet if needed)		

5. REMARKS:

6. PERMIT NUMBER: HW-05-005

7. USE:
☐ Residential ☐ Public Supply ☐ Process
☐ Irrigation ☐ Air Conditioning ☐ Emergency
☐ Test Well ☒ Monitor Well ☐ Replacement

8. WELL DEPTH (completed) Date Started: 4-2-05
15 ft. Date Completed: 4-2-05

9. TYPE ☐ Mud Rotary ☐ Jetted ☒ Bored
☐ Dug ☐ Air Rotary ☐ Driven
☐ Cable tool ☐ Other

10. CASING: ☒ Threaded ☐ Welded
Diam.: 2"
Type: ☒ PVC ☐ Galvanized
☐ Steel ☐ Other
2" in. to 10 ft. depth
_____ in. to _____ ft. depth
Height: Above/Below
Surface _____ ft.
Weight _____ lb./ft.
Drive Shoe? ☐ Yes ☐ No

11. SCREEN
Type: PVC Diam.: 2"
Slot/Gauge: .010 Length: 5
Set Between: 10 ft. and 15 ft. **NOTE: MULTIPLE SCREENS**
_____ ft. and _____ ft. **USE SECOND SHEET**
Sieve Analysis ☐ Yes (please enclose) ☒ No

12. STATIC WATER LEVEL NA ft. below land surface after 24 hours

13. PUMPING LEVEL Below Land Surface. NA
_____ ft. after _____ hrs. Pumping _____ G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield: _____

14. WATER QUALITY NA
Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

15. ARTIFICIAL FILTER (filter pack) ☒ Yes ☐ No
Installed from 8 ft. to 15 ft.
Effective size 20/30 Uniformity Coefficient Uos

16. WELL GROUTED? ☒ Yes ☐ No
☐ Neat Cement ☐ Bentonite ☒ Bentonite/Cement ☐ Other _____
Depth: From 8 ft. to 0 ft.

17. NEAREST SOURCE OF POSSIBLE CONTAMINATION: _____ ft. _____ direction
Type _____ NA
Well Disinfected ☐ Yes ☐ No Type: _____ Amount: _____

18. PUMP: Date installed: NA Not installed ☐
Mfr. Name: _____ Model No.: _____
H.P. _____ Volts _____ Length of drop pipe ___ ft. Capacity ___ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine
☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

19. WELL DRILLER: Rick Bulling CERT. NO.: B-01797
Address: 310 Sunset Dr
Lawrenceburg TN 38570
Telephone No.: 931-823-0755 Fax No.:

20. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

Signed: Rick Bulling Date: 5-16-05
Authorized Representative

DHEC
PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water

PA7-45MW23-SW

2600 Bull Street, Columbia, SC 29201-1708; (803) 898-4300

1. WELL OWNER INFORMATION:
Name: USMC (last) (first)
Address: Parris Island SC
City: Parris Island State: Zip:
Telephone: Work: Home:

2. LOCATION OF WELL: COUNTY: Beaufort
Name: SWMW-45
Street Address:
City: Zip:
Latitude: Longitude:

3. PUBLIC SYSTEM NAME: **PUBLIC SYSTEM NUMBER:**

4. ABANDONMENT: ☐ Yes ☑ No
Grouted Depth: from _____ ft. to _____ ft.

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Gray Sand	2	9
Brown Sand	9	11
Indicate Water Bearing Zones		
(Use a 2nd sheet if needed)		

5. REMARKS:

6. PERMIT NUMBER: HW-05-005

7. USE:
☐ Residential ☐ Public Supply ☐ Process
☐ Irrigation ☐ Air Conditioning ☐ Emergency
☐ Test Well ☑ Monitor Well ☐ Replacement

8. WELL DEPTH (completed) Date Started: 4-2-05
10 ft. Date Completed: 4-2-05

9. TYPE ☐ Mud Rotary ☐ Jetted ☑ Bored
☐ Dug ☐ Air Rotary ☐ Driven
☐ Cable tool ☐ Other

10. CASING: ☑ Threaded ☐ Welded
Diam.: 2"
Type: ☑ PVC ☐ Galvanized
☐ Steel ☐ Other
2" in. to 3 ft. depth
_____ in. to _____ ft. depth
Height: Above/Below
Surface _____ ft.
Weight _____ lb./ft.
Drive Shoe? ☐ Yes ☐ No

11. SCREEN
Type: PVC Diam.: 2"
Slot/Gauge: .010 Length: 7
Set Between: 3 ft. and 10 ft.
_____ ft. and _____ ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☑ No

12. STATIC WATER LEVEL _____ ft. below land surface after 24 hours

13. PUMPING LEVEL Below Land Surface. NA
_____ ft. after _____ hrs. Pumping _____ G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield: _____

14. WATER QUALITY NA
Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

15. ARTIFICIAL FILTER (filter pack) ☑ Yes ☐ No
Installed from 1 ft. to 10 ft.
Effective size 20/30 Uniformity Coefficient yes

16. WELL GROUTED? ☑ Yes ☐ No
☐ Neat Cement ☐ Bentonite ☑ Bentonite/Cement ☐ Other _____
Depth: From 1 ft. to 0 ft.

17. NEAREST SOURCE OF POSSIBLE CONTAMINATION: _____ ft. _____ direction
Type _____ NA
Well Disinfected ☐ Yes ☐ No Type: _____ Amount: _____

18. PUMP: Date installed: NA Not installed ☐
Mfr. Name: _____ Model No.: _____
H.P. _____ Volts _____ Length of drop pipe ___ ft. Capacity ___ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine
☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

19. WELL DRILLER: Rick Bilbrey CERT. NO.: B-01797
Address: 310 Sunset Dr
Dunnavant TN 38570
Telephone No.: 931-823-0755 Fax No.:

20. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

Signed: Rick Bilbrey Date: 5-16-05
Authorized Representative

DHEC 1903 (03/2002)

COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

DHEC
PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 734-5300

1. LOCATION OF WELL:
County: Beaufort System Name: MCRD S.C.
Latitude: 32 20 52.2 Longitude: 80-40-41.1
Distance and Direction from Road Intersections:

Street Address & City of Well Location:

Sketch Map:

2. CUTTING SAMPLES: ☐ Yes ☑ No

Geophysical Logs: ☐ Yes (please enclose) ☐ No

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Sand Gray	2	9
Sand & Silts dark		
Brown	9	16

*Indicate Water Bearing Zones

(Use a 2nd sheet if needed)

3. REMARKS:

4. OWNER OF WELL: USMC
Address: Paris Island, S.C.
Telephone No.:
Engineer: Tetra Tech
Address: 661 Andersen Drive Pittsburg Pa. 15220
Telephone No.: 412-921-8435

5. WELL DEPTH (completed) 16 ft. Date Started: 4/12/05 Date Completed: 4/12/05

6. ☐ Mud Rotary ☐ Jetted ☑ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply–Permit No. ____ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☑ Monitor Well ☐ ____

8. CASING: ☑ Threaded ☐ Welded
Diam.: 2"
Type: ☑ PVC ☐ Galvanized ☐ Steel ☐ Other
2 in. to 5 ft. depth
____ in. to ____ ft. depth
Height: ~~Above~~/Below Surface 6" ft.
Weight ____ lb./ft.
Drive Shoe? ☐ Yes ☑ No

9. SCREEN
Type: PVC Diam.: 2"
Slot/Gauge: .010 Length: 10 ft.
Set Between: 5 ft. and 15 ft.
____ ft. and ____ ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☑ No

10. STATIC WATER LEVEL N/A ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface.
____ ft. after ____ hrs. Pumping N/A G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield: ____

12. WATER QUALITY N/A
Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

13. ARTIFICIAL FILTER (gravel pack) ☑ Yes ☐ No
Installed from 3 ft. to 16 ft.
Effective size 20/30 Uniformity Coefficient Yes

14. WELL GROUTED? ☑ Yes ☐ No
☑ Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ____
Depth: From 6" ft. to 2 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: ____ ft. ____ direction
____ Type well disinfected upon completion ☐ Yes ☐ No Type: N/A Amount: ____

16. PUMP: Date installed: N/A Not installed ☐
Mfr. Name: ____ Model No.: ____
H.P. ____ Volts ____ Length of drop pipe ____ ft. Capacity ____ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.
Registered Business Name: Miller Drilling Date 4/12/05
Address: 105 Helton Drive, Laurenceburg TN
Signed: ____ Authorized Representative Cert. No. 794

DHEC 1903 (10/96) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

DHEC
PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water

2600 Bull Street, Columbia, SC 29201-1708; (803) 734-5300

1. LOCATION OF WELL:

County: Beaufort System Name: MCRD Sites

Latitude: 32-20-52.1 Longitude: 80-40-41.0

Distance and Direction from Road Intersections:

Street Address & City of Well Location:

Sketch Map:

2. CUTTING SAMPLES: ☐ Yes ☒ No

Geophysical Logs: ☐ Yes (please enclose) ☒ No

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Gray Sand	2	10

*Indicate Water Bearing Zones

(Use a 2nd sheet if needed)

3. REMARKS:

4. OWNER OF WELL: USMC

Address: Paris Island S.C.

Telephone No.:

Engineer: Tetra Tech

Address: 661 Andersen Drive Pittsburg, PA 15220

Telephone No.: 412-921-8435

5. WELL DEPTH (completed) 10 ft.

Date Started: 4/12/05

Date Completed: 4/12/05

6. ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug
☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE:
☐ Domestic ☐ Public Supply–Permit No. ______ ☐ Industry
☐ Irrigation ☐ Air Conditioning ☐ Commercial
☐ Test Well ☒ Monitor Well ☐ ______

8. CASING: ☒ Threaded ☐ Welded

Diam.: 2"

Type: ☒ PVC ☐ Galvanized ☐ Steel ☐ Other

0 in. to 5 ft. depth

______ in. to ______ ft. depth

Height: ~~Above~~/Below Surface 6" ft.

Weight ______ lb./ft.

Drive Shoe? ☐ Yes ☐ No

9. SCREEN

Type: PVC Diam.: 2"

Slot/Gauge: .010 Length: 5 ft.

Set Between: 4 ft. and 9 ft. **NOTE: MULTIPLE SCREENS USE SECOND SHEET**

______ ft. and ______ ft.

Sieve Analysis ☐ Yes (please enclose) ☒ No

10. STATIC WATER LEVEL N/A ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface. N/A

______ ft. after ______ hrs. Pumping ______ G.P.M.

Pumping Test: ☐ Yes (please enclose) ☐ No

Yield:

12. WATER QUALITY N/A

Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No

Please enclose lab results.

13. ARTIFICIAL FILTER (gravel pack) ☒ Yes ☐ No

Installed from 4 ft. to 10 ft.

Effective size 20/30 Uniformity Coefficient N/A

14. WELL GROUTED? ☒ Yes ☐ No

☒ Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ______

Depth: From 6" ft. to 1.5 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: ______ ft. ______ direction

______ Type well disinfected ☐ Yes Type: N/A

upon completion ☐ No Amount:

16. PUMP: Date installed: N/A Not installed ☐

Mfr. Name: ______ Model No.: ______

H.P. ______ Volts ______ Length of drop pipe ___ ft. Capacity ___ gpm

TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine
☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

Registered Business Name: Miller Drilling Date: 4/12/05

Address: 125 Helton Drive, Lawrenceburg TN

Signed: [signature] Cert. No.: 794
Authorized Representative

DHEC
PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 734-5300

1. LOCATION OF WELL:
County: Beaufort System Name: MCRD S.E.43
Latitude: 32-20-54.7 Longitude: 80-40-43.4
Distance and Direction from Road Intersections:

Street Address & City of Well Location:

Sketch Map:

2. CUTTING SAMPLES: ☐ Yes ☑ No

Geophysical Logs: ☐ Yes (please enclose) ☑ No

Formation Description	*Thickness of Stratum	*Depth to Bottom of Stratum
Top Soil	0	2
Gray Sand	2	10
Dark Gray sand		
And Silts	10	17

*Indicate Water Bearing Zones

(Use a 2nd sheet if needed)

3. REMARKS:

4. OWNER OF WELL: USMC
Address: Parris Island, S.C.
Telephone No.:
Engineer: Tetra Tech
Address: 661 Anderson Drive Pittsburgh, PA, 15220-2435
Telephone No.: 412-921-8435

5. WELL DEPTH (completed) 17 ft. Date Started: 4/12/05 Date Completed: 4/12/05

6. ☐ Mud Rotary ☐ Jetted ☑ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply–Permit No. ____ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☑ Monitor Well ☐ ____

8. CASING: ☑ Threaded ☐ Welded
Diam.: 2
Type: ☑ PVC ☐ Galvanized ☐ Steel ☐ Other
2 in. to 5 ft. depth
____ in. to ____ ft. depth
Height: ~~Above~~/Below Surface 6"
Weight ____ lb./ft.
Drive Shoe? ☐ Yes ☐ No

9. SCREEN
Type: PVC Diam.: 2
Slot/Gauge: .010 Length: 10 ft.
Set Between: 6 ft. and 16 ft.
____ ft. and ____ ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☑ No

10. STATIC WATER LEVEL N/A ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface. N/A
____ ft. after ____ hrs. Pumping ____ G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield: ____

12. WATER QUALITY
Chemical Analysis ☐ Yes ☐ No N/A Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

13. ARTIFICIAL FILTER (gravel pack) ☑ Yes ☐ No
Installed from 4 ft 6" to 17 ft.
Effective size ____ Uniformity Coefficient ____

14. WELL GROUTED? ☑ Yes ☐ No
☑ Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ____
Depth: From 6" to 2 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: ____ ft. ____ direction
____ Type well disinfected ☐ Yes Type: N/A
upon completion ☐ No Amount: ____

16. PUMP: Date installed: N/A Not installed ☐
Mfr. Name: ____ Model No.: ____
H.P. ____ Volts ____ Length of drop pipe ____ ft. Capacity ____ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.
Registered Business Name: Miller Drilling Date: 4/26/05
Address: 105 Helton Drive, Lawrenceburg, TN
Signed: ____ Authorized Representative Cert. No.: 294

DHEC 1903 (10/96) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

DHEC
PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 734-5300

1. LOCATION OF WELL:
County: Beaufort System Name: MCRD Site 45
Latitude: 32-20-51.1 Longitude: 80-40-43.2
Distance and Direction from Road Intersections:
Street Address & City of Well Location:
Sketch Map:

2. CUTTING SAMPLES: ☐ Yes ☒ No
Geophysical Logs: ☐ Yes (please enclose) ☒ No

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Gray Sand	2	9
*Indicate Water Bearing Zones (Use a 2nd sheet if needed)		

3. REMARKS:

4. OWNER OF WELL: USMC
Address: Paris Island S.C.
Telephone No.:
Engineer: Tetra Tech
Address: 661 Anderson Dr. Pittsburg, PA, 15220
Telephone No.: 412-921-8435

5. WELL DEPTH (completed) 9 ft. Date Started: 4/12/05 Date Completed: 4/12/05

6. ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply–Permit No. ______ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Monitor Well ☐ ______

8. CASING: ☒ Threaded ☐ Welded
Diam.: 2"
Type: ☒ PVC ☐ Galvanized ☐ Steel ☐ Other
2 in. to 3 ft. depth
____ in. to ____ ft. depth
Height: ~~Above~~/Below Surface 6" ft.
Weight ______ lb./ft.
Drive Shoe? ☐ Yes ☐ No

9. SCREEN
Type: PVC Diam.: 2"
Slot/Gauge: .010 Length: 5 ft.
Set Between: 3 ft. and 8 ft. NOTE: MULTIPLE SCREENS
____ ft. and ____ ft. USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☒ No

10. STATIC WATER LEVEL N/A ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface. N/A
____ ft. after ____ hrs. Pumping ____ G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield:

12. WATER QUALITY N/A
Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

13. ARTIFICIAL FILTER (gravel pack) ☒ Yes ☐ No
Installed from 2 ft. to 9 ft.
Effective size 20/30 Uniformity Coefficient ______

14. WELL GROUTED? ☒ Yes ☐ No
☒ Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ______
Depth: From 6" ft. to 1.5 ft. ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: N/A ft. ____ direction
____ Type well disinfected ☐ Yes Type: N/A
upon completion ☐ No Amount: ______

16. PUMP: Date installed: N/A Not installed ☐
Mfr. Name: ______ Model No.: ______
H.P. ____ Volts ____ Length of drop pipe ____ ft. Capacity ____ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.
Registered Business Name: Miller Drilling Date: 4/12/05
Address: 105 Helton Drive, Lawrenceburg TN.
Signed: [signature] Cert. No. 8794
Authorized Representative

DHEC 1903 (10/96) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

DHEC

PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 734-5300

1. LOCATION OF WELL:
County: Beaufort System Name: MCRD Site 45
Latitude: 32-20-50.0 Longitude: 80-40-42.5
Distance and Direction from Road Intersections:

Street Address & City of Well Location:

Sketch Map:

2. CUTTING SAMPLES: ☐ Yes ☒ No

Geophysical Logs: ☐ Yes (please enclose) ☒ No

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Gray Sand	2	10
Brown Sand +		
Silts	10	17
*Indicate Water Bearing Zones (Use a 2nd sheet if needed)		

3. REMARKS:

4. OWNER OF WELL: USMC
Address: Paris Island SC
Telephone No.:
Engineer: Tetra Tech
Address: 661 Andersen Dr. Pittsburgh PA 15220
Telephone No.: 412-921-8435

5. WELL DEPTH (completed) 17 ft. Date Started: 4/12/05 Date Completed: 4/12/05

6. ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply–Permit No. ____ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Monitor Well ☐ ____

8. CASING: ☒ Threaded ☐ Welded
Diam.: 2"
Type: ☒ PVC ☐ Galvanized ☐ Steel ☐ Other
2 in. to 6 ft. depth
____ in. to ____ ft. depth
Height: ~~Above~~/Below Surface 6" ~~ft.~~
Weight ____ lb./ft.
Drive Shoe? ☐ Yes ☐ No

9. SCREEN
Type: PVC Diam.: 2"
Slot/Gauge: .010 Length: 10 ft
Set Between: 6 ft. and 16 ft.
____ ft. and ____ ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☒ No

10. STATIC WATER LEVEL N/A ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface. N/A ft. after ____ hrs. Pumping ____ G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield: ____

12. WATER QUALITY N/A
Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

13. ARTIFICIAL FILTER (gravel pack) ☒ Yes ☐ No
Installed from 4 ft. to 17 ft.
Effective size 20/30 Uniformity Coefficient ____

14. WELL GROUTED? ☒ Yes ☐ No
☒ Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ____
Depth: From 6" ft. to 3 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: ____ ft. ____ direction
____ Type well disinfected upon completion ☐ Yes ☐ No Type: N/A Amount: ____

16. PUMP: Date installed: N/A Not installed ☐
Mfr. Name: ____ Model No.: ____
H.P. ____ Volts ____ Length of drop pipe ____ ft. Capacity ____ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.
Registered Business Name: Miller Drilling Date: 4/12/05
Address: 105 Helton Drive, Lawrenceburg TN
Signed: [signature] Authorized Representative Cert. No.: 594

DHEC 1903 (10/96) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

DHEC
PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 734-5300

1. LOCATION OF WELL:
County: Beaufort System Name: MCRD Site 45
Latitude: 32-20-49.9 Longitude: 80-40-42.9
Distance and Direction from Road Intersections:
Street Address & City of Well Location:
Sketch Map:

2. CUTTING SAMPLES: ☐ Yes ☒ No
Geophysical Logs: ☐ Yes (please enclose) ☒ No

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Gray Sand	2	10

*Indicate Water Bearing Zones
(Use a 2nd sheet if needed)

3. REMARKS:

4. OWNER OF WELL: USMC
Address: Paris Island S.C.
Telephone No.:
Engineer: Tetra Tech
Address: 661 Andersen Dr. Pittsburg, PA 15220
Telephone No.: 412-921-8435

5. WELL DEPTH (completed) 9 ft.
Date Started: 4/12/05
Date Completed: 4/12/05

6. ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply–Permit No. ____ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Monitor Well ☐ ____

8. CASING: ☒ Threaded ☐ Welded
Diam.: 2
Type: ☒ PVC ☐ Galvanized ☐ Steel ☐ Other
2 in. to 4 ft. depth
____ in. to ____ ft. depth
Height: ~~Above~~/Below Surface 6" ~~ft.~~
Weight ____ lb./ft.
Drive Shoe? ☐ Yes ☐ No

9. SCREEN
Type: PVC Diam.: 2
Slot/Gauge: .010 Length: 5 FT
Set Between: 4 ft. and 9 ft.
____ ft. and ____ ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☒ No

10. STATIC WATER LEVEL N/A ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface.
____ ft. after ____ hrs. Pumping N/A G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield:

12. WATER QUALITY N/A
Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

13. ARTIFICIAL FILTER (gravel pack) ☒ Yes ☐ No
Installed from 4 ft. to 10 ft.
Effective size 20/30 Uniformity Coefficient ____

14. WELL GROUTED? ☒ Yes ☐ No
☒ Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ____
Depth: From 6" ~~ft.~~ to 2 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: N/A ~~ft.~~ ____ direction
____ Type well disinfected upon completion ☐ Yes ☐ No Type: N/A Amount:

16. PUMP: Date installed: N/A Not installed ☐
Mfr. Name: ____ Model No.: ____
H.P. ____ Volts ____ Length of drop pipe ____ ft. Capacity ____ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.
Registered Business Name: Miller Drilling Date: 4/12/05
Address: 105 Helton Dr, Lawrenceburg, TN
Signed: [signature] Cert. No.: 794
Authorized Representative

DHEC 1903 (10/96) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

DHEC
PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 734-5300

1. LOCATION OF WELL:
County: Beaufort System Name: MCRD Site 4
Latitude: 32-20-49.1 Longitude: 80-40-43.5
Distance and Direction from Road Intersections:

Street Address & City of Well Location:

Sketch Map:

2. CUTTING SAMPLES: ☐ Yes ☒ No

Geophysical Logs: ☐ Yes (please enclose) ☒ No

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Gray Sand	2	10
Dark Brown Sand		
And Silts	10	17
*Indicate Water Bearing Zones (Use a 2nd sheet if needed)		

3. REMARKS:

4. OWNER OF WELL: USMC
Address: Parris Island S.C.
Telephone No.:
Engineer: Steve Tech
Address: 661 Anderson Dr. Pittsburgh Pa 15220
Telephone No.: 412-921-8435

5. WELL DEPTH (completed) 16 ft. Date Started: 4/13/05 Date Completed: 4/13/05

6. ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply–Permit No. ____ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Monitor Well ☐ ____

8. CASING: ☒ Threaded ☐ Welded
Diam.: 2"
Type: ☒ PVC ☐ Galvanized ☐ Steel ☐ Other
2 in. to 6 ft. depth
____ in. to ____ ft. depth
Height: ~~Above~~/Below Surface 6" ~~ft.~~
Weight ____ lb./ft.
Drive Shoe? ☐ Yes ☐ No

9. SCREEN
Type: PVC Diam.: 2"
Slot/Gauge: .010 Length: 10
Set Between: 6 ft. and 16 ft.
____ ft. and ____ ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☒ No

10. STATIC WATER LEVEL N/A ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface. N/A
____ ft. after ____ hrs. Pumping ____ G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield: ____

12. WATER QUALITY N/A
Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

13. ARTIFICIAL FILTER (gravel pack) ☒ Yes ☐ No
Installed from 5 ft. to 17 ft.
Effective size 20/30 Uniformity Coefficient ____

14. WELL GROUTED? ☒ Yes ☐ No
☒ Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ____
Depth: From 6" ft. to 2 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: ____ ft. ____ direction
____ Type well disinfected ☐ Yes Type: N/A
upon completion ☐ No Amount: ____

16. PUMP: Date installed: N/A Not installed ☐
Mfr. Name: ____ Model No.: ____
H.P. ____ Volts ____ Length of drop pipe ____ ft. Capacity ____ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.
Registered Business Name: Miller Drilling Date: 4/13/05
Address: 125 Helton Drive Lawrenceburg TN
Signed: ____ Authorized Representative Cert. No. 794

DHEC 1903 (10/96) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

DHEC

PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 734-5300

1. LOCATION OF WELL:
County: Beaufort System Name: MCRD SCEY
Latitude: 32-20-50.0 Longitude: 80-40-43.7
Distance and Direction from Road Intersections:

Street Address & City of Well Location:

Sketch Map:

2. CUTTING SAMPLES: ☐ Yes ☑ No

Geophysical Logs: ☐ Yes (please enclose) ☑ No

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Gray Sand	2	10
cate Water Bearing Zones		
(Use a 2nd sheet if needed)		

3. REMARKS:

4. OWNER OF WELL: USMC
Address: Parris Island S.C.
Telephone No:
Engineer: Tetra Tech
Address: 661 Anderson Dr. Pittsburgh Pa 15220
Telephone No.: 412-921-8435

5. WELL DEPTH (completed) 9 ft. Date Started: 4/13/05 Date Completed: 4/13/05

6. ☐ Mud Rotary ☐ Jetted ☑ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply–Permit No. ____ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☑ Monitor Well ☐ ____

8. CASING: ☑ Threaded ☐ Welded
Diam.: 2"
Type: ☑ PVC ☐ Galvanized ☐ Steel ☐ Other
2" in. to 4 ft. depth
____ in. to ____ ft. depth
Height: ~~Above~~/Below Surface 6" ft.
Weight ____ lb./ft.
Drive Shoe? ☐ Yes ☐ No

9. SCREEN
Type: PVC Diam.: 2"
Slot/Gauge: .010 Length: 5 Ft.
Set Between: 4 ft. and 9 ft.
____ ft. and ____ ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☑ No

10. STATIC WATER LEVEL N/A ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface. N/A
____ ft. after ____ hrs. Pumping ____ G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield: ____

12. WATER QUALITY N/A
Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

13. ARTIFICIAL FILTER (gravel pack) ☑ Yes ☐ No
Installed from 3 ft. to 10 ft.
Effective size 20/30 Uniformity Coefficient ____

14. WELL GROUTED? ☑ Yes ☐ No
☑ Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ____
Depth: From 6" ft. to 2 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: ____ ft. ____ direction
____ Type well disinfected ☐ Yes Type: N/A
upon completion ☐ No Amount: ____

16. PUMP: Date installed: N/A Not installed ☐
Mfr. Name: ____ Model No.: ____
H.P. ____ Volts ____ Length of drop pipe ____ ft. Capacity ____ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.
Registered Business Name: Miller Drilling Date: 4/13/05
Address: 105 Helton Dr. Lawrenceburg, TN
Signed: ____ Authorized Representative Cert. No.: 294

DHEC 1903 (10/96) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

DHEC
PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 734-5300

1. LOCATION OF WELL:
County: Beaufort System Name: MCRD Site 45
Latitude: 32-20-49.4 Longitude: 80-40-42.0
Distance and Direction from Road Intersections:
Street Address & City of Well Location:
Sketch Map:

2. CUTTING SAMPLES: ☐ Yes ☒ No
Geophysical Logs: ☐ Yes (please enclose) ☒ No

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Gray Sand	2	10
Brown Silty Sand	10	16

*Indicate Water Bearing Zones
(Use a 2nd sheet if needed)

3. REMARKS:

4. OWNER OF WELL: USMC
Address: Paris Island S.C.
Telephone No.:
Engineer: Tetra Tech
Address: 661 Andersen Dr. Pittsburg, PA. 15220
Telephone No.: 412-921-8435

5. WELL DEPTH (completed) 15 ft. Date Started: 4/13/05 Date Completed: 4/13/05

6. ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE:
☐ Domestic ☐ Public Supply–Permit No. ____ ☐ Industry
☐ Irrigation ☐ Air Conditioning ☐ Commercial
☐ Test Well ☒ Monitor Well ☐ ____

8. CASING: ☒ Threaded ☐ Welded
Diam.: 2"
Type: ☒ PVC ☐ Galvanized ☐ Steel ☐ Other
2 in. to 5 ft. depth
____ in. to ____ ft. depth
Height: ~~Above~~/Below Surface 6" ft.
Weight ____ lb./ft.
Drive Shoe? ☐ Yes ☐ No

9. SCREEN
Type: PVC Diam.: 2"
Slot/Gauge: .010 Length: 10 ft.
Set Between: 5 ft. and 15 ft.
____ ft. and ____ ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☒ No

10. STATIC WATER LEVEL N/A ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface. N/A
____ ft. after ____ hrs. Pumping ____ G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield:

12. WATER QUALITY N/A
Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

13. ARTIFICIAL FILTER (gravel pack) ☒ Yes ☐ No
Installed from 3 ft. to 16 ft.
Effective size 20/30 Uniformity Coefficient

14. WELL GROUTED? ☒ Yes ☐ No
☒ Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other
Depth: From 6" ~~ft.~~ to 2 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: N/A ft. ____ direction
____ Type well disinfected ☐ Yes Type:
upon completion ☐ No Amount:

16. PUMP: Date installed: N/A Not installed ☐
Mfr. Name: ____ Model No.: ____
H.P. ____ Volts ____ Length of drop pipe ____ ft. Capacity ____ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.
Registered Business Name: Miller Drilling Date: 4/13/05
Address: 105 Helton Dr. Lawrenceburg, TN
Signed: [signature] Cert. No.: 794
Authorized Representative

DHEC 1903 (10/96) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

DHEC
PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 734-5300

1. LOCATION OF WELL:
County: Beaufort System Name: MCRD Site 4[illegible]
Latitude: 32-20-49.5 Longitude: 80-40-41.9
Distance and Direction from Road Intersections:
Street Address & City of Well Location:
Sketch Map:

2. CUTTING SAMPLES: ☐ Yes ☒ No
Geophysical Logs: ☐ Yes (please enclose) ☒ No

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Gray Sand	2	10
*Indicate Water Bearing Zones (Use a 2nd sheet if needed)		

3. REMARKS:

4. OWNER OF WELL: USMC
Address: Parris Island S.C.
Telephone No:
Engineer: Tetra Tech
Address: 661 Andersen Dr. Pittsburg, Pa. 15220
Telephone No: 412-921-8435

5. WELL DEPTH (completed) 9 ft.
Date Started: 4/13/05
Date Completed: 4/13/05

6. ☐ Mud Rotary ☐ Jetted ☒ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply–Permit No. ______ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☒ Monitor Well ☐ ______

8. CASING: ☒ Threaded ☐ Welded
Diam.: 2"
Type: ☒ PVC ☐ Galvanized ☐ Steel ☐ Other
2" in. to 4 ft. depth
____ in. to ____ ft. depth
Height: ~~Above~~/Below Surface 6" ~~ft.~~
Weight ______ lb./ft.
Drive Shoe? ☐ Yes ☐ No

9. SCREEN
Type: PVC Diam.: 2"
Slot/Gauge: .010 Length: 5ft
Set Between: 4 ft. and 9 ft.
____ ft. and ____ ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☒ No

10. STATIC WATER LEVEL N/A ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface. N/A
____ ft. after ____ hrs. Pumping ____ G.P.M.
Pumping Test: ☐ Yes (please enclose) ☐ No
Yield:

12. WATER QUALITY N/A
Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

13. ARTIFICIAL FILTER (gravel pack) ☒ Yes ☐ No
Installed from 3 ft. to 10 ft.
Effective size 20/30 Uniformity Coefficient ______

14. WELL GROUTED? ☒ Yes ☐ No
☒ Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ______
Depth: From 6" ft. to 2 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: N/A ft. ____ direction
______ Type well disinfected ☐ Yes Type: N/A
upon completion ☐ No Amount: ______

16. PUMP: Date installed: N/A Not installed ☐
Mfr. Name: ______ Model No.: ______
H.P. ______ Volts ______ Length of drop pipe ___ ft. Capacity ___ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.
Registered Business Name: Miller Drilling Date: 4/13/05
Address: 105 Helton Drive, Lawrenceburg, TN
Signed: [signature] Cert. No. 794
Authorized Representative

DHEC
PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 734-5300

1. LOCATION OF WELL:
County: Beaufort System Name: MCRDS Tc45
Latitude: 32-20-30.4 Longitude: 80-40-42.9
Distance and Direction from Road Intersections:

Street Address & City of Well Location:

Sketch Map:

2. CUTTING SAMPLES: ☐ Yes ☑ No

Geophysical Logs: ☐ Yes (please enclose) ☑ No

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Gray Sand	2	10
Brown Silty Sand	10	17
*Indicate Water Bearing Zones (Use a 2nd sheet if needed)		

3. REMARKS:

4. OWNER OF WELL: USMC
Address: Parris Island
Telephone No.:
Engineer: Tetra Tech
Address: 661 Anderson Dr. Pittsburgh, PA 15220
Telephone No.: 412-921-8435

5. WELL DEPTH (completed) 16 ft. Date Started: 4/13/05 Date Completed: 4/13/05

6. ☐ Mud Rotary ☐ Jetted ☑ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply–Permit No. ____ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☑ Monitor Well ☐ ____

8. CASING: ☑ Threaded ☐ Welded
Diam.: 2"
Type: ☑ PVC ☐ Galvanized ☐ Steel ☐ Other
2 in. to 6 ft. depth
____ in. to ____ ft. depth
Height: ~~Above~~/Below Surface 6" ft.
Weight ____ lb./ft.
Drive Shoe? ☐ Yes ☐ No

9. SCREEN
Type: PVC Diam.: 2"
Slot/Gauge: .010 Length: 10
Set Between: 6 ft. and 10 ft.
____ ft. and ____ ft.
NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis ☐ Yes (please enclose) ☐ No

10. STATIC WATER LEVEL N/A ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface. N/A ft. after ____ hrs. Pumping ____ G.P.M.
Pumping Test: ☐ Yes (please enclose) ☑ No
Yield: ____

12. WATER QUALITY N/A
Chemical Analysis ☐ Yes ☑ No Bacterial Analysis ☐ Yes ☐ No
Please enclose lab results.

13. ARTIFICIAL FILTER (gravel pack) ☑ Yes ☐ No
Installed from 4 ft. to 17 ft.
Effective size 20/30 Uniformity Coefficient ____

14. WELL GROUTED? ☑ Yes ☐ No
☑ Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ____
Depth: From 6" ft. to 2.5 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: N/A ft. direction ____
Type well disinfected upon completion ☐ Yes ☐ No Type: N/A Amount: ____

16. PUMP: Date installed: N/A Not installed ☐
Mfr. Name: ____ Model No.: ____
H.P. ____ Volts ____ Length of drop pipe ____ ft. Capacity ____ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.
Registered Business Name: Miller Drilling Date: 4/13/05
Address: 105 Hilton Drive, Lawrenceburg, TN
Signed: ____ Authorized Representative Cert. No. 794

DHEC 1903 (10/96) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

DHEC

PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 734-5300

1. LOCATION OF WELL:

County: Beaufort System Name: McKOS Sec 43

Latitude: 32-20-30.5 Longitude: 80-40-42.8

Distance and Direction from Road Intersections:

Street Address & City of Well Location:

Sketch Map:

2. CUTTING SAMPLES: ☐ Yes ☑ No

Geophysical Logs: ☐ Yes (please enclose) ☑ No

Formation Description	Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Gray Sand	2	10
ate Water Bearing Zones (Use a 2nd sheet if needed)		

3. REMARKS:

4. OWNER OF WELL: LSMC

Address: 22 S Island, SC

Telephone No.:

Engineer: Jeffrey Jeck

Address: 169 Washington Pa. 15220 Pittsburgh Pa. 15220

Telephone No.: 412-921-8435

5. WELL DEPTH (completed) 9 ft. Date Started: 4/13/05 Date Completed: 4/13/05

6. ☐ Mud Rotary ☐ Jetted ☑ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply--Permit No. ____ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☑ Monitor Well ☐ ____

8. CASING: ☑ Threaded ☐ Welded

Diam.: 2"

Type: ☑ PVC ☐ Galvanized ☐ Steel ☐ Other

2 in. to 4 ft. depth

____ in. to ____ ft. depth

Height: ~~Above~~/Below Surface 6" ~~ft.~~

Weight ____ lb./ft.

Drive Shoe? ☐ Yes ☐ No

9. SCREEN

Type: PVC Diam.: 2"

Slot/Gauge: .010 Length: 5

Set Between: 4 ft. and 9 ft.

____ ft. and ____ ft.

NOTE: MULTIPLE SCREENS USE SECOND SHEET

Sieve Analysis ☐ Yes (please enclose) ☑ No

10. STATIC WATER LEVEL N/A ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface. N/A ft. after ____ hrs. Pumping ____ G.P.M.

Pumping Test: ☐ Yes (please enclose) ☑ No

Yield: ____

12. WATER QUALITY N/A

Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No

Please enclose lab results.

13. ARTIFICIAL FILTER (gravel pack) ☑ Yes ☐ No

Installed from 3 ft. to 10 ft.

Effective size 20/30 Uniformity Coefficient ____

14. WELL GROUTED? ☑ Yes ☐ No

☑ Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ____

Depth: From 6" ft. to 1.5 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: N/A ft. ____ direction

Type well disinfected upon completion ☐ Yes ☐ No Type: ____ Amount: ____

16. PUMP: Date installed: N/A Not installed ☐

Mfr. Name: ____ Model No.: ____

H.P. ____ Volts ____ Length of drop pipe ____ ft. Capacity ____ gpm

TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

Registered Business Name: Miller Drilling Date: 4/13/05

Address: 105 Hilton Drive Lawrenceburg TN

Signed: ____ Authorized Representative Cert. No.: 1799

DHEC 1903 (10/96) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

DHEC

PROMOTE PROTECT PROSPER

Water Well Record
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 734-5300

1. LOCATION OF WELL:

County: Beaufort System Name: MCRDS Tex 43

Latitude: 32-28-52.2 Longitude: 80-40-42.2

Distance and Direction from Road Intersections:

Street Address & City of Well Location:

Sketch Map:

2. CUTTING SAMPLES: ☐ Yes ☑ No

Geophysical Logs: ☐ Yes (please enclose) ☑ No

Formation Description	*Thickness of Stratum	Depth to Bottom of Stratum
Top Soil	0	2
Gray Sand	2	9

*Indicate Water Bearing Zones

(Use a 2nd sheet if needed)

3. REMARKS:

4. OWNER OF WELL: PSMC

Address: Parris Island, S.C.

Telephone No.:

Engineer: Tetra Tech

Address: 661 Andersen Dr. Pittsburgh, Pa. 15220

Telephone No.: 412-921-8435

5. WELL DEPTH (completed) 8 ft. Date Started: 4/13/05 Date Completed: 4/13/05

6. ☐ Mud Rotary ☐ Jetted ☑ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply–Permit No. ____ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☐ Test Well ☑ Monitor Well ☐ ____

8. CASING: ☑ Threaded ☐ Welded

Diam.: 2"

Type: ☑ PVC ☐ Galvanized ☐ Steel ☐ Other

2 in. to 3 ft. depth

____ in. to ____ ft. depth

Height ~~Above~~/Below Surface 6"

Weight ____ lb./ft.

Drive Shoe? ☐ Yes ☐ No

9. SCREEN

Type: PVC Diam.: 2"

Slot/Gauge: .010 Length: 5

Set Between: 3 ft. and 8 ft.

____ ft. and ____ ft.

NOTE: MULTIPLE SCREENS USE SECOND SHEET

Sieve Analysis ☐ Yes (please enclose) ☑ No

10. STATIC WATER LEVEL N/A ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface. N/A ft. after ____ hrs. Pumping ____ G.P.M.

Pumping Test: ☐ Yes (please enclose) ☐ No

Yield: ____

12. WATER QUALITY N/A

Chemical Analysis ☐ Yes ☑ No Bacterial Analysis ☐ Yes ☐ No

Please enclose lab results.

13. ARTIFICIAL FILTER (gravel pack) ☑ Yes ☐ No

Installed from 2 ft. to 8 ft.

Effective size 20/20 Uniformity Coefficient ____

14. WELL GROUTED? ☑ Yes ☐ No

☑ Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ____

Depth: From 6" ft. to 1.5 ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: N/A direction

____ Type well disinfected upon completion ☐ Yes ☐ No Type: ____ Amount: ____

16. PUMP: Date installed: N/A Not installed ☐

Mfr. Name: ____ Model No.: ____

H.P. ____ Volts ____ Length of drop pipe ____ ft. Capacity ____ gpm

TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

Registered Business Name: Miller Drilling Date: 4/17/05

Address: 105 Kelton Dr. Lawrenceburg, TN

Signed: ____ Authorized Representative Cert. No. 294

HEC 1903 (10/96) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

APPENDIX H

PERMANENT MONITORING WELL BORING LOGS

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PA1-45-MW01-D
DATE: 3/29/05 - 4/2/05
GEOLOGIST: Conti
DRILLER: Bilbrey

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	0												
							see MIPs point		Augered to 20'		0		
							SB101		no sampling due				
							for details		to previous info.				
							above 20'		and MIPs data				
	5										0		
	10										0		
	15										0		
3/29/05	20			20'							0		
4/2/05													
	22												
S-1 @ 1350		2/1	2/2		Soft	green grey	sandy clay	SC	wet	.2			
		1/2								.4			
S-2 @ 1400	25	3/1	2/2		Soft	green grey	sandy clay, trace organics	SC	wet	0			

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: Used 8 1/4 in. augers w/ bottom plug to 20' prior to setting casing

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PA1-45-MW01-D

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW01-D
DATE: 4/2/05
GEOLOGIST: Conti
DRILLER: Dilbrey

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	25												
		1 / 2		25'	loose	grey	clayey sand	SM	wet to saturated	0			
S-3 @ 1415	27	4 / 6	1 / 1		loose	grey	silty sand, some shells trace clay	SM	wet	0			
	30												
S-4 @ 1440		2 / 3	1.5 / 2		medium dense	grey	silty sand, some shells	SM	wet	0			
		9 / 18								0			
	35			35'									
S-5 @ 1455		11 / 11	1.5 / 2		medium dense	grey	silty sand, clay lenses, trace shells	SM	moist to wet	0			
		8 / 4								0			
	40			40'									
S-6 @ 1530		18 / 30	1 / 1	41' T.D.	very dense	med grey	silty sand	SM	moist	0			
							Screen: 30' - 40'						
							Sand: 27' - 40.5'						
							pellets: 23' - 27'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: Mud rotary below casing used 2" spoons

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PAI-45-MW01-D

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PA1-45-MW06-D
DATE: 3/14/05 - 3/31/05
GEOLOGIST: Conti
DRILLER: R. Bilbrey

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ**	Borehole**	Driller BZ**
	0												
							See MIPs points		AUGER TO		0		
							SP124 and 125		16' - NO SAMPLING				
							for details		DUE TO				
							above 16'		PREVIOUS INTO				
									AND MIPS				
	5								DATA.				
											0		
	10										0		
	16			16'							0		
S-1 @ 1350	18		1/2		Soft	dk brown	clayey silt (peat)	ML/PT	moist to wet	1.4			
S-2 @ 1400	20		0/2	19' 20'					no recovery	0.8			
3/14 3/31 S-3 @ 1205	22	1 / 2 / 1	.5/2		Soft	blue grey	Sandy clay clayey sand at bottom	SC	poor recovery	0	0		
S-4 @ 1215	24	2 / 2 / 2 / 7	2/2		medium stiff	blue grey	Sandy clay, trace peat frags. and roots	SC		0 / 0			

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4¼" ID AUGERS INITIALLY FOR SAMPLING THEN 8¼ IN. ID TO 19 FT FOR SETTING CASING.

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PA1-45-MW06-D

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW06-D
DATE: 3/31/05
GEOLOGIST: Conti
DRILLER: Bilbrey

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	25			25'									
S-5 @		3/2	1.5/2		v. loose	grey	silty sand	SM	wet	0			
1240	27	3/1								0			
	30			30'									
S-6 @		2/1	2/2		v loose	grey	Silty sand, some shells	SM	wet	0			
1305	32	2/1								0			
	35												
S-7 @		5/11	1.5/2	36.5'	medium dense	grey	silty sand, trace shells, clay lenses; last 6"	SM	wet	0			
1335	37	5/8								0			
	40												
S-8 @		11/40	2/2	41'	v dense	med grey	silty sand, trace clay	SM	moist to wet potential confining layer	0			
1430	42	36/34		T.D.						0			
							screen: 30'-40'						
							sand: 28'-40.5'						
							pellets: 24'-27'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: mud rotary below casing
used 2" spoons

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PAI-45-MW06-D

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW07-D
DATE: 3/14/05 – 4/1/05
GEOLOGIST: Conti 4/1/05
DRILLER: R. Bilbrey

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ**	Borehole**	Driller BZ**
	0												
							See MIPs point		Auger to		0		
							SB119		20' - no sampling				
							for details		due to previous				
							above 20'		info. and MIPs data				
	5										0		
	10										0		
	15										0		
3/14	20										0		
4/1	S@1	10/1	2/2	20'	V soft	blue grey	Sandy clay, trace roots	SC	wet	0			
	15	22	2/2							0			
	25												

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: Used 8 1/4 in augers with bottom plug to 20' prior to setting casing.

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PAI-45-MW07-D

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW07-D
DATE: 4/1/05
GEOLOGIST: Conti
DRILLER: Bilbrey

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	25			25'									
S-2 @ 1230		2 2	2/2	26'	soft	blue grey	clayey sand	SC	wet	0			
	27	2 3			loose	grey	silty sand, trace mica	SM	wet	0			
	30			30.5' 30'									
S-3 @ 1250		2 2	2/2		loose	grey	silty sand, abundant shells	SM	wet to saturated	0			
	32	2 3							possible water producing unit	0			
	35			35'									
S-4 @ 1320		4 11	1.2/2	35.5'	medium dense	grey	silty sand, clay lenses to 35.5'	SM	wet	0			
	37	11 6			dense	grey	silty sand	SP	wet	0			
	40			40'									
S-5 @ 1350		10 25	1/1		dense	med grey	silty sand, trace clay	SM	wet	0			
	42			T.D.									
							Screen: 30'-40'						
							Sand: 26.5'-40.5'						
							pellets: 22.5'-26.5'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: Mud rotary below casing
Used 2" spoons

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PAI-45-MW07-D

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW10-SU
DATE: 4-12-05
GEOLOGIST: Conti
DRILLER: BISHOP

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sample BZ	Borehole **	Driller BZ
1415	0						See Boring Log		3" ASPHALT		0		0
							PAI-45-MW10-SL						
				3			for Details						
	5										0		0
				8									
	9												
				9'							0		0
				TD									
							HSA TO 9'						
							SCREEN 3-8						
							SAND 2-8.5						
							PELLETS TO 1						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4¼" HSA - W BOTM PLUG.

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No ____ Well I.D. #: PAI-45-MW10 SU

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW10SL
DATE: 4/12/05
GEOLOGIST: Conti
DRILLER: BISHOP

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
	0		—				ASPHALT AND SILTY SAND		3" ASPHALT	0			
	2						FROM CUTTINGS			0			
	4												
S-1 e		3/2	.5/2	4 TO 5' ±	LOOSE	BRN TO	SILTY SAND	SM	MOIST → WET	0	*		
12 5 5	6	2/2				GRAY			POOR REC- SOME ASPHALT IN DRIVE SHOE.	0			
	9					WHITHISH							
S-2 e		3/3	1.5/2		LOOSE	GRAY	SILTY F SAND	SM	WET → SATURATED	0			
13 15	11	5/5		11						0			
	14												
S-3 e		0/1	1.6/2		V LOOSE	MED GRAY	SILTY SAND	SM	WET	0			
13 25	16	1/1		16			TR CLAY IN SPOONS			0			
				17' — PT.			DRIVE SHOE.						
				TD 17'			PEAT OBSERVED ON CUTTING HEAD OF AUGER		@ 17' - 16.5 ±				
							HSA TO 17'						
							SCREEN: 11-16						
							SAND 9 TO 16.5						
							PELLETS TO 6						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4¼" HSA w/ AUTO HAMMER - 2" SPOONS
* NG RESP w/ FLOURESCENT METER.

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PAI-45-MW10-SL

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW13-SU
DATE: 4-13-05
GEOLOGIST: Conti
DRILLER: BISHOP

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sample BZ	Borehole**	Driller BZ**
	0						See Boring Log						0
							PAI-45-MW13-SL						
							for details.						
	5			4									0
	10			9									0
				10' TD									
							HSA To 10'						
							SCREEN 4-9						
							Sand 2-9.5						
							Pellets to 1						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4¼" HSA w/ Botm Plug

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PAI-45-MW13-SU

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW13-SL
DATE: 4-13-05
GEOLOGIST: Conti
DRILLER: BISHOP

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole BZ**	Driller BZ**
1300	0				LOOSE	BRN	SILTY SAND - TR ROOTS	SM	TOP 3" TOPSOIL (From Cuttings)	0			
										0			
	4												
S-1 @		1/2	1.6/2	4.5±	LOOSE	BRN GRAY TO GRAY	SILTY F SAND	SM	WET - 4 TO 5'	0			
1305	6	3/4								0			
	9												
S-2 @		5/7	1.6/2		M DENSE	WHITE GRAY	SILTY SAND	SM	WET	0			
1315	11	7/7		11						0			
	14												
S-3 @		1/0	1.6/2		V LOOSE	MED GRAY	SILTY F/M SAND	SM	WET	0			
1327	16	0/0		15.7	SOFT	BRN	Peat Layer	PL	MOIST	0			
				16									
				17' TD									
							HSA TO 17						
							SCREEN 11-16						
							SAND 9-16.5						
							PELLETS TO 6'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4 1/4" HSA W/ AUTO HAMMER / 2" SPOONS

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PAI-45-MW

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW14-SU
DATE: 4-12-05
GEOLOGIST: Conti
DRILLER: BISHOP

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole **	Driller BZ **
	0												
1120							See Boring Log		4" ASPHALT		0		
							MW14-SL For Details						
1130	5			4							0		
1140	10			9							0		
				TD 10'									
							HSA TO 10'						
							SCREEN 4-9						
							SAND 2-9.5						
							PELLETS TO 1'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4 1/4" ID HSA w/ BOTM PLUG

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PAI-45-MW14-SU

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW14-SL
DATE: 4/12/05
GEOLOGIST: Conti
DRILLER: BISHOP

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 e	0	10/10	1/2		M DENSE	BRN TO	TOP 4" ASPHALT SILTY F SAND	SM	DAMP TO	0			
0930	2	6/8				TAN			MOIST	0			
	4	3/3								0			
S-2 e		4/4	1/2	▽	LOOSE	GRAY TO	SILTY SAND	SM	WET ≈ 4' ± WET	0			
0935	6			5.5 ±		ORANG BRN			COLOR CHANGE ≈ 5.5'				
	9			9 ±									
S-3 e		1/1	1/2	10	V SOFT	GRAY	CLAYEY SAND/SANDY CLAY	SC	WET	0			
0945	11	0/0								0			
	14												
S-4 e		1/2	1.2/2	15	SOFT	GRAY	CLAYEY SAND/SANDY CLAY	SC	WET	0			
0955	16	3/1								0			
				TD @ 16'									
							HSA = 16'						
							SCREEN 10-15						
							SAND 8 TO 15.5						
							PELLETS TO						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4 1/4" ID HSA / AUTO HAMMER / 2" SPOONS

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PAI-45-MW14-SL

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW15-SU
DATE: 4-3-05
GEOLOGIST: Conti
DRILLER: Bilbrey

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sample BZ	Borehole **	Driller BZ **
	0												
							SEE BORING LOG						0
							FROM						
							PAI-45-MW16-SL						
							FOR DETAILS						
	5			4			SILTY SAND	SM	From Cuttings				0
	9												
	10			9			SILTY SAND	SM	From Cuttings				0
				10' TD									
							Screen 4-9						
							Sand 2-9.5						
							Pellets to 1'						
							≈ 3 Bags sand						
							½ Bucket Pellets						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: Used 4¼" I.D. augers w/ botm plug

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PAI-45-MW15-SU

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW15-SL
DATE: 4/3/05
GEOLOGIST: Conti
DRILLER: Pilbrey

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sampler	Sampler BZ	Borehole**	Driller BZ**
	0												
1230							SEE BORING LOG						0
							FROM						
							PAI-45-MW16 SL						
							FOR LITHOLOGY						
	5												0
							SILTY SAND		From Cuttings				
	10												0
				13									
	15						CLAYEY SAND		From Cuttings				0
1300	18			18									
	19												
				TD 19									
							SCREEN 13-18						
							SAND 10-18.5						
							PELLETS TO 7'						
							≈ 3.0 BAGS SAND						
							1 Bucket Bent Pellets						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: Used 4 1/4" I.D. augers w/ Bottom Plug.

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PAI-45-MW15-SL

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW16-SU
DATE: 4/3/05
GEOLOGIST: Conti
DRILLER: Bilbrey

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	0												
							See Boring Log						0
							For PAI-45-MW16SL						
							For Lithology						
				4									
	5			∇±									0
	9			9'									0
				TD									
									Set this well				
									based on WT at				
							Screen 4-9		≈ 5' and				
							Sand 2-9.5		previous data				
							Pellets to 1'						
							3.5 bags sand						
							½ bucket pellets						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: Used 4¼ I.D. augers w/ Bottom plug

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PAI-45-MW16-SU

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW16-SL
DATE: 4/3/05
GEOLOGIST: Conti
DRILLER: Bilbrey

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 @ 0900	0	8/8	1.5/2		loose	yellow brown	silty sand	SM	moist top 3" fill	0			
	2	6/4								0			
S-2 @ 0905		2/2	2/2		loose	yellow brown	silty fine sand	SM	moist to wet	0			
	4	2/4				grey @4.5'				0			
S-3 @ 0907		3/7	1.5/2	5'	loose	grey	silty fine sand	SM	wet	0			
	6	3/3				grey brown				0			
S-4 @ 0912		4/3	2/2		loose	grey brown	silty sand	SM	wet	0			
	8	4/5		8'		orange brown				0			
S-5 @ 0925		8/5	1/2		loose	whitish grey	silty sand	SM	wet	0			
	10	3/4								—			
S-6 @ 0930		2/4	2/2		loose	whitish grey	silty sand	SM	wet	0			
	12	3/3								0			
S-7 @ 0940		3/4	1/2	13'									
	14	1/1			v. loose	med grey	clayey sand	SC	wet	0			
S-8 @ 0945		1/1	1.5/2		v. loose	med grey	clayey sand	SC	wet to saturated	0			
	16	0/1								0			
S-9 @ 0955		3/5	0.5/2										
	18	3/1		18'	v. loose	med grey	silty sand, trace clay	SM	wet	0			
				19'			screen: 13'-18'		Poor Rec. tr clay near bottom w/ roots				
				T.D.			sand: 10-18.5'						
							pellets: 7-10						
									≈3.5 BAGS SAND				
									1-5Gal Bucket pellets.				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: Used 4 1/4" I.D. augers - Auto Hammer w/ 2" spoons

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PAI-45-MW16-SL

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW17-SU
DATE: 4-13-05
GEOLOGIST: Conti
DRILLER: BISHOP

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole **	Driller BZ **
	0						See Boring Log						0
							PAI-45-MW17-SL						
							for Details						
	5			4									0
	10			9									0
				TD @ 10'									
							HSA TO 10'						
							SCREEN 4-9						
							SAND 2-9.5						
							PELLETS TO 1'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4¼" HSA W/ BOTTOM PLUG.

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No ____ Well I.D. #: PAI-45-MW17-SU

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW17-SL
DATE: 4-13-05
GEOLOGIST: Conti
DRILLER: BISHOP

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sample-BZ	Borehole**	Driller-BZ**
10 10	0				LOOSE	BRN	SILTY F SAND	SM	3" TOPSOIL	0			
									From Cuttings	0			
	4												
S-1 e		1/1	1.8/2	▼	LOOSE	GRAY BRN	SILTY SAND - TR	SM	WET	0			
10 20	6	3/4					ROCK FRAGS @ 5 TO 6'		WT ≈ 4 or 5' COULD BE FILL	0			
	9					WHITE							
S-2 e		3/1	5/2		V LOOSE	GRAY	SILTY F SAND	SM	WET → SATURATED	0			
10 27	11	0/1		10					(POOR REC)	0			
	14												
S-3 e		1/1	2/2	15	V LOOSE	MED GRAY	SILTY F/M SAND	SM	WET	0			
10 35	16	1/2		15.5	SOFT	BRN	TR CLAY Peat - w/ ROOTS	Pt	MOIST	0			
				16' BOTTM									
							HSA TO 16						
							SCREEN 10 - 15						
							SAND 8 - 15.5						
							PELLETS TO 5'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4 1/4" HSA / AUTO HAMMER / 2" SPOONS

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PAI-45-MW

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW18SU
DATE: 4-13-05
GEOLOGIST: Conti
DRILLER: BISHOP

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole **	Driller BZ **
	0						See Boring Log						0
							PAI-45-MW18-SL						
							for details						
	5			4									0
	10			9									0
				10'									
							HSA TO 10						
							SCREEN 4-9						
							SAND 2-9.5						
							PELLETS TO 1'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4¼" HSA w/ Botm. Plug.

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No ____ Well I.D. #: PAI-45-MW

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW18 SL
DATE: 4-13-05
GEOLOGIST: Conti
DRILLER: BISHOP

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
—	0				LOOSE	BRN	SILTY SAND - TR ROOTS	SM	3" TOPSOIL (From Cuttings)	0			0
										0			
	4												
S-1 C		3/2	1.6/2	▽ 4 TO 5	V LOOSE	BRN TO	SILTY SAND - TR ROOTS	SM	WET	0			
0740	6	1/3		5		GRAY	TO CLAYEY SAND	SC	WET	0			
S-2	9	3/6	1.5/2	9'±									
C 0750		9/12			M DENSE	WHITE GRAY	SILTY F SAND	SM	WET → SATURATED	0			
	11			11						0			
	14												
S-3 C		1/0	1.8/2		V LOOSE	MED GRAY	SILTY F/M SAND TR CLAY	SM	WET	0	0		
0800	16	1/0		16						0	0		
				17'									
				TD									
							HSA TO 17						
							SCREEN 11 TO 16						
							SAND 9 TO 16.5						
							PELLETS TO 6'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4¼" HSA W/ AUTO HAMMER, 2" SPOONS

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No ____ Well I.D. #: PAI-45-MW

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW19-SU
DATE: 4/1/05
GEOLOGIST: Conti
DRILLER: Bilbrey

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sample BZ	Borehole**	Driller BZ**
	0												
							See boring log						0
							PAI-45 TW134-SU						
				3'			and PAI-45-MW19-SL						
							for details						
	5												0
				8'									
	9												0
				T.D.									
							screen: 3'-8'						
							sand: 2'-3'						
							pellets: 1'-2'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: Used 4¼" I.D. augers

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PAI-45-MW19-SU

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PA1-45-MW19-SL
DATE: 4/1/05
GEOLOGIST: Conti
DRILLER: Bilbrey

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole **	Driller BZ **
	0												
		3				y	see boring log	M					0
							PA1-45-TW134-SL						
						grey to	for details						
					loose to	brown	0'-5' silty sand, trace clay	SM	moist				
	5				m. dense								0
					loose	brown	silty sand, trace clay	SM	moist to wet				
					loose	grey	silty sand	SM	wet				
	10												0
				11'									
					loose	med grey	silty sand	SM	wet				
	15												0
				16'									
	17			17'									
				T.D.									
							screen: 11' - 16'						
							sand: 9' - 16.5'						
							pellets: 7' - 9'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: Used 4¼ I.D. augers

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PA1-45-MW19-SL

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW20-SU
DATE: 4-12-05
GEOLOGIST: Conti
DRILLER: BISHOP

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
1650	0						See Boring Log				0		0
							PAI-45-MW 20 SL						
							for details.						
				4									
1655													0
				9									
1700	10												0
				TD 10'									
							HSA TO 10'						
							SCREEN 4-9						
							SAND 2-9.5						
							PELLETS TO 1						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No ____ Well I.D. #: PAI-45-MW20-SU

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW20 SL
DATE: 4-12-05
GEOLOGIST: Conti
DRILLER: BISHOP

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole **	Driller BZ
1530	0				LOOSE	BRN	SILTY SAND - TR ROOTS ≈ 3" TOPSOIL		From Cuttings	0			0
									Moist	0			
	4												
S-1 @		1/1	1.3/2	▼±	V LOOSE	BRN GRAY	SILTY SAND	SM	WET	0			
1542	6	0/1							WT @ 4 ORS	0			
	9					WHITE							
S-2 @		3/3	1.4/2		LOOSE	GRAY	SILTY F SAND	SM	SATURATED	0			
1550	11	4/3		11						0			
	14												
S-3 @		1/0	1.4/2		V LOOSE	MED GRAY	SILTY SAND - TR CLAY	SM	WET	0			
1600	16	0/1		16						0			
				TD 17			TR. PEAT BOTM OF AUGERS		CUTTING HEAD				
							HSA TO 17'						
							SCREEN 16-11						
							SAND 9-16.5						
							PELLETS TO 6						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 4¼" HSA w/ AUTO HAMMER - 2" SPOONS

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PAI-45-MW

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PA1-45-MW21-SU
DATE: 3/31/05
GEOLOGIST: Conti
DRILLER: Bilbrey

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	0						See Boring Log						0
							PA1-45-MW21-SL						
				3'			for details						
	5												0
	8												0
				8'									
				9'									
				T.D.									
							screen: 3'-8'						
							sand: 2'-8.5'						
							pellets: 1'-2'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: Used 4¼ I.D. augers

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PA1-45-MW21-SU

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PA1-45-MW21-SL
DATE: 3/31/05
GEOLOGIST: Conti
DRILLER: Bilbrey

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ**	Borehole**	Driller BZ**
S-1 @ 0734	0	2/4	2/2		Medium dense	brown	Silty sand, trace roots	SM	moist	0			
	2	5/6								0			
S-2 @ 0740		9/8	2/2		medium dense	brown grey	Silty sand	SM	moist wet @ 3.5'	7.1			
	4	11/8		4'		yellow brown				3			
S-3 @ 0747		4/3	1.5/2		medium dense	brown grey	Silty sand, trace clay	SM	wet clay content inc. w/depth	.3			
	6	5/6								1.2			
S-4 @ 0751		4/5	1.5/2		loose	grey	Silty sand	SM	wet	0			
	8	6/4		8'						0			
S-5 @ 0803		1/0	2/2		v. loose	grey	Silty sand, some clay	SM/SC	wet	0			
	10	0/0		10'						0			
S-6 @ 0810		13/18	1.7/2		medium dense	grey	Silty sand	SM	wet to saturated	0			
	12	11/6								0			
S-7 @ 0820		2/1	1.2/2		v. loose	med. grey	Silty fine sand	SM	wet to saturated	0			
	14	0/0								0			
S-8 @ 0830		1/0	2/2	15'	loose	med grey	Silty fine sand	SM	wet to saturated	0			
	16	1/4		16'						0			
				T.D.									
							screen: 10' - 15'						
							sand: 8' - 15.5'						
							pellets: 5' - 8'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: Used 4 1/4 I.D. augers w/ Auto Hammer 2" spoons

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PA1-45-MW21-SL

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PA1-45-MW21-D
DATE: 3/29/05 - 4/4/05
GEOLOGIST: Conti
DRILLER: Bilbrey

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sample BZ	Borehole**	Driller BZ**
	0												
							see MIPs point SB118 for details above 19'		Auger to 19'. no sampling due to previous info. and MIPs data		0		0
	5										0		0
									Set 6" CAS TO 19' (Steel)				
	10										0		0
	15										0		0
3/29/05 4/4/05	20			19'							0		0
S-1 @ 0750	22	1/1 1/1	2/2		M STIFF	GRAY	SILTY CLAY- TR ROOTS ORGANICS.	CL	WET	0 0			
							LESS CLAY AT 23' (Drilling)						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: Used 8 1/4 in. augers with bottom plug to 19' prior to setting casing 5 7/8" Φ Drag bit (mud rot) below casing

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PA1-45-MW21-D

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW21-D
DATE: 4/4/05
GEOLOGIST: Conti
DRILLER: Bilbrey

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	25												
S-2		1/1	1.5/2	26	LOOSE	GRAY	CLAYEY SAND - TR ROOTS	SC	WET	0			
0805	27	1/1			V LOOSE		SILTY SAND	SM	WET	0			
				27									
	30			30									
S-3 e		1/2	1.8/2		M DENSE	GRAY	SILTY SAND - SOME SHELLS	SM	WET	0			
0820	32	3/15		31.5	M DENSE	GRAY	TO SILTY SAND - TR THIN CLAY LENS		WET	0			
	35												
S-4 e		9/18	1.5/2	36±						0			
0845	37	24/30		37	V DENSE	MED GRAY	SILTY F SAND - TR CLAY		VERY COMPACT WET → MOIST	0			
				38' TD									
							SCREEN 27 – 37						
							SAND 25 – 37.5	→	USED 6 BAGS SAND				
							PELLETS TO 22'±						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: Mud rotary below casing
Used 2" spoons

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PAI-45-MW21-D

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW22-SU
DATE: 3/30/05
GEOLOGIST: Conti
DRILLER: Bilbrey

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	0												
							see Boring Log						0
							PAI-45-MW22-SL						
				3'			for details						
	5												0
				8'									
	9			9'									0
				T.D.			screen: 3'-8'						
							sand: 2'-8.5'						
							pellets: 1'-2'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: Used 4 1/4 I.D. augers

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PAI-45-MW22-SU

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW22-SL
DATE: 3/30/05
GEOLOGIST: Conti
DRILLER: Bilbrey

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 @ 0745	2	6/5, 5/3	2/2		loose	grey brown	Silty sand, trace rock fragments	SM	moist	0, 0			
S-2 @ 0748	4	6/3, 3/2	1.5/2	4'	loose	grey brown	Silty sand, trace clay	SM	moist to wet	9.4, 8.2			
S-3 @ 0803	6	3/1, 1/1	1.5/2		v. loose	brown to grey	Silty sand, trace clay	SM	moist to wet	1.1, .8			
S-4 @ 0806	8	13/9, 15/9	2/2		m. dense	grey brown	Silty sand, trace of clay towards bottom	SM	moist to wet	0, -1			
S-5 @ 0819	10	6/7, 5/2	2/2	10'	loose	Lt. gray	Silty sand, trace clay 6'-7'	SM	wet	0, 0			
S-6 @ 0825	12	2/1, 1/1	2/2		V. loose	Lt. grey	Silty sand, trace clay	SM	wet	0, 0			
S-7 @ 0835	14	2/2, 1/2	1.5/2		v. loose	med. grey	Silty sand, trace clay	SM	wet	0, 0			
S-8 @ 0842	16	2/1, 0/0	2/2	15'	V. loose	med grey	Silty sand, trace clay	SM	wet	0, 0			
					V. soft	grey	clayey sand	SC	wet				
				T.D.									
							Screen: 10'-15'						
							Sand: 8'-15.5'						
							pellets: 5'-8'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: Used 4¼ I.D. augers w/ Auto Hammer
2" Spoons

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PAI-45-MW22-SL

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW23-SU
DATE: 4/2/05
GEOLOGIST: Conti
DRILLER: Bilbrey

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sampler	Sampler BZ	Borehole**	Driller BZ**
	0												
							See boring log						0
							PAI-45-TW46-SU						
				3'			and MIPs point						
							SB146 for details						
	5												0
	10			10'									0
	11			11'									0
				T.D.									
							Screen: 3' - 10'						
							sand: 2' - 10.5'						
							pellets: 1' - 2'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: Used 4 1/4" I.D. augers

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PAI-45-MW23-SU

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW23-SL
DATE: 4/2/05
GEOLOGIST: Conti
DRILLER: Bilbrey

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole*	Driller BZ**
	0												
							See boring log						0
							PAI-45-TW146-SL						
							and MIPs point						
							SB146 for details						
	5												0
	10			10'									0
	15			15'									0
	16			16'									0
				T.D.									
							Screen: 10'-15'						
							sand: 6.5'-15.5'						
							pellets: 3'-6.5'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: Used 4¼" I.D. augers

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PAI-45-MW23-SL

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: MCRD Parris Island
PROJECT NUMBER: N5260
DRILLING COMPANY: Miller Drilling Company
DRILLING RIG: CME 750

BORING No.: PAI-45-MW24-SU
DATE: 4/13/05
GEOLOGIST: Conti
DRILLER: BISHOP

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole **	Driller BZ **
	0						See Mips Data		MIPS SB111				0
							For Details		" SB154				
				3'									
	5												0
				8									
	9												
				9' TD									0
							HSA TO 9'						
							SCREEN 3-8'						
							SAND 2-8.5'						
							PELLETS TO 1						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: HSA 4 1/4" ID w/ Bottom Plug

Drilling Area Background (ppm): 0

Converted to Well: Yes ✓ No _____ Well I.D. #: PAI-45-MW-24 SU

APPENDIX I

PERMANENT MONITORING WELL DEVELOPMENT SHEETS

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PAI-45-MW01-D
Site: 45
Date Installed: 4/2/05
Date Developed: 4/5/05
Dev. Method: purge pump
Pump Type: whale

Depth to Bottom (ft.): 40.30
Static Water Level Before (ft.): 3.89
Static Water Level After (ft.): 12.13
Screen Length (ft.): 10'
One Well Volume (gal.): 6.0
Casing ID (in.): 2

Responsible Personnel: CO / SC
Drilling Company: Miller
Project Name: MCRD PI
Project Number: N5260
PID Readings: Bore Hole 0.7 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (~~mL~~ gal./min.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units ms/cm)	Turbidity (NTU)	Remarks (odor, color, etc.)
1220	0	1.5 gpm	3.89	25.11	12.84	5.21	361	milky white, cloudy
1230	15	"	5.68	24.35	12.63	2.97	139	slightly cloudy
1240	30	"	4.82	24.49	12.77	2.71	100.2	slightly cloudy
1250	45	"	11.85	23.51	12.77	2.27	41.1	slightly cloudy, pH confirmed w/ litmus, battery died - used car battery
1300	60	"	12.43	23.29	12.60	1.66	12.7	clear
1320	120	3 gpm	12.36	24.00	11.64	0.96	5.66	clear
1340	180	"	12.24	23.88	10.39	1.08	3.96	clear
1400	240	"	12.18	23.90	9.81	1.20	2.93	clear
1420	300	"	12.10	23.83	9.43	1.28	2.94	clear
1440	360	"	12.14	23.46	9.08	1.33	2.19	clear
1500	420	"	12.10	23.26	8.78	1.34	2.27	clear
1520	480	"	12.14	23.31	8.59	1.35	1.97	clear
1540	540	"	12.13	23.26	8.44	1.36	1.69	clear
end development								

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PA1-45-MW06-D
Site: 45
Date Installed: 3/31/05
Date Developed: 4/5/05
Dev. Method: purge pump
Pump Type: whale

Depth to Bottom (ft.): 43.00
Static Water Level Before (ft.): 6.20
Static Water Level After (ft.): 26.27
Screen Length (ft.): 10
One Well Volume (gal/L): 6.05
Casing ID (in.): 2

Responsible Personnel: CO/SC
Drilling Company: Miller
Project Name: MCRD P1
Project Number: N5260
PID Readings: Bore Hole 0.1 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (~~mL~~ gal/min.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm)	Turbidity (NTU)	Remarks (odor, color, etc.)
0840	0	.41 gpm	6.20	23.39	7.38	0.365	—	grey brown, opaque
0850	4.1	"	10.60	22.97	6.88	0.932	668	very cloudy
0900	8.2	"	11.40	23.24	7.15	1.08	401	very cloudy
0910	23.2	1.5	27.85	23.28	7.34	1.29	146	cloudy, dislodged chunk of clay from pump intake
0920	38.2	1.5	27.50	23.47	7.46	1.52	47.8	slightly cloudy
0930	53.2	1.5	27.07	24.08	7.54	1.65	30.9	clear
0940	68.2	1.5	26.27	24.05	7.61	1.73	20.1	clear
end	development							

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PA1-45-MW07-D
Site: 45
Date Installed: 4/1/05
Date Developed: 4/5/05
Dev. Method: purge pump
Pump Type: whale

Depth to Bottom (ft.): 42.30
Static Water Level Before (ft.): 5.88
Static Water Level After (ft.): 12.96
Screen Length (ft.): 10'
One Well Volume (gal/L): 6.0
Casing ID (in.): 2

Responsible Personnel: CO / SC
Drilling Company: Miller
Project Name: MCRD P1
Project Number: N5260
PID Readings: Bore Hole 0.7 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (~~mL~~ gal/min.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm)	Turbidity (NTU)	Remarks (odor, color, etc.)
1010	0	1.5 gpm	5.88	23.47	8.76	0.339	—	grey brown, opaque
1020	15	"	21.16	22.78	7.74	0.627	462	v. cloudy
1030	30	"	23.42	22.72	7.50	0.964	166	cloudy
1040	45	"	21.89	22.90	7.37	1.20	30.9	slightly cloudy
1050	60	"	17.05	22.81	7.38	1.29	13.8	clear
1055	67.5	"	12.96	22.99	7.38	1.32	10.12	clear
end	development							

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PAI-45-MW10-SU
Site: 45
Date Installed: 4/12/05
Date Developed: 4/15/05
Dev. Method: PURGE PUMP
Pump Type: WHALE

Depth to Bottom (ft.): 7.95
Static Water Level Before (ft.): 2.20
Static Water Level After (ft.): 2.6
Screen Length (ft.): 5
One Well Volume (gal/L): 1
Casing ID (in.): 2"

Responsible Personnel: CONTI
Drilling Company: MILLER
Project Name: MCRD PI
Project Number: N5260
PID Readings: Bore Hole 0 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (~~mL~~/min.) GAL	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm)	Turbidity (NTU) Lamotte/ Horiba	Remarks (odor, color, etc.)
1000		≈1						Went Dry @ 3 mins Brn/Turbid.
1003	3	~1	7'±	—	—	—		
1020		~1	2.3	20.7	5.3	1.18	— / 640	Brown/Turbid Dry @ 4 mins
1024	7	~1	7±					Goes dry, but recovers well,
								but yield cannot keep up w/ 1GPM
1035		~1	3.3	21.1	5.1	1.16	950/ 110	pump
1038	10		7'±					
1045		~1	3.3	21.2	5.1	1.15	500/ 110	
1048	13		7'±					Dry @ 3 mins sl turbid.
1100		~1	2.6	21.3	5.1	1.10	40/40	Clear Dry @ 3 mins
1103	16							
								Dev Done @ 1103

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PAI-45-MW10-SL
Site: 45
Date Installed: 4/12/05
Date Developed: 4/15/05
Dev. Method: PURGE PUMP
Pump Type: WHALE.

Depth to Bottom (ft.): 15.65 TPVC
Static Water Level Before (ft.): 1.80 TPVC
Static Water Level After (ft.): ~15
Screen Length (ft.): 5'
One Well Volume (gal/L): 2.3
Casing ID (in.): 2"

Responsible Personnel: CONTI
Drilling Company: MILLER
Project Name: MCRC PI
Project Number: N5260
PID Readings: Bore Hole 0 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (~~mL~~/min.) g/min	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units _____)	Turbidity (NTU) Lamotte	Remarks (odor, color, etc.)
0830	—	1	1.80		5.			Gray Turbid.
0840	10	1	14.50	19.9	5.7	1.84	—	" "
0850	20	1	14.00	20.2	5.2	1.46	—	Lt " " 800 Turb-HORIBA
0900	25	~.5	14.80	20.5	5.2	1.54	150	" " Sl. Turbid 240 " "
0910	30	.5	≈ 15	20.5	5.1	1.45	55	" " V. SL " 120 " "
0920	35	.5	≈ 15	20.6	5.1	1.44	45	" " " 70 " "
0930	40	.5	≈ 15	20.6	5.1	1.43	26	Clear 51 " "
0940	45	.5	≈ 15	20.9	5.1	1.43	16	" 38 " "
				DONE DEVE		0940		

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PAI-45-MW 13-SU
Site: 45
Date Installed: 4/13/05
Date Developed: 4/17/05
Dev. Method: PURGE
Pump Type: WHALE

Depth to Bottom (ft.): 8.95 TPVC
Static Water Level Before (ft.): 2.87 TPVC
Static Water Level After (ft.): ~8
Screen Length (ft.): 5'
One Well Volume (gal/L): 1.03
Casing ID (in.): 2"

Responsible Personnel: CONTI
Drilling Company: MILLER
Project Name: MCRD PI
Project Number: N5260
PID Readings: Bore Hole 0 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate ~~(mL~~/min.) GAL	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units ms/cm)	Turbidity (NTU)	Remarks (odor, color, etc.)
1110		1	2.87	—	—	—	—	Brn - Turbid.
1120	10	1	~8	20.89	6.1	.421	—	" "
1130	20	0.5	~8	20.91	5.9	.366	550/570	Lt Brn "
1140	25	0.5	~8	20.82	6.0	.378	500/720	" "
1150	30	0.5	~8	20.81	5.9	.445	750/760	" "
1200	35	"	~8	21.17	5.9	.531	75/120	V Lt Brn - V. SL Turbid.
1210	40	"	~8	21.14	6.0	.526	110/97	Clear " "
1220	45	"	~8	21.16	6.0	.528	130/120	" "
			DONE DEV SJC.					
								yield of well just barely able to
								keep up with pump

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PAI-45-MW13-SL
Site: 45
Date Installed: 4-13-05
Date Developed: 4-17-05
Dev. Method: PURGE
Pump Type: WHALE

Depth to Bottom (ft.): 15.85 TPVC
Static Water Level Before (ft.): 2.80 TPVC
Static Water Level After (ft.): 9.60
Screen Length (ft.): 5'
One Well Volume (gal/L): 2.1
Casing ID (in.): 2"

Responsible Personnel: CONTI
Drilling Company: MILLER
Project Name: MCRD PI
Project Number: N5260
PID Readings: Bore Hole 0 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (~~mL~~/min.) GAL	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm)	Turbidity (NTU) Lamotte/Horiba	Remarks (odor, color, etc.)
1030		1	2.80	—	—	—	—	DK Brn Gray - Turbid (Initial)
1040	10	1	9.61	20.75	5.8	1.43	60/98	Lt Br to Clear - sl Turbid.
1050	20	1	9.71	20.83	5.8	1.37	8/11	Clear - Non Turbid.
1055	25	1	9.73	20.93	5.8	1.38	4/3	" "
1100	30	1	9.60	20.98	5.7	1.35	2/1	" "
			DONE DEV	SJC				

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PAI-45-MW14-SU
Site: 45
Date Installed: 4/12/05
Date Developed: 4/16/05
Dev. Method: PURGE
Pump Type: WHALE

Depth to Bottom (ft.): 8.95
Static Water Level Before (ft.): 2.33
Static Water Level After (ft.): < 8'
Screen Length (ft.): 5
One Well Volume (gal/L): ~1
Casing ID (in.): 2

Responsible Personnel: CONTI
Drilling Company: MILLER
Project Name: MCRD-PI
Project Number: N5260
PID Readings: Bore Hole 0 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (~~mL~~/min.) GAL	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm)	Turbidity (NTU)	Remarks (odor, color, etc.)
1000		~1	2.33	20.07	4.4	.263	— / —	LT Brn / Turbid - Dry @ 3 mins
1003	3		8'±					Good Recovery
1015		~1	2.73	21.36	3.9*	.270	— / —	* Checked pH w/ Cal's Standard = 4.0 unit read 3.9 - re calibrate - reads 4 now
1017	5		8'±					Lt Brn / Turbid - Dry @ 2 mins
1030		~1	2.85	20.99	4.5+	.340	370 / 400	Checked w/ pH paper - was ≈ 5
1032	7		8'±					Dry @ 2 mins Lt Brn - Sl Turbid.
1045		~1	3.10	21.22	4.5	.232	200/320	
1047	9		8'±					Dry @ 2 mins Lt Brn - Sl "
1100		~1	2.89	19.49	4.7	.221	110/ 350	
1102	11		8'±					Dry @ 2 mins V Lt Brn VSL "
1115		~1	2.85	20.62	4.8	.216	80/ 180	
1117	13		8'±					Dry @ 2 mins Clear VSL "
1130		~1	2.95	20.44	4.9	.225	85/ 120	
1132	15		8'±					Dry @ 2 mins " Non Turbid
			DONE	DEV	SJC			

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PAL-45-MW14-SL
Site: 45
Date Installed: 4-12-05
Date Developed: 4-16-05
Dev. Method: PURGE
Pump Type: WHALE

Depth to Bottom (ft.): 14.80
Static Water Level Before (ft.): 3.10 TPVC
Static Water Level After (ft.): 14'
Screen Length (ft.): 5'
One Well Volume (gal.): ~2
Casing ID (in.): 2"

Responsible Personnel: CONTI
Drilling Company: MILLER
Project Name: MCRD-PI
Project Number: N5260
PID Readings: Bore Hole 0 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (~~mL~~/min.) GAL	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm)	Turbidity (NTU)	Remarks (odor, color, etc.)
0810		1	3.10	—	—	—	—	Gray / Turbid.
0814	2	.5	14'					Dry @ 4 mins - recovers well
0840		~1	5.55	20.30	5.2	1.04	110/ 99	
0842	4		14'					Dry @ 2 mins - Lt Gray Sl. Turbid.
0910		~1	5.00	21.13	4.9	.871	24/ 50	
0912	6		14'					Dry @ 2 mins - Clear Non "
0945		~1	4.41	21.21	5.0	.847	22/ 39	
0947	8		14'					Dry @ 2 mins - clear
		Done	Dev @	0947	H2S	SPC.		

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PAI-45-MW15-SU
Site: 45
Date Installed: 4/3/05
Date Developed: 4/12/05
Dev. Method: purge pump
Pump Type: whale

Depth to Bottom (ft.): 8.79
Static Water Level Before (ft.): 4.07
Static Water Level After (ft.): 4.13
Screen Length (ft.): 5'
One Well Volume (gal/L): 0.75
Casing ID (in.): 2

Responsible Personnel: CD
Drilling Company: Miller
Project Name: MCAD PI
Project Number: N5260
PID Readings: Bore Hole 0.1 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate ~~(mL~~/min.) gal	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm)	Turbidity (NTU)	Remarks (odor, color, etc.)
1035	—	~1.5 gpm	4.07	19.34	6.69	0.505	—	dry in 2.5 min, brown, v. cloudy
1045	3.75 gal	"	4.12	18.99	6.47	0.356	—	" 2 min, v. cloudy
1055	6.25	"	4.18	19.02	6.05	0.311	897	" 1.5 min, v. cloudy
1105	9.00	"	4.18	18.88	6.05	0.302	—	" 1 min, v. cloudy
1115	10.50	"	4.17	19.25	5.91	0.291	814	" 1 min, v. cloudy
1125	12.00	"	4.18	18.88	5.95	0.289	825	" .5 min, v. cloudy
1135	12.75	"	4.14	18.87	6.00	0.287	720	" .5 min, v. cloudy
1145	13.50	"	4.13	19.11	5.95	0.275	288	" .5 min, cloudy
end	development							

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PAI-45-MW15-SL
Site: 45
Date Installed: 4/3/05
Date Developed: 4/12/05
Dev. Method: purge pump
Pump Type: whale

Depth to Bottom (ft.): 17.61
Static Water Level Before (ft.): 3.87
Static Water Level After (ft.): 5.85
Screen Length (ft.): 5
One Well Volume (gal/L): 2.2
Casing ID (in.): 2

Responsible Personnel: CD
Drilling Company: Miller
Project Name: MCRD PI
Project Number: N5280
PID Readings: Bore Hole 0 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (~~mL~~ gal/min.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units ~~mS/cm~~)	Turbidity (NTU)	Remarks (odor, color, etc.)
1245	—	1 gpm	3.87	20.49	6.05	0.333	—	dry in 4 min, brown, v cloudy
1255	4 gal	"	5.55	19.76	6.17	0.323	547	" 4 min, v. cloudy
1305	8 gal.	"	6.03	20.25	6.11	0.321	182	" 3 min, cloudy
1315	11 gal	"	6.49	19.85	6.18	0.320	59.5	" 2.5 min, slightly cloudy
1325	13.5 gal	"	6.42	19.57	6.25	0.320	47.1	" 2.5 min, slightly cloudy
1335	16.0	"	6.37	19.44	6.23	0.320	41.4	" 2.5 min, clear
1345	18.5	"	5.85	19.53	6.26	0.319	43.4	" 2.5 min, clear
end	development							

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PA1-45-MW16-SD
Site: 45
Date Installed: 4/3/05
Date Developed: 4/4/05
Dev. Method: purge pump
Pump Type: whale

Depth to Bottom (ft.): 10.25
Static Water Level Before (ft.): 6.46
Static Water Level After (ft.): 6.69
Screen Length (ft.): 5
One Well Volume (gal/L): 1.75
Casing ID (in.): 2

Responsible Personnel: CD
Drilling Company: Miller
Project Name: MCRD PI
Project Number: N5260
PID Readings: Bore Hole 0.7 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (mL/min.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units ms/cm)	Turbidity (NTU)	Remarks (odor, color, etc.)
1300	~2 gal	~1 gpm	6.46	20.32	7.23	0.152	—	dry in 2 min, brown, opaque
1310	2.5	"	6.62	20.16	7.08	0.142	—	" .5 min, opaque
1320	3.0	"	6.66	19.60	6.94	0.135	—	" .5 min, translucent
1330	3.5	"	6.65	19.81	6.80	0.134	—	" .5 min, translucent
1340	4.0	"	6.68	20.15	6.85	0.135	912	" .5 min, cloudy
1350	4.5	"	6.67	19.96	6.72	0.135	518	" .5 min, cloudy
1400	5.0	"	6.69	20.23	6.98	0.137	398	" .5 min, cloudy
end development								

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PA1-45-MW16-SL
Site: 45
Date Installed: 4/3/05
Date Developed: 4/4/05
Dev. Method: purge pump
Pump Type: whale

Depth to Bottom (ft.): 20.25
Static Water Level Before (ft.): 7.91
Static Water Level After (ft.): 15.45
Screen Length (ft.): 5
One Well Volume (gal/L): 1.95
Casing ID (in.): 2

Responsible Personnel: CD
Drilling Company: Miller
Project Name: MCRD P1
Project Number: N5260
PID Readings: Bore Hole 0.4 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (mL/min.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm)	Turbidity (NTU)	Remarks (odor, color, etc.)
1500	0	~1 gpm	7.91	21.71	7.19	0.339	1040	yellow brown, v cloudy
1510	10	"	15.38	20.38	7.18	0.303	52.6	slightly cloudy
1515	15	"	15.46	20.17	6.84	0.293	31.2	slightly cloudy
1520	20	"	15.43	20.32	6.74	0.289	19.5	clear
1525	25	"	15.69	20.29	6.74	0.286	13.2	clear
1530	30	"	15.45	20.73	6.75	0.282	4.07	clear
end	development							

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PAI- 45-MW17-SU
Site: 45
Date Installed: 4/13/05
Date Developed: 4/17/05
Dev. Method: PURGE
Pump Type: WHALE

Depth to Bottom (ft.): 9.20
Static Water Level Before (ft.): 3.38 TPVC
Static Water Level After (ft.): ~8.5
Screen Length (ft.): 5'
One Well Volume (gal/L):
Casing ID (in.): 2"

Responsible Personnel: CONTI
Drilling Company: MILLER
Project Name: MCRD PI
Project Number: N5260
PID Readings: Bore Hole 0 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (~~mL~~ GAL/min.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm)	Turbidity (NTU)	Remarks (odor, color, etc.)
0930		~1	3.38					Lt gray - Sl Turbid.
0940	10	"	~8.5*	18.80	6.4	1.94	310/340	" "
0950	20	"	"	18.24	6.3	2.22	40/54	Clear - Non Turbid.
1000	30	"	"	18.69	6.3	2.41	6/5	" "
1010	40	"	"	18.76	6.3	2.50	3/0	" "
			Done @	1010				
								*yield of well just able to keep
								up w/ pump.

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PAI-45-MW17-SL
Site: 45
Date Installed: 4/13/05
Date Developed: 4/17/05
Dev. Method: PURGE
Pump Type: WHALE

Depth to Bottom (ft.): 14.40 TPVC
Static Water Level Before (ft.): 2.58 TPVC
Static Water Level After (ft.): ~14
Screen Length (ft.): 5'
One Well Volume (gal/L): 1.9
Casing ID (in.): 2"

Responsible Personnel: CONTI
Drilling Company: MILLER
Project Name: MCRD PI
Project Number: N5260
PID Readings: Bore Hole 0 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (~~mL~~ GAL/min.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm)	Turbidity (NTU)	Remarks (odor, color, etc.)
0735		~1	2.58	—	—	—	—	DK Brn Gray - Turbid
0740	5		~14					Goes dry @ 5 mins (Good Rec)
0800		~1	3.10	17.65	5.2	3.87	700/620	Lt Gray - Turbid. (SAL. .2)
0803	8		~14					Dry @ 3 mins
0820		~1	3.10	18.42	6.0	3.73	400/370	Lt Gray Sl Turbid
0823	11		~14					Dry @ 3 min.
0840		~1	3.15	18.59	6.0	3.64	130/280	Lt Gray Sl Turbid.
0842	13		~14					Dry @ 2 mins
0900		~1	3.20	18.73	6.3	2.28	60/120	Lt Gray V.Sl Turbid
0902	15		~14					Dry @ 2 mins
0920		~1	3.15	18.66	6.3	2.04	45/65	Clear - Non Turbid
0922	17		~14					
			Done @	0922	SQC.			

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PAI-45-MW18-SU
Site: 45
Date Installed: 4-13-05
Date Developed: 4-16-05
Dev. Method: PURGE
Pump Type: WHALE

Depth to Bottom (ft.): 8.72 TPVC
Static Water Level Before (ft.): 2.03 TPVC
Static Water Level After (ft.): ~ 8'
Screen Length (ft.): 5'
One Well Volume (gal/L): 1.14
Casing ID (in.): 2"

Responsible Personnel: CONTI
Drilling Company: MILLER
Project Name: MCRD PI
Project Number: N5260
PID Readings: Bore Hole 0 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (mL/min.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm)	Turbidity (NTU) Lamotte/Horiba	Remarks (odor, color, etc.)
1400		~1	2.03	—	—	—	—	Brn Gray - Turbid
1403	3		8'±					Dry @ ≈ 3mins - Recovery is ok
1420		~1	5.10	18.66	6.3	.362	—	Brn Gray Turbid.
1421	4		8'±					Dry @ 1 min
1440		~1	2.90	18.70	5.7	.459	450/750	LT Brn Gray - Sl. Turbid.
1441	5		8'					Dry @ 1 min
1500		~1	2.80	19.01	5.8	.480	370/450	Lt Brn Gray - Sl Turbid
1501	6		8'					Dry @ 1 min
1520		~1	2.57	19.02	5.9	.528	320/520	Lt Brn - Sl Turbid.
1521	7		8'					Dry @ 1 min
1540		~1	2.56	19.12	5.8	.498	220/390	Lt Brn Sl Turbid
1541	8		8'					Dry @ 1 min
1600		~1	2.57	19.15	5.9	.516	210/370	Lt Brn VSl Turbid.
1601	9		8'					Dry @ 1 min
			Done @ 1601		SJC			

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PAI-45-MW18-SL
Site: 45
Date Installed: 4-13-05
Date Developed: 4-16-05
Dev. Method: PURGE
Pump Type: WHALE

Depth to Bottom (ft.): 15.35
Static Water Level Before (ft.): 3.05 TPVC
Static Water Level After (ft.): ~14.5
Screen Length (ft.): 5'
One Well Volume (gal/L): 2.09
Casing ID (in.): 2" Φ

Responsible Personnel: CONTI
Drilling Company: MILLER
Project Name: MCRD-PI
Project Number: NS260
PID Readings: Bore Hole 0 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (~~mL~~/min.) GAL	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units ms/cm)	Turbidity (NTU) Lamotte/Horiba	Remarks (odor, color, etc.)
1155		~1	3.05	—	—	—	—	DK Gray Turbid
1158	3		14.5±					Dry ≈ 3 mins
1225		~1	3.45	19.19	5.4	2.33	— —	DK Gray Turbid.
1227	5		14.5					Dry @ 2 mins
1255		~1	3.50	19.56	5.8	2.64	220/460	Lt Gray - Sl Turbid
1257	7		14.5					Dry @ 2 mins
1325		~1	3.94	19.28	5.9	2.61	50/98	Clear - Non Turbid
1327	9		14.5					Dry @ 2 mins
1355		~1	3.65	19.18	5.9	2.59	31/73	Clear Non Turbid
1357	11		14.5					Dry @ 2 mins
			Done Dev @ 1357		SJC.			

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PA1-45-MW19-SU
Site: 45
Date Installed: 4/1/05
Date Developed: 4/3/05
Dev. Method: Purge pump
Pump Type: whale

Depth to Bottom (ft.): 8.58
Static Water Level Before (ft.): 1.59
Static Water Level After (ft.): 4.43
Screen Length (ft.): 5
One Well Volume (gal/L): 1.1
Casing ID (in.): 2"

Responsible Personnel: CD
Drilling Company: Miller
Project Name: MCRD PI
Project Number: N5260
PID Readings: Bore Hole 0 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (mL/min.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units ms/cm)	Turbidity (NTU)	Remarks (odor, color, etc.)
1355	~1.5	~1 gpm	1.59	16.36	7.20	1.15	908	pumped dry in 1.5 min, v. cloudy
1405	3.0	"	2.08	16.01	5.66	1.30	548	" 1.5 min, v. cloudy
1415	4.0	"	3.25	15.99	5.67	1.26	537	" 1 min, v. cloudy
1425	5.0	"	3.46	16.07	5.74	1.26	302	" 1 min, cloudy
1435	6.0	"	3.65	16.01	5.74	1.22	169	" 1 min, cloudy
1445	6.5	"	4.15	16.05	6.04	1.36	233	" .5 min, cloudy
1455	7.0	"	4.33	16.16	6.07	1.30	130	" .5 min, cloudy
	end dev.							

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PA1-45-MW19-SL
Site: 45
Date Installed: 4/1/05
Date Developed: 4/3/05
Dev. Method: purge pump
Pump Type: whale

Depth to Bottom (ft.): 16.02
Static Water Level Before (ft.): 1.47
Static Water Level After (ft.): 6.60
Screen Length (ft.): 5
One Well Volume (gal/L): 2.4
Casing ID (in.): 2

Responsible Personnel: CD
Drilling Company: Miller
Project Name: MCRD PI
Project Number: N5260
PID Readings: Bore Hole 0 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (mL/min.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm)	Turbidity (NTU)	Remarks (odor, color, etc.)
1510	5	~ 1 gpm	1.47	17.37	6.17	2.06	—	dry in 5 min, brown, v cloudy
1520	9	"	7.40	17.80	6.29	1.80	339	" 4 min., v cloudy
1530	13	"	4.95	17.32	6.32	1.64	28.4	" 4 min., slightly cloudy
1540	17	"	4.88	17.50	6.32	1.65	18.7	" 4 min., clear
1550	21	"	6.60	17.36	6.35	1.71	8.31	" 4 min., clear
	end development							

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PAT-45-MW20-SU
Site: 45
Date Installed: 4/12/05
Date Developed: 4/15/05
Dev. Method: PURGE PUMP
Pump Type: WHALE

Depth to Bottom (ft.): 8.73 TPVC
Static Water Level Before (ft.): 4.31 TPVC
Static Water Level After (ft.): ~ 8'
Screen Length (ft.): 5
One Well Volume (gal/L): .8 ~
Casing ID (in.): 2" Φ

Responsible Personnel: CONTI
Drilling Company: MILLER
Project Name: MCRD PI
Project Number: N5260
PID Readings: Bore Hole 0 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (mL/min.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm)	Turbidity (NTU) Lamotte/ Horiba	Remarks (odor, color, etc.)
1405	—	≈ 1 GPM	4.31	—	—	—	—	Gray Brn - Turbid.
1408	3		≈ 8'	19.4	5.0	2.58	—	Dry @ 3 mins
1420	—	≈ 1GPM	4.95					
1422	5		~ 8'					Dry @ 2 mins - Gray Brn-Turbid
1435		≈ .5GPM	4.54	19.3	4.6	4.15	—	
1437	6		~ 8'					
1455			4.40	19.4	4.9	4.33	400/ 530	
1457	7	.5GPM	~ 8'					Dry @ 2 mins Gray Brn - Sl Turbid
1510			4.70	19.5	5.0	4.88	370/ 450	
1512	8	.5GPM	8'					
1530			4.41	19.4	5.0	4.88	130/ 180	
1533	9	< .5GPM	~ 8'					Dry @ 3 mins Clear Sl Turbid
1545			4.90	19.3	4.9	4.83	150/ 230	
1547	10	.5GPM	~ 8'					Dry @ 2 mins Clear Sl "
			Done Dev @ ~1600.					

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PAI-MW 2D-SL
Site: 45
Date Installed: 4-12/05
Date Developed: 4/15/05
Dev. Method: PURGE PUMP
Pump Type: WHALE

Depth to Bottom (ft.): 15.55 TPVC
Static Water Level Before (ft.): 3.35 TPVC
Static Water Level After (ft.): ~13
Screen Length (ft.): 5'
One Well Volume (gal/L): ≈ 2
Casing ID (in.): 2"

Responsible Personnel: CONTI
Drilling Company: MILLER
Project Name: MCRD PI
Project Number: N5260
PID Readings: Bore Hole 0 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate ~~(mL~~/min.) GPM	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm)	Turbidity (NTU) Lamotte/Horiba	Remarks (odor, color, etc.)
1310		1	3.35	—	—	—	—	Gray / Turbid.
1320	10	1	~13	19.7	4.9	2.71	—	" "
1330	20	1	~13	19.3	5.0	2.53	34 / 89	" sl Turbid. to Clear
1340	30	1	~13	19.40	5.0	2.52	20 / 33	Clear
1350	40	1	~13	19.6	5.0	2.59	12 / 19	Clear
1400	50	1	~13	19.6	5.0	2.58	12 / 14	"
		Done	Dev @	1400 Hrs				

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PAI-45-MW21-SU
Site: 45
Date Installed: 3/31/05
Date Developed: 4/3/05
Dev. Method: purge pump
Pump Type: whale

Depth to Bottom (ft.): 10.25
Static Water Level Before (ft.): 3.24
Static Water Level After (ft.): 3.65
Screen Length (ft.): 5
One Well Volume (gal/L): 1.1
Casing ID (in.): 2"

Responsible Personnel: CD
Drilling Company: Miller
Project Name: MCRD PI
Project Number: N5260
PID Readings: Bore Hole 0 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (mL/min.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units ms/cm)	Turbidity (NTU)	Remarks (odor, color, etc.)
1020	~2	~1 gpm	3.24	—	—	—	—	pumped dry in 2 min
1030	4	"	3.75	18.09	5.58	0.633	—	" 2 min
1040	6	"	3.84	18.04	5.67	0.612	—	" 2 min, very cloudy
1050	7.5	"	3.71	17.70	5.86	0.592	—	" 1.5 min, very cloudy
1100	8.5	"	3.75	17.32	5.81	0.587	—	" 1 min, very cloudy
1110	9.5	"	3.62	17.38	5.80	0.579	—	" 1 min, very cloudy
1120	10.5	"	3.64	17.14	5.73	0.593	—	" 1 min, very cloudy
1130	11.5	"	3.65	17.63	5.66	0.602	—	" 1 min, very cloudy
	end development							

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PAI-45-MW21-SL
Site: 45
Date Installed: 3/31/05
Date Developed: 4/3/05
Dev. Method: purge pump
Pump Type: whale

Depth to Bottom (ft.): 15.24
Static Water Level Before (ft.): 1.73
Static Water Level After (ft.): 9.77
Screen Length (ft.): 5
One Well Volume (gal/L): 2.2
Casing ID (in.): 2

Responsible Personnel: CD
Drilling Company: Miller
Project Name: MCRD PI
Project Number: N5260
PID Readings: Bore Hole 0 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (mL/min.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm)	Turbidity (NTU)	Remarks (odor, color, etc.)
1235	—	~1 gpm	1.73	—	—	—	—	start development
1245	10	"	9.62	19.14	5.84	0.820	220	grey, cloudy
1250	15	"	9.65	18.22	5.81	0.818	45	slightly cloudy
1255	20	"	9.73	18.17	5.80	0.810	20	clear
1300	25	"	9.75	18.05	5.79	0.813	13	clear
1305	30	"	9.77	17.61	5.81	0.813	18	clear
	end development							

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PA1-45-MW21-D
Site: 45
Date Installed: 4/4/05
Date Developed: 4/12/05
Dev. Method: purge pump
Pump Type: whale

Depth to Bottom (ft.): 39.89
Static Water Level Before (ft.): 6.02
Static Water Level After (ft.): 30.48
Screen Length (ft.): 10
One Well Volume (gal/L): 5.5
Casing ID (in.): 2

Responsible Personnel: CD
Drilling Company: Miller
Project Name: MCAD PI
Project Number: NS620
PID Readings: Bore Hole 0.5 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate ~~(mL~~/min.) gal	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units ms/cm)	Turbidity (NTU)	Remarks (odor, color, etc.)
0755	—	~3 gpm	6.02	20.87	8.52	0.568	162	cloudy, pale yellow
0805	~30 gpm	"	30.88	21.44	7.07	1.64	5.84	clear
0815	60	"	30.62	21.51	6.92	1.73	2.57	clear
0825	90	"	30.40	21.56	6.85	1.88	3.42	clear
0835	120	"	30.48	21.71	6.84	1.92	2.20	clear
end	development							

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PAI-45-MW22-SU
Site: 45
Date Installed: 3-30-05
Date Developed: 4-2-05
Dev. Method: PURGE PUMP
Pump Type: WHALE

Depth to Bottom (ft.): 10.25 TPVC
Static Water Level Before (ft.): 3.50 TPVC
Static Water Level After (ft.): 7.45
Screen Length (ft.): 5'
One Well Volume (gal/L): 1.1
Casing ID (in.): 2"

Responsible Personnel: SJC
Drilling Company: MILLER DRILLING
Project Name: MCRD PI
Project Number: N5260
PID Readings: Bore Hole 0 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (~~mL/min~~.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm)	Turbidity (NTU) (Lamotte)	Remarks (odor, color, etc.)
1345	~2	1 GPM	NA	—	—	—	—	PUMPED DRY ≈ 2 MIN 1
1400	3	"	6.70	17.32	6.07	.663	78	" " ≈ 1 MIN 2
1415	4	"	6.65	17.13	6.23	.592	71	" " ≈ 1 MIN 3
1430	5	"	7.45	16.97	6.38	.626	40	" " ≈ 1 " 4
	DONE DEV.							
								NOTE: PVC WILL BE CUT OFF
								LATER TO SET FLUSH MT.
								2.1' S.U. NOW
								LT Gray, Turbid 1
								" " " 2
								SL. Turbid 3
								" " 4

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PAI-45-MW22-SL
Site: 45
Date Installed: 3-30-05
Date Developed: 4-2-05
Dev. Method: PURGE PUMP
Pump Type: WHALE

Depth to Bottom (ft.): 15.30 TPVC
Static Water Level Before (ft.): 1.20
Static Water Level After (ft.): 10.73
Screen Length (ft.): 5
One Well Volume (gal/L): 2.3
Casing ID (in.): 2"

Responsible Personnel: SJC
Drilling Company: MILLER
Project Name: MCRD PI
Project Number: N5260
PID Readings: Bore Hole 0 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (mL/min.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units ms/cm)	Turbidity (NTU)	Remarks (odor, color, etc.)
1440	—	~1GPM	1.20	17.70	6.16	.453	—	Gray Turbid
1450	10	"	10.70	17.18	6.03	.394	54	Clear - sl. Turbid.
1455	15	"	10.73	17.43	6.00	.394	34	" "
1500	20	"	10.75	16.98	5.97	.397	18	" "
1505	25	"	10.73	17.15	6.00	.391	11	" Non Turbid
1510	30	"	10.74	17.25	6.03	.388	9	" "
	DONE DEV.							

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PA1-45-MW23-SU
Site: 45
Date Installed: 4/2/05
Date Developed: 4/4/05
Dev. Method: purge pump
Pump Type: whale

Depth to Bottom (ft.): 12.14 TOR
Static Water Level Before (ft.): 4.59
Static Water Level After (ft.): 5.72
Screen Length (ft.): 5'
One Well Volume (gal/L): 1.2
Casing ID (in.): 2

Responsible Personnel: CD
Drilling Company: Miller
Project Name: MCRD P1
Project Number: N5260
PID Readings: Bore Hole 39.8 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (mL/min.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units ms/cm)	Turbidity (NTU)	Remarks (odor, color, etc.)
0755	~3	~1 gpm	4.59	17.51	5.92	0.704	—	dry in 3 min, light yellow, v cloudy
0805	5	"	5.59	18.08	6.03	0.803	—	" 2 min, v cloudy
0815	7	"	5.65	18.42	6.06	0.749	908	" 2 min, v cloudy
0825	8.5	"	5.92	18.11	6.04	0.717	1031	" 1.5 min, v cloudy
0835	9.5	"	5.61	17.95	6.07	0.720	876	" 1 min, v cloudy
0845	10.5	"	5.75	18.02	6.08	0.712	677	" 1 min, v cloudy
0855	11.5	"	5.72	18.19	6.18	0.687	542	" 1 min, v cloudy
	end development							

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PAI-45-MW23-SL
Site: 45
Date Installed: 4/2/05
Date Developed: 4/4/05
Dev. Method: purge pump
Pump Type: whale

Depth to Bottom (ft.): 15.23
Static Water Level Before (ft.): 2.40
Static Water Level After (ft.): 10.76
Screen Length (ft.): 5'
One Well Volume (gal/L): 2.1
Casing ID (in.): 2

Responsible Personnel: CD
Drilling Company: Miller
Project Name: MCRD PI
Project Number: N5260
PID Readings: Bore Hole 27.8 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate (mL/min.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm)	Turbidity (NTU)	Remarks (odor, color, etc.)
0930	~3 gal.	~1 gpm	2.40	18.45	6.67	1.12	—	dry in 3 min, brown, v. cloudy
0950	4.5	"	8.79	20.45	6.90	1.16	—	" 1.5 min, opaque
1010	6.0	"	9.95	20.66	6.97	1.15	—	" 1.5 min, opaque
1030	7.5	"	10.22	21.39	7.01	1.15	—	" 2.5 min, opaque
1050	9.5	"	10.89	21.39	7.03	1.12	—	" 2 min, v. cloudy
1110	11.0	"	10.52	20.73	7.03	1.17	—	" 1.5 min, v. cloudy
1130	12.5	"	10.76	21.36	7.06	1.16	—	" 1.5 min, v. cloudy
	end development							

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: PAI-45-MW24-SU
Site: 45
Date Installed: 4/13/05
Date Developed: 4/17/05
Dev. Method: PURGE
Pump Type: WHALE

Depth to Bottom (ft.): 7.95 TPVC
Static Water Level Before (ft.): 2.61 TPVC
Static Water Level After (ft.): 5.71
Screen Length (ft.): 5'
One Well Volume (gal/L): ≈ 1
Casing ID (in.): 2"

Responsible Personnel: CONTI
Drilling Company: MILLER
Project Name: MCRD PI
Project Number: N5260
PID Readings: Bore Hole 17.9 ppm
PID Readings: Breathing Zone 0 ppm

Time	Cumulative Water Volume (Gal.)	Flow Rate ~~(mL~~/min.) GAL	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units ms/cm)	Turbidity (NTU)	Remarks (odor, color, etc.)
1250		~1	2.61	—	—	—	—	Gray Brn - Turbid
1253	3		7'±					Dry @ ≈ 3 mins
1310		~1	5.51	18.88	5.6	.449	—	Gray Brn Turbid Strong Chem. odor
1311	4		7'±					Dry @ ≈ 1 min Slow Rec.
1330		~.5	5.65	19.15	5.5	.514	—	Gray Brn - Turbid - Chem odor
1331	4.5		7'±					Dry @ 1 min.
1400		~.5	5.60	18.99	5.6	.636	—	Gray Brn - Turbid - Chem Odor
1401	5.0		7'±					Dry @ 1 min
1430		~.5	5.50	18.83	5.6	.720	—	Same as Above
1431	5.5		7±					
1500			5.91	19.20	5.6	.774	1000/920	Brn - Turbid
1501	6.0		7±					Dry @ 1 min
1530			5.95	19.10	5.6	.788	999/920	same as Above
1531	6.5		7±					
			Done Dev			SJC.		

APPENDIX J

TEMPORARY MONITORING WELL DEVELOPMENT, PURGE, AND SAMPLE LOG SHEETS

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-TW-107-SL-12
Sample Location: TW-107-SL
Sampled By: CD
C.O.C. No.: 031205-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Date: 3/12/05	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	NA
Time: 0945								
Method: PERISTALTIC	clear	6.00	1.10	18.61	46.9	0.61	0	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 3/12/05								
Method: PERISTALTIC				Salinity=	0			
Monitor Reading (ppm): 2.8	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 1" PVC								
Total Well Depth (TD): 12.76'								
Static Water Level (WL): 4.07'								
One Casing Volume (gal/L): 1.2L								
Start Purge (hrs): 0905								
End Purge (hrs): 0935								
Total Purge Time (min): 30								
Total Vol. Purged (gal/L): 7.50L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): [illegible]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: TW-107-SL
DATE: 3/12/05

Time (Hrs.)	Water Level (Ft. below TOC)		Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP mV	SAC %	Comments ~~START PURGE~~
0835	4.07	Volume(L)									start initial well development
0845	6.38	3.500	350	5.89	1.11	52.4	0.88	18.57	79	0	clear
0855	6.48	7.000	350	5.96	1.11	17.7	0.78	18.71	46	0	clear
0905	6.53	10.500	350	6.00	1.10	7.55	0.61	18.69	29	0	clear, end development
											start purge
0915	5.57	2.500	250	6.07	1.10	23.1	0.61	18.62	16	0	clear
0925	5.41	5.000	250	6.04	1.10	62.7	0.62	18.67	7	0	clear
0935	5.38	7.500	250	6.00	1.10	46.9	0.61	18.61	0	0	clear, end purge
0945											start sample

SIGNATURE(S): Peter Isolar

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-TW-108-SU-08
Sample Location: TW-108-SU
Sampled By: CD
C.O.C. No.: 031105-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

Date: 3/10/05	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Time: 1410	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	NA
Method: PERISTALTIC	CLEAR	5.80	.472	19.55	104	7.09	102	—

PURGE DATA:

Date: —	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: PERISTALTIC				Salinity=	0			
Monitor Reading (ppm): —		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material								
Type: 1" PVC								
Total Well Depth (TD): 9.45'								
Static Water Level (WL): 3.39'								
One Casing Volume (gal/L): 1.2L								
Start Purge (hrs): 1330								
End Purge (hrs): 1340								
Total Purge Time (min): 10								
Total Vol. Purged (gal/L): 1.2L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	✓

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): SJ Lonks

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: TW-108-SU
DATE: 3/10/05

Time (Hrs)	Water Level (Ft. below TOC)		Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP (mV)	SAC %	Comments ~~START PURGE~~
1330	3.39	Volume(L)	—								Start initial well development
1340											Went dry @ 1340
1410	6.5	—	NA	5.80	.472	104	7.09	19.55	102	0	Sample upon recovery

SIGNATURE(S): Chris Dooley

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-TW-108-SL-15
Sample Location: TW-108-SL
Sampled By: CD
C.O.C. No.: 031105-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 3/10/05								
Time: 1250								
Method: PERISTALTIC	light brown	6.15	0.506	18.85	494	0.75	-9	

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 3/10/05								
Method: PERISTALTIC				Salinity	= 0			
Monitor Reading (ppm): —		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material Type: 1" PVC								
Total Well Depth (TD): 14.89'								
Static Water Level (WL): 2.78'								
One Casing Volume (gal/L): 1.2L								
Start Purge (hrs): 1155								
End Purge (hrs): 1245								
Total Purge Time (min): 50								
Total Vol. Purged (gal/L): 9.50L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): [signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: TW-108-SL
DATE: 3/10/05

Time (Hrs.)	Water Level (Ft. below TOC)	Volume(L)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP mV	SAC %	Comments ~~START PURGE~~
1110	2.78	—	—	—	—	—	—	—	—	—	start initial well development
1115	3.83	5.500	550	6.09	0.531	—	1.78	18.57	24	0	very turbid, light brown
1125	3.83	9.900	450	6.02	0.512	159	0.69	18.38	15	0	slightly cloudy
1135	3.70	13.900	400	6.00	0.506	57.1	0.65	18.43	10	0	slightly cloudy
1145	3.60	17.400	350	6.04	0.506	32.0	0.57	18.52	5	0	slightly cloudy
											end development
1155	3.15	1.500	150	6.09	0.510	322	0.63	18.52	0	0	turbid, start purge
1205	3.15	3.000	150	6.09	0.509	462	0.86	18.40	-3	0	turbid
1215	3.15	4.500	150	6.12	0.508	529	0.79	18.65	-6	0	turbid
1225	3.15	6.000	150	6.12	0.508	422	0.84	18.77	-7	0	turbid
1235	3.15	7.500	150	6.13	0.506	387	0.75	18.68	-8	0	turbid
1245	3.15	9.500	150	6.15	0.506	494	0.75	18.85	-9	0	turbid, end purge
1250	—	—	—	—	—	—	—	—	—	—	Start sample

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-TW-109-SU-08
Sample Location: TW-109-SU
Sampled By: CD
C.O.C. No.: 031105-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Date: 3/10/05	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	NA
Time: 1710								
Method: PERISTALTIC	cloudy	6.67	1.22	14.83	55	3.77	11	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 3/10/05								
Method: PERISTALTIC				Salinity =	0.1			
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 1" PVC								
Total Well Depth (TD): 9.30'								
Static Water Level (WL): 4.13'								
One Casing Volume (gal/L): 1.2L								
Start Purge (hrs): 1640								
End Purge (hrs): 1645								
Total Purge Time (min): 5								
Total Vol. Purged (gal/L): 1.2L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): [signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: TW-109-SU
DATE: 3/10/05

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP mV	SAC %	Comments ~~START PURGE~~
1640	4.13 Volume (L)	—								Start initial well development
1645	—									went dry @ 1645
1710	—	1.2	400	6.67	1.22	55	3.77	14.83	11	0.1 Sample upon recovery @ 1710

SIGNATURE(S): Chris Jackson

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-TW-109-SL-16
Sample Location: TW-109-SL
Sampled By: CD
C.O.C. No.: 031105-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 3/10/05								
Time: 1635								
Method: PERISTALTIC	sltly cloudy	6.21	0.471	18.49	66.4	0.77	0	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 3/10/05								
Method: PERISTALTIC				Salinity=	0			
Monitor Reading (ppm): —		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material								
Type: 1" PVC								
Total Well Depth (TD): 17.29'								
Static Water Level (WL): 4.38'								
One Casing Volume (gal/L): 0.7L								
Start Purge (hrs): 1530								
End Purge (hrs): 1630								
Total Purge Time (min): 60								
Total Vol. Purged (gal/L): 10.75L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): [signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: TW-109-SL
DATE: 3/10/05

Time (Hrs.)	Water Level (Ft. below TOC)		Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP mV	SAC 0%	Comments ~~START PURGE~~
1450	4.38	Volume(L)	—	—	—	—	—	—	—	—	Start initial well development
1500	10.58	4.000	400	6.28	0.569	—	10.67	19.89	57	0	very turbid, grey brown
1510	10.68	5.500	150	6.09	0.527	920	1.05	19.22	28	0	turbid
1520	10.57	7.000	150	6.12	0.518	431	0.83	19.02	15	0	cloudy, end development
1530	10.66	1.500	150	6.13	0.503	328	0.62	19.23	10	0	cloudy, start purge
1540	10.65	3.000	150	6.17	0.497	213	0.74	19.23	7	0	cloudy
1550	10.85	4.500	150	6.15	0.489	108.7	0.68	18.91	5	0	cloudy
1600	10.98	6.250	175	6.14	0.484	65.0	0.53	19.05	5	0	slightly cloudy
1610	9.71	7.750	150	6.18	0.488	83.6	0.77	18.58	3	0	cloudy
1620	9.30	9.250	150	6.17	0.479	57.9	0.90	18.39	2	0	slightly cloudy
1630	9.23	10.750	150	6.21	0.471	66.4	0.77	18.49	0	0	slightly cloudy, end purge
1635	—	—	—	—	—	—	—	—	—	—	start sample

SIGNATURE(S): Chris Dolan

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-TW-118-SL-11
Sample Location: TW-118-SL
Sampled By: CD
C.O.C. No.: 031205-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 3/11/05								
Time: 1655								
Method: PERISTALTIC	sltly. cloudy	5.73	0.714	17.43	229	0.55	3	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 3/11/05								
Method: PERISTALTIC				Salinity=	0			
Monitor Reading (ppm): 103.8	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 1" PVC								
Total Well Depth (TD): 11.92'								
Static Water Level (WL): 3.55'								
One Casing Volume (gal/L): 1.2L								
Start Purge (hrs): 1620								
End Purge (hrs): 1650								
Total Purge Time (min): 30								
Total Vol. Purged (gal/L): 6.00L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
—	—	Colin Jordan

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: TW-118-SL
DATE: 3/11/05

Time (Hrs.)	Water Level (Ft. below TOC)		Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP mV	SAC %	Comments ~~START PURGE~~
1550	3.55	Volume	—	—	—	—	—	—	—	—	start initial well development
1600	4.64	4.000L	400	5.68	0.717	—	1.07	17.86	27	0	very cloudy, grey green
1610	4.64	8.000	400	5.72	0.717	573	0.52	17.88	15	0	cloudy
1620	4.65	12.000	400	5.72	0.717	303	0.46	17.87	12	0	slightly cloudy
											end development
											start purge
1630	4.15	2.000	200	5.74	0.715	488	0.53	17.52	6	0	cloudy
1640	4.15	4.000	200	5.73	0.715	335	0.54	17.44	5	0	slightly cloudy
1650	4.13	6.000	200	5.73	0.714	229	0.55	17.43	3	0	slightly cloudy
											end purge
1655	—	—	—	—	—	—	—	—	—	—	Start sample

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-TW-119-SL-15
Sample Location: TW-119-SL
Sampled By: CD
C.O.C. No.: 031205-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 3/12/05								
Time: 1450								
Method: PERISTALTIC	Clear	6.09	0.572	19.31	6.84	0.69	13	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 3/12/05								
Method: PERISTALTIC				Salinity =	0			
Monitor Reading (ppm): 1.5	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 1" PVC								
Total Well Depth (TD): 16.13'								
Static Water Level (WL): 3.93'								
One Casing Volume (gal/L): 1.2L								
Start Purge (hrs): 1415								
End Purge (hrs): 1445								
Total Purge Time (min): 30								
Total Vol. Purged (gal/L): 6.00 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	

Signature(s): Chris Dooley

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: TW-119-SL
DATE: 3/12/05

Time (Hrs.)	Water Level (Ft. below TOC)		Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP mV	SAC %	Comments ~~START PURGE~~
1345	3.93	Volume(L)									Start initial well development
1355	4.57	4.000	400	6.04	0.592	163	0.91	18.96	28	0	slightly cloudy
1405	4.59	8.000	400	5.99	0.576	25.4	0.56	19.06	24	0	clear
1415	4.59	12.000	400	6.03	0.572	11.1	0.57	19.00	19	0	clear
											end development
											start purge
1425	4.30	2.000	200	6.07	0.574	11.7	0.75	19.41	15	0	clear
1435	4.29	4.000	200	6.08	0.574	9.05	0.72	19.49	13	0	clear
1445	4.29	6.000	200	6.09	0.572	6.84	0.69	19.31	13	0	clear, end purge
1450											start sample

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-TW-125-SL-16
Sample Location: TW-125-SL
Sampled By: CD
C.O.C. No.: 031105-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 3/11/05								
Time: 0935								
Method: PERISTALTIC	sltly.cloudy	5.88	0.611	20.20	209	0.68	30	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 3/11/05								
Method: PERISTALTIC				Salinity =	0			
Monitor Reading (ppm): 3.2		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material Type: 1" PVC								
Total Well Depth (TD): 16.89'								
Static Water Level (WL): 3.99'								
One Casing Volume (gal/L): 1.2 L								
Start Purge (hrs): 0850								
End Purge (hrs): 0930								
Total Purge Time (min): 40								
Total Vol. Purged (gal/L): 10.00 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD —

Duplicate ID No.:

Signature(s): Colin Sadler

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: TW-125-SL
DATE: 3/11/05

Time (Hrs)	Water Level (Ft. below TOC)		Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP (mV)	SAC %	Comments ~~START PURGE~~
0810	3.99	Volume(L)									Start initial well development
0820	4.85	4.500	450	5.91	0.648	—	1.00	19.77	93	0	very turbid, brown grey
0830	4.85	9.000	450	5.88	0.639	526	1.00	19.78	66	0	turbid
0840	4.86	13.500	450	5.87	0.631	307	0.83	19.77	58	0	cloudy; end development
											start purge
0850	4.34	2.000	200	5.90	0.621	465	0.67	19.58	47	0	cloudy
0900	4.33	4.000	200	5.91	0.622	386	0.87	19.78	40	0	cloudy
0910	4.34	6.000	200	5.87	0.615	353	0.73	20.06	36	0	cloudy
0920	4.34	8.000	200	5.89	0.612	259	0.66	20.14	32	0	cloudy
0930	4.33	10.000	200	5.88	0.611	209	0.68	20.20	30	0	slightly cloudy
											end purge
0935	—	—	—	—	—	—	—	—	—	—	start sample

SIGNATURE(S): Alin Jackson

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-TW-134-SU-08
Sample Location: TW-134-SU
Sampled By: CD
C.O.C. No.: 031105-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 3/11/05								
Time: 1215								
Method: PERISTALTIC	brown	6.11	0.873	17.32	—	6.12	53	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 3/11/05								
Method: PERISTALTIC				Salinity =	0			
Monitor Reading (ppm): 3.9	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 1" PVC								
Total Well Depth (TD): 8.85'								
Static Water Level (WL): 3.13'								
One Casing Volume (gal/L): 1.2L								
Start Purge (hrs): 1135								
End Purge (hrs): 1145								
Total Purge Time (min): 10								
Total Vol. Purged (gal/L): 1.2L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle If Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): Chris Daka

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: TW-134-SU
DATE: 3/11/05

Time (Hrs)	Water Level (Ft. below TOC)		Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP (mV)	SAC %	Comments ~~START PURGE~~
1135	3.13	Volume(L)	—	—	—	—	—	—	—	—	start initial well development
1145	—	1.2	400	—	—	—	—	—	—	—	went dry @ 1145
1215	—	—	—	6.11	0.873	—	6.12	17.32	53	0	sample upon recovery very turbid

SIGNATURE(S): Colin Jacobs

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-TW-134-SL-15
Sample Location: TW-134-SL
Sampled By: CD
C.O.C. No.: 031105-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 3/11/05								
Time: 1115								
Method: PERISTALTIC	sltly. cloudy	6.43	2.93	18.22	101.6	0.77	-37	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 3/11/05								
Method: PERISTALTIC				Salinity=	0.1			
Monitor Reading (ppm): 4.2		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material Type: 1" PVC								
Total Well Depth (TD): 15.86'								
Static Water Level (WL): 3.26								
One Casing Volume (gal/L): 1.2L								
Start Purge (hrs): 1030								
End Purge (hrs): 1110								
Total Purge Time (min): 40								
Total Vol. Purged (gal/L): 8.00 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD yes

Duplicate ID No.: FD031105-01

Signature(s): [illegible]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: TW-134-SL
DATE: 3/11/05

Time (Hrs)	Water Level (Ft. below TOC)	Volume (L)	Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP (mV)	SAC %	Comments ~~START PURGE~~
1000	3.26		—	—	—	—	—	—	—	—	start initial well development
1010	5.05	4.000	400	6.23	3.02	—	1.91	18.14	13	0.2	very turbid, grey
1020	5.05	8.000	400	6.29	3.05	378	1.02	18.03	10	0.2	slightly cloudy
1030	5.04	12.000	400	6.31	3.01	190	0.88	18.03	-19	0.1	slightly cloudy
											end development
											start purge
1040	4.08	2.000	200	6.36	3.16	312	0.80	17.97	-26	0.2	slightly cloudy
1050	4.09	4.000	200	6.39	3.02	233	0.84	18.01	-31	0.1	slightly cloudy
1100	4.10	6.000	200	6.43	2.96	164	0.69	18.07	-34	0.1	slightly cloudy
1110	4.10	8.000	200	6.43	2.93	101.6	0.77	18.22	-37	0.1	slightly cloudy
											end purge
1115	—	—	—	—	—	—	—	—	—	—	start sample

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-TW-138-SU-11
Sample Location: TW-138-SU
Sampled By: CD
C.O.C. No.: 031105-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 3/11/05								
Time: 1525								
Method: PERISTALTIC	cloudy brn	5.51	0.569	18.24	643	0.61	21	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 3/11/05								
Method: PERISTALTIC				salinity = 0				
Monitor Reading (ppm): 23.5		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material Type: 1" PVC								
Total Well Depth (TD): 11.05'								
Static Water Level (WL): 4.74'								
One Casing Volume (gal/L): 1.2L								
Start Purge (hrs): 1440								
End Purge (hrs): 1520								
Total Purge Time (min): 40								
Total Vol. Purged (gal/L): 8.00L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD —

Duplicate ID No.:

Signature(s): Chi Dolan

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: TW-138-SU
DATE: 3/11/05

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP (mV)	SAC %	Comments ~~START PURGE~~
1400	4.74 Volume	—	—	—	—	—	—	—	—	initial well development
1410	5.69 3.00L	300	5.77	0.753	—	1.78	18.47	12	0	opaque, dark brown
1420	5.72 6.000L	300	5.62	0.614	—	0.65	18.59	9	0	opaque
1430	5.71 9.000	300	5.56	0.568	—	0.55	18.57	14	0	very cloudy
1440	5.71 12.000	300	5.55	0.562	—	0.55	18.54	17	0	very cloudy
										end development
1450	5.47 2.000	200	5.54	0.575	—	0.63	18.36	17	0	start purge, V. cloudy
1500	5.47 4.000	200	5.55	0.583	—	0.60	18.36	17	0	very cloudy
1510	5.48 6.000	200	5.53	0.584	985	0.61	18.27	19	0	very cloudy
1520	5.50 8.000	200	5.51	0.569	643	0.61	18.24	21	0	very cloudy, end purge
1525	— —	—	—	—	—	—	—	—	—	Start sample

SIGNATURE(S): Clio Dodson

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-TW-138-SL-16
Sample Location: TW-138-SL
Sampled By: CD
C.O.C. No.: 031105-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 3/11/05								
Time: 1345								
Method: PERISTALTIC	s/tly. cloudy	5.88	1.34	19.01	261	0.63	3	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 3/11/05								
Method: PERISTALTIC				Salinity =	0.1			
Monitor Reading (ppm): 12.5	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 1" PVC								
Total Well Depth (TD): 16.08'								
Static Water Level (WL): 4.73'								
One Casing Volume (gal/L): 1.2L								
Start Purge (hrs): 1310								
End Purge (hrs): 1340								
Total Purge Time (min): 30								
Total Vol. Purged (gal/L): 6.00L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
—	—	Chr. Jacobs

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: TW-138-SL
DATE: 3/11/05

Time (Hrs)	Water Level (Ft. below TOC)		Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP (mV)	SAC %	Comments ~~START PURGE~~
1240	4.73	Volume(L)	—	—	—	—	—	—	—	—	Start initial well development
1250	6.06	4.000	400	5.87	1.38	—	1.65	19.49	33	0.1	very turbid, grey brown
1300	6.06	8.000	400	5.78	1.35	570	0.72	19.21	20	0.1	very cloudy
1310	6.06	12.000	400	5.80	1.33	298	0.53	19.23	17	0.1	cloudy, end development
											start purge
1320	5.41	2.000	200	5.83	1.33	285	0.63	19.06	10	0.1	cloudy
1330	5.39	4.000	200	5.87	1.32	260	0.63	19.09	6	0.1	slightly cloudy
1340	5.38	6.000	200	5.88	1.34	261	0.63	19.01	3	0.1	slightly cloudy
											end purge
1345	—	—	—	—	—	—	—	—	—	—	start sample

SIGNATURE(S): Colin Goodlar

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-TW-146-SL-10
Sample Location: TW-146-SL
Sampled By: CD
C.O.C. No.: 031205-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 3/12/05								
Time: 1105								
Method: PERISTALTIC	sltly. cloudy	5.86	0.787	18.53	153	0.64	22	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 3/12/05								
Method: PERISTALTIC				salinity=	0			
Monitor Reading (ppm): 22.0	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 1" PVC								
Total Well Depth (TD): 11.05'								
Static Water Level (WL): 4.12'								
One Casing Volume (gal/L): 1.2L								
Start Purge (hrs): 1030								
End Purge (hrs): 1100								
Total Purge Time (min): 30								
Total Vol. Purged (gal/L): 7.50 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s): [illegible]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: TW-146-SL
DATE: 3/12/05

Time (Hrs)	Water Level (Ft. below TOC)		Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP (mV)	SAC %	Comments ~~START PURGE~~
1000	4.12	Volume(L)									start initial well development
1010	6.17	3.750	375	~~6.40~~	~~0.00~~	~~216~~	~~8.94~~	~~22.55~~	12	~~0~~	slightly cloudy
1020	6.27	7.500	375	~~6.95~~	~~0.00~~		~~9.75~~	~~21.52~~	~~36~~	~~0~~	protective cover on probe
				5.78	0.785	49.6	2.42	18.24	54	0	clear
1030	6.27	11.250	375	5.68	0.781	28.9	0.79	18.28	46	0	clear
											end development
											start purge
1040	5.47	2.500	250	5.78	0.788	209	0.62	18.37	34	0	slightly cloudy
1050	5.47	5.000	250	5.83	0.782	142	0.62	18.45	27	0	slightly cloudy
1100	5.47	7.500	250	5.86	0.787	153	0.64	18.53	22	0	slightly cloudy, end purge
1105											start sample

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-TW-148-SL-12
Sample Location: TW-148-SL
Sampled By: CD
C.O.C. No.: 031205-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 3/12/05								
Time: 1325								
Method: PERISTALTIC	clear	6.31	3.51	18.92	5.93	0.66	3	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 3/12/05								
Method: PERISTALTIC				salinity=	0.2			
Monitor Reading (ppm): 2.8	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 1" PVC								
Total Well Depth (TD): 12.81'								
Static Water Level (WL): 4.98'								
One Casing Volume (gal/L): 1.2L								
Start Purge (hrs): 1240								
End Purge (hrs): 1320								
Total Purge Time (min): 40								
Total Vol. Purged (gal/L): 8.00L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
—	—	[signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: TW-148-SL
DATE: 3/12/05

Time (Hrs.)	Water Level (Ft. below TOC)		Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP (mV)	SAC %	Comments ~~START PURGE~~
1210	4.98	Volume(L)									start initial well development
1220	8.08	4.000	400	6.24	3.96	—	3.57	18.48	40	0.2	very cloudy, brown
1230	8.11	7.000	300	6.20	3.95	44.7	3.88	18.54	30	0.2	clear
1240	10.92	10.000	300	6.23	3.94	22.0	2.71	18.52	22	0.2	clear
											end development
											start purge
1250	7.58	2.000	200	6.33	4.01	15.7	1.62	18.92	16	0.2	clear
1300	7.49	4.000	200	6.75	3.63	8.42	0.79	18.88	10	0.2	clear
1310	7.51	6.000	200	6.33	3.55	6.57	0.67	18.90	6	0.2	clear
1320	7.53	8.000	200	6.31	3.51	5.93	0.66	18.92	3	0.2	clear, end purge
											start sample
1325											

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-TW-158-SL-11
Sample Location: TW-158-SL
Sampled By: CO
C.O.C. No.: 031105-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 3/10/05								
Time: 1035								
Method: PERISTALTIC	grey brown	5.96	1.12	17.79	744	0.61	-18	

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 3/10/05								
Method: PERISTALTIC				Salinity	= 0.1			
Monitor Reading (ppm): —		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material								
Type: 1" PVC								
Total Well Depth (TD): 12.41'								
Static Water Level (WL): 4.05'								
One Casing Volume (gal/L): 1.2L								
Start Purge (hrs): 0940								
End Purge (hrs): 1030								
Total Purge Time (min): 50								
Total Vol. Purged (gal/L): 9.00L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): [illegible]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: TW-158-SL
DATE: 3/10/05

Time (Hrs.)	Water Level (Ft. below TOC)		Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP (mV)	SAC %	Comments START PURGE
0850	4.05 ~~4.09~~	volume	—	—	—	—	—	—	—	—	Start initial well development
0900	—	2.000L	400	—	—	—	—	—	—	—	
0910	4.86	6.000	400	5.62	1.15	—	0.76	18.05	21	.1	very turbid, grey brown
0920	5.83	9.000	300	5.64	1.14	—	0.49	18.03	10	0.1	very turbid
0930	5.82	12.000	300	5.71	1.14	—	0.48	18.02	4	0.1	very turbid
											end development
0940	4.43	13.500	150	5.78	1.13	—	0.62	17.74	-4	0.1	start purge, turbid
0950	4.41	15.000	150	5.85	1.13	—	0.50	17.71	-9	0.1	very turbid
1000	4.40	16.500	150	5.88	1.13	—	0.50	17.54	-13	0.1	very turbid
1010	4.40	18.000	150	5.91	1.12	1032	0.55	17.52	-15	0.1	very turbid
1020	4.40	19.500	150	5.93	1.12	983	0.52	17.44	-17	0.1	turbid
1030	4.40	21.000	150	5.96	1.12	744	0.61	17.79	-18	0.1	turbid, end purge
1035	—	—	—	—	—	—	—	—	—	—	start sample

SIGNATURE(S): [illegible]

APPENDIX K

PERMANENT MONITORING WELL PURGE AND SAMPLE LOG SHEETS

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW-AMW-2-02
Sample Location: PAI-45MW-AMW-2
Sampled By: D. WESTRHOFF
C.O.C. No.: 022505-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

Date: 2/25/05	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Time: 1300								
Method: PERISTALTIC	CLEAR	5.43	0.447	16.66	17	0.64	45	0.0

PURGE DATA:

Date: 2/25/05	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: PERISTALTIC								
Monitor Reading (ppm): 9.1		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material								
Type: 2" STAINLESS								
Total Well Depth (TD): ~~10.05~~	19.50							
Static Water Level (WL): 1.70								
One Casing Volume (gal/L): 2.9								
Start Purge (hrs): 1050								
End Purge (hrs): 1250								
Total Purge Time (min): 120								
Total Vol. Purged (gal/L): 4								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	✓

OBSERVATIONS / NOTES:

TUBE @ 2' OFF BOTTOM OF WELL

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
		[signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW-AMW-2
DATE: 2/25/05

Time (Hrs)	Water Level (Ft below TOC)	Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP mV	SAC %	Comments START PURGE
1050	1.70	180								CLEAR, NO ODOR
1100	1.86	125	5.38	0.477	46	1.19	17.43	55	0.0	
1105	1.85		5.35	0.474	39	0.85	17.04	57	0.0	
1115	1.85		5.33	0.468	39	0.70	16.73	56	0.0	
1125	1.85		5.31	0.465	35	0.67	16.38	56	0.0	
1135	1.85		5.32	0.463	29	0.60	16.87	55	0.0	
1145	1.86		5.33	0.461	27	0.57	17.44	52	0.0	
1155	1.87		5.32	0.460	26	0.59	17.23	52	0.0	
1205	1.87		5.35	0.458	25	0.57	17.60	50	0.0	
1215	1.87		5.37	0.455	20	0.55	17.80	48	0.0	
1225	1.86		5.36	0.453	21	0.61	16.93	49	0.0	
1240	1.85		5.43	0.450	18	0.64	16.75	45	0.0	
1250	1.83		5.43	0.447	17	0.64	16.66	45	0.0	END PURGE - SAMPLE @ 1300

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GWAMW5-02
Sample Location: AMW5
Sampled By: R. SIMPSON
C.O.C. No.: 021505-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA SAL %
Date: 2-15-05								
Time: 1425								
Method: PERISTALTIC	CLEAR	6.27	0.754	17.4	21	1.8	-82	0

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 2-15-05								
Method: PERISTALTIC								
Monitor Reading (ppm): 234		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material								
Type: 2" STAINLESS STEEL								
Total Well Depth (TD): 17.90								
Static Water Level (WL): 2.46								
One Casing Volume (gal/l): 2.5								
Start Purge (hrs): 1255								
End Purge (hrs): 1425								
Total Purge Time (min): 90								
Total Vol. Purged (gal/l): 2.6								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	✓

OBSERVATIONS / NOTES:

TUBING SET 2' OFF BTM

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): [illegible]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: MW-AMW5
DATE: 2.15.05

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP (mV)	SAC %	Comments START PURGE
1255	2.46	110	—	—	—	—	—	—	—	RUST COLOR FLOCK
1305	2.54	↓	6.45	0.735	150	8.8	17.2	-74	0	IN PURGE WATER
1315	2.53	↓	6.31	0.729	110	2.7	17.0	-77	↓	NO ODOR
1325	↓	↓	6.31	0.730	85	2.4	17.1	-78	↓	
1335	↓	↓	6.30	~~0.74~~ 0.735	70	1.8	17.1	-81	↓	0.735 S. COND.
1345	↓	↓	6.29	0.768	60	2.0	17.2	-84	↓	
1355	↓	↓	6.28	0.738	50	1.8	17.2	-84	↓	CLEARING
1405	↓	↓	6.29	0.780	42	1.9	17.2	-85	↓	
1410	↓	↓	6.29	0.751	40	1.4	17.2	-84	↓	
1415	↓	↓	6.29	0.752	30	1.3	17.2	-83	↓	
1425	↓	↓	6.27	0.754	21	1.8	17.4	-82	↓	

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW01-D-02
Sample Location: PAI-45-MW01-D
Sampled By: CD
C.O.C. No.: 041805-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 4/16/05								
Time: 1220								
Method: PERISTALTIC	clear	10.26	0.877	23.01	12.3	0.46	-185	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/16/05								
Method: PERISTALTIC				salinity =	0.0			
Monitor Reading (ppm): —		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 39.95'								
Static Water Level (WL): 3.68'								
One Casing Volume (~~gal~~ L): 22.3L								
Start Purge (hrs): 1110								
End Purge (hrs): 1215								
Total Purge Time (min): 65								
Total Vol. Purged (~~gal~~ L): 19.50L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	~~2~~ 40 mL vials	yes
		6	

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD —

Duplicate ID No.: FD 041605-01

Signature(s): Chris Jordan

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW01-D
DATE: 4/16/05

Time (Hrs)	Water Level (Ft. below TOC)		Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP (mV)	SAC %	Comments
											START PURGE
1110	3.68	Volume(L)									clear
1120	3.92	3.00	300	10.72	0.828	73.5	2.10	23.22	-79	0.0	slightly cloudy
1130	3.93	6.00	300	11.27	0.784	61.5	0.75	22.74	-159	0.0	slightly cloudy
1140	3.94	9.00	300	10.98	0.760	39.2	0.61	23.08	-192	0.0	slightly cloudy
1150	3.95	12.00	300	10.60	0.790	20.4	0.51	23.13	-193	0.0	clear
1200	3.96	15.00	300	10.43	0.836	17.3	0.49	23.01	-189	0.0	clear
1210	3.96	18.00	300	10.27	0.860	13.7	0.46	23.04	-185	0.0	clear
1215	3.96	19.50	300	10.26	0.877	12.3	0.46	23.01	-185	0.0	clear, end purge
1220											start sample

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SW/MW 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-~~MW~~GW02-SU-02
Sample Location: PAI-45-MW02-SU
Sampled By: CD
C.O.C. No.: 041505-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 4/13/05								
Time: 1005								
Method: PERISTALTIC	clear	6.28	0.589	18.86	8.23	1.30	66	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/13/05								
Method: PERISTALTIC								
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material				Salinity=	0.0			
Type: 2" PVC								
Total Well Depth (TD): 6.92'								
Static Water Level (WL): 0.78'								
One Casing Volume (~~gal~~): 3.7L								
Start Purge (hrs): 0840								
End Purge (hrs): 1000								
Total Purge Time (min): 80								
Total Vol. Purged (~~gal~~): 9.30L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): [signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW02-SU
DATE: 4/13/05

Time (Hrs)	Water Level (Ft. below TOC)		Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mv)	SAC %	Comments
0840	0.78	Volume	200								START PURGE
0850	3.29	2.00L	200	5.94	0.588	27.7	2.81	18.19	270	0.0	clear yellow
0900	3.61	4.00	100	6.03	0.578	32.3	1.64	18.19	220	0.0	clear
0910	3.75	5.00	100	6.08	0.578	22.0	1.52	18.35	180	0.0	clear
0920	4.05	6.00	100	6.15	0.584	13.2	1.43	18.45	144	0.0	clear
0930	4.34	7.00	80	6.19	0.583	12.2	1.25	18.50	112	0.0	clear
0940	4.55	7.80	75	6.22	0.581	8.98	1.32	18.83	92	0.0	clear
0950	4.71	8.55	75	6.21	0.588	7.91	1.40	18.70	80	0.0	clear
0955	4.80	8.92	75	6.25	0.589	7.65	1.30	18.71	72	0.0	clear
1000	4.88	9.30	75	6.28	0.589	8.23	1.30	18.86	66	0.0	clear, end purge
1005											start sample

SIGNATURE(S): Allen Graber

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-~~MW~~GW02-SL-02
Sample Location: PAI-45-MW02-SL
Sampled By: CD
C.O.C. No.: 041505-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 4/13/05								
Time: 1220								
Method: PERISTALTIC	Clear	6.76	0.423	19.24	2.15	0.57	-73	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/13/05								
Method: PERISTALTIC								
Monitor Reading (ppm): —		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material				Salinity =	0.0			
Type: 2" PVC								
Total Well Depth (TD): 14.82								
Static Water Level (WL): 1.27								
One Casing Volume (~~gal~~): 7.7L								
Start Purge (hrs): 1100								
End Purge (hrs): 1215								
Total Purge Time (min): 75								
Total Vol. Purged (~~gal~~): 15.00L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
—	—	[signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW02-SL
DATE: 4/13/05

Time (Hrs.)	Water Level (Ft. below TOC)		Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Deg. C)	ORP (mV)	SAC %	Comments
											START PURGE
1100	1.27	volume									clear, yellow
1110	2.52	2.00L	200	7.78	0.271	6.68	1.93	19.35	44	0.0	clear
1120	2.51	4.00	"	8.34	0.264	4.83	0.74	18.99	-10	0.0	clear
1130	2.51	6.00	"	7.04	0.263	3.52	0.58	19.01	-40	0.0	clear
1140	2.53	8.00	"	6.94	0.272	3.02	0.56	19.09	-59	0.0	clear
1150	2.55	10.00	"	6.93	0.302	2.94	0.55	19.08	-71	0.0	clear
1200	2.55	12.00	"	6.86	0.345	2.62	0.55	19.13	-75	0.0	clear
1205	2.55	13.00	"	6.88	0.380	2.59	0.57	19.07	-75	0.0	clear
1210	2.53	14.00	"	6.77	0.404	2.37	0.57	19.21	-74	0.0	clear
1215	2.53	15.00	"	6.76	0.423	2.15	0.57	19.24	-73	0.0	clear, end purge
1220											start sample

SIGNATURE(S): Chris Jacobs

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW0354-02
Sample Location: MW0354
Sampled By: R. SIMPSON
C.O.C. No.: 021505-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA SAL %
Date: 2.15.05								
Time: 1105								
Method: PERISTALTIC	CLEAR	6.92	0.813	15.6	4.5	2.0	16	0

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 2.15.05								
Method: PERISTALTIC								
Monitor Reading (ppm): 0.3		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material Type: 2" PVC - 4' SCREEN								
Total Well Depth (TD): 6.90								
Static Water Level (WL): 2.44								
One Casing Volume (gal/L): 0.7								
Start Purge (hrs): 0935								
End Purge (hrs): 1105								
Total Purge Time (min): 90								
Total Vol. Purged (gal/L): 2.4								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	✓

OBSERVATIONS / NOTES:

TUBING SET 1.5'± OFF BTM

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
—	—	[signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: MW 0354
DATE: 2.15.05

Time (Hrs)	Water Level (Ft. below TOC)	Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP mV	SAC %	Comments START PURGE
0935	2.44	100	—	—	—	—	—	—	—	CLOUDY - LT GRAY
0945	2.78	↓	7.06	1.04	340	6.5	16.0	-80	0	NO ODOR
0955	3.00	↓	7.13	0.970	120	4.8	15.8	-52	↓	
1005	3.15	↓	7.01	0.901	27	2.9	15.7	-32	↓	CLEARING
1015	3.28	↓	6.93	0.843	14	2.2	15.6	-11	↓	
1025	3.28	↓	6.91	0.850	6.5	2.1	15.6	-3	↓	
1035	↓	↓	6.92	0.820	5.9	2.4	15.6	8	↓	
1045	↓	↓	6.94	0.810	5.2	1.8	15.6	10	↓	
1055	↓	↓	6.92	0.810	4.9	2.2	15.6	18	↓	
1100	↓	↓	6.92	0.812	4.6	2.0	15.6	17	↓	
1105	↓	↓	6.92	0.813	4.5	2.0	15.6	16	↓	

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW-03SL-02
Sample Location: MW03SL
Sampled By: K. SIMPSON
C.O.C. No.: 021505-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA SAL %
Date: 2-15-05								
Time: 0915								
Method: PERISTALTIC	CLEAR	6.05	1.37	18.1	1.2	2.5	-62	0.1

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 2-15-05								
Method: PERISTALTIC								
Monitor Reading (ppm): 72.3		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material Type: 2" PVC - 5' SCREEN								
Total Well Depth (TD): 15.00								
Static Water Level (WL): 2.70								
One Casing Volume (gal/L): 2.0								
Start Purge (hrs): 0755								
End Purge (hrs): 0915								
Total Purge Time (min): 80								
Total Vol. Purged (gal/l): 2.6								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	✓

OBSERVATIONS / NOTES:

TUBING SET 1.5'± OFF BTM

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s):

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: MW 3 SL
DATE: 2.15.05

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP mV	SAC %	Comments
										START PURGE
0755	2.70	125								LT. YELLOW, NO ODOR
0805	2.95		6.10	1.47	6.3	4.8	16.9	-69	0.1	
0815			6.17	1.47	5.2	4.2	17.4	-76		
0825			6.11	1.44	4.0	3.5	18.1	-80		
0835			6.09	1.48	3.1	3.0	17.8	-78		
0845			6.05	1.46	2.2	3.1	17.9	-69		
0855			6.02	1.43	1.8	3.0	18.0	-61		
0905			6.04	1.37	1.5	2.6	18.1	-62		
0910			6.05	1.38	1.3	2.7	18.1	-63		
0915			6.05	1.37	1.2	2.5	18.1	-62		

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-MW04-SU
Sample Location: PAI-45-GW04-SU -02
Sampled By: D. WESTERHOFF
C.O.C. No.: 0224-05-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

Date: 2/23/05	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA SAL
Time: 1130								
Method: PERISTALTIC	CLEAR	5.08	0.303	17.6	33	19.9	235	0.0

PURGE DATA:

Date: 2/23/05	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: PERISTALTIC								
Monitor Reading (ppm): 0.9	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material								
Type: 2" PVC								
Total Well Depth (TD): 7.15								
Static Water Level (WL): 2.60								
One Casing Volume (gal/L): 0.75								
Start Purge (hrs): 0838								
End Purge (hrs): 1125								
Total Purge Time (min): 167								
Total Vol. Purged (gal/L): 7								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	✓

OBSERVATIONS / NOTES:

DO READINGS SUSPECT - UNABLE TO CORRECT THRU CLEANING + RECALIB. NEW UNIT ORDERED.

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): [illegible]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW04-SU
DATE: 2/23/05

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP (mV)	SAC %	Comments START PURGE
0838	2.60	150								SLIGHT BROWN COLOR
0843	3.04	150	5.13	0.373	110	7.1	16.6	223	0.0	NO ODOR
0848	3.01		5.22	0.350	120	19.9	16.4	224	0.0	
0855	2.92		5.24	0.342	130	18.2	16.6	225	0.0	SLIGHT METALLIC ODOR
0900	~~2.2~~ 2.93		5.21	0.328	140	18.7	16.5	229	0.0	(RUST?)
0905	2.93		5.25	0.328	140	19.4	16.7	227	0.0	
0915	2.97	300	5.25	0.321	160	19.9	16.8	22.8	0.0	↑ FL RT. TO CLEAR
0920	3.59	150	5.20	0.316	170	19.9	16.4	248	0.0	↓ FL RT TO 150 ml/min.
0930	3.00	150	5.22	0.299	190	19.9	17.0	235	0.0	
0940	3.00		5.17	0.304	190	19.2	17.1	233	0.0	
0950	3.02		5.15	0.304	170	19.9	17.2	232	0.0	
1000	3.01		5.14	0.303	130	19.9	17.4	232	0.0	
1010	3.03		5.13	0.303	100	19.9	17.4	232	0.0	
1030	3.07		5.10	0.303	75	19.9	17.5	234	0.0	
1040	3.09		5.11	0.302	55	19.9	17.5	235	0.0	
1050	3.11		5.10	0.301	50	19.1	17.5	234	0.0	
1100	3.12		5.07	0.301	45	19.7	17.4	235	0.0	
1110	3.13		5.04	0.299	40	16.8	17.5	235	0.0	
~~1115~~ 1120	3.13		5.05	~~0.000~~ 0.298	35	17.8	17.5	235	0.0	
1125	3.14		5.08	0.303	33	19.9 *	17.6	235	0.0	SAMPLE @ 1130

SIGNATURE(S): [illegible]

* D.O. READINGS SUSPECT - CLEANING + RECALIB. ATTEMPTS TO CORRECT WERE NOT SUCCESSFUL.

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-~~MW~~ GW04-SL-02
Sample Location: PAI-45-MW04-SL
Sampled By: D. WESTDRHOFF
C.O.C. No.: 0224-05-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other ~~NA~~ SAL (%)
Date: 2/23/05								
Time: 1320								
Method: PERISTALTIC	CLEAR	3.23	1.22	19.6	37	19.94*	93	0.1

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 2/23/05								
Method: PERISTALTIC								
Monitor Reading (ppm): 280		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 14.99								
Static Water Level (WL): 2.68								
One Casing Volume (gal/L): 2.0								
Start Purge (hrs): 1205								
End Purge (hrs): ~~70~~ 1315								
Total Purge Time (min): 70								
Total Vol. Purged (gal/L): 2.2								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	✓

OBSERVATIONS / NOTES:

DO METER NOT WORKING - PING SENDING NEW UNIT FOR USE ON 2/24
CLEANING / RE-CALIBRATION DID NOT FIX THE PROBLEM.

Circle If Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

WELL CAP FILLED W/ H_2O

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PA1-45-MW04-SL
DATE: 2/23/05

Time (Hrs)	Water Level (Ft. below TOC)	Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP (mV)	SAC %	Comments START PURGE
1205	2.68	140	—	—	—	—	—	—	—	CLEAR W/ FINE
1210	2.90		5.43	1.53	29	19.9	19.9	98	0.1	PARTICULATES (RUST)
1215	2.95		5.44	1.50	21	19.9	19.8	89	0.1	NO ODOR DESPITE
1230	2.95		5.45	1.33	14	17.7	20.0	135	0.1	ELEV. PID READINGS
1240	2.96		5.13	1.45	8.8	ERROR	19.9	141	0.1	CLEAN DO SENSOR @
1250	2.97		5.24	1.35	7.4	"	19.6	107	0.1	1220 - RECAL @
1300	2.96		5.24	1.28	6.3	"	19.7	96	0.1	1230 - DO SENSOR
1305			5.23	1.25	7.7	"	19.6	96	0.1	ERROR
1315			5.23	1.22	3.7	"	19.6	93	0.1	END OF PURGE - SAMPLE
										@ 1320

SIGNATURE(S) [signature]

DO READINGS SUSPECT.

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

PAI-45GW-D-02

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: ~~PAI-45-GW-AMW~~
Sample Location: PAI-45-MW04-D
Sampled By: D. WESTERHOFF
C.O.C. No.: 022405-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

Date: 2/23/05	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other ~~NA~~ SAL(%)
Time: 1535								
Method: PERISTALTIC	CLEAR	6.23	18.0	21.6	2.2	12.2	-92	1.1

PURGE DATA:

Date: 2/23/05	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: PERISTALTIC								
Monitor Reading (ppm): 0 ppm	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material								
Type: 2" PVC								
Total Well Depth (TD): 41.80								
Static Water Level (WL): 4.25								
One Casing Volume (gal/L): 6.1								
Start Purge (hrs): 1350								
End Purge (hrs): 1530								
Total Purge Time (min): 100								
Total Vol. Purged (gal/L): 6								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	✓

OBSERVATIONS / NOTES:

SAMPLE ID NO: PAI-45-GW-04D-02
D.O. SUSPECT.
TUBING @ 2' OFF BOT. OF WELL.

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW04D
DATE: 2/23/05

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP mV	SAC 0%	Comments START PURGE
1350	4.25	220								CLEAR, NO ODOR
1355	4.55	"	6.15	18.3	3.7	19.6	22.2	-70	1.1	
1400	4.76	250	6.20	17.6	3.3	14.8	22.1	-75	1.0	
1415	4.84		6.24	16.8	1.3	14.1	21.8	-81	1.0	
1420	4.85		6.23	16.9	0.50	13.5	21.8	-85	1.0	
1430	4.79	220	6.23	17.3	0.70	14.1	21.6	-84	1.0	
1440	4.75		6.23	17.6	0.60	12.6	21.7	-88	1.0	
1450	4.76		6.23	17.8	0.70	12.4	22.0	-89	1.1	
1500	4.77		6.23	17.8	1.2	12.6	22.0	-90	1.1	
1510	4.79		6.23	17.8	0.90	12.5	22.0	-90	1.1	
1520	4.78		6.23	17.8	0.65	11.6	21.9	-91	1.1	
1530	4.77		6.23	18.0	2.2	12.2	21.6	-92	1.1	END PURGE - SAMPLE @ 1535

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-~~M~~GWO5-SU-02
Sample Location: PAI-45-MWO5-SU
Sampled By: CD
C.O.C. No.: 041505-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

Date: 4/13/05	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Time: 1445	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	NA
Method: PERISTALTIC	clear	7.16	0.561	21.67	2.83	5.73	139	—

PURGE DATA:

Date: 4/13/05	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: PERISTALTIC				Salinity=	0.0			
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 6.88'								
Static Water Level (WL): 3.82'								
One Casing Volume (~~gal~~): 1.9L								
Start Purge (hrs): 1355								
End Purge (hrs): 1440								
Total Purge Time (min): 45								
Total Vol. Purged (~~gal~~): 5.25 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): [signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW~~45~~-05 (10)
DATE: 4/13/05

Time (Hrs)	Water Level (Ft. below TOC)		Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	SAC %	Comments
											START PURGE
1355	3.82	Volume (L)									clear
1405	4.28	1.50	150	6.74	0.551	7.50	7.55	21.13	123	0.0	clear
1415	4.52	2.75	125	6.88	0.546	3.83	5.85	21.12	129	0.0	clear
1425	4.61	3.75	100	7.02	0.549	4.93	5.66	21.46	132	0.0	clear
1435	4.65	4.75	"	7.13	0.558	2.59	5.68	21.67	137	0.0	clear
1440	4.66	5.25	"	7.16	0.561	2.83	5.73	21.67	139	0.0	clear, end purge
1445											start sample

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW05-SL-02
Sample Location: PAI-45MW05-SL
Sampled By: D WESTERHOFF
C.O.C. No.: 022505-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Date: 2/25/05	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	NA
Time: 1010								
Method: PERISTALTIC	CLEAR	5.71	1.61	17.51	4.94	0.66	-15	0.1

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 2/25/05								
Method: PERISTALTIC								
Monitor Reading (ppm): 0		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material								
Type: 2" PVC								
Total Well Depth (TD): 14.00								
Static Water Level (WL): 4.35								
One Casing Volume (gal/L): 1.6								
Start Purge (hrs): 0845								
End Purge (hrs): 1000								
Total Purge Time (min): 75								
Total Vol. Purged (gal/L): 2								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	—

OBSERVATIONS / NOTES:

TUBING @ 2" OF BOTTOM OF WELL

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): [illegible]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45MW05-SL
DATE: 2/25/05

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	SAC %	Comments
										START PURGE
0845	4.35	200	—	—	—	—	—	—	—	CLEAR, NO ODOR
0850	4.86	120	5.45	1.46	5.00	2.01	17.80	67	0.1	↓ FL. RT
0855	4.92		5.55	1.47	5.51	1.26	17.47	41	0.1	
0900	4.95		5.57	1.47	6.42	1.07	17.52	38	0.1	
0910	4.99		5.60	1.50	8.71	0.90	17.58	14	0.1	
0920	5.00		5.60	1.51	7.47	0.87	17.81	8	0.1	
0930	5.02		5.63	1.55	7.79	0.98	17.65	0	0.1	
0940	5.04		5.67	1.57	6.34	0.69	17.64	-6	0.1	
0950	5.05		5.74	1.59	6.36	0.79	17.56	-11	0.1	
1000	5.05		5.71	1.61	4.94	0.66	17.51	-15	0.1	END OF PURGE - SAMPLE @ 1010

SIGNATURE(S):

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW-06-54-02
Sample Location: MW 06 54
Sampled By: K. SIMPSON
C.O.C. No.: 021505-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA SAC %
Date: 2.14.05								
Time: 1010								
Method: PERISTALTIC	CLEAR	6.60	3.15	16.0	4.2	2.9	-79	0.2

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 2.14.05								
Method: PERISTALTIC								
Monitor Reading (ppm): 0.7		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material								
Type: 2" PVC - 5' SCREEN								
Total Well Depth (TD): 6.95								
Static Water Level (WL): 3.48								
One Casing Volume (gal/L): 0.6								
Start Purge (hrs): 0810								
End Purge (hrs): 1010								
Total Purge Time (min): 120								
Total Vol. Purged (gal/L): 3.7								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	✓

OBSERVATIONS / NOTES:

TUBING SET @ 1.5' ± OFF BTM

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): [illegible]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: MW6 SU
DATE: 2-14-05

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	SAC %	Comments
										START PURGE
0810	3.48	115	—	—	—	—	—	—	—	LT. RUST COLOR
0820	3.55	↓	6.18	0.641	330	7.0	16.5	-67	0	
0830	3.58	↓	6.22	0.622	150	4.0	16.3	-82	0	
0840	↓	↓	6.27	0.858	65	3.9	16.2	-88	0	
0850	↓	↓	6.38	1.35	31	4.5	16.2	-96	0.1	
0900	↓	↓	6.49	2.00	3.0	3.6	16.1	-97	↓	
0910	↓	↓	6.57	2.10	3.0	3.1	16.2	-98	↓	
0920	3.59	↓	6.55	2.41	2.4	3.5	16.4	-92	↓	
0930	↓	↓	6.57	2.50	2.0	2.9	16.4	-93	↓	
0940	↓	↓	6.58	2.87	4.3	3.2	16.2	-84	↓	
0950	3.60	↓	6.59	2.91	4.5	2.8	16.1	-84	↓	
1000	↓	↓	6.59	3.12	4.3	3.4	16.1	-79	0.2	
1005	↓	↓	6.60	3.13	4.3	2.9	16.0	-79	0.2	
1010	↓	↓	6.60	3.15	4.2	2.8	16.0	-79	0.2	

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW-06SL-02
Sample Location: MW06SL
Sampled By: K. SIMPSON
C.O.C. No.: 021505-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA SAC %
Date: 2.14.05								
Time: 1155								
Method: PERISTALTIC	CLEAR	5.88	0.693	18.8	3.5	2.4	-14	

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 2.14.05								
Method: PERISTALTIC								
Monitor Reading (ppm): 27.4		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material Type: 2" PVC - 5' SCREEN								
Total Well Depth (TD): 14.47								
Static Water Level (WL): 2.80								
One Casing Volume (gal/L): 1.9								
Start Purge (hrs): 1040								
End Purge (hrs): 1155								
Total Purge Time (min): 75								
Total Vol. Purged (gal/L): 2.4								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL (9)	8-40 mL vials	✓
		3X VOL. FOR MS/MSD	

OBSERVATIONS / NOTES:

PUMP INLET (TUBING) SET 2.8' OFF BTM

Circle if Applicable:

MS/MSD	Duplicate ID No.:
YES	—

Signature(s): [illegible]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: MW06 SL
DATE: 2-14-05

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP (mv)	SAC %	Comments START PURGE
1040	2.80	175	—	—	—	—	—	—	—	CLEAR NO ODOR
1050	2.98	175	5.93	0.860	19	3.9	18.4	30	0	TR. RED FLOCKING
1100	2.98	120	5.85	0.794	15	3.5	18.6	23		IN WATER
1110	2.99		5.83	0.763	12	3.1	18.7	14		
1120	2.99		5.85	0.720	10	2.6	18.7	7		
1130	3.00		5.87	0.708	7.8	2.8	18.8	-4		
1140	3.00		5.86	0.729	6.0	2.6	18.8	-9		
1145			5.88	0.698	4.6	2.0	18.8	-13		
1150			5.89	0.694	3.9	2.5	18.8	-13		
1155			5.88	0.693	3.5	2.4	18.8	-14		

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW06-D-02
Sample Location: PAI-45-MW06-D
Sampled By: CO
C.O.C. No.: 041905-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Date: 4/18/05	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	NA
Time: 1425								
Method: PERISTALTIC	clear	7.28	1.57	22.97	7.2	0.45	-84	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/18/05								
Method: PERISTALTIC				Salinity=	0.1			
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 39.93'								
Static Water Level (WL): 3.55'								
One Casing Volume (~~gal~~): 22.4L								
Start Purge (hrs): 1335								
End Purge (hrs): 1420								
Total Purge Time (min): 45								
Total Vol. Purged (~~gal~~): 13.50L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
—	—	[signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW06-D
DATE: 4/18/05

Time (Hrs)	Water Level (Ft. below TOC)		Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	SAC %	Comments
1335	3.55	Volume (L)									START PURGE
1345	4.44	3.00	300	7.04	1.51	31	1.28	22.87	36	0.1	clear
1355	4.49	6.00	300	7.20	1.53	19	0.55	22.85	-30	0.1	clear
1405	4.49	9.00	300	7.25	1.55	13	0.48	22.90	-59	0.1	clear
1415	4.50	12.00	300	7.28	1.57	8.8	0.45	22.97	-78	0.1	clear
1420	4.50	13.50	300	7.28	1.57	7.2	0.45	22.97	-84	0.1	clear, end purge
1425											start sample

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW0754-02
Sample Location: MW0754
Sampled By: K. SIMPSON
C.O.C. No.: 021505-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA SAV %
Date: 2.14.05								
Time: 1410								
Method: PERISTALTIC	CLEAR	6.50	0.462	16.2	1.4	6.0	117	0

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 2.14.05								
Method: PERISTALTIC								
Monitor Reading (ppm): 0.7		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material Type: 2" PVC 5' SCREEN								
Total Well Depth (TD): 7.05								
Static Water Level (WL): 2.94								
One Casing Volume (gal/L): 0.7								
Start Purge (hrs): 1300								
End Purge (hrs): 1410								
Total Purge Time (min): 70								
Total Vol. Purged (gal/L): 2.1								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	✓
	6	VIALS	
		2X VOL FOR DUP	

OBSERVATIONS / NOTES:

TUBING SET 1.5' OFF BTM

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
—	FD 021405-01	K. Simpson

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: MW07SU
DATE: 2-14-05

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP mV	SAC %	Comments START PURGE
1300	2.94	125								CLEAR, NO ODOR
1310	3.29	125	6.52	0.471	6.9	8.1	16.8	77	0	
1320	3.40	110	6.50	0.462	6.0	6.2	16.7	97		
1330	3.34		6.52	0.462	~~6.94~~	6.9	16.7	106		TURB = 5.9
1340	3.34		6.49	0.462	3.4	6.8	16.6	109		
1350			6.50	0.462	2.2	6.1	16.4	115		
1400			6.51	0.462	2.0	6.1	16.3	118		
1410			6.50	0.462	1.4	6.0	16.2	117		

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW07SL-02
Sample Location: MW07SL
Sampled By: K. SIMPSON
C.O.C. No.: 021505-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other SAC 070 NA
Date: 2-14-05								
Time: 1550								
Method: PERISTALTIC	CLEAR	5.83	0.460	17.8	9	3.2	27	0

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 2-14-05								
Method: PERISTALTIC								
Monitor Reading (ppm): 0.4		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material								
Type: 2" PVC - 5' SCREEN								
Total Well Depth (TD): 14.80								
Static Water Level (WL): 2.83								
One Casing Volume (gal/L): 2.0								
Start Purge (hrs): 1440								
End Purge (hrs): 1550								
Total Purge Time (min): 70								
Total Vol. Purged (gal/L): 2.0								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	✓

OBSERVATIONS / NOTES:

TUBING SET 1.5'± OFF BTM

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: MW07SL
DATE: 2.14.05

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP mV	SAC %	Comments START PURGE
1440	2.85	105	—	—	—	—	—	—	—	CLOUDY, NO ODOR
1450	2.98	↓	5.99	0.455	120	5.5	17.8	88	0	
1500	2.98	↓	5.93	0.458	81	4.5	17.4	83	0	
1520	2.98	↓	5.87	0.457	23	3.5	17.6	44	0	CLEAR, NO ODOR.
1530	↓	↓	5.83	0.469	20	3.3	17.5	32	0	" "
1540	↓	↓	5.83	0.457	19	3.2	17.6	30	0	" "
1550	↓	↓	5.83	0.460	9	3.2	17.8	27	0	" "

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW07-D-02
Sample Location: PAI-45-MW07-D
Sampled By: CD
C.O.C. No.: 041905-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

Date: 4/18/05	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Time: 1535	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	NA
Method: PERISTALTIC	clear	7.29	1.25	22.34	29	0.58	-89	—

PURGE DATA:

Date: 4/18/05	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: PERISTALTIC				salinity =	0.1			
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 39.61'								
Static Water Level (WL): 3.76'								
One Casing Volume (~~gal~~): 22.2L								
Start Purge (hrs): 1445								
End Purge (hrs): 1530								
Total Purge Time (min): 45								
Total Vol. Purged (~~gal~~): 13.50L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle If Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Chris Jeahn

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW07-D ~~PAI 45 MW07 D~~ (CB)
DATE: 4/18/05

Time (Hrs)	Water Level (Ft. below TOC)		Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	SAC 0%	Comments
1445	3.76	Volume(L)									START PURGE
1455	4.46	3.00	300	7.23	1.17	180	1.38	22.15	-19	0.1	clear
1505	4.48	6.00	300	7.22	1.19	110	0.58	22.18	-54	0.1	slightly cloudy
1515	4.47	9.00	300	7.25	1.21	55	0.52	22.26	-72	0.1	slightly cloudy
1525	4.48	12.00	300	7.26	1.23	34	0.51	22.33	-84	0.1	clear
1530	4.49	13.50	300	7.29	1.25	29	0.58	22.34	-89	0.1	clear, end purge
1535											Begin sample

SIGNATURE(S): Alin Dooley

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW08-SU-02
Sample Location: PAI-45-MW08-SU
Sampled By: D. WESTERHOFF
C.O.C. No.: 022405-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA% Sat
Date: 2/24/05								
Time: 1000								
Method: PERISTALTIC	CLEAR	5.75	0.682	17.2	6.93	17.4	72	0.0

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 2/24/05								
Method: PERISTALTIC								
Monitor Reading (ppm): 1865(1)		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material								
Type: 2" PVC								
Total Well Depth (TD): 7.00								
Static Water Level (WL): 2.58								
One Casing Volume (gal/L): .72								
Start Purge (hrs): 0840								
End Purge (hrs): 0955								
Total Purge Time (min): 75								
Total Vol. Purged (gal/L): 2.2								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	✓

OBSERVATIONS / NOTES:

(1) - @ HEADSPACE OF MW, B.Z. READINGS @ 0.0 ppm

D.O METER READINGS SUSPECT.

TUBING @ 2' OF BOT. OF WELL.

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): [illegible]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW08-SU
DATE: 2/28/05

Time (Hrs)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP (mV)	SAC %	Comments START PURGE
0840	2.58	140	—	—	—	—	—	—	—	LT. BROWN, NO ODOR
0845	2.87	~~2~~ 140	5.82	0.741	90	19.9 *	16.5	300	0.0	DESPITE ELEV. PID
0850	2.92		5.84	0.731	75	16.7	16.5	210	0.0	READINGS (1865 ppm)
0855	2.92		5.83	0.727	65	14.4	16.6	176	0.0	
0905	2.93		5.79	0.718	38	14.6	16.9	133	0.0	
0915	2.94		5.77	0.700	24	16.4	16.9	111	0.0	
0925	2.96		5.75	0.691	24	19.0	17.0	92	0.0	
0935	3.00		5.75	0.687	15	19.9*	17.0	89	0.0	
0945	3.02		5.74	0.684	11	18.5	17.1	79	0.0	
0950	3.02		5.74	0.682	9.84	18.0	17.1	75	0.0	
0955	3.01		5.75	0.682	6.93	17.4	17.2	72	0.0	END OF PURGE - SAMPLE @ 1000

SIGNATURE(S): [illegible]

* DO READINGS SUSPECT

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW-08SL-02
Sample Location: PAI-45MW-08SL
Sampled By: D. WESTERHOFF
C.O.C. No.: 022405-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other ~~NA~~% SA
Date: 2/24/05								
Time: 1145								
Method: PERISTALTIC	CLEAR	5.33	0.356	19.5	7.11	13.9	45	0.0

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 2/24/05								
Method: PERISTALTIC								
Monitor Reading (ppm): 1666		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material								
Type: 2" PVC								
Total Well Depth (TD): 14.70								
Static Water Level (WL): 2.67								
One Casing Volume (gal/L): 2.0								
Start Purge (hrs): 1020								
End Purge (hrs): 1140								
Total Purge Time (min): 80								
Total Vol. Purged (gal/L): 3.0								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	✓

OBSERVATIONS / NOTES:

DUP COLLECTED @ THIS LOCATIONS

TUBING @ 2' ABOVE BOTTOM OF WELL - APPLIES TO ALL LOCATIONS

Circle if Applicable:

MS/MSD	Duplicate ID No.: FD022405-01

Signature(s):

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW-085L
DATE: 2/24/05

Time (Hrs)	Water Level (Ft. below TOC)	Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	SAC %	Comments START PURGE
1020	2.67	200								START PURGE - LT. BROWN
1025	2.68	200	5.14	0.352	197	19.9+	19.3	149	0.0	NO ODOR - LOTS OF
1030	2.62	160	5.17	0.353	83	17.0	19.3	122	0.0	FINE PARTICULATES
1035	2.62		5.21	0.351	46	15.1	19.3	111	0.0	
1045	2.64		5.25	0.351	37	15.8	19.3	84	0.0	
1055	2.64		5.31	0.353	21	17.2	19.5	66	0.0	
1105	2.65		5.32	0.354	16	16.1	19.6	59	0.0	
1115	2.65		5.35	0.355	12	16.1	19.6	51	0.0	
1125	2.65		5.36	0.355	9.18	15.1	19.7	48	0.0	
1135	2.65		5.33	0.355	7.90	13.2	19.6	47	0.0	
1140	2.65		5.33	0.356	7.11	13.9	19.5	45	0.0	END PURGE - SAMPLE @ 1145

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW09-D-02
Sample Location: PAI-45-MW09-D
Sampled By: D. WESTERHOFF
C.O.C. No.: 022505-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

Date: 2/24/05	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA % SAL
Time: 1530								
Method: PERISTALTIC	CLEAR	7.74	1.15	22.14	4.21	0.61	-134	0.1

PURGE DATA:

Date: 2/24/05	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: PERISTALTIC								
Monitor Reading (ppm): 0.6	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material								
Type: 2" PVC								
Total Well Depth (TD): 41.50								
Static Water Level (WL): 4.21								
One Casing Volume (gal/L): 6.1								
Start Purge (hrs): 1400								
End Purge (hrs): 1530								
Total Purge Time (min): 90								
Total Vol. Purged (gal/L): 4								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	—

OBSERVATIONS / NOTES:

TUBING SET @ 2' OFF BOTTOM OF WELL

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW09-D
DATE: 02/24/05

Time (Hrs)	Water Level (Ft. below TOC)	Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP mV	SAC %	Comments START PURGE
1400	4.21	220								CLEAR, NO ODOR
~~1400~~ 1405	4.75	175	7.24	1.16	81	1.69	22.32	25	0.1	
1410	4.65	180	7.44	1.17	46	1.10	21.95	-14	0.1	
1415	4.62		7.61	1.17	12	0.85	22.00	-52	0.1	
1425	4.64		7.88	1.16	4.91	0.76	22.14	-83	0.1	
1435	4.64		7.86	1.16	4.69	0.81	22.19	-102	0.1	
1445	4.65		7.85	1.15	9.69	0.64	22.12	-115	0.1	
1455	4.66		7.78	1.15	8.03	0.70	22.14	-117	0.1	
1508	4.66		7.78	1.15	9.47	0.68	22.14	-128	0.1	
1515	4.66		7.73	1.15	5.93	0.61	22.13	-131	0.1	
1525	4.66		7.74	1.15	4.21	0.61	22.14	-134	0.1	END OF PURGE
1530										SAMPLE

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW10-SU-02
Sample Location: PAI-45-MW10-SU
Sampled By: CD
C.O.C. No.: 041805-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Date: 4/17/05	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	NA
Time: 0950								
Method: PERISTALTIC	clear	6.37	1.25	21.21	2.1	0.86	-4	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/17/05								
Method: PERISTALTIC				Salinity =	0.1			
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 7.90'								
Static Water Level (WL): 2.08'								
One Casing Volume (gal/L): 3.6 L								
Start Purge (hrs): 0835								
End Purge (hrs): 0945								
Total Purge Time (min): 70								
Total Vol. Purged (gal/L): 7.00 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): [illegible]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW10-SU
DATE: 4/17/05

Time (Hrs.)	Water Level (Ft. below TOC)	Volume (L)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Deg.C)	ORP (mV)	SAC %	Comments
0835	2.08										START PURGE
0845	2.39	1.00	100	6.00	1.13	21	1.92	21.17	259	0.1	clear
0855	2.33	2.00	100	6.08	1.14	7.6	1.16	21.07	147	0.1	clear
0905	2.13	3.00	100	6.17	1.14	5.8	1.33	21.33	76	0.1	clear
0915	2.29	4.00	100	6.21	1.16	3.4	1.73	21.24	45	0.1	clear, pump stopped
0925	2.33	5.00	100	6.25	1.20	8.6	1.02	21.21	29	0.1	clear
0935	2.33	6.00	100	6.33	1.24	2.7	0.89	21.18	9	0.1	clear
0940	2.34	6.50	100	6.35	1.24	2.2	0.91	21.17	2	0.1	clear
0945	2.34	7.00	100	6.37	1.25	2.1	0.86	21.21	-4	0.1	clear, end purge
0950											start sample

SIGNATURE(S): Clin Dodson

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW10-SL-02
Sample Location: PAI-45-MW10-SL
Sampled By: CO
C.O.C. No.: 04805-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 4/17/05								
Time: 1050								
Method: PERISTALTIC	clear	6.73	1.40	22.00	8.3	0.66	-12	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/17/05								
Method: PERISTALTIC				Salinity =	0.1			
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 15.91'								
Static Water Level (WL): 2.04'								
One Casing Volume (~~gal~~ L): 8.6 L								
Start Purge (hrs): 1000								
End Purge (hrs): 1045								
Total Purge Time (min): 45								
Total Vol. Purged (~~gal~~ L): 9.00 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	~~3~~ 40 mL vials	yes
		9	

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
yes	—	[signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW10-SL
DATE: 4/17/05

Time (Hrs)	Water Level (Ft. below TOC)	Volume (L)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	SAC %	Comments
1000	2.04										START PURGE
1010	2.80	2.00	200	6.24	1.30	31	2.17	21.97	47	0.1	clear
1020	2.83	4.00	200	6.31	1.32	20	0.93	21.88	19	0.1	clear
1030	2.85	6.00	200	6.40	1.37	12	0.85	21.93	2	0.1	clear
1035	2.87	7.00	200	6.43	1.39	11	0.67	21.97	-4	0.1	clear
1040	2.89	8.00	200	6.43	1.39	9.1	0.65	22.06	-9	0.1	clear
1045	2.89	9.00	200	6.43	1.40	8.3	0.66	22.00	-12	0.1	clear, end purge
1050											start sample

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW13-SU-02
Sample Location: PAI-45-MW13-SU
Sampled By: CD
C.O.C. No.: 041905-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

Date: 4/19/05	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Time: 0925	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	NA
Method: PERISTALTIC	clear	5.89	0.167	20.40	24	1.88	243	—

PURGE DATA:

Date: 4/19/05	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: PERISTALTIC				Salinity=	0.0			
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 8.89'								
Static Water Level (WL): 2.91'								
One Casing Volume (~~gal~~ L): 3.7 L								
Start Purge (hrs): 0815								
End Purge (hrs): 0920								
Total Purge Time (min): 65								
Total Vol. Purged (~~gal~~ L): 6.50 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
—	—	Chris Dodd

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW13-SU
DATE: 4/19/05

Time (Hrs)	Water Level (Ft below TOC)	Volume (L)	Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP (mV)	SAC %	Comments
											START PURGE
0815	2.91										clear
0825	3.01	1.00	100	5.72	0.258	55	3.21	19.64	301	0.0	slightly cloudy
0835	3.04	2.00	100	5.76	0.185	50	2.33	20.04	283	0.0	slightly cloudy
0845	3.04	3.00	100	5.84	0.187	37	2.00	20.21	268	0.0	clear
0855	3.04	4.00	100	5.81	0.173	30	1.95	20.21	261	0.0	clear
0905	3.04	5.00	100	5.83	0.161	27	1.91	20.29	254	0.0	clear
0915	3.04	6.00	100	5.85	0.158	27	1.87	20.32	248	0.0	clear
0920	3.05	6.50	100	5.89	0.167	24	1.88	20.40	243	0.0	clear, end purge
0925											start sample

SIGNATURE(S): Chris Dodson

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW13-SL-02
Sample Location: PAI-45-MW13-SL
Sampled By: CD
C.O.C. No.: 041905-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 4/19/05								
Time: 1025								
Method: PERISTALTIC	clear	6.20	1.38	21.74	2.1	0.62	56	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/19/05								
Method: PERISTALTIC				salinity=	0.1			
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 15.78'								
Static Water Level (WL): 2.87'								
One Casing Volume (gal/L): 8.1L								
Start Purge (hrs): 0930								
End Purge (hrs): 1020								
Total Purge Time (min): 50								
Total Vol. Purged (gal/L): 7.50L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Chris Dealer

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PA1-45-MW13-SL
DATE: 4/19/05

Time (Hrs.)	Water Level (Ft. below TOC)	Volume (L)	Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	SAC %	Comments
											START PURGE
0930	2.87										clear
0940	3.08	1.50	150	6.06	1.32	18	3.89	20.90	289	0.1	clear
0950	3.09	3.00	150	6.17	1.34	11	1.19	21.12	201	0.1	clear
1000	3.09	4.50	150	6.17	1.35	6.5	0.74	21.37	122	0.1	clear
1010	3.10	6.00	150	6.18	1.37	3.1	0.61	21.34	78	0.1	clear
1015	3.10	6.75	150	6.19	1.38	2.2	0.59	21.45	66	0.1	clear
1020	3.11	7.50	150	6.20	1.38	2.1	0.62	21.74	56	0.1	clear, end purge
1025											Start sample

SIGNATURE(S): Clin Jordan

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW14-SU-02
Sample Location: PAI-45-MW14-SU
Sampled By: CD
C.O.C. No.: 041805-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 4/17/05								
Time: 1550								
Method: PERISTALTIC	clear	5.62	0.203	22.51	0.55	2.37	113	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/17/05								
Method: PERISTALTIC				Salinity =	0.0			
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 8.88'								
Static Water Level (WL): 2.33'								
One Casing Volume (~~gal~~ L): 4.0 L								
Start Purge (hrs): 1440								
End Purge (hrs): 1545								
Total Purge Time (min): 65								
Total Vol. Purged (~~gal~~ L): 6.50 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle If Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): Chris Jacobs

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW14-SU
DATE: 4/17/05

Time (Hrs)	Water Level (Ft. below TOC)		Flow (mL/Min)	pH (SU)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	SAC %	Comments
											START PURGE
1440	2.33	Volume (L)									clear
1450	2.52	1.00	100	7.05	0.213	3.9	3.91	22.42	137	0.0	clear
1500	2.51	2.00	100	5.54	0.209	3.3	2.69	22.31	138	0.0	clear
1510	2.51	3.00	100	5.53	0.206	1.5	2.51	22.34	132	0.0	clear
1520	2.51	4.00	100	5.51	0.205	1.3	2.41	22.54	128	0.0	clear
1530	2.50	5.00	100	5.54	0.205	0.90	2.44	22.43	122	0.0	clear
1540	2.50	6.00	100	5.59	0.204	0.50	2.38	22.28	116	0.0	clear
1545	2.49	6.50	100	5.62	0.203	0.65	2.37	22.51	113	0.0	clear, end purge
1550											Start sample

SIGNATURE(S): Chris Dooley

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW14-SL-02
Sample Location: PAI-45-MW14-SL
Sampled By: CD
C.O.C. No.: 041805-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

Date: 4/17/05	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Time: 1650	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	NA
Method: PERISTALTIC	clear	7.42	0.856	22.32	6.4	0.71	-95	—

PURGE DATA:

Date: 4/17/05	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: PERISTALTIC				salinity=	0.0			
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 15.08'								
Static Water Level (WL): 2.09'								
One Casing Volume (gal/L): 8.1L								
Start Purge (hrs): 1600								
End Purge (hrs): 1645								
Total Purge Time (min): 45								
Total Vol. Purged (gal/L): 8.25 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
—	—	[signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW14-SL
DATE: 4/17/05

Time (Hrs)	Water Level (Ft. below TOC)		Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	SAC %	Comments
											START PURGE
1600	2.09	Volume(L)									clear
1610	4.25	2.00	200	7.10	0.846	16	1.19	22.19	10	0.0	clear
1620	5.20	4.00	200	7.26	0.847	13	0.77	22.25	-43	0.0	clear
1630	5.48	5.50	150	7.35	0.856	8.7	0.69	22.23	-73	0.0	clear
1640	5.43	7.00	150	7.40	0.856	8.0	0.68	22.47	-88	0.0	clear
1645	5.38	8.25	125	7.42	0.856	6.4	0.71	22.32	-95	0.0	clear, end purge
1650											Start sample

SIGNATURE(S): Chris Deeder

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW15-SU-02
Sample Location: PAI-45-MW15-SU
Sampled By: CD
C.O.C. No.: 041805-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 4/16/05								
Time: 0930								
Method: PERISTALTIC	clear	6.17	0.306	18.32	1.88	1.87	147	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/16/05								
Method: PERISTALTIC				Salinity =	0.0			
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 8.80'								
Static Water Level (WL): 4.40'								
One Casing Volume (gal/L): 2.8L								
Start Purge (hrs): 0815								
End Purge (hrs): 0925								
Total Purge Time (min): 70								
Total Vol. Purged (gal/L): 7.00 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD — Duplicate ID No.:

Signature(s): [illegible]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW15-SU
DATE: 4/16/05

Time (Hrs.)	Water Level (Ft. below TOC)		Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	SAC 254	Comments
											START PURGE
0815	4.40	Volume (L)									clear
0825	4.51	1.00	100	6.31	0.432	23.0	5.33	15.80	313	0.0	clear
0835	4.54	2.00	100	6.47	0.424	16.8	4.57	16.13	311	0.0	clear
0845	4.55	3.00	100	6.42	0.410	10.38	3.48	16.79	297	0.0	clear
0855	4.56	4.00	100	6.30	0.369	6.30	2.80	17.43	260	0.0	clear
0905	4.57	5.00	100	6.29	0.338	4.81	2.60	17.53	223	0.0	clear
0910	4.58	5.50	100	6.26	0.334	3.66	2.40	17.93	202	0.0	clear
0915	4.59	6.00	100	6.21	0.325	2.62	2.13	18.01	181	0.0	clear
0920	4.59	6.50	100	6.19	0.311	2.31	2.04	18.34	162	0.0	clear
0925	4.60	7.00	100	6.17	0.306	1.88	1.87	18.32	147	0.0	clear, end purge
0930											start sample

SIGNATURE(S): Colin Gooder

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW15-SL-02
Sample Location: PAI-45-MW15-SL
Sampled By: CD
C.O.C. No.: 041805-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 4/16/05								
Time: 1035								
Method: PERISTALTIC	clear	6.41	0.318	19.20	3.27	0.71	3	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/16/05								
Method: PERISTALTIC				Salinity =	0.0			
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 17.61'								
Static Water Level (WL): 4.13'								
One Casing Volume (~~gal~~ L): 8.4L								
Start Purge (hrs): 0945								
End Purge (hrs): 1030								
Total Purge Time (min): 45								
Total Vol. Purged (~~gal~~ L): 6.75L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): [signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW15-SL
DATE: 4/16/05

Time (Hrs)	Water Level (Ft. below TOC)	Volume (L)	Flow (mL/Min)	pH (S.U.)	S. Cond. (ms/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	SAC %	Comments
											START PURGE
0945	4.13										clear
0955	4.90	1.50	150	6.33	0.313	21.7	1.18	18.68	123	0.0	clear
1005	4.99	3.00	150	6.34	0.315	11.9	0.83	18.92	59	0.0	clear
1015	5.05	4.50	150	6.40	0.317	6.34	0.76	19.00	27	0.0	clear
1025	5.09	6.00	150	6.40	0.317	3.94	0.71	19.19	10	0.0	clear
1030	5.10	6.75	150	6.41	0.318	3.27	0.71	19.20	3	0.0	clear, end purge
1035											~~clear~~ start sample.

SIGNATURE(S): Chris Jackson

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-~~MW~~GW16-SU-02
Sample Location: PAI-45-MW16-SU
Sampled By: CD
C.O.C. No.: 041805-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 4/15/05								
Time: 1405								
Method: PERISTALTIC	clear	6.24	0.153	20.81	2.23	4.37	156	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/15/05								
Method: PERISTALTIC				Salinity=	0.0			
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 9.12'								
Static Water Level (WL): 5.70'								
One Casing Volume (~~gal~~ L): 2.2L								
Start Purge (hrs): 1315								
End Purge (hrs): 1400								
Total Purge Time (min): 45								
Total Vol. Purged (~~gal~~ L): 4.50 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	~~6~~ 40 mL vials	yes
		9	

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
yes	

Signature(s): [signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW16-SU
DATE: 4/15/05

Time (Hrs)	Water Level (Ft. below TOC)	Volume (L)	Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Deg C)	ORP (mV)	SAC %	Comments
1315	5.70										START PURGE
1325	5.82	1.00	100	6.93	0.167	22.7	8.07	20.83	129	0.0	clear
1335	5.81	2.00	100	6.32	0.157	4.86	4.83	20.83	145	0.0	clear
1345	5.80	3.00	100	6.20	0.152	3.22	4.57	20.80	153	0.0	clear
1355	5.79	4.00	100	6.22	0.152	2.25	4.46	20.87	155	0.0	clear
1400	5.79	4.50	100	6.24	0.153	2.23	4.37	20.81	156	0.0	clear, end purge
1405											Start sample

SIGNATURE(S): Clin Jrad

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW16-SL-02
Sample Location: PAI-45-MW16-SL
Sampled By: CD
C.O.C. No.: 041805-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 4/15/05								
Time: 1535								
Method: PERISTALTIC	clear	6.49	0.439	20.96	1.11	0.67	24	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/15/05								
Method: PERISTALTIC				Salinity=	0.0			
Monitor Reading (ppm): —		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 17.77'								
Static Water Level (WL): 5.47'								
One Casing Volume (~~gal/L~~): 7.5 L								
Start Purge (hrs): 1440								
End Purge (hrs): 1530								
Total Purge Time (min): 50								
Total Vol. Purged (~~gal/L~~): 7.50 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD — Duplicate ID No.:

Signature(s):

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW16-SL
DATE: 4/15/05

Time (Hrs.)	Water Level (Ft. below TOC)	Volume (L)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (ms/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	SAC %	Comments
1440	5.47										START PURGE
1450	5.72	1.50	150	6.44	0.587	4.69	1.28	21.07	156	0.0	clear
1500	5.73	3.00	150	6.48	0.570	3.99	1.15	21.23	136	0.0	clear
1510	5.73	4.50	150	6.52	0.522	2.10	0.74	21.03	71	0.0	clear
1520	5.74	6.00	150	6.50	0.469	1.37	0.69	20.95	40	0.0	clear
1525	5.74	6.75	150	6.51	0.459	1.19	0.68	20.96	31	0.0	clear
1530	5.75	7.50	150	6.49	0.439	1.11	0.67	20.96	24	0.0	clear, end purge
1535											start sample

SIGNATURE(S): Colin Foster

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW17-SU-02
Sample Location: PAI-45-MW17-SU
Sampled By: CD
C.O.C. No.: 041905-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Date: 4/18/05	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	NA
Time: 1205								
Method: PERISTALTIC	clear	6.86	2.18	20.84	4.8	1.14	-36	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/18/05								
Method: PERISTALTIC				Salinity=	0.1			
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 9.12'								
Static Water Level (WL): 3.19'								
One Casing Volume (~~gal~~): 3.7L								
Start Purge (hrs): 1115								
End Purge (hrs): 1200								
Total Purge Time (min): 45								
Total Vol. Purged (~~gal~~): 6.75L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle If Applicable:

MS/MSD	Duplicate ID No.:
—	

Signature(s): [illegible]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW17-SU
DATE: 4/18/05

Time (Hrs.)	Water Level (Ft. below TOC)	Volume (L)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	SAC %	Comments
											START PURGE
1115	3.19										
1125	3.28	1.50	~~0.15~~ 150	7.12	2.23	13	1.48	20.92	11	0.1	clear
1135	3.29	3.00	150	7.01	2.20	11	1.19	20.80	-13	0.1	clear
1145	3.30	4.50	150	6.96	2.20	7.9	1.12	20.87	-26	0.1	clear
1155	3.31	6.00	150	6.87	2.19	6.1	1.16	20.89	-33	0.1	clear
1200	3.31	6.75	150	6.86	2.18	4.8	1.14	20.84	-36	0.1	clear, end purge
1205											start sample

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW17-SL-02
Sample Location: PAI-45-MW17-SL
Sampled By: CD
C.O.C. No.: 041905-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 4/18/05								
Time: 1300								
Method: PERISTALTIC CD	~~6.18~~ clear	6.18	4.72	21.07	2.3	0.82	24	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/18/05								
Method: PERISTALTIC				Salinity =	0.2			
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 14.91'								
Static Water Level (WL): 2.99'								
One Casing Volume (~~gal~~): 7.4 L								
Start Purge (hrs): 1210								
End Purge (hrs): 1255								
Total Purge Time (min): 45								
Total Vol. Purged (~~gal~~): 6.75 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
—	—	[signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW17-SL
DATE: 4/18/05

Time (Hrs)	Water Level (Ft. below TOC)		Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	SAC %	Comments
1210	2.99	Volume(L)									START PURGE
1220	3.62	1.50	150	6.21	4.84	15	10.16	22.14	43	0.3	clear
1230	3.70	3.00	150	6.23	4.73	9.0	1.50	21.27	34	0.2	clear
1240	3.72	4.50	150	6.16	4.73	5.1	0.93	21.08	30	0.2	clear
1250	3.73	6.00	150	6.20	4.73	3.8 @	~~2~~ 0.90	21.17	26	0.2	clear
1255	3.74	6.75	150	6.18	4.72	2.3	0.82	21.07	24	0.2	clear, end purge
1300											start sample

SIGNATURE(S): Clin Dawler

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW18-SU-02
Sample Location: PAI-45-MW18-SU
Sampled By: CD
C.O.C. No.: 041805-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Date: 4/18/05	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	NA
Time: 0945								
Method: PERISTALTIC	clear	7.54	0.484	19.51	30	0.81	-22	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/18/05								
Method: PERISTALTIC				salinity=	0.0			
Monitor Reading (ppm): –	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 8.65'								
Static Water Level (WL): 2.18'								
One Casing Volume (gal/L): 4.0L								
Start Purge (hrs): 0830								
End Purge (hrs): 0940								
Total Purge Time (min): 70								
Total Vol. Purged (gal/L): 7.00 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): [signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW18-SU
DATE: 4/18/05

Time (Hrs)	Water Level (Ft. below TOC)		Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP mV	SAC %	Comments
0830	2.18	Volume (L)									START PURGE
0840	2.94	1.00	100	6.60	0.534	250	3.65	19.11	285	0.0	clear
0850	2.63	2.00	100	6.76	0.518	100	1.56	19.37	250	0.0	cloudy
0900	3.06	3.00	100	6.82	0.487	100	1.03	19.18	174	0.0	slightly cloudy, pump stopped
0910	3.12	4.00	100	6.94	0.472	120	0.95	19.29	86	0.0	slightly cloudy
0920	3.08	5.00	100	7.01	0.467	55	1.02	19.45	32	0.0	slightly cloudy
0930	3.09	6.00	100	7.05	0.467	45	0.85	19.51	2	0.0	slightly cloudy
0935	3.12	6.50	100	7.05	0.474	34	0.85	19.43	-11	0.0	slightly cloudy
0940	3.14	7.00	100	7.54	0.484	30	0.81	19.51	-22	0.0	clear
0945											clear, end purge
											start sample

SIGNATURE(S): Colin Jordan

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW18-SL-02
Sample Location: PAI-45-MW18-SL
Sampled By: CO
C.O.C. No.: 041805-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Date: 4/18/05	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	NA
Time: 1050								
Method: PERISTALTIC	clear	8.05	2.87	20.19	4.6	0.60	-89	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/18/05								
Method: PERISTALTIC				Salinity=	0.1			
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 15.84'								
Static Water Level (WL): 3.21'								
One Casing Volume (gal): 7.7 L								
Start Purge (hrs): 1000								
End Purge (hrs): 1045								
Total Purge Time (min): 45								
Total Vol. Purged (gal): 7.75 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
—	—	Chris Deeks

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-4S-MW18-SL
DATE: 4/18/05

Time (Hrs)	Water Level (Ft below TOC)	Volume (L)	Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Deg C)	ORP (mV)	SAC %	Comments
											START PURGE
1000	3.21										clear
1010	4.47	2.00	200	7.85	4.33	23	1.19	20.52	-2	0.2	clear
1020	4.75	4.00	200	8.44	3.22	12	0.66	20.06	-46	0.2	clear
1030	4.63	5.50	150	8.54	2.96	7.8	0.65	20.11	-70	0.1	clear
1040	4.63	7.00	150	8.16	2.89	5.5	0.62	20.10	-83	0.1	clear
1045	4.64	7.75	150	8.05	2.87	4.6	0.60	20.19	-89	0.1	clear, end purge
1050											begin sample

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW19-SU-02
Sample Location: PAI-45-MW19-SU
Sampled By: CO
C.O.C. No.: 041805-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Date: 4/16/05	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	NA
Time: 1425								
Method: PERISTALTIC	clear	6.16	1.51	18.38	2.83	1.19	35	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/16/05								
Method: PERISTALTIC				Salinity=	0.1			
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 8.53'								
Static Water Level (WL): 1.71'								
One Casing Volume (~~gal~~ L): 4.1 L								
Start Purge (hrs): 1315								
End Purge (hrs): 1420								
Total Purge Time (min): 65								
Total Vol. Purged (~~gal~~ L): 6.50 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
—	—	[signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW19-SU
DATE: 4/16/05

Time (Hrs.)	Water Level (Ft below TOC)	Volume (L)	Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	SAC %	Comments
1315	1.71										START PURGE
1325	2.47	1.00	100	7.80	1.54	75.8	2.23	18.67	22	0.1	clear
1335	2.54	2.00	100	6.96	1.56	20.1	1.04	18.48	-30	0.1	slightly cloudy
1345	2.54	3.00	100	6.46	1.54	7.74	1.01	18.21	-11	0.1	clear
1355	2.54	4.00	100	6.32	1.53	6.25	1.01	18.17	3	0.1	clear
1405	2.55	5.00	100	6.22	1.52	4.11	1.09	18.30	18	0.1	clear
1415	2.56	6.00	100	6.19	1.51	2.99	1.15	18.37	30	0.1	clear
1420	2.57	6.50	100	6.16	1.51	2.83	1.19	18.38	35	0.1	clear, end purge
1425											Start sample

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N5260 SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW19-SL-02
Sample Location: PAI-45-MW19-SL
Sampled By: CO
C.O.C. No.: 041805-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	NA
Date: 4/16/05								
Time: 1535								
Method: PERISTALTIC	clear	6.11	2.12	19.38	3.93	0.81	50	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/16/05								
Method: PERISTALTIC				Salinity =	0.1			—
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 16.08'								
Static Water Level (WL): 1.63'								
One Casing Volume (gal/L): 9.1L								
Start Purge (hrs): 1445								
End Purge (hrs): 1530								
Total Purge Time (min): 45								
Total Vol. Purged (gal/L): 6.75L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
—	—	[signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW19-SL
DATE: 4/16/05

Time (Hrs)	Water Level (Ft. below TOC)		Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Deg.C)	ORP (mV)	SAC %	Comments
1445	1.63	Volume(L)									START PURGE
1455	2.66	1.50	150	5.81	3.57	15.1	2.31	19.67	104	0.2	clear
1505	2.83	3.00	150	6.05	2.29	8.12	0.87	19.39	73	0.1	clear
1515	2.85	4.50	150	6.09	2.13	6.22	0.79	19.36	62	0.1	clear
1525	2.86	6.00	150	6.10	2.14	4.74	0.82	19.38	54	0.1	clear
1530	2.87	6.75	150	6.11	2.12	3.93	0.81	19.38	50	0.1	clear, end purge
1535											start sample

SIGNATURE(S): Chris Jordan

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW20-SU-02
Sample Location: PAI-45-MW20-SU
Sampled By: CD
C.O.C. No.: 041805-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	NA
Date: 4/17/05								
Time: 1255								
Method: PERISTALTIC	clear	6.02	1.67	20.31	37	0.96	40	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/17/05								
Method: PERISTALTIC				salinity =	0.1			
Monitor Reading (ppm): —		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material								
Type: 2" PVC								
Total Well Depth (TD): 8.68'								
Static Water Level (WL): 3.74'								
One Casing Volume (gal/L): 3.1 L								
Start Purge (hrs): 1120								
End Purge (hrs): 1250								
Total Purge Time (min): 90								
Total Vol. Purged (gal/L): 9.00 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): Colin Jordan

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW20-SU
DATE: 4/17/05

Time (Hrs)	Water Level (Ft. below TOC)	Volume (L)	Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Deg Celcius)	ORP (mV)	SAC %	Comments
											START PURGE
1120	3.74										
1130	4.17	1.00	100	6.07	2.66	55	1.49	20.26	78	0.1	slightly cloudy, pale yellow
1140	4.34	2.00	"	6.02	1.95	310	2.10	19.86	68	"	slightly cloudy
1150	4.41	3.00	"	6.01	1.75	340	2.32	20.00	65	"	cloudy
1200	4.43	4.00	"	6.00	1.60	270	2.01	20.18	64	"	cloudy
1210	4.44	5.00	"	5.99	1.51	180	1.95	20.30	63	"	cloudy
1220	4.46	6.00	"	5.97	1.48	95	1.54	20.23	59	"	slightly cloudy
1225	4.46	6.50	"	5.99	1.55	80	1.40	20.20	55	"	slightly cloudy
1230	4.46	7.00	"	6.00	1.58	55	1.20	20.33	52	"	slightly cloudy
1235	4.45	7.50	"	6.01	1.63	45	1.17	20.46	48	"	clear
1240	4.45	8.00	"	6.02	1.66	40	1.10	20.48	45	"	clear
1250	4.47	9.00	"	6.02	1.67	37	0.96	20.31	40	"	clear, end purge
1255											Start sample

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW20-SL-02
Sample Location: PAI-45-MW20-SL
Sampled By: CD
C.O.C. No.: 041805-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 4/17/05								
Time: 1400								
Method: PERISTALTIC	clear	6.11	2.68	20.82	4.8	0.77	32	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/17/05								
Method: PERISTALTIC				salinity=	0.1			
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material								
Type: 2" PVC								
Total Well Depth (TD): 15.81'								
Static Water Level (WL): 3.50'								
One Casing Volume (gal/L): 7.6L								
Start Purge (hrs): 1310								
End Purge (hrs): 1355								
Total Purge Time (min): 45								
Total Vol. Purged (gal/L): 6.75 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
—	—	[signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW20-SL
DATE: 4/17/05

Time (Hrs)	Water Level (Ft. below TOC)		Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP (mV)	SAC %	Comments
											START PURGE
1310	3.50	Volume(L)									clear
1320	3.78	1.50	150	6.21	3.99	13	2.33	20.95	51	0.2	clear
1330	3.79	3.00	150	6.16	3.09	6.4	1.00	20.94	40	0.2	clear
1340	3.78	4.50	150	6.12	2.99	3.6	0.78	20.81	36	0.1	clear
1350	3.75	6.00	150	6.11	2.87	4.1	0.74	20.82	33	0.1	clear
1355	3.75	6.75	150	6.11	2.68	4.8	0.77	20.82	32	0.1	clear, end purge
1400											start sample

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SW/MW 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-~~MW~~21-SU-02 GW (D)
Sample Location: PAI-45-MW21-SU
Sampled By: CD
C.O.C. No.: 041505-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Date: 4/14/05	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	NA
Time: 1305								
Method: PERISTALTIC	clear	5.86	0.705	17.13	8.19	0.95	37	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/14/05								
Method: PERISTALTIC				Salinity =	0.0			
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 8.01'								
Static Water Level (WL): 1.94'								
One Casing Volume ~~(gal/L)~~: 3.7 L								
Start Purge (hrs): 1200								
End Purge (hrs): 1300								
Total Purge Time (min): 60								
Total Vol. Purged ~~(gal/L)~~: 6.00 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
—	—	Chris Jacobs

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PA1-45-MW21-SU
DATE: 4/14/05

Time (Hrs)	Water Level (Ft. below TOC)		Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mv)	SAC %	Comments
											START PURGE
1200	1.94	Volume(L)									clear
1210	2.16	1.00	100	6.15	0.730	42.1	3.17	15.89	56	0.0	clear
1220	2.21	2.00	100	6.23	0.731	18.9	1.88	16.54	36	0.0	clear
1230	2.23	3.00	100	6.21	0.727	13.4	1.45	16.87	28	0.0	clear
1240	2.25	4.00	100	6.06	0.725	12.0	1.23	16.92	29	0.0	clear
1250	2.27	5.00	100	6.01	0.715	8.68	1.10	17.06	31	0.0	clear
1300	2.29	6.00	100	5.86	0.705	8.19	0.95	17.13	37	0.0	clear, end purge.
1305											start sample

SIGNATURE(S): Colin Jordan

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-~~MW~~21-SL-02 (GCD)
Sample Location: PAI-45-MW21-SL
Sampled By: CD
C.O.C. No.: 041505-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 4/14/05								
Time: 1420								
Method: PERISTALTIC	clear	5.91	0.893	18.30	5.31	0.90	29	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/14/05								
Method: PERISTALTIC				Salinity=	0.0			
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 14.96'								
Static Water Level (WL): 1.88'								
One Casing Volume (~~gal~~ L): 8.1 L								
Start Purge (hrs): 1330								
End Purge (hrs): 1415								
Total Purge Time (min): 45								
Total Vol. Purged (~~gal~~ L): 6.75 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
—	—	Chris Jordan

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-4S-MW21-SL
DATE: 4/14/05

Time (Hrs)	Water Level (Ft below TOC)		Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Deg Celsius)	ORP (mV)	SAC %	Comments
1330	1.88	Volume(L)									START PURGE
1340	2.15	1.50	150	5.86	0.866	33.0	1.66	17.57	57	0.0	clear
1350	2.17	3.00	150	5.91	0.876	19.0	0.93	18.18	45	0.0	clear
1400	2.19	4.50	150	5.91	0.889	9.96	0.79	18.23	37	0.0	clear
1410	2.20	6.00	150	5.93	0.893	7.01	0.86	18.27	32	0.0	clear
1415	2.21	6.75	150	5.91	0.893	5.31	0.90	18.30	29	0.0	clear, end purge
1420											start sample

SIGNATURE(S): Chris Brodrue

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-MW21-D-02 (CD)
Sample Location: PAI-45-MW21-D
Sampled By: CD
C.O.C. No.: 041505-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

Date: 4/14/05	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Time: 1535	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	NA
Method: PERISTALTIC	clear	7.26	2.01	20.81	2.37	0.54	-108	—

PURGE DATA:

Date: 4/14/05	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method: PERISTALTIC				Salinity =	0.0			
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 36.96'								
Static Water Level (WL): 3.34'								
One Casing Volume (~~gal~~ L): 20.7L								
Start Purge (hrs): 1445								
End Purge (hrs): 1530								
Total Purge Time (min): 45								
Total Vol. Purged (~~gal~~ L): 13.50 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
—	—

Signature(s): [signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW21-D
DATE: 4/14/05

Time (Hrs)	Water Level (Ft. below TOC)	Volume (L)	Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	SAC %	Comments
											START PURGE
1445	3.34										clear
1455	3.88	3.00	300	6.99	1.95	5.15	0.90	21.02	-35	0.1	clear
1505	3.92	6.00	300	7.22	1.95	3.55	0.67	21.04	-73	0.1	clear
1515	3.93	9.00	300	7.23	1.98	3.15	0.61	20.93	-93	0.1	clear
1525	3.94	12.00	300	7.26	2.00	2.39	0.55	20.85	-104	0.1	clear
1530	3.95	13.50	300	7.26	2.01	2.37	0.54	20.81	-108	0.1	clear, end purge
1535											start sample

SIGNATURE(S): Clin Jacobs

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-~~14~~W22-SU-~~00~~ 6 CD
Sample Location: PAI-45-MW22-SU
Sampled By: CD
C.O.C. No.: 041505-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Date: 4/14/05	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	NA
Time: 0925								
Method: PERISTALTIC	clear	6.44	0.860	15.75	4.53	1.88	46	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/14/05								
Method: PERISTALTIC				Salinity=	0.0			
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 7.48'								
Static Water Level (WL): 2.16'								
One Casing Volume (~~gal~~ L): 3.2L								
Start Purge (hrs): 0815								
End Purge (hrs): 0920								
Total Purge Time (min): 65								
Total Vol. Purged (~~gal~~ L): 6.50 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
—	—	Chris Jacobs

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PA1-45-MW22-SU
DATE: 4/14/05

Time (Hrs)	Water Level (Ft below TOC)		Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Deg C/F)	ORP (mV)	SAC %	Comments
0815	2.16	Volume									START PURGE
0825	2.85	1.00 L	100	6.33	0.868	10.40	3.89	14.71	317	0.0	clear
0835	3.32	2.00	100	6.26	0.855	9.14	2.01	15.37	302	0.0	clear
0845	3.25	3.00	100	6.33	0.855	11.3	1.70	15.60	240	0.0	clear
0855	3.28	4.00	100	6.37	0.857	9.71	1.76	15.62	172	0.0	clear
0905	3.28	5.00	100	6.40	0.861	8.19	1.76	15.60	104	0.0	clear
0910	3.30	5.50	100	6.42	0.860	5.78	1.86	15.66	78	0.0	clear
0915	3.31	6.00	100	6.42	0.860	5.31	1.84	15.73	59	0.0	clear
0920	3.31	6.50	100	6.44	0.860	4.83	1.88	15.75	46	0.0	clear, end purge
0925											start sample

SIGNATURE(S): [illegible]

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-~~MW~~GCD22-SL-02
Sample Location: PAI-45-MW22-SL
Sampled By: CD
C.O.C. No.: 041505-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 4/14/05								
Time: 1045								
Method: PERISTALTIC	Clear	6.22	0.516	17.46	7.49	0.74	-21	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/14/05								
Method: PERISTALTIC				Salinity =	0.0			
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 15.11'								
Static Water Level (WL): 1.84'								
One Casing Volume (~~gal~~ L): 8.2L								
Start Purge (hrs): 0950								
End Purge (hrs): 1040								
Total Purge Time (min): 50								
Total Vol. Purged (~~gal~~ L): 7.50L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
—	—	[signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW22-SL
DATE: 4/14/05

Time (Hrs.)	Water Level (Ft. below TOC)		Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Deg.C)	ORP (mV)	SAC %	Comments
0950	1.84	Volume (L)									START PURGE
1000	2.20	1.50	150	6.22	0.497	21.1	1.76	16.89	22	0.0	clear
1010	2.23	3.00	150	6.23	0.511	10.20	1.10	17.32	2	0.0	clear
1020	2.25	4.50	150	6.23	0.514	5.64	0.91	17.44	-10	0.0	clear
1030	2.26	6.00	150	6.21	0.515	4.63	0.82	17.40	-17	0.0	clear
1040	2.27	7.50	150	6.22	0.516	3.49	0.74	17.46	-21	0.0	clear, end purge
1045											start sample

SIGNATURE(S): Colin Jordan

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-~~MW~~GW23-SU-02 (CD)
Sample Location: PAI-45-MW23-SU
Sampled By: CD
C.O.C. No.: 041505-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA
Date: 4/15/05								
Time: 0955								
Method: PERISTALTIC	Clear	6.26	0.96	18.76	8.23	1.27	9	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/15/05								
Method: PERISTALTIC				Salinity =	0.0			
Monitor Reading (ppm): —		SEE LOW FLOW PURGE DATA SHEET, Page 2						
Well Casing Diameter & Material								
Type: 2" PVC								
Total Well Depth (TD): 10.04'								
Static Water Level (WL): 2.71'								
One Casing Volume (gal/L): 4.4L								
Start Purge (hrs): 0845								
End Purge (hrs): 0950								
Total Purge Time (min): 65								
Total Vol. Purged (gal/L): 6.50 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	3-40 mL vials	yes

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD —

Duplicate ID No.: —

Signature(s): [signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW23-SU-
DATE: 4/15/05

Time (Hrs)	Water Level (Ft. below TOC)	Volume (L)	Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	SAC %	Comments
											START PURGE
0845	2.71										clear, orange yellow
0855	3.08	1.00	100	5.98	0.99	234	1.82	18.26	241	0.0	cloudy
0905	3.14	2.00	100	6.11	0.98	154	1.27	19.05	163	0.0	slightly cloudy
0915	3.07	3.00	100	6.17	0.98	131	1.10	18.87	96	0.0	slightly cloudy
0925	3.05	4.00	100	6.25	0.96	46.1	1.01	18.77	54	0.0	clear
0935	3.07	5.00	100	6.23	0.95	17.4	1.19	18.83	30	0.0	clear
0945	3.06	6.00	100	6.26	0.96	10.73	1.23	18.69	16	0.0	clear
0950	3.06	6.50	100	6.26	0.96	8.23	1.27	18.76	9	0.0	clear, end purge
0955											start sample

SIGNATURE(S): Chris Jordan

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N 5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-~~MW~~23-SL-02 GW
Sample Location: PAI-45-MW23-SL
Sampled By: CD
C.O.C. No.: 041505-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Date: 4/15/05	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	NA
Time: 1135								
Method: PERISTALTIC	clear	6.89	1.34	21.63	9.13	0.85	-96	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/15/05								
Method: PERISTALTIC				salinity=	0.1			
Monitor Reading (ppm): —	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 15.25'								
Static Water Level (WL): 2.73'								
One Casing Volume (~~gal~~ L): 7.7 L								
Start Purge (hrs): 1030								
End Purge (hrs): 1130								
Total Purge Time (min): 60								
Total Vol. Purged (~~gal~~ L): 7.00 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	~~3~~ 40 mL vials	yes
		6	

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
—	FD 041505-01	Chris Jordan

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PA1-45-MW23-SL
DATE: 4/15/05

Time (Hrs)	Water Level (Ft. below TOC)		Flow (mL/Min)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	SAC %	Comments
											START PURGE
1030	2.73	Volume(L)									clear
1040	4.53	1.50	150	6.63	1.32	15.8	1.71	21.22	6	0.1	clear
1050	6.02	3.00	150	6.81	1.33	11.6	0.78	21.22	-44	0.1	clear
1100	6.48	4.00	100	6.85	1.34	10.23	0.90	21.36	-66	0.1	clear
1110	6.87	5.00	100	6.88	1.34	12.8	0.87	21.35	-81	0.1	clear
1115	6.96	5.50	100	6.89	1.34	12.2	0.88	21.41	-87	0.1	clear
1120	7.06	6.00	100	6.89	1.34	11.2	0.88	21.41	-91	0.1	clear
1125	7.19	6.50	100	6.90	1.34	10.85	0.87	21.45	-94	0.1	clear
1130	7.20	7.00	100	6.89	1.34	9.13	0.85	21.63	-96	0.1	clear, end purge
1135											begin sample

SIGNATURE(S): Clin Dooley

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: MCRD PARRIS ISLAND
Project No.: CTO 335 N5260
SWMU 45

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type:
[ ] QA Sample Type:

Sample ID No.: PAI-45-GW24-50-00
Sample Location: PAI-45-MW24-50
Sampled By: CD
C.O.C. No.: 041905-1
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	Other
Date: 4/19/05	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	NA
Time: 1230								
Method: PERISTALTIC	Clear	6.17	1.00	21.68	10	1.80	27	—

PURGE DATA:

	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Date: 4/19/05								
Method: PERISTALTIC				Salinity=	0.0			
Monitor Reading (ppm): 709	SEE LOW FLOW PURGE DATA SHEET, Page 2							
Well Casing Diameter & Material Type: 2" PVC								
Total Well Depth (TD): 7.89'								
Static Water Level (WL): 2.51'								
One Casing Volume (~~gal~~): 3.3 L								
Start Purge (hrs): 1050								
End Purge (hrs): 1225								
Total Purge Time (min): 95								
Total Vol. Purged (~~gal~~): 9.50 L								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
VOCs	HCL	~~3~~ 40 mL vials	yes
		6	

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:	Signature(s):
—	FD 041905-01	[signature]

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: MCRD PARRIS ISLAND
PROJECT NUMBER: CTO 335 N5260

WELL ID.: PAI-45-MW24-SU
DATE: 4/19/05

Time (Hrs.)	Water Level (Ft. below TOC)		Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celsius)	ORP (mV)	SAC %	Comments
1050	2.51	Volume(L)									START PURGE
1100	3.43	1.00	100	6.11	0.96	26	3.85	21.11	114	0.0	clear, chemical odor
1110	3.59	2.00	100	6.10	0.93	120	2.23	20.91	80	0.0	clear
1120	3.94	3.00	100	6.10	0.92	140	1.91	21.21	57	0.0	clear, pale yellow
1130	4.02	4.00	100	6.15	0.99	75	1.90	21.20	47	0.0	slightly cloudy, pale yellow
1140	4.16	5.00	100	6.19	1.06	55	2.12	21.41	39	0.0	slightly cloudy
1150	4.33	6.00	100	6.21	1.09	75	2.13	21.19	35	0.0	clear
1155	4.50	6.50	100	6.19	1.10	130	2.20	21.35	34	0.0	slightly cloudy
1200	4.70	7.00	100	6.21	1.10	95	2.20	21.43	34	0.0	slightly cloudy
1205	4.83	7.50	100	6.23	1.09	75	2.10	21.61	32	0.0	slightly cloudy
1210	4.94	8.00	100	6.24	1.08	55	1.98	21.57	29	0.0	slightly cloudy
1215	5.05	8.50	100	6.25	1.06	30	1.70	21.79	26	0.0	clear
1220	5.06	9.00	100	6.24	1.04	15	1.57	21.45	24	0.0	clear
1225	5.08	9.50	100	6.17	1.00	10	1.80	21.68	27	0.0	clear
1230											clear, end purge
											start sample

SIGNATURE(S): Colin Gordon

APPENDIX L

DATA VALIDATION LETTERS

Tetra Tech NUS **INTERNAL CORRESPONDENCE**

TO:	**M. SLADIC**	**DATE:**	**JULY 1, 2005**
FROM:	**ETHAN G. LEE**	**COPIES:**	**DV FILE**

SUBJECT: **ORGANIC DATA VALIDATION- VOA**
CTO 335 – MCRD PARRIS ISLAND
SAMPLE DELIVERY GROUP (SDG) – 3353

SAMPLES: 20/AQUEOUS/

FD041505-01	FD041605-01	PAI-45-GW01-D-02
PAI-45-GW02-SL-02	PAI-45-GW02-SU-02	PAI-45-GW05-SU-02
PAI-45-GW15-SL-02	PAI-45-GW15-SU-02	PAI-45-GW16-SL-02
PAI-45-GW16-SU-02	PAI-45-GW19-SL-02	PAI-45-GW19-SU-02
PAI-45-GW21-D-02	PAI-45-GW21-SL-02	PAI-45-GW21-SU-02
PAI-45-GW22-SL-02	PAI-45-GW22-SU-02	PAI-45-GW23-SL-02
PAI-45-GW23-SU-02	TB041305-01	

OVERVIEW

The sample set for CTO 335, MCRD Parris Island, SDG 3353 consists of nineteen (19) aqueous environmental samples and one (1) trip blank. Two (2) field duplicate pairs (FD041505-01 / PAI-45-GW23-SL-02; FD041605-01 / PAI-45-GW01-D-02) are included in this SDG.

All samples were analyzed for target compound list (TCL) volatile organic compounds (VOCs). The samples were collected by TetraTech NUS on April 13-16, 2005 and analyzed by Katahdin Analytical Services. All analyses were conducted in accordance with Naval Facilities Engineering Service Center (NFESC) Quality Assurance/Quality Control (QA/QC) criteria. VOC analyses were conducted using SW-846 method 8260B.

The data contained in this SDG were validated with regard to the following parameters:

- * Data completeness
- * Holding times
- * Surrogate recoveries
- Initial/continuing calibrations
- * Laboratory method/field blank results
- * Field duplicate results
- Detection Limits

The symbol (*) indicates that quality control criteria were met for this parameter. Problems affecting data quality are discussed below; documentation supporting these findings is presented in Appendix C. Qualified analytical results are presented in Appendix A. Results as reported by the laboratory are presented in Appendix B.

Initial Calibration Analyses

The initial calibration standards run on 2/25/05 between 17:21 and 21:42 and on 4/22/05 between 16:07 and 22:34 had average relative response factors (RRFs) <0.05 for acetone. Positive and nondetected results reported for acetone were qualified as estimated (J) and rejected (UR), respectively, in the associated samples.

Continuing Calibration Analyses

The continuing calibration standard run on 4/19/05 at 09:12 had a CCal RRF <0.05 for acetone. The nondetected result reported for acetone was qualified as rejected (UR) in the associated sample.

The continuing calibration standard run on 4/23/05 at 09:37 had a CCal RRF <0.05 for acetone. Positive and nondetected results reported for acetone were qualified as estimated (J) and rejected (UR), respectively, in the associated samples.

The continuing calibration standard run on 4/26/05 at 08:59 had a CCal RRF <0.05 for acetone. Positive and nondetected results reported for acetone were qualified as estimated (J) and rejected (UR), respectively, in the associated samples.

The continuing calibration standard run on 4/26/05 at 21:25 had CCal RRFs <0.05 for 2-butanone and acetone. Positive and nondetected results reported for acetone were qualified as estimated (J) and rejected (UR), respectively, in the associated samples. Nondetected results reported for 2-butanone were qualified as rejected (UR) in the associated samples.

The continuing calibration standard run on 4/27/05 at 09:27 had CCal RRFs <0.05 for 2-butanone and acetone. Positive and nondetected results reported for acetone were qualified as estimated (J) and rejected (UR), respectively, in the associated samples. Nondetected results reported for 2-butanone were qualified as rejected (UR) in the associated samples.

Laboratory Method/Field Blanks

The following compounds were detected in the laboratory method and/or trip blanks at the maximum concentration indicated below:

Compound	Maximum Concentration	Action Level
Methylene chloride[1]	2 ug/L	20 ug/L
1,2,4-Trichlorobenzene[2]	0.7 ug/L	3.5 ug/L
1,2,4-Trichlorobenzene[3]	0.6 ug/L	3.0 ug/L
1,2,4-Trichlorobenzene[4]	0.8 ug/L	4.0 ug/L
1,2,4-Trichlorobenzene[5]	0.6 ug/L	3.0 ug/L
1,1,2-Trichlorotrifluoroethane[6]	1.0 ug/L	5.0 ug/L

(1) Detected in method blank from batch WG16180.
(2) Detected in method blank from batch WG16359.
(3) Detected in method blank from batch WG16426.
(4) Detected in method blank from batch WG16444.
(5) Detected in method blank from batch WG16489.
(6) Detected in trip blank TB041305-01.

Action levels of 10X the maximum concentration for methylene chloride and 5X the maximum concentrations for the remaining analytes were established to evaluate laboratory and trip blank contamination. Dilution factors and sample aliquots were taken into consideration during the

application of all action levels. These analytes were not qualified for laboratory or trip blank contamination because the results in the associated samples were nondetects.

Detection limits

Positive results that were less than the practical quantitation limit (PQL) but above the method detection limit (MDL) were qualified as estimated (J) due to uncertainty near the detection limit.

Notes

The continuing calibration standard run on 4/19/05 at 09:12 had percent differences (%Ds) >25% for bromomethane, carbon disulfide, and cyclohexane. No action was required on this basis.

The continuing calibration standard run on 4/26/05 at 08:59 had %Ds >25% for 1,2,4-trichlorobenzene, methyl acetate, and methyl tert-butyl ether (MTBE). No action was required on this basis.

The continuing calibration standard run on 4/26/05 at 21:25 had %Ds >25% for 1,2,4-trichlorobenzene and MTBE. No action was required on this basis.

The continuing calibration standard run on 4/27/05 at 09:27 had a %D >25% for 1,2,4-trichlorobenzene. No action was required on this basis.

Samples FD041505-01 and PAI-45-GW23-SL-02 were diluted 10X for cis-1,2-dichloroethene because the concentrations exceeded the upper level of the calibration range of the instrument.

Sample PAI-45-GW21-SU-02 was diluted 10X for cis-1,2-dichloroethene, tetrachloroethene, and trichloroethene because the concentrations exceeded the upper level of the calibration range of the instrument.

Sample PAI-45-GW22-SU-02 was diluted 100X for cis-1,2-dichloroethene, tetrachloroethene, trans-1,2-dichloroethene, trichloroethene, and vinyl chloride because the concentrations exceeded the upper level of the calibration range of the instrument.

Sample PAI-45-GW23-SU-02 was diluted 20X for cis-1,2-dichloroethene, trichloroethene, and vinyl chloride because the concentrations exceeded the upper level of the calibration range of the instrument.

The result for 2-butanone in sample PAI-45-GW22-SU-02 was reported incorrectly in the electronic data deliverable (EDD). The data reviewer corrected the database.

EXECUTIVE SUMMARY

Laboratory Performance Issues: Several analytes were qualified due to calibration noncompliance.

Other factors affecting data quality: Several analytes were qualified due to uncertainty near the detection limit.

The data for these analyses were reviewed with reference to the EPA Functional Guidelines for Organic Data Validation (10/99) and the NFESC guidelines IRCDQM (Sept., 1999). The text of this report has been formulated to address only those problem areas affecting data quality.

"I attest that the data referenced herein were validated according to the agreed upon validation criteria as specified in the NFESC guidelines and the Quality Assurance Project Plan (QAPP)."

Tetra Tech NUS
Ethan G. Lee
Environmental Scientist

TetraTech NUS
Joseph A. Samchuck
Data Validation Quality Assurance Officer

Attachments:

Appendix A – Qualified Analytical Results
Appendix B – Results as Reported by the Laboratory
Appendix C – Support Documentation

Tetra Tech NUS **INTERNAL CORRESPONDENCE**

TO:	**M. SLADIC**	**DATE:**	**JULY 1, 2005**
FROM:	**ETHAN G. LEE**	**COPIES:**	**DV FILE**

SUBJECT: **ORGANIC DATA VALIDATION- VOA**
CTO 335 – MCRD PARRIS ISLAND
SAMPLE DELIVERY GROUP (SDG) – 3354

SAMPLES: 19/AQUEOUS/

FD041905-01	PAI-45-GW06-D-02	PAI-45-GW07-D-02
PAI-45-GW10-SL-02	PAI-45-GW10-SU-02	PAI-45-GW13-SL-02
PAI-45-GW13-SU-02	PAI-45-GW14-SL-02	PAI-45-GW14-SU-02
PAI-45-GW17-SL-02	PAI-45-GW17-SU-02	PAI-45-GW18-SL-02
PAI-45-GW18-SU-02	PAI-45-GW20-SL-02	PAI-45-GW20-SU-02
PAI-45-GW24-SU-02	PAI-45-WB-041805-01	TB041505-01
TB041805-01		

OVERVIEW

The sample set for CTO 335, MCRD Parris Island, SDG 3354 consists of sixteen (16) aqueous environmental samples, one (1) source water blank (PAI-45-WB-041805-01), and two (2) trip blanks. One (1) field duplicate pair (FD041905-01 / PAI-45-GW24-SU-02) is included in this SDG.

All samples were analyzed for target compound list (TCL) volatile organic compounds (VOCs). The samples were collected by TetraTech NUS on April 15, 17, 18, and 19, 2005 and analyzed by Katahdin Analytical Services. All analyses were conducted in accordance with Naval Facilities Engineering Service Center (NFESC) Quality Assurance/Quality Control (QA/QC) criteria. VOC analyses were conducted using SW-846 Method 8260B.

The data contained in this SDG were validated with regard to the following parameters:

- * Data completeness
- * Holding times
- * Surrogate recoveries
- Initial/continuing calibrations
- * Laboratory method/field blank results
- Field duplicate results
- Detection Limits

The symbol (*) indicates that quality control criteria were met for this parameter. Problems affecting data quality are discussed below; documentation supporting these findings is presented in Appendix C. Qualified analytical results are presented in Appendix A. Results as reported by the laboratory are presented in Appendix B.

Initial Calibration Analyses

The initial calibration standard run on 4/22/05 between 16:07 and 22:34 had an average relative response factor (RRF) <0.05 for acetone. Positive and nondetected results reported for acetone were qualified as estimated (J) and rejected (UR), respectively, in the associated samples.

Continuing Calibration Analyses

The continuing calibration standard run on 4/26/05 at 20:43 had a %D >25% and a CCal RRF <0.05 for acetone. Positive and nondetected results reported for acetone were qualified as estimated (J) and rejected (UR), respectively, in the associated samples.

The continuing calibration standard run on 4/27/05 at 08:43 had a CCal RRF <0.05 for acetone. Positive and nondetected results reported for acetone were qualified as estimated (J) and rejected (UR), respectively, in the associated samples.

The continuing calibration standard run on 4/27/05 at 09:27 had CCal RRFs <0.05 for 2-butanone and acetone. Nondetected results reported for 2-butanone and acetone were qualified as rejected (UR) in the associated samples. Positive results reported for acetone were qualified as estimated (J) in the associated samples.

The continuing calibration standard run 4/28/05 at 07:32 had a CCal RRF <0.05 for acetone. Positive results reported for acetone were qualified as estimated (J) in the associated samples.

Laboratory Method/Field Blanks

The following compounds were detected in the laboratory method and/or trip blanks at the maximum concentration indicated below:

Compound	Maximum Concentration	Action Level
Trichloroethene[1]	0.5 ug/L	2.5 ug/L
1,2,4-Trichlorobenzene[1]	0.4 ug/L	2.0 ug/L
1,2,4-Trichlorobenzene[2]	0.6 ug/L	3.0 ug/L
Trichloroethene[3]	4 ug/L	20 ug/L
1,2,4-Trichlorobenzene[3]	0.8 ug/L	4.0 ug/L
1,2,4-Trichlorobenzene[4]	0.7 ug/L	3.5 ug/L
1,1,2-Trichlorotrifluoroethane[5]	0.4 ug/L	2.0 ug/L
Acetone[5]	2 ug/L	20 ug/L
Trans-1,2-dichloroethene[5]	0.3 ug/L	1.5 ug/L
1,1,1-Trichloroethane[5]	0.2 ug/L	1.0 ug/L
1,2-Dichloroethane[5]	0.4 ug/L	2.0 ug/L
Toluene[5]	0.4 ug/L	2.0 ug/L
1,2,4-Trichlorobenzene[5]	0.6 ug/L	3.0 ug/L
Methylcyclohexane[5]	0.5 ug/L	2.5 ug/L

(1) Detected in method blank from batch WG16490.
(2) Detected in method blank from batch WG16489.
(3) Detected in method blank from batch WG16528.
(4) Detected in method blank from batch WG16565.
(5) Detected in method blank from batch WG16606.

Action levels of 10X the maximum concentration for acetone and 5X the maximum concentrations for the remaining analytes were established to evaluate laboratory blank contamination. Dilution factors and sample aliquots were taken into consideration during the application of all action levels. These analytes were not qualified for laboratory blank contamination because the results in the associated samples were either above the action levels or they were nondetects.

Field Duplicate Precision

Field duplicate imprecision (RPD >30%) was noted for 1,1-dichloroethane for field duplicate pair FD041905-01 / PAI-45-GW24-SU-02. Positive results reported for 1,1-dichloroethane were qualified as estimated (J) in this field duplicate pair only.

Detection limits

Positive results that were less than the practical quantitation limit (PQL) but above the method detection limit (MDL) were qualified as estimated (J) due to uncertainty near the detection limit.

Notes

The continuing calibration standard run on 4/26/05 at 20:43 had percent differences (%Ds) >25% for 1,2,4-trichlorobenzene, bromomethane, and total xylenes. No action was taken on this basis.

The continuing calibration standard run on 4/27/05 at 08:43 had a %D >25% for total xylenes. No action was taken on this basis.

The continuing calibration standard run on 4/27/05 at 09:27 had a %D >25% for 1,2,4-trichlorobenzene. No action was taken on this basis.

The continuing calibration standard run on 4/28/05 at 07:32 had a %D >25% for 1,2,4-trichlorobenzene. No action was taken on this basis.

The continuing calibration standard run on 4/28/05 at 17:02 had CCal RRFs <0.05 for 2-butanone and acetone. No qualification action was required because the associated samples did not report results for these analytes.

The continuing calibration standard run on 4/29/05 at 10:34 had a CCal RRF <0.05 for acetone. No qualification action was required because the associated sample did not report a result for acetone.

Samples FD041905-01 and PAI-45-GW24-SU-02 were diluted 20X for all analytes except cis-1,2-dichloroethene and trichloroethene. This resulted in elevated reporting limits.

Samples FD041905-01 and PAI-45-GW24-SU-02 were diluted 500X for cis-1,2-dichloroethene and trichloroethene because the concentrations exceeded the upper level of the calibration range of the instrument.

Sample PAI-45-GW10-SL-02 was diluted 20X for trichloroethene because the concentration exceeded the upper level of the calibration range of the instrument.

Sample PAI-45-GW10-SU-02 was diluted 5X for trichloroethene because the concentration exceeded the upper level of the calibration range of the instrument.

Sample PAI-45-GW13-SL-02 was diluted 5X for cis-1,2-dichloroethene because the concentration exceeded the upper level of the calibration range of the instrument.

Sample PAI-45-GW20-SL-02 was diluted 100X for cis-1,2-dichloroethene, tetrachloroethene, and trichloroethene because the concentrations exceeded the upper level of the calibration range of the instrument.

Sample PAI-45-GW20-SU-02 was diluted 50X for cis-1,2-dichloroethene, tetrachloroethene, and trichloroethene because the concentrations exceeded the upper level of the calibration range of the instrument.

EXECUTIVE SUMMARY

Laboratory Performance Issues: Several analytes were qualified due to calibration noncompliance.

Other factors affecting data quality: 1,1-dichloroethane was qualified due to field duplicate imprecision. Several analytes were qualified due to uncertainty near the detection limit.

The data for these analyses were reviewed with reference to the EPA Functional Guidelines for Organic Data Validation (10/99) and the NFESC guidelines IRCDQM (Sept., 1999). The text of this report has been

formulated to address only those problem areas affecting data quality.

"I attest that the data referenced herein were validated according to the agreed upon validation criteria as specified in the NFESC guidelines and the Quality Assurance Project Plan (QAPP)."

Tetra Tech NUS
Ethan G. Lee
Environmental Scientist

TetraTech NUS
Joseph A. Samchuck
Data Validation Quality Assurance Officer

Attachments:

Appendix A – Qualified Analytical Results
Appendix B – Results as Reported by the Laboratory
Appendix C – Support Documentation

Tetra Tech NUS **INTERNAL CORRESPONDENCE**

TO:	**M. SLADIC**	**DATE:**	**JULY 11, 2005**
FROM:	**BERNARD F SPADA III**	**COPIES:**	**DV FILE**

SUBJECT: **ORGANIC DATA VALIDATION- VOA/SVOC/PEST/HERB**
CTO 335, MCRD PARRIS ISLAND
SDG 3351

SAMPLES: 21/Aqueous

FD021405-01	FD022405-01	PAI-45-GW03-SL-02
PAI-45-GW03-SU-02	PAI-45-GW04-D-02	PAI-45-GW04-SL-02
PAI-45-GW04-SU-02	PAI-45-GW05-SL-02	PAI-45-GW06-SL-02
PAI-45-GW06-SU-02	PAI-45-GW07-SL-02	PAI-45-GW07-SU-02
PAI-45-GW08-SL-02	PAI-45-GW08-SU-02	PAI-45-GW09-D-02
PAI-45-GW-AMW-2-02	PAI-45-GW-AMW-5-02	RB022505-01
TB021405-01	TB022305-01	TB022505-01

OVERVIEW

The sample set for CTO 335 MCRD Parris Island, SDG 3351 consists of fifteen (15) environmental aqueous samples, one (1) rinse blank, three (3) trip blanks, and two (2) field duplicates. The samples were analyzed for Target Compound List (TCL) volatile organic compounds (VOC). The field duplicate pairs included within this SDG are (FD021405-01 / PAI-45-GW07-SU-02) and (FD022405-01 / PAI-45-GW08SL-02).

The samples were collected by TetraTech NUS on February 14, 15, 23, 24, and 25, 2005 and analyzed by Katahdin Analytical Services. All analyses were conducted in accordance with Naval Facilities Engineering Service Center (NFESC) Quality Assurance/Quality Control (QA/QC) criteria using SW-846 Method 8260B analysis and reporting protocols. The data contained in this SDG were validated with regard to the following parameters:

* • Data completeness
* • Holding times
• Initial/continuing calibrations
• Field/Laboratory method blank results
* • Detection Limits
* • Field Duplicate Precision

The symbol (*) indicates that quality control criteria were met for this parameter. Problems affecting data quality are discussed below; documentation supporting these findings is presented in Appendix C. Qualified Analytical results are presented in Appendix A. Results as reported by the laboratory are presented in Appendix B.

Volatiles

The initial calibration performed on February 25, 2005 on the GCMS-M instrument and all associated continuing calibrations were below the 0.05 relative response factor (RRF) quality control criterion for acetone. Non-detected results for acetone were rejected (UR) in samples FD022405-01, PAI-45-GW04-D-02, PAI-45-GW08SL-02, and PAI-45-GW08-SU-02.

The initial calibration performed on February 11, 2005 on the GCMS-Z instrument was below the 0.05 RRF quality control criterion for acetone and 2-butanone. All associated continuing calibrations were also below the 0.05 RRF criterion for acetone. Positive and non-detected results for acetone and 2-butanone were qualified as estimated (J) and rejected (UR) respectively, in samples TB021405-01, PAI-45-GW06-SU-02, PAI-45-GW06-SL-02, PAI-45-GW07-SL-02, PAI-45-GW03-SL-02, FD021405-01, PAI-45-GW07-SU-02, PAI-45-GW03-SU-02, and PAI-45-GW-AMW-5-02.

The initial calibration performed on February 24, 2005 on the GCMS-Z instrument and the associated continuing calibration was below the 0.05 RRF quality control criterion for acetone. The associated continuing calibration performed on February 28 at 08:04 was below the RRF criterion for 2-butanone. Positive and non-detected results for acetone and 2-butanone were qualified as estimated (J) and rejected (UR) respectively, in samples TB022305-05, PAI-45-GW04-SL-02, and PAI-45-GW04-SU-02.

The continuing calibration performed on February 21 at 07:35 on the GCMS-Z instrument was also below the 0.05 RRF quality control criterion for 2-butanone. No action was taken on this basis because no results for 2-butanone associated with this calibration were used for validation.

The continuing calibration performed on March 2 at 08:53 on the GCMS-M instrument was also below the 0.05 RRF quality control criterion for 2-butanone. No action was taken on this basis because no results for 2-butanone used for validation were associated with this calibration.

The following compounds were detected in the method blanks:

Compound	Maximum Concentration	Blank Action Level
Methylcyclohexane	0.4 ug/L	2.0 ug/L
1,2,4-Trichlorobenzene	0.5 ug/L	2.5 ug/L
Trichloroethene	0.7 ug/L	3.5 ug/L
Methylene chloride	3.0 ug/L	30 ug/L

Dilution factors and sample aliquots were taken into consideration during the application of all action levels. Positive results for the aforementioned compounds below the action level were qualified as non-detected (U). Field quality control blanks were not qualified due to method blank contamination.

The results for cis-1,2-dichloroethene exceeded the 30% relative percent difference quality control criterion in the field duplicate pair FD021405-01 and PAI-45-GW07-SU-02. No action was taken on this basis because the difference between results was <2X the reporting limit.

Additional Comments:

Positive results reported below the quantitation limit but above the method detection limit were qualified as estimated (J).

The sample names on the chains of custody were inconsistent. The reviewer added or removed dashes to make the sample naming format consistent.

EXECUTIVE SUMMARY

Laboratory Performance Issues: Qualifications were made based on calibration non-compliances and method blank contamination.

Other Factors Affecting Data Quality: None.

The data for these analyses were reviewed with reference to the EPA Functional Guidelines for Organic Data Validation (10/99), and the NFESC guidelines IRCDQM (Sept., 1999). The text of this report has been formulated to address only those problem areas affecting data quality.

"I attest that the data referenced herein were validated according to the agreed upon validation criteria as specified in the NFESC guidelines and the Quality Assurance Project Plan (QAPP)."

Tetra Tech NUS
Bernard F Spada III
Chemist/Data Validator

TetraTech NUS
Joseph A. Samchuck
Data Validation Quality Assurance Officer

Attachments:

Appendix A – Qualified Analytical Results
Appendix B – Results as Reported by the Laboratory
Appendix C – Support Documentation

Tetra Tech NUS **INTERNAL CORRESPONDENCE**

TO:	**M. SLADIC**	**DATE:**	**JULY 11, 2005**
FROM:	**BERNARD F SPADA III**	**COPIES:**	**DV FILE**
SUBJECT:	**ORGANIC DATA VALIDATION- VOC CTO 335, MCRD PARRIS ISLAND SDG 3352**		
SAMPLES:	18/Aqueous		

FD031105-01	PAI-45-TW107-SL-12	PAI-45-TW108-SL-15
PAI-45-TW108-SU-08	PAI-45-TW109-SL-16	PAI-45-TW109-SU-08
PAI-45-TW118-SL-11	PAI-45-TW119-SL-15	PAI-45-TW125-SL-16
PAI-45-TW134-SL-15	PAI-45-TW134-SU-08	PAI-45-TW138-SL-16
PAI-45-TW138-SU-11	PAI-45-TW146-SL-10	PAI-45-TW148-SL-12
PAI-45-TW158-SL-11	TB031005-01	TB031205-01

OVERVIEW

The sample set for CTO 335 MCRD Parris Island, SDG 3352 consists of fifteen (15) environmental aqueous samples, two (2) trip blanks, and one (1) field duplicate. The samples were analyzed for Target Compound List (TCL) volatile organic compounds (VOC). The field duplicate pair included within this SDG is FD031105-01 and PAI-45-TW134-SL-15.

The samples were collected by TetraTech NUS on March 10, 11, and 12, 2005 and analyzed by Katahdin Analytical Services. All analyses were conducted in accordance with Naval Facilities Engineering Service Center (NFESC) Quality Assurance/Quality Control (QA/QC) criteria using SW-846 Method 8260B analysis and reporting protocols. The data contained in this SDG were validated with regard to the following parameters:

* • Data completeness
* • Holding times
• Initial/continuing calibrations
• Field/Laboratory method blank results
* • Field duplicate precision
* • Detection Limits

The symbol (*) indicates that quality control criteria were met for this parameter. Problems affecting data quality are discussed below; documentation supporting these findings is presented in Appendix C. Qualified Analytical results are presented in Appendix A. Results as reported by the laboratory are presented in Appendix B.

Volatiles

The initial calibration performed on February 25, 2005 and all continuing calibrations were below the 0.05 relative response factor (RRF) quality control criterion for acetone. Non-detected results for acetone were rejected (UR) in all samples.

The continuing calibration performed on March 15 at 08:18 on the GCMS-M instrument was also below the 0.05 RRF quality control criterion for 2-butanone. Non-detected results for 2-butanone were rejected (UR) in samples PAI-45-TW134-SU-08, PAI-45-TW134-SL-15, PAI-45-TW138-SU-11, PAI-45-TW107-SL-12, PAI-45-TW146-SL-10, and PAI-45-TW119-SL-15. No action was taken for the remaining associated samples on this basis because no results for 2-butanone were used for validation.

The following compounds were detected in the method blanks:

Compound	Maximum Concentration	Blank Action Level
cis-1,2-Dichloroethene	0.4 ug/L	2.0 ug/L
Trichloroethene	0.7 ug/L	3.5 ug/L
Methylene chloride	3.0 ug/L	30 ug/L

Dilution factors and sample aliquots were taken into consideration during the application of all action levels. Positive results for the aforementioned compounds below the action level were qualified as non-detected (U). Field quality control blanks were not qualified due to method blank contamination.

Samples FD031105-01, PAI-45-TW107-SL-12, PAI-45-TW109-SL-16, PAI-45-TW109-SU-08, PAI-45-TW119-SL-15, PAI-45-TW125-SL-16, PAI-45-TW134-SL-15, PAI-45-TW138-SL-16, PAI-45-TW138-SU-11, PAI-45-TW146-SL-10, and PAI-45-TW148-SL-12 were re-analyzed at dilutions because the concentration of target analytes exceeded the linear calibration range of the instruments. The on-range results were used for validation.

The results for tetrachloroethene and toluene exceeded the linear calibration range of the instrument in sample PAI-TW109-SU-08. The sample was not re-analyzed within calibration range. The results for tetrachloroethene and toluene were qualified as estimated (J) in sample PAI-TW109-SU-08.

Additional Comments:

Positive results reported below the quantitation limit but above the method detection limit were qualified as estimated (J).

The sample names on the chains of custody were inconsistent. The reviewer added or removed dashes to make the sample naming format consistent.

EXECUTIVE SUMMARY

Laboratory Performance Issues: Qualifications were made based on calibration non-compliances and method blank contamination.

Other Factors Affecting Data Quality: None.

The data for these analyses were reviewed with reference to the EPA Functional Guidelines for Organic Data Validation (10/99), and the NFESC guidelines IRCDQM (Sept., 1999). The text of this report has been formulated to address only those problem areas affecting data quality.

"I attest that the data referenced herein were validated according to the agreed upon validation criteria as specified in the NFESC guidelines and the Quality Assurance Project Plan (QAPP)."

Bernard F Spada III

Tetra Tech NUS
Bernard F Spada III
Chemist/Data Validator

Tetra Tech NUS
Joseph A. Samchuck
Data Validation Quality Assurance Officer

Attachments:
Appendix A – Qualified Analytical Results
Appendix B – Results as Reported by the Laboratory
Appendix C – Support Documentation

APPENDIX M

GROUNDWATER LEVEL MEASUREMENT SHEETS

Tetra Tech NUS, Inc.

GROUNDWATER LEVEL MEASUREMENT SHEET

Project Name: MCRD PI
Project No.: N5260
Location: SITE 45
Personnel: CONTI / DOOLAN
Weather Conditions:
Measuring Device:
Tidally Influenced: Yes ___ No ✓
Remarks:

Well or Piezometer Number	Date	Time	Elevation of Reference Point (feet)*	Total Well Depth (feet)*	Water Level Indicator Reading (feet)*	Thickness of Free Product (feet)*	Groundwater Elevation (feet)	Comments
MW01SU	4-26	0905			2.33			
MW01SL		0903			2.36			
MW01D		0904			4.27			
MW02SU		0927			2.51			
MW02SL		0926			2.37			
MW03SU		0920			2.94			
MW03SL		0921			2.97			
MW04SU		0846			2.67			
MW04SL		0847			2.68			
MW04D		0848			3.55			
MW05SU		0854			4.65			
MW05SL		0852			4.26			
MW05D		0853			5.40			
MW06SU		0915			3.44			
MW06SL		0914			2.96			
MW06D		0916			4.17			
MW07SU		0911			3.02			
MW07SL		0910			3.04			
MW07D		0909			4.35			
MW08SU		0908			2.80			
MW08SL		0907			2.72			
* MW09D		0851			4.02			
MW10D		0927			3.95			
MW11D		0837			3.97			

* All measurements to the nearest 0.01 foot

Tetra Tech NUS, Inc.

GROUNDWATER LEVEL MEASUREMENT SHEET

Project Name: MCRD PI
Project No.: N5260
Location:
Personnel:
Weather Conditions:
Measuring Device:
Tidally Influenced: Yes ___ No ✓
Remarks:

Well or Piezometer Number	Date	Time	Elevation of Reference Point (feet)*	Total Well Depth (feet)*	Water Level Indicator Reading (feet)*	Thickness of Free Product (feet)*	Groundwater Elevation (feet)*	Comments
PZ 09S		0908			2.76			
PZ 10S		0912			2.99			
PZ 11S		0913			2.83			
MW10SU		0919			2.42			
MW10SL		0920			2.35			
MW 13SU		0917			3.16			
MW13SL		0918			3.05			
MW14SU		0901			2.62			
MW14SL		0900			2.36			
MW15SU		0857			4.83			
MW15SL		0858			4.62			
MW16SU		0855			6.27			
MW16SL		0856			6.16			
MW17SU		0850			3.42			
MW17SL		0849			3.22			
MW18SU		0841			2.75			
MW18SL		0840			3.53			
MW19SU		0839			2.21			
MW19SL		0838			2.14			
MW 20SU		0842			3.90			
MW20SL		0843			3.69			
MW 21SU		0923			2.59			
MW21SL		0924			2.53			
MW21D		0925			3.98			

* All measurements to the nearest 0.01 foot

Tetra Tech NUS, Inc.

GROUNDWATER LEVEL MEASUREMENT SHEET

Project Name: MCRD - PI
Project No.: N5260
Location:
Personnel:
Weather Conditions:
Measuring Device:
Tidally Influenced: Yes ___ No ✓
Remarks:

Well or Piezometer Number	Date	Time	Elevation of Reference Point (feet)*	Total Well Depth (feet)*	Water Level Indicator Reading (feet)*	Thickness of Free Product (feet)*	Groundwater Elevation (feet)*	Comments
MW22SU	4/26	0929			2.63			
MW22SL		0928			2.52			
MW23SU		0859			3.07			
MW23SL		0858			3.41			
MW24SU		0930			2.78			

(5)

* All measurements to the nearest 0.01 foot

Page ____ of ____

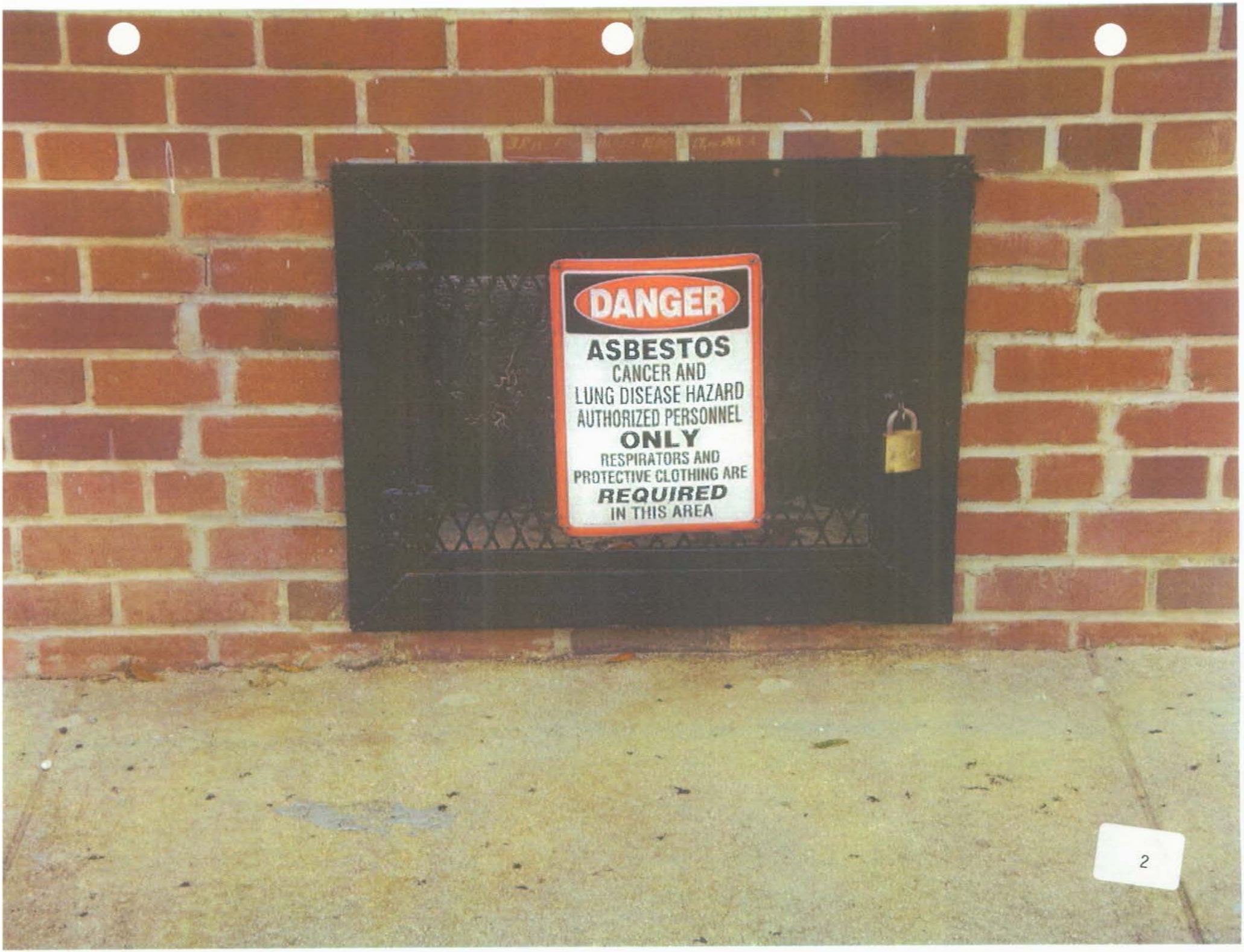
24
29

APPENDIX N

SITE 45 PHOTOGRAPHS

Photo	Description
1	Rear of Building 293 – Depot Law Center from parking area (facing/looking Southeast).
2	Locked crawl space access of Building 293 (rear of building)
3	Front of Depot Law Center – Building 293 (facing/looking West)
4	Front entrance of Depot Law Center – Building 293 (facing/looking Northwest)
5	Front of Building 200 – Temporary Housing Building (lobby and registration area facing West)
6	Rear of Building 200 – Temporary Housing Building
7	Close-up of foundation slab of Building 200 – Temporary Housing Building (rear)
8	Rear corner of Building 200 – Temporary Housing Building (rear facing Southeast)
9	Southwest corner of Building 200 (front) – Temporary Housing Building (facing/looking Northeast)

1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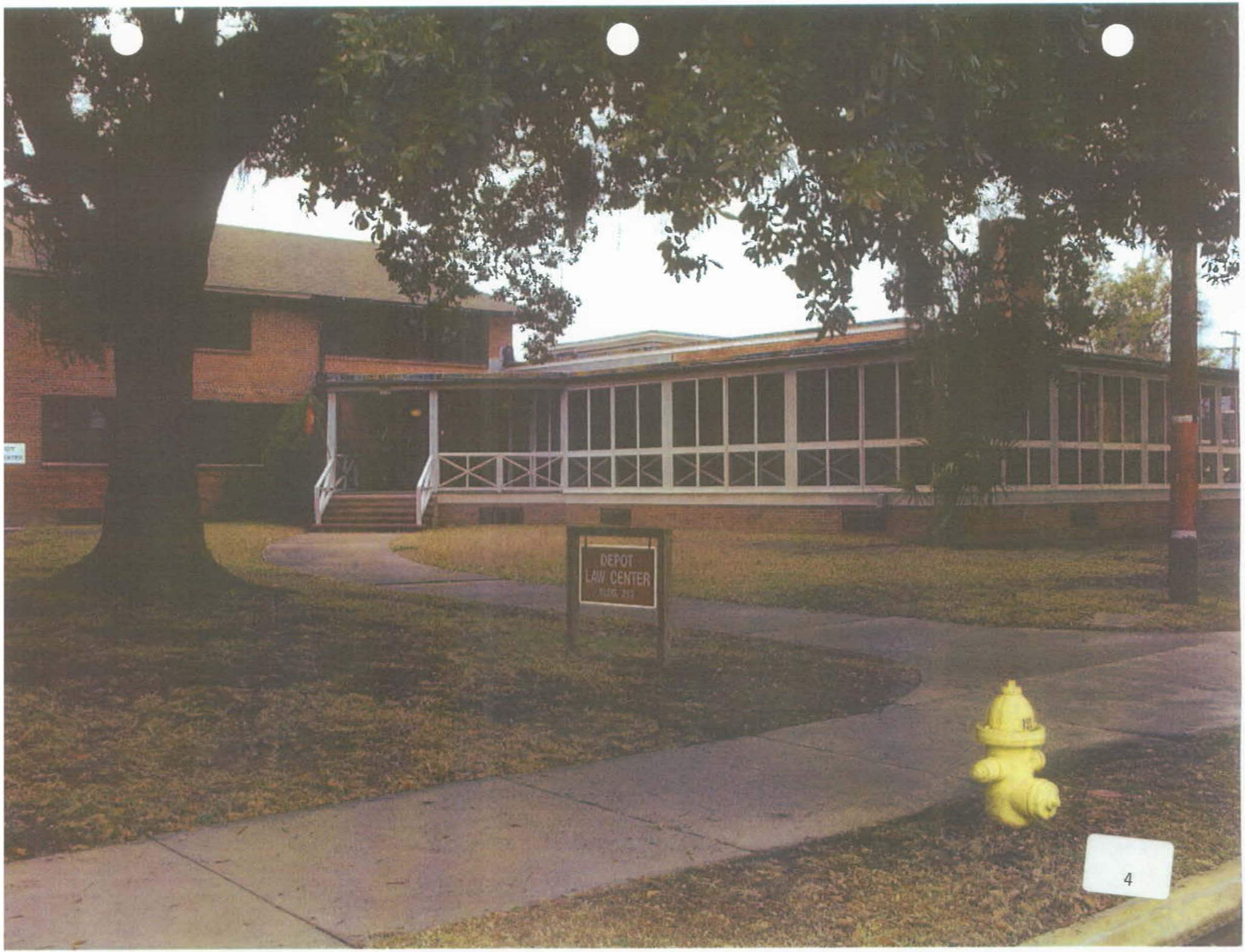
ASBESTOS
CANCER AND
LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL
ONLY
RESPIRATORS AND
PROTECTIVE CLOTHING ARE
REQUIRED
IN THIS AREA
2

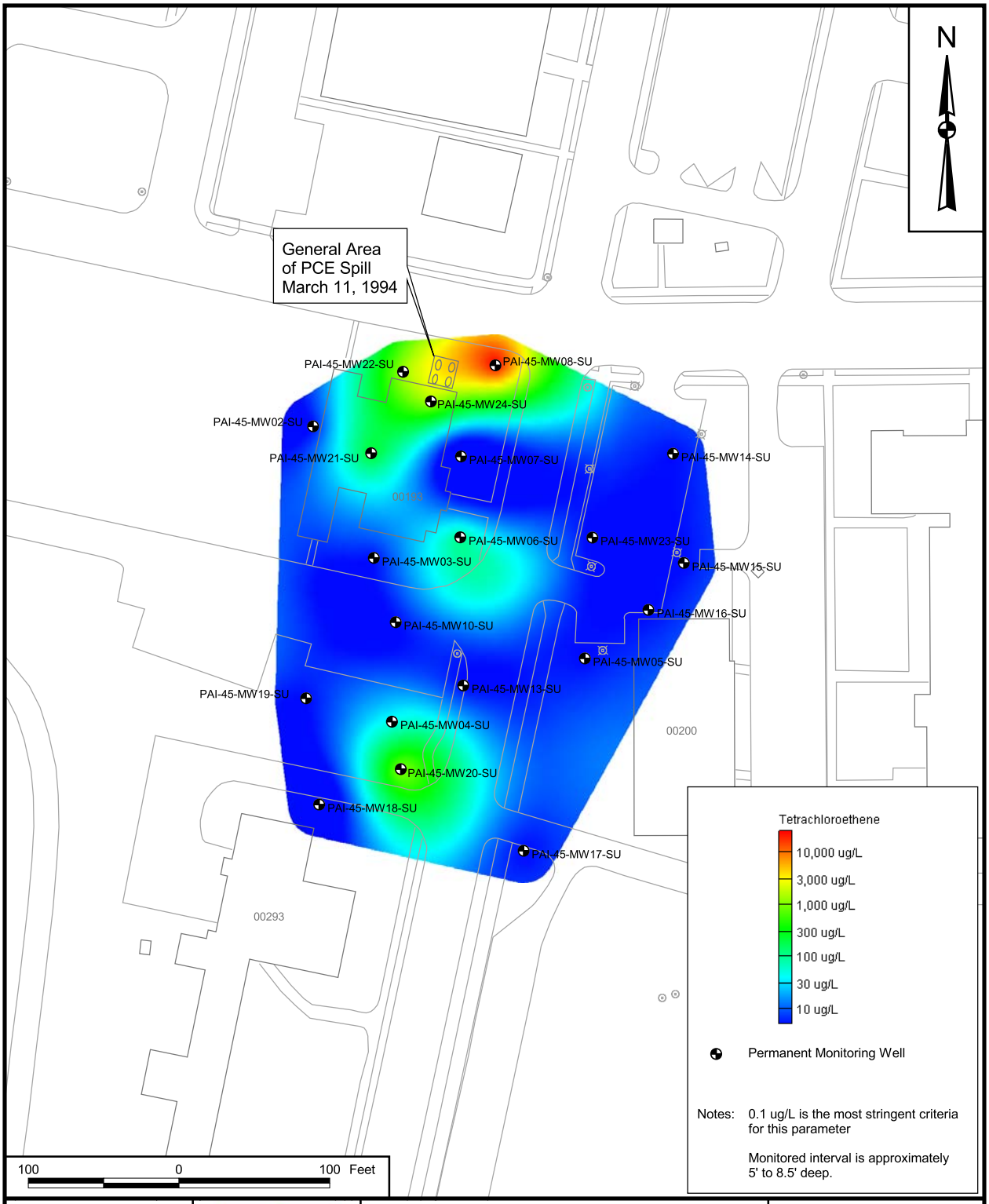

DEPOT
LAW CENTER
4

FX4
OFF ROAD

L

8

6



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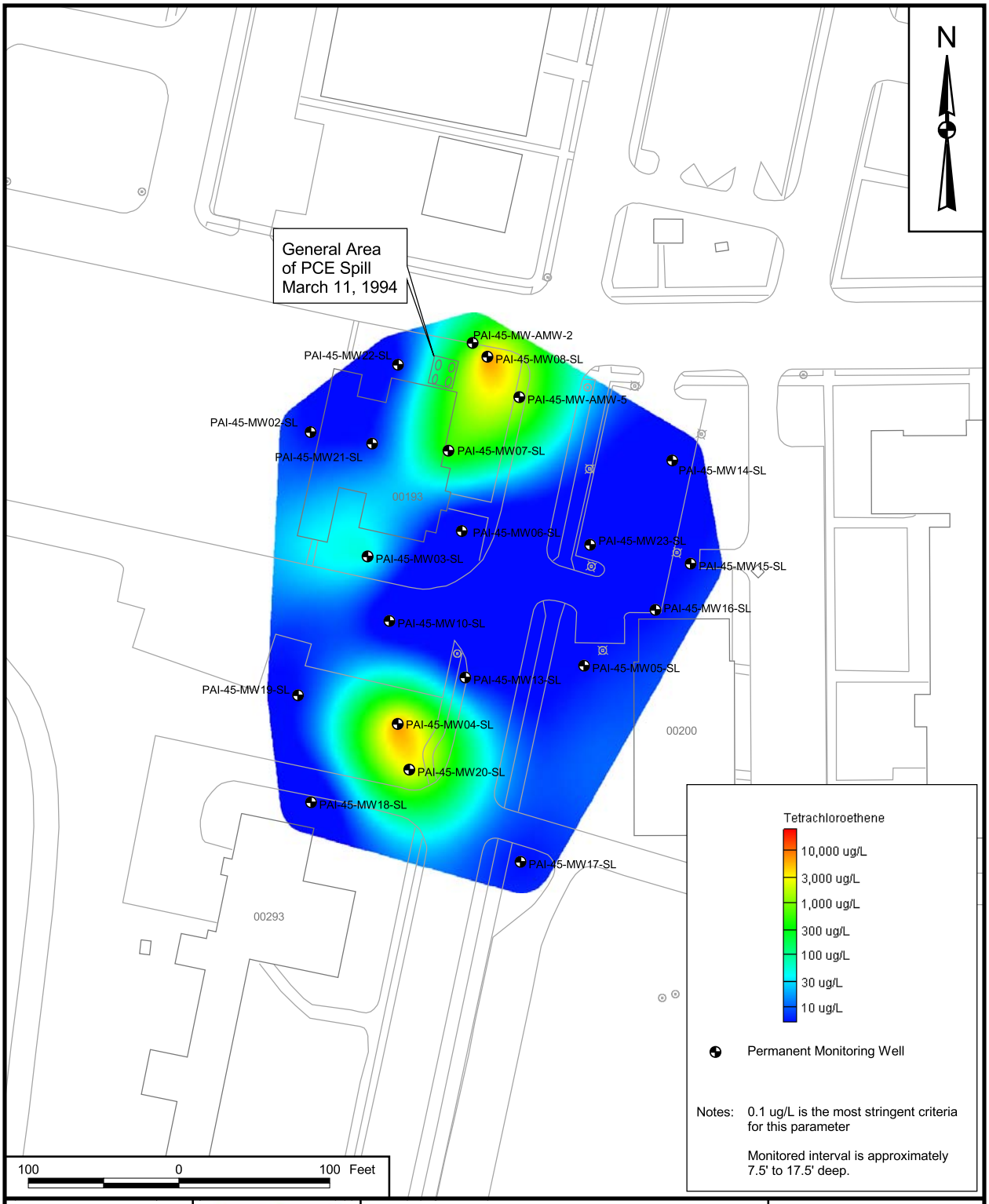
A. JANOCHA	9/12/05			N5260
CHECKED BY	DATE			APPROVED BY / DATE
M. FRANCIS	9/12/05			___ / ___
COST/SCHEDULE-AREA				APPROVED BY / DATE
				___ / ___
SCALE				DRAWING NO. / REV
AS NOTED				FIGURE 4 - 3 / 0

NAVFAC

PCE IN SURFICIAL UPPER WELLS
SWMU 45 (MONITORING WELLS ONLY)
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS_MW_ONLY.APR PCE SHALLOW LAYOUT 9/12/05 AJ



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A. JANOCHA	9/12/05
CHECKED BY	DATE
M. FRANCIS	9/12/05
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

NAVFAC

PCE IN SURFICIAL LOWER WELLS
SWMU 45 (MONITORING WELLS ONLY)
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
N5260	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	REV
FIGURE 4 - 4	0

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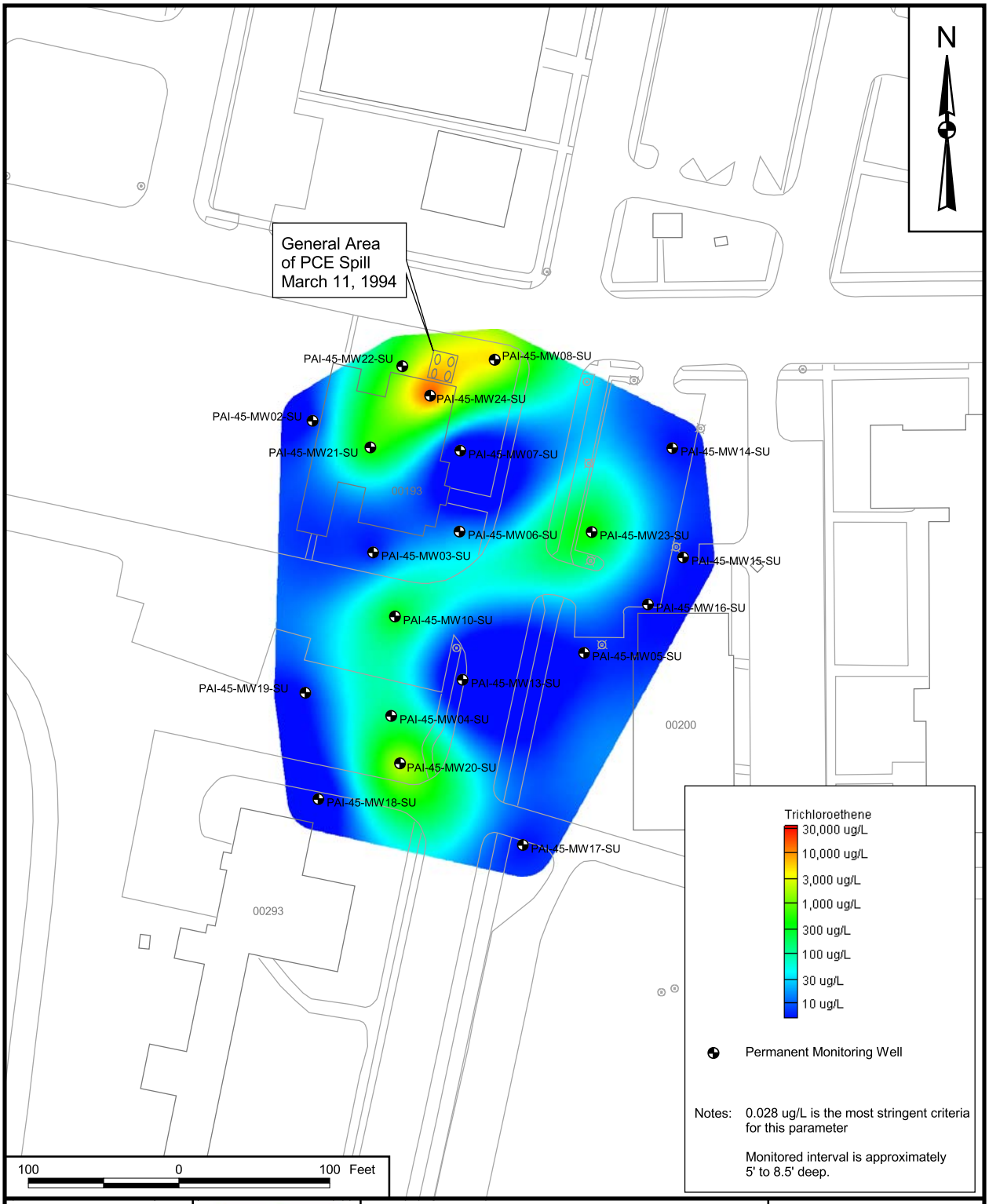

DRAWN BY	DATE
A. JANOCHA	9/12/05
CHECKED BY	DATE
M. FRANCIS	9/12/05
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

NAVFAC

TCE IN SURFICIAL UPPER WELLS
SWMU 45 (MONITORING WELLS ONLY)
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
N5260	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	REV
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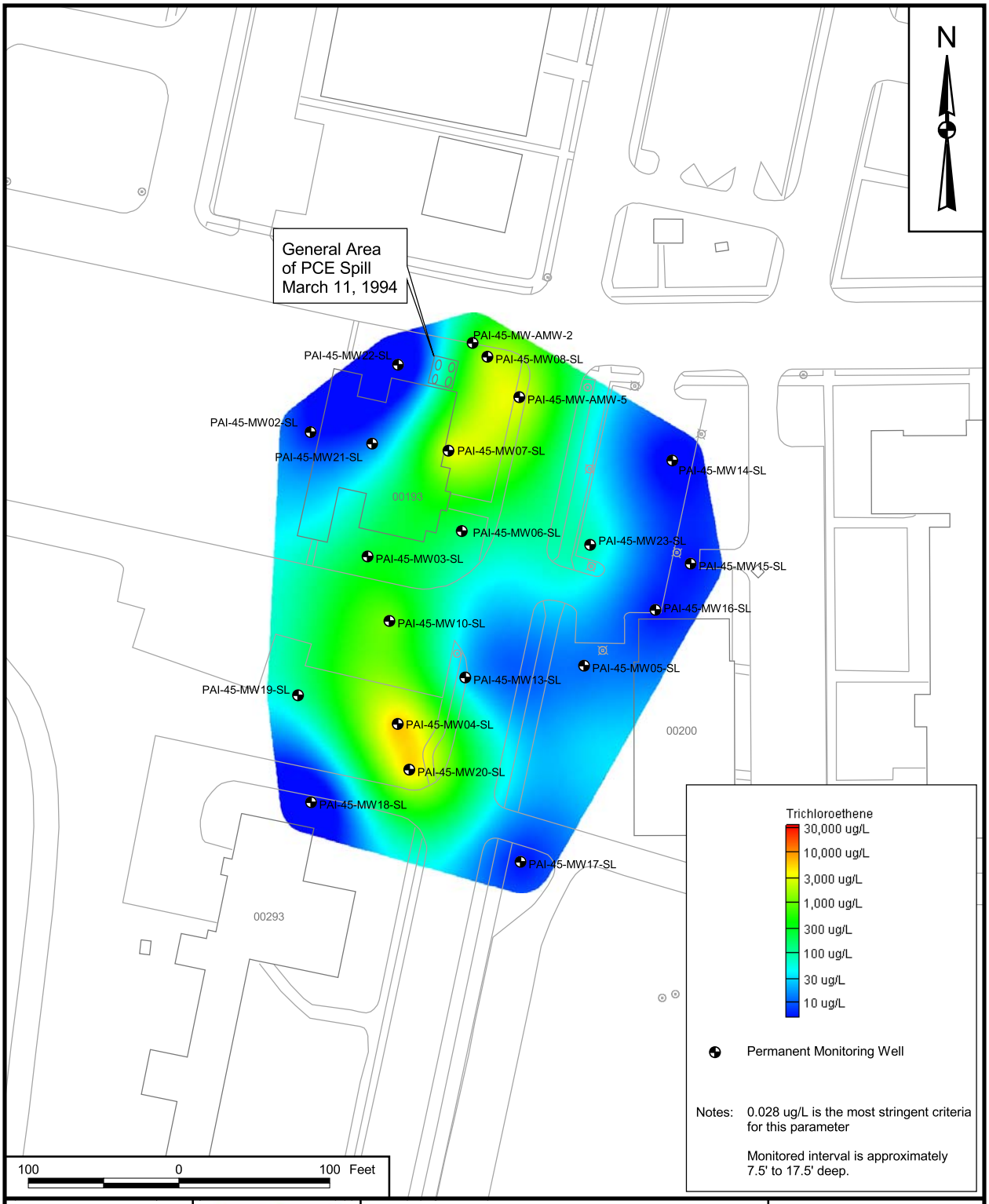

DRAWN BY	DATE
A. JANOCHA	9/12/05
CHECKED BY	DATE
M. FRANCIS	9/12/05
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

NAVFAC

TCE IN SURFICIAL LOWER WELLS
SWMU 45 (MONITORING WELLS ONLY)
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
N5260	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	REV
FIGURE 4 - 6	0

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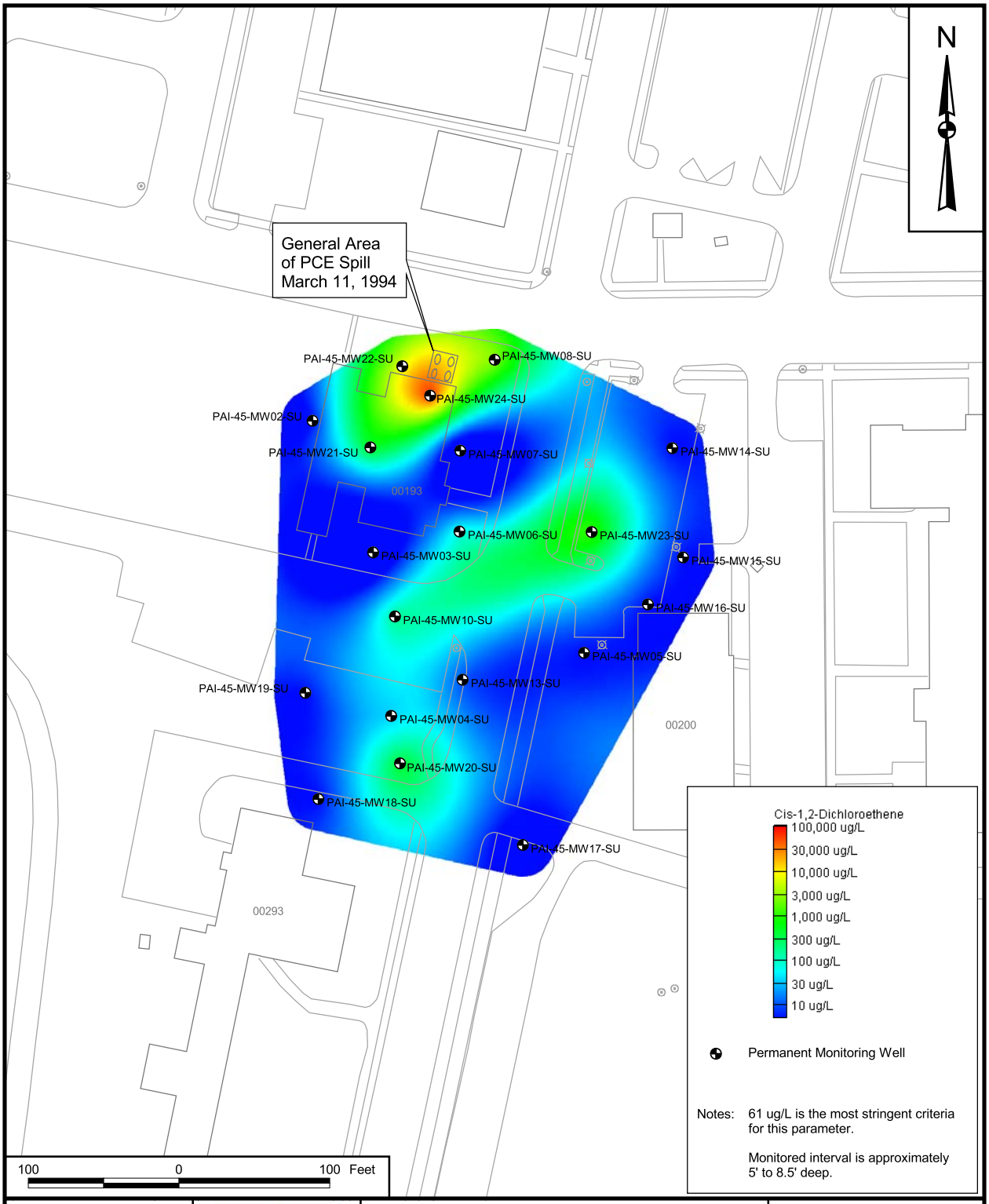

DRAWN BY	DATE		CIS-1,2-DICHLOROETHENE IN SURFICIAL UPPER WELLS	CONTRACT NUMBER N5260	
A. JANOCHA	9/12/05		SWMU 45 (MONITORING WELLS ONLY)	APPROVED BY ___	DATE ___
CHECKED BY	DATE		MCRD PARRIS ISLAND	APPROVED BY ___	DATE ___
M. FRANCIS	9/12/05		PARRIS ISLAND, SOUTH CAROLINA		
COST/SCHEDULE-AREA				DRAWING NO. FIGURE 4 - 7	REV 0
SCALE AS NOTED					

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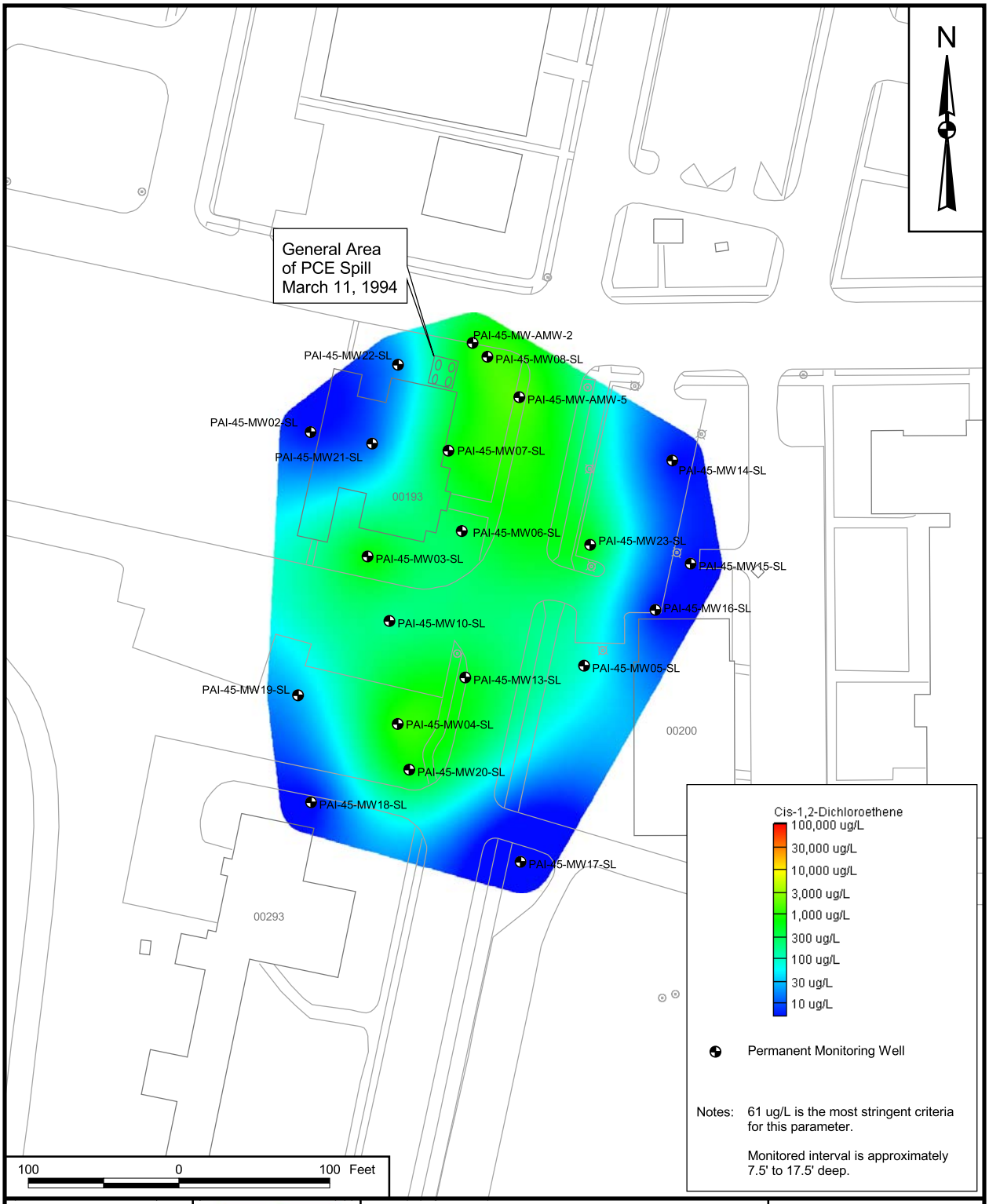

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CHECKED BY	DATE
M. FRANCIS	9/12/05
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

NAVFAC

CIS-1,2-DICHRLOROETHENE IN SURFICIAL LOWER WELLS

SWMU 45 (MONITORING WELLS ONLY)

MCRD PARRIS ISLAND

PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
N5260	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	REV
FIGURE 4 - 8	0

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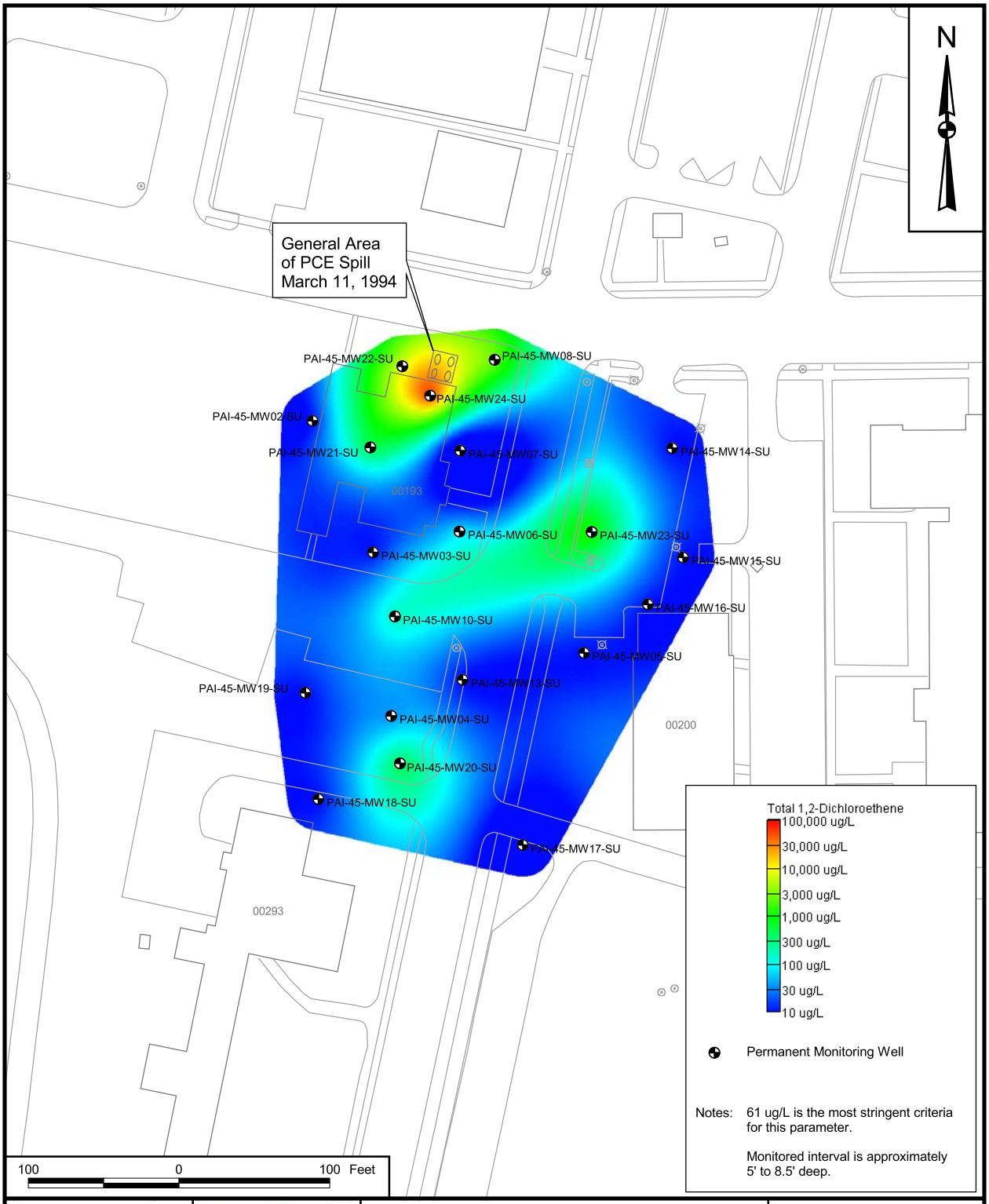

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A. JANOCHA	9/12/05
CHECKED BY	DATE
M. FRANCIS	9/12/05
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

NAVFAC

TOTAL 1,2-DICHLOROETHENE IN SURFICIAL UPPER WELLS

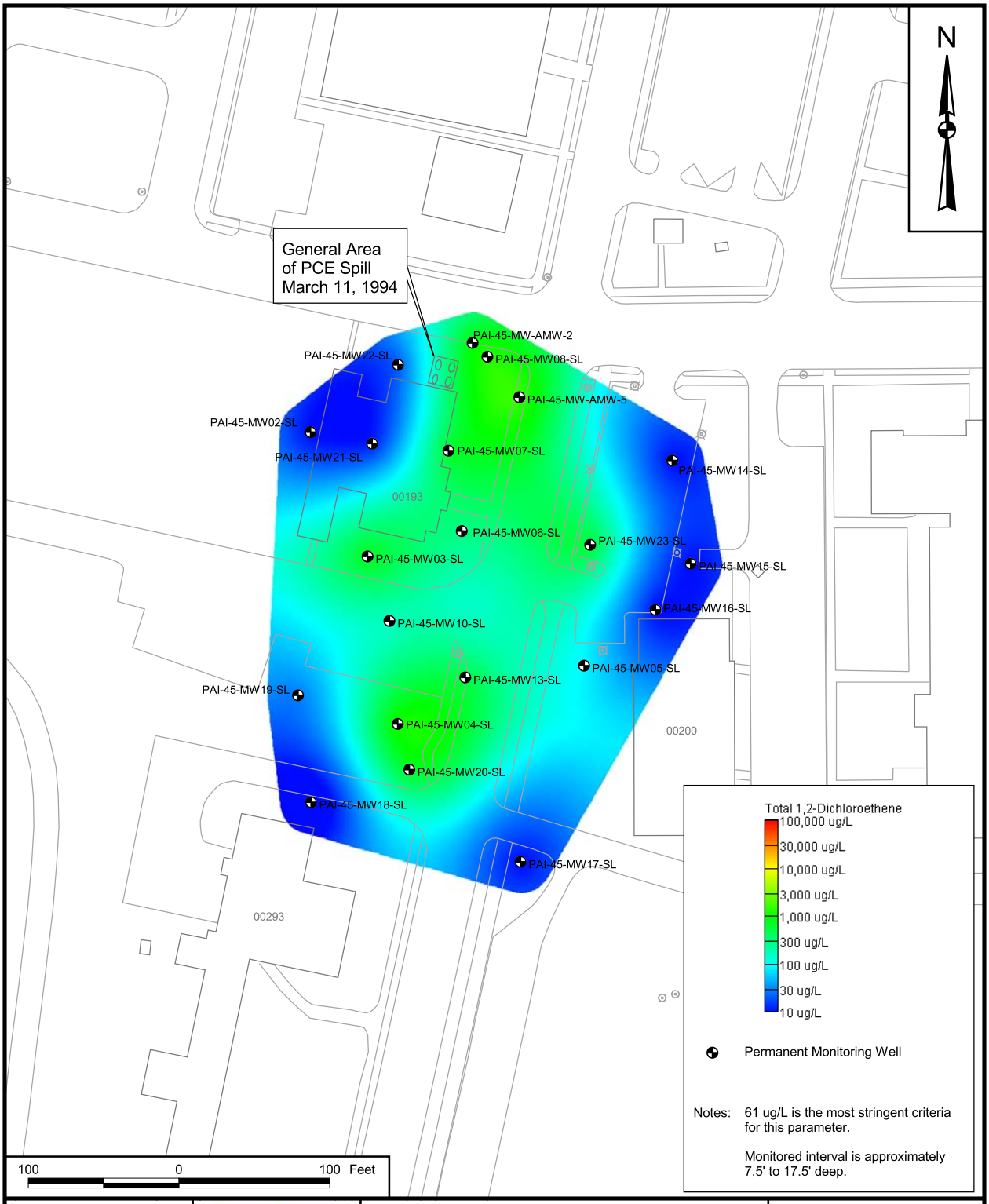
SWMU 45 (MONITORING WELLS ONLY)

MCRD PARRIS ISLAND

PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
N5260	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	REV
FIGURE 4 - 9	0

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS_MW_ONLY.APR TOTAL SHALLOW LAYOUT 9/12/05 AJ



DRAWN BY	DATE
A. JANOCHA	9/12/05
CHECKED BY	DATE
M. FRANCIS	9/12/05
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

NAVFAC

TOTAL 1,2-DICHLOROETHENE IN SURFICIAL LOWER WELLS

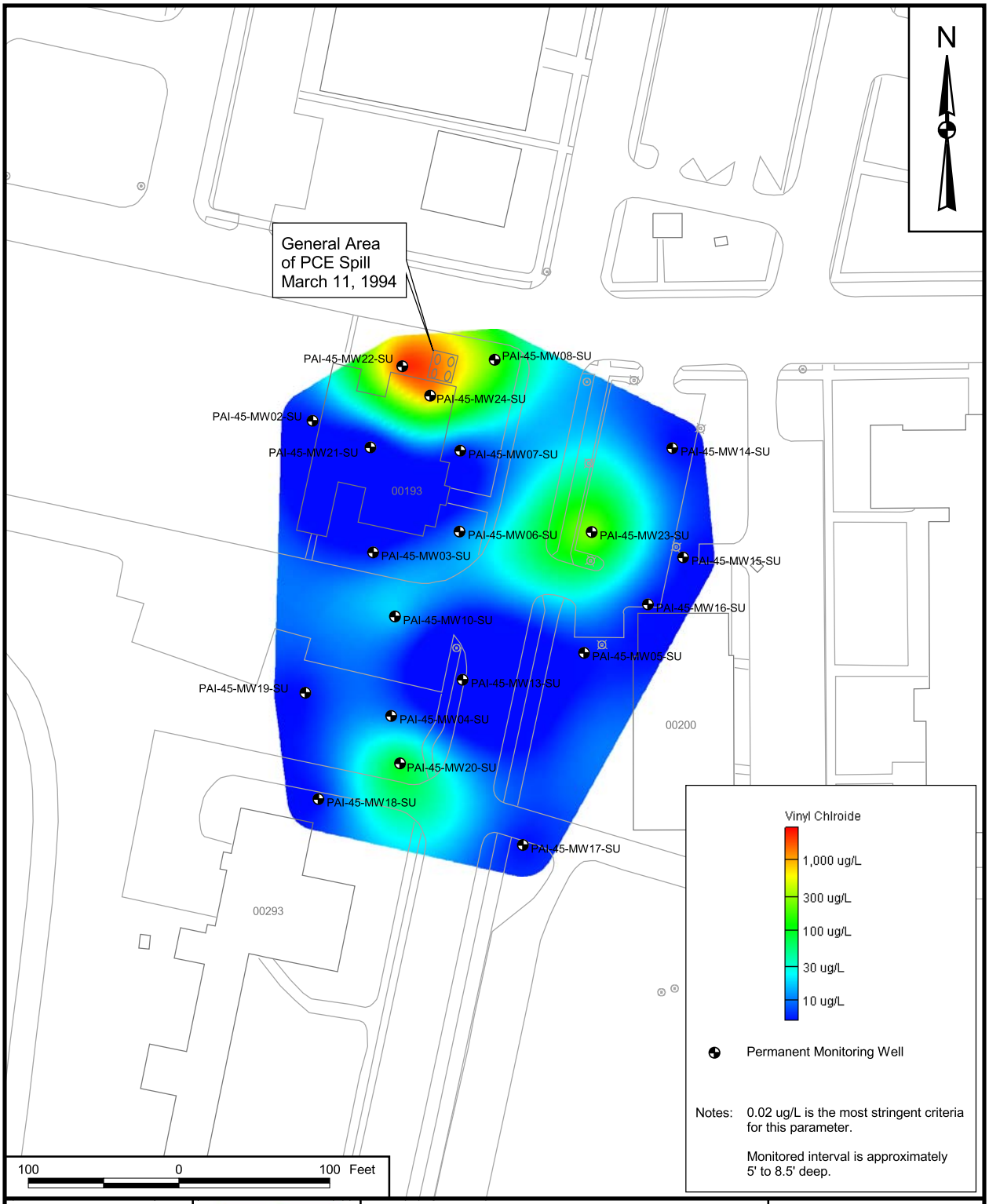
SWMU 45 (MONITORING WELLS ONLY)

MCRD PARRIS ISLAND

PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
N5260	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	REV
FIGURE 4 - 10	0

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS_MW_ONLY.APR TOTAL INTERMEDIATE LAYOUT 9/12/05 AJ



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A. JANOCHA	9/12/05			N5260
CHECKED BY	DATE			APPROVED BY / DATE
M. FRANCIS	9/12/05			___ / ___
COST/SCHEDULE-AREA				APPROVED BY / DATE
				___ / ___
SCALE				DRAWING NO. / REV
AS NOTED				FIGURE 4 - 11 / 0

VINYL CHLORIDE IN SURFICIAL UPPER WELLS
SWMU 45 (MONITORING WELLS ONLY)
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

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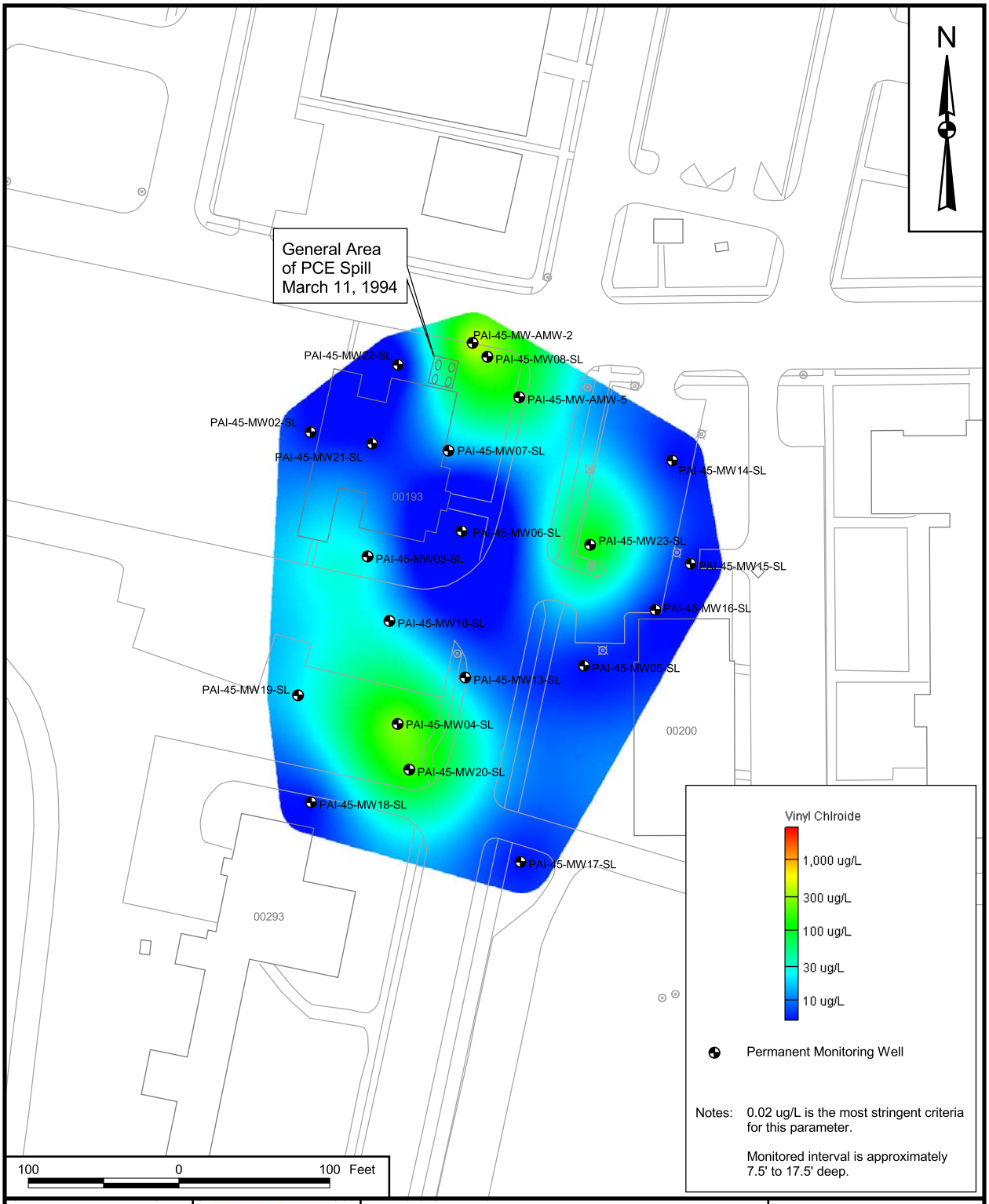


DRAWN BY	DATE
A. JANOCHA	9/12/05
CHECKED BY	DATE
M. FRANCIS	9/12/05
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

NAVFAC

VINYL CHLORIDE IN SURFICIAL LOWER WELLS
SWMU 45 (MONITORING WELLS ONLY)
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
N5260	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	REV
FIGURE 4 - 12	0

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS_MW_ONLY.APR VC INTERMEDIATE LAYOUT 9/12/05 AJ

APPENDIX O

GROUNDWATER VELOCITY CALCULATIONS

CLIENT PARRIS ISLAND		JOB NUMBER	
SUBJECT SEEPAGE VELOCITY CALCULATIONS			
BASED ON		DRAWING NUMBER	
BY MGC	CHECKED BY MLM	APPROVED BY	DATE 8/25/05

$$V_x = \frac{K}{n_e} \cdot \frac{dh}{dl}$$

WHERE K = HYDRAULIC CONDUCTIVITY
n_e = EFFECTIVE POROSITY
$\frac{dh}{dL}$ = HYDRAULIC GRADIENT

UPPER SURFICIAL WELLS

K = 8 FT/DAY (FROM SECTION 3.4.3.1 IN TEXT)
n_e = .30 APPROXIMATE EFFECTIVE POROSITY FOR SAND (FETTER, PG 64)
dh/dL = .005 FROM POTENTIOMETRIC SURFACE CONTOUR MAP

$$= \frac{8}{.30} \cdot .005$$

$$= .133 \text{ FT/DAY}$$

$$= 48.66 \text{ FT/YEAR}$$

CLIENT		JOB NUMBER	
PARRIS ISLAND			
SUBJECT			
SEEPAGE VELOCITY CALCULATIONS			
BASED ON		DRAWING NUMBER	
BY	CHECKED BY	APPROVED BY	DATE
MGL	MLM		8/25/05

LOWER SURFICIAL WELLS

K = 2 Ft / DAY (FROM SECTION 3.4.3.1 IN TEXT)

ne = .30 APPROXIMATE EFFECTIVE POROSITY FOR SAND (FETTER, PG 64)

dh/dL = .006 FROM POTENTIOMETRIC SURFACE CONTOUR MAP

$= \frac{2}{.30} \cdot .006$

= .04 Ft / DAY

= 14.6 Ft / YEAR

CLIENT PARRIS ISLAND		JOB NUMBER	
SUBJECT SEEPAGE VELOCITY CALCULATIONS			
BASED ON		DRAWING NUMBER	
BY MGL	CHECKED BY MCM	APPROVED BY	DATE 8/25/05

DEEP WELLS

K = 1 Ft/DAY (FROM SECTION 3.4.3.1 IN TEXT)

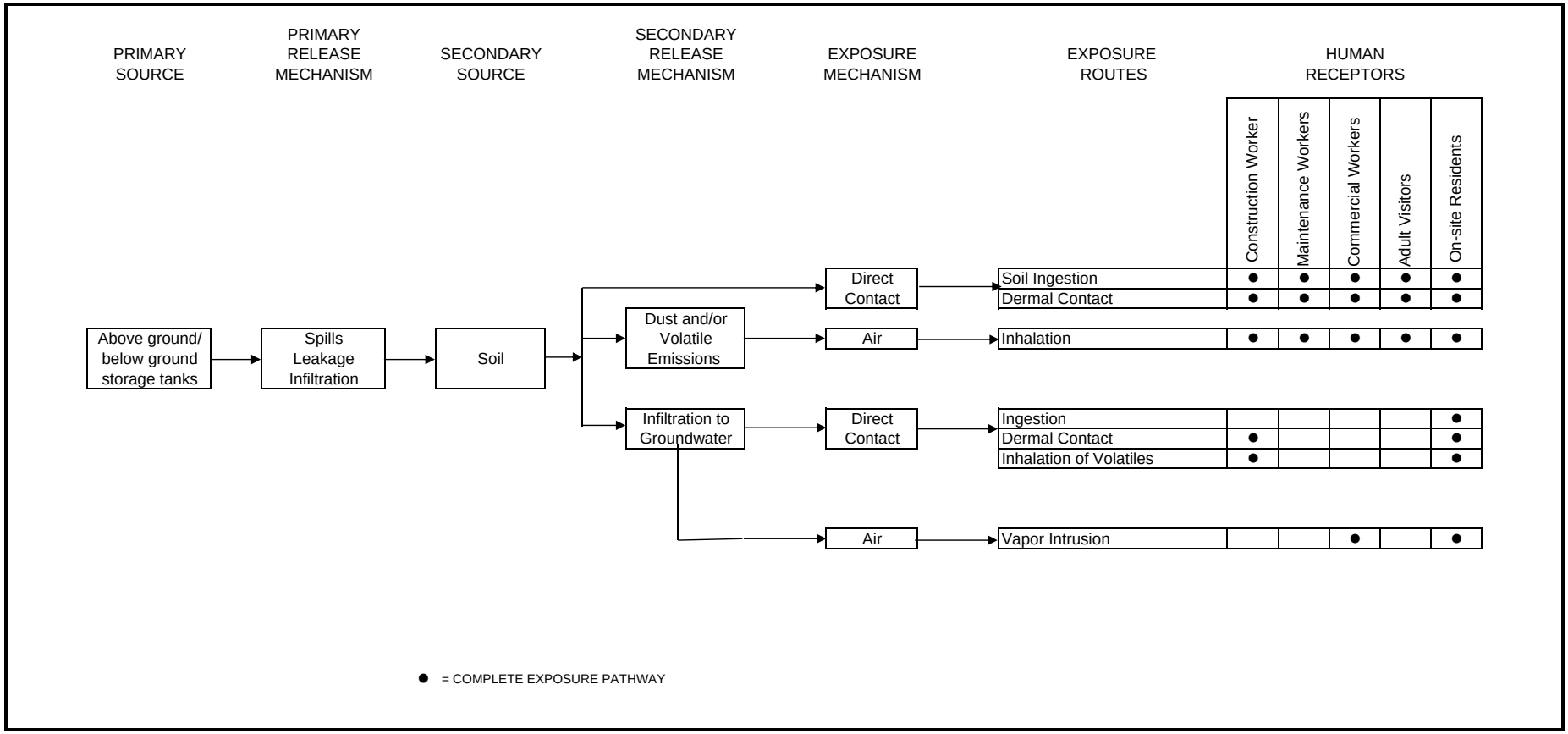
ne = .30 APPROXIMATE EFFECTIVE POROSITY FOR SAND (FETTER PG 64)

dh/dL = .004 FROM POTENTIOMETRIC SURFACE CONTOUR MAP

$= \frac{1}{.30} \cdot .004$

= .013 Ft/DAY

= 4.86 FT/YEAR



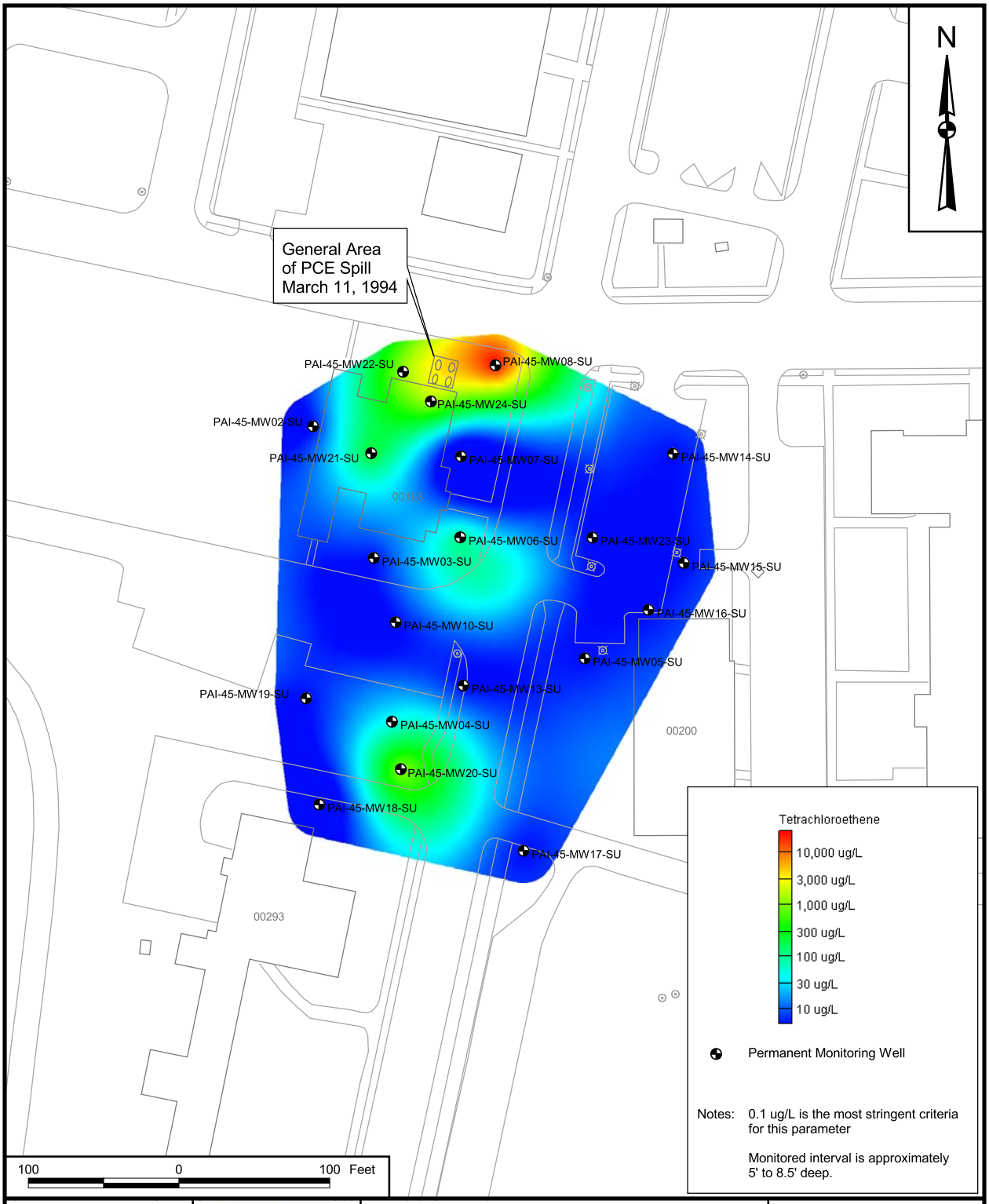
APPENDIX P

REVISED CONCEPTUAL SITE MODEL
SITE 45 - FORMER MWR DRY CLEANING FACILITY
MCRD PARRIS ISLAND, SOUTH CAROLINA

APPENDIX Q

GROUNDWATER MODELING FIGURES

USING PERMANENT WELLS ONLY

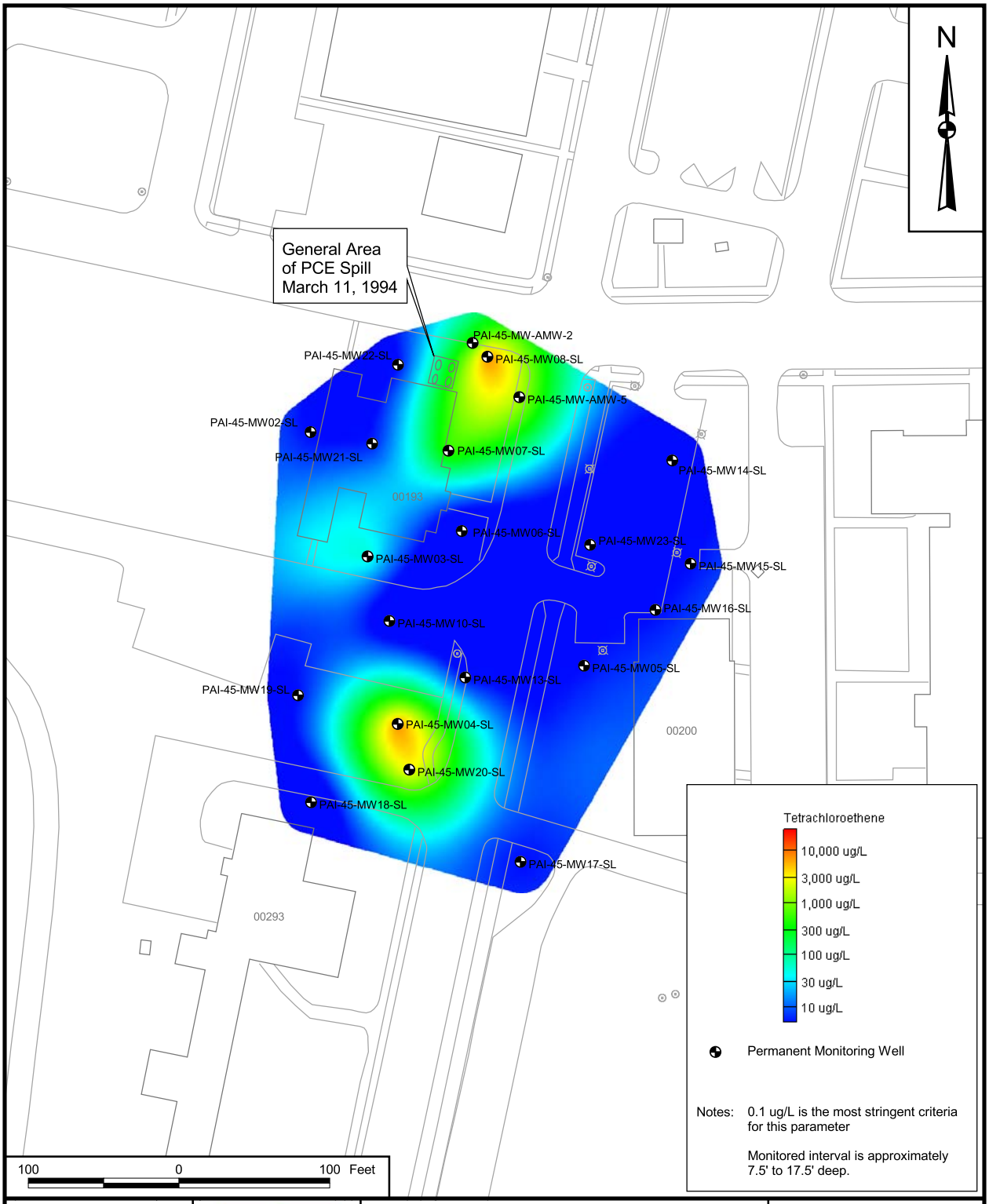


DRAWN BY	DATE			CONTRACT NUMBER
A. JANOCHA	9/12/05			N5260
CHECKED BY	DATE			APPROVED BY / DATE
M. FRANCIS	9/12/05			___ / ___
COST/SCHEDULE-AREA				APPROVED BY / DATE
				___ / ___
SCALE				DRAWING NO. / REV
AS NOTED				FIGURE 4 -5 / 0

NAVFAC

PCE IN SURFICIAL UPPER WELLS
SWMU 45 (MONITORING WELLS ONLY)
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS_MW_ONLY.APR PCE SHALLOW LAYOUT 9/12/05 AJ

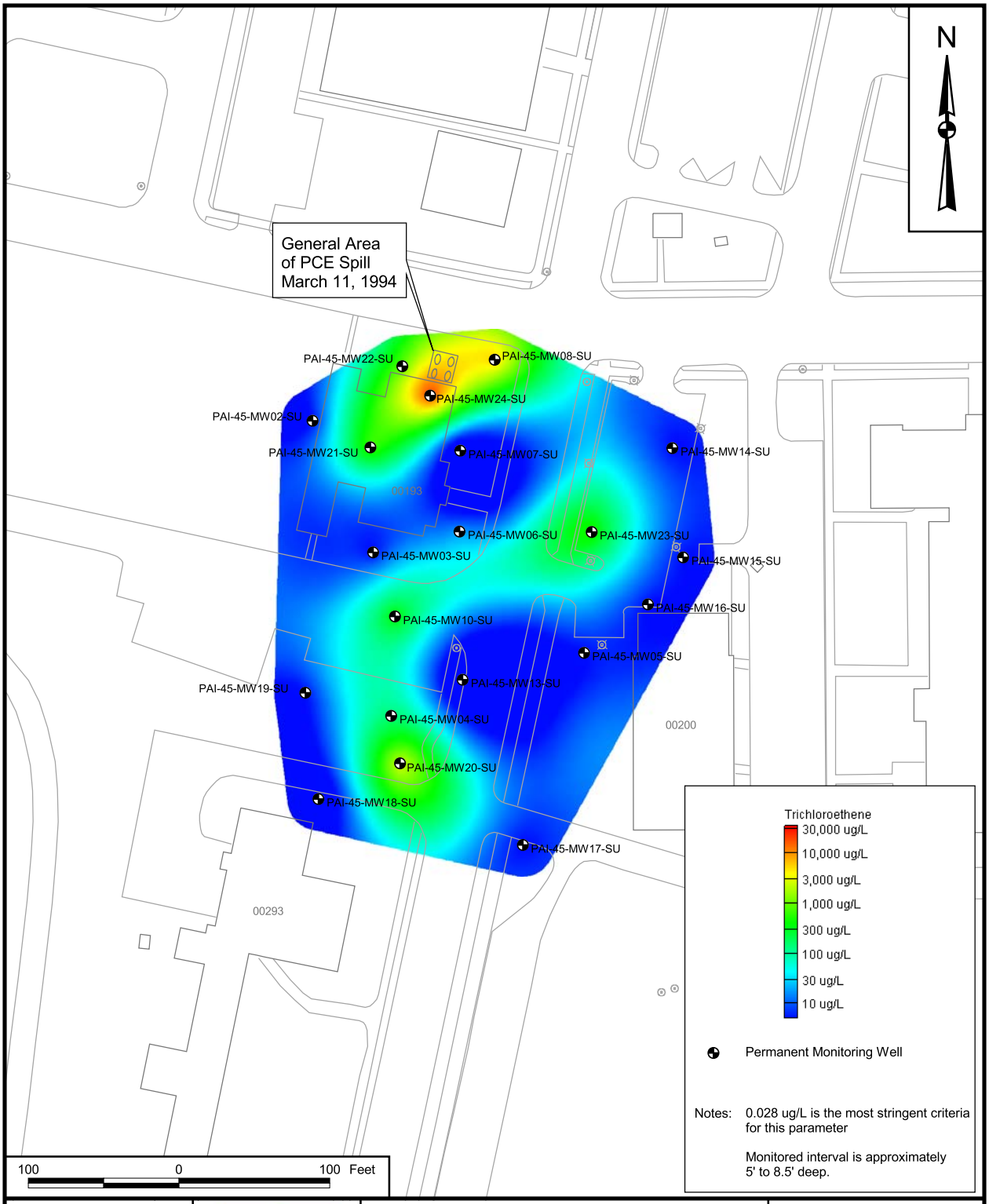


DRAWN BY	DATE			CONTRACT NUMBER
A. JANOCHA	9/12/05			N5260
CHECKED BY	DATE			APPROVED BY / DATE
M. FRANCIS	9/12/05			___ / ___
COST/SCHEDULE-AREA				APPROVED BY / DATE
				___ / ___
SCALE				DRAWING NO. / REV
AS NOTED				FIGURE 4 - 6 / 0

NAVFAC

PCE IN SURFICIAL LOWER WELLS
SWMU 45 (MONITORING WELLS ONLY)
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS_MW_ONLY.APR PCE INTERMEDIATE LAYOUT 9/12/05 AJ

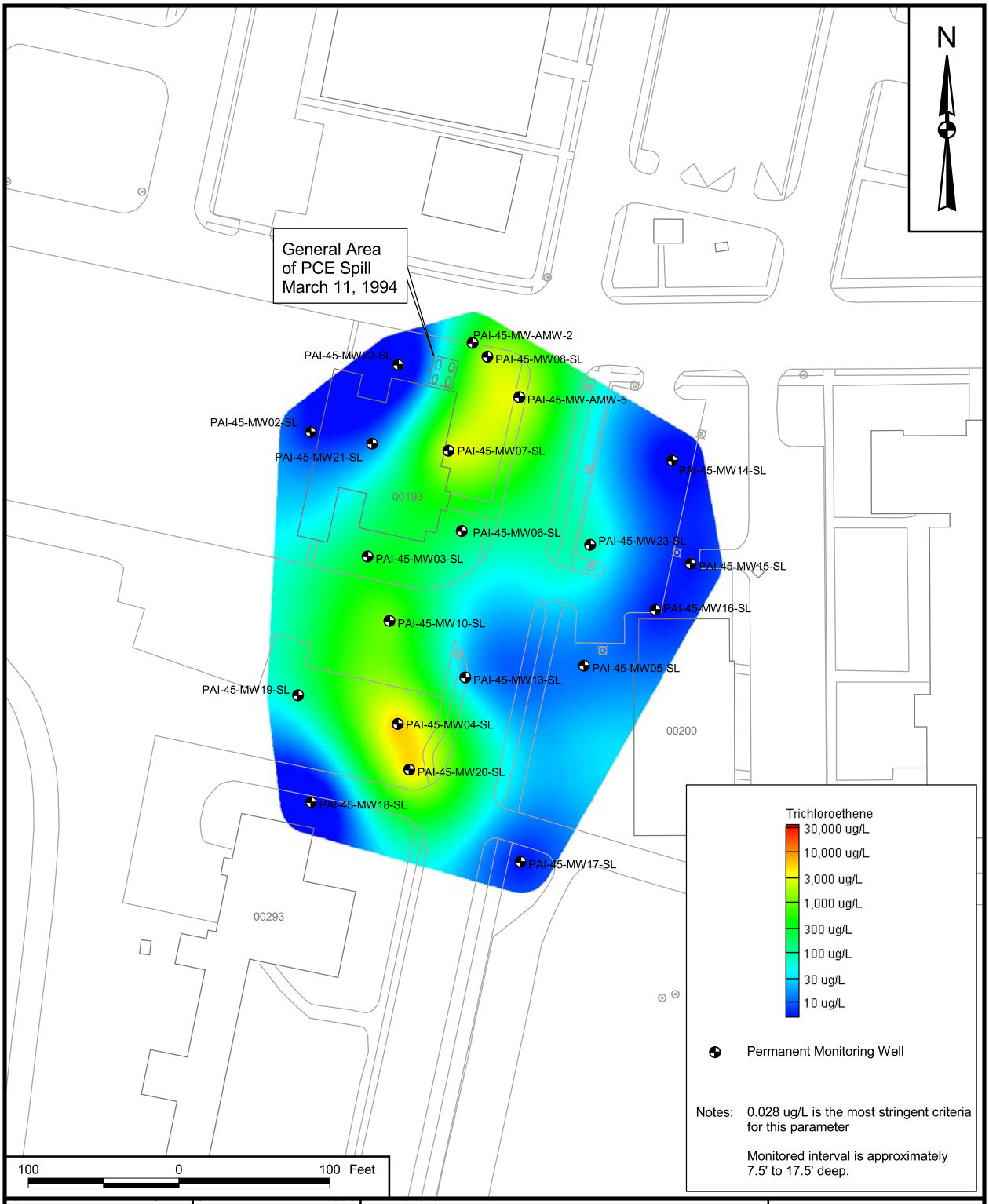


DRAWN BY	DATE			CONTRACT NUMBER
A. JANOCHA	9/12/05			N5260
CHECKED BY	DATE			APPROVED BY / DATE
M. FRANCIS	9/12/05			___ / ___
COST/SCHEDULE-AREA				APPROVED BY / DATE
				___ / ___
SCALE				DRAWING NO. / REV
AS NOTED				FIGURE 4 - 7 / 0

NAVFAC

TCE IN SURFICIAL UPPER WELLS
SWMU 45 (MONITORING WELLS ONLY)
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS_MW_ONLY.APR TCE SHALLOW LAYOUT 9/12/05 AJ

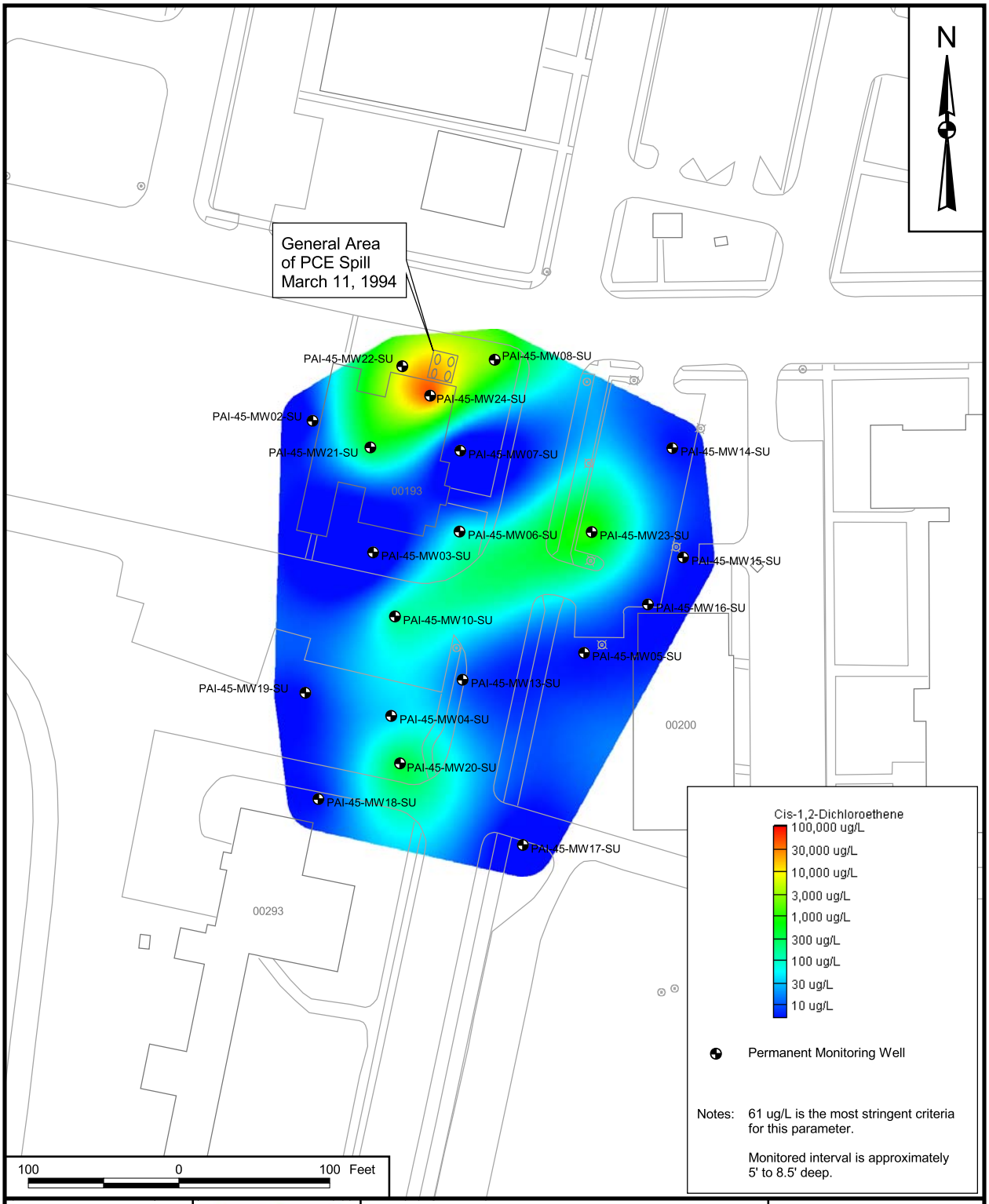


DRAWN BY	DATE			CONTRACT NUMBER
A. JANOCHA	9/12/05			N5260
CHECKED BY	DATE			APPROVED BY / DATE
M. FRANCIS	9/12/05			___ / ___
COST/SCHEDULE-AREA				APPROVED BY / DATE
				___ / ___
SCALE				DRAWING NO. / REV
AS NOTED				FIGURE 4 - 8 / 0

NAVFAC

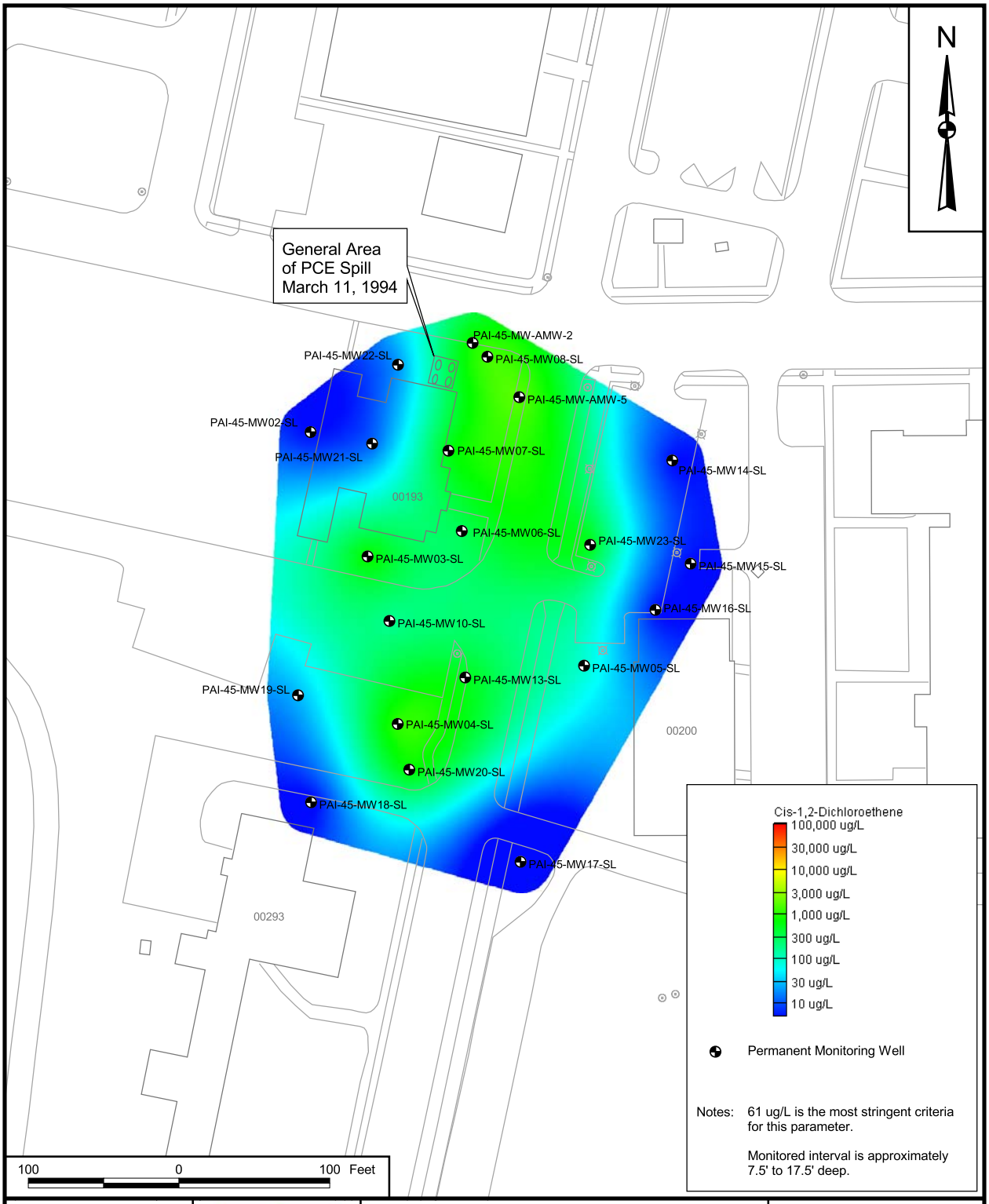
TCE IN SURFICIAL LOWER WELLS
SWMU 45 (MONITORING WELLS ONLY)
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS_MW_ONLY.APR TCE INTERMEDIATE LAYOUT 9/12/05 AJ



DRAWN BY	DATE		CIS-1,2-DICHLOROETHENE IN SURFICIAL UPPER WELLS	CONTRACT NUMBER N5260	
A. JANOCHA	9/12/05		SWMU 45 (MONITORING WELLS ONLY)	APPROVED BY ___	DATE ___
CHECKED BY	DATE		MCRD PARRIS ISLAND	APPROVED BY ___	DATE ___
M. FRANCIS	9/12/05		PARRIS ISLAND, SOUTH CAROLINA		
COST/SCHEDULE-AREA				DRAWING NO. FIGURE 4 - 9	REV 0
SCALE AS NOTED					

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS_MW_ONLY.APR CIS SHALLOW LAYOUT 9/12/05 AJ



DRAWN BY	DATE
A. JANOCHA	9/12/05
CHECKED BY	DATE
M. FRANCIS	9/12/05
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

NAVFAC

CIS-1,2-DICHRLOROETHENE IN SURFICIAL LOWER WELLS

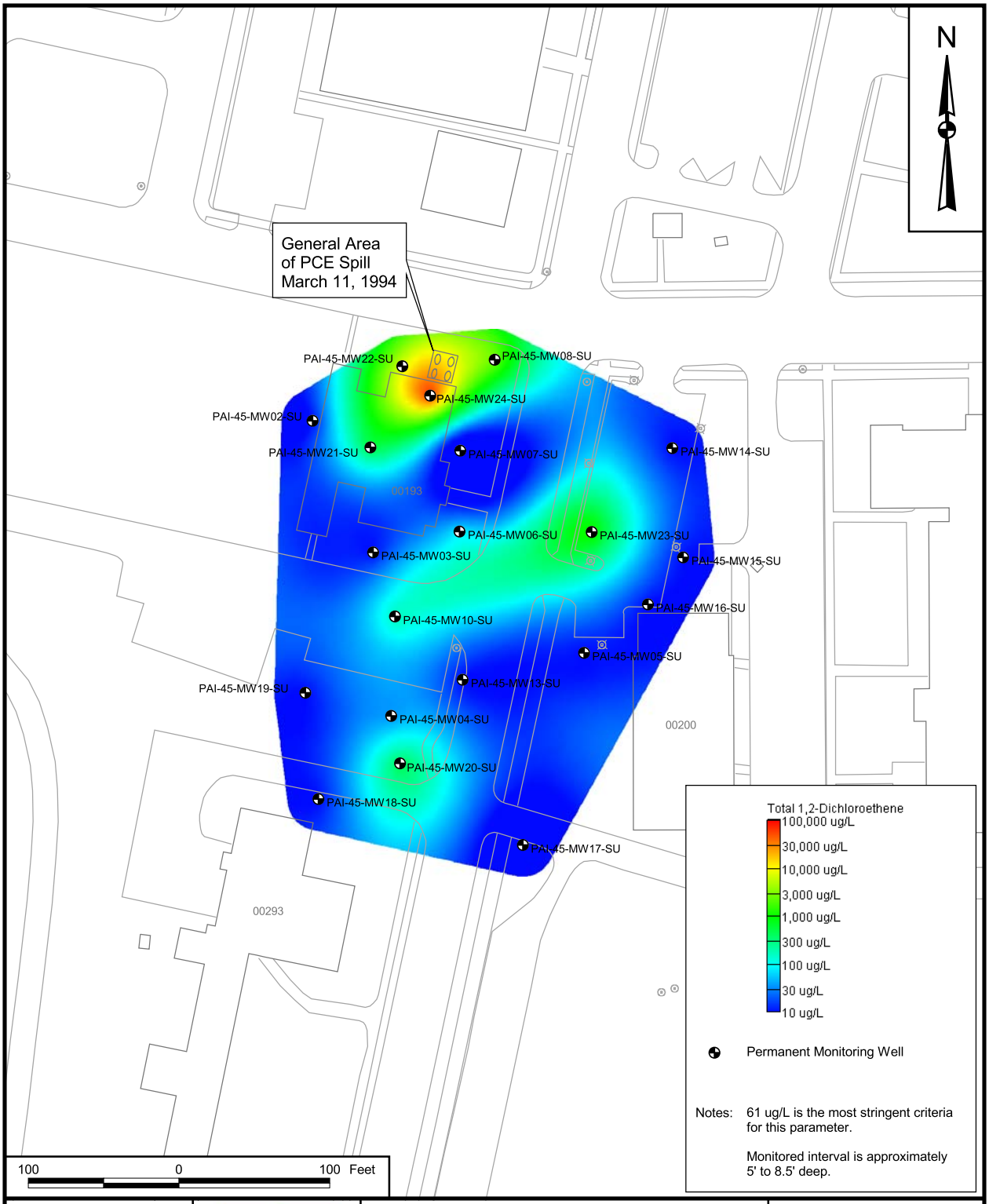
SWMU 45 (MONITORING WELLS ONLY)

MCRD PARRIS ISLAND

PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
N5260	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	REV
FIGURE 4 - 10	0

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS_MW_ONLY.APR CIS INTERMEDIATE LAYOUT 9/12/05 AJ



DRAWN BY	DATE
A. JANOCHA	9/12/05
CHECKED BY	DATE
M. FRANCIS	9/12/05
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

NAVFAC

TOTAL 1,2-DICHLOROETHENE IN SURFICIAL UPPER WELLS

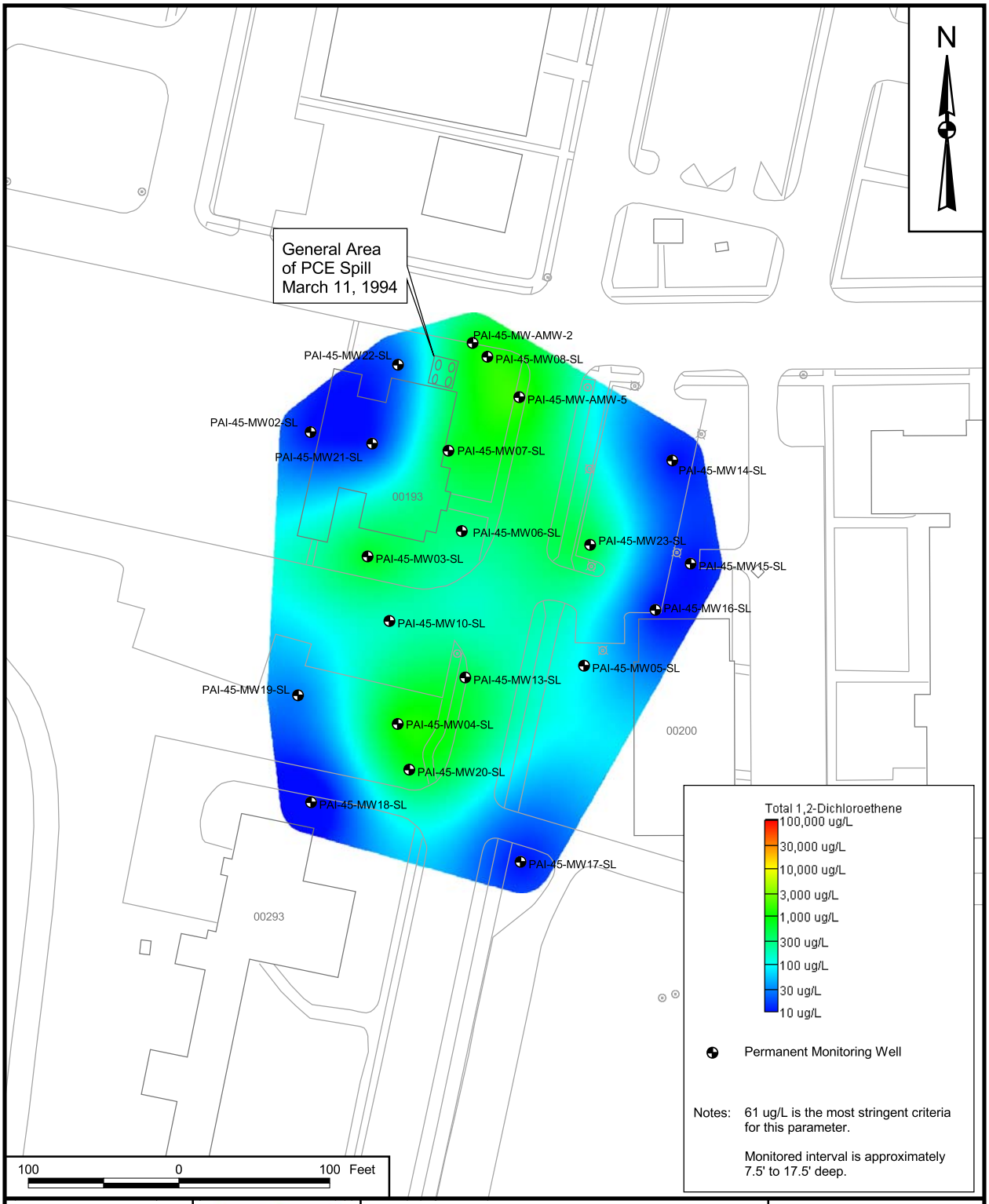
SWMU 45 (MONITORING WELLS ONLY)

MCRD PARRIS ISLAND

PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
N5260	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	REV
FIGURE 4 - 11	0

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS_MW_ONLY.APR TOTAL SHALLOW LAYOUT 9/12/05 AJ



DRAWN BY	DATE
A. JANOCHA	9/12/05
CHECKED BY	DATE
M. FRANCIS	9/12/05
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

NAVFAC

TOTAL 1,2-DICHLOROETHENE IN SURFICIAL LOWER WELLS

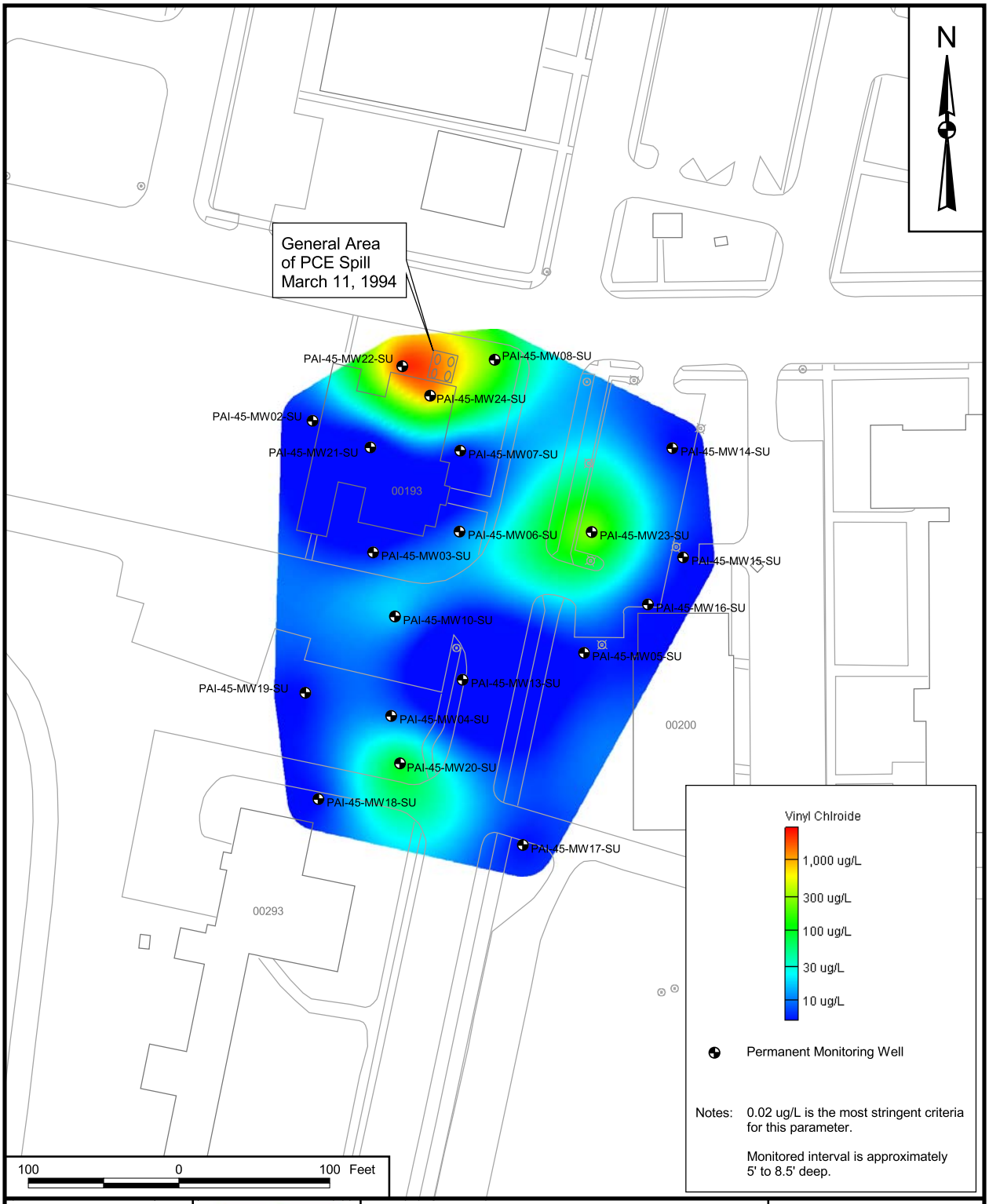
SWMU 45 (MONITORING WELLS ONLY)

MCRD PARRIS ISLAND

PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
N5260	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	REV
FIGURE 4 - 12	0

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS_MW_ONLY.APR TOTAL INTERMEDIATE LAYOUT 9/12/05 AJ

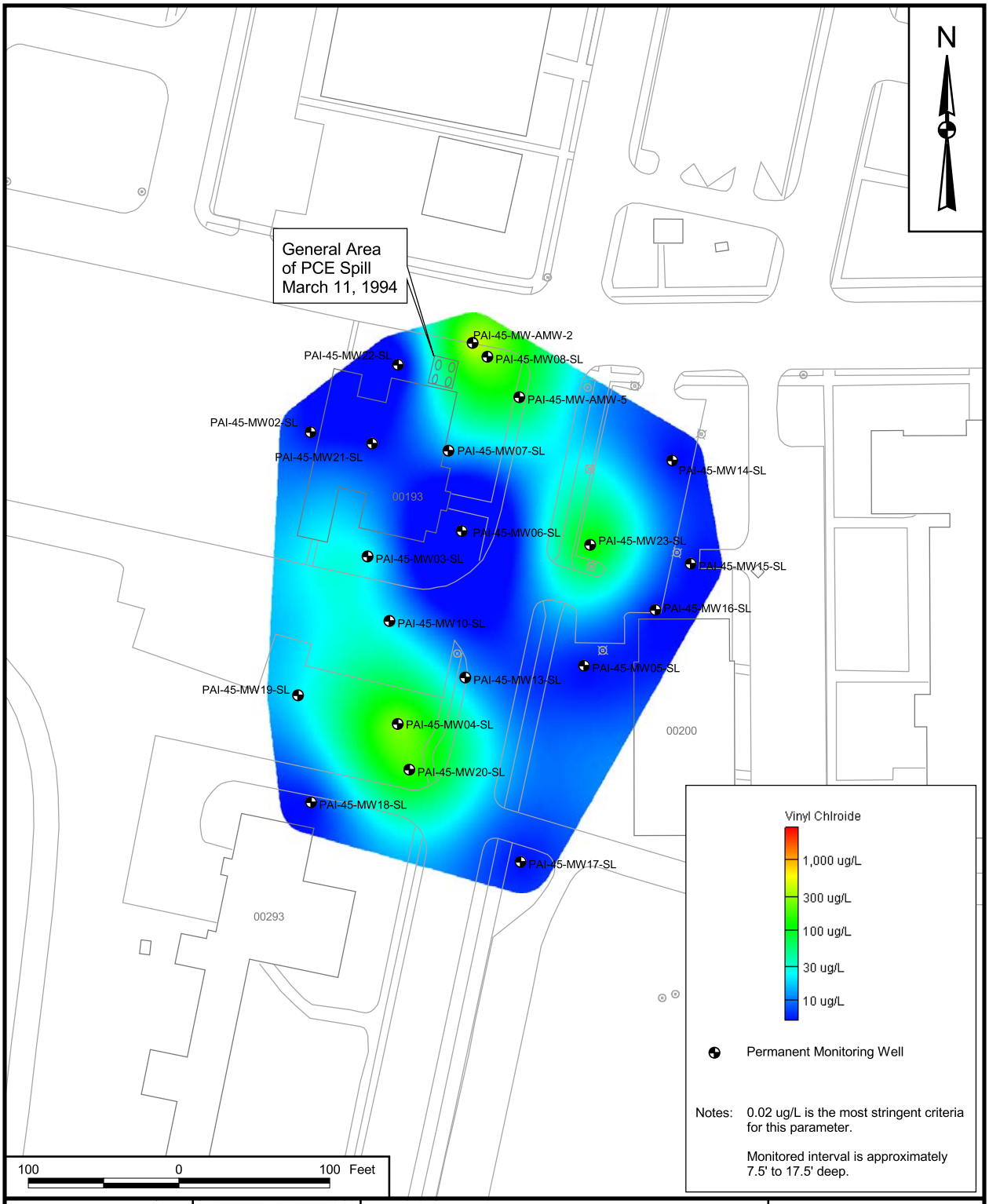


DRAWN BY	DATE			CONTRACT NUMBER
A. JANOCHA	9/12/05			N5260
CHECKED BY	DATE			APPROVED BY / DATE
M. FRANCIS	9/12/05			___ / ___
COST/SCHEDULE-AREA				APPROVED BY / DATE
				___ / ___
SCALE				DRAWING NO. / REV
AS NOTED				FIGURE 4 - 13 / 0

NAVFAC

VINYL CHLORIDE IN SURFICIAL UPPER WELLS
SWMU 45 (MONITORING WELLS ONLY)
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS_MW_ONLY.APR VC SHALLOW LAYOUT 9/12/05 AJ



DRAWN BY	DATE
A. JANOCHA	9/12/05
CHECKED BY	DATE
M. FRANCIS	9/12/05
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

NAVFAC

VINYL CHLORIDE IN SURFICIAL LOWER WELLS
SWMU 45 (MONITORING WELLS ONLY)
MCRD PARRIS ISLAND
PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NUMBER	
N5260	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	REV
FIGURE 4 - .14	0

P:\GIS\PARRISISLAND_MCRD\APR\SWMU45_EVS_MW_ONLY.APR VC INTERMEDIATE LAYOUT 9/12/05 AJ

APPENDIX R

GROUNDWATER VAPOR INTRUSION MODELING RESULTS

MAXIMUM DETECTED GROUNDWATER CONCENTRATIONS

CALCULATION OF INDOOR AIR CONCENTRATIONS

DATA ENTRY SHEET

GW-SCREEN
Version 3.1; 02/04

Reset to

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
75343	9.70E+01	1,1-Dichloroethane

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	110	LS	20	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)		ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
LS	OR		LS	1.62	0.39	0.076

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET

ABC

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.42E-02	1.05E-05	5.61E-03	25	6,895	330.55	523.00	3.16E+01	5.06E+03	0.0E+00	5.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
95	0.314	0.079	1.65E-08	0.957	1.58E-08	18.75	0.39	0.087	0.303	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
1.69E+04	1.00E+06	4.00E-04	15	7,339	4.54E-03	1.89E-01	1.78E-04	1.03E-02	1.53E-04	7.29E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
95	15	1.83E+04	0.10	1.56E+01	1.03E-02	4.00E+02	2.83E+16	3.04E-04	5.56E+00	NA	5.0E-01

DATA ENTRY SHEET

GW-SCREEN
Version 3.1; 02/04

Reset to

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
75354	7.40E+01	1,1-Dichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	110	LS	20	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type Lookup Soil	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
LS			LS	1.62	0.39	0.076

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET

ABC

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
9.00E-02	1.04E-05	2.60E-02	25	6,247	304.75	576.05	5.89E+01	2.25E+03	0.0E+00	2.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^v (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
95	0.314	0.079	1.65E-08	0.957	1.58E-08	18.75	0.39	0.087	0.303	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
1.69E+04	1.00E+06	4.00E-04	15	6,326	2.17E-02	9.02E-01	1.78E-04	1.25E-02	1.78E-04	8.54E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
95	15	6.68E+04	0.10	1.56E+01	1.25E-02	4.00E+02	3.66E+13	3.37E-04	2.25E+01	NA	2.0E-01

DATA ENTRY SHEET

GW-SCREEN
Version 3.1; 02/04

Reset to

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
107062	3.00E-01	1,2-Dichloroethane

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	110	LS	20	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
LS			LS	1.62	0.39	0.076

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET

ABC

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
1.04E-01	9.90E-06	9.77E-04	25	7,643	356.65	561.00	1.74E+01	8.52E+03	2.6E-05	0.0E+00

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
95	0.314	0.079	1.65E-08	0.957	1.58E-08	18.75	0.39	0.087	0.303	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
1.69E+04	1.00E+06	4.00E-04	15	8,412	7.67E-04	3.19E-02	1.78E-04	1.44E-02	2.42E-04	1.15E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
95	15	9.56E+00	0.10	1.56E+01	1.44E-02	4.00E+02	5.46E+11	4.02E-04	3.85E-03	2.6E-05	NA

DATA ENTRY SHEET

GW-SCREEN
Version 3.1; 02/04

Reset to

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
156592	1.10E+05	cis-1,2-Dichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	110	LS	20	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type Lookup Soil	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
LS			LS	1.62	0.39	0.076

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET

ABC

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.36E-02	1.13E-05	4.07E-03	25	7,192	333.65	544.00	3.55E+01	3.50E+03	0.0E+00	3.5E-02

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
95	0.314	0.079	1.65E-08	0.957	1.58E-08	18.75	0.39	0.087	0.303	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
1.69E+04	1.00E+06	4.00E-04	15	7,633	3.27E-03	1.36E-01	1.78E-04	1.02E-02	1.55E-04	7.39E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
95	15	1.49E+07	0.10	1.56E+01	1.02E-02	4.00E+02	3.85E+16	3.06E-04	4.58E+03	NA	3.5E-02

DATA ENTRY SHEET

GW-SCREEN
Version 3.1; 02/04

Reset to

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
156605	3.40E+03	trans-1,2-Dichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	110	LS	20	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type Lookup Soil	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
LS			LS	1.62	0.39	0.076

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET

ABC

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.07E-02	1.19E-05	9.36E-03	25	6,717	320.85	516.50	5.25E+01	6.30E+03	0.0E+00	7.0E-02

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
95	0.314	0.079	1.65E-08	0.957	1.58E-08	18.75	0.39	0.087	0.303	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
1.69E+04	1.00E+06	4.00E-04	15	7,030	7.64E-03	3.18E-01	1.78E-04	9.82E-03	1.44E-04	6.86E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
95	15	1.08E+06	0.10	1.56E+01	9.82E-03	4.00E+02	1.85E+17	2.92E-04	3.15E+02	NA	7.0E-02

DATA ENTRY SHEET

GW-SCREEN
Version 3.1; 02/04

Reset to

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
127184	2.60E+04	Tetrachloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	110	LS	20	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type Lookup Soil	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
LS			LS	1.62	0.39	0.076

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET

ABC

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.20E-02	8.20E-06	1.84E-02	25	8,288	394.40	620.20	1.55E+02	2.00E+02	5.9E-06	6.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
95	0.314	0.079	1.65E-08	0.957	1.58E-08	18.75	0.39	0.087	0.303	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
1.69E+04	1.00E+06	4.00E-04	15	9,451	1.40E-02	5.81E-01	1.78E-04	1.00E-02	1.43E-04	6.86E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
95	15	1.51E+07	0.10	1.56E+01	1.00E-02	4.00E+02	9.00E+16	2.91E-04	4.40E+03	5.9E-06	6.0E-01

DATA ENTRY SHEET

GW-SCREEN
Version 3.1; 02/04

Reset to

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016	3.50E+04	Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	110	LS	20	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type Lookup Soil	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
LS			LS	1.62	0.39	0.076

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET

ABC

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	1.1E-04	4.0E-02

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
95	0.314	0.079	1.65E-08	0.957	1.58E-08	18.75	0.39	0.087	0.303	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
1.69E+04	1.00E+06	4.00E-04	15	8,433	8.06E-03	3.35E-01	1.78E-04	1.10E-02	1.59E-04	7.59E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
95	15	1.17E+07	0.10	1.56E+01	1.10E-02	4.00E+02	2.83E+15	3.12E-04	3.66E+03	1.1E-04	4.0E-02

DATA ENTRY SHEET

GW-SCREEN
Version 3.1; 02/04

Reset to

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
75014	3.00E+03	Vinyl chloride (chloroethene)

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	110	LS	20	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
LS			LS	1.62	0.39	0.076

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET

ABC

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
1.06E-01	1.23E-05	2.69E-02	25	5,250	259.25	432.00	1.86E+01	8.80E+03	8.8E-06	1.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^v (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
95	0.314	0.079	1.65E-08	0.957	1.58E-08	18.75	0.39	0.087	0.303	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
1.69E+04	1.00E+06	4.00E-04	15	4,887	2.34E-02	9.73E-01	1.78E-04	1.47E-02	2.10E-04	1.00E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
95	15	2.92E+06	0.10	1.56E+01	1.47E-02	4.00E+02	3.28E+11	3.72E-04	1.09E+03	8.8E-06	1.0E-01

APPENDIX S

SOIL GAS AND VAPOR INTRUSION SCREENING

SOIL GAS VAPOR INTRUSION MODELING RESULTS

MAXIMUM DETECTED SOIL GAS CONCENTRATIONS

CALCULATION OF INDOOR AIR CONCENTRATIONS

APPENDIX S
SCREENING TO DETERMINE WHETHER VAPOR INTRUSION IS A SIGNIFICANT EXPOSURE PATHWAY
SWMU 45
PARRIS ISLAND, SOUTH CAROLINA

Introduction

A review and evaluation of soil gas data collected during sampling in June-July 2010 and indoor air samples collected at the new dry cleaning facility at SWMU 45, Parris Island, South Carolina, was conducted to determine if the contaminant concentrations in groundwater pose a potential risk associated with vapor intrusion (VI). EPA's *Draft Vapor Intrusion Guidance* (November 2002) was used to conduct a screening evaluation.

EPA's *Draft Vapor Intrusion Guidance*

The intent of the EPA's VI guidance is to provide a tool for conducting a screening evaluation to determine whether the VI exposure pathway is complete and whether it poses an unacceptable risk to human health. A complete pathway means that humans are exposed to vapors originating from site contamination. The approach suggested in the EPA's VI guidance begins with simple and reasonably conservative screening approaches and gradually progresses toward a more complex assessment involving greater use of site-specific data. For sites determined to have a complete pathway, the EPA's VI guidance provides recommendations on how to evaluate whether the pathway poses a potential significant risk to human health.

EPA's VI guidance employs a tiered approach to determine whether the exposure pathway is complete and whether the vapors area present at levels that may pose an unacceptable risk. Although vapors may be present beneath a building, the vapors may not pose a significant risk to human health. Estimating human health risks from indoor air exposure depends upon human exposure to the vapors. If contaminant vapors do not enter the building, the exposure pathway is incomplete. If contaminant vapors enter the building, the contaminants may be at low levels that risk would be considered negligible.

Tier 1—Primary Screening

Primary Screening is designed to quickly screen out sites at which the VI pathway does not ordinarily need further consideration. This evaluation determines whether any potential exists for VI and unacceptable risks and whether immediate action is warranted.

Question 1: Are chemicals of sufficient volatility and toxicity known or reasonably suspected to be present in the subsurface (e.g. in unsaturated soils, soil gas, or the uppermost portions of the groundwater and/or capillary fringe?

YES. Volatile organic compounds have been detected in the groundwater, soil gas, and indoor air samples.

If YES, continue with Question 2.

Question 2: Are currently (or potentially) inhabited buildings or areas of concern under future development scenarios located near ... subsurface contaminants found in Table 1 [of the EPA VI guidance]?

YES. Buildings, including the new dry cleaning facility, are located within 100 feet horizontally or vertically from the groundwater plume.

If YES, continue with Question 3.

Question 3: Does evidence suggest immediate action may be warranted to mitigate current risks?

NO. No odors or physiological effects have been reported by workers. The new dry cleaning facility is located upstream of the current groundwater plume area, so the risk of an acute safety concern is very unlikely.

If NO, continue with Question 4, Secondary Screening.

Tier 2—Secondary Screening

The vapor intrusion pathway is complex. Therefore, the EPA VI guidance recommends that a comprehensive assessment of the VI pathway using all available lines of evidence be conducted before drawing conclusions about the risks posed by the pathway. Collection of indoor air quality data without evidence to support the potential for vapor intrusion from subsurface sources can lead to confounding results. Indoor air quality can be influenced by chemicals commonly used in the building (e.g., cleaners, paints, solvents) or occupant activities (e.g., smoking). Outdoor air in urban areas contain detectable concentrations of volatile organic compounds. Using a sequential approach, the secondary screening involves comparing available measured or reasonably estimated concentrations of contaminants in groundwater to target concentrations identified in Questions 4 and 5.

Question 4(a): Are indoor air quality data available?

YES. Six indoor (plus one duplicate) and two ambient air samples were collected.

If YES, proceed to Question 4(b).

Question 4(b): Do measured indoor air concentrations of constituents of potential concern identified in Question 1 (and any degradation products) exceed the target concentrations given in Tables 2(a), 2(b), or 2(c)?

NO. The target concentrations are the EPA risk range ($1x10^{-4}$ to $1x10^{-6}$) for carcinogens or 1 for noncarcinogens, as presented in Tables 2(a), 2(b), and 2(c). No indoor air concentrations exceed the $1x10^{-4}$ risk level for carcinogens or 1 for noncarcinogens. However, concentrations of benzene, 1,2-dichloroethane (1,2-DCA), and tetrachloroethene (PCE) exceeded residential screening criteria set at a cancer risk level of $1x10^{-6}$. Only PCE concentrations exceeded the industrial screening criterion set at a cancer risk level of $1x10^{-6}$. A quantitative risk assessment conducted for benzene, 1,2-DCA, and PCE for a dry cleaning facility worker (i.e., an industrial worker) for the reasonable maximum exposure (RME) scenario results in a cancer risk approximately equal to $2x10^{-5}$ and a hazard index less than 1. Thus,

cancer risks are within acceptable levels, and no adverse noncarcinogenic effects are anticipated due to vapor intrusion.

If NO, proceed to Subsurface Source Identification - Question 4(c).

Question 4(c): Is there any potential contamination (source of vapors) in the unsaturated zone soil at any depth above the water table?

YES.

If YES, skip to Soil Gas Assessment—Question 4(g).

Question 4(g): Do measured or reasonably estimated soil gas concentrations exceed the generic target media-specific concentrations given in Tables 2(a), 2(b), or 2(c)?

NO. The generic target media-specific concentrations correspond to a risk-based screening concentration using default exposure assumptions for residential exposure. The table concentrations correspond to the lesser of the risk-based values corresponding to a hazard quotient of one or a cancer risk level of $1x10^{-4}$ [Table 2(a)], $1x10^{-5}$ [Table 2(b)], or $1x10^{-6}$ [Table 2(c)]. The target risk levels are the EPA risk range ($1x10^{-4}$ $1x10^{-6}$) for carcinogens or a hazard quotient of 1 for noncarcinogens. No concentrations exceeded either a cancer risk level of $1x10^{-4}$ or a hazard quotient of 1. However, concentrations of benzene, ethylbenzene, and PCE exceed the residential screening criteria set at a $1x10^{-6}$ risk level. Concentrations of PCE also exceed the industrial screening criterion at a $1x10^{-6}$ risk level. Risks estimated using the Johnson and Ettinger model for benzene, ethylbenzene, and PCE indicate that cumulative cancer risks do not exceed $1x10^{-6}$ and the cumulative hazard index is less than 1.

If NO, proceed to Question 4(h).

Question 4(h): Is the nature and extent of soil contamination adequately characterized and has an adequate demonstration been made to show that the soil gas sampling techniques used could reasonably detect an elevated concentration of vapors if they were present in the site setting?

YES. If YES, continue with Question 4(i).

Question 4(i): Are there site conditions and/or data limitations that may make the use of generic soil gas attenuation factors inappropriate?

NO. The soil gas data considered with the indoor air data indicate the pathway is incomplete and/or does not pose an unacceptable risk to human health. Soil gas concentrations do not exceed the 10^{-4} cancer risk level or a hazard quotient of 1. The target risk range for carcinogens is $1x10^{-6}$ to $1x10^{-4}$, and the target risk level for noncarcinogens is a hazard quotient of 1. Risks calculated for dry cleaning facility workers from indoor air and from soil gas indicate that risks are less than or within acceptable levels.

Note that uncertainty is associated with the indoor air data. The Lead Researcher of GSI Environmental vapor intrusion evaluation conducted at the new dry cleaning facility noted that good pressure control was not achieved during sampling potentially due to ventilation slats in the building that cannot be closed (Tetra Tech, August 2010). As stated in the Subsurface Vapor Intrusion Guidance (USEPA, November 2002), indoor air quality can be influenced by background levels of volatile chemicals within a building. In the case of the new dry cleaning facility, it is likely that the majority of the PCE detected in the indoor air samples is originating from within the dry cleaning facility based on the difference in attenuation factors between radon and PCE noted by the GSI Lead Researcher (Tetra Tech, 2010). Despite the indoor air data uncertainties, no further assessment of the vapor intrusion pathway is recommended because calculated risks were within acceptable limits.

DATA ENTRY SHEET

SG-ADV
Version 3.1; 02/04

Reset to

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
71432	3.40E+00			Benzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of Ls (cell F24)					
15	24.4	20	24.4	0	0	LS		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
LS	1.62	0.39	0.076	LS	1.62	0.39	0.076	LS	1.62	0.39	0.076

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	25	25	250

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Molecular weight, MW (g/mol)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
8.80E-02	9.80E-06	5.54E-03	25	7,342	353.24	562.16	78.11	7.8E-06	3.0E-02

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	9.4	0.314	0.314	0.314	0.079	1.65E-08	0.957	1.58E-08	4,000	3.40E+00	6.92E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.06E+06	3.77E-04	15	8,019	4.39E-03	1.83E-01	1.78E-04	1.22E-02	0.00E+00	0.00E+00	1.22E-02	9.4

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	3.40E+00	0.10	1.56E+01	1.22E-02	4.00E+02	7.44E+13	2.23E-04	7.59E-04	7.8E-06	3.0E-02

END

DATA ENTRY SHEET

SG-ADV
Version 3.1; 02/04

Reset to

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
107062	8.80E-01			1,2-Dichloroethane

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of Ls (cell F24)					
15	24.4	20	24.4	0	0	LS		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
LS	1.62	0.39	0.076	LS	1.62	0.39	0.076	LS	1.62	0.39	0.076

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	25	25	250

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Molecular weight, MW (g/mol)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
1.04E-01	9.90E-06	9.77E-04	25	7,643	356.65	561.00	98.96	2.6E-05	0.0E+00

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	9.4	0.314	0.314	0.314	0.079	1.65E-08	0.957	1.58E-08	4,000	8.80E-01	6.92E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.06E+06	3.77E-04	15	8,412	7.67E-04	3.19E-02	1.78E-04	1.44E-02	0.00E+00	0.00E+00	1.44E-02	9.4

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	8.80E-01	0.10	1.56E+01	1.44E-02	4.00E+02	5.46E+11	2.24E-04	1.97E-04	2.6E-05	NA

END

DATA ENTRY SHEET

SG-ADV
Version 3.1; 02/04

Reset to

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
100414	1.30E+01			Ethylbenzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of Ls (cell F24)					
15	24.4	20	24.4	0	0	LS		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
LS	1.62	0.39	0.076	LS	1.62	0.39	0.076	LS	1.62	0.39	0.076

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	25	25	250

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Molecular weight, MW (g/mol)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.50E-02	7.80E-06	7.86E-03	25	8,501	409.34	617.20	106.17	0.0E+00	1.0E+00

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	9.4	0.314	0.314	0.314	0.079	1.65E-08	0.957	1.58E-08	4,000	1.30E+01	6.92E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.06E+06	3.77E-04	15	10,040	5.89E-03	2.45E-01	1.78E-04	1.04E-02	0.00E+00	0.00E+00	1.04E-02	9.4

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	1.30E+01	0.10	1.56E+01	1.04E-02	4.00E+02	1.89E+16	2.23E-04	2.90E-03	NA	1.0E+00

END

DATA ENTRY SHEET

SG-ADV
Version 3.1; 02/04

Reset to

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
127184	2.40E+02			Tetrachloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of Ls (cell F24)					
15	24.4	20	24.4	0	0	LS		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
LS	1.62	0.39	0.076	LS	1.62	0.39	0.076	LS	1.62	0.39	0.076

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	25	25	250

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Molecular weight, MW (g/mol)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.20E-02	8.20E-06	1.84E-02	25	8,288	394.40	620.20	165.83	5.9E-06	6.0E-01

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	9.4	0.314	0.314	0.314	0.079	1.65E-08	0.957	1.58E-08	4,000	2.40E+02	6.92E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.06E+06	3.77E-04	15	9,451	1.40E-02	5.81E-01	1.78E-04	1.00E-02	0.00E+00	0.00E+00	1.00E-02	9.4

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	2.40E+02	0.10	1.56E+01	1.00E-02	4.00E+02	9.00E+16	2.23E-04	5.34E-02	5.9E-06	6.0E-01

END

DATA ENTRY SHEET

SG-ADV
Version 3.1; 02/04

Reset to

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
79016	9.50E-01			Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
15	24.4	20	24.4	0	0	LS		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
LS	1.62	0.39	0.076	LS	1.62	0.39	0.076	LS	1.62	0.39	0.076

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	300	0.1	0.83	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	25	25	250

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Molecular weight, MW (g/mol)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	131.39	1.1E-04	4.0E-02

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	9.4	0.314	0.314	0.314	0.079	1.65E-08	0.957	1.58E-08	4,000	9.50E-01	6.92E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.06E+06	3.77E-04	15	8,433	8.06E-03	3.35E-01	1.78E-04	1.10E-02	0.00E+00	0.00E+00	1.10E-02	9.4

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	9.50E-01	0.10	1.56E+01	1.10E-02	4.00E+02	2.83E+15	2.23E-04	2.12E-04	1.1E-04	4.0E-02

END