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FINAL SUPPLEMENTAL REMEDIAL INVESTIGATION FOR SITE 73 OPERABLE UNIT 21 (OU 21) AMPHIBIOUS VEHICLE MAINTENANCE FACILITY MCB CAMP LEJEUNE NC

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CH2M HILL

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Supplemental Remedial Investigation
Site 73 – Operable Unit No. 21
Amphibious Vehicle Maintenance Facility

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

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Executive Summary

Introduction

This report presents the Supplemental Remedial Investigation (SRI) for Site 73 at Marine Corps Base (MCB) Camp Lejeune in Jacksonville, North Carolina. Site 73 encompasses the Amphibious Vehicle Maintenance Facility located in the Courthouse Bay Area. Site 73 is roughly bounded by State Route 172 (Sneads Ferry Road) to the north, Courthouse Bay to the south and unnamed tributaries to Courthouse Bay to the east and west. Operable Unit No. 21 consists solely of Site 73. This report summarizes previous investigations and presents the data, results, and conclusions related to investigation activities conducted by CH2M HILL between 2005 and 2006. This report also includes the addendum to the Ecological Risk Assessment (ERA) for Site 73.

A Final Remedial Investigation (RI) Report was submitted by Baker Environmental, Inc. (Baker, 1997a). However, in 2005 the MCB Camp Lejeune Partnering Team concluded that the 1997 RI Report and subsequent site investigations (SIs) did not adequately characterize the site and requested additional investigative activities in the form of a SRI.

CH2M HILL conducted SRI activities to complete the characterization of soil and groundwater impacts present at the site. Field activities were conducted in accordance with the *Amended RI Work Plan, Operable Unit No. 21 (Site 73), Marine Corps Base Camp Lejeune, North Carolina* prepared by CH2M HILL in October 2005 (CH2M HILL, 2005a) .

This SRI report was prepared by CH2M HILL under the Naval Facilities Engineering Command (NAVFAC), Mid-Atlantic Division (MIDLANT), Comprehensive Long-term Environmental Action—Navy (CLEAN) III Contract N62470-02-D-3052, Contract Task Order 105. This report is for submittal to NAVFAC – MIDLANT, MCB Camp Lejeune Installation and Environment Department—Environmental Management Division, the U.S. Environmental Protection Agency (USEPA), and the North Carolina Department of Environment and Natural Resources.

Site 73 Use

The Amphibious Vehicle Maintenance Facility (Site 73), which began its current operations in 1946, consists of numerous buildings, aboveground storage tanks, underground storage tanks (USTs), vehicle wash racks, and oil-water separators. Active USTs and former UST locations are present within the fenced area surrounding Building A47 and in the vicinity of Buildings A1, A2, and A10 (See **Figure 2-3**).

Historical records indicate that standard operating procedures from 1946 until approximately 1976 included discharging used motor oil and used battery acid directly onto the un-paved ground surface near the current location of Building A47. Previous investigations did not encounter soil or groundwater impacts related to the battery acid disposal practices, and neither the used oil nor the battery acid disposal areas are visually

evident as much of the investigation areas are currently paved, or developed with buildings and/or roads.

Based on the results of the SRI and previous phases of the SI, the primary contaminants of concern at Site 73 are the chlorinated solvent compounds trichloroethene (TCE) and its daughter products of reductive dechlorination, including 1,1-dichloroethene (DCE), cis-1,2 dichloroethene (cis-1,2-DCE), and vinyl chloride (VC), and the petroleum-related compound benzene.

The objectives of the SRI for Site 73 were to do the following:

- Collect information to supplement and/or verify the environmental setting at the site, including hydrogeology, geology, hydrology, topography, and the presence of anthropogenic influences that may affect the hydrology or contaminant pathways at the site.
- Characterize the sources via the collection of analytical data, and evaluate the migration and dispersal characteristics of the waste.
- Characterize the hazardous constituents (if any) via the collection of groundwater and soil samples in the vicinity of the site. Characterization includes a definition of the extent, origin, direction and rate of movement of any contamination.
- Evaluate potential receptors by collecting data describing human populations and environmental systems susceptible to contaminant exposure.

Site Physical Characteristics

Site 73 lies within an area of low topographic relief adjacent to Courthouse Bay, an inlet of the New River. The majority of the site is paved or developed with maintenance and storage buildings.

The site is underlain by Coastal Plain sediments consisting of sands, silts, clays, and cemented sands and shell beds belonging to the Belgrade, River Bend, and Castle Hayne Formations (Fm.). The surficial aquifer exists within the shallow undifferentiated deposits and the upper Belgrade Fm. A dense silty horizon within the Belgrade Fm. acts as a confining unit for the underlying Castle Hayne aquifer. However, at Site 73, the Belgrade Fm. appears to be laterally discontinuous and allows hydraulic communication between the surficial and Castle Hayne aquifers.

The River Bend Fm. underlies the Belgrade Fm. and is composed of sands, silt, shell and fossil fragments, and trace amounts of clay. Below this layer the composition of the River Bend Fm. changes to a fine to medium grained sand with trace amounts of silts and shells. The River Bend Fm. overlies the Castle Hayne Fm., which is encountered at a depth of approximately 110 feet (ft) below ground surface (bgs) at Site 73.

In general, the groundwater flow direction within the surficial and Castle Hayne aquifers is to the southeast. Downward vertical hydraulic potentials were calculated between the surficial and Castle Hayne aquifers. Hydraulic conductivity values for the surficial and Castle Hayne aquifers have been estimated to be 1.3 ft per day (ft/day) and 3.6 ft/day,

respectively. The horizontal seepage velocity within these same aquifers has been calculated to be approximately 0.20 ft/day and 0.02 ft/day, respectively.

Potable water for MCB Camp Lejeune and the surrounding residential area is provided by public water supply wells that pump groundwater from the Castle Hayne aquifer. Although fresh water is present within the surficial, Castle Hayne, Beaufort, and Peedee aquifers, all of which are located below MCB Camp Lejeune, only the Castle Hayne aquifer is used by MCB Camp Lejeune as a water supply source.

Nature and Extent of Contamination

Groundwater

During the April 2006 groundwater sampling event, volatile organic compounds (VOCs) including benzene, TCE, 1,1-DCE, cis-1,2-DCE, and VC exceeded their respective North Carolina Groundwater Quality Standards (NCGWQS) and/or maximum contaminant level in one or more of the monitoring wells. Other chlorinated volatile organic compounds (CVOCs) were detected at concentrations below their respective NCGWQS and are therefore not considered contaminants of concern.

VC was frequently detected in both aquifers, and had the greatest number of detections exceeding the NCGWQS, with 5 samples exceeding standards in the surficial aquifer and 14 samples exceeding standards in the Castle Hayne aquifer. The greatest concentrations of VC were detected in samples collected from the Castle Hayne aquifer; the maximum concentration of VC within the Castle Hayne aquifer was reported at IR73-MW44DW (130 micrograms per liter [µg/L]).

TCE and cis-1,2-DCE were detected above their respective NCGWQS in multiple samples collected from monitoring wells screened in the Castle Hayne aquifer. The majority of TCE and cis-1,2-DCE detections in the Castle Hayne aquifer is occurred between Building A47 and Courthouse Bay. The greatest TCE concentration was detected at IR73-MW49DW (840 µg/L), and the greatest cis-1,2-DCE concentration was detected at IR73-MW49IW (1,300 µg/L).

Benzene was detected at concentrations above the NCGWQS in three monitoring wells screened in the surficial aquifer and nine monitoring wells screened in the Castle Hayne aquifer. The distribution of benzene within the surficial aquifer is limited to the area northeast of Building A47. The benzene plume within the Castle Hayne aquifer extends from the paved area associated with Building A47 to Courthouse Bay, and is concentrated between Building A47, the approximate location of the former maintenance building, and the suspected location of UST A47-1. The greatest benzene concentration detected in the Castle Hayne aquifer was reported in a groundwater sample collected from monitoring well IR73-MW44DW at a concentration of 8.9 µg/L.

The greatest VOC concentrations are located beneath the paved area associated with Building A47. Contaminants detected in the surficial aquifer (TCE, VC, and benzene) appear to originate in the vicinity of UST A47-3. The greatest concentrations of VOCs (TCE, 1,1-DCE, cis-1,2-DCE, VC, and benzene) detected within the Castle Hayne aquifer were generally detected in samples collected from IR73-MW44DW or IR73-MW49DW, located

between Building A47 and the approximate footprint of the former maintenance building and in the suspected vicinity of UST A47-1.

Historical groundwater monitoring data indicate decreasing concentrations of TCE and cis-1,2-DCE within source area wells and a corresponding increase in VC, indicating that reductive dechlorination is occurring at Site 73. The data also shows that benzene concentrations are gradually approaching the NCGWQS.

Evaluation of natural attenuation indicator parameters, (including dissolved oxygen, oxidation-reduction potential, nitrate, iron, sulfate, alkalinity, methane, total organic carbon, and chloride) indicates that conditions for natural attenuation are favorable or that natural attenuation is currently occurring in both the surficial and Castle Hayne aquifers. Both fuel-related hydrocarbons and chlorinated solvents are capable of being depleted by natural processes in each aquifer.

Soil

During previous SIs and periodic long-term monitoring events, free-phase petroleum product (generally about 0.25-inch thick) has been observed in monitoring well IR73-MW14, located in the parking area southeast of Building A47. Laboratory analysis of groundwater samples collected from monitoring well IR73-MW14 generally do no not indicate the presence of elevated concentrations of VOCs. Previous efforts to remove the free product, including numerous aggressive fluid vapor recovery events, have not been entirely successful.

In October 2005, a total of 30 soil borings (designated as IS-100 through IS-129) were advanced in the area surrounding IR73-MW14 to assess the nature and extent of petroleum, oil, and lubricants (POL) impacts and evaluate their connection to the free product observed in this well. In January 2008, an additional 10 soil borings (designated as IS-130 through IS-139) were installed to address data gaps remaining from the October 2005 investigation.

Although a specific source of free product was not identified during the POL investigation activities completed in October 2005 and January 2008, an area of POL-impacted soils was identified and generally defined northeast of, and adjacent to, the former maintenance building. This impact is likely the result of multiple surficial spills, rather than a single event, prior to the construction of the concrete paved parking area.

Within the POL-impacted area in the vicinity IR73-MW14, historical groundwater level measurements indicate that seasonal fluctuations in the water table result in the cyclical submergence of the previously described concrete layer. Discovery of elevated concentrations of oil and grease and total petroleum hydrocarbon-diesel range organics beneath the concrete layer, suggests that rise and fall of the water table may have led to the lateral migration of product along the upper and lower surfaces of the concrete layer.

Surface Water and Sediment

RI activities completed by Baker between 1995 and 1996 included surface water and sediment sampling in Courthouse Bay and it surrounding tributaries. The original RI concluded that Courthouse Bay is not impacted by CVOCs and benzene detected in groundwater at Site 73. Therefore, impact to surface water and sediment was not further evaluated in the SRI.

Fate and Transport

Source Areas

The areal extent of the 'total VOC' plume is approximately 19 acres; vertically, the plume extends to a depth of approximately 110 ft bgs, with the greatest concentrations detected between 60 and 75 ft bgs. The areal extent of the POL-impacted soil area is approximately 1.5 acres, extending from the ground surface to the water table and ranging from 5 to 8 ft bgs.

Based on the chemical and physical data gathered during the various phases of investigation conducted at Site 73, the CVOCs detected in groundwater samples and POL-impacts detected in soil samples are likely to be the result of historical disposal activities. Specifically, the impacts to groundwater appear to be related to USTs A47-3 and A47-1, and the historical vehicle maintenance activities.

Contaminant Transport

Shallow groundwater flow upgradient of the Site 73 source area is generally to the south to southeast towards Courthouse Bay. Groundwater flow within the Castle Hayne aquifer is generally southeast towards Courthouse Bay.

The presence of VOCs in groundwater samples collected from wells screened within the Castle Hayne aquifer provides evidence of downward vertical gradients at Site 73. Benzene and VC concentrations above their respective NCGWQS are reported as deep as 110 ft bgs in monitoring well IR73-MW41DW, located on the tank trail adjacent to Courthouse Bay. No contaminants were detected above laboratory detection limits in samples collected from the deepest Site 73 monitoring wells, screened from 145 to 150 ft bgs (IR73-MW26DW, IR73-MW51, IR73-MW52, and IR73-MW53). During this SRI, three deep monitoring wells were installed to specifically to delineate the vertical extent of contamination in the vicinity of Building A47 (IR73-MW11DW and IR73-MW17DW [screened from 81 to 86 ft bgs] and IR73-MW49DWA [screened from 121 to 126 ft bgs]). No target analytes were detected above their respective NCGWQS in these three newly installed monitoring wells.

Groundwater Predictive Modeling

BIOCHLOR groundwater modeling predicts that TCE, cis-1,2-DCE, and VC will each attenuate below their respective NCGWQS within the next 40 to 80 years. It should be noted, however, the presence of petroleum compounds within the aquifer may speed reductive dechlorination by acting as an additional carbon source.

In addition, modeling indicates TCE, cis-1,2-DCE, and VC may reach Courthouse Bay at concentrations of 3 µg/L, 1 µg/L, and 1 µg/L, respectively. These predicted concentrations are well below the surface water standards for TCE (92.4 µg/L), cis-1,2-DCE (13,000 µg/L), and VC (525 µg/L). Therefore, the contaminant concentrations present at Site 73 are not expected to reach Courthouse Bay above surface water standards in the future.

Human Health Risk Assessment

A Human Health Risk Assessment (HHRA) was completed as part of the RI (Baker, 1997a) evaluating the projected impact of contaminants of concern on human health and/or the environment now and in the future. Current and future receptors evaluated included: current military personnel, current trespassers, current adult fisherman, current child receptor for aquatic biota ingestion, future residents, and future construction workers. Exposure scenarios evaluated included: exposure to surface soil, surface water, and sediment for current receptors; ingestion of fish and crab tissue for adult fisherman and child receptor; and surface soil, groundwater, surface water, and sediment exposure for future receptors. The results of the HHRA concluded the following:

- There was no unacceptable risk to human health and/or the environment under current use scenarios.
- The risk from ingestion of groundwater for future adult and child residential receptors exceeds the USEPA's acceptable risk range. The primary driver for the elevated risk was VC in groundwater.

Ecological Risk Assessment

No unacceptable risks to the environment were identified in the ERA. An addendum to the ERA was prepared to evaluate if there have been any changes in exposure pathways since the completion of the ERA, to compare the concentrations of site-related constituents to current legally enforceable water quality standards, and to evaluate whether the conclusions of the ERA are still valid.

Site features and characteristics have changed since the ERA, including the covering of surface soils with concrete, the delineation of free product and total petroleum hydrocarbons, oil and grease contamination, and the identification of a wetland. These features and characteristics were considered in conjunction with the most recent surface water and groundwater analytical data to provide an updated evaluation of ecological risks at Site 73.

The results of the evaluation support the original conclusions of the ERA that aquatic receptors are unlikely to be significantly at risk from Site 73 releases. The review also indicated that the modest risks identified for terrestrial receptors in the ERA have likely been reduced through a reduction in exposure to contaminated soils.

Recommendations

Based on the results and conclusions of SRI activities at Site 73, a Feasibility Study is recommended to evaluate appropriate remedial alternatives to reduce the VOC concentrations in an effort to reduce the time required to reach the remedial goals for Site 73, and prevent contaminant migration to Courthouse Bay or water supply wells across Courthouse Bay.

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Acronyms and Abbreviations

AOC	area of concern
ATEC	ATEC Environmental Consultants
atm-m^3/M	atmosphere-cubic meter per mole
AWQC	federal Ambient Water Quality Criteria
Baker	Baker Environmental, Inc.
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, xylenes
CDI	chronic daily intake
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
Cis-1,2-DCE	cis-1,2 dichloroethene
CLEAN	Comprehensive Long-term Environmental Action Navy
cm/sec	centimeters per second
COC	contaminant of concern
COPC	chemical of potential concern
CS	Confirmation Study
CSF	carcinogenic slope factor
CSM	conceptual site model
CVOC	chlorinated volatile organic compound
°F	degrees Fahrenheit
DCE	1,1-dichloroethene
DDD	dichlorodiphenyldichloroethane
DNAPL	dense non-aqueous phase liquid
DO	dissolved oxygen
DPT	direct-push technology
EMD	MCB Camp Lejeune Installation and Environment Department—Environmental Management Division
ERA	Ecological Risk Assessment
ER-L	effects range – low
ER-M	effects range - medium
ESE	Environmental Science & Engineering, Inc.
Fe(II)	ferrous iron
FFA	Federal Facilities Agreement
Fm	Formation
FS	Feasibility Study
ft	foot/feet
ft/day	feet per day
ft/ft	feet per foot
ft/year	feet per year
GSI	Groundwater Technology Government Services, Inc.

HDD	horizontal directionally drilled
HHRA	Human Health Risk Assessment
HI	hazard index
IAS	Initial Assessment Study
ICR	incremental lifetime cancer risk
IDW	investigation-derived waste
IRP	Installation Restoration Program
K_d	distribution coefficient
K_h	Henry's Law Constant
K_{oc}	partition coefficient
K_{ow}	octanol-water partition coefficient
LNAPL	light non-aqueous phase liquid
LTM	long-term monitoring
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
MCB	Marine Corps Base
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
MIDLANT	Mid-Atlantic Division
ml/g	milliliters per gram
msl	mean sea level
mV	millivolt
NAES	Natural Attenuation Evaluation Study
NAIP	natural attenuation indicator parameter
NAVFAC	Naval Facilities Engineering Command
NC	North Carolina
NCDENR	North Carolina Department of Environment and Natural Resources
NCGWQS	North Carolina Groundwater Quality Standards
NCWQS	North Carolina Water Quality Standards
NPL	National Priorities List
O&G	oil and grease
ORP	oxidation-reduction potential
OWS	oil-water separator
PAHs	polynuclear aromatic hydrocarbons
PCB	polychlorinated biphenyl
POL	petroleum, oil, and lubricants
QI	quotient index
RAC	Remedial Action Contract
RAO	remedial action objectives
RfD	reference dose
RI	Remedial Investigation
RRSL	Residential Regional Screening Level

SGI	Supplemental Groundwater Investigation
SI	site investigation
SRI	Supplemental Remedial Investigation
SVOC	semivolatile organic compound
TCE	trichloroethene
TOC	total organic carbon
TPH	total petroleum hydrocarbon
TPH-DRO	total petroleum hydrocarbon-diesel range organics
Tracer	Tracer Research Corporation
USEPA	U.S. Environmental Protection Agency
UST	underground storage tank
VC	vinyl chloride
VOC	volatile organic compound
WAR	Water & Air Research, Inc.

SECTION 1

Introduction

This Supplemental Remedial Investigation (SRI) report presents the field activities, findings, and conclusions relating to the environmental investigation activities conducted by CH2M HILL in 2005 and 2006, at Operable Unit No. 21, Site 73, Marine Corps Base (MCB) Camp Lejeune located in Onslow County, North Carolina. Site 73 encompasses the Amphibious Vehicle Maintenance Facility located in the Courthouse Bay area of the Base.

Historical environmental investigations at Site 73 initially focused on two underground storage tanks (USTs), UST SA-21 and UST A47-3, which contained gasoline and diesel fuel, respectively. UST SA-21 was reportedly removed in 1991 and UST A47-3 was replaced in 1992. The UST investigations revealed the presence of both petroleum-related volatile organic compounds (VOCs) and chlorinated volatile organic compounds (CVOCs) in the soils and groundwater underlying the paved areas of the Site.

The first site-wide Remedial Investigation (RI) was conducted between 1995 and 1997 by Baker Environmental, Inc. (Baker) to evaluate the nature, significance, and extent of the reported releases. The findings of these investigations were documented in Baker's 1997 Final RI Report. However, in 2005 the MCB Camp Lejeune Partnering Team determined that the 1997 RI Report and subsequent site investigations (SIs) did not adequately characterize the Site, and requested additional investigative activities in the form of a SRI.

The SRI was completed in accordance with the 2005 *Amended RI Work Plan, Operable Unit No. 21 (Site 73), Marine Corps Base Camp Lejeune, North Carolina* prepared by CH2M HILL. This SRI report was prepared by CH2M HILL under the Naval Facilities Engineering Command (NAVFAC), Mid Atlantic Division (MIDLANT), Comprehensive Long-term Environmental Action—Navy (CLEAN) III Contract N62470-02-D-3052, Contract Task Order 105. This report is for submittal to NAVFAC MIDLANT, MCB Camp Lejeune Installation and Environment Department—Environmental Management Division (EMD), the U.S. Environmental Protection Agency (USEPA), and North Carolina Department of Environment and Natural Resources (NCDENR).

1.1 Objectives and Approach

The objectives of the SRI are to:

- Compile a complete history of SI activities;
- Describe the site setting, including hydrogeology, geology, hydrology, topography, and anthropogenic factors that may influence fate and transport of site contaminants;
- Characterize the distribution of the site contaminants via the collection and analysis of groundwater, soil, and soil gas samples (characterization includes evaluation of the source, nature and extent, and rate of movement of any contamination);

- Evaluate potential receptors by collecting data describing human populations and environmental systems susceptible to contaminant exposure;
- Evaluate the risk of any contaminants associated with the Site to the environment; and
- Provide recommendations for site management.

1.2 Report Organization

This SRI is composed of the following sections:

- **Section 1—**Introduction
- **Section 2—**Background
- **Section 3—**SRI Field Activities
- **Section 4—**Site Physical Characteristics
- **Section 5—**Nature and Extent of Contamination
- **Section 6—**Contaminant Fate and Transport
- **Section 7—**Human Health Risk Assessment
- **Section 8—**Ecological Risk Assessment
- **Section 9—**Conclusions and Recommendations
- **Section 10—**References

Figures and tables referenced throughout the text are provided at the end of each section.

SECTION 2

Background

MCB Camp Lejeune was placed on the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) National Priorities List (NPL) effective November 4, 1989. Subsequent to this listing, the USEPA Region IV, NCDENR, the Department of the Navy, and the U.S. Marine Corps entered into a Federal Facilities Agreement (FFA) for MCB Camp Lejeune. The primary purpose of the FFA was to ensure that environmental impacts associated with past and present activities at the Base are thoroughly investigated and that appropriate CERCLA response and Resource Conservation and Recovery Act corrective action alternatives are developed and implemented, as necessary, to protect public health and welfare and the environment.

The following sections present a summary of the site setting, history and previous phases of investigation conducted at Site 73.

2.1 Site Setting and History

MCB Camp Lejeune encompasses approximately 236 square miles of land in Onslow County, North Carolina, adjacent to the southern side of the City of Jacksonville. Jacksonville is the largest city near MCB Camp Lejeune and contains approximately half of the county's total population. Since 1990, much of the MCB Camp Lejeune complex has been part of Jacksonville. The areas adjacent to the Base are generally rural.

The Base is bisected by the New River, which flows into the Atlantic Ocean in a southeasterly direction. The Base is bordered by the Atlantic Ocean to the east, U.S. Route 17 to the west and State Route 24 to the north. **Figure 2-1** shows the location of MCB Camp Lejeune.

Site 73 encompasses the Amphibious Vehicle Maintenance Facility located in the Courthouse Bay Area of MCB Camp Lejeune as shown on **Figure 2-2**. The site is roughly bounded by State Route 172 (Sneads Ferry Road) to the north, Courthouse Bay to the south and unnamed tributaries to Courthouse Bay to the east and west. Courthouse Bay Road bisects Site 73 and serves as the main point of access to the Amphibious Vehicle Maintenance Facility. A site map is shown on **Figure 2-3**.

The topographic relief within Site 73 is moderate, with a gentle slope towards the bay. Consequently, stormwater runoff tends to drain directly south to Courthouse Bay, to the two small unnamed tributaries located east and west of the facility, or to the retention ponds located west of Buildings A3, A9, A10, and A11, and ultimately discharging to Courthouse Bay. There is a broad marshy area associated with the western tributary. Directly north of the site is another large marsh and stream that discharges north into the New River. The marsh located directly north is separated from the site by State Route 173, which represents a local topographic high and surface water runoff divide.

The Amphibious Vehicle Maintenance Facility is an active facility which began operations in 1946 and consists of numerous buildings, aboveground storage tanks, USTs, vehicle wash racks, and oil-water separators (OWSs). Ten current and former USTs are associated with Site 73. Four USTs (A10/SA26, A47-3, A47-4 and A47-5) contain or contained diesel fuel. Four USTs (SA21, A12-1, A12-2 and A2) contain or contained both diesel and gasoline. UST A47-2 is suspected to have contained diesel, gasoline, or waste oil (Baker, 1997a). The former contents of UST A47-1 are unknown but suspected to have been diesel, gasoline, or waste oil. UST SA21 was removed in 1991. UST A47-3 was removed and reportedly replaced. USTs A10/SA26, A12-1, A12-2, and A2 were transferred into the Installation Restoration Program (IRP) in 1994. The current status of A47-1, A47-2, A47-4, and A47-5 is unknown. Based on an April 1994 letter from EMD to NCDENR, tanks A47-1, A-2, A-10, and A-12 were transferred into the IRP at Site 73. The known and/or suspected locations of these USTs are shown on **Figure 2-3**.

Several improvements to the site have been made since the initial RI (Baker, 1997a). The area of land located southwest of the intersection of State Route 172 and Courthouse Bay Road was previously wooded, but is currently the location of Buildings A71, A72, and SA81, and has been paved with asphalt for parking. Building A71 is a command post and Building A72 is used for maintenance. Building SA81 is a Hazmat Storage Area. Stormwater retention ponds have been created in the previously wooded area west of Buildings A3, A9, A10, and A11. The formerly grassy area southwest of Building A1 has been developed into Buildings A66, A102, SA64, SA67, SA68, and SA69 and paved for parking. Building A66 is used for maintenance and operations. Buildings SA67, SA68, and SA69 are warehouses. Building SA64 is a Hazmat Storage Area. Additionally, an armory (Building A73) has been constructed in the northeast corner of the site since the completion of the RI (Baker, 1997a).

Maintenance activities at the Amphibious Vehicle Maintenance Facility were historically conducted in building A3 located southeast of the current Building A47. Following the construction of Building A47, building A3 was demolished. The construction of Building A47 and the demolition of Building A3 occurred between 1983 and 1989. **Figure 2-3** shows the approximate footprint of the former maintenance building, and **Figures A-1, A-2, A-3, A-4,** and **A-5** provided in **Appendix A** show historical aerial photography of Site 73 from 1956 to 2004.

2.2 Facility-wide Demography and Land Use

MCB Camp Lejeune is home to active duty, dependent, retiree, and civilian populations of approximately 150,000 personnel. Approximately 47,000 military personnel are stationed at the Base, including 39,000 Marines for resident formal school training and 8,000 Marines and Department of Defense employees for job enhancement training. MCB Camp Lejeune provides housing, training facilities, logistical support, and administrative supplies for Fleet Marine Force units and other assigned units.

MCB Camp Lejeune is composed of training facilities that include Camp Geiger, Camp Johnson, Stone Bay, Greater Sandy Run Training Area, and Marine Corps Air Station New River. Military training operations at the Base include 54 live-fire ranges, 89 maneuver areas, 33 gun positions, 25 tactical landing zones, and a military operation in an urban

terrain training facility. In addition, the beach frontage of the Base is capable of supporting amphibious operations.

MCB Camp Lejeune is located within Onslow County, along the coastal plain of North Carolina. The Base covers more than 153,000 acres that consist of approximately 26,000 acres of water and 127,000 acres of terrestrial features. The topographic elevation of the Base ranges from sea level to approximately 70 feet (ft) above sea level, with much of the land surface traversed by swales, wetlands, streams, and creeks that drain into the New River. The Base encompasses a 92-mile perimeter, including approximately 14 miles along the Atlantic Ocean. The ocean frontage of the Base is composed of a fragile barrier island system that is separated from the mainland by salt marshes, small bays, and an intracoastal waterway.

Past environmental investigations at MCB Camp Lejeune have identified a total of 176 sites, including 85 UST sites, which contain impacted soil and/or groundwater. Assessment of the various sites has indicated that the contaminants released from past storage and disposal activities at the installation have occasionally migrated through the surface and subsurface soils to the surficial aquifer and several surface water bodies. Contaminants identified during the site assessments at MCB Camp Lejeune include battery acid, fuels, paints and thinners, polychlorinated biphenyls (PCBs), pesticides, herbicides, solvents, used oils, and heavy metals (NPL Site Narrative Listing, 1995).

2.3 Previous Investigations

Environmental investigations at Site 73 initially focused on two USTs which stored gasoline and diesel fuel, UST SA-21 and UST A47/3. UST SA-21 was reportedly removed in 1991 and UST A47/3 was replaced in 1992. Over time, the investigations expanded to include investigations of past site activities including the historical dumping of battery acid, and petroleum, oil, and lubricants (POL). **Figure 2-4** illustrates the approximate location and boundaries of previous areas of investigation**. Table 2-1** summarizes the target parameters analyzed during the previous investigations and **Table 2-2** summarizes the previous investigation activities.

2.3.1 Initial Assessment Study (Water and Air Research, Inc., 1983)

In 1983, Water and Air Research, Inc. (WAR) submitted an Initial Assessment Study (IAS) for MCB Camp Lejeune and outlying areas to identify and assess sites posing a potential threat to human health or the environment due to contamination from past handling and disposal procedures associated with hazardous materials.

The study included the following activities:

- Collection and evaluation of archival and activities records relating to waste generation, handling and disposal, characterization of physical conditions at the site such as geology, hydrogeology, and identification of migration pathways and potential receptors;
- Interviews with current and past employees; and
- Land-based and aerial tours of potential historical disposal sites.

The IAS examined 76 sites at MCB Camp Lejeune. Fifty-four sites were judged to present no significant risk and thus required no further evaluation. Twenty-two sites, including Site 73, warranted further investigation to assess potential long-term impacts to human health and the environment and were thus recommended for a Confirmation Study (CS). As a result of the IAS, MCB Camp Lejeune was placed on the NPL.

The IAS contained a statement that indicated the standard operating procedure for changing the motor oil of an amphibious vehicle from 1946 through 1977 consisted of driving the vehicle into a wooded area and draining the used oil onto the ground. The IAS also reported the standard operating procedure for disposing of used battery acid at Site 73 from 1946 through 1977 was to discharge the acid to shallow hand-dug ditches located northeast of the Maintenance Building (A3).

In an attempt to quantify the amount of waste oil and battery acid discharged to the ground surface, WAR estimated that approximately 400,000 gallons of waste oil may have been discharged directly onto the ground surface at the facility based on the assumptions of 208 amphibious vehicles requiring four oil changes (15 gallons each) per year for 32 years. WAR estimated approximately 20,000 gallons of waste battery acid were disposed of in the area northeast of former maintenance Building A3 based on the assumptions of 60 gallons per month for 27 years.

The IAS recommended a CS to further investigate the reported releases at Site 73 and evaluate the potential impact to site soil or groundwater.

2.3.2 Confirmation Study (Environmental Science and Engineering, Inc., 1984–1990)

The CS of the 22 sites identified in the IAS was conducted by Environmental Science & Engineering, Inc. (ESE) between 1984 and 1987. The purpose of the study was to assess the presence and/or absence of contamination at each of the 22 sites and evaluate the need for further characterization and/or remediation.

During the CS at Site 73, ESE installed four shallow groundwater monitoring wells in 1984 and a fifth shallow monitoring well in 1986. Two rounds of groundwater samples were collected and analyzed for VOCs, cadmium, chromium, lead, antimony, oil and grease (O&G), and total phenols (analytical methods are not available). Groundwater samples were collected in 1984 from the four newly installed wells and the existing supply well (See **Figure 2-6** in **Appendix B** for locations of the three potable water supply wells within 1 mile of Site 73: BB-44, BB-47, and BB-220). In 1987, groundwater samples were collected from all five ESE wells, and analyzed for the previously referenced analytes as well as xylenes, methyl ethyl ketone, methyl isobutyl ketone, ethylene dibromide and hexavalent chromium. Several substances were detected in the groundwater samples that exceeded their respective North Carolina Groundwater Quality Standard (NCGWQS), including chlorinated solvents, benzene, and lead.

Surface water and sediment samples were collected from three locations in Courthouse Bay. The analytical results identified the presence of metals, phenols, and O&G in the sediment at concentrations below the applicable NC standards. Chromium was detected in the surface water at levels below the freshwater standard.

2.3.3 UST SA-21 Investigation (ATEC, 1992 and Baker, 1992 and 1993)

Subsurface investigations were conducted in the vicinity of UST SA-21 (**Figure 2-3,** and **Figure 1-9** in **Appendix B**) by ATEC Environmental Consultants (ATEC, 1992) and Baker (Baker, 1992 and 1993). ATEC advanced eight soil borings for the purpose of collecting soil samples and investigating the shallow geology at the site. Upon completion of the borings, groundwater monitoring wells were installed. Groundwater samples collected from these wells were analyzed for total petroleum hydrocarbons (TPHs) by USEPA Method 8015 and benzene, toluene, ethylbenzene, and xylenes (BTEX). The greatest concentrations of target analytes detected in the soils included TPH at 490 milligrams per kilogram (mg/kg), which most closely resembled diesel fuel, and BTEX compounds (5 mg/kg). Benzene was detected in the groundwater sample collected from monitoring well IR73-MW07 at a concentration of 45 micrograms per liter (µg/L) (exceeding the NCGWQS of 1 µg/L.

Based on the benzene concentrations detected in groundwater and TPH and BTEX concentrations in soil, ATEC recommended that additional soil and groundwater sampling should be conducted in the area (See **Figure 2-4**). As shown in **Figure 1-9** of **Appendix B,** benzene was detected in groundwater at a concentration of 38 µg/L exceeding its NCGWQS of 1 µg/L in one monitoring well, at IR73-MW15; TPH closely resembling weathered gasoline was detected in groundwater at IR73-MW03 at a concentration of 390 µg/L. In 1993, additional soil samples were collected in the vicinity of the former UST-SA21 to evaluate the nature and extent of subsurface contamination. Laboratory analytical results for soil samples showed that the contamination was concentrated north, east and southeast of the former UST-SA21 and generally between 2.0 to 6.0 ft below ground surface (bgs). Monitoring wells (MW-16, MW-17, MW-18, DW-3, DW-4 and RW-1) were also installed during this phase of the assessment. Groundwater samples collected from the monitoring wells listed above were analyzed for BTEX and total VOCs, with no detected exceedances of NCGWQS.

2.3.4 UST A47-3 Investigation (GSI, 1993 and Law-Catlin, 1993)

UST A47-3 is located east of Building A47 (**Figure 2-3**) and was investigated by Groundwater Technology Government Services, Inc. (GSI) and Law-Catlin in 1993. GSI advanced seven soil borings from which seven soil samples were collected for TPH analysis according to EPA Preparation Methods 3550/5030 and USEPA Method 8015. The borings were later converted into shallow groundwater monitoring wells and sampled for analysis of BTEX. TPH was detected in the soil samples ranging from 440 to 3,000 mg/kg.

Law-Catlin conducted an additional investigation of the site in which 48 subsurface soil samples were collected from 16 soil borings for analysis of TPH. The greatest detection of TPH in soil was 1.6 mg/kg in a sample collected approximately 20 ft north of UST A47-3. The soil borings were converted into twelve shallow groundwater monitoring wells and three deep Type III monitoring wells and one recovery well. In addition to the groundwater samples collected from the monitoring wells, ten groundwater samples were also collected by means of a QED Hydropunch. All groundwater samples were analyzed for BTEX. Groundwater samples were also collected from several shallow wells and analyzed for non-fuel specific compounds via USEPA Method 610. The results revealed the presence of elevated levels of several chlorinated organic compounds including vinyl chloride (VC), trans-1,2-dichloroethene (1,2-DCE), trichloroethene (TCE), cis,1,2-DCE,and 1,2,4-

trimethylbenzene. However, only benzene was detected in excess of its NCGWQS. The greatest detection of benzene in groundwater was 13.0 µg/L collected from monitoring well IR73-A47/3-8 (See **Figure 1-15** in **Appendix B**).

2.3.5 Preliminary Investigation (Baker, 1994)

A soil gas survey and groundwater screening program was implemented at Site 73 by Baker from June 7 through June 14, 1994. The purpose of this phase of investigation was to accomplish the following:

- Assess the presence of additional impacted areas; and
- Better define the identified source areas.

Baker subcontracted Tracer Research Corporation (Tracer) of Monmouth, New Jersey to execute the program.

In general, the soil gas and groundwater samples collected from the nodes of a site-wide 200-ft by 200-ft grid. This phase of investigation focused upon areas of the Site that had not previously been addressed (**Figure 2-4**). Additional sampling locations were biased toward suspected source areas, such as OWSs, active and former USTs, and miscellaneous areas such as active and former vehicle wash down basins. Tracer collected a shallow groundwater sample from each sampling location, and an attempt was also made to obtain a soil gas sample from each sampling location; however, at some locations, the close proximity of the shallow groundwater level to the top of the ground surface precluded the successful collection of soil gas samples.

Each soil gas and groundwater sample was analyzed by Tracer's mobile gas chromatograph for BTEX, total volatile hydrocarbons, trichloroethane, TCE, tetrachloroethene, and methylene chloride. These parameters were selected to cover a broad range of petroleum hydrocarbons and chlorinated solvents which comprise the two classes of organic contaminants of concern at this site.

Groundwater sample screening results indicated the presence of six areas of chlorinated solvent contamination, the largest of which were located at the northern edge of Site 73 near Building A73 and within the concrete covered area located between Building A47 and Courthouse Bay. Ten small areas of benzene impacted groundwater were also identified across the site. Twelve individual areas of VOC contamination were identified, the largest of which includes most of the concrete paved area between Building A47 and Courthouse Bay.

Soil gas sampling produced similar results, indicating the presence of a large chlorinated solvent plume beneath the concrete paved area between Building A47 and Courthouse Bay and multiple smaller areas of benzene and VOC contamination scattered across the site.

Using the results of the preliminary investigations and previous investigations, Baker subdivided Site 73 into nine distinct areas of concern (AOCs). Each AOC is briefly described below. See **Figure B-1** in **Appendix B** for a site-wide figure identifying the Baker AOCs.

- **AOC #1:** The general area identified in the Camp Lejeune CS (ESE, 1990) where an estimated 400,000 gallons of waste oil may have been disposed. USTs A47-1, A47-4 and A47-5 are located in AOC #1.

- **AOC #2:** A vehicle roadway/ditch area at the extreme southwestern edge of the site which leads into Courthouse Bay. Groundwater discharge had been observed from seeps located on both sides of the roadway/ditch; however, no detectable levels of VOCs were present in samples collected from this area.
- **AOC #3:** The former location of UST SA-26, a 550-gallon waste oil tank. The UST was removed after it was determined to be leaking.
- **AOC #4:** A 30,000-gallon UST (UST SA-21) that previously contained diesel fuel and gasoline.
- **AOC #5:** The general area identified in the Camp Lejeune CS (ESE, 1990) where an estimated 20,000 gallons of waste battery acid may have been disposed.
- **AOC #6:** The location of UST A47-3, a 30,000-gallon diesel fuel tank.
- **AOC #7:** An unnamed stream which borders Site 73 on the east, which may be a potential receptor for shallow groundwater and surface water runoff.
- **AOC #8:** The area of Courthouse Bay which could be impacted by shallow groundwater discharge and surface water runoff.
- **AOC #9:** An unnamed stream which borders Site 73 on the west, which may be a potential receptor for shallow groundwater and/or surface water runoff.

2.3.6 Remedial Investigation (Baker, 1997a)

From April 1995 to May 1996, RI field activities were conducted by Baker to further characterize the nature and extent of potential impacts to soil, groundwater, sediment, and surface water within each AOC identified in the Preliminary Investigation. Baker assessed characteristics for fate and transport and potential human health and ecological risks of each contaminant of concern within each medium.

Baker concluded that the majority of the impacted soil and groundwater was located in the vehicle wash area in the center/southeast portion of the site (AOC # 1 and AOC # 6). The primary contaminants of concern in groundwater were: TCE, cis-1,2 dichloroethene (cis-1,2 DCE), VC, and benzene. The greatest detected concentrations during the RI were: TCE at 320 µg/L and cis-1,2-DCE at 120 µg/L in the uppermost portion of the Castle Hayne aquifer, and VC at an estimated concentration of 43 µg/L and benzene at an estimated concentration of 27 µg/L in the uppermost portion of the surficial aquifer. **Figures 4-1** through **Figure 4-14** provided in **Appendix B** show the analytical results of the soil, groundwater, sediment, and surface water sampling completed during Baker's RI activities.

The source of groundwater impacts detected within AOC # 1 was attributed to former UST A-47-1, reportedly located in the vicinity of Building A47, rather than the reported historical waste oil disposal activities. Baker attributed the chlorinated solvent contamination identified in AOC# 6 to past use and disposal practices of solvents related to the maintenance activities conducted in Building A3.

2.3.7 Proposed Remedial Action Plan (Baker, 1997b)

A draft Proposed Remedial Action Plan was prepared by Baker in February 1997 to evaluate the remedial action alternatives for addressing groundwater contamination in the surficial and Castle Hayne aquifers at Site 73. The remedial action alternatives proposed for the surficial aquifer included: no action, natural attenuation, two scenarios of groundwater extraction and treatment, and air sparging. The remedial action alternatives considered for the Castle Hayne aquifer included: no action, natural attenuation, groundwater extraction and treatment, and two scenarios of in-well aeration.

Based on the detailed evaluation of these remedial alternatives, natural attenuation, long term-monitoring of groundwater and surface water, and aquifer use restrictions were recommended as the preferred remedies for Site 73 groundwater. Review of the administrative record indicates that a final version of this report was not submitted or approved.

2.3.8 Supplemental Groundwater Investigation (Baker, 1998a)

In 1998, Baker conducted a Supplemental Groundwater Investigation (SGI), to assess whether TCE degradation was evident, to further delineate the extent of the benzene and chlorinated solvent plumes and to clarify analytical discrepancies concerning the data collected during the RI. The field activities conducted during the SGI included the collection of additional groundwater samples in April 1998 from one monitoring well screened in the surficial aquifer (IR73-MW09) and five monitoring wells screened in the Castle Hayne aquifer (IR73-DW02, IR73-DW03, IR73-DW-04, IR73-DW05 and IR73-DW10). All samples were analyzed for VOCs via USEPA Method 8260A. A summary of the analytical results is provided in **Table 1** of **Appendix B**. The SGI concluded that:

- There was indirect evidence that natural attenuation was occurring in the surficial and Castle Hayne aquifers due to increasing concentrations of TCE daughter products.
- The plume(s) in the surficial aquifer had not changed shape or size between the RI and SGI, a period of one year.
- The groundwater contaminant plumes still required further delineation.

The SGI recommended that a Natural Attenuation Evaluation Study (NAES) be performed and additional investigation be conducted to define the extent of impacted groundwater.

2.3.9 Groundwater Modeling Report (Baker, 1998b)

In April 1998, Baker prepared a Groundwater Modeling Report to support the evaluation of remedial alternatives considered in the Feasibility Study (FS) (Section 2.4.10). The modeling effort involved data interpretation using MODFLOW and MODPATH to simulate the site specific hydrogeologic framework at Site 73, which could be used in selecting a remedial alternative.

The model consisted of three primary components:

- Groundwater flow path analysis for the surficial aquifer, Castle Hayne confining unit, and Castle Hayne aquifer;

- Sensitivity analysis of hydrogeologic parameters affecting contaminant transport (e.g., recharge, horizontal hydraulic conductivity, leakage); and
- Simulations of capture zones for various pump and treat scenarios in the surficial and Castle Hayne aquifers.

The report concluded that the MODFLOW model accurately simulated groundwater flow beneath Site 73; and the model could be useful in predicting the ultimate fate of groundwater contaminants. The report also indicated that the model could be used to demonstrate that contaminants detected in water supply well BB-44 were not likely to have originated from Site 73 as originally thought. Groundwater to surface water discharge concentrations were predicted using Draft Risk Analysis Framework (NCDENR, 1996) to estimate discharges to Courthouse Bay; since natural attenuation is occurring at Site 73, the results suggested using other bio-attenuation models to predict future concentrations and attenuation.

2.3.10 Feasibility Study (Baker, 1998c)

In 1998, Baker conducted an FS for Site 73, drawing upon the previous phases of investigation, including the RI and SGI. The media of concern addressed by the FS included groundwater (in both the surficial and Castle Hayne aquifers) and fish and crab tissue.

The remedial action objectives (RAOs) of the FS were to:

- Mitigate the potential for direct exposure to contaminated groundwater via ingestion, dermal contact, and inhalation; and
- Treat the zones of impacted groundwater to meet specified remediation levels.

Separate remedial action alternatives were developed for the surficial and Castle Hayne aquifers to achieve these RAOs. The surficial aquifer alternatives included: no action, natural attenuation with monitoring and aquifer-use restrictions, groundwater extraction and treatment, and air sparging with soil vapor extraction. The Castle Hayne aquifer alternatives included: no action, natural attenuation with monitoring and aquifer-use restrictions, groundwater extraction and treatment, and in-well aeration. Baker compared the overall protectiveness, compliance with standards, long-term effectiveness and permanence, reduction of toxicity, mobility, or volume through treatment, short-term effectiveness, implementability, and cost of each alternative; however, final alternative recommendations were not made in the FS.

2.3.11 Long-term Monitoring (Baker, 2000-2005)

Baker began long-term monitoring (LTM) of groundwater at the site in July 2000; semi-annual sampling and reporting. Although no Record of Decision was in place, the monitoring program at Site 73 was implemented to evaluate concentration trends over time, and degradation through natural processes. Groundwater samples were collected on a semiannual basis from 28 monitoring wells screened in both the shallow and Castle Hayne aquifers. Groundwater samples collected under this program were analyzed for VOCs and natural attenuation indicator parameters (NAIPs).

In September 2005, CH2M HILL conducted an evaluation of the LTM program to optimize base-wide groundwater monitoring activities. The LTM Optimization report (CH2M HILL, 2005b) recommended removal of Site 73 from the LTM program, as it was a part of ongoing investigations and studies in which the LTM requirements are being fulfilled or exceeded by site specific monitoring programs.

2.3.12 Natural Attenuation Evaluation Study (CH2M HILL, Baker, CDM 2002)

A NAES was performed in 2000 to evaluate if natural attenuation processes could reduce groundwater contamination to levels that are protective of human health and the environment. **Figures 4-2, 4-3, 4-6, 4-9, 4-12,** and **4-15** of the NAES report (CH2M HILL, Baker, CDM, 2002) provided in **Appendix B** illustrate the conclusions summarized below.

BTEX —Surficial Aquifer

- The extent of the benzene plume within the surficial aquifer has remained relatively unchanged since the original RI (1995).
- The benzene plume extends hydraulically downgradient from just southeast of Building A47to Courthouse Bay.
- The benzene concentrations have remained steady or decreased considerably since the RI, which indicates that benzene and other fuel related compounds may be degrading due to natural processes.

BTEX —Upper Castle Hayne (Deep) Aquifer

- Benzene was the only BTEX constituent detected in the upper Castle Hayne aquifer.
- Concentrations of benzene ranged from less than 20 µg/L, southeast of Building A47 to less than 0.5 µg/L at Courthouse Bay.
- Dissolved phase benzene did not appear to be reaching Courthouse Bay by means of groundwater discharge.

Chlorinated Solvents—Surficial Aquifer

- TCE and daughter compounds cis-1,2-DCE and VC continued to be present in the surficial aquifer.
- The greatest concentration of TCE was detected just southeast of Building A47 with levels decreasing toward Courthouse Bay.
- The reduced levels of TCE, the presence of daughter compounds, and their distribution were indicative of natural attenuation.

Chlorinated Solvents —Upper Castle Hayne (Deep) Aquifer

- TCE and daughter compounds cis-1,2-DCE and VC were identified in the upper Castle Hayne aquifer.
- The contaminant distribution was oriented in a north-south direction through the center of the site, southeast of Building A47.

- The extent of impacted groundwater had not be defined in the northern and western portions of the site.
- Modeling indicated that reductive dechlorination was taking place in the deeper groundwater.

2.3.13 Technology Evaluation (Baker, 2003)

In 2003, Baker prepared a Technology Evaluation of potential remedial options to be considered for "hot spot" area reduction of VOCs in groundwater. The surficial aquifer was not included in the Technology Evaluation, as the concentrations of contaminants of concern were not present in sufficient quantities to warrant active remediation, and VOC concentrations in the surficial aquifer should be naturally attenuated, as indicated in the NAES (CH2M HILL, Baker, CDM, 2002). However, in the Castle Hayne aquifer, concentrations of TCE exceeding 1,000 µg/L, were identified as a "hot spot" and recommended for treatment.

Five different treatment technologies were evaluated including: *in-situ* chemical oxidation using permanganate, abiotic reduction using colloidal iron injection, enhanced reductive dechlorination promoted by HRC®, bio-augmentation, sparging with hydrogen, cometabolic sparging with air and propane, or sparging with ozone using horizontal wells. Each of the technologies was evaluated based on effectiveness, site constraints, depth of the contaminant mass, presence of underground utilities, land use, and cost.

The technology selected for implementation at Site 73 was hydrogen sparging delivered by means of a horizontal directionally drilled (HDD) well. According to Baker, the advantages of this technology were that the installation of the HDD well would involve minimal disruption to site activities and the technology would actively address the site contaminants. The disadvantage was the initial capital cost to construct the HDD well and sparging equipment. However, future costs would then be minimal and consist of only operation and maintenance. Baker estimated that the length of time required for hydrogen sparging to meet the RAOs would be on the order of 5 years.

2.3.14 Horizontal Sparge Well Pilot Study Report (MicroPact Engineering, Inc. and Baker, 2004-2006)

From March 2004 through May 2005, MicroPact Engineering, Inc. and Baker conducted a Pilot Study on the TCE "hot spot", located near building A-47, to evaluate the effectiveness of hydrogen sparging for the remediation of dissolved-phase chlorinated VOCs. The stated goal of the pilot study was to achieve an order of magnitude reduction in dissolved phase TCE concentrations.

In February 2004, Baker supervised the construction of a 900-ft long HDD well with 400 ft of screened area, installed to a nominal depth of 75 ft bgs. The hydrogen biosparge system was designed based on the estimated zone of influence, desired sparge volume, injection pressure, gas flow rate, sparge time, and sparge frequency. Approximately 40 hydrogen injections were completed during the study, beginning on March 18, 2004 and ending on May 26, 2005.

Groundwater samples were collected and analyzed on six occasions: two prior to the Pilot Study implementation, three during the study, and one at the conclusion of the study. The draft pilot study report (MicroPact and Baker, 2006) concluded that TCE concentrations were reduced by an order of magnitude in intermediate monitoring wells MW-35IWA and MW-37IWB and deep monitoring wells MW-35IWC MW-38IWC; the wells with the greatest initial concentrations of TCE. Four wells experienced a modest reduction in TCE concentrations during the study, and TCE concentrations increased in three wells. Two wells had no detectable concentrations before and after the study.

The average TCE concentration decreased approximately 35 percent over the 15-month study period, while the average total VOC concentration decreased by approximately 8 percent. Hydrogen was not detected above the background concentration in any of the monitored wells.

Since residual hydrogen that remained in the subsurface following the termination of sparging would have been consumed quickly, the long-term residual effects of hydrogen sparging were not expected to be significant.

2.3.15 Horizontal Sparge Well Pilot Study (CH2M HILL, 2007)

In 2007, CH2M HILL initiated a pilot study to evaluate the effectiveness of air and ozone sparging for removal of TCE and associated chlorinated VOC-impacted groundwater present in the vicinity of the former maintenance Building A3, southeast of Building A47. The pilot test was performed using the existing HDD well. Final results of this study have not been published.

In order to complete the evaluation of the air and ozone sparging system, which operated on a continuous basis for a minimum period of 12 months, CH2M HILL collected groundwater and soil gas samples at intervals of 1, 3, and 6 months following system activation. CH2M HILL conducted the 9-month sampling event in December 2007 and the 12-month sampling event in March 2008 prior to system shutdown in March 2008.

During the baseline, 1-month, 3-month, and 6-month sampling events, groundwater samples were collected from 15 existing monitoring wells positioned at the interior, exterior, and periphery of the plume. All groundwater samples were analyzed for VOCs using USEPA Method 8260B. Groundwater geochemical parameters including pH, conductivity, oxidation-reduction potential (ORP) and dissolved oxygen (DO) were monitored in the field.

CH2M HILL installed four soil gas monitoring wells to assess the potential for soil vapor migration and intrusion in the vicinity of Building A47. The periodic monitoring was conducted to evaluate whether VOC concentrations exceeded risk-based thresholds that would require mitigation of the soil vapors. Soil gas samples were collected in Summa canisters with Teflon tubing attached to stainless steel vapor probes installed in the soil gas wells. The soil gas samples were analyzed for VOCs by USEPA Method TO-15.

Results of the groundwater sampling events completed to date indicate a general decreasing trend in TCE and associated chlorinated VOC concentrations in groundwater, and an increase in DO content in groundwater. The decreased chlorinated solvent concentrations and increased DO suggests the sparge system radius of influence encompasses the zone of impacted groundwater.

2.4 Results of Previous Investigations

The following sections discuss the nature and extent of contamination for all media at Site 73 as identified through the investigations discussed in Section 2.3.

2.4.1 Soil

Between 1985 and 2005 multiple phases of investigation were conducted to assess the impacts to surface and subsurface soil, the most comprehensive of which was during the RI (Baker, 1997a). Laboratory analytical testing focused upon petroleum hydrocarbons, O&G, inorganics, VOCs, and semi-volatile organic compounds (SVOCs).

- Low-levels of VOCs were detected in surface and subsurface soils at concentrations generally below screening levels. The generally low soil concentrations suggested an absence of large-scale releases involving solvents, or possible volatilization, migration to the water table and dispersal or natural attenuation of VOCs. Since the distribution of contaminants in soil did not appear to follow a discernible pattern, the RI concluded that past releases or disposal events had not resulted in long-term impacts to soil.
- The SVOC 2,4-dinitrophenol was detected at an estimated concentration of 200 micrograms per kilogram (µg/kg), exceeding the soil screening level (USEPA Region III Soil Screening Level, October 1995) of 100 µg/kg in the soil sample collected from soil boring IR73-MW23 during the RI (Baker, 1997a). The remaining SVOC concentrations detected in soil samples were below the applicable soil screening levels. The current USEPA Region IV Residential Regional Screening Level (RRSL) (June 2008) for 2,4-dinitrophenol is 12,000 µg/kg indicating the single detection of 2,4-dinitrophenol does not require further evaluation.
- The generally low-level (below screening levels), widespread detection of pesticides in surface soil samples was presumed to be the result of pest control applications and not disposal. However, one sample, collected from soil boring IR73-MW14 was reported to contain 4,4'- dichlorodiphenyldichloroethane (DDD) [1,1'-(2,2-dichloroethylidene)bis(4-chlorobenzene)] at a concentration of 9,100 µg/kg in excess of the screening level (USEPA Region III Soil Screening Level, October 1995) of 700 µg/kg, and was interpreted to be the result of a small surface spill. The concentration detected in the soil sample collected from IR73-MW14 also exceeds current USEPA Region IV RSLs (June 2008) for 4,4'-DDD (2,000 µg/kg – RSSL and 7,200 µg/kg – Industrial RSL). Based on the limited extent (single exceedance) and location of the 4,4'-DDD-impacted soil (below the concrete parking lot), no further investigation was recommended.
- The PCB Aroclor 1254 was detected in soil borings (approximately 2 to 4 feet bgs) collected during the installation of monitoring well IR73-MW14 (35 J mg/kg) and during the installation of soil boring 73-SB07 (56 mg/kg) (adjacent to monitoring well IR73-A47/3-22) during the initial RI. Based on the current RRSL for Aroclor 1254 of 110 mg/kg, limited extent of impacted soil, location of the impacted soils (below concrete parking lot and adjacent to fence line area), no further evaluation is required.
- Elevated metals concentrations were detected across the site (greater than two times the mean base background concentrations) and were attributed to site-specific conditions.

Based on the Human Health Risk Assessment (HHRA) (Baker, 1997a), only aluminum and iron were retained as chemicals of potential concern (COPCs) and neither pose an unacceptable risk to human health according to the HHRA.

- Free phase petroleum product (assumed to be used motor oil) has been persistently detected during LTM sampling events in monitoring well IR73-MW14, screened in the surficial aquifer. The free product (generally ¼-inch thick), is monitored by the Base Remedial Action Contract (RAC) Contractor and attempts have been made to remove the product using aggressive fluid vapor recovery. In 2005 and 2008, CH2M HILL conducted direct-push technology (DPT) investigations to assess the nature and extent of petroleum-impacted soils in the vicinity of monitoring well IR73-MW14. The results of this investigation are discussed in Section 5.2.

2.4.2 Groundwater

The most comprehensive site-wide groundwater characterization at Site 73 took place during the original RI sampling events in 1995 and 1996. Further characterization was completed as part of the SGI (Baker, 1998a) and the NAES (CH2M HILL, Baker, CDM, 2002). Over the course of these investigations, groundwater samples were analyzed for VOCs, SVOCs, pesticides, PCBs, metals, and NAIPs. Based on the results of these previous investigations, as well as the semiannual LTM program, the following conclusions were reached:

- During the original RI, the extent of the benzene plume was delineated horizontally, with the plume extending from the approximate center of the site (southeast of Building A47) toward Courthouse Bay. The former USTSA-21 located in the vicinity of Building A47 was reported to be the suspected source of the benzene contamination. The areal extent of the benzene plume appeared relatively stable between the original RI, conducted in 1995, and the NAES, completed in 2000. However concentrations of benzene decreased by an order of magnitude between the original RI and the NAES, to less than 20 µg/L. The NAES and subsequent LTM reports concluded that the reduction in benzene and other fuel-related compounds were the result of contaminant degradation by natural attenuation processes.

- During the RI and the SGI, benzene was only detected above its NCGWQS in one monitoring well (IR73-DW03) screened within the Castle Hayne aquifer and was thought to be the result of cross-contamination introduced during monitoring well installation (Baker, 1998a). However during the NAES and subsequent LTM sampling events, a benzene plume was identified in the Castle Hayne aquifer that mirrored the size and concentration of that was seen in the surficial aquifer. Concentrations ranged from 20 µg/L in the center of the site to less than 0.5 µg/L at Courthouse Bay in the surficial aquifer. Similar to the benzene plume in the surficial aquifer, benzene concentrations in the Castle Hayne aquifer decreased from the time of the original RI and the NAES. The benzene concentrations in the Castle Hayne aquifer were 13 µg/L or less at the time of the NAES.

- Chlorinated solvents (TCE, DCE, and VC) have historically been detected in the surficial aquifer at concentrations above the applicable NCGWQS. During the original RI, the maximum concentration of TCE was 46 µg/L at IR73-MW27. The greatest concentrations

have historically been in the central portion of the site, with concentrations decreasing towards Courthouse Bay, as well as decreasing over time. The horizontal extent of the chlorinated solvent plume in the surficial aquifer was delineated during the original RI.

- The greatest concentrations of chlorinated VOCs were found to be present in the Castle Hayne aquifer. During the original RI, TCE was detected at a maximum concentration of 320 µg/L in a sample collected from IR73-MW13DW. During the NAES, it was determined that the chlorinated VOC plume in the Castle Hayne aquifer was oriented in a north-south direction through the center of the site and higher levels of TCE were present than previously thought. TCE was detected at a maximum concentration of 990 µg/L in a sample collected from IR73-MW44DW during the NAES and at a maximum concentration of 1,800 µg/L at IR73-MW49DW during the 2003 LTM sampling event. The horizontal and vertical extent of chlorinated VOC contamination in the Castle Hayne aquifer was not defined during the original RI, the SGI, or the NAES.
- The NAES and subsequent LTM reports concluded that reduced levels of TCE, the presence of TCE daughter compounds, and favorable geochemical conditions were indicative of sustainable natural attenuation in both the surficial and Castle Hayne aquifers (both biotic and abiotic).
- The NAES concluded that the natural processes of attenuation (biotic and abiotic) were likely able to significantly limit the migration of TCE within the surficial aquifer toward Courthouse Bay.
- In the Castle Hayne aquifer, the NAES concluded that based on first-order degradation rates and the flow paths in the upper Castle Hayne Aquifer, it is unlikely that organic compounds (including VC) were being discharged to Courthouse Bay. This conclusion was supported by the absence of chlorinated VOC detections in the monitoring wells screened within the Upper Castle Hayne aquifer installed along Courthouse Bay.
- Inorganic compounds detected in the surficial and Castle Hayne aquifers during the original RI consisted predominantly of iron and manganese, which had site-wide exceedances of their respective NCGWQS. However, these inorganics (and many other metals) are commonly detected in groundwater at Camp Lejeune at levels exceeding the state standards, and are therefore not considered site-related contamination unless the detected concentration is greater than two times the mean background concentration. Therefore, the iron and manganese exceedances were not considered to be the result of past waste disposal practices at Site 73.

2.4.3 Surface Water and Sediment

Surface water and sediment were thoroughly investigated during the RI (Baker, 1997a). Samples were collected from Courthouse Bay and its surrounding tributaries, and analyzed for VOCs, SVOCs, inorganics, pesticides, and PCBs. Based on the results of the RI, it was concluded that:

- CVOCs were not detected in surface water or sediment samples and has been taken to indicate that contamination in Site 73 groundwater was not impacting Courthouse Bay.

- Polynuclear aromatic hydrocarbons (PAHs) were detected in one sediment sample collected during the RI. Baker concluded that the PAH detection was a result of fossil fuel combustion related to the high volume of boat and amphibious vehicle traffic on the Bay and not site related.
- The low-level widespread detection of pesticides in sediment samples was not attributed to past site activities, rather the observed concentrations were similar to those observed throughout MCB Camp Lejeune.
- Various inorganic compounds were evenly distributed across sediments and surface water in Courthouse Bay and the two unnamed tributaries. Of the detected compounds, only arsenic, iron, and lead in sediment sample 73-SD09 and silver and zinc in surface water samples 73-SW 04 and 73-SW06 exceeded the applicable regulatory criteria or background concentrations.

2.4.4 Human Health Risk Assessment

A HHRA was completed as part of the RI (Baker, 1997a) to evaluate the projected impact of contaminants of concern (COCs) on human health and/or the environment now and in the future. Current and future receptors evaluated included: current military personnel, current trespassers, current adult fisherman, current child receptor for aquatic biota ingestion, future residents, and future construction workers. Exposure scenarios evaluated included: exposure to surface soil, surface water, and sediment for current receptors; ingestion of fish and crab tissue for adult fisherman and child receptors; and surface soil, groundwater, surface water, and sediment exposure for future receptors. The results of the HHRA concluded:

- There was no unacceptable risk to human health and/or the environment under current use scenarios.
- The risk from ingestion of groundwater for future adult and child residential receptors exceeds the USEPA's acceptable risk range for VC.

2.4.5 Ecological Risk Assessment

An Ecological Risk Assessment (ERA) was completed as part of the RI (Baker, 1997a), to evaluate whether past site operations have adversely impacted terrestrial and aquatic communities on, or adjacent to, Site 73. Soil, surface water, and sediment samples collected during RI activities were compared to published values for toxicity in various aquatic and terrestrial species. In addition, fish, crabs, and benthic macroinvertebrates were collected and analyzed. Overall, the ERA concluded that conditions at Site 73 may adversely impact the aquatic and terrestrial ecosystems at the site, specific findings were:

- Aquatic receptors appear to be impacted by pesticides in the sediments. However, the ERA concluded that the compounds were not site-related contaminants, but were most likely remnants of past Base-wide applications; and
- There is potential for exposure to site-related contaminants to cause some impacts to soil invertebrates and plants and a slight decrease in terrestrial vertebrate populations primarily due to exposure to metals in surface water and surface soil.

2.5 Data Gaps from Previous Investigations

Despite the completion of numerous phases of investigation at Site 73, the nature and extent of contamination had not been completely characterized. Specific data gaps included:

- The vertical extent of groundwater contamination in the Castle Hayne aquifer had not been delineated in the vicinity of monitoring well IR73-MW49DW.
- The horizontal extent of contamination in the Castle Hayne aquifer had not been fully delineated in the northwest portion of the site.
- The source of the free product observed in monitoring well IR73-MW14 had not been identified and delineated.

Table 2-1
Summary of Parameters Analyzed during Previous Investigations
Operable Unit No.21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Investigation	Sample Date	Sample Media	Oil and Grease (9071)	Oil and Grease (method not available)	TPH (8015)	TPH (method not available)	Volatile Organic Compounds (8247/8240A)	VOCs (OLC03.2 Low Concentration VOCs)	Semivolatile Organic Compounds (8270)	Pesticides (8081)	Metals (1311)	Metals: Cadmium, chromium, lead, antimony, hexavalent chromium (method not available)	Used/Waste Oil (524.2)	BTEX	BTEX, Total Volatile Hydrocarbons, TCA, TCE, PCE, and Methylene Chloride (Method not available - mobile gas chromatograph)	Total Phenols (method not available)	Volatile Organics (method not available)	Purgeable Halocarbons (601)	Purgeable Aromatics (602)	Volatile Organic Compounds (8260A)	VOAs (5030A/8260B)	Methyl ethyl ketone, methyl isobutyl ketone, ethylene dibromide (Method not available)	BNA (625)	Dissolved Gases (RSK 175)	Natural Attenuation Parameters	Nitrate, Nitrite, Sulfate, Orthophosphate (300.0)	Sulfide (4500)	Total Organic Carbon (9060)	Total Organic Carbon (415.1)	Total Organic Nitrogen (351.2)	Ammonia (Method 350.1)	Ferrous and Ferric Iron and Iron (3500D and SW846-6010B)	Ferrous Iron, Sulfate, Chloride (Hach)	Alkalinity (2320)
		Groundwater		X								X				X	X					X												
		Surface Water		X								X				X	X					X												
Confirmation Study	1985 - 1990	Sediment		X								X				X	X					X												
		Soil				X								X																				
UST Investigations	1991 - 1993	Groundwater				X								X			X																	
		Soil Gas													X																			
Preliminary Investigation	1994	Groundwater													X																			
		Soil	X		X	X	X		X	X	X																							
Remedial Investigation	1995	Groundwater											X	X				X	X				X											
Supplemental Groundwater Investigation	1996	Groundwater												X						X														
Long Term Monitoring	2000 to 2005	Groundwater												X			X								X									
Natural Attenuation Evaluation	2002	Groundwater																			X			X	X	X		X		X	X		X	X
		Groundwater						X						X										X	X	X	X		X			X		X
Amended Remedial Investigatior	2006	Soil	X		X																													

Notes:
Analytical method in paranthesis
BTEX - Benzene, Toluene, Ethylbenzene, Xylenes
BNA - Base Neutral Analysis
PCE - Tetrachloroethane
TCA - Trichlorotethane
TPH - Total Petroleum Hydrocarbon
TCE - Trichloroethene
VOC - Volatile Organic Compound

Table 2-2
Summary of Previous Investigations
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Site 73 Investigation	Year	Media Investigated	Purpose of Investigation	Type of Contamination Investigated	Activities	Shallow/Deep Aquifer	Results and Conclusions	Data Gaps
Initial Assessment Study (Water and Air Research, Inc.)	1983	NA	Evaluate historical records for evidence of environmental releases	Any	Office evaluation, Site visits	NA	An estimated 400,000 gallons of waste oil was discharged directly onto the ground surface at this facility, primarily near Building A-47. In addition to the waste oil, approximately 20,000 gallons of waste battery acid was also reportedly disposed in the area northeast of Building A-47. The waste battery acid was poured into shallow hand-shoveled holes which were then backfilled. Neither disposal area is visually apparent. The suspected disposal locations are now covered in concrete, buildings or roads.	--
Confirmation Study (Environmental Science and Engineering, Inc.)	1984-1990	--	Generate Data on sitewide contamination; sampling focused in areas where washing had occurred, or locations of existing or suspected former USTs	Metals (Cadmium, chromium, lead, antimony), Total Phenols (analytical methods are not available), VOCs, Oil&Grease	Groundwater Sampling	NA	--	No samples were taken from the deep aquifer
	1984	GW	--	Metals (Cadmium, chromium, lead, antimony), Total Phenols (analytical methods are not available), VOCs, Oil&Grease	Groundwater Sampling	Shallow	The most significant contaminants detected were benzene (17 µg/L; 73GW4), 1,1-dichloroethylene (2.3 µg/L; 73GW4), trans-1,2-dichloroethene (360 µg/L; 73GW3), toluene (4 µg/L; 73GW4), vinyl chloride (74 µg/L; 73GW4), cadmium (10 µg/L; 73GW2), chromium (95µg/L; 73GW1), lead (109 µg/L; 73GW1), and oil and grease (2,000 µg/L; 73GW1 and 73GW2).	--
	1987	GW	--	The previous set of compounds was analyzed with the addition of xylenes, methyl ethyl ketone, methyl isobutyl ketone, ethylene dibromide, and hexavalent chromium	Groundwater Sampling	Shallow		--
	1984-1987	SW/SWS	--	Assumed to be the same as groundwater samples (?)	Surface Water Sampling/SW Sediment sampling in Off-Shore Areas in Courthouse Bay (3 locations)	NA	Courthouse Bay Sediment: Detections of cadmium (0.69 mg/kg; 73SD3), chromium (11.8 to 53 mg/kg), lead (8.5 to 22.2 mg/kg), phenols (0.207 to 1.56 mg/kg) and oil and grease (314 to 1,510 mg/kg). Courthouse Bay Surface Water: Detection of chromium, but the levels were below the freshwater standard.	--
UST SA-21 Investigation (ATEC, 1991 and Baker, 1992 and 1993)	1991-1993	SS	Determine if UST was leaking into soil and/or GW	Petroleum Hydrocarbons, Oil & Grease, Benzene	Sampling of surficial and subsurface & Deep soil. UST SA-21 is leaking. UST SA-21 was a steel 30,000 gallon capacity tank which contained both gasoline and diesel fuel. This tank was installed in 1959 and removed in 1991.	Shallow + Deep	TPH concentrations ranged from 4 mg/kg to 2,004 mg/kg in deep soil borings, and ND to 1,269 mg/kg in shallow soil borings (1992).	--
		GW	Determine if UST was leaking into soil and/or GW	Benzene, VOCs		Shallow + Deep	No benzene or Total VOCs in shallow or deep groundwater wells, except MW-15 (Shallow) = 38 ug/L benzene and 38 ug/L VOCs (1992).	No
UST A47-3 Investigation (GSI, 1993 and Law-Catlin, 1993)	1993	SS	Determine if UST was leaking into soil and/or GW	Petroleum Hydrocarbons, Oil & Grease	Sampling of surficial and subsurface soil	Above WT	UST A-47/3 was leaking. UST A-47/3 was a steel 30,000 gallon capacity tank which contained diesel fuel. Available information indicated that this UST was installed in 1986. A hydrostatic test was performed on A47/3 in late 1992, and was replaced with a fiberglass tank.	Law-Catlin indicated that solvents may have been disposed of at Site 73 although no specific disposal locations or dates were identified.
		GW	--	BTEX Compounds	GW and Soil Sampling	Shallow	BTEX Concentrations in GW ranged from BDL to 18 µg/L (1993).	--
Preliminary Investigation (Baker, 1994)	1994	GW	Better define source areas of contamination, generate additional data regarding the presence or absence of contamination in areas not investigated previously	Metals, VOCs	--	--	--	--
Remedial Investigation (Baker, 1997)	1997	--	Evaluate the nature and extent of the threat to public health and the environment caused by release or threatened release of contaminants at Site 73	--	Sampling of surficial and subsurface soil, groundwater,sediment, surface water, benthic species, aquatic species. Human health risk assessment and ecological risk assessment. Characterize site contamination.			--
		SS	--	Petroleum hydrocarbons, TCL Organics, TAL metals.	--	Above WT	11 VOCs were detected in surface and sub-surface soils collected at Site 73, however, none of the compounds exceeded EPA's Soil Screening Levels to be protective of groundwater. High concentrations of SVOCs were detected in surface soil sample 73-AC2-MW07-00 (collected from an area where evidence of waste disposal was observed during field observations), and in subsurface soil samples collecteld from soil boring locations 73-MW15B, 73-MW14, 73-SB01, 73-SB06 (All located near USTs or oil/water separators which may be the source of elevated SVOCs). 2,4-Dinitrophenol and benzo(a)pyrene were detected in the soils at concentrations exceeding applicable soil screening levels for groundwater protection.	--

Table 2-2
Summary of Previous Investigations
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Site 73 Investigation	Year	Media Investigated	Purpose of Investigation	Type of Contamination Investigated	Activities	Shallow/Deep Aquifer	Results and Conclusions	Data Gaps
Remedial Investigation (Baker, 1997)		GW	--	VOCs, SVOCs, pesticides, PCBs, TSS, Total metals, Dissolved metals, BOD, COD, TOC, TKN, TDS, Total Phosphorus, microbial count, Alkalinity.	--	Shallow + Deep	The most significant contamination was found in AOCs #1 and #6. Based on the results of the RI AOC #1 contained a BTEX plume in the shallow/surficial aquifer. Solvent contamination (TCE, cis-1,2-DCE, and VC) was found in the shallow (surficial) and deep aquifer (upper castle hayne). The highest concentrations detected were 320 µg/L TCE, 120 µg/L cis-1,2-DCE, and 43 µg/L VC.	--
		SW/SWS	--	TCL Organics, TAL Metals, TOC, grain-size distribution.	Sampling water and sediments in Courthouse Bay, and creeks near Site 73	SW		--
		HHR, ER	--	ER (Fish & Crab): TCL Organics, TAL Metals.		SW		Unknown whether ecosystem risk would decrease over time
Proposed Remedial Action Plan (Baker, 1997)	1997	GW	Based on RI, describes 5 alternatives for the remediation of the shallow and deep groundwater zones of the Site 73 aquifer.	identified COCs were TCE, cis-1,2-DCE, VC, Benzene	Assessment of pump&treat alternatives, existing contamination data, natural attenuation data, etc to describe proposed RA's.	Shallow+Deep	Natural Attenuation was the preferred remedial alternative for both the shallow and deep aquifer.	--
Supplemental Groundwater Investigation (Baker, 1998)	1998	GW	Add additional data to the Proposed RA and RI Findings	CVOC, Benzene, NAIPs		Shallow + Deep	Natural Attenuation is occurring in the surficial and deep aquifers. The plume in the surficial aquifer had not changed in shape or size between the RI and SGI. The benzene plume in the shallow aquifer is stable, and decreasing in concentration. It extends from the center of the site to the Bay, but at the Bay it is not above surface water quality standards. The benzene plume in the deep aquifer does not extend to the Bay.	The CVOC plume delineation remains incomplete in the northern and western portions of the site, for both the shallow and deep aquifers. Natural degradation is occuring, but the CVOC plumes still extend to the Bay.
Groundwater Modeling Report *(Baker,1998)*	*1998*	*GW*	Use MODFLOW to adequately simulate existing site conditions at Site 73; predict fate & transport of TCE, cis-1,2-DCE, and VC using flowpaths and observed degradation rates.	Fate & Transport of TCE, DCE, VC in the shallow and deep aquifer.		Shallow + Deep	Model indicates that natural degradation is occuring in the deep aquifer.	--
Feasibility Study (Baker, 1998)	1998	GW, ER	The media of concern at Site 73 addressed by the FS included groundwater (in both the surficial and deep aquifer) and fish and crab tissue. The remedial action objectives (RAOs) of the FS were to mitigate the potential for direct exposure to contaminated	CVOCs in shallow and deep aquifer, and ecological impact of surface waters	assessment of alternatives, development of RG's, and RAO's		Baker analyzed the overall protectiveness, compliance with standards, long-term effectiveness and permanence, reduction of toxicity, mobility, or volume through treatment, short-term effectiveness, implementability, and cost of each alternative.	--
Long Term Monitoring (Baker, 2000-2005)	2000-2005	GW	Verify that plume is stable and not expanding	CVOC, Benzene				--
Natural Attenuation Evaluation Study (CH2M HILL, Baker, CDM 2002)	2002	GW	Document the extent to which natural attenuation is occuring, and if it is occuring fast enough to protect human health and the environment to the extent necessary	CVOC, Benzene, NAIPs		Shallow+Deep	Baker concluded that natural attentuation was occuring the in the shallow, intermediate, and deep aquifers.	
Technology Evaluation (Baker, 2003)	2003	GW	Evalute technologies proposed in RA (1997)					--
Horizontal Sparge Well (MicroPact Engineering, Inc. and Baker 2004-2006)	2004-2006	GW	Evaluate the potential for enhanced bioremediation in the deep aquifer by sparging with H2(g)	TCE, cis-1,2-DCE, VC				--

NOTES:
BTEX - Benzene, Toluene, Ethylbenzene, Xylenes
cis -1,2-DCE - Cis - 1,2 Dichloroethene
CVOC - Chlorinated Volatile
ER - ecosystem risk
GW - groundwater
HHR - human health risk
NA - Not Available
NAIPs- Natural Attenuation Indicator Parameters
SS - Surface and Subsurface Soil
SW/SWS - Surface Water and Surface Water Sediments
SVOCs - Semi-Volatile Organic Compounds
TCE - Trichloroethene
TCL - Target Compound List
TAL - Target Analyte List
TPH - Total Petroleum Hydrocarbon
UST - Underground Storage Tank
VC - Vinyl Chloride
VOCs - Volatile Organic Compounds
WT - Water Table

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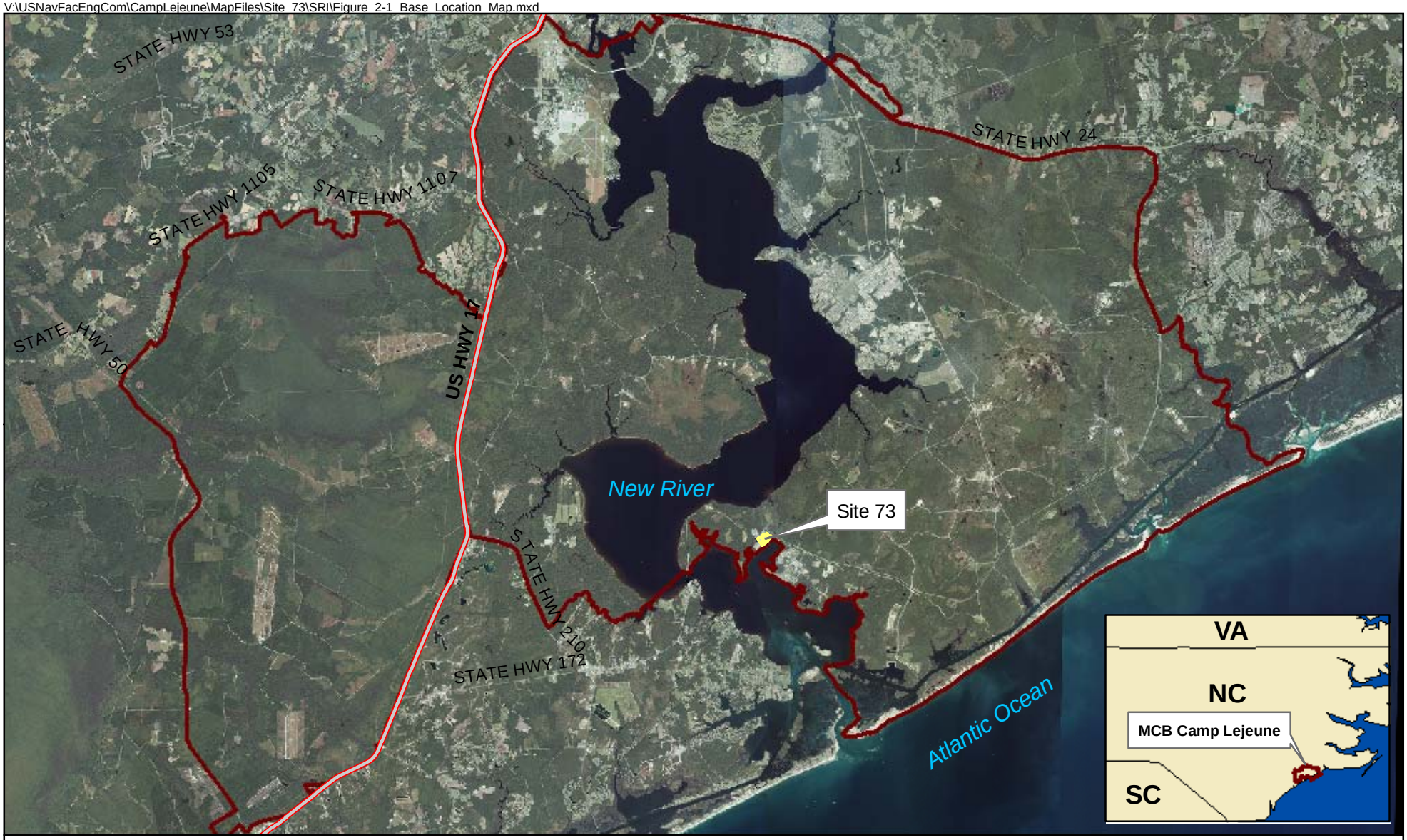


Legend

- Highways
- Site 73
- Installation Boundary

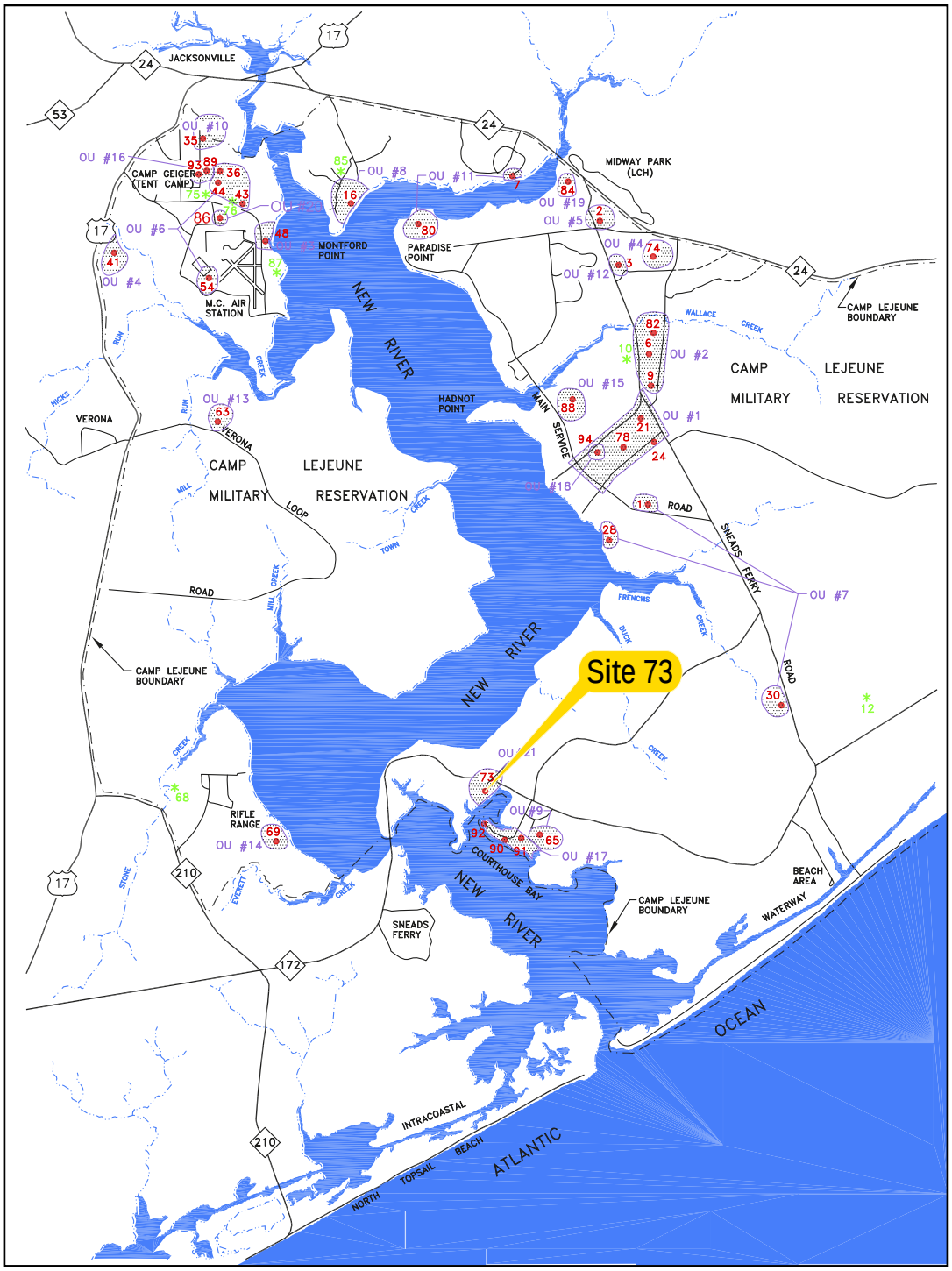
N

0 7,500 15,000 30,000 Feet

1 inch = 15,000 feet

Figure 2-1
Site Location Map
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

CH2MHILL



Vicinity Map

LEGEND

73 Denotes Site 73*

OU # 21 Denotes Operable Unit #21*

68 Denotes Pre-RI Site*

*not to scale

N

4,500 0 4,500 Feet

Approximate Scale

Figure 2-2
Base Map with Site 73 and Adjacent IR Sites
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

CH2MHILL

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Legend

- Oil-Water Separator (O-W)
- Monitoring Well
- Abandoned Well
- Contaminated Soil Stockpile Area
- Hazmat Storage
- Vehicle Washdown Areas
- Location of Existing/Former UST's
- Stormwater Retention Pond
- UST SA-21 Investigation 1991-1993 (SS, GW)
- Base Boundary
- Approximate Location of Former Maintenance Building

Note:
- * Indicates Abandoned Well

N

0 300 600 Feet

1 inch = 300 feet

Figure 2-3
Possible Source Areas of Contamination
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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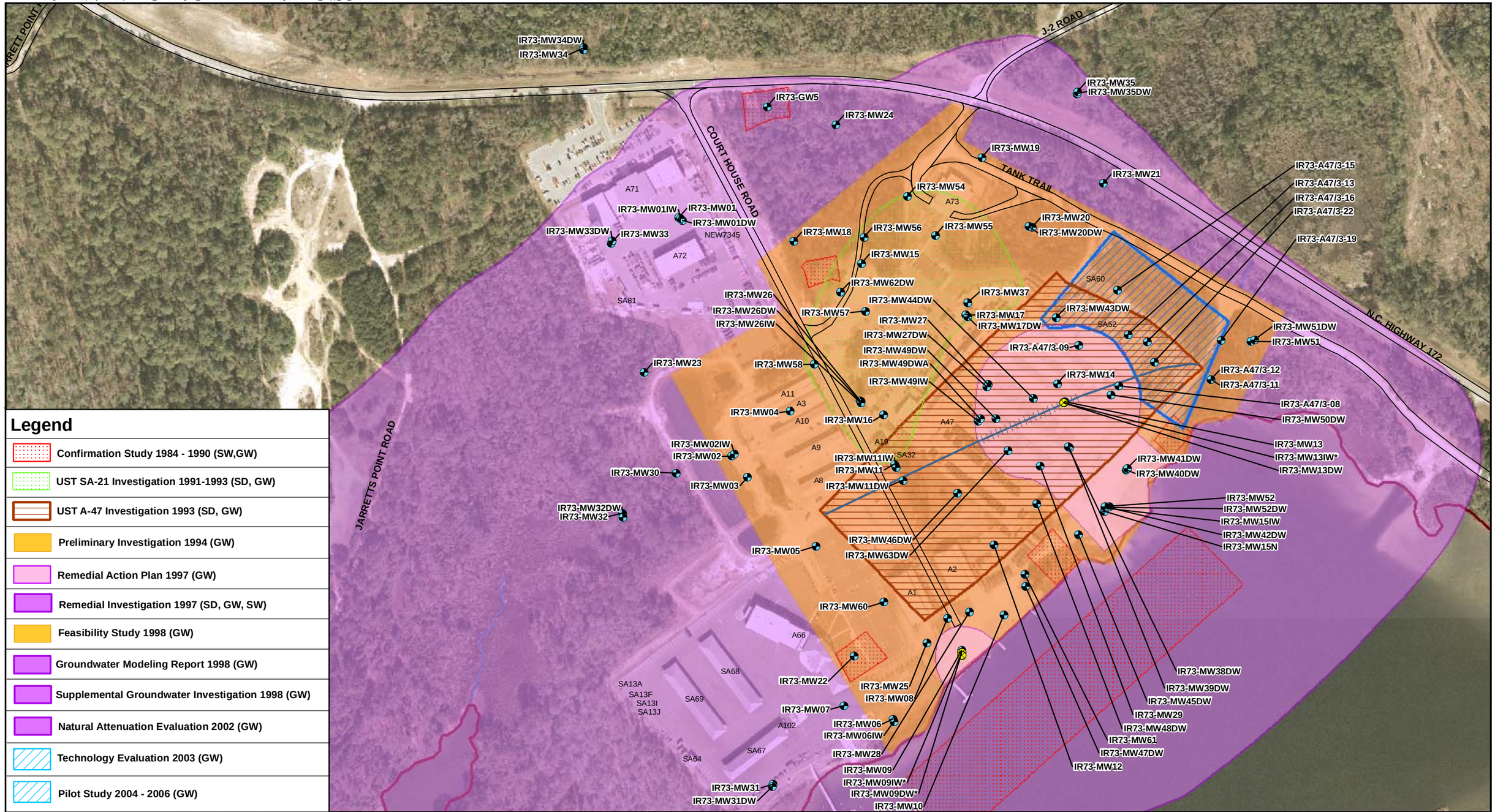
V:\USNavFacEngCom\CampLejeune\MapFiles\Site_73\SRI\Figure_2-4 - Site 73 Previous Investigation Areas_Supp_RI_2007.mxd



Legend

- Monitoring Well
- Abandoned Well
- Base Boundary
- Horizontal Sparge Well (located approximately 75-85 ft bgs, installed 2004-2006)

Notes:
-SW= Surface Water
-GW= Groundwater
-SD= Sediment
- * Indicates Abandoned Well

N

0 300 600 Feet

1 inch = 300 feet

Figure 2-4
Previous Investigations
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

CH2MHILL

SECTION 3

SRI Field Activities

This section presents a summary of field activities conducted in support of the Site 73 SRI conducted by CH2M HILL between 2005 and 2008. Additional details of sampling events and descriptions of quality assurance/quality control procedures, and available background data are provided in **Appendices F** and **G**. All SRI field activities were conducted in accordance with the procedures outlined in the October 2005 *Amended RI Work Plan, Operable Unit No. 21 (Site 73), Marine Corps Base Camp Lejeune, North Carolina (*CH2M HILL, 2005a) and the *Master Project Plans* (CH2M HILL, 2005c).

The scope of the SRI consisted of:

- Investigation of petroleum-impacted soils in the vicinity of monitoring well IR73-MW14, using DPT;
- Delineation of deep impacts to groundwater, through the installation of two new monitoring wells screened at depths of 81 to 86 ft bgs and one new monitoring well screened at a depth of 121 to 126 ft bgs;
- Collection and laboratory analysis of groundwater samples from all site monitoring wells; and
- Surveying of the newly installed monitoring wells.

3.1 Subsurface Soil Sampling

In October 2005, a total of 30 soil borings (designated as IS-100 through IS-129) were advanced in the area surrounding IR73-MW14 to assess the nature and extent of POL-impacted soils and evaluate their connection to the free product occasionally observed in this well. In January 2008, an additional 10 soil borings (designated as IS-130 through IS-139) were installed to address data gaps remaining from the October 2005 investigation (**Figure 3-1**).

During both the October 2005 and January 2008 sampling events, soil borings were advanced using a DPT drill rig. Continuous soil cores were collected from each boring in disposable acetate sleeves using a macro-core soil sampler, extending from the ground surface to the water table (approximately 3 to 10 ft bgs). During the October 2005 sampling event, soil samples were collected from the one foot interval directly above the apparent water table. However, in January 2008, the water table was significantly higher than in October 2005, and so for consistency the January 2008 soil samples were collected from the same depth intervals as the October 2005 samples. Soil samples were not collected from soil borings indicating either obvious and significant petroleum impacts (e.g. IS-107, IS-112, and IS-127) or from the borings indicating no petroleum impacts (e.g. IS-106, IS-115, and IS-116). The presence of a secondary concrete floor beneath Building A47 prevented collection of soil samples from IS-130 and IS-131. Based on the field screening data and field observations, the

majority of the soil cores appeared to be impacted by petroleum-related compounds. A summary of the field observations is presented in **Table 3-1**.

Soil samples intended for laboratory analysis were placed in labeled containers, immediately packed on ice in coolers, and transported under chain-of-custody via courier to Paradigm Analytical Laboratories, Inc. of Wilmington, North Carolina (October 2005) or GPL Laboratories of Frederick, Maryland (January 2008). All samples were analyzed for O&G by USEPA Method 9071, and total petroleum hydrocarbons (TPH) - diesel range organics (DRO) by USEPA Method 3545/8015.

During the investigation, a three-inch thick layer of concrete was encountered at a depth of six feet bgs in 18 of the 30 borings, shown in **Figure 3-1**. No historical information regarding the origin or purpose of this feature is available. During the October 2005 sampling event, the target sample interval of one foot above the water table was approximately 1 foot below the concrete layer.

3.2 Monitoring Well Installation

On April 4 and 5, 2006 three monitoring wells were installed within the lower Castle Hayne aquifer at Site 73 to delineate the vertical extent of impacted groundwater. The newly installed wells, designated as IR73-MW11DW, IR73-MW17DW and IR73-MW49DWA, were installed at the locations shown on **Figure 3-2**. **Table 3-2** summarizes the construction of all monitoring wells including total depth, screen interval, and top of casing elevation. **Appendix C** contains detailed soil boring logs and monitoring well construction diagrams for each newly installed monitoring well (boring logs and well construction diagrams submitted in the RI [Baker, 1997a] are not reproduced in this appendix). A complete description of the site-specific geology and hydrogeology is provided in Section 3.3.2.

The three lower Castle Hayne aquifer monitoring wells were installed using rotosonic drilling techniques. Drilling and well installation activities were conducted by North Carolina licensed well drillers under the supervision of a CH2M HILL hydrogeologist and in accordance with North Carolina Well Construction Standards. CH2M HILL subcontracted North Carolina licensed well drillers Prosonic Corporation and Probe Technology, Inc., to complete the rotosonic drilling and well installation services.

The dual-line casing method of the rotosonic technique consists of a four-inch diameter core barrel and multiple overriding outer casings, which are advanced using high-frequency vibration and low rotational energy. The core barrel may be advanced up to 10 ft ahead of the override casings, which are then advanced to the depth of the core barrel. The override casings provide borehole stability while the core barrel is retrieved and a continuous soil core extruded. In its simplest form, rotosonic drilling is conducted using only the core barrel and a single, six-inch diameter override casing. However, the drilling activities at Site 73 employed multiple override casings that were temporarily left in place while drilling continued to greater depths. In this manner, the shallower portions of the aquifer were effectively isolated from the borehole thereby reducing the potential for cross-contamination during drilling activities. The rotosonic drilling technique significantly reduced the volume of investigation-derived waste (IDW) generated and allowed for the installation of three Type III-equivalent wells in only 3 days.

Boreholes for monitoring wells IR73-MW11DW and IR73-MW17DW were advanced to a depth of 87 ft bgs, and borehole IR73-MW49DWA was advanced to a depth of 127 ft bgs. The monitoring wells were constructed within each borehole using two-inch inner diameter Schedule 40 polyvinyl chloride well casing and 5 ft of 0.010-inch slotted screen. A well-graded, fine sand filter pack was placed in the annular space between the well screen and borehole wall from the bottom of the borehole to approximately 2 ft above the top of the well screen. Bentonite chips were placed on top of the filter pack to form a seal of at least 2 ft in thickness. After hydration of the bentonite chips, the remaining annular space of the borehole was grouted with a Portland cement/bentonite grout to within a few inches of the ground surface. A watertight, locking, expansion cap was installed on top of the 2-inch diameter casing. Monitoring wells IR73-MW17DW and IR73-MW49DWA were completed at the surface using a steel flush-mount manhole protective cover with a 2 ft by 2 ft concrete pad. Monitoring well IR73-MW11DW was completed with an above-grade protective cover and 2 ft by 2 ft concrete pad.

3.3 Monitoring Well Development

Each newly installed monitoring well was developed by surging and over-pumping with a submersible pump across the entire length of the well screen. Well development was generally achieved when the pump discharge was free of visible sediment, the groundwater geochemical parameters (pH, specific conductance, DO, ORP, and temperature) had stabilized, and the turbidity had either stabilized or was below 20 nephelometric turbidity units. Stabilization generally occurred when pH measurements remained constant within 0.1 standard units, specific conductance varied no more than 10 percent and the temperature was constant for three consecutive readings. All development fluids were containerized and managed as IDW.

3.4 Groundwater Sampling

Upon completion installation and development of the new monitoring wells, comprehensive groundwater sampling event was conducted at Site 73, including all existing and newly installed monitoring wells. A total of 78 monitoring wells were sampled from April 9, through April 21, 2006.

Prior to commencement of sampling activities, water level measurements were recorded from all Site 73 monitoring wells. Water level depths were converted to water-level elevations using the top-of-casing elevation survey data. Groundwater sampling was conducted in accordance with Base Master Plans. Prior to sampling, disposable polyethylene tubing was advanced down each monitoring well to the middle of the screened zone, and groundwater was purged at a low-flow rate (between 0.1 and 0.3 liters per minute) using a peristaltic pump. During the monitoring well purging, water quality parameters including pH, specific conductance, temperature, DO, ORP, and turbidity were measured using portable multi-parameter meters. Groundwater samples were collected after field parameters had stabilized over consecutive readings, as described in Section 4.1.2, and/or at least one well volume had been purged from the well. Groundwater sampling sheets are provided in **Appendix D**.

Following completion of the purging activities, groundwater samples were collected in appropriately labeled containers and immediately packed on ice in coolers and shipped under chain-of-custody via Federal Express to Mitkem Corporation of Warwick, Rhode Island, an NCDENR-approved laboratory. All samples were analyzed for VOCs by Method OLC03.2 and NAIPs (nitrate, nitrite, sulfate, chloride, sulfide, total organic carbon (TOC), alkalinity, ferrous and ferric iron, total iron, and dissolved gases [methane, ethane, and ethene]). The monitoring wells sampled and the parameters analyzed are listed in **Table 3-3**. Laboratory reports and chain-of-custody forms are included in **Appendix E** and **Appendix F,** respectively.

3.5 Investigation-derived Waste Management

CH2M HILL coordinated all IDW management activities with the Base RAC, The Shaw Group. All solid IDW generated during the Site 73 SRI field investigation was placed in U.S. Department of Transportation -approved 55-gallon steel drums with liners. Liquid IDW was placed in a storage tank. Personnel protective equipment, soil cuttings, drilling fluids, and other liquids were containerized separately. Weather resistant labels were placed on the drums to identify the contents.

3.6 Site Survey

Surveying activities were conducted in October 2006 for all new monitoring well locations at Site 73. The well locations were referenced both horizontally and vertically to permanent land monuments or a grid system. The survey controls were tied to a benchmark and the 1983 North American Datum. Ground surface and monitoring well top of casing vertical control were surveyed to the nearest 0.01 ft, and the horizontal control was to the nearest 0.10 ft. Each monitoring well top of casing was notched or otherwise marked to identify a constant measuring point for measuring depths to groundwater to calculate groundwater elevations.

Table 3-1
Free Product and Soil Investigation Boring Field Screening Summary
Operable Unit No. 21 (Site 73)
Technical Memorandum
MCB Camp Lejeune
North Carolina

BORING NO.	SAMPLE ID	SAMPLE DEPTH (feet bgs)	SAMPLE DATE	OIL & GREASE (mg/kg)	TPH-DRO (mg/kg)	STAINING	CONCRETE LAYER	DTW FT.	COMMENTS
100	IS100-7-8	7 - 8	10/20/2005	**3,150**	**366**	NO	YES	8.0	
101	IS101-7-8	7 - 8	10/20/2005	**688**	**136**	NO	YES	8.5	
102	IS102-7-8	7 - 8	10/20/2005	136	**74.1**	NO	YES	8.0	
103	IS103-7-8	7 - 8	10/20/2005	**392**	17.8	NO	YES	8.0	
104	IS104-7-8	7 - 8	10/20/2005	35.3	7.26	NO	YES	8.0	
105	IS105-2-3	2 - 3	10/20/2005	**2,290**	**2,120**	NO	YES	>10.0	Little recovery 5 - 10
106	NS	NS	NS	NS	NS	NO	NO	6.5	
107	NS	NS	NS	NS	NS	NO	NO	8.0	
108	IS108-7-8	7 - 8	10/20/2005	**26,400**	**418**	NO	NO	8.0	
109	IS109-7-8	7 - 8	10/20/2005	**1,280**	**372**	NO	NO	8.0	
110	IS110-7-8	7 - 8	10/20/2005	74.9	3.11	NO	YES	8.0	
111	IS111-7-8	7 - 8	10/21/2005	228	**68.1**	NO	YES	8.0	
	IS111-7-8 DUP	7 - 8	10/21/2005	**365**	19.4				
112	NS	NS	NS	NS	NS	**YES**	YES	7.5	Below concrete, ***FREE PRODUCT**
113	IS113-7-8	7 - 8	10/20/2005	87.4	2.77	NO	YES	7.5	
114	IS114-7-8	7 - 8	10/21/2005	96.8	3.69	NO	YES	8.0	
115	NS	NS	NS	NS	NS	NO	NO	5.5	Little recovery 5 - 10
116	NS	NS	NS	NS	NS	NO	NO	6.0	
117	IS117-2-3	2 - 3	10/21/2005	56.8	<0.756	NO	NO	3.8	DUPLICATE
	IS117-2-3-DUP	2 - 3	10/21/2005	24.6	<0.891				MS/MSD
118	IS118-7-8	7 - 8	10/21/2005	**492**	**90.6**	NO	NO	8.0	
119	IS119-7-8	7 - 8	10/21/2005	64.9	**61.5**	NO	NO	7.0	
120	IS120-7-8	7 - 8	10/21/2005	63.2	23.4	NO	YES	7.5	
121	IS121-5-6	5 - 6	10/21/2005	37.4	<0.832	NO	NO	6.0	Petoleum odor
122	IS122-7-8	7 - 8	10/21/2005	104	**71.5**	**YES**	NO	7.5	Petoleum odor
123	IS123-7-8	7 - 8	10/21/2005	35.6	<0.801	NO	YES	7.5	
124	IS124-6-7	6 - 7	10/22/2005	208	5.1	**YES**	YES	7.5	Below concrete
125	IS125-6-7	6 - 7	10/22/2005	63.8	8.17	**YES**	YES	7.5	Below concrete
126	IS126-6-7	6 - 7	10/22/2005	172	**204**	**YES**	YES	7.5	Below concrete
127	NS	NS	NS	NS	NS	**YES**	YES	9.5	Below concrete
128	IS128-7-8	7 - 8	10/22/2005	**580**	**67.5**	**YES**	YES	>10.0	Below concrete
129	IS129-7-8	7 - 8	10/22/2005	92.7	6.64	**YES**	YES	8.0	Below concrete
130	NS	NS	NS	NS	NS	NO	YES	NM	Refusal at 2 ft bgs
131	NS	NS	NS	NS	NS	NO	YES	NM	Refusal at 2 ft bgs
132	IS132-4-5	4 - 5	1/17/2008	**1,500**	**320**	**YES**	NO	5.0	Petoleum odor
	IS132-4-5DUP	4 - 5	1/17/2008	**1,000**	**380**				
133	IS133-7-8	7 - 8	1/18/2008	**620**	92	NO	NO	2.0	
134	IS134-7-8	7 - 8	1/18/2008	<130	6.3	NO	NO	5.0	
135	IS135-7-8	7 - 8	1/18/2008	**970**	**3,300**	NO	NO	5.0	
136	IS136-7-8	7 - 8	1/18/2008	**440**	12	NO	NO	5.0	
137	IS137-7-8	7 - 8	1/18/2008	**350**	<2.4	NO	NO	5.0	
138	IS138-7-8	7 - 8	1/18/2008	200	7.0	NO	NO	5.0	
139	IS139-7-8	7 - 8	1/18/2008	<120	<2.0	**YES**	NO	5.0	Petoleum odor
North Carolina Action Levels (mg/kg)				**250**	**40**				

Notes:
NM= Not measured
NS = Not sampled
*FREE PRODUCT = Free product detected in boring.
DTW = Depth to groundwater
TPH-DRO - Total Petroleum Hydrocarbons - Diesel Range Organics
bgs - below ground surface

Table 3-2
Summary of Monitoring Well Construction Details
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Well Identification	Easting Coordinate	Northing Coordinate	Top of Casing (ft msl)	Ground Elevation (ft msl)	Well Depth (ft)	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)
73-A47/3-12	282670.93	3830234.98	8.10	6.50	17.00	2.00	17.00
73-A47/3-13	282588.81	3830278.90	8.54	8.70	15.00	1.5	15.00
73-A47/3-15	282577.25	3830322.92	n.a.	n.a.	16.78	n.a.	n.a.
73-A47/3-16	282607.86	3830271.83	7.75	6.30	15.50	4.00	15.50
73-A47/3-19	282680.91	3830273.39	7.27	5.27	19.20	n.a.	n.a.
73-A47/3-22	282614.91	3830252.12	10.45	8.60	18.50	1.00	2.00
73-A47/3-8	282579.93	3830228.64	6.87	7.50	17.00	2.00	17.00
73-A47/3-9	282540.38	3830268.49	7.15	7.80	17.00	2.00	17.00
73-MW01	282146.32	3830394.17	15.35	13.40	18.00	3.00	18.00
73-MW01DW	282149.99	3830391.28	15.92	14.30	57.00	47.00	58.00
73-MW01IW	282148.07	3830393.00	15.86	13.80	38.00	25.00	35.00
73-MW02	282198.61	3830159.54	14.66	12.80	18.00	3.00	18.00
73-MW02IW	282201.12	3830161.72	14.39	12.50	32.00	20.00	30.00
73-MW03	282214.04	3830138.80	13.70	11.90	18.00	3.00	18.00
73-MW04	282256.26	3830203.63	12.86	13.20	11.50	2.00	11.00
73-MW05	282281.66	3830070.79	15.78	13.90	18.00	3.00	18.00
73-MW06	282357.51	3829900.74	7.32	5.40	10.00	3.00	10.00
73-MW06IW	282358.62	3829898.31	6.86	4.88	43.00	32.00	42.00
73-MW07	282309.13	3829913.70	13.94	11.80	17.00	4.00	17.00
73-MW08	282411.23	3829999.91	10.98	9.00	11.50	2.00	11.00
73-MW09	282425.13	3829968.24	18.47	15.67	11.00	3.00	11.00
73-MW09DW	282425.43	3829965.78	6.69	7.13	150.00	145.00	150.00
73-MW09IW	282423.11	3829966.48	6.74	7.10	62.00	52.00	63.00
73-MW10	282466.69	3830003.15	6.54	6.80	11.00	2.00	11.00
73-MW11	282359.13	3830151.43	13.14	11.30	18.00	3.00	18.00
73-MW11DW	282367.22	3830135.64	12.95	10.61	90.00	82.00	87.00
73-MW11IW	282360.66	3830148.32	13.00	11.20	38.00	27.00	37.00
73-MW12	282457.12	3830072.33	9.76	10.10	15.00	3.00	15.00
73-MW13	282526.90	3830213.01	8.43	8.80	18.00	3.00	18.00
73-MW13DW	282525.87	3830211.74	8.28	8.80	70.00	52.00	71.00
73-MW14	282519.61	3830230.66	8.48	8.80	18.00	3.00	18.00
73-MW15	282326.49	3830348.89	5	3.30	10.00	3.00	10.00
73-MW15N	n.a.	n.a.	n.a.	n.a.	14.50	n.a.	n.a.
73-MW15IW	282566.05	3830108.13	4.68	3.20	46.00	34.00	44.00
73-MW16	282348.05	3830200.43	11.13	11.40	15.00	2.00	15.00
73-MW17	282429.34	3830298.39	10.69	11.80	18.00	3.00	18.00
73-MW17DW	282431.13	3830296.53	9.76	10.11	87.00	82.00	87.00
73-MW18	282259.70	3830370.73	12.19	10.20	17.00	3.00	17.00

Table 3-2
Summary of Monitoring Well Construction Details
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Well Identification	Easting Coordinate	Northing Coordinate	Top of Casing (ft msl)	Ground Elevation (ft msl)	Well Depth (ft)	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)
73-MW19	282445.13	3830453.18	12.73	10.90	18.00	3.00	18.00
73-MW20	282494.84	3830384.70	7.70	5.70	18.00	3.00	18.00
73-MW20DW	282491.28	3830385.30	7.32	5.80	53.00	43.00	54.00
73-MW21	282564.57	3830427.64	7.26	5.20	20.00	5.00	20.00
73-MW22	282319.33	3829962.53	10.11	8.10	10.50	3.00	10.00
73-MW23	282112.31	3830241.84	11.67	9.80	18.00	3.00	18.00
73-MW24	282301.25	3830485.67	6.59	4.80	18.00	3.00	18.00
73-MW25	282390.82	3829975.38	11.09	8.40	9.00	2.00	9.00
73-MW26	282326.03	3830213.50	16.04	14.10	16.00	3.00	16.00
73-MW26DW	282325.05	3830213.55	15.83	n.a.	150.00	145.00	150.00
73-MW26IW	282326.04	3830211.71	16.15	14.20	55.00	45.00	55.00
73-MW27	282451.09	3830230.10	9.52	9.90	18.00	3.00	16.00
73-MW27DW	282449.82	3830227.68	8.66	8.98	75.00	65.00	75.00
73-MW28	282433.04	3830006.25	11.45	9.30	11.00	2.00	11.00
73-MW29	282502.28	3830149.94	8.76	9.20	18.00	3.00	18.00
73-MW30	282144.09	3830142.63	9.13	7.40	18.00	3.00	18.00
73-MW31	282239.45	3829836.55	12.06	9.90	12.00	2.00	12.00
73-MW31DW	282238.68	3829834.43	11.85	9.60	70.00	60.00	70.00
73-MW32	282091.21	3830103.48	6.73	4.20	9.00	2.00	9.00
73-MW32DW	282091.52	3830099.54	6.85	4.10	51.00	41.00	51.00
73-MW33	282080.02	3830368.71	14.32	11.60	12.00	2.00	12.00
73-MW33DW	282080.86	3830371.28	14.33	11.70	56.00	46.00	56.00
73-MW34	282052.82	3830561.13	12.9	10.10	17.00	2.00	17.00
73-MW34DW	282052.61	3830559.28	12.57	9.90	61.00	51.00	61.00
73-MW35	282539.26	3830517.96	12.89	10.50	18.00	3.00	18.00
73-MW35DW	282538.52	3830516.09	13.29	10.60	61.00	51.00	61.00
73-MW36	282906.19	3829693.67	8.4	5.80	11.00	2.50	11.00
73-MW36DW	282907.66	3829695.02	8.67	6.20	45.00	35.00	45.00
73-MW37	282431.22	3830310.39	11.12	11.22	18.00	3.00	18.00
73-MW38DW	282530.23	3830168.53	8.22	8.54	110.00	100.00	110.00
73-MW39DW	282531.42	3830167.56	8.06	8.37	70.00	60.00	70.00
73-MW40DW	282587.20	3830146.00	5.98	4.40	70.00	60.00	70.00
73-MW41DW	282588.46	3830147.64	5.83	4.50	110.00	100.00	110.00
73-MW42DW	282566.50	3830109.86	5.64	3.94	110.00	100.00	110.00
73-MW43DW	282518.20	3830295.68	7.52	7.96	70.00	60.00	70.00
73-MW44DW	282495.83	3830216.45	8.56	9.02	70.00	60.00	70.00
73-MW45DW	282540.09	3830082.34	3.33	3.79	70.00	60.00	70.00
73-MW46DW	282420.98	3830123.09	10.12	n.a.	75.00	65.00	75.00

Table 3-2
Summary of Monitoring Well Construction Details
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Well Identification	Easting Coordinate	Northing Coordinate	Top of Casing (ft msl)	Ground Elevation (ft msl)	Well Depth (ft)	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)
73-MW47DW	282488.03	3830031.28	9.17	n.a.	75.00	65.00	75.00
73-MW48DW	282498.90	3830112.35	8.09	n.a.	75.00	65.00	75.00
73-MW49DW	282458.86	3830196.25	9.67	n.a.	75.00	65.00	75.00
73-MW49DWA	282443.54	3830196.14	8.23	8.69	127.00	122.00	127.00
73-MW49IW	282441.57	3830193.94	8.46	8.71	55.00	45.00	55.00
73-MW50DW	282572.23	3830219.77	7.93	n.a.	75.00	65.00	75.00
73-MW51	282710.33	3830272.19	6.55	4.00	150.00	145.00	150.00
73-MW51DW	282713.81	3830274.17	6.94	4.30	74.00	64.00	74.00
73-MW52	282570.77	3830110.13	5.75	3.10	150.00	145.00	150.00
73-MW52DW	282568.18	3830108.84	4.68	3.20	60.00	50.00	61.00
73-MW53	282909.21	3829696.23	8.4	5.80	150.00	145.00	150.00
73-MW54	282371.56	3830415.29	12.98	10.00	15.00	2.50	15.00
73-MW55	282399.22	3830376.57	12.15	11.60	11.50	5.00	20.00
73-MW56	282328.97	3830374.68	14.18	9.30	14.00	4.25	14.00
73-MW57	282330.47	3830302.01	12.37	12.30	12.00	2.43	13.48
73-MW58	282279.93	3830250.02	14.92	15.20	14.00	4.20	16.00
73-MW60	282348.49	3830015.78	13.13	10.70	22.50	4.99	19.42
73-MW61	282487.36	3830043.03	11.04	10.20	21.50	5.19	19.67
73-MW62DW	282305.83	3830321.10	18.00	14.20	30.00	24.79	30.00
73-MW63DW	282470.58	3830164.77	7.91	8.27	76.00	65.00	75.00

Notes:

Well has been abandoned.
n.a. - not available.
ft msl - feet above mean sea level
ft bgs - feet below ground surface

Table 3-3
Monitoring Wells Sampled and Parameters Analyzed During Supplemental RI Field Activities - April 2006
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Well/Station ID	Sample ID	Chloride, nitrate, nitrite, sulfate (EPA Method 300.0 IC)	Total Organic Carbon (EPA Method 415.1)	Volatile Organic Compounds (OLC03.2 Low Concentration VOCs)	Methane, Ethane, Ethene (RSK 175)	Alkalinity (Standard Method 2320)	Ferrous and Ferric Iron (Standard Method 3500D)	Sulfide (Standard Method 4500)	Iron (SW846-6010B)
IR73-A47/3-8	IR73-GWA47/3-8-06B	X	X	X	X	X	X	X	X
IR73-47/3-22	IR73-GWA47/3-22-06B	X	X	X	X	X	X	X	X
IR73-A47/3-12	IR73-GWA47/3-12-06B	X	X	X	X	X	X	X	X
IR73-A47/3-15	IR73-GWA47/3-15-06B	X	X	X	X	X	X	X	X
IR73-A47/3-16	IR73-GWA47/3-16-06B	X	X	X	X	X	X	X	X
IR73-A47/3-19	IR73-GWA47/3-19-06B	X	X	X	X	X	X	X	X
IR73-A47/3-9	IR73-GWA47/3-9-06B	X	X	X	X	X	X	X	X
IR73-MW01	73-GW01-06B	X	X	X	X	X	X	X	X
IR73-MW01DW	73-GW01DW-06B	X	X	X	X	X	X	X	X
IR73-MW01IW	73-GW01IW-06B	X	X	X	X	X	X	X	X
IR73-MW02	IR73-GW02-06B	X	X	X	X	X	X	X	X
IR73-MW02IW	IR73-GW02IW-06B	X	X	X	X	X	X	X	X
IR73-MW03	IR73-GW03-06B	X	X	X	X	X	X	X	X
IR73-MW06	IR73-GW06-06B	X	X	X	X	X	X	X	X
IR73-MW06IW	IR73-GW06IW-06B	X	X	X	X	X	X	X	X
IR73-MW08	IR73-GW08-06B	X	X	X	X	X	X	X	X
IR73-MW09	IR73-GW09-06B	X	X	X	X	X	X	X	X
IR73-MW10	IR73-GW10-06B	X	X	X	X	X	X	X	X
IR73-MW11	IR73-GW11-06B	X	X	X	X	X	X	X	X
IR73-MW11DW	IR73-GW11DW-06B	X	X	X	X	X	X	X	X
IR73-MW11IW	IR73-GW11IW-06B	X	X	X	X	X	X	X	X
IR73-MW12	IR73-GW12-06B	X	X	X	X	X	X	X	X
IR73-MW13	IR73-GW13-06B	X	X	X	X	X	X	X	X
IR73-MW13DW	IR73-GW13DW-06B	X	X	X	X	X	X	X	X
IR73-MW15	IR73-GW15-06B	X	X	X	X	X	X	X	X
IR73-MW15IW	IR73-GW15IW-06B	X	X	X	X	X	X	X	X
IR73-MW15N	IR73-GW15N-06B	X	X	X	X	X	X	X	X
IR73-MW16	IR73-GW16-06B	X	X	X	X	X	X	X	X
IR73-MW17	IR73-GW17-06B	X	X	X	X	X	X	X	X
IR73-MW17DW	IR73-GW17DW-06B	X	X	X	X	X	X	X	X
IR73-MW18	IR73-GW18-06B	X	X	X	X	X	X	X	X
IR73-MW19	IR73-GW19-06B	X	X	X	X	X	X	X	X
IR73-MW20	IR73-GW20-06B	X	X	X	X	X	X	X	X
IR73-MW20DW	IR73-GW20DW-06B	X	X	X	X	X	X	X	X
IR73-MW21	IR73-GW21-06B	X	X	X	X	X	X	X	X
IR73-MW23	IR73-GW23-06B	X	X	X	X	X	X	X	X
IR73-MW25	IR73-GW25-06B	X	X	X	X	X	X	X	X
IR73-MW26DW	IR73-GW26DW-06B	X	X	X	X	X	X	X	X
IR73-MW27	IR73-GW27-06B	X	X	X	X	X	X	X	X
IR73-MW27DW	IR73-GW27DW-06B	X	X	X	X	X	X	X	X
IR73-MW28	IR73-GW28-06B	X	X	X	X	X	X	X	X
IR73-MW29	IR73-GW29-06B	X	X	X	X	X	X	X	X
IR73-MW30	IR73-GW30-06B	X	X	X	X	X	X	X	X

Table 3-3
Monitoring Wells Sampled and Parameters Analyzed During Supplemental RI Field Activities - April 2006
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Well/Station ID	Sample ID	Chloride, nitrate, nitrite, sulfate (EPA Method 300.0 IC)	Total Organic Carbon (EPA Method 415.1)	Volatile Organic Compounds (OLC03.2 Low Concentration VOCs)	Methane, Ethane, Ethene (RSK 175)	Alkalinity (Standard Method 2320)	Ferrous and Ferric Iron (Standard Method 3500D)	Sulfide (Standard Method 4500)	Iron (SW846-6010B)
IR73-MW31	IR73-GW31-06B	X	X	X	X	X	X	X	X
IR73-MW31DW	IR73-GW31DW-06B	X	X	X	X	X	X	X	X
IR73-MW33DW	IR73-GW33DW-06B	X	X	X	X	X	X	X	X
IR73-MW34	IR73-GW34-06B	X	X	X	X	X	X	X	X
IR73-MW34DW	IR73-GW34DW-06B	X	X	X	X	X	X	X	X
IR73-MW35	IR73-GW35-06B	X	X	X	X	X	X	X	X
IR73-MW35DW	IR73-GW35DW-06B	X	X	X	X	X	X	X	X
IR73-MW37	IR73-GW37-06B	X	X	X	X	X	X	X	X
IR73-MW38DW	IR73-GW38-06B	X	X	X	X	X	X	X	X
IR73-MW39DW	IR73-GW39DW-06B	X	X	X	X	X	X	X	X
IR73-MW40DW	IR73-GW40DW-06B	X	X	X	X	X	X	X	X
IR73-MW41DW	IR73-GW41DW-06B	X	X	X	X	X	X	X	X
IR73-MW42DW	IR73-GW42DW-06B	X	X	X	X	X	X	X	X
IR73-MW43DW	IR73-GW43DW-06B	X	X	X	X	X	X	X	X
IR73-MW44DW	IR73-GW44DW-06B	X	X	X	X	X	X	X	X
IR73-MW45DW	IR73-GW45DW-06B	X	X	X	X	X	X	X	X
IR73-MW46DW	IR73-GW46DW-06B	X	X	X	X	X	X	X	X
IR73-MW47DW	IR73-GW47DW-06B	X	X	X	X	X	X	X	X
IR73-MW48DW	IR73-GW48DW-06B	X	X	X	X	X	X	X	X
IR73-MW49DW	IR73-GW49DW-06B	X	X	X	X	X	X	X	X
IR73-MW49DWA	IR73-GW49DWA-06B	X	X	X	X	X	X	X	X
IR73-MW49IW	IR73-GW49IW-06B	X	X	X	X	X	X	X	X
IR73-MW50DW	IR73-GW50DW-06B	X	X	X	X	X	X	X	X
IR73-MW51	IR73-GW51-06B	X	X	X	X	X	X	X	X
IR73-MW51DW	IR73-GW51DW-06B	X	X	X	X	X	X	X	X
IR73-MW52	IR73-GW52-06B	X	X	X	X	X	X	X	X
IR73-MW52DW	IR73-GW52DW-06B	X	X	X	X	X	X	X	X
IR73-MW53	IR73-GW53-06B	X	X	X	X	X	X	X	X
IR73-MW54	IR73-GW54-06B	X	X	X	X	X	X	X	X
IR73-MW55	IR73-GW55-06B	X	X	X	X	X	X	X	X
IR73-MW56	IR73-GW56-06B	X	X	X	X	X	X	X	X
IR73-MW58	IR73-GW58-06B	X	X	X	X	X	X	X	X
IR73-MW61	IR73-GW61-06B	X	X	X	X	X	X	X	X
IR73-MW62DW	IR73-GW62DW-06B	X	X	X	X	X	X	X	X
IR73-MW63DW	IR73-GW63DW-06B	X	X	X	X	X	X	X	X

Notes:
Analytical method in paranthesis

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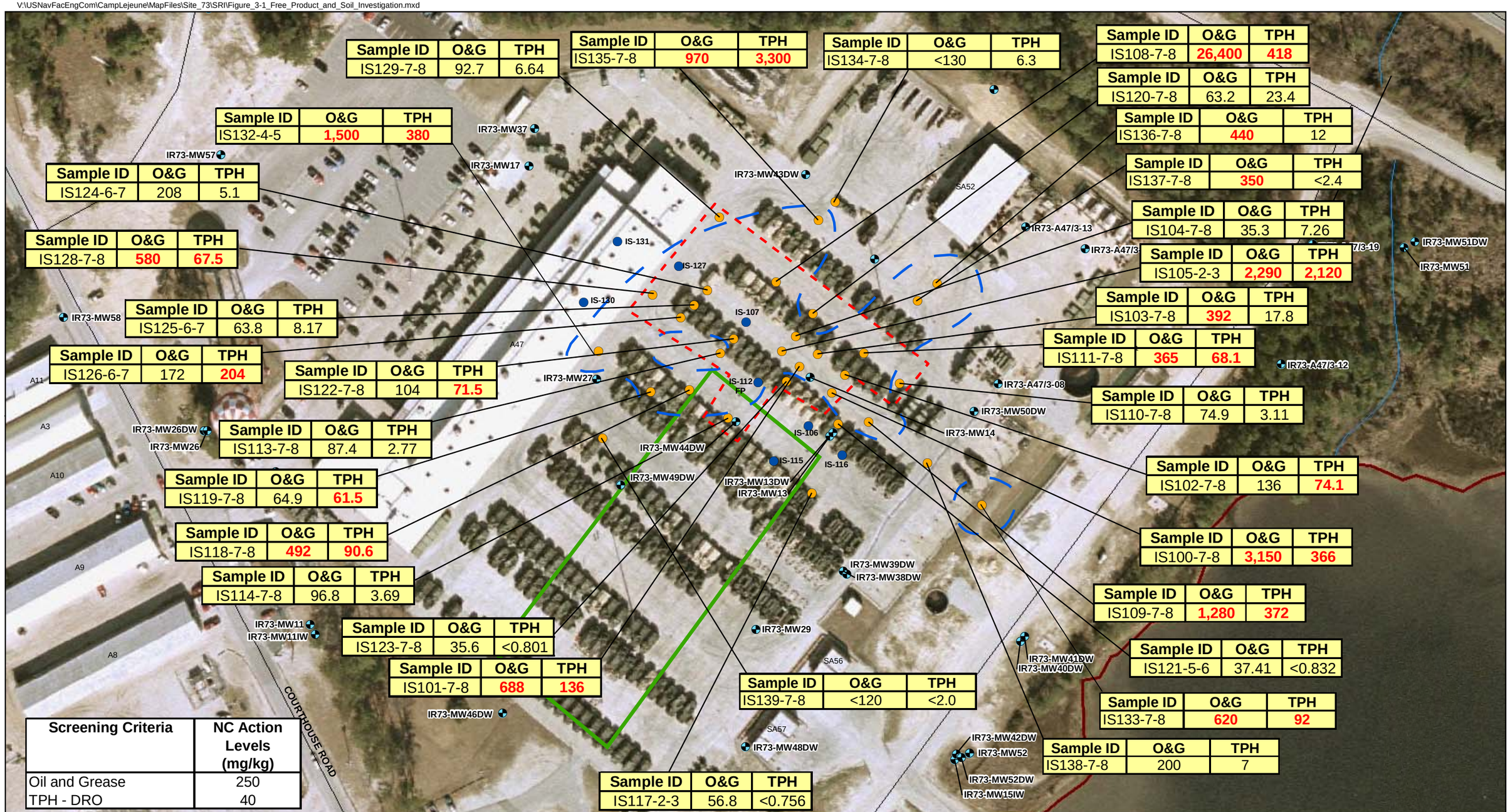

Sample ID	O&G	TPH
IS129-7-8	92.7	6.64

Sample ID	O&G	TPH
IS135-7-8	970	3,300

Sample ID	O&G	TPH
IS134-7-8	<130	6.3

Sample ID	O&G	TPH
IS108-7-8	26,400	418

Sample ID	O&G	TPH
IS120-7-8	63.2	23.4

Sample ID	O&G	TPH
IS136-7-8	440	12

Sample ID	O&G	TPH
IS137-7-8	350	<2.4

Sample ID	O&G	TPH
IS104-7-8	35.3	7.26

Sample ID	O&G	TPH
IS105-2-3	2,290	2,120

Sample ID	O&G	TPH
IS103-7-8	392	17.8

Sample ID	O&G	TPH
IS111-7-8	365	68.1

Sample ID	O&G	TPH
IS110-7-8	74.9	3.11

Sample ID	O&G	TPH
IS102-7-8	136	74.1

Sample ID	O&G	TPH
IS100-7-8	3,150	366

Sample ID	O&G	TPH
IS109-7-8	1,280	372

Sample ID	O&G	TPH
IS121-5-6	37.41	<0.832

Sample ID	O&G	TPH
IS133-7-8	620	92

Sample ID	O&G	TPH
IS138-7-8	200	7

Sample ID	O&G	TPH
IS132-4-5	1,500	380

Sample ID	O&G	TPH
IS124-6-7	208	5.1

Sample ID	O&G	TPH
IS128-7-8	580	67.5

Sample ID	O&G	TPH
IS125-6-7	63.8	8.17

Sample ID	O&G	TPH
IS126-6-7	172	204

Sample ID	O&G	TPH
IS122-7-8	104	71.5

Sample ID	O&G	TPH
IS113-7-8	87.4	2.77

Sample ID	O&G	TPH
IS119-7-8	64.9	61.5

Sample ID	O&G	TPH
IS118-7-8	492	90.6

Sample ID	O&G	TPH
IS114-7-8	96.8	3.69

Sample ID	O&G	TPH
IS123-7-8	35.6	<0.801

Sample ID	O&G	TPH
IS101-7-8	688	136

Sample ID	O&G	TPH
IS139-7-8	<120	<2.0

Sample ID	O&G	TPH
IS117-2-3	56.8	<0.756

Screening Criteria	NC Action Levels (mg/kg)
Oil and Grease	250
TPH - DRO	40

Legend
- Monitoring Wells
- Soil Sample Location
- Soil Boring Location (not sampled)
- Estimated Extent of Concrete at Approximately 6 feet bgs
- Estimated Extent of Soil Exceeding Actions Levels Based on October 2005 and January 2008 Sampling Results
- Approximate Location of Former Maintenance Building
- Base Boundary

N

0 100 200 Feet

1 inch = 100 feet

Notes:
-FP = Free Product
-O&G = Oil and Grease
-TPH - DRO = Total Petroleum
-Hydrocarbons - Diesel Range Organics
-All results are reported in mg/kg.
-Soil samples 1S100 through 1S129 collected in October 2005
-Soil samples 1S130 through 1S139 collected in January 2008
-Concentrations in BOLD exceed the NC Action Level

Figure 3-1
Free Product and Soil Investigation Analytical Results
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

CH2MHILL

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Legend

- Monitoring Well
- Base Boundary

N

0 300 600 Feet

1 inch = 300 feet

Figure 3-2
Monitoring Well Locations
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

CH2MHILL

SECTION 4

Site Physical Characteristics

This section describes the physical characteristics of the region, MCB Camp Lejeune, and Site 73 in particular. The majority of this section is based on prior knowledge of conditions at the Base, but has been modified to incorporate the findings from the SRI field activities discussed in Section 3.

4.1 Regional and Facility-wide Physiography, Climate, and Surface Water Hydrology

MCB Camp Lejeune is located on 236 square miles of land in Onslow County, North Carolina, adjacent to the southern side of the City of Jacksonville. Jacksonville is the largest city near the Base and contains approximately half of the county's total population. Since 1990, much of the MCB Camp Lejeune complex has been part of Jacksonville. The areas adjacent to the Base are generally rural. The Base is bisected by the New River, which flows into the Atlantic Ocean in a southeasterly direction. The Base is bordered by the Atlantic Ocean to the east, U.S. Route 17 to the west, and State Route 24 to the north.

As shown on **Figure 4-1**, the MCB Camp Lejeune facility lies within the outer part of the Atlantic Coastal Plain Physiographic Province in North Carolina, which stretches from Georgia to Long Island, New York. The physiography of the area is typical of the Atlantic Coastal Plain with stepped terraces consisting of wide, gently eastward-sloping plains separated by linear, steeper, northward and eastward-facing scarps. Low elevations and relatively low relief characterize topography across MCB Camp Lejeune and the general vicinity of Site 73. The surface elevations range from sea level to approximately 70 ft above mean sea level (msl) with most of MCB Camp Lejeune's elevation ranging from 20 to 40 ft above msl.

The New River and its tributaries bisect MCB Camp Lejeune. The land at MCB Camp Lejeune generally slopes toward the New River with a grade of about 0.5 percent. The relief between stream and interstream areas typically ranges from 20 to 30 ft. Site 73 is relatively flat, located between two small unnamed tributaries located to the east and west of the site, ultimately discharging to Courthouse Bay, which borders the site to the south.

Mild winters and hot humid summers generally characterize climatic conditions within southeastern North Carolina and at MCB Camp Lejeune. Winters are usually short and mild with occasional short, cold periods. Summers are long, hot and humid. Average annual net precipitation is approximately 50 inches. Ambient air temperatures generally range from 33 to 53 degrees Fahrenheit (°F) in the winter months and 71°F to 88°F during the summer months. Winds are generally south to southwesterly in the summer and north to northwesterly in the winter.

4.2 Site 73 Topography, Drainage, and Surface Features

Site 73 consists of the Amphibious Vehicle Maintenance Facility and is roughly bounded by State Route 172 (Sneads Ferry Road) to the north, Courthouse Bay to the south and unnamed tributaries to Courthouse Bay to the east and west. The ground surface elevation at Site 73 ranges from approximately 3 to 16 ft above msl. The surface of Site 73 is covered with a mix of vegetation (grasses and heavily wooded areas), asphalt, concrete, buildings, and structures. The outer perimeter of the site is heavily wooded, whereas the central portion of the site is covered with asphalt roads and parking areas (for personal vehicles), concrete parking areas (for heavy equipment), four operations and maintenance buildings, an armory, eight warehouses, numerous wash basins, four hazardous materials storage shelters, several OWSs, aboveground storage tanks, a water tower, and numerous smaller facilities and shelters. The central portion of Site 73 contains three stormwater retention ponds. The wooded areas on the perimeter of the site are bisected by numerous tank trails and contain several areas used for troop maneuvers and training.

Stormwater runoff tends to drain directly south to Courthouse Bay, to the two small unnamed tributaries located east and west of the facility, or to the retention ponds located west of Buildings A3, A9, A10, and A11. The stormwater retention ponds and unnamed tributaries discharge to Courthouse Bay. Site 73 has numerous areas where the natural topography has been modified by man-made stormwater collection systems, concrete and paved parking lots, and various structures located on the site. Rain collected in the stormwater system travels through one of the OWSs and is eventually transported via underground piping and discharged along the northwestern edge of Courthouse Bay. Infiltration rates are expected to be fairly low in the vicinity of the buildings and parking areas; however, high rates of infiltration are expected in the unpaved areas (Baker, 1997a). The hydrologic features of Site 73 are shown on **Figure 4-2**.

4.3 Geology and Hydrogeology

4.3.1 General Regional Geologic and Hydrogeologic Framework

Southeastern North Carolina and MCB Camp Lejeune are within the Tidewater region of the Atlantic Coastal Plain physiographic province. The Tidewater region is of low relief, with elevations averaging about 20 ft above msl, and is generally swampy. The MCB Camp Lejeune area is underlain by an eastward thickening wedge of marine and non-marine sediments ranging in age from early Cretaceous to Holocene. The eastward thickening wedge of sediment begins at the Fall Line (western boundary of Atlantic Coastal Plain physiographic province) and dips to the southeast towards the coast. Along the coastline, several thousands of feet of interlayered, unconsolidated sediment are present consisting of gravel, sand, silt, clay deposits, calcareous clays, shell beds, with occasional beds of sandstone, and limestone that was deposited over pre-Cretaceous crystalline basement rock. Minor amounts of detrital carbonate shells and secondary minerals such as glauconite, siderite, and chlorite often distinguish these sedimentary units.

Coastal Plain sedimentation and deposition was controlled by fluctuations in sea level on a subsiding continental margin in marine and near-shore environments (Winner and Coble, 1989). Confining units associated with specific aquifers within the Coastal Plain region are

composed of less permeable beds of clay and silt. Within the MCB Camp Lejeune area, approximately 1,500 ft of a sedimentary sequence that overlies the basement rock consists of seven aquifers and their associated confining units including the Surficial, Castle Hayne, Beaufort, Peedee, Black Creek, and Upper and Lower Cape Fear aquifers (Cardinell, Berg, and Lloyd, 1993). Hydrostratigraphic units of the North Carolina Coastal Plain are contained in **Table 4-1**.

Recharge of aquifers within the Coastal Plain region generally occurs within interstream areas. Recharge to the aquifers has been estimated in the range of 5 to 21 inches of rainfall yearly (Heath, 1989). Natural discharge of groundwater from the Coastal Plain aquifer system is generally into streams, swamps, and lakes. Evapotranspiration from the soil zone and upward leakage through confining units into streams, estuaries, swamps, and ocean contribute to groundwater discharge. The New River estuary serves as the principal discharge area for groundwater from the Castle Hayne aquifer within the vicinity of MCB Camp Lejeune (Harned, Lloyd, and Treece, 1989).

4.3.2 Site-Specific Geologic and Hydrogeologic Framework

This section presents the geological and hydrogeological characteristics of Site 73 based on SRI field activities and the results of previous investigations. The results of the geologic and hydrogeologic characterization will aid in determining the fate, transport, and risks associated with contamination in the groundwater at Site 73. **Figure 4-3** shows the locations of the geologic cross-sections depicted by **Figures 4-4** through **4-6**. These interpretations are based upon previous investigations conducted by Baker and supplemented with recent field information collected by CH2M HILL.

Site Geology

The regional stratigraphic framework of the Lower Coastal Plain in North Carolina is shown by **Table 4-1**. According to Cardinell, et al. (1993), three of the upper Tertiary Formations (Yorktown, Eastover, and Pungo River) shown on **Table 4-1** are not present in the vicinity of MCB Camp Lejeune. It has also been postulated that the New River may have eroded the Belgrade Formation (Fm.) locally at MCB Camp Lejeune, although it is observed at Site 73.

Within the vicinity of Site 73, the uppermost undifferentiated deposits of Holocene and Pleistocene age sediments consist of very fine to fine sands with varying amounts of silt ranging in thickness from 10 to 15 ft. Thin, discontinuous silt and clay lenses, and peat beds are found within the undifferentiated deposits. The Belgrade Fm. lies directly beneath the undifferentiated deposits, with an approximate thickness of 10 to 20 ft.

The Oligocene age River Bend Fm. underlies the Belgrade Fm., and is composed of sands, silt, shell and fossil fragments, and trace amounts of clay. Sands tend to be cemented within this formation. The River Bend Fm. overlies the Eocene age Castle Hayne Fm. which was encountered at a depth of approximately 110 ft bgs and consisted of greenish gray fine silty sand.

Cross-section A-A′ (**Figure 4-4**) trends from the west to the east and crosses the central portion of Site 73. The undifferentiated deposits are shown to vary in thickness from 0 to 15 ft, and consist of mostly sand and silty sand, with sandy clay in the eastern portion of the Site. The underlying Belgrade Fm., a discontinuous, plastic, silty clay layer is encountered

within the vicinity of Site 73 at depths ranging from approximately 10 to 30 ft bgs, and is identified in each of the boring logs along A-A′ with the exception of IR73-MW02 and IR73-A47/3-12 located at the eastern and western portions of the Site, respectively. The partially cemented sands and fossil shell hash in the upper portion of the River Bend Fm. were observed between 30 to 110 ft bgs. The fossil layer is an identifying characteristic of the River Bend Fm. (Cardinell, Berg, and Lloyd, 1993). A greenish gray silty sand layer and greenish gray fine sand layer was observed at 107 ft bgs and 117 ft bgs respectively in boring IR73-MW49DWA.

Cross-section B-B′ (**Figure 4-5**) trends from north to south across the central portion of the Site. The undifferentiated deposits observed in this portion of the Site consist of very fine to fine sands or silty sand ranging in thickness from 10 to 15 ft. The Belgrade Fm. is also present and appears to be continuous along the length of the B-B′ cross section, ranging in thickness from 5 to 20 ft. The upper portion of the River Bend Fm. consists of a fine sand and discontinuous cemented sand beds ranging in thickness from approximately 30 to 50 ft. Partially cemented sands and fossil shell hash of the River Bend Fm., were observed between 50 to 65 ft bgs and 70 to 115 ft bgs. The partially cemented sands and fossil shell hash present at 50 to 60 ft bgs was discontinuous across the B-B′ cross section. A continuous greenish gray, fine sand layer, observed in soil borings IR73-MW49DWA and IR73-MW09DW, is present approximately 115 to 120 ft bgs and below along the B-B′ section.

Cross-section C-C′ (**Figure 4-6**) trends from the west to east along the site boundary with Courthouse Bay. The undifferentiated deposits observed in this portion of the Site consist of very fine to fine sand or silty sand, ranging in thickness from 5 to 15 ft. The underlying Belgrade Fm. is again present, ranging in thickness from 20 to 25 ft, and appears to be discontinuous in the eastern portion of the Site based on the absence of the clay layer in soil boring IR73-A47/3-8. The upper portion of the River Bend Fm. consists of a fine sand and discontinuous cemented sand beds ranging in thickness from approximately 25 to 40 ft. Partially cemented sands and fossil shell hash of the River Bend Fm., were observed between 55 to 120 ft bgs and appear to be continuous across the along C-C′ cross section. A laterally continuous greenish gray, fine sand layer is present at a depth of approximately 120 ft bgs in soil borings IR73-MW09DW and IR73-MW51.

Site Hydrogeology

The Surficial aquifer, Castle Hayne confining unit and the Castle Hayne aquifer have all been described at MCB Camp Lejeune (Cardinell, Berg, and Lloyd., 1993). Hydrogeologic characteristics of the surficial (water table) and Castle Hayne aquifers underlying Site 73 were evaluated by reviewing available information and installing a network of monitoring wells within the Surficial aquifer and at several depths within the Castle Hayne aquifer.

During the April 2006 well gauging event (**Table 4-2)**, groundwater was encountered at depths ranging from 1.08 ft bgs (IR73-MW30) to 12.18 ft bgs (IR73-MW62DW) in wells screened in the unconfined Surficial aquifer and ranging from 0.92 ft bgs (IR73-MW45DW) to 13.00 ft bgs (IR73-MW26DW) in wells screened in the Castle Hayne aquifer. The variation in the depth to groundwater is primarily attributed to topographical changes. **Figures 4-7, 4-8,** and **4-9** depict the April 2006 potentiometric surface contours for the surficial and Castle Hayne aquifer (wells screened predominantly within the cemented sand unit [50 to 90 ft bgs] and wells screened within the lower sand unit [110 to 150 ft bgs]), respectively.

Figure 4-7 indicates that the groundwater flow within the surficial aquifer is generally toward the southeast, with average hydraulic gradients consistent with the topography of the site (0.004 feet per foot [ft/ft]). The northern area of the site exhibits radial flow, a result of localized mounding in the vicinity of Buildings A3 and A11 and the stormwater retention ponds. Shallow groundwater is anticipated to discharge to Courthouse Bay and the eastern and western unnamed tributaries.

Figure 4-8 indicates that the groundwater flow regime within the cemented sand unit of the Castle Hayne aquifer (wells screened from 50 to 90 ft bgs) generally trends toward the southeast with an average hydraulic gradient of 0.002 ft/ft.

Figure 4-9 indicates the groundwater flow associated with the lower sand unit of the Castle Hayne aquifer (wells screened from 110 to 150 ft bgs) appears to be generally in a southeastern direction.

Vertical hydraulic potentials were calculated between the surficial and Castle Hayne aquifers using the water level data between adjacent wells screened in the respective intervals (well pairs IR73-MW06/IR73-MW06IW, IR73-MW13/IR73-MW13IW, IR73-MW20/IR73-MW20DW, IR73-MW31/IR73-MW31DW, IR73-MW34/IR73-MW34DW and IR73-MW35/IR73-MW35DW). The vertical hydraulic potential was calculated by dividing the difference in water-level elevations by the distance between the center points of the two screened intervals of the two wells. The vertical hydraulic potential calculations are summarized in **Table 4-3**. Based on the April 2006 water-level data, a slight downward potential exists, ranging from 0.005 to 0.054 ft/ft, between all well pairs except IR73-MW06/IR73-MW06IW, which has a very slight upward gradient of 0.0007 ft/ft.

Slug tests were performed at the site on May 22, and May 23, 1995 and February 26, 1996 by Baker. Slug tests were performed on IR73 -MW01A, IR73-MW03, IR73-MW11A, IR73-MW13, IR73-MW20, IR73-MW21, IR73-MW22, IR73-MW23, IR73-MW01B, IR73-MW11B and IR73-MW15B. The geometric mean conductivity recorded for the surficial aquifer was 1.3 feet per day (ft/day) (4.6×10^{-4} centimeters per second [cm/sec]) and the geometric mean for the upper portion of the Castle Hayne aquifer (below the confining clay) was 3.6 ft/day (1.3×10^{-3} cm/sec). These values were calculated using the Geraughty and Miller Aquifer Test Solver (AQTESOLV) program that uses the Bouwer and Rice (1976) method for unconfined aquifers. These values are consistent with expected values of hydraulic conductivity for the well-sorted fine sands observed at the site (Fetter, 1986).

Additional slug tests were performed in the surficial aquifer during the May 1999 NAES. Slug tests were performed in monitoring wells IR73-A473-8, IR73-MW13, IR73-MW15, IR73-MW-27 and IR73-MW-29. Results of these tests indicated an average horizontal hydraulic conductivity of approximately 12 ft/day (4.23×10^{-3} cm/sec). These values are an order of magnitude greater than those obtained during the RI (Baker, 1997a).

Using effective porosity values for silts and sands in the range of 25 to 35 percent (Freeze and Cherry, 1979), average linear seepage velocities for the surficial aquifer was estimated to range from 0.137 to 0.192 ft/day (50 to 70 feet per year [ft/year]) and from 0.021 to 0.029 feet/day (8 to 10 ft/year) in the Castle Hayne aquifer.

4.3.3 Regional Water Usage

Regionally in southeastern North Carolina, the Castle Hayne aquifer may be utilized as a potable source of domestic water supply, watering lawns or filling swimming pools. Potable water available to MCB Camp Lejeune and the surrounding residential area is provided by water supply wells that pump groundwater from the Castle Hayne aquifer. Although freshwater is present within the surficial, Castle Hayne, Beaufort and Peedee aquifers, all of which are located below MCB Camp Lejeune, only the Castle Hayne aquifer is used by MCB Camp Lejeune as a water supply source (Cardinell, Berg, and Lloyd, 1993).

Three active water supply wells are located within a one-mile radius of Site 73 and two active wells are located just beyond the one mile radius. Water supply wells are shown on **Figure 2-6** of the Baker FS (1998) which is provided in **Appendix B**. Production well BB-44, located across Courthouse Bay approximately 4,225 ft southeast of Site 73, is screened from 32 to 62 ft bgs. TCE was detected in this well at a concentration of 1 µg/L during a study conducted by Greenhorne and O'Mara, Inc. in 1992. It was concluded that the water supply well had likely been impacted by the infiltration of surface contaminants to the shallow groundwater and Site 73 was listed as one of the possible sources for the contamination (Greenhorne and O'Mara, 1992). Subsequent sampling of the well by Baker in 1993 did not detect any VOCs.

Based on the groundwater flow direction there are no water supply wells located between Site 73 and groundwater discharge points. MCB Camp Lejeune controls all the land between Site 73 and associated groundwater discharge points. The most recent Wellhead Protection Plan (AH Environmental Consultants, 2002) indicates that production well BB-44 is still active.

TABLE 4-1
Hydrostratigraphic Units of the North Carolina Coastal Plain
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Geologic Units			Hydrogeologic Units
System	**Series**	**Formation**	**Aquifer and Confining Unit**
Quaternary	Holocene/Pleistocene	Undifferentiated	Surficial Aquifer
Tertiary	Pliocene	Pinehurst[1]	Yorktown confining unit[1]
		Waccamaw[1]	Yorktown Aquifer[1]
	Miocene	Yorktown[1]	Yorktown Aquifer[1]
			Pungo River confining unit[1]
		Pungo River[1]	Pungo River Aquifer[1]
		Belgrade	Castle Hayne confining unit[2]
	Oligocene	Belgrade	Castle Hayne confining unit[2]
		River Bend	Castle Hayne Aquifer
	Eocene	Castle Hayne	Castle Hayne Aquifer

Notes:

[1] Geologic and hydrogeologic units not present beneath MCB Camp Lejeune.

[2] Intermittent lenticular pattern provides semi-confining conditions at Site 73.

Source: Modified from Harned et al., 1989.

Table 4-2
Summary of Groundwater Elevations in April 2006
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Well ID	Date (dd/mm/yy)	DTW (ft bTOC)	TOC (ft msl)	Well Depth (ft)	Water Elevation (ft msl)
73-A47/3-12	04/08/06	5.49	8.10	17.00	2.61
73-A47/3-13	04/08/06	NM	8.54	15.00	NM
73-A47/3-15	04/08/06	5.96	n.a.	n.a.	n.a.
73-A47/3-16	04/08/06	5.05	7.75	15.50	2.70
73-A47/3-19	04/08/06	6.11	7.27	19.18	1.16
73-A47/3-22	04/08/06	7.45	10.45	18.50	3.00
73-A47/3-8	04/08/06	4.15	6.87	17.00	2.72
73-A47/3-9	04/08/06	3.60	7.15	17.00	3.55
73-MW01	04/08/06	9.95	15.35	18.00	5.40
73-MW01DW	04/08/06	10.24	15.92	57.00	5.68
73-MW01IW	04/08/06	10.10	15.86	38.00	5.76
73-MW02	04/08/06	6.74	14.66	18.00	7.92
73-MW02IW	04/08/06	17.00	14.39	32.00	-2.61
73-MW03	04/08/06	7.50	13.70	18.00	6.20
73-MW04	04/08/06	NM	12.86	11.50	NM
73-MW05	04/08/06	NM	15.78	18.00	NM
73-MW06	04/08/06	5.22	7.32	10.00	2.10
73-MW06IW	04/08/06	4.74	6.86	43.00	2.12
73-MW07	04/08/06	NM	13.94	17.00	NM
73-MW08	04/08/06	5.13	10.98	11.50	5.85
73-MW09	04/08/06	3.30	18.47	11.00	15.17
73-MW09DW	04/08/06	NM	6.69	150.00	NM
73-MW09IW	04/08/06	NM	6.74	62.00	NM
73-MW10	04/08/06	2.84	6.54	11.00	3.70
73-MW11	04/08/06	5.80	13.14	18.00	7.34
73-MW11DW	04/08/06	12.60	12.95	90.00	0.35
73-MW11IW	04/08/06	9.89	13.00	38.00	3.11
73-MW12	04/08/06	4.38	9.76	15.00	5.38
73-MW13	04/08/06	3.40	8.43	18.00	5.03
73-MW13DW	04/08/06	5.51	8.28	70.00	2.77
73-MW14	04/08/06	3.74	8.48	18.00	4.74
73-MW15	04/08/06	3.70	5	10.00	1.30
73-MW15IW	04/08/06	2.22	4.68	46.00	2.46
73-MW15N	04/08/06	7.65	n.a.	14.50	n.a.
73-MW16	04/08/06	3.60	11.13	15.00	7.53
73-MW17	04/08/06	5.71	10.69	18.00	4.98
73-MW17DW	04/08/06	10.21	9.76	86	-0.45
73-MW18	04/08/06	6.40	12.19	17.00	5.79
73-MW19	04/08/06	6.81	12.73	18.00	5.92
73-MW20	04/08/06	2.67	7.70	18.00	5.03
73-MW20DW	04/08/06	4.34	7.32	53.00	2.98
73-MW21	04/08/06	3.72	7.26	20.00	3.54
73-MW22	04/08/06	NM	10.11	10.50	NM
73-MW23	04/08/06	4.76	11.67	18.00	6.91
73-MW24	04/08/06	NM	6.59	18.00	NM
73-MW25	04/08/06	4.63	11.09	9.00	6.46
73-MW26	04/08/06	DRY	16.04	16.00	DRY
73-MW26DW	04/08/06	13.00	15.83	150.00	2.83
73-MW26IW	04/08/06	DRY	16.15	55.00	DRY
73-MW27	04/08/06	3.25	9.52	18.00	6.27
73-MW27DW	04/08/06	6.66	8.66	75.00	2.00
73-MW28	04/08/06	6.33	11.45	11.00	5.12

Table 4-2
Summary of Groundwater Elevations in April 2006
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Well ID	Date (dd/mm/yy)	DTW (ft bTOC)	TOC (ft msl)	Well Depth (ft)	Water Elevation (ft msl)
73-MW29	04/08/06	3.40	8.76	18.00	5.36
73-MW30	04/08/06	1.08	9.13	18.00	8.05
73-MW31	04/08/06	8.93	12.06	12.00	3.13
73-MW31DW	04/08/06	9.00	11.85	70.00	2.85
73-MW32	04/08/06	NM	6.73	9.00	NM
73-MW32DW	04/08/06	NM	6.85	51.00	NM
73-MW33	04/08/06	NM	14.32	12.00	NM
73-MW33DW	04/08/06	10.60	14.33	56.00	3.73
73-MW34	04/08/06	7.44	12.9	17.00	5.46
73-MW34DW	04/08/06	9.55	12.57	61.00	3.02
73-MW35	04/08/06	8.30	12.89	18.00	4.59
73-MW35DW	04/08/06	10.06	13.29	61.00	3.23
73-MW36	04/08/06	NM	8.4	11.00	NM
73-MW36DW	04/08/06	NM	8.67	45.00	NM
73-MW37	04/08/06	5.70	11.12	18.00	5.42
73-MW38DW	04/08/06	5.36	8.22	110.00	2.86
73-MW39DW	04/08/06	5.30	8.06	70.00	2.76
73-MW40DW	04/08/06	2.92	5.98	70.00	3.06
73-MW41DW	04/08/06	3.30	5.83	110.00	2.53
73-MW42DW	04/08/06	2.86	5.64	110.00	2.78
73-MW43DW	04/08/06	4.55	7.52	70.00	2.97
73-MW44DW	04/08/06	5.65	8.56	70.00	2.91
73-MW45DW	04/08/06	0.92	3.33	70.00	2.41
73-MW46DW	04/08/06	6.95	10.12	75.00	3.17
73-MW47DW	04/08/06	6.19	9.17	75.00	2.98
73-MW48DW	04/08/06	5.22	8.09	75.00	2.87
73-MW49DW	04/08/06	6.32	9.67	75.00	3.35
73-MW49DWA	04/08/06	6.47	8.23	126.00	1.76
73-MW49IW	04/08/06	6.52	8.46	55.00	1.94
73-MW50DW	04/08/06	4.80	7.93	75.00	3.13
73-MW51	04/08/06	3.33	6.55	150.00	3.22
73-MW51DW	04/08/06	4.00	6.94	74.00	2.94
73-MW52	04/08/06	2.94	5.75	150.00	2.81
73-MW52DW	04/08/06	2.20	4.68	60.00	2.48
73-MW53	04/08/06	4.81	8.4	150.00	3.59
73-MW54	04/08/06	6.70	12.98	15.00	6.28
73-MW55	04/08/06	5.95	12.15	11.50	6.20
73-MW56	04/08/06	7.39	14.18	14.00	6.79
73-MW57	04/08/06	5.12	12.37	12.00	7.25
73-MW58	04/08/06	6.45	14.92	14.00	8.47
73-MW60	04/08/06	NM	13.13	22.50	NM
73-MW61	04/08/06	6.41	11.04	21.50	4.63
73-MW62DW	04/08/06	12.18	18.00	30.00	5.82
73-MW63DW	04/08/06	6.12	7.91	76.00	1.79

Notes:
NM - not measured
n.a. - not available.
ft bTOC - feet below top of casing
ft msl - feet above mean sea level
DTW - Depth to Water
TOC - Top of Well Casing

Table 4-3
Vertical Hydraulic Gradient Calculations, April 2006
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Well ID	Date	DTW (feet bgs)	TOC (feet msl)	Well Depth (feet)	Water Elevation (feet msl)	Screen Interval (feet below TOC)	Center Point of Screen (feet below TOC)	Vertical Gradient
73-MW06	04/08/06	5.22	7.32	10	2.10	3 to 10	6.5	
73-MW06IW	04/08/06	4.74	6.86	43	2.12	32 to 42	37	0.000656
73-MW13	04/08/06	3.4	8.43	18	5.03	3 to 18	10.5	
73-MW13DW	04/08/06	5.51	8.28	70	2.77	52 to 71	61.5	-0.044314
73-MW20	04/08/06	2.67	7.70	18	5.03	3 to 18	10.5	
73-MW20DW	04/08/06	4.34	7.32	53	2.98	43 to 54	48.5	-0.053947
73-MW31	04/08/06	8.93	12.06	12	3.13	2 to 12	7	
73-MW31DW	04/08/06	9.00	11.85	70	2.85	60 to 70	65	-0.004828
73-MW34	04/08/06	7.44	12.9	17	5.46	2 to 17	9.5	
73-MW34DW	04/08/06	9.55	12.57	61	3.02	51 to 61	56	-0.052473
73-MW35	04/08/06	8.3	12.89	18	4.59	3 to 18	10.5	
73-MW35DW	04/08/06	10.06	13.29	61	3.23	51 to 61	56	-0.02989

Notes:
DTW - depth to water
bgs - below ground surface
TOC - top of casing
msl - mean sea level

Source: USGS Report by Cardinell, A.P., S.A. Berg, and O.B. Lloyd, Jr. (1993)

Figure 4-1
Physiographic Provinces of Eastern North Carolina
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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N

0 2,000 4,000 Feet

1 inch = 2,000 feet

Figure 4-2
Site 73 Hydrologic Features
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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Legend

- Monitoring Well
- Abandoned Well
- Cross Section Alignment
- Base Boundary

N

0 300 600 Feet

1 inch = 300 feet

Figure 4-3
Geologic Cross Section Location Map
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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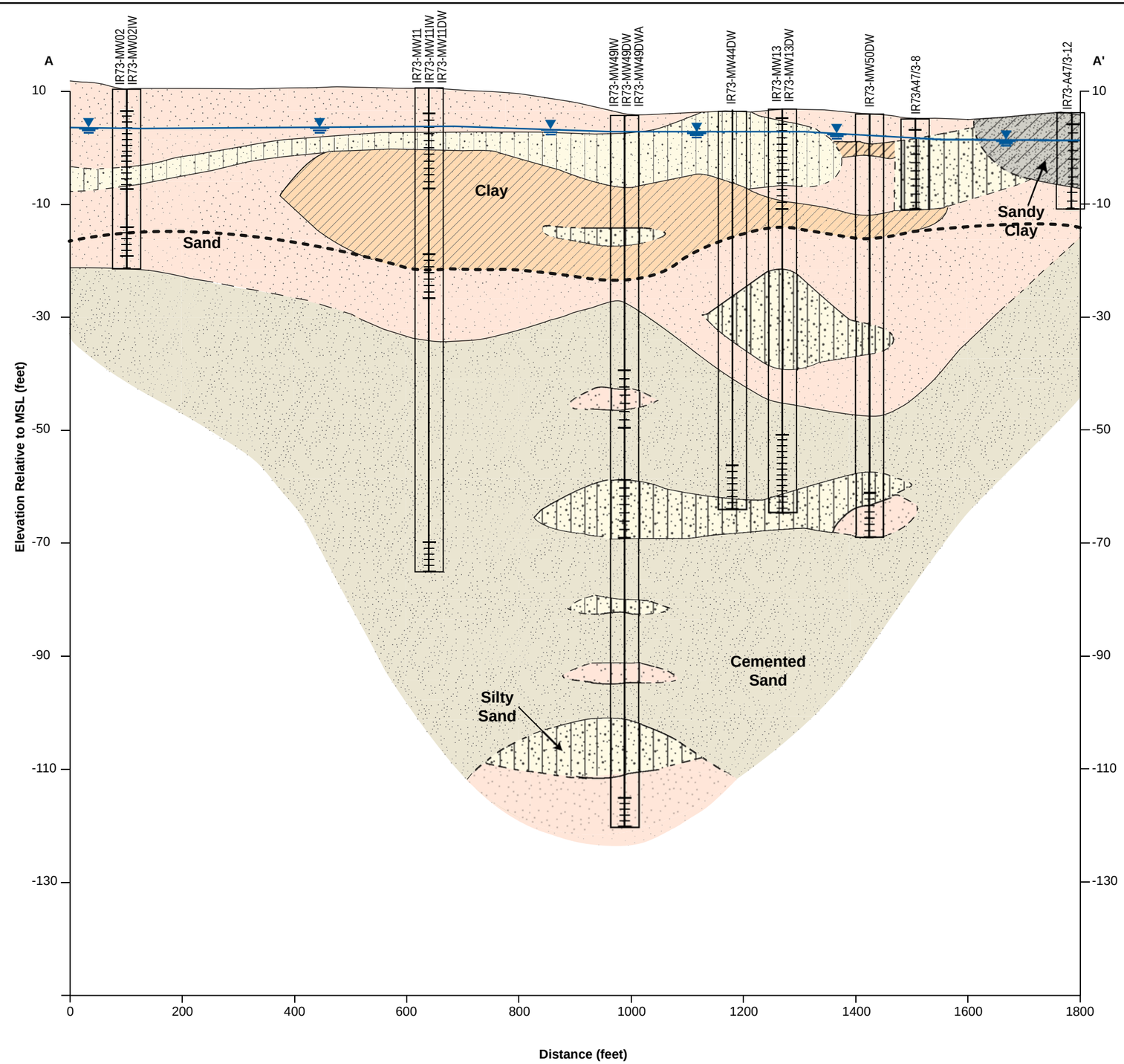

Horizontal : 1" = 200'
Vertical: 1" = 20'
V.E. = 10x

LEGEND

- Clay
- Silty Sand
- Cemented Sand
- Sand
- Sandy Clay
- Screened Interval
- Inferred Geologic Contact
- Water Table Elevation (Measured in water table wells within the Surficial aquifer)
- Inferred Surficial Aquifer/Castle Hayne Aquifer Contact

NOTE

1) The depth and thickness of the subsurface strata indicated on this section (profile) were generalized from and interpolated between test locations. Information on actual subsurface conditions apply only to the specific locations indicated. Subsurface conditions and water levels at other locations may differ from conditions occurring at the indicated locations.
2) All water levels were measured during sampling event in April 2006.

Figure 4-4
Geological Cross Section (A-A')
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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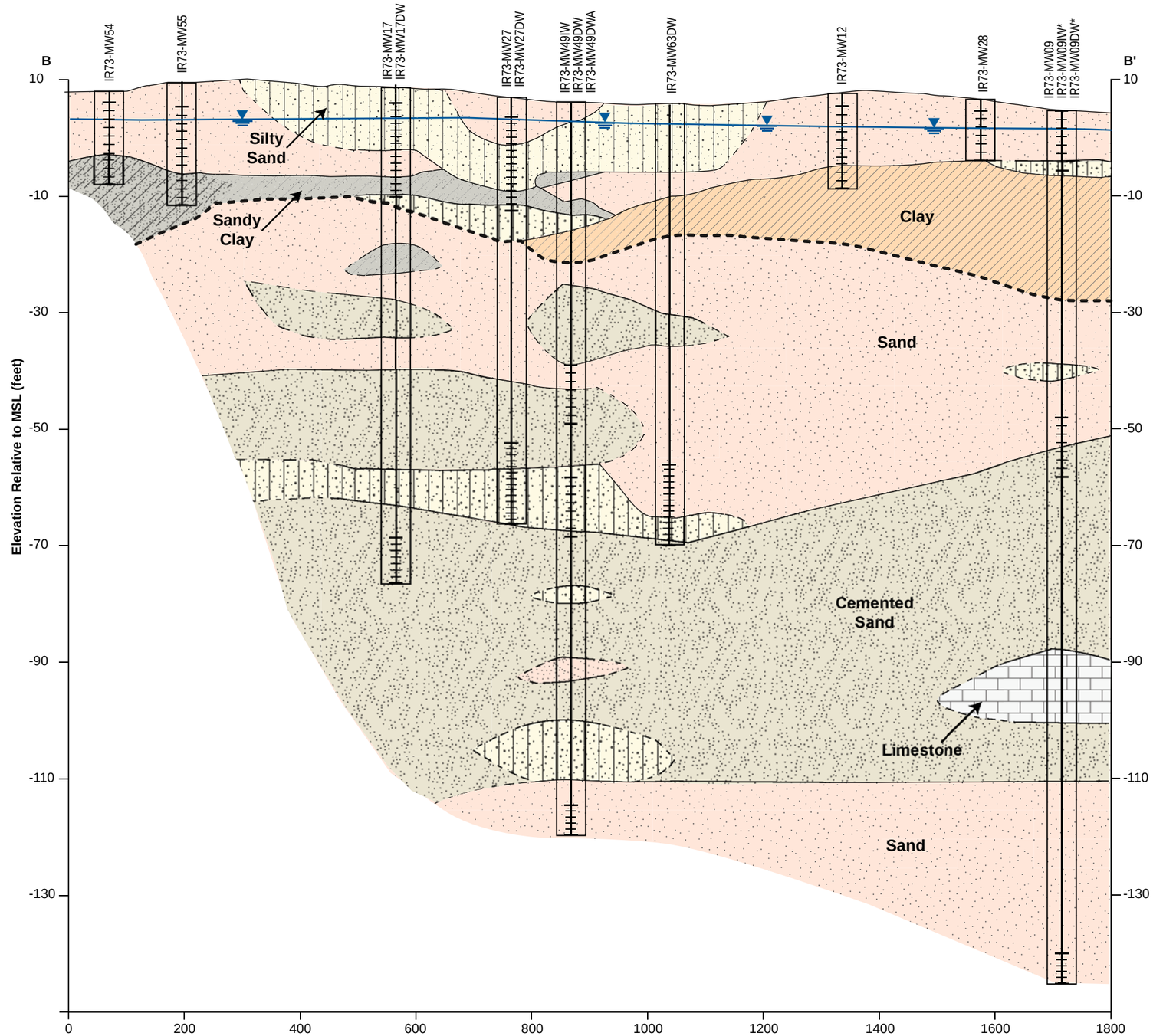

Horizontal : 1" = 200'
Vertical: 1" = 20'
V.E. = 10x

LEGEND

- Clay
- Silty Sand
- Cemented sand
- Sand
- Sandy Clay
- Limestone
- Screened Interval
- Inferred geologic contact
- Water table elevation (Measured in water table wells within the Surficial aquifer)
- Inferred Surficial aquifer/Castle Hayne aquifer contact

NOTE

1) The depth and thickness of the subsurface strata indicated on this section (profile) were generalized from and interpolated between test locations. Information on actual subsurface conditions apply only to the specific locations indicated. Subsurface conditions and water levels at other locations may differ from conditions occurring at the indicated locations.
2) All water levels were measured during sampling event in April 2006.
3) * Monitoring wells IR73-MW09IW and IR73-MW09DW abandoned prior to April 2006 sampling event.

Figure 4-5
Geological Cross Section (B-B')
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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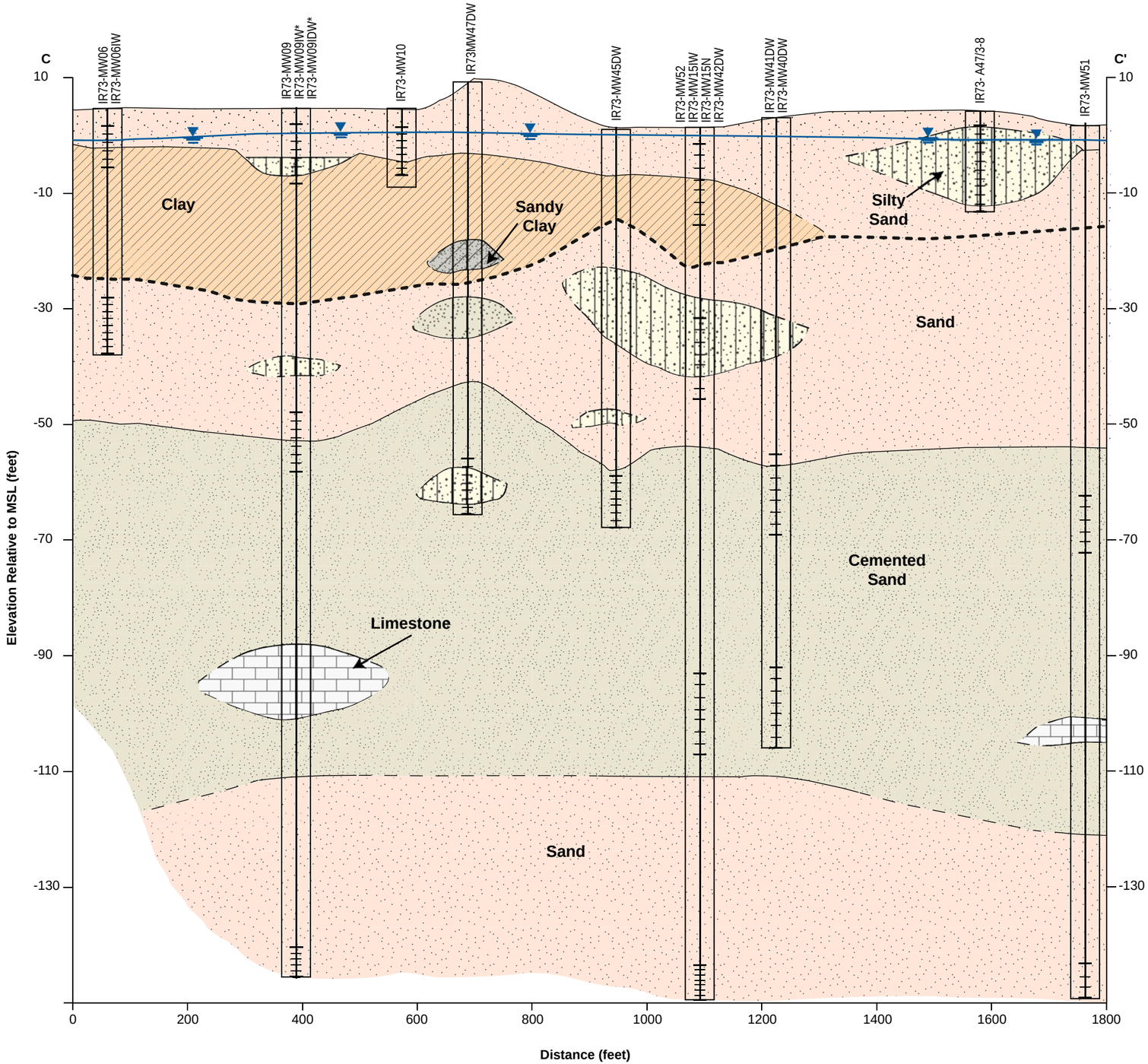

Horizontal : 1" = 200'
Vertical: 1" = 20'
V.E. = 10x

LEGEND

- Clay
- Silty Sand
- Cemented Sand
- Sand
- Sandy Clay
- Limestone
- Screened Interval
- Inferred Geologic Contact
- Water Table Elevation (Measured in water table wells within the Surficial aquifer)
- Inferred Surficial Aquifer/Castle Hayne Aquifer Contact

NOTE

1) The depth and thickness of the subsurface strata indicated on this section (profile) were generalized from and interpolated between test locations. Information on actual subsurface conditions apply only to the specific locations indicated. Subsurface conditions and water levels at other locations may differ from conditions occurring at the indicated locations.
2) All water levels were measured during sampling event in April 2006.
3) * Monitoring wells IR73-MW09IW and IR73-MW09DW abandoned prior to April 2006 sampling event.

Figure 4-6
Geological Cross Section (C-C')
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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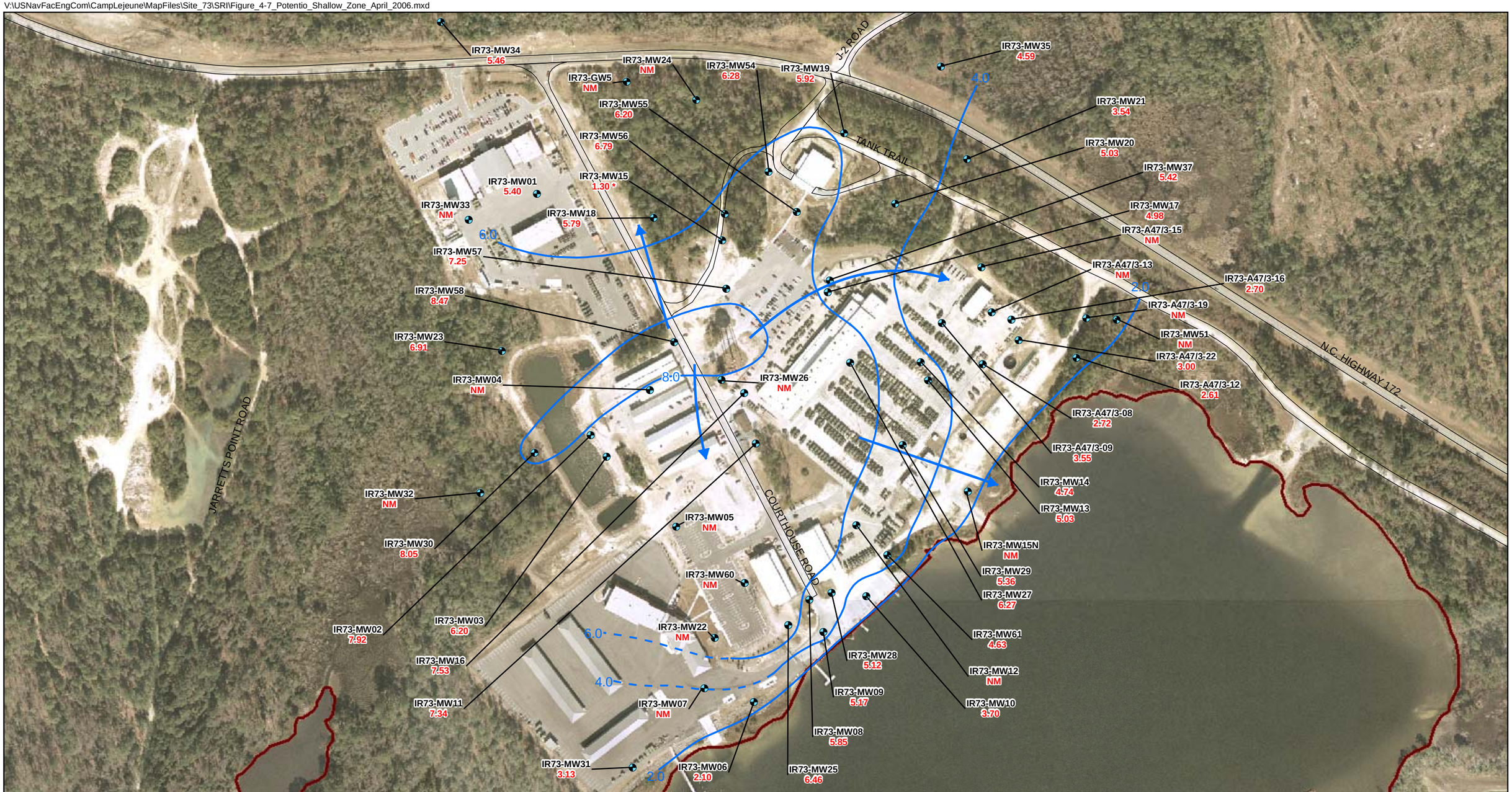

Legend

- Monitoring Wells
- Potentiometric Surface Contour (dashed where inferred)
- Base Boundary
- Direction of Groundwater Flow
- 2.10 Water level elevation

Note:
-All water level elevations are reported in feet above mean sea level.
-Potentiometric surface contours have been interpolated between monitoring well locations. Actual conditions may differ from those shown on this figure.
-NM = Not measured
-IR73-MW15 not used for contouring.

N

0 300 600 Feet

1 inch = 300 feet

Figure 4-7
Potentiometric Surface Map of Water Table, April 2006
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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Legend

- Monitoring Wells
- Potentiometric Surface Contour (dashed where inferred)
- Direction of Groundwater Flow
- Base Boundary
- 2.85 Water Level Elevation

Note:
-All water level elevations are reported in feet above mean sea level.
-Potentiometric surface contours have been interpolated between monitoring well locations. Actual conditions may differ from those shown on this figure.
-NM = Not measured

N

0 300 600 Feet

1 inch = 300 feet

Figure 4-8
Potentiometric Surface Map of Upper Castle Hayne Aquifer
(50 to 90 feet bgs), April 2006
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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Legend

- Monitoring Wells
- Base Boundary
- Potentiometric Surface Contour (dashed where inferred)
- 2.81 Water Level Elevation
- Direction of Groundwater Flow

Note:
-All water level elevations are reported in feet above mean sea level.
-Potentiometric surface contours have been interpolated between monitoring well locations. Actual conditions may differ from those shown on this figure.
-NM = Not measured

N

0 150 300 600 Feet

1 inch = 300 feet

Figure 4-9
Potentiometric Surface Map of Lower Castle Hayne Aquifer
(150 feet bgs) Aquifer, April 2006
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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SECTION 5

Nature and Extent of Contamination

This section discusses the nature and extent of contamination at Site 73. The discussion is organized into two parts. Section 5.1 discusses how the data are presented and evaluated and defines the various criteria used to compare the concentration of compounds and analytes found in site media. The results of the sampling activities are described in Section 5.2.

5.1 Data Presentation and Evaluation

5.1.1 Data Presentation

Detected concentrations for each parameter for each group of samples are listed in tables at the end of this section. These tables summarize the maximum concentrations along with the detection frequency for each group of samples. The tables also identify those results that exceed selected regulatory and human-health based criteria. This comparison is not a means of screening out potential contaminants from further consideration; that step is performed in the HHRA in Section 7. The purpose of this comparison is to help focus the subsequent discussions concerning nature and extent on those compounds that are likely to be most significant.

Figures are also presented, where appropriate, to show analyte detections in groundwater exceeding relevant comparison criteria. Additionally, contaminant isoconcentration maps are presented in plan and cross-sectional views to show the distribution of the primary groundwater contaminants across the Site.

Groundwater sampling sheets, complete analytical results from off-site laboratories, chain-of-custody forms and data validation reports for the SRI are provided in **Appendices D, E,** and **F.**

5.1.2 Regulatory Comparison Criteria

Analytical results for soil and groundwater samples collected during the SRI were compared against regulatory standards or criteria. As discussed in Section 5.1.1, this comparison was performed to evaluate nature and extent of contamination and not to eliminate compounds from further consideration.

Soil results from the DPT assessment were compared to NC Action Levels for TPH and O&G. The State of North Carolina, through the *Groundwater Section Guidelines for the Investigation and Remediation of Soil and Groundwater*, establishes a series of Action Levels that are appropriate for the purpose of classifying contaminated soil associated with non UST-related spills or releases. NC Action Levels are intended as guidance for remedial actions. NC Action Levels for TPH and O&G are 40 mg/kg and 250 mg/kg, respectively.

Groundwater analytical data were compared to both NCGWQS and federal maximum contaminant levels (MCLs), as these are the enforceable regulatory standards.

Table 5-1 lists the chemical-specific regulatory criteria used to evaluate results for groundwater. Brief explanations of the general classes of criteria are provided below.

- **North Carolina Groundwater Quality Standards –** The State of North Carolina, through rules of Subchapter 2L of the North Carolina Administrative Code Title 15A, establishes a series of classifications and water quality standards that are appropriate for the purpose of classifying groundwater in the state. NCGWQS are enforceable standards intended to provide a guidance level in preventing groundwater pollution above naturally occurring levels of specified chemical constituents and are based upon what is considered naturally occurring. The goal is to preserve and protect present and anticipated uses of groundwater.
- **MCLs for Groundwater –** MCLs are enforceable standards promulgated under the Safe Drinking Water Act for public water supplies consumed by a minimum of 25 persons. The MCLs are designed for the protection of human health, based on laboratory or epidemiological studies. They are designed to prevent adverse human health effects associated with a 70-year lifetime exposure for an average adult (70 kg) consuming two liters of water per day. Contaminants exceeding MCLs must be treated or removed from the public water supply prior to its potable use.

5.1.3 Comparison to Background Concentrations

Background soil and groundwater concentrations were addressed for MCB Camp Lejeune as part of the base-wide *Background Investigation Report* (CH2M HILL, 2001). The objective of the background investigation was to establish background concentrations of metals, pesticides, and PAHs in surface and subsurface soil and groundwater for comparison to IRP site data to better identify release-related constituents of concern.

Base-wide background groundwater and soil quality was established for the Background Investigation Report by collecting samples from non-impacted areas that represent the underlying geologic conditions at MCB Camp Lejeune and areas indicative of anthropogenic background conditions. Base-wide background data for surface soil, subsurface soil, and groundwater are provided in **Appendix G**. Comparisons of Base-wide background and site data were performed on both a population to population basis and by comparing site maximums to background 95-percent upper tolerance limits in accordance with the procedures outlined in the referenced Base-wide background report.

5.2 Site 73 SRI Sampling Results

5.2.1 Groundwater

Groundwater samples were obtained from 78 monitoring wells in April 2006 as part of the SRI field activities, as described in Section 3. The target parameters are listed in **Table 5-1**. **Table 5-2** lists groundwater quality parameters measured during field sampling activities. Analytical results are presented in **Tables 5-3** and **5-4.**

VOCs

Sixteen VOCs were detected above method detection limits in both the surficial and Castle Hayne aquifers during the April 2006 field activities including: 1,1-DCE, 1,4-dichlorobenzene, benzene, carbon disulfide, chlorobenzene, cis-1,2-DCE, cyclohexane, ethylbenzene, isopropylbenzene, methylcyclohexane, methylene chloride, toluene, trans-1,2-DCE, TCE, VC, and total xylenes. Of the 16 VOCs detected, concentrations of benzene, TCE, 1,1-DCE, cis-1,2-DCE and VC exceeded the NCGWQS and/or MCLs in one or more of the monitoring wells.

In general, the greatest concentrations of dissolved-phase VOCs are located beneath the paved area adjacent to Building A47. Contaminants detected in the surficial aquifer (TCE, VC, and benzene) appear to originate in the northeast portion of the concrete pad, in the vicinity of UST A47-3. The greatest concentrations of contaminants detected in the Castle Hayne aquifer (TCE, 1,1-DCE, cis-1,2-DCE, VC, and benzene) were generally found in samples collected from IR73-MW44DW or IR73-MW49DW, located between Building A47 and the approximate footprint of the former Maintenance Building (A-3) and in the vicinity of UST A47-1.

TCE and cis-1,2-DCE were detected above their respective NCGWQS in multiple samples collected from monitoring wells screened in the Castle Hayne aquifer. The maximum lateral extent of TCE and cis-1,2-DCE impacts at all monitored depths are shown in **Figures 5-1** and **5-5**, respectively. The greatest TCE concentration, 840 µg/L, was detected in a sample collected from monitoring well IR73-MW49DW, and the greatest cis-1,2-DCE concentration was detected at monitoring well IR73-MW49IW at 1,300 µg/L. See **Figures 5-2** through **5-4** (A-A′, B-B′, and C-C′) for cross sectional views of the TCE plume and **Figures 5-6** through **5-8** for cross sectional views of the cis-1,2-DCE plume. The plume cross sections verify that the maximum vertical extent of impacted groundwater has been delineated. TCE was detected above its NCGWQS in only one shallow monitoring well, IR73-A47/3-9, at a concentration of 3.1 µg/L. Cis-1,2-DCE was not detected above its NCGWQS in any shallow monitoring wells.

1,1-DCE was detected at concentrations greater than its NCGWQS of 7 µg/L in two groundwater samples collected from monitoring wells screened in the Castle Hayne aquifer (IR73-MW44DW at a concentration of 21 µg/L and IR73-MW49DW at concentration of 13 µg/L). Both of these wells are located in the paved parking area between Building A47 and the approximate footprint of the former maintenance building.

VC was the most prevalent CVOC detected above NCGWQS during the SRI sampling, with five samples exceeding standards in the surficial aquifer and 14 samples exceeding standards in the Castle Hayne aquifer. **Figure 5-9** shows the maximum lateral extent of VC concentrations in the surficial and Castle Hayne aquifers. **Figures 5-10, 5-11,** and **5-12** provide cross-sectional views of the VC plume.

In the surficial aquifer, exceedances of the VC NCGWQS were detected as far north as monitoring well IR73-A47/3-9, near Building SA52 and as far south as monitoring well IR73-MW09. The maximum concentration of VC within the surficial aquifer was reported at monitoring well IR73-MW13 (7.8 µg/L), which is located in the center of the concrete covered area east of Building A47. In the Castle Hayne aquifer, VC exceedances of the NCGWQS were limited to the area between Building A47, Courthouse Bay, Courthouse Bay

Road, and the wooded perimeter. The maximum concentration of VC within the Castle Hayne aquifer was reported at monitoring well IR73-MW44DW (130 µg/L), which is located between Building A47 and Courthouse Bay.

Benzene was detected at concentrations above the NCGWQS of 1 µg/L in three monitoring wells screened in the surficial aquifer and nine monitoring wells screened in the Castle Hayne aquifer. The distribution of benzene within the surficial aquifer is limited to the eastern corner of the paved area located adjacent and east Building A47 (**Figure 5-13**). Detectable concentrations of benzene in the Castle Hayne aquifer extend from the paved area associated with Building A47 to Courthouse Bay, and are most highly concentrated between Building A47 and the approximate location of the former maintenance building and in the suspected vicinity of UST A47-1 (**Figure 5-13**). The greatest benzene concentration was detected in the Castle Hayne aquifer at monitoring well IR73-MW44DW at a concentration of 8.9 µg/L. Benzene was detected as deep as 150 ft bgs in monitoring well IR73-MW52DW, albeit at a concentration below the NCGWQS. Cross sectional views of the maximum vertical extent of the benzene plume are provided in **Figures 5-14, 5-15,** and **5-16**.

Analytical results from groundwater samples collected from monitoring wells screened in the Castle Hayne aquifer indicate that the vertical extent of contamination has been delineated at Site 73.

VOC Contaminant Trends

Data collected during the LTM program by Baker and current groundwater analytical data derived from monitoring wells IR73-MW39DW, IR73-MW44DW, and IR73-MW49DW are plotted on **Figures 5-17**, **5-18**, and **5-19**, respectively. Each figure shows a considerable decrease in TCE and cis-1,2-DCE over time and a corresponding increase in VC, indicating that reductive dechlorination is taking place at Site 73. **Figure 5-17** also shows that the benzene concentration at IR73-MW39DW is gradually approaching the NCGWQS.

Natural Attenuation Indicator and Other Wet Chemistry Parameters

During the April 2006 SRI sampling event, field measurements and groundwater samples were collected from 78 monitoring wells in order to evaluate the geochemical characteristics of the surficial and Castle Hayne aquifers. Field measurements collected during the purging of the wells included DO and ORP, as shown on **Table 5-2**. Additionally, groundwater samples were collected and submitted for laboratory analysis of geochemical parameters that included nitrate, nitrite, sulfate, sulfide, chloride, ferric iron, ferrous iron, total (unfiltered) iron, TOC, methane and alkalinity. Concentration trends in the geochemical parameters can be used to evaluate whether biodegradation of the VOCs is occurring.

A summary of NAIPs from the April 2006 groundwater monitoring event is provided in **Table 5-5.** Data collected from monitoring wells IR73-MW37 (source area), IR73-MW55 (source area), IR73-A47/3-12 (side gradient) and IR73-MW09 (downgradient) will be used to assess surficial aquifer trends. Data collected from monitoring wells IR73-MW20DW (upgradient), IR73-MW49DW (source area), IR73-MW13DW (source area), IR73-MW41DW (side gradient) and IR73-MW47DW (downgradient) will be used to assess Castle Hayne aquifer trends. Trends for specific groundwater geochemical parameters, including alkalinity, chloride, methane, ferrous iron, and TOC for the surficial aquifer and chloride,

methane, and alkalinity for the Castle Hayne aquifer are plotted on **Figures 5-20** and **5-21** and are discussed in detail below.

ORP. ORP is an indicator of electron activity in groundwater. Biological processes generally occur within a prescribed ORP range (USEPA, 1998). As microbial activity depletes available electron acceptors, ORP decreases. ORP measurements less than +50 millivolt (mV) are indicative of conditions favorable to reductive dechlorination; however ORP measurements less than -100 mV are considered ideal.

ORP measurements are, in general, negative across the site, ranging from -251 mV to +246 mV in the surficial aquifer, with 34 of 42 measurements less than +50 mV and 23 of 42 measurements less than -100 mV. ORP measurements for the Castle Hayne aquifer ranged from -315 mV to +59 mV, with 35 of 36 measurements less than +50 mV and 27 of 36 measurements less than -100 mV. In general, groundwater samples with ORP measurements greater than 50 mV were collected from monitoring wells located around the perimeter of the site and not within the vicinity of groundwater impacts. These results suggest that conditions are favorable for reductive dechlorination in both the surficial and Castle Hayne aquifer within the areas of greatest contamination.

DO. DO concentrations were measured during purging of each monitoring well to assess whether anaerobic conditions are present in the aquifer. Generally, DO concentrations below 1.0 mg/L are considered to be indicative of anaerobic conditions. Chlorinated hydrocarbons (including TCE, and its daughter products cis-1,2-DCE, and VC) can be degraded by the microbially–mediated process of reductive dechlorination. As the DO is depleted within the aquifer, other electron acceptors such as nitrate, ferrous iron, and sulfate may be used by microorganisms to facilitate reductive dechlorination reactions.

The DO concentrations recorded during the April 2006 groundwater sampling event indicate that both aerobic and anaerobic conditions exist in the surficial and Castle Hayne aquifers at Site 73. During the April 2006 groundwater sampling event, DO concentrations recorded within the surficial aquifer ranged from <0.01 mg/L in 24 monitoring wells to 8.77 mg/L at IR73-MW58; and DO concentrations recorded within the Castle Hayne aquifer ranged from <0.01 mg/L in 23 monitoring wells to 3.37 mg/L at IR73-MW33DW. The aerobic regions of the surficial aquifer are generally not located within the extent of the plume and may be due to the replenishment of DO in the aquifer by rainwater that infiltrates through the vadose zone to recharge the aquifer. Aerobic conditions generally do not exist within the extent of the plume in the Castle Hayne aquifer. Further, degradation daughter products were present within the surficial and Castle Hayne aquifers during the April 2006 groundwater sampling event suggesting that anaerobic conditions may be facilitating the reductive dechlorination of CVOCs.

Nitrate. Nitrate can be used as an electron acceptor for anaerobic degradation of CVOCs after the DO is depleted in the aquifer. Nitrate also competes as an electron acceptor in the reductive dechlorination process. Nitrate concentrations should typically be less than 1.0 mg/L in order for reductive dechlorination reactions to occur. In addition, nitrite concentrations would be expected to increase in areas where nitrate reduction is occurring.

Within the surficial aquifer, nitrate was reported to be present in the groundwater samples collected from 16 of 42 monitoring wells during the April 2006 groundwater sampling

event, with concentrations ranging from less than 0.13 mg/L in multiple monitoring wells to 3 mg/L at monitoring well IR73-MW58. Nitrate concentrations were typically less than 1.0 mg/L in the surficial aquifer. Groundwater samples exhibiting nitrate concentrations greater than 1.0 mg/L were collected from wells located outside of the extent of the surficial aquifer plume. Nitrite was detected at concentrations greater than the corresponding nitrate concentration in 20 of 42 wells. Therefore, within the surficial aquifer, the low concentrations of nitrate and corresponding presence of nitrite may indicate that conditions are favorable for the reductive dechlorination of CVOCs.

Within the Castle Hayne aquifer, nitrate was reported to be present in 10 of the 36 groundwater samples collected from Site 73 monitoring wells during the April 2006 groundwater sampling event, with concentrations ranging from less than 0.13 mg/L in multiple monitoring wells to 2.2 mg/L at monitoring well IR73-MW06IW. Nitrate was detected at a concentration above 1.0 mg/L in only two wells screened in the Castle Hayne aquifer, which are located adjacent to Courthouse Bay. Nitrite was detected in 18 of the 36 wells, and exceeded the corresponding nitrate concentration in 13 of the 30 wells. Similar to the surficial aquifer, the generally low concentrations of nitrate and corresponding presence of nitrite may indicate that conditions are favorable for the reductive dechlorination of CVOCs in the Castle Hayne aquifer.

Ferrous Iron. Ferrous iron (Fe[II]) is produced by the reduction of ferric iron, a common constituent of soil and rock. Measurable levels of Fe(II) in groundwater indicate a reducing environment favorable to reductive dechlorination. Fe(II) was detected in 19 of 42 wells in the surficial aquifer and in 4 of 36 wells in the Castle Hayne aquifer. **Figure 5-20** shows the geochemical trend downgradient in the surficial aquifer. The source area has the greatest concentration of measurable Fe(II), with decreasing concentrations side and downgradient. These results indicate that a favorable environment for reductive dechlorination may exist in the surficial aquifer, but generally does not exist in the Castle Hayne aquifer.

Sulfate. Sulfate may also be used by soil microorganisms as an electron acceptor in hydrocarbon biodegradation within aquifers. Decreasing concentrations of the sulfate ion may indicate degradation of hydrocarbons by sulfate reduction. During sulfanogenesis, sulfates are reduced to sulfide as microorganisms oxidize carbon. Sulfate concentrations are generally less than 20 mg/L in order for reductive dechlorination to occur. In addition, sulfide concentrations would increase within the aquifer when sulfate reduction is occurring. However, sulfide will preferentially precipitate with available dissolved metals (for example, ferrous iron) before remaining dissolved in groundwater.

Within the surficial aquifer, sulfate concentrations during the April 2006 groundwater sampling event were less than 20 mg/L in 21 of the 46 wells sampled, with concentrations ranging from less than 5 mg/L in multiple monitoring wells to 130 mg/L in monitoring wells IR73-MW27 and IR73-MW31. Groundwater samples collected from wells within the extent of the surficial aquifer plume generally exhibited concentrations below 20 mg/L. Sulfide was detected at low concentrations in 5 of the 46 wells sampled. These results indicate that limited sulfanogenesis may be occurring.

Within the Castle Hayne aquifer, sulfate concentrations were less than 20 mg/L in 29 of 36 wells sampled, with concentrations ranging from less than 5 mg/L in multiple monitoring wells to 66 mg/L in monitoring well IR73-MW34DW during the April 2006

groundwater sampling event. Several of the samples in which the sulfate concentration exceeded 20 mg/L were collected from monitoring wells associated with the greatest contaminant concentrations in the Castle Hayne aquifer. Further, sulfide was not detected in any wells screened in the Castle Hayne aquifer. These results suggest that conditions may be favorable for reductive dechlorination, although the high sulfate concentrations may inhibit the subsequent formation of methanogenic conditions (optimal for reductive dechlorination). This may be the reason for persistently high contaminant concentrations, i.e. sulfate inhibition prevents the full degradation to ethane.

Methane. The production of methane (methanogenesis) is observed at sites where reductive dechlorination is actively occurring. The average background concentrations of methane at Site 73 were 0.09 mg/L and 0.1 mg/L in the surficial and Castle Hayne aquifers, respectively (CH2M HILL, Baker, CDM, 2002). This alone is indicative that reducing and methanogenic conditions are common in the vicinity of Site 73.

During the SRI, methane levels at Site 73 ranged from less than 0.014 mg/L to 7.5 mg/L in the surficial aquifer and from less than 0.014 mg/L to 5 mg/L in the Castle Hayne aquifer. Elevated concentrations of methane extend across the site. As shown on **Figures 5-20** and **5-21**, source area monitoring wells contain the greatest concentrations of methane. Monitoring wells yielding groundwater with measurable concentrations of daughter products typically also yielded elevated concentrations of methane, providing evidence that reductive dechlorination is likely occurring due to methanogenic conditions.

Alkalinity. Elevated alkalinity (i.e., more than twice background) is indicative of elevated levels of carbon dioxide generated by the biodegradation of fuel-related contamination and natural organic material (USEPA, 1998; Wiedemeier et al., 1996). The average background concentration of bicarbonate/carbonate alkalinity is 4 mg/L in both the surficial and Castle Hayne aquifers (CH2M HILL, Baker, CDM, 2002).

In the surficial aquifer, alkalinity concentrations range from less than 20 mg/L to 670 mg/L, showing no particular correlation to VOC concentration. In the Castle Hayne aquifer, alkalinity concentrations range from less than 20 mg/L to 470 mg/L. Monitoring wells exhibiting elevated concentrations of benzene, cis-1,2-DCE and/or VC generally also exhibited elevated alkalinity concentrations. These results indicate that the degradation of fuel-related contamination and natural organic material is taking place in the Castle Hayne aquifer.

TOC. TOC is a measure of the amount of available substrate (carbon source) material. TOC levels supportive of natural attenuation typically are 20 mg/L or greater (USEPA, 1998; Wiedemeier et al, 1996).

Within the surficial aquifer, TOC concentrations range from less than 10 mg/L to 230 mg/L, with 18 of 42 results exceeding 20 mg/L. **Figure 5-20** shows measurable TOC levels in the trending wells in the surficial aquifer. Based on the presence of TOC at concentrations greater than 20 mg/L in approximately 40 percent of the samples, there appears to be sufficient substrate to support the dechlorination process in portions of the surficial aquifer.

Within the Castle Hayne aquifer, TOC concentrations range from less than 10 mg/L to 65 mg/L. TOC was detected in only three of the wells sampled and exceeded 20 mg/L in

just one sample. Based on the absence of TOC in all but three samples, there does not appear to be sufficient substrate to support the dechlorination process in the Castle Hayne aquifer.

Chloride. Like the geochemical indicators presented above, chloride concentrations greater than background concentrations are indicative that reduction of chlorinated solvent-related contamination is occurring (USEPA, 1998; Wiedemeier et al, 1996). The average chloride concentration detected in background wells in the surficial aquifer was 27 mg/L and in the Castle Hayne aquifer was 13.7 mg/L (CH2M HILL, Baker, CDM, 2002).

During the April 2006 groundwater sampling event, chloride concentrations ranged from 10 mg/L to 580 mg/L in the surficial aquifer, with 27 of 42 wells sampled exhibiting chloride concentrations greater than background, and from 13 mg/L to 1,300 mg/L in the Castle Hayne aquifer, with 35 of 36 wells sampled exhibiting chloride concentrations greater than background.

These results suggest that reductive dechlorination is prevalent across the site; monitoring wells exhibiting the greatest chloride concentrations generally do not correspond to particularly high VOC concentrations in either aquifer. This could indicate that reductive dechlorination has already occurred, and chloride is the only degradation byproduct remaining, or that seawater is intruding into the aquifers.

Summary. Analysis of the above geochemical parameters indicates that conditions are favorable for natural attenuation and that natural attenuation is ongoing in both the surficial and Castle Hayne aquifers. Both fuel-related hydrocarbons and chlorinated solvents are capable of being attenuated by natural processes in each aquifer. These conclusions are consistent with the Natural Attenuation Evaluation Report (CH2M HILL, Baker, CDM, 2002).

5.2.2 Soil Sampling

Of the 30 soil borings installed during the October 2005 soil investigation, free product was detected in only one boring, IS-112, located approximately 50 feet southwest of monitoring well IR73-MW14. The January 2008 phase of investigation did not encounter free product. Product sheen was also observed in three borings (IS-124, IS-125, and IS-127) located approximately 150 feet to 175 feet northwest of monitoring well IR73-MW14 (**Figure 3-1**).

Analytical results indicated the presence of O&G in all 24 of the soil samples submitted for analysis. TPH-DRO constituents were also detected in 21 of the 24 analyzed soil samples. Of the O&G and TPH-DRO detections, thirteen of the soil samples were reported to contain TPH-DRO and/or O&G concentrations in excess of the applicable NC Action Levels. TPH-DRO was detected at a maximum concentration of 2,120 mg/kg (IS-105) and O&G was detected at a maximum concentration of 26,400 mg/kg (IS-108).

Analytical results from the January 2008 phase of investigation reported the presence of O&G and TPH-DRO in six of the eight analyzed soil samples (**Figure 3-1**). Of the O&G and TPH-DRO detections, five of the soil samples contained concentrations of TPH-DRO and/or O&G in excess of applicable NC Action Levels. TPH-DRO was detected at a maximum concentration of 3,300 mg/kg (IS-135) and O&G was detected at a maximum concentration of 1,500 mg/kg (IS-132). **Table 5-6** contains a summary of the analytical results from the two field events.

5.2.3 Surface Water and Sediment

As discussed in Section 2.5.3, RI activities completed by Baker between 1995 and 1996 included surface water and sediment sampling in Courthouse Bay and its surrounding tributaries. The original RI concluded that Courthouse Bay has not been impacted by CVOCs or by benzene detected in groundwater at Site 73. Therefore, impact to surface water and sediment was not evaluated in the SRI.

Table 5-1
Analytical Parameters and Water Quality Standards
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Chemical Name	CAS Number	NCGWQS [1] (µg/L)	MCL-Groundwater [2] (µg/L)
Volatile Organic Compounds (µg/L)			
1,1-Dichloroethene	75-35-4	7	7
1,4-Dichlorobenzene	106-46-7	1.4	75.0000
Benzene	71-43-2	1	5.0000
Carbon disulfide	75-15-0	700	--
Chlorobenzene	108-90-7	50	100
Cyclohexane	110-82-7	--	--
Ethylbenzene	100-41-4	550	700
Methylcyclohexane	108-87-2	--	--
Methylene chloride	75-09-2	4.6	5
Toluene	108-88-3	1,000	1,000
Trichloroethene	79-01-6	2.8	5
Vinyl chloride	75-01-4	0.015	2
Xylene, total	1330-20-7	530	10,000
cis-1,2-Dichloroethene	156-59-2	70	70
isopropylbenzene	98-82-8	70	--
trans-1,2-Dichloroethene	156-60-5	100	100
Total Metals (µg/L)			
Iron	7439-89-6	300	--
Natural Attenuation Parameters (mg/L)			
Alkalinity	471-341	--	--
Chloride	16887-00-6	250	--
Ferric iron	--	--	--
Ferrous iron	--	--	--
Nitrate	14797-55-8	10	10
Nitrite	14797-65-0	1	1
Sulfate	14808-79-8	250	--
Sulfide	18496-25-8	--	--
Total organic carbon (TOC)	--	--	--
Natural Attenuation Parameters (µg/L)			
Methane	74-82-8	--	--

Notes:
[1] North Carolina Groundwater Quality Standards
[2] Federal Maximum Contaminant Levels for Drinking Water
µg/L = micrograms per liter
mg/L = milligrams per liter

Table 5-2
Summary of Groundwater Quality Parameters April 2006
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Well ID	Date (mm/dd/yy)	Temperature (^{0}C)	pH (SU)	Conductivity (mS/cm)	DO (mg/L)	ORP (mV)	Ferrous Iron (mg/L)	Turbidity (NTU)
Site 73								
IR73-A47/3-8	04/10/06	19.20	8.31	0.920	0.00	-101	3.4	6.47
IR73-47/3-22	04/19/06	17.02	9.06	1.600	0.30	-47	4.0	86.60
IR73-A47/3-12	04/12/06	18.25	7.06	0.415	0.00	-137	5.0	5.92
IR73-A47/3-15	04/12/06	17.33	6.66	0.364	0.00	-124	4.4	10.90
IR73-A47/3-16	04/19/06	16.40	6.57	1.000	0.00	-96	3.0	1.40
IR73-A47/3-19	04/19/06	17.10	6.30	0.510	0.00	-76	0.5	4.56
IR73-A47/3-9	04/09/06	19.89	5.32	0.082	0.00	-149	3.2	4.41
IR73-MW01	04/10/06	18.00	5.01	0.280	0.98	51	4.0	4.75
IR73-MW01DW	04/10/06	19.14	9.20	0.106	3.12	11	0.0	4.21
IR73-MW01IW	04/10/06	19.45	11.51	0.031	2.78	-115	2.2	2.09
IR73-MW02	04/11/06	18.00	6.86	0.320	0.00	-135	1.0	6.61
IR73-MW02IW	04/11/06	19.17	10.48	0.057	2.46	-66	1.0	8.33
IR73-MW03	04/11/06	16.13	11.90	0.276	1.58	-126	4.0	3.15
IR73-MW06	04/12/06	17.12	9.91	0.621	1.91	-81	4.0	8.07
IR73-MW06IW	04/12/06	20.70	7.34	0.330	0.00	-142	0.0	1.51
IR73-MW08	04/18/06	17.73	8.99	0.105	1.81	-58	NM	0.68
IR73-MW09	04/18/06	20.72	9.36	0.145	0.49	-71	1.0	0.36
IR73-MW10	04/20/06	21.30	10.96	0.454	0.00	-109	1.0	8.23
IR73-MW11	04/10/06	16.90	8.64	0.174	0.00	-131	1.5	1.79
IR73-MW11DW	04/11/06	19.60	10.09	0.370	0.00	-124	0.3	1.77
IR73-MW11IW	04/10/06	19.50	9.57	0.178	0.00	-164	4.0	4.07
IR73-MW12	04/10/06	18.53	6.58	0.245	0.00	-184	1.0	2.11
IR73-MW13	04/09/06	19.00	7.61	0.270	0.00	-136	2.0	1.16
IR73-MW13DW	04/09/06	20.40	8.78	0.619	0.00	-129	3.0	0.40
IR73-MW15	04/12/06	16.70	10.02	1.620	0.00	-115	5.0	11.50
IR73-MW15IW	04/19/06	19.21	9.60	0.238	1.02	-84	1.0	0.00
IR73-MW15N	04/12/06	16.29	6.06	NM	0.36	-79	5.6	4.43
IR73-MW16	04/09/06	16.09	13.80	0.237	2.54	-191	3.0	1.20
IR73-MW17	04/09/06	19.33	6.83	0.655	0.00	-206	1.6	1.79
IR73-MW17DW	04/09/06	21.12	8.32	0.165	0.00	-213	1.0	1.74
IR73-MW18	04/18/06	16.38	9.39	0.138	0.38	-68	NM	3.14
IR73-MW19	04/11/06	17.26	6.54	1.750	0.00	-180	3.6	48.60

Table 5-2
Summary of Groundwater Quality Parameters April 2006
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Well ID	Date (mm/dd/yy)	Temperature (^{0}C)	pH (SU)	Conductivity (mS/cm)	DO (mg/L)	ORP (mV)	Ferrous Iron (mg/L)	Turbidity (NTU)
Site 73								
IR73-MW20	04/19/06	15.36	11.52	0.087	1.00	-157	1.5	0.50
IR73-MW20DW	04/19/06	18.00	7.42	0.380	0.28	-119	0.0	0.44
IR73-MW21	04/21/06	15.50	5.07	0.248	0.00	164	4.0	47.50
IR73-MW23	04/11/06	15.80	4.19	0.120	0.00	188	1.2	3.90
IR73-MW25	04/12/06	16.50	10.75	0.126	3.39	-121	4.0	4.39
IR73-MW26DW	04/19/06	21.00	13.11	2.350	0.00	-208	0.8	1.94
IR73-MW27	04/09/06	18.39	NM	0.382	2.14	-251	0.0	0.00
IR73-MW27DW	04/09/06	21.20	6.85	0.840	0.00	-87	0.0	11.60
IR73-MW28	04/20/06	17.56	8.56	0.141	0.79	-101	1.0	2.01
IR73-MW29	04/09/06	19.10	6.64	0.180	3.39	76	0.0	16.40
IR73-MW30	04/11/06	15.50	5.20	0.140	0.30	-30	1.0	3.12
IR73-MW31	04/12/06	19.30	6.58	0.770	0.00	64	0.0	0.59
IR73-MW31DW	04/12/06	20.09	12.71	0.216	2.96	-197	0.0	0.49
IR73-MW33DW	04/10/06	19.31	9.78	0.060	3.37	7	0.0	4.41
IR73-MW34	04/21/06	16.70	5.54	0.096	0.00	136	> 10	710
IR73-MW34DW	04/21/06	18.30	6.45	0.320	0.27	-32	0.0	2.65
IR73-MW35	04/20/06	16.70	4.82	0.120	0.41	246	NM	3.60
IR73-MW35DW	04/20/06	18.60	12.47	0.232	0.46	-169	NM	1.09
IR73-MW37	04/09/06	19.17	5.42	0.289	0.00	-139	2.4	4.57
IR73-MW38DW	04/09/06	19.90	7.44	0.410	0.00	-112	0.0	49.40
IR73-MW39DW	04/09/06	19.52	12.55	0.379	2.18	-116	0.0	1.20
IR73-MW40DW	04/20/06	21.21	7.93	0.188	0.00	-163	1.0	1.49
IR73-MW41DW	04/20/06	19.48	8.92	0.486	0.00	-118	2.0	2.96
IR73-MW42DW	04/18/06	19.87	7.40	0.446	0.22	-175	NM	1.77
IR73-MW43DW	04/09/06	20.38	7.56	0.324	0.00	-153	0.8	2.26
IR73-MW44DW	04/09/06	21.19	7.07	0.465	0.00	-146	3.6	9.17
IR73-MW45	04/18/06	18.51	10.94	0.221	0.45	-131	1.0	7.47
IR73-MW46DW	04/12/06	19.84	8.00	0.200	0.00	-99	0.2	5.43
IR73-MW47DW	04/20/06	20.80	7.53	0.530	0.00	-97	1.0	1.40
IR73-MW48DW	04/11/06	20.95	7.89	0.216	0.00	-155	1.2	4.21
IR73-MW49DW	04/10/06	20.93	7.05	0.779	0.00	-156	3.6	4.32
IR73-MW49DWA	04/10/06	22.40	8.32	0.480	0.00	-209	2.0	27.16

Table 5-2
Summary of Groundwater Quality Parameters April 2006
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Well ID	Date (mm/dd/yy)	Temperature (^{0}C)	pH (SU)	Conductivity (mS/cm)	DO (mg/L)	ORP (mV)	Ferrous Iron (mg/L)	Turbidity (NTU)
Site 73								
IR73-MW49IW	04/10/06	20.97	7.22	0.601	0.00	-127	2.2	1.74
IR73-MW50DW	04/09/06	20.90	8.36	1.670	0.00	-101	4.6	0.40
IR73-MW51	04/18/06	18.40	13.03	0.482	0.00	-205	1.0	5.14
IR73-MW51DW	04/18/06	17.73	7.70	0.322	0.31	-45	NM	2.98
IR73-MW52	04/19/06	20.37	8.06	2.500	0.00	-315	0.2	1.80
IR73-MW52DW	04/19/06	19.37	7.20	0.659	0.27	-169	2.0	1.09
IR73-MW53	04/21/06	15.00	7.38	0.062	0.00	59	1.2	4.15
IR73-MW54	04/12/06	16.70	9.71	0.277	0.00	-124	4.4	2.23
IR73-MW55	04/11/06	17.10	9.34	0.910	0.00	-124	6.0	9.22
IR73-MW56	04/11/06	16.10	8.98	0.218	0.00	-147	1.2	2.06
IR73-MW58	04/11/06	24.20	6.80	0.000	8.77	74	1.0	12.70
IR73-MW61	04/20/06	20.70	9.41	0.448	0.00	-33	1.4	6.64
IR73-MW62DW	04/12/06	19.60	6.81	0.068	0.00	-140	4.2	52.10
IR73-MW63DW	04/11/06	21.39	7.54	0.309	0.00	-136	2.4	12.10

Notes

^{o}C - degrees Celsius
DO - Dissolved oxygen
mS/cm - milliSiemens per centimeter
mg/L - milligrams per liter
mV - milliVolt
NM - Not measured
NTU - Nephelometric Turbidity Unit
ORP - Oxidation Reduction Potential
SU - Standard Unit

Table 5-3
Detected Concentrations of VOCs, Metals, and Geochemical Parameters in Shallow Groundwater from April 2006
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Station ID	**MCL-Groundwater**	**NCGWQS**	IR73-A47/3-09	IR73-A47/3-12	IR73-A47/3-15	IR73-A47/3-16	IR73-A47/3-19		IR73-A47/3-22	IR73-A47/3-8		IR73-MW01	IR73-MW02	IR73-MW02IW	IR73-MW03
Sample ID			IR73-A47/3-9-06B	IR73-A47/3-12-06B	IR73-A47/3-15-06B	IR73-A47/3-16-06B	IR73-GWA47/3-19-06B	IR73-GWA47/3-19-06BDUP	IR73-A47/3-22-06B	IR73-GWA47/3-8-06B	IR73-GWA47/3-8-06BDUP	IR73-GW01-06B	IR73-GW02-06B	IR73-GW02IW-06B	IR73-GW03-06B
Sample Date			04/09/06	04/12/06	04/12/06	04/19/06	04/21/06	04/21/06	04/19/06	04/10/06	04/10/06	04/10/06	04/11/06	04/11/06	04/11/06
Chemical Name															
Volatile Organic Compounds (µg/L)															
1,1-Dichloroethene	7	7	0.45 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,4-Dichlorobenzene	75	1.4	0.5 U	0.33 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Benzene	5	1	3.3	0.33 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2.8	2.7	0.5 U	0.5 U	0.5 U	0.5 U
Carbon disulfide	--	700	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chlorobenzene	100	50	0.5 U	6.7	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Cyclohexane	--	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2.9	3	0.5 U	0.5 UJ	0.5 U	0.5 U
Ethylbenzene	700	550	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1.3	1.3	0.5 U	0.5 U	0.5 U	0.5 U
Methylcyclohexane	--	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	4.6	4.5	0.5 U	0.5 UJ	0.5 U	0.5 U
Toluene	1,000	1,000	0.5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.42 J	0.41 J	0.5 U	0.5 U	0.5 U	0.5 U
Trichloroethene	5	2.8	3.1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.32 J	0.5 U
Vinyl chloride	2	0.015	6.2	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	3.7	3.8	0.5 U	0.5 U	0.5 U	0.5 U
Xylene, total	10,000	530	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1.2	1.2	0.5 U	0.5 U	0.5 U	0.5 U
cis-1,2-Dichloroethene	70	70	52	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.65	0.61	0.5 U	0.5 U	20	0.5 U
isopropylbenzene	--	70	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	13	12	0.5 U	0.5 U	0.5 U	0.5 U
trans-1,2-Dichloroethene	100	100	2.1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.38 J	0.5 U	0.5 U	2	0.5 U
Total Metals (µg/L)															
Iron	--	300	2,500	4,100	23,000	20,000	5,100	4,200	62,000	15,000	15,000	17,000	4,700	7,500	9,500
Wet Chemistry (mg/L)															
Alkalinity	--	--	40	410	340	460	440	450	440	420	420	90	150	32	240
Chloride	--	250	55 J	96 J	68 J	49 J	530 J	580 J	560 J	62 J	56 J	35 J	10 J	16 J	14 J
Ferric iron	--	--	10 U	10 U	20	16	10 U	10 U	47	12	11	16	10 U	10 U	10 U
Ferrous iron	--	--	2.2 J	1.3	3.7	4.8 J	2.3 J	2.2	15 J	3.6 J	4.4 J	1 J	1 U	1 U	1 UJ
Methane (UG/L)	--	--	5.9	0.075	4.8	4.3	7	7.3	4.7	5.2	5.7	0.49	0.1 U	0.58 U	1.2 U
Nitrate	10	10	0.13 UJ	0.13 U	0.13 U	1.9 J	0.13 U	0.24 J	0.44 J	0.13 U	0.13 U	0.13 U	0.28	0.19 U	0.15
Nitrite	1	1	0.43 J	0.44 J	0.44 J	0.13 U	0.13 U	0.13 U	0.13 U	0.68	0.84	0.14	0.17 J	0.13 UJ	0.21
Sulfate	--	250	5 U	5 U	5 U	5 U	5 U	5 U	5 U	14 J	9.6 J	95 J	18	5 U	5 UJ
Sulfide	--	--	0.03 U	0.03 U	0.03 U	0.03 U	0.03 UJ	0.03 UJ	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
Total organic carbon (TOC)	--	--	24	27	31	29	45	44	19	28	22	10 U	10	10 U	26

Notes:
U- Analyte not detected
J- Reported value is estimated
UJ- Analyte not detected. Quantitation limit is imprecise
NA- Not analyzed
Shading represents exceedance of MCL
Bold outline represents exceedance of NCGWQS Standards
µg/L -Micrograms per Liter
mg/L - Milligrams per Liter

Table 5-3
Detected Concentrations of VOCs, Metals, and Geochemical Parameters in Shallow Groundwater from April 2006
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Station ID	**MCL-Groundwater**	**NCGWQS**	IR73-MW06	IR73-MW08	IR73-MW09	IR73-MW10	IR73-MW11	IR73-MW12	IR73-MW13	IR73-MW15	IR73-MW15N	IR73-MW16	IR73-MW17	IR73-MW18	IR73-MW19	IR73-MW20	IR73-MW21	IR73-MW23
Sample ID			IR73-GW06-06B	IR73-GW08-06B	IR73-GW09-06B	IR73-GW10-06B	IR73-GW11-06B	IR73-GW12-06B	IR73-GW13-06B	IR73-GW15-06B	IR73-GW15N-06B	IR73-GW16-06B	IR73-GW17-06B	IR73-GW18-06B	IR73-GW19-06B	IR73-GW20-06B	IR73-GW21-06B	IR73-GW23-06B
Sample Date			04/12/06	04/18/06	04/18/06	04/20/06	04/10/06	04/10/06	04/09/06	04/12/06	04/12/06	04/09/06	04/09/06	04/18/06	04/11/06	04/19/06	04/21/06	04/11/06
Chemical Name																		
Volatile Organic Compounds (µg/L)																		
1,1-Dichloroethene	7	7	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,4-Dichlorobenzene	75	1.4	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Benzene	5	1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2.9	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Carbon disulfide	--	700	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.79	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chlorobenzene	100	50	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Cyclohexane	--	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.43 J	0.36 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Ethylbenzene	700	550	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methylcyclohexane	--	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	1,000	1,000	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Trichloroethene	5	2.8	0.5 U	0.5 U	0.5 U	0.5 U	0.62	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Vinyl chloride	2	0.015	0.5 U	0.5 U	3.5	0.5 U	0.5 U	0.38 J	7.8 J	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Xylene, total	10,000	530	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
cis-1,2-Dichloroethene	70	70	0.5 U	0.5 U	0.32 J	0.5 U	3.1	1.8	6.8	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
isopropylbenzene	--	70	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.3 J	0.62	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1.5	0.5 U	0.5 U	0.5 U	0.33 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Total Metals (µg/L)																		
Iron	--	300	51,000	3,700	1,300	4,100	1,100	700	1,400	16,000	13,000	17,000	280	1,800	10,000	2,800	20,000	2,600
Wet Chemistry (mg/L)																		
Alkalinity	--	--	670	94	150	290	95	120	150	490	270	250	320	75	430	61	20 U	20 U
Chloride	--	250	46 J	15 J	20 J	28 J	17 J	28 J	71 J	340 J	55 J	19 J	31 J	35 J	170 J	16 J	140 J	34 J
Ferric iron	--	--	47	10 U	10 U	10 U	10 U	10 U	10 U	12	10 U	16	10 U	10 U	10 U	10 U	17	10 U
Ferrous iron	--	--	4.3 J	1 UJ	1 UJ	1 U	1 U	1 UJ	1.3 J	4.6	3.5 J	1 UJ	1 UJ	1 UJ	4.5	2.9	3.1 J	1 UJ
Methane (UG/L)	--	--	2.2	1.7	0.43	1.3	0.84	0.82	3.1	7.5	1.5	0.97	3	0.15	3.6 U	0.38	0.028	0.18 U
Nitrate	10	10	0.17	0.3 J	0.52 J	0.13 U	0.17	0.13 U	0.13 UJ	0.13 U	0.13 U	0.13 UJ	0.13 UJ	1.8 J	0.13 U	0.13 U	0.13 U	0.35
Nitrite	1	1	0.86 J	0.13 U	0.13 U	0.13 U	0.26	0.62	0.36 J	0.13 U	0.4 J	0.64 J	0.57 J	0.13 U	0.13 UJ	0.13 U	0.13 U	0.13 U
Sulfate	--	250	5 U	7.2	5 U	27	24 J	7.9 J	5 U	5.3	5 U	28	5 U	80	5 U	56	40	6.4 J
Sulfide	--	--	0.03 U	0.03 U	0.03 U	0.03 UJ	0.03 U	0.03 U	0.56	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.095	0.03 UJ	0.03 UJ	0.056
Total organic carbon (TOC)	--	--	58	10 U	10 U	10	10 U	10 U	30	18	41	14	25	20 U	42	20 U	10 U	21

Notes:
U- Analyte not detected
J- Reported value is estimated
UJ- Analyte not detected. Quantitation limit is imprecise
NA- Not analyzed
Shading represents exceedance of MCL
Bold outline represents exceedance of NCGWQS Standards
µg/L -Micrograms per Liter
mg/L - Milligrams per Liter

Table 5-3
Detected Concentrations of VOCs, Metals, and Geochemical Parameters in Shallow Groundwater from April 2006
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Station ID	**MCL-Groundwater**	**NCGWQS**	IR73-MW25		IR73-MW27	IR73-MW28	IR73-MW29	IR73-MW30	IR73-MW31	IR73-MW34	IR73-MW35	IR73-MW37	IR73-MW54	IR73-MW55	IR73-MW56	IR73-MW58	IR73-MW61	IR73-MW62DW
Sample ID			IR73-GW25-06B	R73-GW25-06BDUP	IR73-GW27-06B	IR73-GW28-06B	IR73-GW29-06B	IR73-GW30-06B	IR73-GW31-06B	IR73-GW34-06B	IR73-GW35-06B	IR73-GW37-06B	IR73-GW54-06B	IR73-GW55-06B	IR73-GW56-06B	IR73-GW58-06B	IR73-GW61-06B	R73-GW62DW-06B
Sample Date			04/12/06	04/12/06	04/09/06	04/20/06	04/09/06	04/11/06	04/12/06	04/21/06	04/20/06	04/09/06	04/12/06	04/11/06	04/11/06	04/11/06	04/20/06	04/12/06
Chemical Name																		
Volatile Organic Compounds (µg/L)																		
1,1-Dichloroethene	7	7	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,4-Dichlorobenzene	75	1.4	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Benzene	5	1	0.5 U	0.5 U	0.51	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Carbon disulfide	--	700	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chlorobenzene	100	50	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Cyclohexane	--	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Ethylbenzene	700	550	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methylcyclohexane	--	--	0.5 U	0.5 U	0.41 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	1,000	1,000	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Trichloroethene	5	2.8	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1.5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Vinyl chloride	2	0.015	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Xylene, total	10,000	530	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
cis-1,2-Dichloroethene	70	70	0.5 U	0.5 U	1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1.9	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
isopropylbenzene	--	70	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.94	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Total Metals (µg/L)																		
Iron	--	300	13,000	13,000	910	280	1,100	18,000	4,500	65,000	3,500	2,100	5,200	13,000	840	20,000	1,600	3,600
Wet Chemistry (mg/L)																		
Alkalinity	--	--	100	92	310	140	69	37	220	20 U	20 U	110	160	400	100	62	270	51
Chloride	--	250	25 J	23 J	87 J	14 J	38 J	16 J	24 J	68 J	34 J	31 J	17 J	55 J	31 J	18 J	33 J	24 J
Ferric iron	--	--	12	13	10 U	10 U	10 U	18	10 U	65	10 U	10 U	10 U	11	10 U	20	10 U	10 U
Ferrous iron	--	--	1 U	1 U	1 UJ	1 U	1 UJ	1 UJ	1 UJ	1 U	1 UJ	2.6 J	3 J	2.1	1 U	1 U	1 UJ	1.2 J
Methane (UG/L)	--	--	0.46	0.38	3.9	0.046	0.62	0.5 U	0.1	0.014 U	0.081	1.1	2.2	1.5	1	0.014 U	2.7	2.3
Nitrate	10	10	0.13 U	0.28 J	0.13 UJ	0.13 U	0.31 J	0.13 U	0.13 U	0.66 J	0.13 U	0.13 UJ	0.13 U	0.13 U	0.13 U	3	0.31 J	0.13 U
Nitrite	1	1	0.15 J	0.14	0.39 J	0.13 U	0.38 J	0.13 U	0.4 J	0.13 U	0.13 U	0.37 J	0.24 J	0.58 J	0.13 U	0.13 UJ	0.13 U	0.13 UJ
Sulfate	--	250	26	17	130	11	11	5.8 J	130	23	12	6.8	5 U	8.1	6.5 J	70	5 U	5 U
Sulfide	--	--	0.03 U	0.03 U	0.66	0.03 UJ	0.03 U	0.03 U	0.03 U	0.03 UJ	0.03 UJ	0.03 U	0.03 U	0.03 U	0.4	0.03 U	0.03 UJ	0.03 U
Total organic carbon (TOC)	--	--	10 U	12	29	10 U	11	46	10 U	230	10 U	13	16	25	20	10 U	23	10 U

Notes:
U- Analyte not detected
J- Reported value is estimated
UJ- Analyte not detected. Quantitation limit is imprecise
NA- Not analyzed
Shading represents exceedance of MCL
Bold outline represents exceedance of NCGWQS Standards
µg/L -Micrograms per Liter
mg/L - Milligrams per Liter

Table 5-4
Detected Concentrations of VOCs, Metals, and Geochemical
Parameters in Deep Groundwater from April 2006
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Station ID	**MCL-Groundwater**	**NCGWQS**	IR73-MW01DW		IR73-MW01IW	IR73-MW06IW	IR73-MW11DW		IR73-MW11IW	IR73-MW13DW	IR73-MW15IW	IR73-MW17DW	IR73-MW20DW	IR73-MW26DW	IR73-MW27DW		IR73-MW31DW
Sample ID			IR73-GW01DW-06BDUP	IR73-GW01DW-06B	IR73-GW01IW-06B	IR73-GW06IW-06B	IR73-GW11DW-06B	IR73-GW11DW-06BDUP	IR73-GW11IW-06B	IR73-GW13DW-06B	IR73-GW15IW-06B	IR73-GW17DW-06B	IR73-GW20DW-06B	IR73-GW26DW-06B	IR73-GW27DW-06B	IR73-GW27DW-06B2	IR73-GW31DW-06B
Sample Date			04/10/06	04/10/06	04/10/06	04/12/06	04/11/06	04/11/06	04/10/06	04/09/06	04/19/06	04/09/06	04/19/06	04/19/06	04/09/06	04/10/06	04/12/06
Chemical Name																	
Volatile Organic Compounds (µg/L)																	
1,1-Dichloroethene	7	7	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	4.2	0.5 U	0.5 U	0.5 U	0.5 U	0.63	NA	0.5 U
Benzene	5	1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	3.7	0.5 U	0.5 U	0.56	0.5 U	0.73	NA	0.5 U
Cyclohexane	--	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U
Methylene chloride	5	4.6	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U
Toluene	1,000	1,000	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U
Trichloroethene	5	2.8	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	200	0.5 U	0.5 U	0.5 U	0.5 U	52	NA	0.5 U
Vinyl chloride	2	0.015	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	32	0.5 U	0.5 U	0.5 U	0.5 U	3.1	NA	0.5 U
cis-1,2-Dichloroethene	70	70	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	130	0.5 U	0.5 U	0.5 U	0.5 U	29	NA	0.5 U
trans-1,2-Dichloroethene	100	100	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2.9	0.5 U	0.5 U	0.5 U	0.5 U	1.3	NA	0.5 U
Total Metals (µg/L)																	
Iron	--	300	420	210	3,900	1,900	240	280	4,700	2,500	1,800	820	900	200 U	670	NA	200 U
Wet Chemistry (mg/L)																	
Alkalinity	--	--	200	200	47	20 U	180	170	100	140	190	120	200	190	NA	320	150
Chloride	--	250	28 J	28 J	30 J	19 J	37 J	14 J	13 J	120 J	95 J	32 J	43 J	1,100 J	NA	69 J	84 J
Ferrous iron	--	--	1 UJ	1 UJ	1 UJ	1 UJ	1 U	1 U	1 U	1 UJ	1 UJ	1 UJ	1 U	1 U	NA	1 UJ	1 U
Methane (µg/L)	--	--	0.014 U	0.014 U	2.4	1.6	0.014 U	0.031 U	5	1.8	0.58	0.014 U	0.036 J	0.082	1.8	NA	0.014 U
Nitrate	10	10	0.44	0.45	0.72	2.2	0.13 U	0.13 U	0.13 U	0.13 UJ	0.17 J	0.13 UJ	0.13 U	0.13 U	NA	0.6 J	0.39
Nitrite	1	1	0.32	0.36	0.23	0.33 J	0.13 U	0.13 U	0.27	0.23 J	0.13 U	0.37 J	0.13 U	0.13 U	NA	0.39 J	0.14 J
Sulfate	--	250	18 J	16 J	27 J	5 U	5 UJ	5 UJ	18 J	7.4	5 U	7	5 U	33	NA	22	10
Total organic carbon (TOC)	--	--	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	NA	10 U

Notes:
U- Analyte not detected
J- Reported value is estimated
UJ- Analyte not detected. Quantitation limit is imprecise
NA- Not analyzed
R- Unreliable result
Shading represents exceedance of MCL
Bold outline represents exceedance of NCGWQS Standards
µg/L - Micrograms per Liter
mg/L - Milligrams per Liter

Table 5-4
Detected Concentrations of VOCs, Metals, and Geochemical
Parameters in Deep Groundwater from April 2006
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Station ID	**MCL-Groundwater**	**NCGWQS**	IR73-MW33DW	IR73-MW34DW	IR73-MW35DW	IR73-MW38DW	IR73-MW39DW		IR73-MW40DW	IR73-MW41DW		IR73-MW42DW	IR73-MW43DW	IR73-MW44DW	IR73-MW45DW	
Sample ID			IR73-GW33DW-06B	IR73-GW34DW-06B	IR73-GW35DW-06B	IR73-GW38DW-06B	IR73-GW39DW-06B	IR73-GW39DW-06BDUP	IR73-GW40DW-06B	IR73-GW41DW-06BDUP	IR73-GW41DW-06B	IR73-GW42DW-06B	IR73-GW43DW-06B	IR73-GW44DW-06B	IR73-GW45DW-06BDUP	IR73-GW45DW-06B
Sample Date			04/10/06	04/21/06	04/20/06	04/09/06	04/09/06	04/09/06	04/20/06	04/20/06	04/20/06	04/19/06	04/09/06	04/09/06	04/18/06	04/18/06
Chemical Name																
Volatile Organic Compounds (µg/L)																
1,1-Dichloroethene	7	7	0.5 R	0.5 U	0.5 U	0.5 U	2.7 J	0.36 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	21	0.5 U	0.5 U
Benzene	5	1	0.5 U	0.5 U	0.5 U	0.5 U	5.5 J	0.87 J	0.5 U	1.7	1.6	0.5 U	0.5 U	8.9	0.31 J	0.73
Cyclohexane	--	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.82	0.5 U	0.5 U
Methylene chloride	5	4.6	0.5 R	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	1,000	1,000	0.5 UJ	0.5 U	0.5 U	0.5 U	0.4 J	0.27 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.6	0.5 U	0.5 U
Trichloroethene	5	2.8	0.5 U	0.5 U	0.5 U	0.5 U	20 J	4.8 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	290	3.1	7.1
Vinyl chloride	2	0.015	0.5 R	0.5 U	0.5 U	0.5 UJ	14 J	1.9 J	0.5 U	5.1	5	0.5 U	0.5 U	130 J	1.4	1.2
cis-1,2-Dichloroethene	70	70	0.35 J	0.5 U	0.5 U	0.5 U	15 J	4.1 J	0.5 U	13	12	0.5 U	0.5 U	400	7.5	16
trans-1,2-Dichloroethene	100	100	0.5 R	0.5 U	0.5 U	0.5 U	0.71 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	23	0.5 U	0.5 U
Total Metals (µg/L)																
Iron	--	300	630	710	1,500	630	2,800	2,600	600	2,300	2,300	890	680	4,700	1,600	1,700
Wet Chemistry (mg/L)																
Alkalinity	--	--	110	82	130	170	140	100	170	260	270	190	180	470	200	200
Chloride	--	250	33 J	41 J	23 J	42 J	41 J	28 J	52 J	280 J	300 J	49 J	39 J	98 J	70 J	71 J
Ferrous iron	--	--	1 U	1 U	1 UJ	1 UJ	1 UJ	1 UJ	1 U	1 UJ	1 UJ	1 UJ	1 UJ	2 J	1 UJ	1 UJ
Methane (µg/L)	--	--	0.014 U	0.014 U	0.029	0.035	1.7 J	0.15 J	0.039	1.3	1.6	0.041	0.095	4.8	0.12	0.14
Nitrate	10	10	0.13 UJ	0.13 U	0.16 J	0.13 UJ	0.13 UJ	0.13 UJ	0.33 J	0.13 U	0.23 J	0.13 U	0.13 UJ	0.13 UJ	1.1 J	1.2 J
Nitrite	1	1	0.21 J	0.13 U	0.13 U	0.3 J	0.29 J	0.17 J	0.13 U	0.13 U	0.13 U	0.13 U	0.38 J	0.52 J	0.13 U	0.13 U
Sulfate	--	250	14	66	8.8	5 U	5 U	8.6	5 U	5 U	5 U	5 U	8.8	54	19	19
Total organic carbon (TOC)	--	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	65	20 U	10 U	10 U	16	10 U	10 U

Notes:
U- Analyte not detected
J- Reported value is estimated
UJ- Analyte not detected. Quantitation limit is imprecise
NA- Not analyzed
R- Unreliable result
Shading represents exceedance of MCL
Bold outline represents exceedance of NCGWQS Standards
µg/L - Micrograms per Liter
mg/L - Milligrams per Liter

Table 5-4
Detected Concentrations of VOCs, Metals, and Geochemical
Parameters in Deep Groundwater from April 2006
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Station ID	**MCL-Groundwater**	**NCGWQS**	IR73-MW46DW	IR73-MW47DW	IR73-MW48DW	IR73-MW49DW	IR73-MW49DWA	IR73-MW49IW	IR73-MW50DW	IR73-MW51	IR73-MW51DW	IR73-MW52	IR73-MW52DW	IR73-MW53	IR73-MW63DW	
Sample ID			IR73-GW46DW-06B	IR73-GW47DW-06B	IR73-GW48DW-06B	IR73-GW49DW-06B	IR73-GW49DWA-06B	IR73-GW49IW-06B	IR73-GW50DW-06B	IR73-GW51-06B	IR73-GW51DW-06B	IR73-GW52-06B	IR73-GW52DW-06B	IR73-GW53-06B	73-GW63DW-06BDU	IR73-GW63DW-06B
Sample Date			04/12/06	04/20/06	04/11/06	04/10/06	04/10/06	04/10/06	04/09/06	04/18/06	04/18/06	04/19/06	04/19/06	04/21/06	04/11/06	04/11/06
Chemical Name																
Volatile Organic Compounds (µg/L)																
1,1-Dichloroethene	7	7	0.36 J	0.5 U	1.8	13	0.5 U	4	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	4.3	3.8
Benzene	5	1	0.5 U	0.5 U	1.7	8.1	0.5 U	5.1	5.7	0.5 U	0.5 U	0.5 U	0.51	0.5 U	5	4.4
Cyclohexane	--	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methylene chloride	5	4.6	0.5 U	0.5 U	0.5 U	0.5 U	0.64	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U	0.5 U
Toluene	1,000	1,000	0.5 U	0.5 U	0.5 U	0.36 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Trichloroethene	5	2.8	9	1.8	82	840	0.5 U	170	0.5 U	0.5 U	0.5 U	0.5 U	0.87	0.5 U	540	520
Vinyl chloride	2	0.015	2.9	0.5 U	4	70 J	0.5 U	57 J	37 J	0.5 U	0.5 U	0.5 U	2.1	0.5 U	11	10
cis-1,2-Dichloroethene	70	70	18	2.1	77	550	0.5 U	1,300	14	0.5 U	0.5 U	0.5 U	5.9	0.5 U	210	200
trans-1,2-Dichloroethene	100	100	2.1	0.5 U	0.5 U	14	0.5 U	39 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	7.8	6.5
Total Metals (µg/L)																
Iron	--	300	200 U	230	770	3,200	1,600	1,900	5,500	240	200 U	200 U	1,400	5,900	1,900	2,000
Wet Chemistry (mg/L)																
Alkalinity	--	--	180	210	180	360	200	320	320	230	180	190	190	24	280	280
Chloride	--	250	71 J	71 J	58 J	91 J	350 J	130 J	450 J	140 J	22 J	1,300 J	170 J	25 J	15 J	62 J
Ferrous iron	--	--	1 UJ	1 U	1 UJ	1.5	1 U	1 U	1.6 J	1 U	1 UJ	1 U	1 UJ	1.6 J	1 U	1 U
Methane (µg/L)	--	--	0.27	0.25	0.25 U	2.2	0.16	1.4	3.8	0.12	0.041	0.041	0.51	0.064	0.53 U	0.58 U
Nitrate	10	10	0.13 U	0.13 U	0.13 U	0.13 UJ	0.13 UJ	0.13 UJ	0.13 UJ	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U
Nitrite	1	1	0.18 J	0.13 U	0.2	0.34 J	0.13 UJ	0.25 J	0.13 UJ	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 UJ	0.27 J
Sulfate	--	250	5 U	5 U	5 UJ	33	12	9.3	5 U	5.6	5 U	50	5 U	11	7.3 J	24 J
Total organic carbon (TOC)	--	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	16	10 U	20 U

Notes:
U- Analyte not detected
J- Reported value is estimated
UJ- Analyte not detected. Quantitation limit is imprecise
NA- Not analyzed
R- Unreliable result
Shading represents exceedance of MCL
Bold outline represents exceedance of NCGWQS Standards
µg/L - Micrograms per Liter
mg/L - Milligrams per Liter

Table 5-5
Summary of Natural Attenuation Indicator Parameters
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Parameter	Range of Results (during April 2006 sampling event)	Condition Needed for Natural Attenuation	Favorable / Unfavorable
Oxidation-Reduction Potential	Surficial Aquifer: -251 mV to +246 mV	Less than +50 mV (favorable)	Surficial Aquifer: Favorable
	Castle Hayne Aquifer: -315 mV to +59 mV	Less than -100 mV (ideal)	Castle Hayne Aquifer: Favorable
Dissolved Oxygen	Surficial Aquifer: 0.00 mg/L to 8.77 mg/L	Less than 1.0 mg/L	Surficial Aquifer: Favorable
	Castle Hayne Aquifer: 0.00 mg/L to 3.37 mg/L		Castle Hayne Aquifer: Favorable
Nitrate	Surficial Aquifer: <0.13 mg/L to 3 mg/L	Less than 1.0 mg/L	Surficial Aquifer: Favorable
	Castle Hayne Aquifer: <0.13 mg/L to 2.2 mg/L		Castle Hayne Aquifer: Favorable
Ferrous Iron	Surficial Aquifer: Measurable in 19 of 42 wells	Measurable Levels	Surficial Aquifer: Favorable
	Castle Hayne Aquifer: Measurable in 4 of 36 wells		Castle Hayne Aquifer: Unfavorable
Sulfate	Surficial Aquifer: <5 mg/L to 130 mg/L	Less than 20 mg/L	Surficial Aquifer: Favorable
	Castle Hayne Aquifer: <5 mg/L to 66 mg/L		Castle Hayne Aquifer: Favorable
Methane	Surficial Aquifer: <0.014 mg/L to 7.5 mg/L	Measurable Levels	Surficial Aquifer: Favorable
	Castle Hayne Aquifer: <0.014 mg/L to 5 mg/L		Castle Hayne Aquifer: Favorable
Alkalinity	Surficial Aquifer: <20 mg/L to 670 mg/L	Twice the background concentration (Greater than 8 mg/L)	Surficial Aquifer: Unfavorable
	Castle Hayne Aquifer: <20 mg/L to 470 mg/L		Castle Hayne Aquifer: Favorable
Total Organic Carbon	Surficial Aquifer: <10 mg to 230 mg/L	Greater than 20 mg/L	Surficial Aquifer: Unfavorable
	Castle Hayne Aquifer: <10 mg/L to 65 mg/L		Castle Hayne Aquifer: Unfavorable
Chloride	Surficial Aquifer: 10 mg/L to 580 mg/L	Greater than the background concentration (Surficial Aquifer: 27 mg/L; Castle Hayne Aquifer: 13.7 mg/L)	Surficial Aquifer: Favorable
	Castle Hayne Aquifer: 13 mg/L to 1,300 mg/L		Castle Hayne Aquifer: Favorable

Notes:
mV - millivolts
mg/L - milligrams per liter

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Well ID	TCE
IR73-A47/3-09	3.1
IR73-A47/3-12	0.5 U
IR73-A47/3-15	0.5 U
IR73-A47/3-16	0.5 U
IR73-A47/3-19	0.5 U
IR73-A47/3-22	0.5 U
IR73-A47/3-8	0.5 U
IR73-MW01	0.5 U
IR73-MW02	0.5 U
IR73-MW02IW	0.32 J
IR73-MW03	0.5 U
IR73-MW06	0.5 U
IR73-MW08	0.5 U
IR73-MW09	0.5 U
IR73-MW10	0.5 U
IR73-MW11	0.62
IR73-MW12	0.5 U
IR73-MW13	0.5 U
IR73-MW15	0.5 U
IR73-MW15N	0.5 U
IR73-MW16	0.5 U
IR73-MW17	0.5 U
IR73-MW18	0.5 U
IR73-MW19	0.5 U
IR73-MW20	0.5 U
IR73-MW21	0.5 U
IR73-MW23	0.5 U
IR73-MW25	0.5 U
IR73-MW27	0.5 U
IR73-MW28	0.5 U
IR73-MW29	0.5 U
IR73-MW30	0.5 U
IR73-MW31	0.5 U
IR73-MW34	0.5 U
IR73-MW35	0.5 U
IR73-MW37	1.5
IR73-MW54	0.5 U
IR73-MW55	0.5 U
IR73-MW56	0.5 U
IR73-MW58	0.5 U
IR73-MW61	0.5 U
IR73-MW62DW	0.5 U

Well ID	TCE
IR73-MW01DW	0.5 U
IR73-MW01IW	0.5 U
IR73-MW06IW	0.5 U
IR73-MW11DW	0.5 U
IR73-MW11IW	0.5 U
IR73-MW13DW	200
IR73-MW15IW	0.5 U
IR73-MW17DW	0.5 U
IR73-MW20DW	0.5 U
IR73-MW26DW	0.5 U
IR73-MW27DW	52
IR73-MW31DW	0.5 U
IR73-MW33DW	0.5 U
IR73-MW34DW	0.5 U
IR73-MW35DW	0.5 U
IR73-MW38DW	0.5 U
IR73-MW39DW	20 J
IR73-MW40DW	0.5 U
IR73-MW41DW	0.5 U
IR73-MW42DW	0.5 U
IR73-MW43DW	0.5 U
IR73-MW44DW	290
IR73-MW45DW	7.1
IR73-MW46DW	9
IR73-MW47DW	1.8
IR73-MW48DW	82
IR73-MW49DW	840
IR73-MW49DWA	0.5 U
IR73-MW49IW	170
IR73-MW50DW	0.5 U
IR73-MW51	0.5 U
IR73-MW51DW	0.5 U
IR73-MW52	0.5 U
IR73-MW52DW	0.87
IR73-MW53	0.5 U
IR73-MW63DW	540

Legend

- Monitoring Well
- Base Boundary
- Estimated Extent of Impacted Groundwater NCGWQS

U Not Detected
J Estimated Value

Note:
-NCGWQS for TCE = 2.8 µg/L
-All concentrations are reported in µg/L. Actual conditions may differ from those shown on this figure.
-Extent of impact is approximate and is based on analytical data collected from monitoring wells screened at multiple depths in both the surficial and Castle Hayne aquifers. Additional information illustrating the horizontal and vertical extent of impacts is provided in Figures 5-2, 5-3, and 5-4.
-* Monitoring wells not sampled
-IR73-MW14 not sampled due to presence of free product

N

0 400 800 Feet

1 inch = 400 feet

Figure 5-1
Approximate Extent of TCE Exceedances, April 2006
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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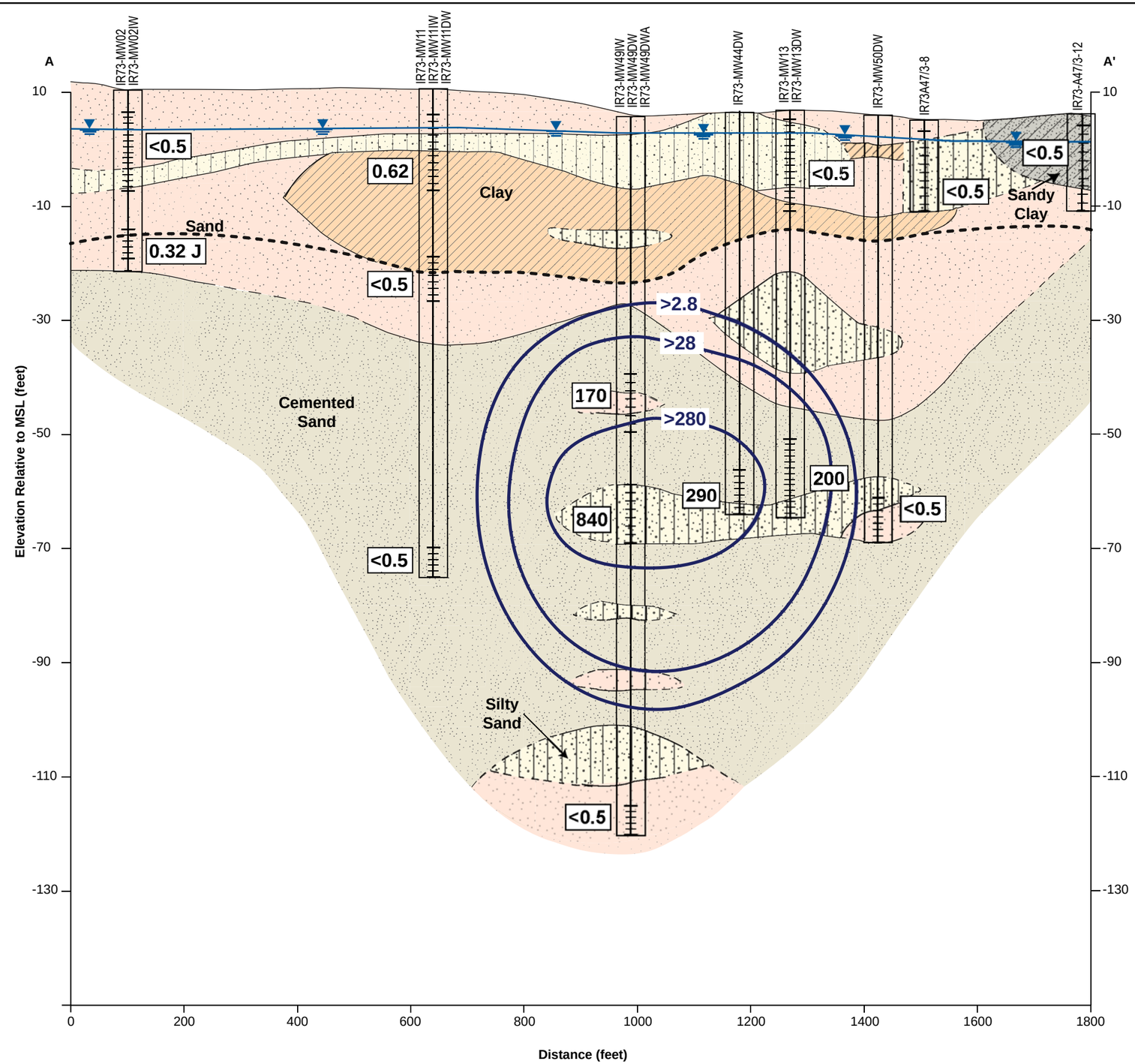

Horizontal : 1" = 200'
Vertical: 1" = 20'
V.E. = 10x

LEGEND

- Clay
- Silty Sand
- Cemented Sand
- Sand
- Sandy Clay
- Screened Interval
- Inferred Geologic Contact
- Water Table Elevation (Measured in water table wells within the Surficial aquifer)
- >2.8 TCE Isocontour, µg/L
- J Estimated Value
- Inferred Surficial Aquifer/Castle Hayne Aquifer Contact

NOTE

1) The depth and thickness of the subsurface strata indicated on this section (profile) were generalized from and interpolated between test locations. Information on actual subsurface conditions apply only to the specific locations indicated. Subsurface conditions and water levels at other locations may differ from conditions occurring at the indicated locations.
2) All water levels were measured during sampling event in April 2006.

Figure 5-2
Cross Sectional View of TCE Distribution (A-A')
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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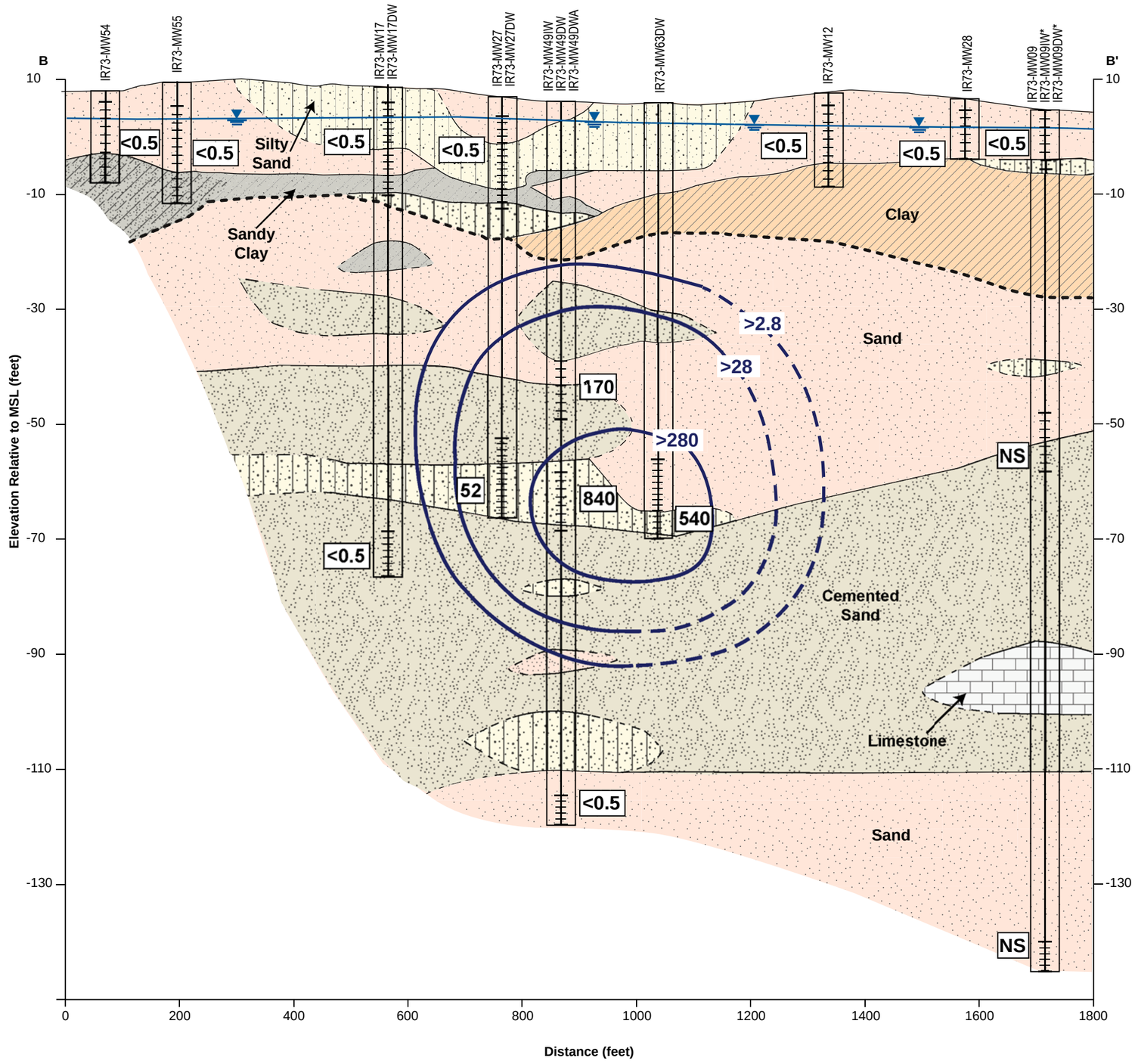
ES032009015MKE Figure5-2_CampLejeune_Site73_A-A'_v5.ai 03.24.09 sls



Horizontal : 1" = 200'
Vertical: 1" = 20'
V.E. = 10x

LEGEND

- Clay
- Silty Sand
- Cemented Sand
- Sand
- Sandy Clay
- Limestone
- Screened Interval
- Inferred Geologic Contact
- Water Table Elevation (Measured in water table wells within the Surficial aquifer)
- >2.8 TCE Isocontour, µg/L
- J Estimated Value
- NS Not Sampled
- Inferred Surficial Aquifer/Castle Hayne Aquifer Contact

NOTE
1) The depth and thickness of the subsurface strata indicated on this section (profile) were generalized from and interpolated between test locations. Information on actual subsurface conditions apply only to the specific locations indicated. Subsurface conditions and water levels at other locations may differ from conditions occurring at the indicated locations.
2) All water levels were measured during sampling event in April 2006.
3) * Monitoring wells IR73-MW09IW and IR73-MW09DW abandoned prior to April 2006 sampling event.

Figure 5-3
Cross Sectional View of TCE Distribution (B-B')
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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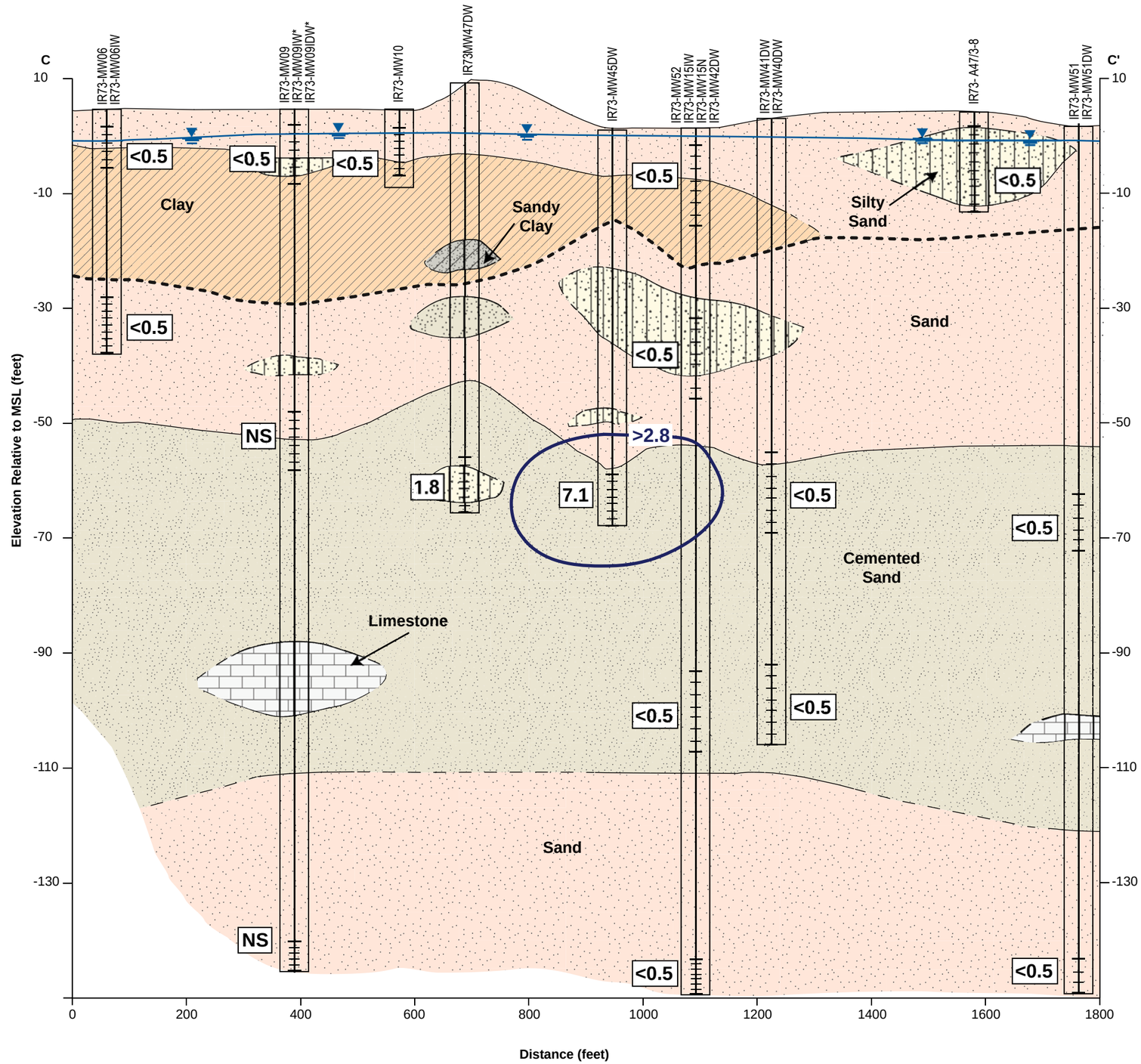
ES032009015MKE Figure5-3_CampLejeune_Site73_B-B'_v3.ai 03.19.09 sls



Horizontal : 1" = 200'
Vertical: 1" = 20'
V.E. = 10x

LEGEND

- Clay
- Silty Sand
- Cemented Sand
- Sand
- Sandy Clay
- Limestone
- Screened Interval
- Inferred Geologic Contact
- Water Table Elevation (Measured in water table wells within the Surficial aquifer)
- >2.8 TCE Isocontour, µg/L
- NS Not Sampled
- Inferred Surficial Aquifer/Castle Hayne Aquifer Contact

NOTE

1) The depth and thickness of the subsurface strata indicated on this section (profile) were generalized from and interpolated between test locations. Information on actual subsurface conditions apply only to the specific locations indicated. Subsurface conditions and water levels at other locations may differ from conditions occurring at the indicated locations.
2) All water levels were measured during sampling event in April 2006.
3) * Monitoring wells IR73-MW09IW and IR73-MW09DW abandoned prior to April 2006 sampling event.

Figure 5-4
Cross Sectional View of TCE Distribution (C-C')
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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ES122008019MKE Figure5-4_CampLejeune_Site73_C-C'_v4.ai 03.24.09 sls

V:\USNavFacEngCom\CampLejeune\MapFiles\Site_73\SRI\Figure_5-5_Approx_Extents_DCE_Impacts_April2006.mxd

Well ID	cis-1,2-DCE
IR73-A47/3-09	52
IR73-A47/3-12	0.5 U
IR73-A47/3-15	0.5 U
IR73-A47/3-16	0.5 U
IR73-A47/3-19	0.5 U
IR73-A47/3-22	0.5 U
IR73-A47/3-8	0.65
IR73-MW01	0.5 U
IR73-MW02	0.5 U
IR73-MW02IW	20
IR73-MW03	0.5 U
IR73-MW06	0.5 U
IR73-MW08	0.5 U
IR73-MW09	0.32 J
IR73-MW10	0.5 U
IR73-MW11	3.1
IR73-MW12	1.8
IR73-MW13	6.8
IR73-MW15	0.5 U
IR73-MW15N	0.5 U
IR73-MW16	0.5 U
IR73-MW17	0.5 U
IR73-MW18	0.5 U
IR73-MW19	0.5 U
IR73-MW20	0.5 U
IR73-MW21	0.5 U
IR73-MW23	0.5 U
IR73-MW25	0.5 U
IR73-MW27	1
IR73-MW28	0.5 U
IR73-MW29	0.5 U
IR73-MW30	0.5 U
IR73-MW31	0.5 U
IR73-MW34	0.5 U
IR73-MW35	0.5 U
IR73-MW37	1.9
IR73-MW54	0.5 U
IR73-MW55	0.5 U
IR73-MW56	0.5 U
IR73-MW58	0.5 U
IR73-MW61	0.5 U
IR73-MW62DW	0.5 U

Well ID	cis-1,2-DCE
IR73-MW01DW	0.5 U
IR73-MW01IW	0.5 U
IR73-MW06IW	0.5 U
IR73-MW11DW	0.5 U
IR73-MW11IW	0.5 U
IR73-MW13DW	130
IR73-MW15IW	0.5 U
IR73-MW17DW	0.5 U
IR73-MW20DW	0.5 U
IR73-MW26DW	0.5 U
IR73-MW27DW	29
IR73-MW31DW	0.5 U
IR73-MW33DW	0.35 J
IR73-MW34DW	0.5 U
IR73-MW35DW	0.5 U
IR73-MW38DW	0.5 U
IR73-MW39DW	15 J
IR73-MW40DW	0.5 U
IR73-MW41DW	13
IR73-MW42DW	0.5 U
IR73-MW43DW	0.5 U
IR73-MW44DW	400
IR73-MW45DW	16
IR73-MW46DW	18
IR73-MW47DW	2.1
IR73-MW48DW	77
IR73-MW49DW	550
IR73-MW49DWA	0.5 U
IR73-MW49IW	1,300
IR73-MW50DW	14
IR73-MW51	0.5 U
IR73-MW51DW	0.5 U
IR73-MW52	0.5 U
IR73-MW52DW	5.9
IR73-MW53	0.5 U
IR73-MW63DW	210

Legend

- Monitoring Well
- Base Boundary
- Estimated Extent of Impacted Groundwater

U Not Detected
J Estimated Value

Note:
-NCGWQS for cis-1,2-DCE = 70 µg/L
-All concentrations are reported in µg/L. Actual conditions may differ from those shown on this figure.
-Extent of contamination is approximate and is based on analytical data collected from monitoring wells screened at multiple depths in both the surficial and deep aquifers. Additional information illustrating the horizontal and vertical extent of impacts is provided in plume cross sectional views.
-* Monitoring wells not sampled
-IR73-MW14 not sampled due to free product in well

N

0 400 800 Feet

1 inch = 400 feet

Figure 5-5
Approximate Extent of cis-1,2-DCE Exceedances, April 2006
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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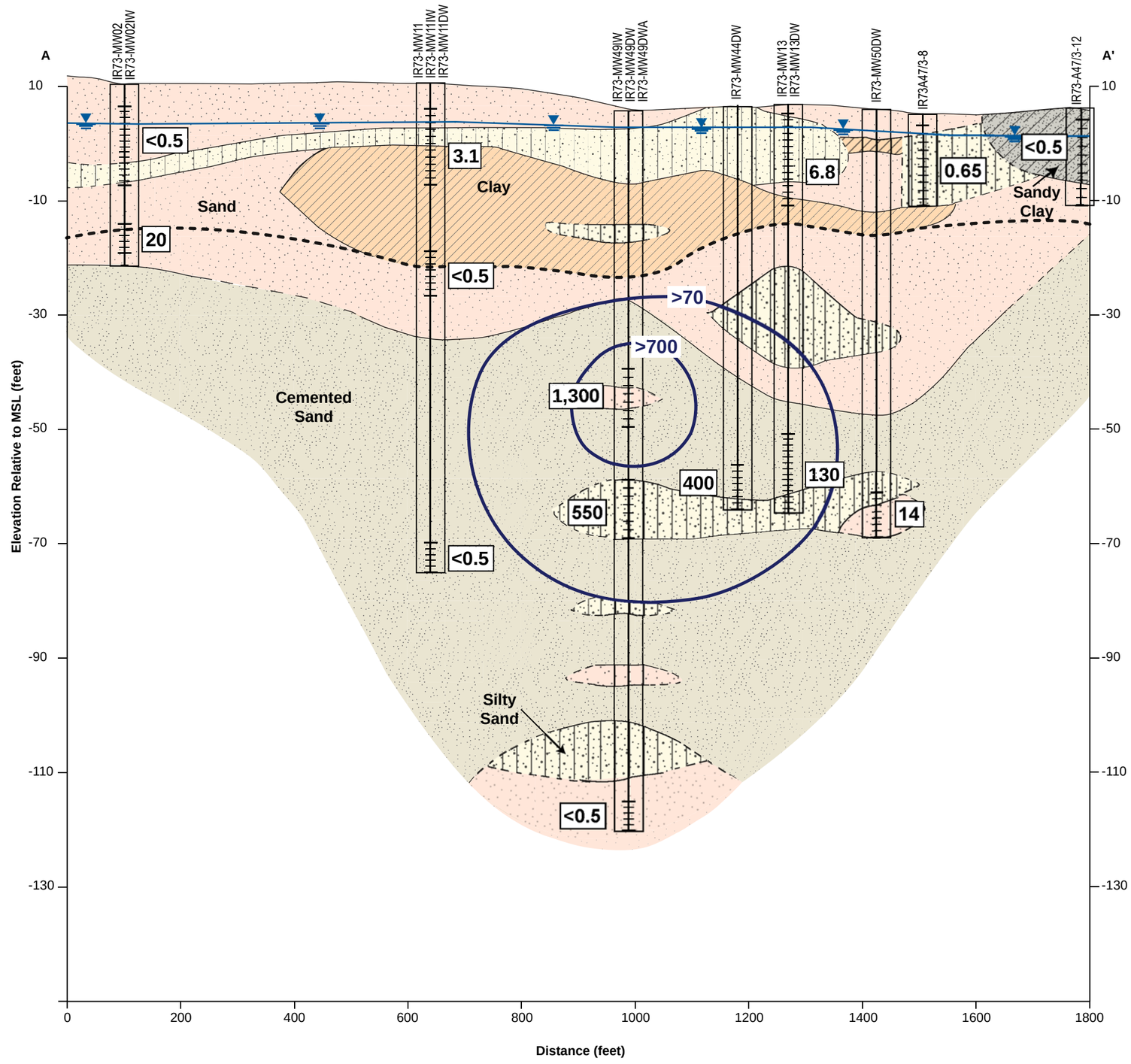

Horizontal : 1" = 200'
Vertical: 1" = 20'
V.E. = 10x

LEGEND

- Clay
- Silty Sand
- Cemented Sand
- Sand
- Sandy Clay
- Screened Interval
- Inferred Geologic Contact
- Water Table Elevation (Measured in water table wells within the Surficial aquifer)
- >70 cis-1,2 DCE Isocontour, µg/L
- Inferred Surficial Aquifer/Castle Hayne Aquifer Contact

NOTE

1) The depth and thickness of the subsurface strata indicated on this section (profile) were generalized from and interpolated between test locations. Information on actual subsurface conditions apply only to the specific locations indicated. Subsurface conditions and water levels at other locations may differ from conditions occurring at the indicated locations.
2) All water levels were measured during sampling event in April 2006.

Figure 5-6
Cross Sectional View of cis-1,2-DCE Distribution (A-A')
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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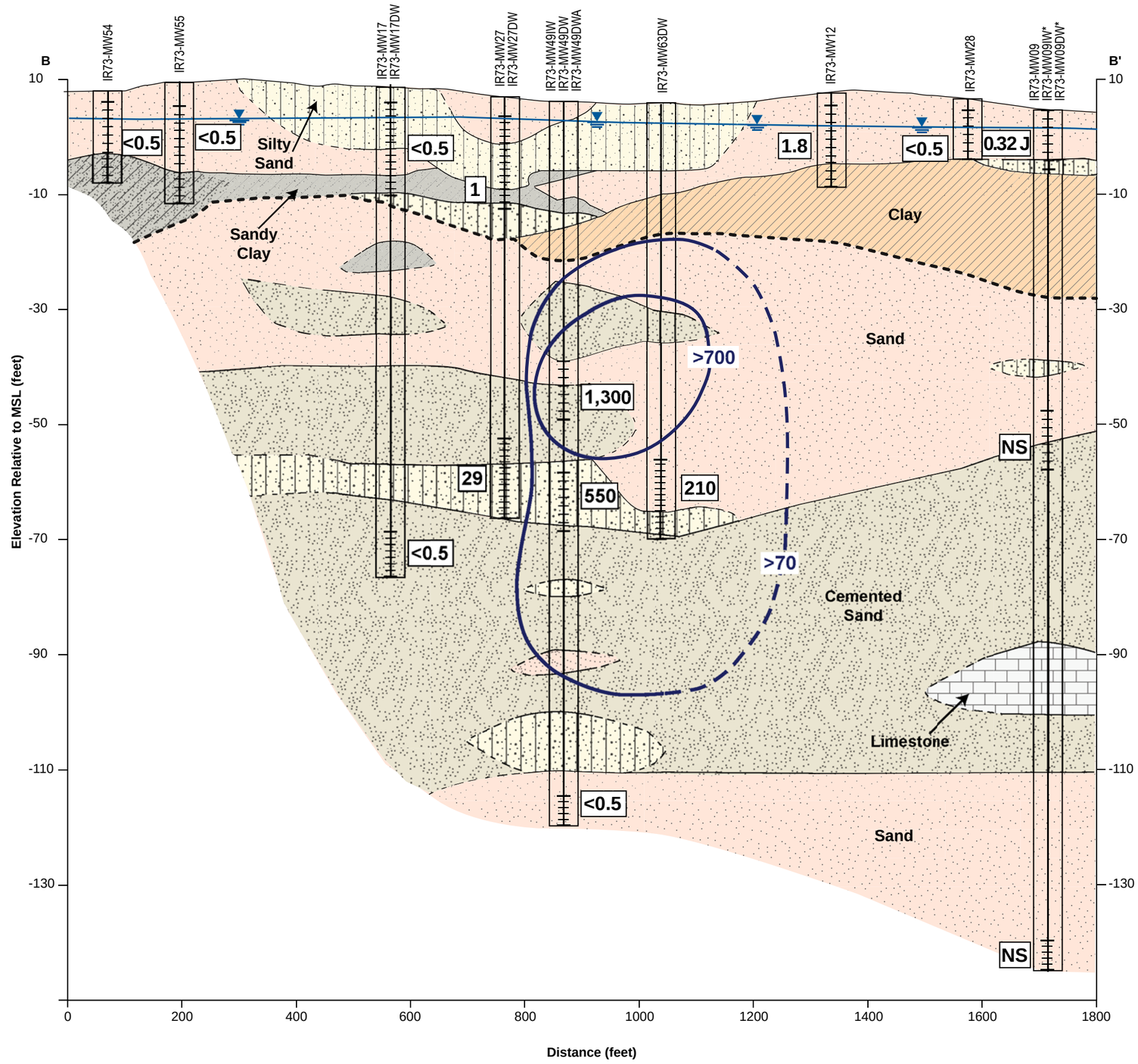
ES032009015MKE Figure5-6_CampLejeune_Site73_A-A'_v5.ai 03.24.09 sls



Horizontal : 1" = 200'
Vertical: 1" = 20'
V.E. = 10x

LEGEND

- Clay
- Silty Sand
- Cemented Sand
- Sand
- Sandy Clay
- Limestone
- Screened Interval
- Inferred Geologic Contact
- Water Table Elevation (Measured in water table wells within the Surficial aquifer)
- >70 cis-1,2 DCE Isocontour, µg/L
- J Estimated Value
- NS Not Sampled
- Inferred Surficial Aquifer/Castle Hayne Aquifer Contact

NOTE
1) The depth and thickness of the subsurface strata indicated on this section (profile) were generalized from and interpolated between test locations. Information on actual subsurface conditions apply only to the specific locations indicated. Subsurface conditions and water levels at other locations may differ from conditions occurring at the indicated locations.
2) All water levels were measured during sampling event in April 2006.
3) * Monitoring wells IR73-MW09IW and IR73-MW09DW abandoned prior to April 2006 sampling event.

Figure 5-7
Cross Sectional View of cis-1,2-DCE Distribution (B-B')
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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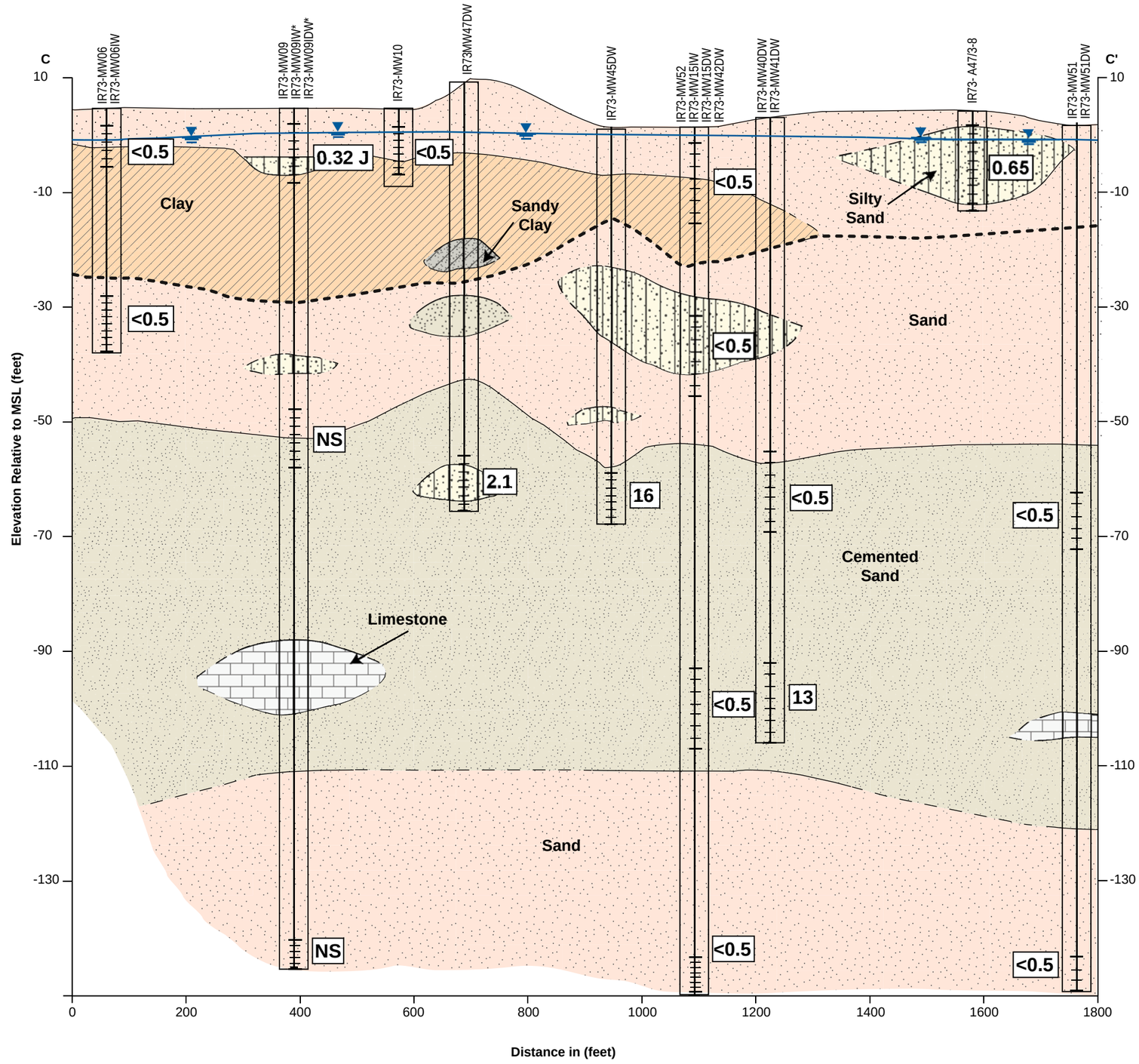
ES032009015MKE Figure5-7_CampLejeune_Site73_B-B'_v4.ai 03.24.09 sls



Horizontal : 1" = 200'
Vertical: 1" = 20'
V.E. = 10x

LEGEND

- Clay
- Silty Sand
- Cemented sand
- Sand
- Sandy Clay
- Limestone
- Screened Interval
- Inferred geologic contact
- Water table elevation (Measured in water table wells within the Surficial aquifer)
- J Estimated Value
- NS Not Sampled
- Inferred Surficial aquifer/Castle Hayne aquifer contact

NOTE
1) The depth and thickness of the subsurface strata indicated on this section (profile) were generalized from and interpolated between test locations. Information on actual subsurface conditions apply only to the specific locations indicated. Subsurface conditions and water levels at other locations may differ from conditions occurring at the indicated locations.
2) All water levels were measured during sampling event in April 2006.
3) * Monitoring wells IR73-MW09IW and IR73-MW09DW abandoned prior to April 2006 sampling event.

Figure 5-8
Cross Sectional View of cis-1,2-DCE Distribution (C-C')
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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ES032009015MKE Figure5-8_CampLejeune_Site73_C-C'_v4.ai 03.24.09 sls

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Well ID	VC
IR73-A47/3-09	6.2
IR73-A47/3-12	0.5 U
IR73-A47/3-15	0.5 U
IR73-A47/3-16	0.5 U
IR73-A47/3-19	0.5 U
IR73-A47/3-22	0.5 U
IR73-A47/3-8	3.8
IR73-MW01	0.5 U
IR73-MW02	0.5 U
IR73-MW02IW	0.5 U
IR73-MW03	0.5 U
IR73-MW06	0.5 U
IR73-MW08	0.5 U
IR73-MW09	3.5
IR73-MW10	0.5 U
IR73-MW11	0.5 U
IR73-MW12	0.38 J
IR73-MW13	7.8 J
IR73-MW15	0.5 U
IR73-MW15N	0.5 U
IR73-MW16	0.5 UJ
IR73-MW17	0.5 UJ
IR73-MW18	0.5 U
IR73-MW19	0.5 U
IR73-MW20	0.5 U
IR73-MW21	0.5 U
IR73-MW23	0.5 U
IR73-MW25	0.5 U
IR73-MW27	0.5 U
IR73-MW28	0.5 U
IR73-MW29	0.5 U
IR73-MW30	0.5 U
IR73-MW31	0.5 U
IR73-MW34	0.5 U
IR73-MW35	0.5 U
IR73-MW37	0.5 U
IR73-MW54	0.5 U
IR73-MW55	0.5 U
IR73-MW56	0.5 U
IR73-MW58	0.5 U
IR73-MW61	0.5 U
IR73-MW62DW	0.5 U

Well ID	VC
IR73-MW01DW	0.5 U
IR73-MW01IW	0.5 U
IR73-MW06IW	0.5 U
IR73-MW11DW	0.5 U
IR73-MW11IW	0.5 U
IR73-MW13DW	32
IR73-MW15IW	0.5 U
IR73-MW17DW	0.5 U
IR73-MW20DW	0.5 U
IR73-MW26DW	0.5 U
IR73-MW27DW	3.1
IR73-MW31DW	0.5 U
IR73-MW33DW	0.5 R
IR73-MW34DW	0.5 U
IR73-MW35DW	0.5 U
IR73-MW38DW	0.5 UJ
IR73-MW39DW	14 J
IR73-MW40DW	0.5 U
IR73-MW41DW	5.1
IR73-MW42DW	0.5 U
IR73-MW43DW	0.5 U
IR73-MW44DW	130 J
IR73-MW45DW	1.4
IR73-MW46DW	2.9
IR73-MW47DW	0.5 U
IR73-MW48DW	4
IR73-MW49DW	70 J
IR73-MW49DWA	0.5 U
IR73-MW49IW	57 J
IR73-MW50DW	37 J
IR73-MW51	0.5 U
IR73-MW51DW	0.5 U
IR73-MW52	0.5 U
IR73-MW52DW	2.1
IR73-MW53	0.5 U
IR73-MW63DW	11

Legend

- Monitoring Well
- Base Boundary
- Groundwater Impacted Above Measured Detection Limit

U Not Detected
J Estimated Value

Note:
-All concentrations are reported in µg/L. Actual conditions may differ from those shown on this figure.
-Extent of contamination is approximate and is based on analytical data collected from monitoring wells screened at multiple depths in both the surficial and deep aquifers. Additional information illustrating the horizontal and vertical extent of impacts is provided in plume cross sectional views.
-* Monitoring wells not sampled
-IR-MW14 not sampled due to free product in well

N

0 400 800 Feet

1 inch = 400 feet

Figure 5-9
Approximate Extent of VC Exceedances, April 2006
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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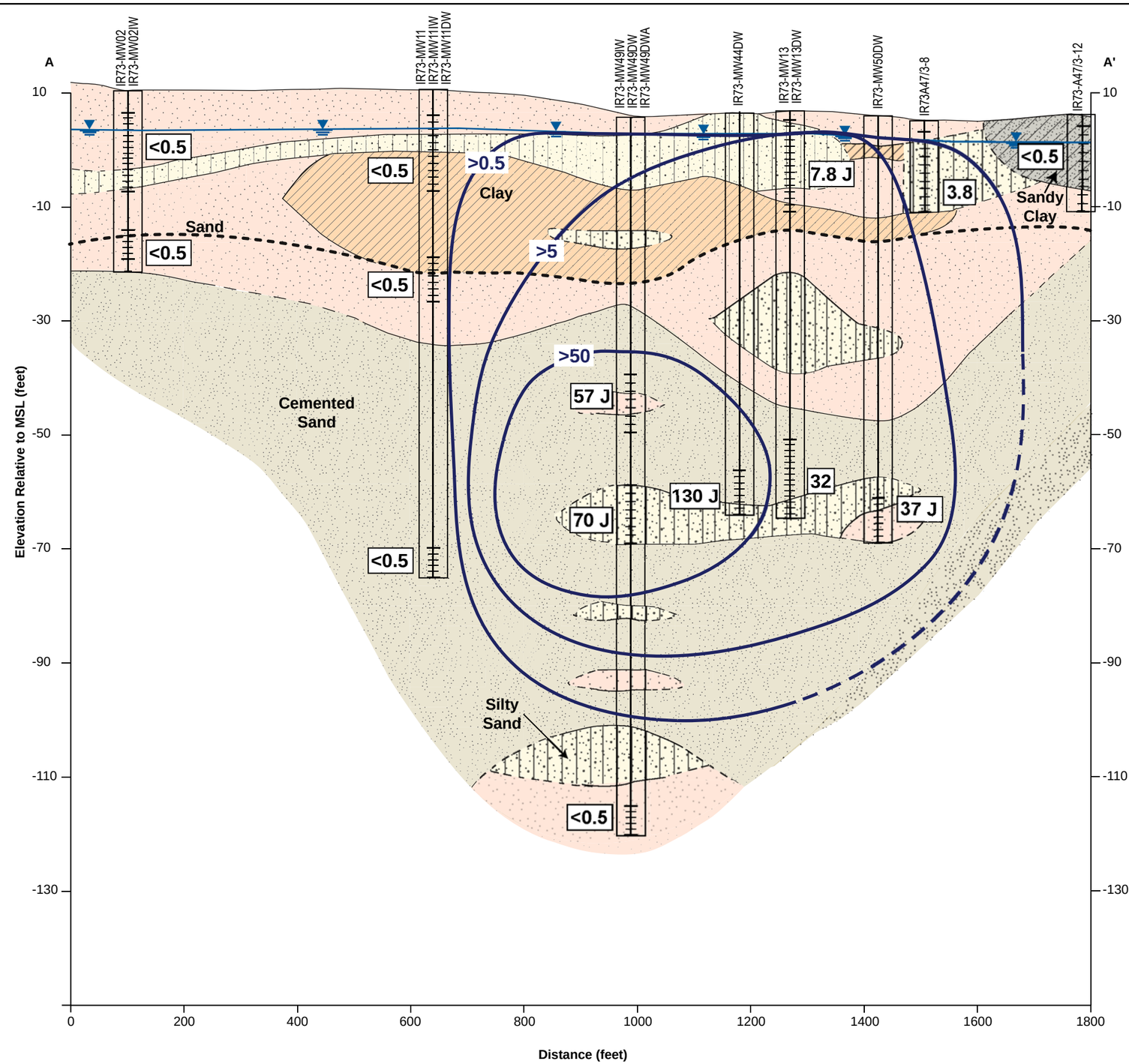

Horizontal : 1" = 200'
Vertical: 1" = 20'
V.E. = 10x

LEGEND

- Clay
- Silty Sand
- Cemented Sand
- Sand
- Sandy Clay
- Screened Interval
- Inferred Geologic Contact
- Water Table Elevation (Measured in water table wells within the Surficial aquifer)
- >0.5 VC Isocontour, µg/L
- J Estimated Value
- Inferred Surficial Aquifer/Castle Hayne Aquifer Contact

NOTE

1) The depth and thickness of the subsurface strata indicated on this section (profile) were generalized from and interpolated between test locations. Information on actual subsurface conditions apply only to the specific locations indicated. Subsurface conditions and water levels at other locations may differ from conditions occurring at the indicated locations.
2) All water levels were measured during sampling event in April 2006.

Figure 5-10
Cross Sectional View of VC Distribution (A-A')
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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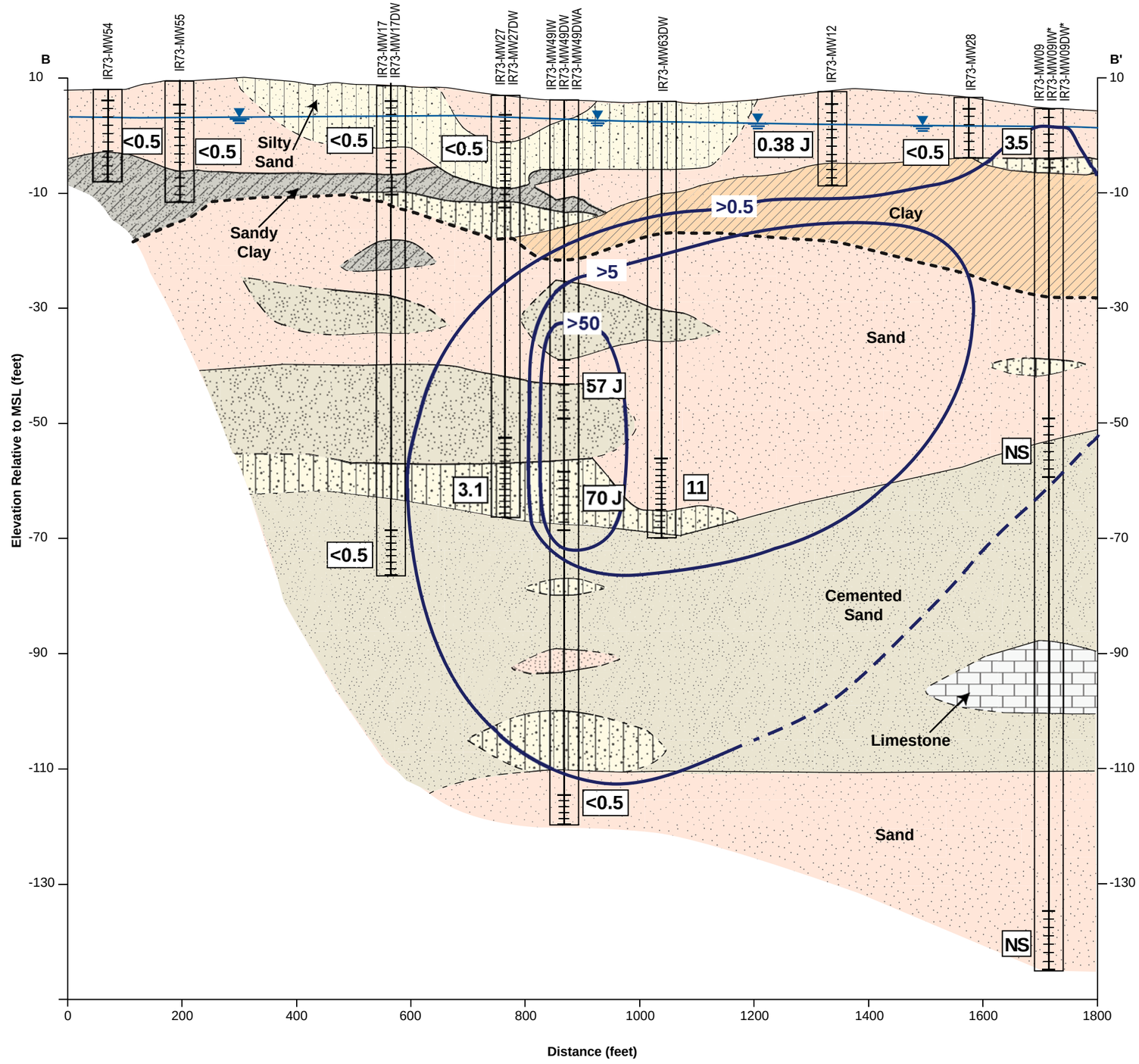
ES032009015MKE Figure5-10_CampLejeune_Site73_A-A'_v5.ai 03.24.09 sls



Horizontal : 1" = 200'
Vertical: 1" = 20'
V.E. = 10x

LEGEND

- Clay
- Silty Sand
- Cemented Sand
- Sand
- Sandy Clay
- Limestone
- Screened Interval
- Inferred Geologic Contact
- Water table elevation (Measured in water table wells within the Surficial aquifer)
- >0.5 VC Isocontour, µg/L
- J Estimated Value
- NS Not Sampled
- Inferred Surficial Aquifer/Castle Hayne Aquifer Contact

NOTE
1) The depth and thickness of the subsurface strata indicated on this section (profile) were generalized from and interpolated between test locations. Information on actual subsurface conditions apply only to the specific locations indicated. Subsurface conditions and water levels at other locations may differ from conditions occurring at the indicated locations.
2) All water levels were measured during sampling event in April 2006.
3) * Monitoring wells IR73-MW09IW and IR73-MW09DW abandoned prior to April 2006 sampling event.

Figure 5-11
Cross Sectional View of VC Distribution (B-B')
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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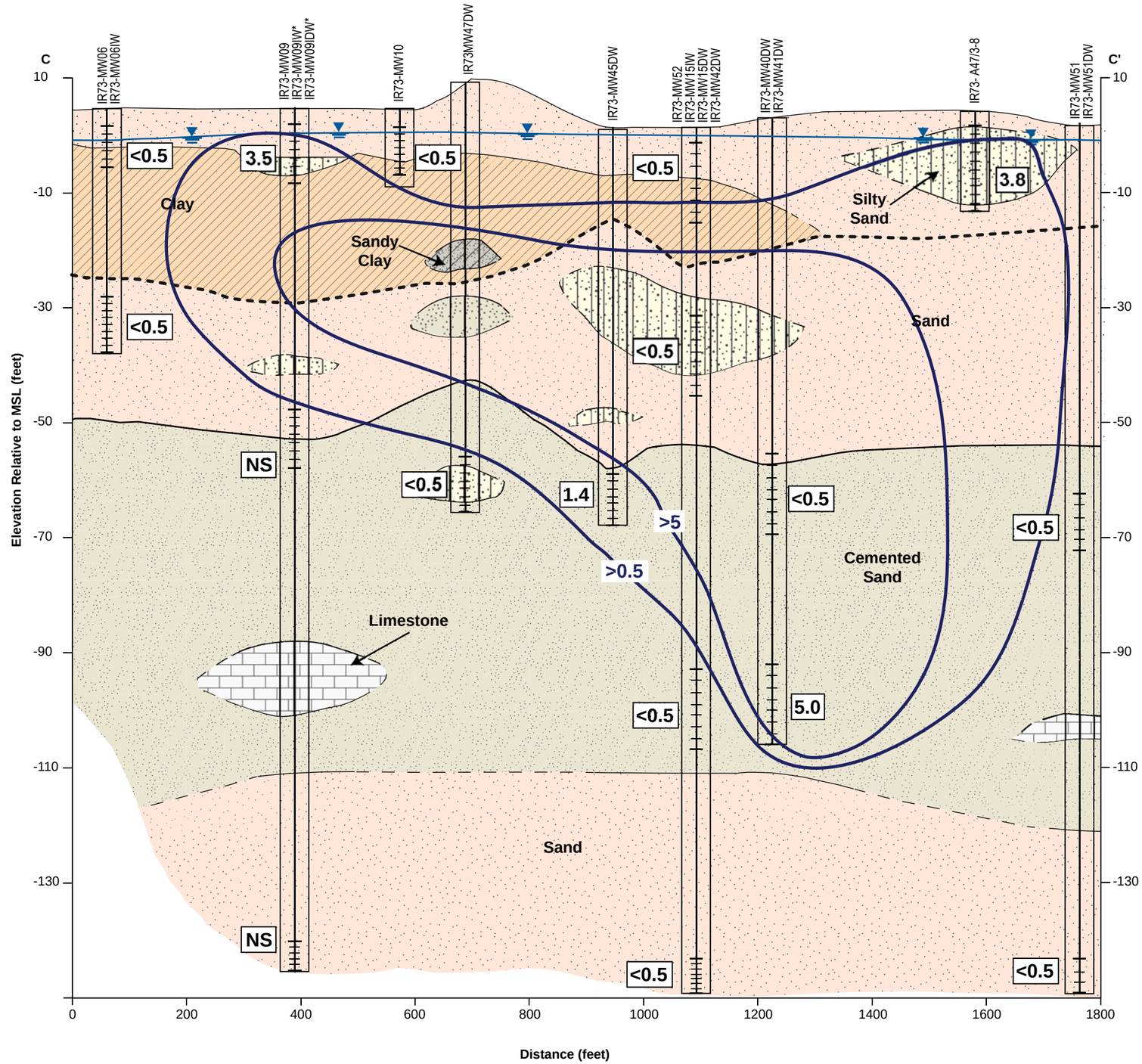
ES032009015MKE9MKE Figure5-11_CampLejeune_Site73_B-B'_v3.ai 03.19.09 sls



Horizontal : 1" = 200'
Vertical: 1" = 20'
V.E. = 10x

LEGEND

- Clay
- Silty Sand
- Cemented Sand
- Sand
- Sandy Clay
- Limestone
- Screened Interval
- Inferred Geologic Contact
- Water Table Elevation (Measured in water table wells within the Surficial aquifer)
- >0.5 VC Isocontour, µg/L
- NS Not Sampled
- Inferred Surficial Aquifer/Castle Hayne Aquifer Contact

NOTE
1) The depth and thickness of the subsurface strata indicated on this section (profile) were generalized from and interpolated between test locations. Information on actual subsurface conditions apply only to the specific locations indicated. Subsurface conditions and water levels at other locations may differ from conditions occurring at the indicated locations.
2) All water levels were measured during sampling event in April 2006.
3) * Monitoring wells IR73-MW09IW and IR73-MW09DW abandoned prior to April 2006 sampling event.

Figure 5-12
Cross Sectional View of VC Distribution (C-C')
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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ES032009015MKE Figure5-12_CampLejeune_Site73_C-C'_v4.ai 03.24.09 sls

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Well ID	Benzene
IR73-A47/3-09	3.3
IR73-A47/3-12	0.33 J
IR73-A47/3-15	0.5 U
IR73-A47/3-16	0.5 U
IR73-A47/3-19	0.5 U
IR73-A47/3-22	0.5 U
IR73-A47/3-8	2.8
IR73-MW01	0.5 U
IR73-MW02	0.5 U
IR73-MW02IW	0.5 U
IR73-MW03	0.5 U
IR73-MW06	0.5 U
IR73-MW08	0.5 U
IR73-MW09	0.5 U
IR73-MW10	0.5 U
IR73-MW11	0.5 U
IR73-MW12	0.5 U
IR73-MW13	2.9
IR73-MW15	0.5 U
IR73-MW15N	0.5 U
IR73-MW16	0.5 U
IR73-MW17	0.5 U
IR73-MW18	0.5 U
IR73-MW19	0.5 U
IR73-MW20	0.5 U
IR73-MW21	0.5 U
IR73-MW23	0.5 U
IR73-MW25	0.5 U
IR73-MW27	0.51
IR73-MW28	0.5 U
IR73-MW29	0.5 U
IR73-MW30	0.5 U
IR73-MW31	0.5 U
IR73-MW34	0.5 U
IR73-MW35	0.5 U
IR73-MW37	0.5 U
IR73-MW54	0.5 U
IR73-MW55	0.5 U
IR73-MW56	0.5 U
IR73-MW58	0.5 U
IR73-MW61	0.5 U
IR73-MW62DW	0.5 U

Well ID	Benzene
IR73-MW01DW	0.5 U
IR73-MW01IW	0.5 U
IR73-MW06IW	0.5 U
IR73-MW11DW	0.5 U
IR73-MW11IW	0.5 U
IR73-MW13DW	3.7
IR73-MW15IW	0.5 U
IR73-MW17DW	0.5 U
IR73-MW20DW	0.56
IR73-MW26DW	0.5 U
IR73-MW27DW	0.73
IR73-MW31DW	0.5 U
IR73-MW33DW	0.5 U
IR73-MW34DW	0.5 U
IR73-MW35DW	0.5 U
IR73-MW38DW	0.5 U
IR73-MW39DW	5.5 J
IR73-MW40DW	0.5 U
IR73-MW41DW	1.7
IR73-MW42DW	0.5 U
IR73-MW43DW	0.5 U
IR73-MW44DW	8.9
IR73-MW45DW	0.73
IR73-MW46DW	0.5 U
IR73-MW47DW	0.5 U
IR73-MW48DW	1.7
IR73-MW49DW	8.1
IR73-MW49DWA	0.5 U
IR73-MW49IW	5.1
IR73-MW50DW	5.7
IR73-MW51	0.5 U
IR73-MW51DW	0.5 U
IR73-MW52	0.5 U
IR73-MW52DW	0.51
IR73-MW53	0.5 U
IR73-MW63DW	5.0

Legend

- Monitoring Well
- Base Boundary
- Estimated Extent of Impacted Groundwater NCGWQS

U Not Detected
J Estimated Value

Note:
-NCGWQS for Benzene = 1.0 µg/L.
-All concentrations are reported in µg/L. Actual conditions may differ from those shown on this figure.
-Extent of contamination is approximate and is based on analytical data collected from monitoring wells screened at multiple depths in both the surficial and deep aquifers. Additional information illustrating the horizontal and vertical extent of impacts is provided in plume cross sectional views.
- * Monitoring wells not sampled
-IR73-MW14 not sampled due to free product in well

N

0 400 800 Feet

1 inch = 400 feet

Figure 5-13
Approximate Extent of Benzene Exceedances, April 2006
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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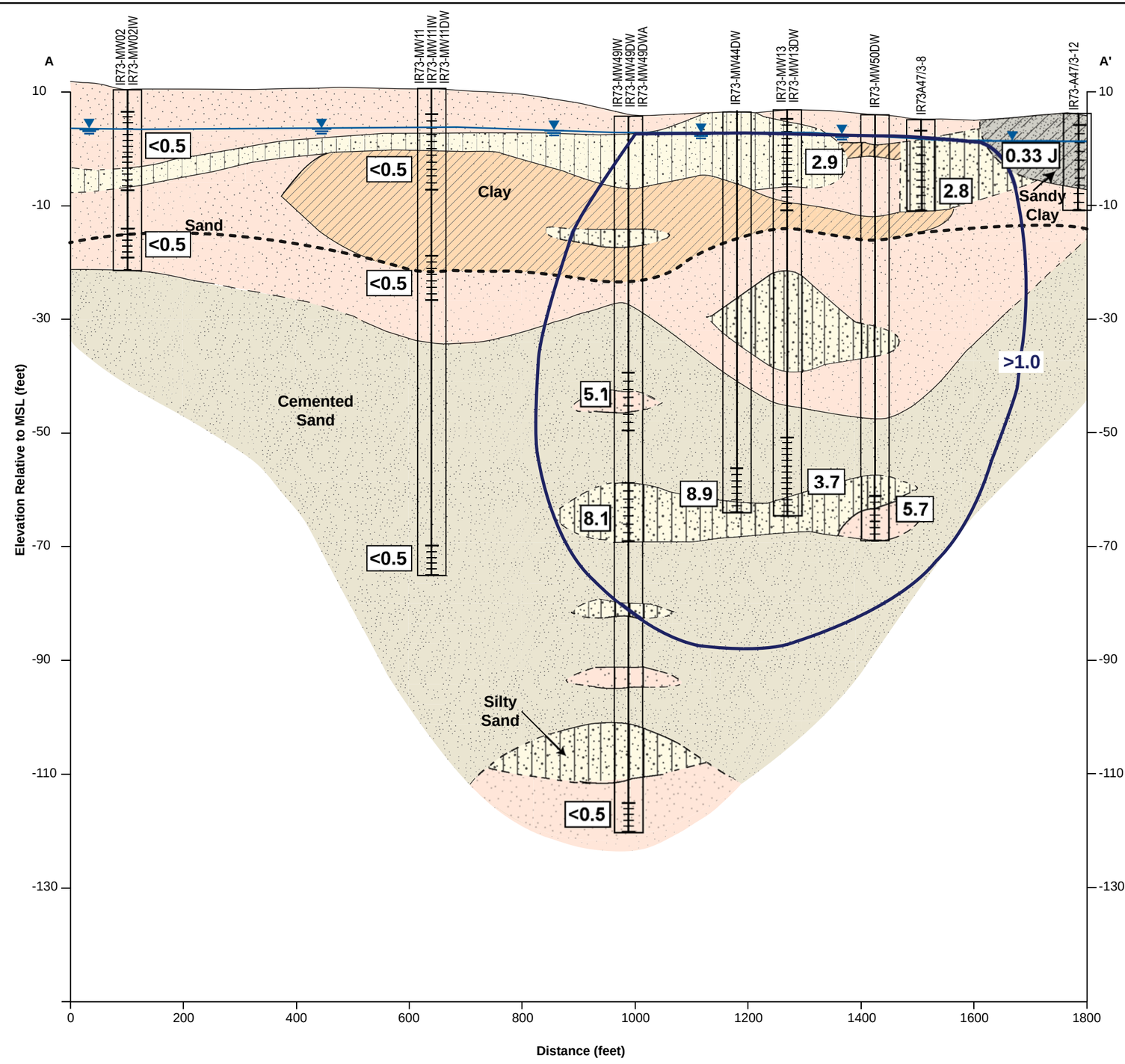

Horizontal : 1" = 200'
Vertical: 1" = 20'
V.E. = 10x

LEGEND

- Clay
- Silty Sand
- Cemented Sand
- Sand
- Sandy Clay
- Screened Interval
- Inferred Geologic Contact
- Water Table Elevation (Measured in water table wells within the Surficial aquifer)
- >1.0 Benzene Isocontour, µg/L
- J Estimated Value
- NS Not Sampled
- Inferred Surficial Aquifer/Castle Hayne Aquifer Contact

NOTE

1) The depth and thickness of the subsurface strata indicated on this section (profile) were generalized from and interpolated between test locations. Information on actual subsurface conditions apply only to the specific locations indicated. Subsurface conditions and water levels at other locations may differ from conditions occurring at the indicated locations.
2) All water levels were measured during sampling event in April 2006.

Figure 5-14
Cross Sectional View of Benzene Distribution (A-A')
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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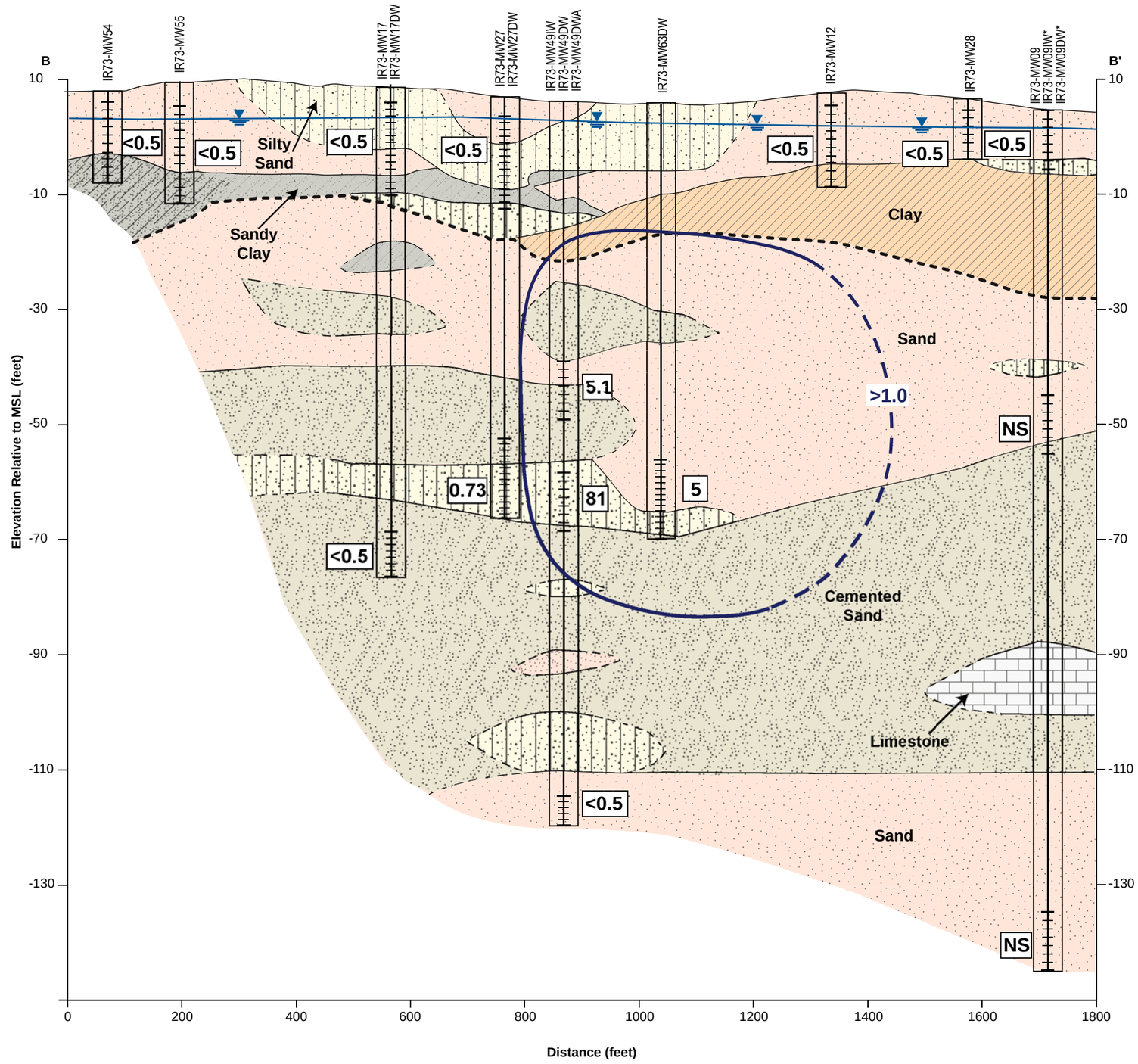
ES032009015MKE Figure5-14_CampLejeune_Site73_A-A'_v5.ai 03.24.09 sls



Horizontal : 1" = 200'
Vertical: 1" = 20'
V.E. = 10x

LEGEND

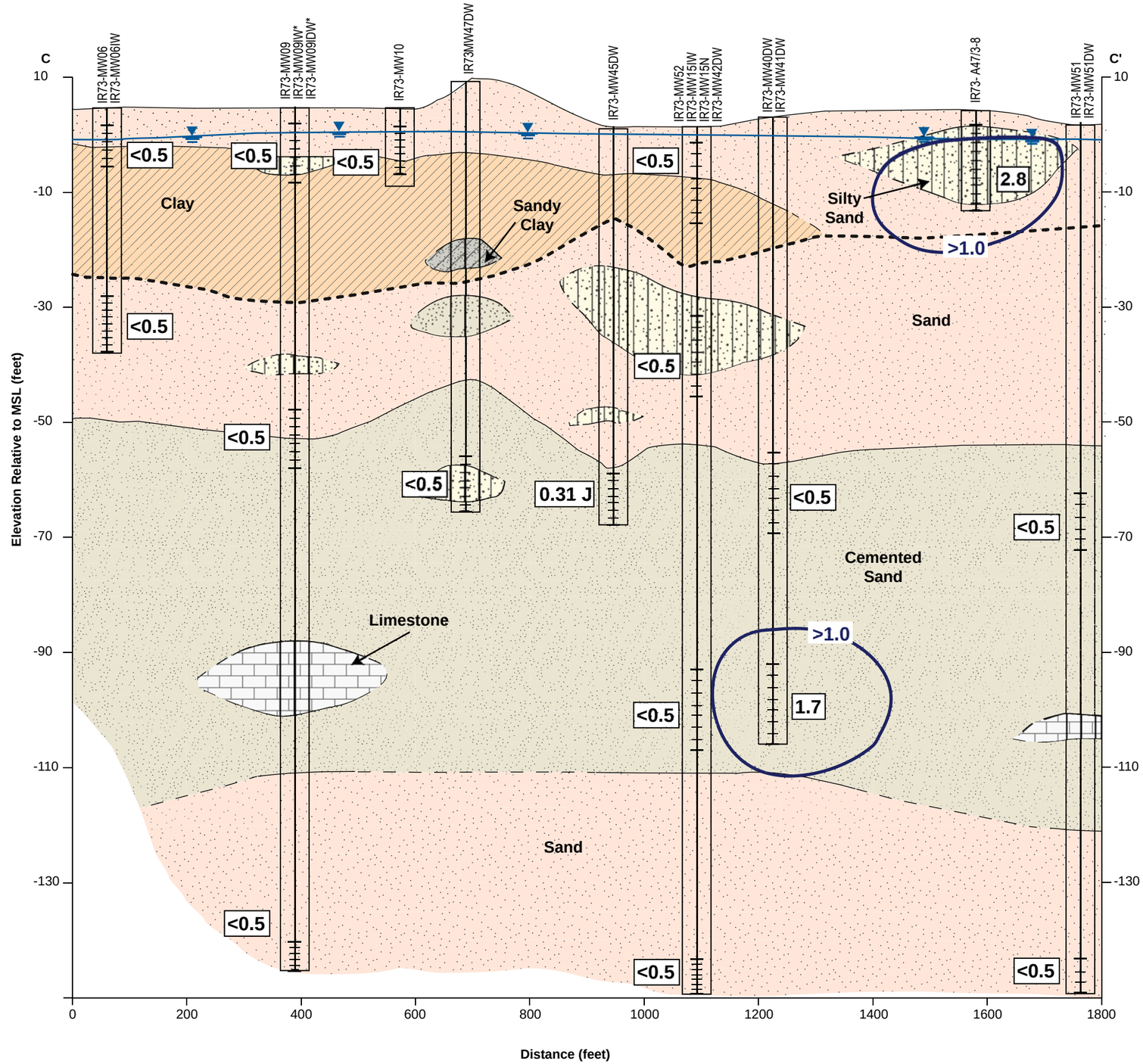
- Clay
- Silty Sand
- Cemented Sand
- Sand
- Sandy Clay
- Limestone
- Screened Interval
- Inferred Geologic Contact
- Water Table Elevation (Measured in water table wells within the Surficial aquifer)
- >1.0 Benzene Isocontour, µg/L
- NS Not Sampled
- Inferred Surficial Aquifer/Castle Hayne Aquifer Contact

NOTE
1) The depth and thickness of the subsurface strata indicated on this section (profile) were generalized from and interpolated between test locations. Information on actual subsurface conditions apply only to the specific locations indicated. Subsurface conditions and water levels at other locations may differ from conditions occurring at the indicated locations.
2) All water levels were measured during sampling event in April 2006.
3) * Monitoring wells IR73-MW09IW and IR73-MW09DW abandoned prior to April 2006 sampling event.

Figure 5-15
Cross Sectional View of Benzene Distribution (B-B')
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

CH2MHILL

ES032009015MKE Figure5-15_CampLejeune_Site73_B-B'_v3.ai 03.19.09 sls



Horizontal : 1" = 200'
Vertical: 1" = 20'
V.E. = 10x

LEGEND

- Clay
- Silty Sand
- Cemented Sand
- Sand
- Sandy Clay
- Limestone
- Screened Interval
- Inferred Geologic Contact
- Water Table Elevation (Measured in water table wells within the Surficial aquifer)
- >1.0 Benzene Isocontour, µg/L
- J Estimated Value
- NS Not Sampled
- Inferred Surficial Aquifer/Castle Hayne Aquifer Contact

NOTE
1) The depth and thickness of the subsurface strata indicated on this section (profile) were generalized from and interpolated between test locations. Information on actual subsurface conditions apply only to the specific locations indicated. Subsurface conditions and water levels at other locations may differ from conditions occurring at the indicated locations.
2) All water levels were measured during sampling event in April 2006.
3) * Monitoring wells IR73-MW09IW and IR73-MW09DW abandoned prior to April 2006 sampling event.

Figure 5-16
Cross Sectional View of Benzene Distribution (C-C')
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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ES032009015MKE Figure5-16_CampLejeune_Site73_C-C'_v5.ai 03.24.09 sls

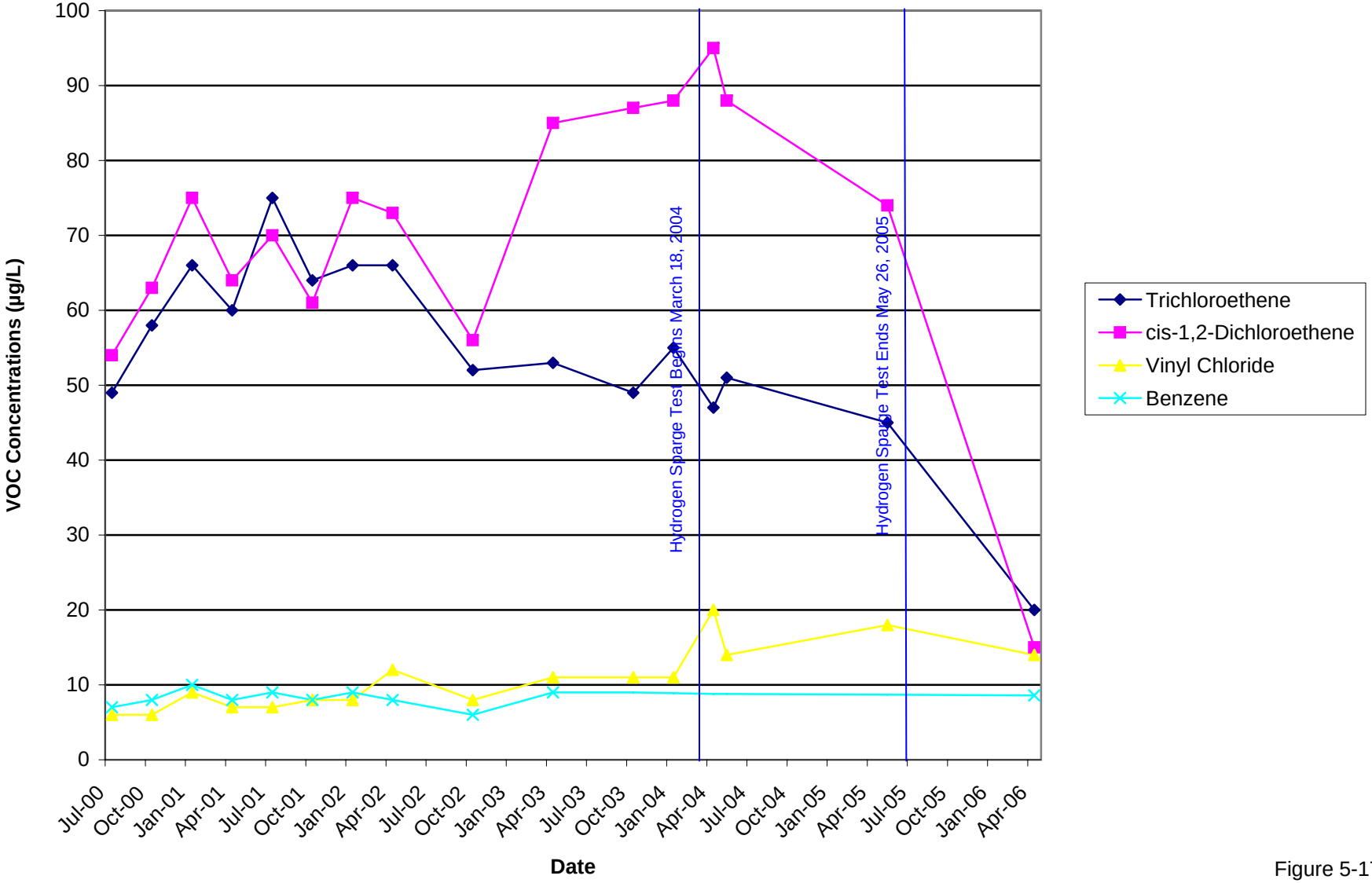

Figure 5-17
Historical Analytical Data, IR73-MW39DW
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune,
North Carolina

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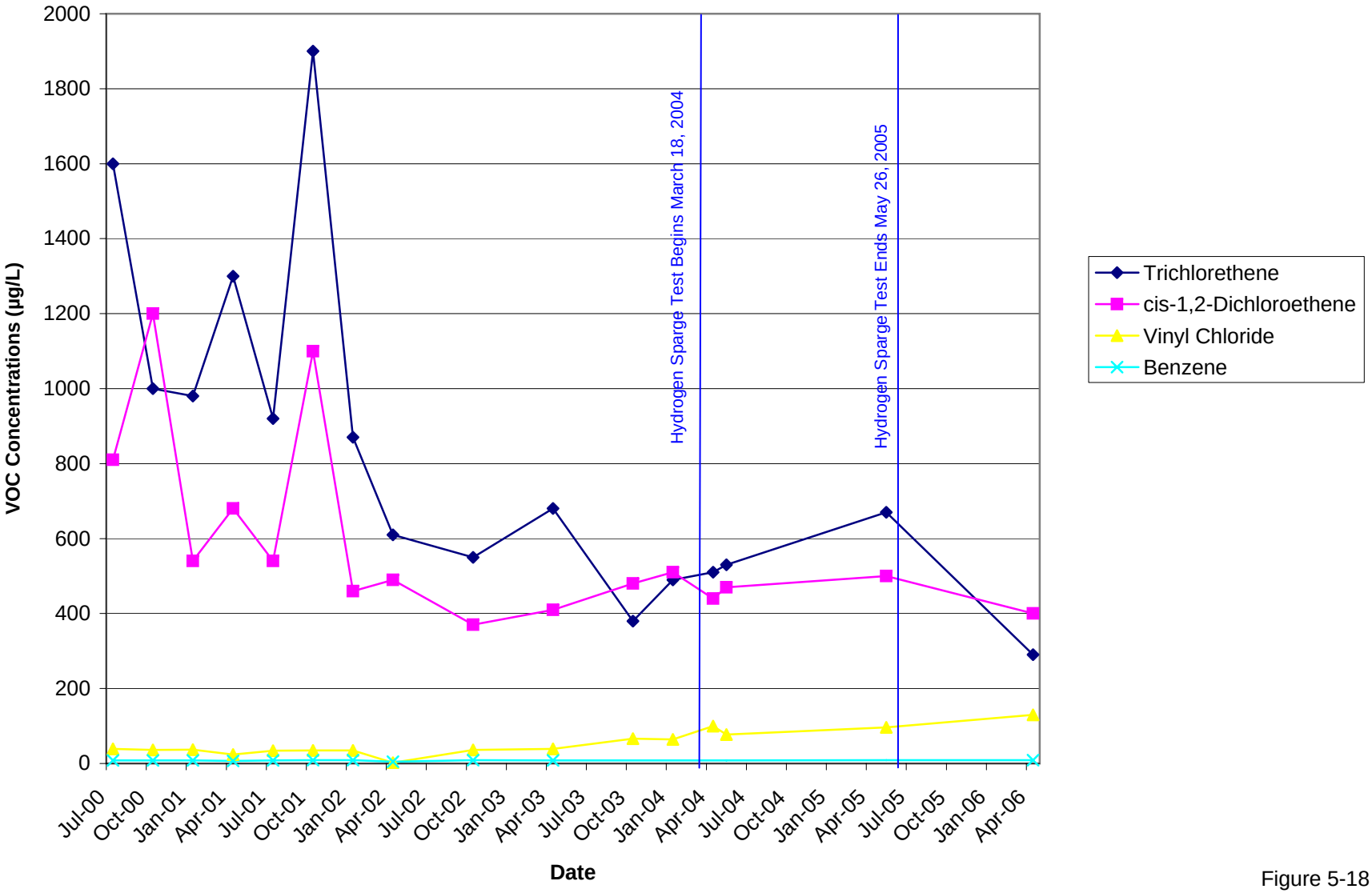

Figure 5-18
Historical Analytical Data, IR73-MW44DW
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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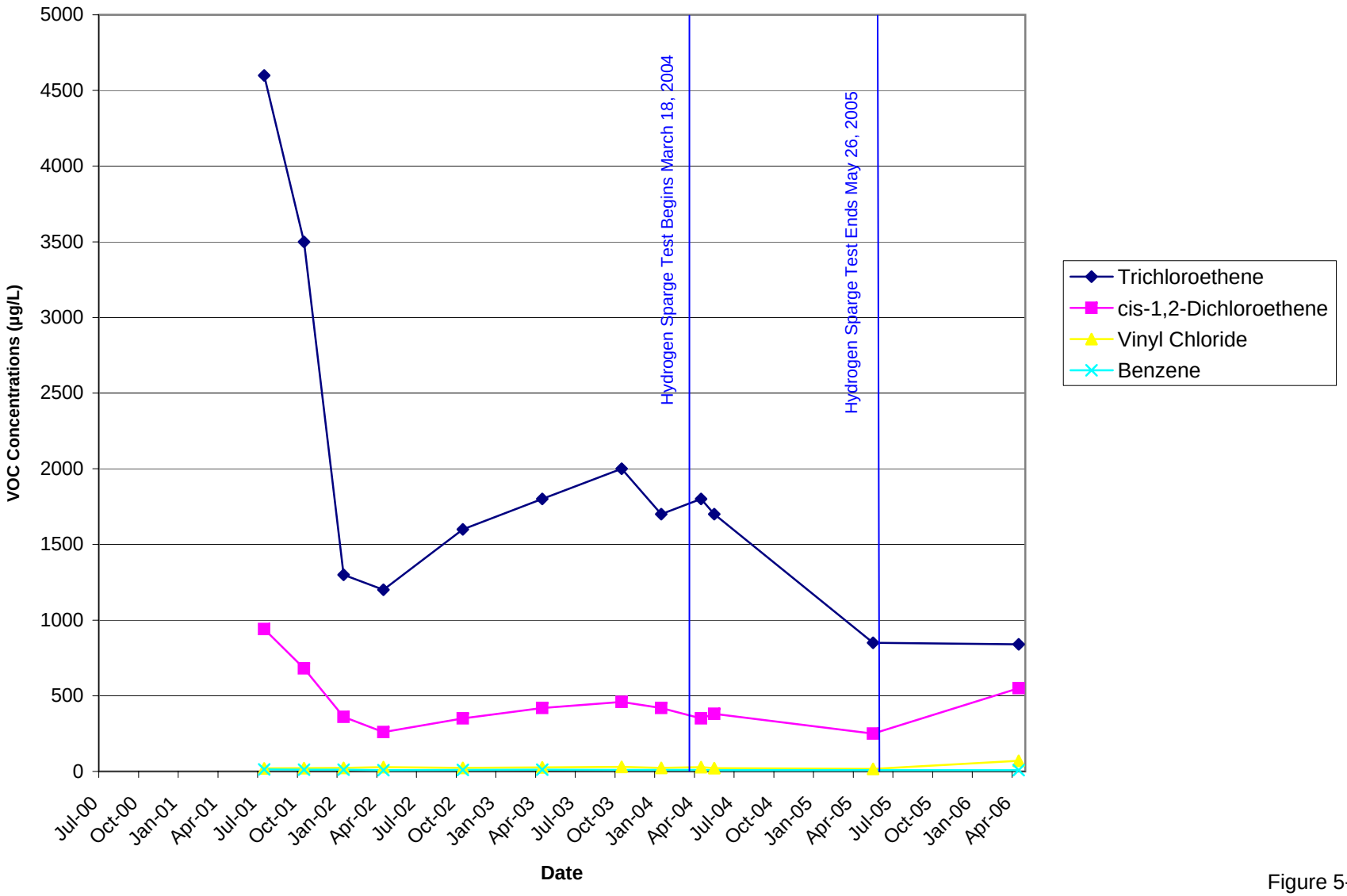

Figure 5-19
Historical Analytical Data, IR73-MW49DW
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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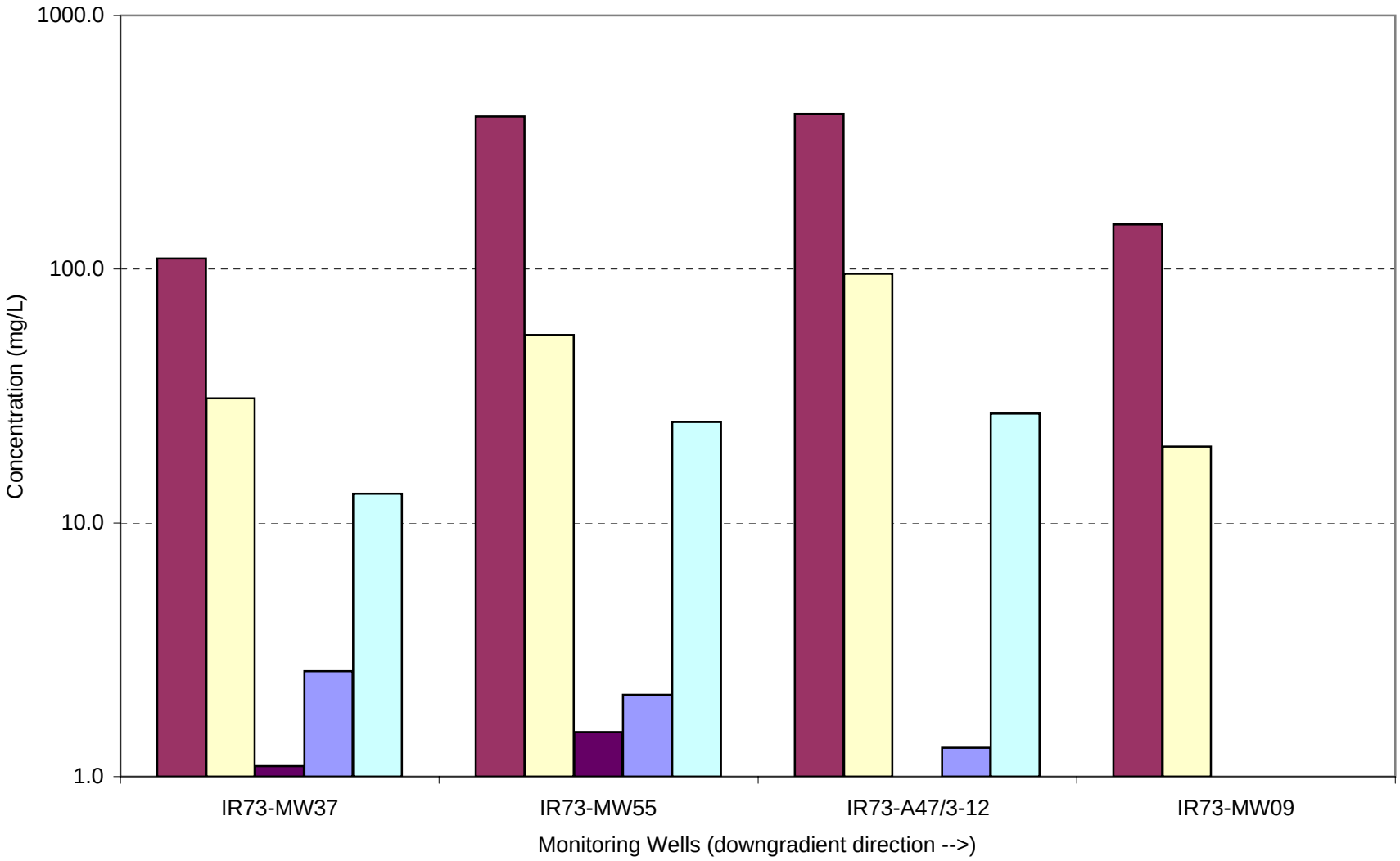

Alkalinity (as CaCO3)
Chloride
Methane
Ferrous Iron
Total Organic Carbon

Figure 5-20
Groundwater Geochemical Data from the Surficial Aquifer, April 2006
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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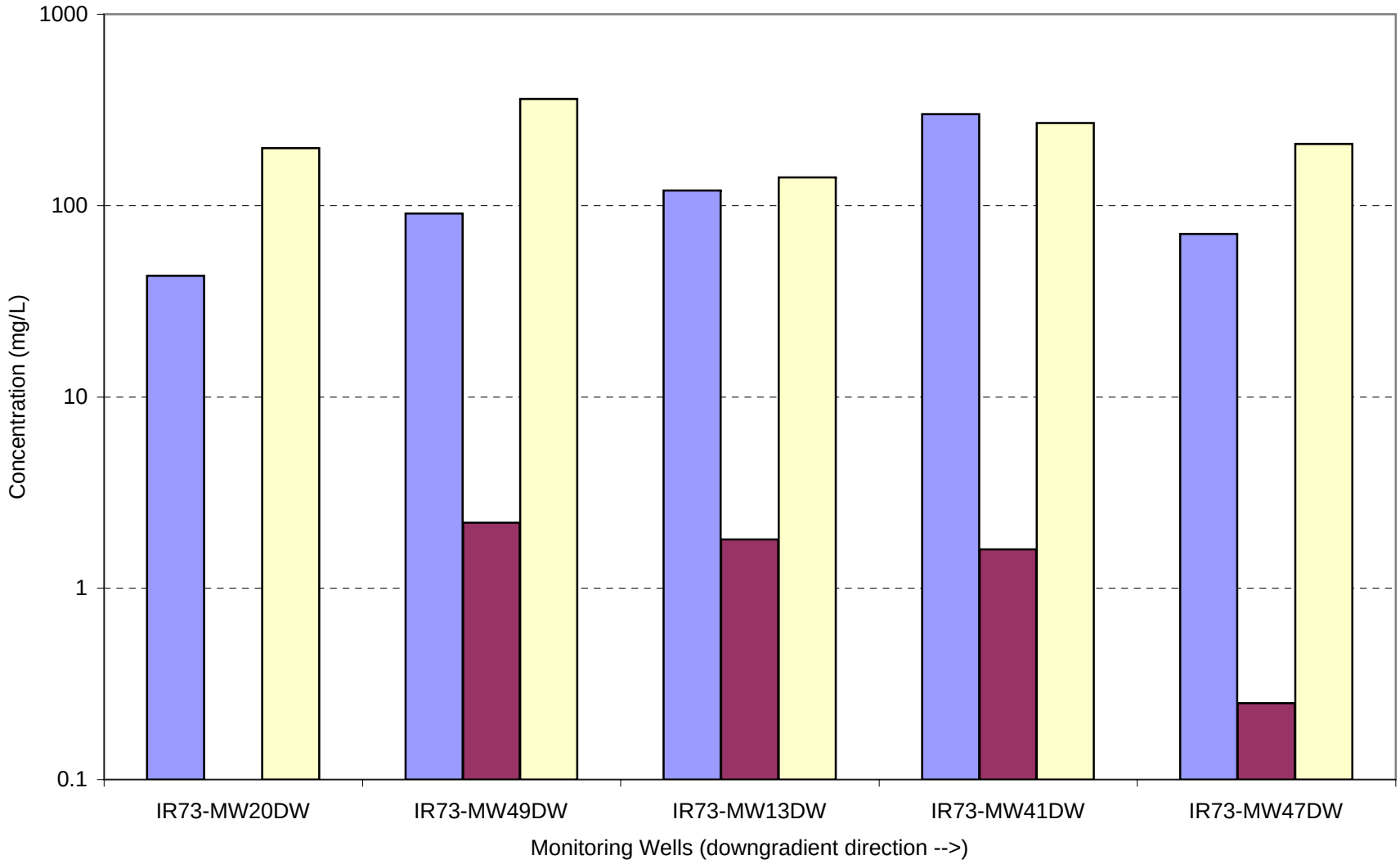

Chloride
Methane
Alkalinity

Figure 5-21
Groundwater Geochemical Data from the Castle Hayne Aquifer, April 2006
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

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SECTION 6

Contaminant Fate and Transport

The fate and transport of dissolved phase CVOCs and petroleum related compounds are discussed in this section, to support the nature and extent of contamination and to aid in defining remedial alternatives. Section 6.1 defines contaminant mobility and persistence and identifies the contaminant group(s) of interest at the site, the physical and chemical properties of those contaminants and the physical and hydraulic properties of the hydrogeologic units. Section 6.2 applies these predicted attenuation conditions to observed contaminant migration and attenuation at Site 73.

6.1 Contaminant Mobility and Persistence

The probable behavior of contaminants is determined by their physical, chemical and biological interaction with the environment. The mobility and persistence of the chemicals in the environment are two key characteristics in determining probable behavior. Mobility is the potential for a chemical to migrate from a site and persistence is a measure of how long a chemical will remain in the environment. Mobility and persistence of chemicals depend both on the physical and chemical characteristics of the contaminants and those of the hydrogeologic units. One important aspect of understanding the mobility and persistence of site contaminants is their predominant role in the evaluation of the extent at which natural attenuation is occurring at the site.

Natural attenuation, as defined by the USEPA Office of Research and Development and Office of Solid Waste and Emergency Response, is "the biodegradation, dispersion, dilution, sorption, volatilization, and/or chemical and biochemical stabilization of contaminants to effectively reduce contaminant toxicity, mobility, or volume to levels that are protective of human health and the environment." (USEPA, 1999).

6.1.1 Contaminant Groups

Organic constituents have been detected in soil and groundwater at this site. The nature and extent of these chemicals are discussed in detail in Section 5. As discussed in Section 5, the predominant site-related contaminants are CVOCs; however, a benzene plume originating from fuel-related hydrocarbon contamination also persists at the site. The fate and transport of the four most prevalent CVOCs (TCE, 1,1-DCE, cis-1,2-DCE, and VC) detected at Site 73 and benzene, are discussed in the following sections.

6.1.2 Physical and Chemical Properties of Representative Compounds

Various basic physical and chemical properties affect the transport of chemicals in the environment at this site. The following are considered to be the most important properties:

- Sorption
- Volatilization
- Degradation

- Bioaccumulation
- Liquids in non-aqueous phases

The following general and chemical-specific profiles briefly describe how the chemical and physical properties (e.g., water solubility, specific gravity) of the site-related organic compounds affect their mobility and persistence in the environment. **Table 6-1** contains data for the representative chemicals on the physical and chemical properties that are relevant to fate and transport. **Table 5-2** contains data on pH, conductivity, temperature, DO, ORP, and turbidity in groundwater obtained during sampling at Site 73. The processes acting on the site-related CVOCs are briefly described below.

Sorption

Sorption is the tendency for chemicals to adsorb to and desorb from materials in the media through which the contaminants are being transported. The subsurface materials likely to sorb chemicals typically are clays and organic material. The soils and sediments beneath Site 73 consist mainly of very fine to medium grained sand, with varying amounts of silt and clay. This material would be less likely to sorb chemicals.

The conventional measure of sorption is the distribution coefficient (K_d) of soil and geologic material for the chemical. The K_d for organic chemicals is the product of a partition coefficient (K_{oc}) of the chemical and the fraction of organic carbon in the soil. In general, chemicals with a K_{oc} greater than 10,000 milliliters per gram (ml/g), or a log K_{oc} greater than 5 (for example, many SVOCs) have high degrees of adsorption and consequentially low mobility, whereas chemicals with a K_{oc} lower than 1,000 ml/g or log K_{oc} lower than 3 (for example, many VOCs) have lower degrees of adsorption and consequentially higher mobility. Of all the site-related VOCs, TCE has the greatest log K_{oc}, thus a greater tendency for sorption relative to the other site-related VOCs. VC has the lowest log K_{oc}, thus a lower tendency for sorption relative to the other site-related VOCs. All five of the VOCs listed have similar log K_{oc} values and all are considered to have a medium to high mobility in soil. CVOCs in the non-aqueous and aqueous phase generally do not tend to partition into soil, but will remain or partition into the non-aqueous and aqueous liquids. The high mobility of these compounds indicates that leaching from soil to groundwater is likely. A higher K_{oc} also contributes to greater bioaccumulation.

The migration rates of different dissolved contaminants vary depending on a chemical's degree of adsorption. As a first estimate, dissolved contaminants will move at the rate of groundwater flow, or by advection.

Hydraulic conductivity tests performed at Site 73 indicate that the average hydraulic conductivity value for the sand and silty sand surficial aquifer ranges from approximately 1.3 to 12 ft/day and the average hydraulic conductivity for the Castle Hayne aquifer is approximately 3.6 ft/day. Using effective porosity values for silts and sands in the range of 25 to35 percent (Freeze and Cherry, 1979), average linear seepage velocities within the surficial aquifer were estimated to range from 0.137 to 0.192 ft/day (50 to 70 ft/year) and from 0.021 to 0.029 ft/day (8 to 10 ft/year) in the Castle Hayne aquifer.

Typically, contaminants will not move as rapidly as the groundwater because of adsorption of the contaminant on the geologic media. For each contaminant detected at the site, it is theoretically possible to calculate a retardation coefficient, which is an estimate of the degree

to which the contaminant is slowed by adsorption in relation to the groundwater flow velocity. Soil retardation coefficients for VOCs at Site 73 are listed in **Table 6-2**. The retardation coefficient is calculated according to the following equation:

$$R = 1 + p_b \times K_d / n_e$$

where:

R = Retardation coefficient (dimensionless)
p_b = Bulk density (grams per cubic centimeter)
K_d = Distribution coefficient (ml/g)
n_e = Effective porosity (dimensionless)

The effect of retardation is estimated by dividing the groundwater-flow velocity by R, which provides a value of migration that is either equal to the flow rate (in the case of no retardation) or less than the flow rate (in the presence of retardation).

For the reasons discussed earlier in this section, estimates of the rates of contaminant migration are approximate and the estimates of R have an even greater level of uncertainty than do the estimates of the rates of groundwater flow. Contaminant migration velocities can be approximated by modifying the Darcy Equation to utilize the available groundwater velocity data described in **Section 4.3.2** and the chemical specific properties presented in **Table 6-2.** The Darcy Equation can be used to calculate a groundwater velocity within a porous media as shown in the following equation.

$$V_L = (K \times i)/n_e$$

where:

V_L = Linear groundwater velocity [L/T}
K = Hydraulic conductivity [L/T]
i = Hydraulic gradient [dimensioless]
n_e = Effective porosity [dimensioless]

Contaminant migration velocity is the quotient of the linear groundwater velocity and the retardation factor as shown below

$$V_{COC} = V_L/R$$

where:

V_{coc} = Velocity of the Contaminant of Concern [L/T]
V_L = Linear groundwater velocity [L/T}
R = Retardation coefficient (dimensionless)

Approximate contaminant migration velocities for the associated COCs are listed in **Table 6-2.** Of all the COCs listed in **Table 6-2**, TCE will travel at the slowest rate due to the relatively higher retardation coefficient and the chemicals affinity to sorb onto, or partition into organic matter which may be coating aquifer media. Because VC has a retardation coefficient of 1.0, it will have a contaminant migration velocity comparable to ambient groundwater.

Volatilization

Volatilization is the tendency for some chemicals, particularly VOCs, to change from a liquid or adsorbed state to a gas. A conventional measure of volatility is Henry's Law Constant (K_h). Values of K_h for the representative chemicals are provided in **Table 6-1**.

Compounds with K_h values higher than 10^{-3} atmosphere-cubic meter per mole (atm-m^3/M) are expected to volatilize readily from water to air, whereas those with K_h values lower than 10^{-5} atm-m^3/M are relatively non-volatile.

The dominant process for removing CVOCs from shallow soil is volatilization into the atmosphere, indicated by this chemical group's relatively high vapor pressure and K_h. For this reason, CVOCs infrequently occur in shallow soil. CVOCs in shallow groundwater will likely volatilize into soil gas overlying the water table. The vapor pressure and K_h indicate that of the four site-related CVOCs, 1,1-DCE will volatilize at a significantly greater rate than the others, followed by VC, cis-1,2-DCE, and TCE.

Once in the atmosphere, CVOCs tend to remain in the gas phase. Some of the gaseous CVOCs, however, may be solubilized in water and fall as rain.

Degradation

Degradation is the transformation of one chemical to another either biotically (biodegradation) or abiotically through such processes as hydrolysis and photolysis. Biodegradation occurs when microorganisms convert one chemical to another as part of their respiration process. Hydrolysis is the reaction of a chemical with water and photolysis is the result of exposing the chemical to light.

Degradation is commonly expressed as a half-life that composites the degradation by whatever processes may be operating. Estimates of half-lives for the representative chemicals are provided in **Table 6-1**.

CVOCs can undergo biodegradation through three different pathways: use as an electron acceptor (reductive dechlorination) which occurs under anaerobic conditions, use as an electron donor (oxidation), or co-metabolism.

The most significant biodegradation process for TCE and cis-1,2-DCE occurs via reductive dechlorination (USEPA, 1998). During reductive dechlorination, which is usually microbially- mediated, CVOCs serve as electron acceptors contingent on the availability of an adequate supply of electron donors. Anthropogenic (that is, fuel hydrocarbons, landfill leachate, etc.) or natural organic carbon sources act as electron donors. A chlorine atom is removed from the CVOC during the process and is replaced with a hydrogen atom. CVOCs are eventually transformed into innocuous byproducts, such as carbon dioxide, ethane, ethene and water, as shown on **Figure 6-1**.

The rate of reductive dechlorination appears to decrease significantly as the degree of chlorination decreases. Thus, TCE tends to degrade more rapidly than cis-1,2-DCE and VC. These less chlorinated compounds have been found to degrade as electron donors under aerobic conditions.

Concentrations of parent (TCE at Site 73) and daughter products (1,1-DCE, cis-1,2-DCE, and VC at Site 73) and concentrations of natural attenuation indicator parameters are used to

evaluate whether reductive dechlorination is occurring at a site. The USEPA guidance document provides guidelines to assess whether concentrations of these compounds are low or high enough to suggest that reductive dechlorination or another biodegradation process is occurring at a site (USEPA, 1999).

Concentrations of daughter products and chloride ions that are greater than background concentrations or that increase downgradient through the plume indicate that reductive dechlorination may be occurring. Low concentrations of DO, nitrate, ferric (III) iron, sulfate and carbon dioxide also suggest reductive dechlorination is occurring. High concentrations of TOC and dissolved hydrogen are also indicative of active reductive dechlorination.

In addition to reductive dechlorination, cis-1,2-DCE and VC may also degrade via oxidation. Additionally, benzene typically degrades via oxidation. Increased concentrations of carbon dioxide, DO, dissolved hydrogen, and alkalinity above background concentrations may indicate that oxidation, as opposed to reduction, of these compounds is occurring. Ethene and ethane concentrations in excess of those indicated in the USEPA guidance document (USEPA, 1999) indicate that reductive dechlorination is occurring to VC.

Bioaccumulation

Bioaccumulation is the process of chemicals adsorbing to and accumulating in plants and the organ tissue of animals. This process is expressed as the octanol-water partition coefficient (K_{ow}), which is the ratio of the concentration of a chemical in octanol and in water at equilibrium and at a specified temperature. Octanol is an organic solvent that is used as a surrogate for natural organic matter. This parameter is used to help predict the fate of chemicals in the environment and the chemicals tendency to accumulate in biological material. SVOCs tend to have higher K_{ow} values and CVOCs tend to have lower K_{ow} values. This would indicate that VOCs would tend to remain in the aqueous phase and would not readily bioaccumulate.

The more highly chlorinated VOCs at Site 73, such as TCE, will tend to bioaccumulate slightly more readily than less chlorinated VOCs, such as 1,1-DCE, cis-1,2-DCE, and VC, which have a lower K_{ow} values.

Non-Aqueous Phase Liquids

Because of their relatively low solubility, CVOCs, with the exception of VC, can occur in aquifers as dense non-aqueous phase liquids (DNAPLs) when present in the undissolved free-phase form. They are referred to as dense because they are denser than water when present in free-phase and, therefore, will sink through the aquifer. The DNAPL will slowly partition (dissolve) into the surrounding groundwater at a rate and concentration dependent on the solubility of the compound, temperature, chemical characteristics of the groundwater and other factors.

Dissolved concentrations of CVOCs in groundwater at approximately 1 to 5 percent of a compound's solubility would suggest the presence of DNAPL in the subsurface. The maximum concentrations of TCE, 1,1-DCE, cis-1,2-DCE and VC observed in the April 2006 sampling event at Site 73 were 840 µg/L (IR73-MW49DW), 21 µg/L (IR73-MW44DW), 1,300 µg/L (IR73-MW49IW), and 130 µg/L (IR73-MW44DW), respectively. All of these compounds were present in concentrations less than 1 percent of their respective

solubilities, indicating that the presence of DNAPL TCE, 1,1-DCE, cis-1,2-DCE, and VC is not likely.

Light non-aqueous phase liquids (LNAPLs) associated with fuel-hydrocarbon contamination have been observed consistently in monitoring well IR73-MW14. Residual LNAPL exists in soils located beneath the paved area southeast of Building A47 which serves as a source of free product observed in the well. As with DNAPLs, LNAPLs will slowly dissolve into the surrounding groundwater at a rate and concentration dependent on the solubility of the compound, temperature, chemical characteristics of the groundwater and other factors. The maximum concentration of benzene observed in the April 2006 sampling event at Site 73 was 8.9 µg/L (IR73-MW44DW).

6.1.3 Physical Properties of the Aquifer

The following physical mechanisms are considered to be the most important aquifer properties in controlling the fate and transport of contaminants dissolved in groundwater during migration:

- Advection
- Dispersion

Advection is the transport of dissolved contaminants by the bulk motion of flowing groundwater. It is the primary transport mechanism for dissolved contamination along the hydraulic gradient. Advection controls the rate and direction of contaminant migration. The average groundwater flow velocity for shallow and deep groundwater at Site 73 has been calculated to be 38 to 70 ft/year and 5 to 10 ft/year, respectively. A slight downward hydraulic gradient exists, ranging from 0.005 to 0.054 ft/ft.

Dispersion is the spreading of dissolved contaminants from the path they would be expected to follow during advection. It results from the spatial variation in aquifer permeability, fluid mixing, and molecular diffusion. Dispersion primarily controls the concentration of the contaminant at any point in the flow system.

Dispersion occurs in moving groundwater because of local variations in flow velocities caused by the variability of the hydraulic conductivity of the porous media. Typically, the degree of dispersion is greater in the direction of groundwater flow than in directions perpendicular to it. The concentrations of the chemicals at the center of the contaminant plume will decrease as dispersion dilutes the contaminant mass. Some contaminants will migrate more rapidly than the center of mass of the concentration and some will migrate more slowly. The center of mass would move at the rate estimated by dividing the groundwater flow velocity by the retardation coefficient of the migrating chemical, as described earlier.

6.2 Contaminant Migration at Site 73

This section discusses the likely site-specific source area(s) at Site 73 and potential mechanisms for contaminant release and migration from that area.

Fundamental to describing fate and transport at the site is the conceptual site model (CSM), which is described in this section. The CSM qualitatively defines the various contaminant sources, release mechanisms, relative rates of migration and persistence of contaminants and migration pathways for contaminants at Site 73.

6.2.1 Source Areas

Based on field investigations associated with the SRI, the greatest contaminant concentrations are located beneath the paved area adjacent to Building A47. Subsurface soils contain significant concentrations of TPH and O&G that is likely the result of multiple spills over time associated with maintenance activities at the facility. Contaminants detected above standards in the surficial aquifer (TCE, VC, and benzene) appear to originate in the northeast portion of the concrete pad, in the vicinity of UST A47-3. The greatest concentrations of contaminants detected in the Castle Hayne aquifer (TCE, 1,1-DCE, cis-1,2-DCE, VC, and benzene) are generally detected at either monitoring well IR73-MW44DW or IR73-MW49DW, located between Building A47 and the approximate footprint of the former maintenance building and in the suspected vicinity of UST A47-1.

Elevated TPH, O&G, and CVOC concentrations between Building A47 and the approximate footprint of the former maintenance building suggest that contamination is a result of historic disposal activities conducted at Site 73, supporting conclusions drawn by previous SIs.

LNAPL exists in the area surrounding monitoring well IR73-MW14, and may be residual product resulting from historical disposal activities (used motor oil was discharged directly from the vehicles onto the ground surface at the former facility). It is also possible that the LNAPL is associated with UST A47-1, since the exact location and status of this tank are not known.

6.2.2 Releases from Soil to the Atmosphere

TPH and O&G have been detected above NC Action Levels in subsurface soils in the concrete parking area between Building A47 and Courthouse Bay at Site 73. Therefore, volatilization, which is the primary mechanism for releasing volatile contaminants from soil to the atmosphere, may be considered part of the potential contaminant release at Site 73. However, this is not probable due to the amount of time that the contamination has existed in the subsurface is considerable and volatiles have likely already been released.

6.2.3 Releases from Soil to Groundwater

Percolation of precipitation, both rainfall and snowmelt, through the unsaturated soil can dissolve contaminants and strip them from soil, then transport them to the underlying groundwater. Thus, surface and subsurface soil, which contain TPH and O&G above NC Action Levels, can serve as sources of contaminants to groundwater. The concrete pavement overlying the majority of the impacted soils limits the amount of surface water infiltration through the impacted soils.

6.2.4 Migration of Contaminants in Groundwater

This section addresses the migration of contaminants within the surficial and Castle Hayne aquifers and addresses potential downward migration into the Castle Hayne aquifer or lateral migration to sidegradient and downgradient surface water bodies.

General Conceptual Model of Groundwater Flow

Recharge to the Groundwater System. Stormwater runoff tends to drain directly south to Courthouse Bay, to the two small unnamed tributaries located east and west of the facility or to the retention ponds located west of Buildings A3, A9, A10, and A11, ultimately discharging to Courthouse Bay. Precipitation that falls within the vicinity of Building A47 will run off the surface towards the stormwater collection system, evaporate or transpire into the air, or infiltrate the surface of the ground. Most infiltration occurs in areas of the site that are grass or gravel covered and the ground is flat or has a low slope. The ground surface immediately surrounding Building A47 is paved causing precipitation to run off toward the stormwater drainage and collection systems. Site 73 is an industrial area covered mostly by buildings and other structures, asphalt, and concrete, designed to drain towards the retention ponds. While in the retention ponds, stormwater runoff infiltrates the surface of the ground. Undeveloped portions of the site, such as the western wooded areas, enable infiltration of precipitation, as well. Any infiltrating water moves by gravity downward through the vadose zone. At some depth (generally on the order of 2 to 13 ft bgs), the infiltrating water reaches the water table and enters the shallow groundwater system.

Hydrogeology of the Surficial Aquifer System. In general, the surficial aquifer system at Site 73 occurs within undifferentiated Quaternary and Miocene deposits, consisting of very fine to fine sands with varying amounts of silt. Thin, discontinuous silt and clay lenses are also present in the surficial aquifer. The surficial aquifer ranges in thickness from approximately 10 to 15 ft.

The surficial aquifer is separated from the Castle Hayne aquifer by a laterally discontinuous layer of gray clay with varying amounts of silt, and sand. This layer locally acts as confining unit, and ranges in thickness from approximately 0 to 23 ft. While relatively continuous over the central portion of the site, this layer is apparently absent in the eastern and western portions of the site. Where present, this layer is anticipated to retard groundwater flow surficial to the Castle Hayne aquifer. Conversely, where the confining unit is discontinuous or contains a greater sand content there exists the potential for movement of groundwater from the surficial to the Castle Hayne aquifer. The unit described here is a lower member of the Belgrade Fm.

The Castle Hayne aquifer predominantly consists of fine to medium grained sands with varying amounts of silt and calcareous shell fragments as well as trace amounts of clay. The aquifer also contains limestone and cemented sand layers that vary in the degree of consolidation from hard and recrystallized to loose beds of gravel-sized cemented sand clasts. The presence of shell-rich and limestone-cemented sand layers likely provide the most conductive zones within the Castle Hayne aquifer. The Castle Hayne aquifer is encountered at depths of approximately 15 to 30 ft bgs at the site. The Castle Hayne aquifer exists within the River Bend and Castle Hayne Fms.

Discharge from the Groundwater System. CVOCs and benzene were present in relatively low concentrations in the Site 73 shallow wells during the April 2006 sampling event with only VC and benzene exceeding their applicable NCGWQS in multiple monitoring wells. The benzene plume within the surficial aquifer is located in the northeast portion of the paved area between Building A47 and Courthouse Bay and appears to be associated with UST A47-3. The downgradient extent of the benzene plume within the surficial aquifer appears to be the eastern edge of pavement between Building A47 and Courthouse Bay. The CVOC plume within the surficial aquifer, consisting mostly of VC, is generally concentrated in the same area as benzene. The downgradient extent of the CVOC plume within the surficial aquifer appears to be Courthouse Bay, extending as far south as the end of Courthouse Road, near monitoring well IR73-MW09.

Higher CVOC and benzene concentrations were detected in the Castle Hayne aquifer. Within the Castle Hayne aquifer, CVOCs were detected primarily in the paved area between Building A47 and Courthouse Bay, the location of former liquids disposal activities. The downgradient extent of the CVOC plume within the Castle Hayne aquifer appears to be Courthouse Bay, southeast of Building A47, near monitoring well IR73-MW45DW. The benzene plume within the Castle Hayne aquifer is also located beneath the paved area between Building A47 and Courthouse Bay and appears to be in the vicinity of UST A47-1. The downgradient extent of the benzene plume within the Castle Hayne aquifer appears to be the paved roadway between the amphibious vehicles parking area and Courthouse Bay, near IR73-MW41DW. The maximum concentration of VOCs within the Castle Hayne aquifer at Site 73 was reported at well IR73-MW44DW, located southeast of Building A47 in the center of the paved area between the building and Courthouse Bay.

The presence of CVOCs and benzene within the surficial and Castle Hayne aquifers during the April 2006 sampling event and the groundwater flow direction within both aquifers suggest that the plume is migrating toward Courthouse Bay.

Conceptual Model of Contaminant Transport. Previous sections have described how contamination was released and transported to the groundwater and how groundwater moves at the site. In this section, the migration of contaminants in groundwater at Site 73 is described. First, the upgradient contamination conditions are discussed. These conditions provide a background against which possible effects of the site on the groundwater can be evaluated. Then the migration of contamination through the groundwater underlying the source area and the likely effects of the site on the groundwater, including biological and abiotic degradation, are discussed. Finally, the potential for discharge of contaminated groundwater to surface water is discussed.

Upgradient Groundwater. Shallow groundwater flow upgradient of the Site 73 source area is generally to the south-southeast towards Courthouse Bay; however, localized mounding exists around Buildings A3 and A11 and the stormwater retention ponds, creating radial flow around this location. Groundwater flow within the Castle Hayne aquifer is generally southeast towards Courthouse Bay. Neither CVOCs nor benzene were detected at concentrations exceeding NCGWQS in upgradient (northwest of Building A47) wells in either the surficial or Castle Hayne aquifer.

Source Area Groundwater. CVOC and benzene impacted groundwater within the vicinity of Building A47 exists in the surficial aquifer, but is more prevalent in the Castle Hayne

aquifer. Based upon the groundwater flow direction in the surficial and Castle Hayne aquifers, migration of the CVOCs and benzene is southeastward toward Courthouse Bay.

A factor that would decrease the apparent migration rate of contaminants in the groundwater is degradation, biological or otherwise. The presence of 1,1-DCE, cis-1,2-DCE, and VC in wells during the April 2006 sampling event indicates that TCE is actively degrading. The mass concentrations of daughter products are similar to TCE concentrations in most cases.

Vertical migration of the VOCs is occurring at Site 73 as evidenced by the presence of VOCs in wells screened in the Castle Hayne aquifer. As discussed in Section 3.3.2, downward vertical potentials have been measured between the surficial and Castle Hayne aquifers. Benzene and VC concentrations above their respective NCGWQS are reported as deep as 110 ft bgs in monitoring well IR73-MW41DW, located on the tank trail adjacent to Courthouse Bay. VOCs were not detected above laboratory reporting limits in monitoring wells IR73-MW38DW and IR73-MW42DW, located in the vicinity of IR73-MW41DW and also screened to 110 ft bgs. No contaminants were detected above laboratory detection limits in samples collected from monitoring wells screened from 145 to 150 ft bgs (IR73-MW26DW, IR73-MW51, IR73-MW52, and IR73-MW53).

Downgradient Groundwater. Site 73 is bordered downgradient by Courthouse Bay, which is the ultimate location for nearly all surface water and groundwater associated with the site. Multiple shallow and deep wells located adjacent to Courthouse Bay were sampled during the SRI activities. Within the surficial aquifer, most VOCs were not detected along Courthouse Bay; however, VC was detected above NCGWQS in IR73-MW09, located south of the source area near the end of Courthouse Road. VOCs were not detected in the majority of groundwater samples collected from the Castle Hayne aquifer wells adjacent to Courthouse Bay or were detected below standards, with the exception of benzene in monitoring well IR73-MW41DW, TCE in monitoring well IR73-MW45DW, and VC in monitoring wells IR73-MW41DW, IR73-MW45DW, and IR73-MW52DW.

6.3 BIOCHLOR Modeling

Predictive modeling was conducted as part of the SRI to estimate the time for groundwater impacts to achieve NCGWQS via natural attenuation and the potential for CVOC concentrations to reach Courthouse Bay. Groundwater fate and transport modeling was performed for Site 73 using BIOCHLOR Version 2.2 (Aziz et al., 2002).

BIOCHLOR is a screening level model that utilizes the three dimensional analytical model by Domenico (1987). BIOCHLOR can simulate one-dimensional advection, three-dimensional dispersion, linear adsorption and biotransformation via reductive dechlorination. Reductive dechlorination is assumed to occur under anaerobic conditions and dissolved solvent degradation is assumed to follow a sequential first-order decay process.

It should be noted the model used in this evaluation is a screening level model and is meant to be used only as a decision-making tool. Further, the model is not designed to account for complexities such as multiple source areas, the presence of additional carbon sources (such as petroleum products) and previously implemented remedial actions. Therefore, results of

the model evaluation should only be used as estimates when evaluating remedial technologies and not as actual future concentrations.

6.3.1 Model Development

For purposes of this evaluation, only the flow path in the Castle Hayne aquifer was modeled, as CVOC concentrations are relatively low in the surficial aquifer. The flow path was selected parallel to groundwater flow from the source area to a potential point of discharge at Courthouse Bay. The intent of flow path selection was to select a flow path along the centerline of the contaminant plume. The model was set up with a plume centerline that runs from monitoring well IR73-MW49DW (source area) south through monitoring well IR73-MW63DW and through monitoring well IR73-MW47DW to Courthouse Bay. This flow path intersects Courthouse Bay approximately 700 ft downgradient of the source area.

6.3.2 BIOCHLOR Model Calibration

Based on available groundwater data collected during the SRI sampling event in April 2006, the model was calibrated to groundwater concentrations along the plume centerline described in Section 6.3.1.

Model inputs include: the source area decay coefficient, constituent half-life (biological decay rate), release date, initial source area concentration, source zone width and thickness, soil density, fraction organic carbon, constituent partition coefficients, aquifer hydraulic conductivity, hydraulic gradient, effective porosity, and longitudinal dispersivity. The individual decay coefficients for the model were estimated by model calibration using constituent half-lives. Initial source area concentrations were also estimated by model calibration. A summary of model inputs and calibration data is provided in **Table 6.3**.

The BIOCHLOR model can be set up to include up to two biodegradation zones. This allows the individual decay constants to be varied within the plume. A two-zone model is appropriate for plumes that undergo rapid biodegradation near the source area, but lower rates of degradation further downgradient. However, a two-zone model can only be used when the plume is a steady state near the source area, meaning the source is constant. This assumption is not appropriate for plumes where source area concentrations are relatively low and DNAPL is not present.

The Site 73 model was set up as a single zone model such that decay coefficients (estimated by constituent half-lives) remained constant in the upgradient and downgradient portions of the plume. The single zone approach was chosen following review of the concentration profiles along the plume centerline.

Historical time-series data from the source area was used to estimate the source area decay rate. The source area decay rate was estimated by plotting constituent concentrations in the source area well (IR73-MW49DW) on a logarithmic scale versus time and fitting a trendline. The slope of the trendline is the estimated source area decay rate. The source area decay rate was estimated from this calculation to be 0.3/yr. The high decay rate may be attributable to the presence of additional carbon in the aquifer related to the detected petroleum compounds. However, this high decay rate yielded unreasonably high initial source area

concentrations during model calibration. Therefore, the source area decay rate was decreased to 0.1/yr for modeling purposes.

The initial source concentrations for TCE (46,000 µg/L), cis-1,2-DCE (30,000 µg/L), and VC (4,000 µg/L) were based on a release date of 1966, which was estimated based on the site history.

The half-lives estimated through model calibration were 2.5 years for TCE, 0.80 years for cis-1,2-DCE and 0.50 years for VC. These half-lives are generally within the range of published literature values.

Model inputs and the results of the model calibration are shown in the calibration run included in **Table 6-3** and **Appendix H.** The constituent concentrations detected in each well generally match the constituent concentrations predicted by the model.

6.3.3 BIOCHLOR Model Prediction

The calibrated model was used to predict constituent concentrations and the maximum plume extent for each constituent at dates of 2026 (20 years from present), 2046 (40 years from present), 2066 (60 years from present), 2076 (70 years from present), and 2086 (80 years from present). The results are summarized in **Table 6-4** and the model runs are provided in **Appendix H.**

The model predicts TCE, cis-1,2-DCE, and VC will each attenuate below the NCGWQS standards within the next 40 to 130 years. Specifically, the model predicts TCE will fall below the NCGWQS standard of 2.8 µg/L within approximately the next 60 years, cis-1,2-DCE will fall below the NCGWQS standard of 70 µg/L within approximately the next 40 years, and VC concentrations will fall below the groundwater standard of 0.015 µg/L within approximately the next 130 years. It should be noted, however, the presence of petroleum compounds within the aquifer may speed reductive dechlorination by acting as an additional carbon source.

In addition, results of the modeling indicate TCE, cis-1,2-DCE, and VC may reach Courthouse Bay at concentrations of 3 µg/L, 1 µg/L, and 1 µg/L, respectively. These predicted concentrations are well below the surface water standards for TCE (92.4 µg/L), cis-1,2-DCE (13,000 µg/L), and VC (2.4 µg/L). Therefore, the contaminant concentrations present at Site 73 are not expected to reach Courthouse Bay above surface water standards in the future.

Table 6-1
Physical, Chemical, and Half-Life Data of COCs
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

CHEMICAL	Molecular Weight (g/mole)	Specific Gravity (unitless)	Water Solubility (mg/L)	Vapor Pressure (mm Hg) @ 25°C	K_h (atm-m^3/ mole)	kP_a	Log K_{oc} (ml/g)	Log K_{ow} (ml/g)	Half-Life Range (days)					
									Soil		Groundwater		Surface Water	
									Low	High	Low	High	Low	High
Volatile Organic Compounds														
Trichloroethene	131.39 (1)	1.46 (1)	1100 (1)	57.8 (1)	0.00892 (5)	NA	2.10 (5)	2.42 (5)	180 (2)	365 (2)	320 (2)	1,640 (2)	180 (2)	365 (2)
1,1-Dichloroethene	96.94 (8)	1.2129 (8)	400 (5)	500 (5)	0.154 (5)	NA	1.81 (5)	2.13 (5)	2.33 (9)		2.33 (9)		0.01875 (9)	
Cis-1,2-Dichloroethene	96.94 (1)	1.28 (5)	3500 (5)	200 (5)	0.0075 (5)	NA	1.50 (5)	1.86 (5)	28 (2)	180 (2)	56 (2)	2,875 (2)	28 (2)	180 (2)
Vinyl Chloride	62.50 (7)	0.91 (7)	1100 (7)	2660 (7)	0.0265 (7)	NA	0.39 (7)	0.60 (7)	Rapid (9)		18 (9)		0.0194 (9)	
Benzene	78.11 (8)	0.8787 (8)	1780 (5)	76 (5)	0.00543 (5)	NA	1.81 (5)	2.13 (5)	100 (9)		1.4 (9)		0.026 (9)	

Notes:
K_{oc} = Organic carbon partition coefficient
K_{ow} = Octanol-water partition coefficient
K_h= Henry's Law Constant
U = No value is provided because of the uncertainty in the form of these chemicals in the environment.
NA = Indicates parameter not appropriate for the chemical

Data sources:
(1) Montgomery and Welkom. 1989. Groundwater Chemicals Desk Reference. Volume 1.
(2) Howard, Ph. H. et al. 1991. *Handbook of Environmental Degradation Rates.*
(3) Region III BTAG Screening Levels. Interim Draft, 1/19/95
(4) Dragun, James. 1998. *The Soil Chemistry of Hazardous Materials2nd Edition*. Kd estimates, not Koc
(5) United States Environmental Protection Agency. October 1990. *Subsurface Contamination Reference Guide.*
(6) Little, A.D. 1987. The Installation Restoration Toxicity Guide. United States Air Force System Command, Wright-Patterson Air Force Base.
(7) Montgomery, John H. 1996. Groundwater Chemicals Desk Reference. Second Edition.
(8) Spectrum Laboratories Chemical Fact Sheets. http://www.speclab.com/compound/
(9) Montgomery, John H. Groundwater Chemicals Desk Reference. Third Edition.

Table 6-2
Soil Retardation Coefficients for Representative Chemicals
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Chemicals	Log K_{oc} (mL/g)	K_d (mg/g)	R (dimentionless)	V_{coc} (ft/day)	
				Surficial aquifer	Castle Hayne aquifer
Trichloroethene	2.10	0.15	2.40	0.043 to 0.080	5.83×10^{-3} to 0.012
1,1-Dichloroethene	1.81	0.08	1.72	0.061 to 0.113	8.24×10^{-3} to 0.017
Cis-1,2-Dichloroethene	1.50	0.04	1.35	0.074 to 0.137	0.010 to 0.021
Vinyl Chloride	0.39	0.00	1.03	0.104 to 0.192	0.014 to 0.029
Benzene	1.81	0.08	1.72	0.061 to 0.113	8.24×10^{-3} to 0.017

Notes:
K_{oc} = Organic carbon partition coefficient
K_d = Distribution coefficient
R = Retardation coefficient = $1 + K_d \times p_b / n_e$
p_b = Soil bulk density = 1.85 grams per cubic centimeter
n_e = Effective porosity = 0.20
V_{coc}= Contaminant migration velocity (ft/day)
NA = Not applicable; K_d provided
For organics, $K_d = K_{oc}$ x fraction of organic carbon, estimated to be 0.0012 for soil based on site-specific measurements
cited in Woodward-Clyde, et. al., August 1990. *Multimedia exposure Assessment Model (Multimed) for Evaluating the Land Disposal of Wastes -- Model Theory.*

Table 6-3
Summary of BIOCHLOR Input and Calibration
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

Input Parameters

Parameter	Value	Units	Basis
Hydraulic Conductivity	0.002	cm/sec	Calculated from site data
Hydraulic Gradient	0.002	ft/ft	Calculated from site data
Effective Porosity	0.2	-	Typical of site soils; model calibration
Longitudinal Dispersivity	18.677	ft	Calculated from estimated plume length using Xu and Eckstein equation
Transverse Dispersivity Ratio	0.1	-	Default
Vertical Dispersivity Ratio	1.E-99	-	Conservatively assumes little vertical dispersion
Soil Bulk Density	1.6	kg/L	Typical of site soils; model calibration
Fraction Organic Carbon	0.001	-	Typical of site soils; model calibration
PCE Partition Coefficient	426	L/kg	BIOCHLOR Default Value
TCE Partition Coefficient	130	L/kg	BIOCHLOR Default Value
DCE Partition Coefficient	125	L/kg	BIOCHLOR Default Value
VC Partition Coefficient	30	L/kg	BIOCHLOR Default Value
Ethene Partition Coefficient	302	L/kg	BIOCHLOR Default Value
TCE Half-Life	2.5	years	Literature values; model calibration
DCE Half-Life	0.8	years	Literature values; model calibration
VC Half-Life	0.50	years	Literature values; model calibration
Simulation Time	40	years	Release date of 1966 based on site history; model calibration
Model Area Width	500	ft	Potential plume width
Modeled Area Length	800	ft	Distance along plume centerline from source to unnamed stream
Source Thickness in Saturated Zone	50	ft	Estimated based on site conditions; model calibration
Width	110	ft	Estimated source width; model calibration
Source Area Decay Rate	0.1	1/yr	Estimated based on historical data; model calibration
Initial TCE Concentration	46,000	µg/L	Estimated based on site conditions; model calibration
Initial DCE Concentration	30,000	µg/L	Estimated based on site conditions; model calibration
Initial VC Concentration	4,000	µg/L	Estimated based on site conditions; model calibration

Model Calibration

		TCE		DCE		VC	
Well ID	Distance from Source Area (ft)	Model Predicted (µg/L)	Actual (µg/L)	Model Predicted (µg/L)	Actual (µg/L)	Model Predicted (µg/L)	Actual (µg/L)
73-MW49DW	Source	843	840	550	550	73	70
73-MW63DW	110	580	540	223	210	117	11
73-MW47DW	530	35.5	1.8	12.3	2.1	6.2	<0.5

Notes:
TCE = Trichloroethene; DCE = cis-1,2-Dichloroethene; VC = Vinyl Chloride
Actual Concentrations based on data collected in April 2006.

Table 6-4
Summary of BIOCHLOR Predictions
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
MCB Camp Lejeune
North Carolina

TCE (Initial Source Concentration 46,000 µg/L)

Date	Maximum Concentration (µg/L)	Distance from Source of Maximum Concentration (ft)	Maximum Plume Extent (ft)	Concentration at Courthouse Bay (µg/L)
2026	114	Source	265	Below SW Standard
2046	15.4	Source	250	Below SW Standard
2066	Below GW Standard	Below GW Standard	Below GW Standard	Below SW Standard
2076	Below GW Standard	Below GW Standard	Below GW Standard	Below SW Standard
2086	Below GW Standard	Below GW Standard	Below GW Standard	Below SW Standard

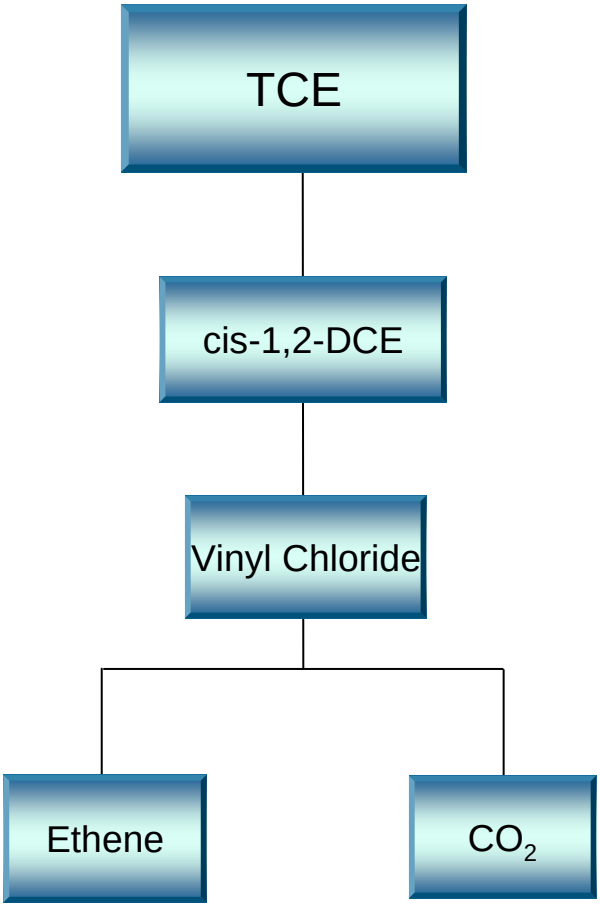
cis-1,2-DCE (Initial Source Concentration 30,000 µg/L)

Date	Maximum Concentration (µg/L)	Distance from Source of Maximum Concentration (ft)	Maximum Plume Extent (ft)	Concentration at Courthouse Bay (µg/L)
2026	74.4	Source	105	Below SW Standard
2046	Below GW Standard	Below GW Standard	Below GW Standard	Below SW Standard
2066	Below GW Standard	Below GW Standard	Below GW Standard	Below SW Standard
2076	Below GW Standard	Below GW Standard	Below GW Standard	Below SW Standard
2086	Below GW Standard	Below GW Standard	Below GW Standard	Below SW Standard

VC (Initial Source Concentration 4,000 µg/L)

Date	Maximum Concentration (µg/L)	Distance from Source of Maximum Concentration (ft)	Maximum Plume Extent (ft)	Concentration at Courthouse Bay (µg/L)
2026	12.2	160	800	Below SW Standard
2046	2.5	80	800	Below SW Standard
2066	0.34	80	800	Below SW Standard
2076	0.12	80	585	Below SW Standard
2086	0.046	80	320	Below SW Standard
2096	Below GW Standard	Below GW Standard	Below GW Standard	Below SW Standard

Notes:
TCE = Trichloroethene, cis-1,2-DCE = cis-1,2-dichloroethene, VC = vinyl chloride
"GW Standard" refers to the North Carolina 2L Groundwater Standard (TCE = 2.8 µg/L, cis-1,2-DCE = 70 µg/L, VC = 0.015 µg/L)
"SW Standard" refers to the North Carolia Surface Water Standard (TCE = 92.4 µg/L, cis-1,2-DCE = 13,000 µg/L,VC = 525 µg/L)



TCE – Trichloroethene

DCE – Dichloroethene

CO_2 - Carbon Dioxide

Figure 6-1
Degradation Pathway of TCE
Operable Unit No. 21 (Site 73)
Supplemental Remedial Investigation
Marine Corps Base, Camp Lejeune
North Carolina

CH2MHILL

SECTION 7

Human Health Risk Assessment

A HHRA was conducted as part of the original RI (Baker, 1997a), evaluating the projected impact of COCs on human health and/or the environment, now and in the future, in a "no further remedial action scenario." The HHRA was conducted in accordance with USEPA Risk Assessment Guidance (USEPA, 1989 and USEPA, 1991a) and USEPA Region IV Supplemental Risk Guidance (USEPA, 1991b). This section discusses the HHRA process followed in the original RI and summarizes the findings of the HHRA.

7.1 Human Health Risk Assessment Process

The HHRA process examined the data generated during the sampling and analytical phase of the RI and identified COCs with respect to geographical, demographic, physical and biological characteristics of the study area. These factors were combined with an understanding of physical and chemical properties of site-associated contaminants (and their fate & transport processes), and were used to estimate contaminant concentrations at logical exposure pathway endpoints. Finally, contaminant intake levels were calculated for hypothetical receptors. Toxicological properties are applied in order to estimate potential public health threats posed by detected contaminants. The components of the HHRA included:

- Hazard identification
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Uncertainty analysis
- Conclusions

Six environmental media were investigated for potential human health risks during the RI: surface soils, subsurface soils, groundwater, surface water, sediment, and aquatic biota.

7.1.1 Hazard Identification

Data generated during the original RI and previous studies were validated and the data set was reduced to obtain the highest quality data set available for quantitative risk analysis and calculations. Based on the validated data set, COPCs were identified. The basis for retaining a chemical as a COPC was based on the contaminant's prevalence, persistence, mobility, anthropogenic levels, toxicity, background and naturally occurring levels at Site 73, and State and Federal criteria for soil, groundwater, and surface water. See **Table 6-12** in **Appendix I** for a list of COPCs retained for the HHRA for each media of concern.

7.1.2 Exposure Assessment

Potential source areas and potential migration routes, in conjunction with contaminant fate and transport information, were combined to produce a site conceptual model, from which

exposure pathways were estimated. The HHRA identified potential migration routes for Site 73 COPCs as:

- The vertical migration of contaminants from surface soil to subsurface soil
- Leaching of contaminants from subsurface soil to water-bearing zones
- Vertical migration from shallow water-bearing zones to deeper flow systems
- Horizontal migration in groundwater in the direction of groundwater flow
- Groundwater discharge into local streams
- Aeolian erosion and subsequent deposition of windblown dust

Currently groundwater is not utilized as a potable source at Site 73. However, the shallow and deep groundwater were evaluated in the HHRA as a single exposure source since it has been shown that there is a potential interconnection between the surficial and Castle Hayne aquifers. Although unlikely, it is possible that the surficial aquifer could be developed for potable water use in the future, if residential homes are built on site. Therefore, in accordance with USEPA guidance, groundwater exposure was conservatively evaluated for future residential receptors. The current and future receptors and potential exposure pathways were evaluated during the HHRA are shown in **Figure 6-1** of **Appendix I**.

Exposure was quantified using estimations of chronic daily intakes (CDIs) for each medium considered (See **Table 6-13** in **Appendix I**), for each COPC, in each exposure pathway stated above. Two types of CDIs were calculated for each scenario: carcinogenic and noncarcinogenic. See **Table 6-12** in **Appendix I** for the full list of human health COPCs.

7.1.3 Toxicity Assessment

The toxicity of each COPC was calculated using a dose-response evaluation to evaluate potential human health and environmental impacts, using information on the nature and magnitude of the exposure.

As part of the dose-response evaluation, a carcinogenic slope factor (CSF) and reference dose (RfD) were calculated for each COPC. The CSF is an exposure index used to estimate the upper-bound lifetime probability of developing cancer as a result of exposure to a particular dose of a potential carcinogen (USEPA, 1989). The RfD is an exposure index for noncarcinogenic effects of chemical substances and is an estimate of the daily exposure level for a human population that is not likely to produce an appreciable risk of adverse effects during a lifetime.

7.1.4 Risk Characterization

Estimated incremental lifetime cancer risks (ICRs) and hazard indices (HIs) were calculated for identified receptor groups possibly exposed to COPCs by the exposure pathways and receptors listed above. Risks are presented in **Appendix I Tables 6-19** through **6-26.** A cancer risk range of 1×10^{-6} to 1×10^{-4} is used to evaluate the calculated ICR levels. Any ICR value within this range is considered "acceptable"; an ICR greater than 1×10^{-4} denotes an existing cancer risk. A noncarcinogenic risk of 1.0 is used as an upper limit to which calculated HI values are compared. Any HI exceeding 1.0 indicates an existing noncarcinogenic risk (USEPA, 1989).

For the current receptor scenario, the carcinogenic and noncarcinogenic risks calculated for all exposure pathways for military personnel, adult and adolescent trespassers, and adult and child fishermen were within acceptable risk ranges for exposure to surface water, surface soil, sediment, and ingestion of aquatic biota. The only unacceptable risk was to future child and adult residential receptors; the total carcinogenic risk from groundwater ingestion (95 percent of this risk was associated with VC ingestion) exceeded the acceptable range of risk for USEPA's *maximum* exposure scenario. Total Carcinogenic risk from groundwater ingestion (94 percent of this risk is associated with VC ingestion) did *not* exceed the acceptable range of risk for USEPA's *plausible* exposure scenario.

7.1.5 Uncertainty Analysis

Site-specific sources of uncertainty in the risk assessment included:

- **Sampling strategy—**Soil is often the main source of contamination released to other media, so soil sampling intervals should be appropriate for the exposure pathways and contaminant transport routes of concern.
- **Analytical data—**Credibility of the HHRA relies on the quality of the analytical data; the inherent uncertainty associated with analytical data is reduced through data validation.
- **Exposure Assessment—**Uncertainty arises from estimating the chemical concentration during exposure for each media and estimating the contaminant intakes during exposure. Estimated contaminant concentrations can be derived using statistical modeling and receptor intake can be estimated using exposure factors developed within USEPA guidelines and based on conservative assumptions.
- **Toxicity Assessment—**Uncertainties arise due to existing data providing insufficient information about toxic exposure and human exposure data display inherent variability and lack adequate concentration estimates. Using safety factors and employing conservative assumptions may overestimate toxicity effects.

7.2 Summary and Conclusions

A HHRA was completed as part of the RI (Baker, 1997a) evaluating the projected impact of COCs on human health and/or the environment now and in the future.

Current and future receptors evaluated included: current military personnel, current trespassers, current adult fisherman, current child receptor for aquatic biota ingestion, future residents, and future construction workers.

Exposure scenarios evaluated included: exposure to surface soil, surface water, and sediment for current receptors; ingestion of fish and crab tissue for adult fisherman and child receptor; and surface soil, groundwater, surface water, and sediment exposure for future residential receptors. The results of the HHRA concluded:

- There was no unacceptable risk to human health under current use scenarios.
- The risk from ingestion of groundwater for future adult and child residential receptors exceeds the USEPA's acceptable risk range. The primary driver for the elevated risk was VC in groundwater.

SECTION 8

Ecological Risk Assessment

An ERA was conducted as part of the original RI (Baker, 1997a) to evaluate whether past site operations at Site 73 have adversely impacted terrestrial or ecological communities in and around the site and to evaluate the potential (future) effects of contaminants at Site 73 to sensitive ecological receptors such as wetlands, protected species, and fish nurseries. The ERA was conducted in accordance with *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (USEPA, 1997) and *Framework for Ecological Risk Assessment* (USEPA, 1992).This section discusses the ERA process followed in the original RI and summarizes the findings of the ERA. As part of the SRI, an ERA Addendum was completed to assess whether the conclusions of the original ERA were still valid. The findings of the ERA Addendum are presented in this section. Tables and Figures relevant to the ERA are included in **Appendix J**.

8.1 ERA Process

The ERA process examined the data generated during the sampling and analytical phase of the RI. In addition, fish and crab samples were collected and analyzed and benthic macroinvertebrates were collected and identified. The components of the ERA are outlined below.

- **Problem Formulation—**includes preliminary characterization of exposure and effects.
- **Analysis—**includes evaluation of data to evaluate exposure and potential effects on ecological receptors from the stressors.
- **Risk Characterization—**includes evaluation of the likelihood of adverse effects occurring as a result of exposure to a stressor (i.e., the potential decrease in aquatic and terrestrial populations at Site 73 from site-related contaminants).

8.1.1 Problem Formulation

As part of the original RI, ecological surveys and habitat characterization were conducted and chemical analyses were performed on samples collected from surface soil, sediment, surface water, fish and crabs, and benthic macroinvertibrates. Based on the characterization and analysis, COPCs and potential ecological receptors were identified. Toxicological information for contaminants detected in the media listed above was then used to evaluate the potential adverse ecological effects to those receptors.

Identification of COPCs

The basis for retaining a chemical as a COPC was based on the contaminant's historical information, prevalence, toxicity, comparison to established screening values, comparison to investigation associated field and laboratory blank data, and comparison to background or

naturally occurring levels. See **Table 7-5** in **Appendix J** for COPCs identified for ecological receptors in each media.

Exposure Assessment

The ecological receptors at risk from contamination at Site 73 were identified in site visits, which included a habitat evaluation and field investigations. The exposure assessment evaluated the interaction of stressors (COPCs) with ecological receptors.

The ERA identified the primary receptors of contaminants in surface water and sediment as: fish, benthic macroinvertebrates, other aquatic flora and fauna, and some terrestrial faunal species. The main routes of potential exposure to surface water/sediment were ingestion or dermal contact, and the exposure points include species living in, or coming into contact with on-site or downgradient surface water/sediment. See **Figure 7-1** in **Appendix J** for a conceptual diagram of ecological receptors at Site 73.

The ERA identified the primary receptors of contaminants in surface soil as: deer, rabbits, foxes, raccoons, birds, and other terrestrial flora and fauna. The main routes of potential exposure to soil were identified as ingestion, dermal contact, and/or direct uptake (for flora). The point of exposure included species living in, or coming into contact with contaminated surface soil, or bioaccumulation from consumption of smaller organisms. Since bioaccumulation is likely to occur at Site 73, it was retained for further analysis.

8.1.2 Analysis

The ecological effects data developed during problem formulation were used to assess potential risks to aquatic and/or terrestrial receptors. Contaminant concentrations detected in each media (surface water, sediment, fish tissue, surface soil) were compared against aquatic and terrestrial screening values. **Table 7-2** and **7-3** in **Appendix J** show the detected concentrations of COPCs compared to their screening values in surface water and sediment.

8.1.3 Risk Characterization

The risk characterization evaluates the potential for decrease in the aquatic and terrestrial populations from contaminants identified at the site. The quotient index (QI) approach is used to characterize the risk to aquatic receptors from exposure to surface water and sediments and to terrestrial receptors from exposure to surface soil, surface water, and biota. A QI greater than 1 indicates a significant potential risk.

The QI equation is dependent on exposure concentration, CDI, surface water screening values, sediment screening values , and terrestrial reference values. See **Table 7-19, 7-20, 7-21,** and **7-22** in **Appendix J** for QIs of surface water and terrestrial species for the low and medium effects range.

8.1.4 Uncertainty Analysis

The uncertainties evaluated in the ERA were sampling method, interpretation of benthic macroinvertebrate diversity, variations in screening values, and variations in terrestrial risk models. Site-specific sources of uncertainty in the risk assessment included.

- **Sampling strategy—**Soil is often the main source of contamination released to other media, so soil sampling intervals should be appropriate for the exposure pathways.
- **Analytical data—**Credibility of the ERA relies on the quality of the analytical data, and available quantitation limits; the inherent uncertainty associated with analytical data is reduced through data validation.
- **Exposure Assessment—**Uncertainties arise in estimating the length of time a particular species will remain at a certain contaminated location, so most often the result is an extremely over conservative estimate of risk (e.g., assuming a fox will spend 80 percent of its time in one sampling location out of ten which had a detection).
- **Aquatic and Terrestrial Risk Models—**The large variation in terrestrial and aquatic risk models is also a factor creating uncertainty.

8.1.5 Summary and Conclusions

An ERA was completed as part of the RI (Baker, 1997a), to evaluate whether past site operations have (or will) adverse impacts to terrestrial and aquatic communities on, or adjacent to, Site 73. Soil, surface water, and sediment samples collected during RI activities were compared to published values for toxicity in various aquatic and terrestrial species. In addition, fish and crabs were collected and analyzed and benthic macroinvertebrates were collected and identified. Overall, the ERA concluded that conditions at Site 73 may adversely impact the aquatic and terrestrial ecosystems at the site, specific findings were:

- Aquatic receptors appear to be impacted by pesticides and metals in the sediments. However, the ERA concluded that the compounds are not site-related contaminants, but are most likely remnants of past Base-wide applications.
- Terrestrial receptors such as the raccoon showed a significant potential risk (QI ranging from 10 to 100), and was driven by aluminum in the surface water, sediment, and fish tissue.

8.2 Addendum to the ERA

An Addendum to the ERA was completed by CH2M HILL in October 2006 in order to do the following:

- Evaluate if there were any changes in exposure pathways since the completion of the ERA.
- Compare the concentrations of site-related constituents detected in surface water to current legally enforceable surface water quality standards [federal Ambient Water Quality Criteria (AWQC) and North Carolina Water Quality Standards (NCWQS)].

- Review the groundwater data collected as part of the supplemental RI and evaluate whether the conclusions of the ERA are still valid.

8.2.1 Reductions in Exposure

Although some risks were identified for terrestrial receptors, surface soils in the AOCs have since been covered by concrete. Terrestrial habitat no longer exists in the former AOCs.

8.2.2 Previously Undelineated Sources

Since the preparation of the original RI, a source not previously delineated was identified in the eastern portion of the facility (in the vicinity of monitoring well IR73-MW14). The SRI indicates that the TPH and O&G contamination detected in this area are likely a consequence of multiple spills over time associated with maintenance activities. While ecological receptors could be exposed to this contamination via groundwater transport and discharge to a surface water body, there is no complete exposure pathway to soil contamination because the site is covered with concrete.

8.2.3 New Potential Exposure Pathways and Receptors

Due to the identification of a previously undelineated source or physical changes at the facility, there were three areas of potential concern identified that may present the potential for new and complete exposure pathways to ecological receptors. The first, described above, was the source identified near monitoring well IR73-MW-14. As discussed, ecological receptors cannot be exposed to contaminated soils in this area. The only potential pathway of concern is the discharge of contaminated groundwater to surface water.

The second area of potential concern is Wetland 1, located at the northeast end of the facility near the armory building (**Figure 1, Appendix J**). This wetland was identified by a CH2M HILL ecologist during the preparation of the SRI. The wetland likely formed from a low lying pond area that was known to exist in the past. The original RI depicts the former pond area on Figure 3-9. Wetland 1 is located upgradient from the Site 73 groundwater plumes, and concentrations of soil exceeding standards in the ERA were located hydrologically down-gradient of the wetland. As such, no complete exposure pathway to the wetland exists from the groundwater plumes or soils at the site.

The third area of potential concern is the permitted ponds at the west end of the facility. The ponds were built in 1999 for storm water retention. During the preparation of the SRI, a CH2M HILL ecologist observed that water in the northern pond likely overflows into Marsh 1 (**Figure 1, Appendix J**). There was concern that contaminated groundwater may discharge into this northern pond and then be transported to Marsh 1. However, a review of site hydrology indicated that Site 73 groundwater plumes in the surficial aquifer do not impact nearby stormwater ponds. As such, outflow from the northern pond is not expected to pose a significant risk to Marsh 1 or Tributary 1 (**Figure 1, Appendix J**).

8.2.4 Comparison of Historical Surface Water Concentrations to Existing Surface Water Quality Standards

A comparison of the concentrations of constituents detected in surface water to current legally enforceable AWQC and NCWQS was completed to assess if the 1995 surface water

data are compliant with current standards. Because the salinity of the water in the streams and bay likely varies, detected concentrations were compared to both freshwater and marine standards.

8.2.5 New Groundwater Data

VOCs and inorganics were detected in surface water during the original RI. However, water quality standards were available only for acetone and a subset of the inorganics. Freshwater NCWQS were available for acetone, silver, and zinc (NCDENR, 2004). The maximum concentration of acetone was below the NCWQS. Silver and zinc each exceeded NCWQSs in only one of eleven samples. Silver and zinc each exceeded NCWQS in only one of 11 samples. Silver was detected in surface water sample SW-06 at a concentration of 6.4 µg/L, exceeding the NCWQS of 0.06 µg/L and zinc was detected in SW-04 at a concentration of 103 µg/L, exceeding the NCWQS of 50 µg/L. Surface water samples SW-06 and SW-04 were collected in Courthouse Bay along with six additional samples. Based on the isolated detections of silver and zinc at concentrations exceeding the NCWQS in Courthouse Bay, the inorganics in surface water are unlikely to pose a risk to populations of aquatic receptors in Courthouse Base. Additional lines of evidence include the following:

- Silver was not detected in the sediment sample co-located with surface water sample SW-06.
- The analytical data are for total rather than dissolved metals. Federal ambient water quality criteria for most metals are expressed as dissolved concentrations because the dissolved fraction is the most representative of what is bioavailable (USEPA, 2008). Dissolved concentrations are often far lower than total concentrations.
- Surface water samples SW-04 and SW-06 were collected near the shoreline in relatively shallow water. Near shore samples would be expected to have a higher level of suspended solids in a tidal environment compared to those collected further offshore in deeper water.
- Silver and zinc detected in surface water are also not expected to be related to the use of amphibious vehicles in Courthouse Bay.

Freshwater AWQC were available for iron and aluminum (USEPA, 2008). Iron exceeded the AWQC of 1,000 µg/L in only one of nine samples (SW-01 at a concentration of 4,540 µg/L). Surface water sample SW-01 is representative of surface water conditions upgradient of Site 73, therefore iron is not considered a site related contaminant. Aluminum exceeded the AWQC of 87 µg/L in three of eleven samples (SW-01 at 384 µg/L, SW-11 at 500 µg/L, and SW-12 at 324 µg/L). As indicated, surface water sample SW-01 is located upgradient of the site, and samples SW-11, and SW-12 were collected from the western tributary to Courthouse Bay. Again, we have detection of aluminum in the water column upgradient of the site, the analysis was for total metals, and the samples were collected from shallow watercourses. Aluminum is a common contaminant found in surface water samples at Camp Lejeune with natural or sampler-induced turbidity, as it frequently is in sediment and soil at naturally elevated concentrations. The western tributary, in which aluminum was detected, drains to the far western portion of the Courthouse Bay Boat Basin area. This is area would not likely be influenced by the Amphibious Vehicle Maintenance Facility or

amphibious vehicle traffic. No aluminum was detected in surface water downgradient of the Amphibious Vehicle Maintenance Facility (Sites 73), indicating that aluminum found in the surface water is un-related to these vehicles or maintenance activities conducted at Site 73.

A comparison of the groundwater data presented in the original RI and the most current groundwater data was completed to verify that the results of the ERA are still appropriate. Comparisons of maximum concentrations of site related constituents detected in groundwater in 1995 and 2006 suggest that concentrations have decreased in the surficial aquifer and have increased in the Castle Hayne aquifer (**Table 1, Appendix J**). The SRI indicates that migration of chlorinated VOCs and benzene is southeast toward Courthouse Bay. A conservative approach to evaluate the potential risk to aquatic receptors in the bay is to compare maximum groundwater concentrations detected in 2006 to ecological benchmarks for surface water. This conservative comparison does not take into account the attenuation in concentrations expected between the well under consideration and Courthouse Bay where the discharge occurs. The lower of the USEPA Region IV freshwater and marine ecological screening values (USEPA, 2001) were preferentially used to evaluate the potential for these maximum concentrations to pose a risk to aquatic receptors. If Region 4 ecological screening values were not available, they were supplemented with other commonly used ecological benchmarks. There were no North Carolina water quality criteria available for these chemicals. With the exception of TCE, maximum detected concentrations of the chlorinated VOCs and benzene were well below ecological benchmarks (**Table 1, Appendix J**). TCE is not expected to pose a significant risk. Results of modeling conducted for the SRI indicate that TCE may reach Courthouse Bay at a concentration of 3 µg/L, significantly lower than the ecological benchmark.

8.2.6 Conclusions

Although concentrations in the Castle Hayne aquifer have increased, the contaminant concentrations present at Site 73 are not expected to reach Courthouse Bay above surface water ecological benchmarks in the future. These findings are supported by RI activities conducted by Baker between 1995 and 1996 which indicated that ecological receptors in Courthouse Bay and the adjacent tributaries were not being impacted by chlorinated VOCs and benzene detected in groundwater at Site 73.

The results of the evaluation support the original conclusions of the ERA that aquatic receptors are unlikely to be significantly at risk from Site 73 releases. The updated ERA also concluded that the modest risks identified for terrestrial receptors in the initial ERA have likely been reduced through a reduction in exposure to contaminated soils.

SECTION 9

Conclusions and Recommendations

This section presents the conclusions reached based upon the SRI activities conducted at Site 73 and provides recommendations for site management.

The objectives of the SRI for Site 73 were to do the following:

- Collect information to supplement and/or verify the environmental setting at the Site, including hydrogeology, geology, hydrology, topography, and the presence of anthropogenic influences that may affect the hydrology or contaminant pathways at the site.
- Characterize the sources via the collection of analytical data, and evaluate the migration and dispersal characteristics of the waste.
- Characterize the hazardous constituents (if any) via the collection of groundwater and soil samples in the vicinity of the Site. Characterization includes a definition of the extent, origin, direction and rate of movement of any contamination.
- Evaluate potential receptors by collecting data describing human populations and environmental systems susceptible to contaminant exposure.

9.1 Findings and Conclusions

9.1.1 Site Physical Characteristics

Site 73 lies within an area of low topographic relief adjacent to Courthouse Bay, an inlet of the New River. The majority of the site is paved or developed with maintenance and storage buildings.

The site is underlain by marine and non-marine sediments ranging in age from early Cretaceous to Holocene. Within the vicinity of Site 73, the uppermost sediments belong to the Undifferentiated Fm. and consist of fine-to-medium grained sands with a lesser amount of silt and clay, extending to depths of 0 to 30 ft bgs. The Belgrade Fm., confining unit of the Castle Hayne Aquifer, lies directly beneath the Undifferentiated Fm.. The approximate thickness of the Belgrade Fm. is 10 to 20 ft. At Site 73, this Formation appears to be laterally discontinuous and allows for a hydraulic communication between the surficial and Castle Hayne aquifers.

The River Bend Fm. underlies the Belgrade Fm. and is composed of sands, silt, shell and fossil fragments, and trace amounts of clay. Sands tend to be cemented within this Formation. The amount of shell fragments decreases with depth to approximately 55 to 65 ft bgs, where a greenish-gray to olive very fine sand to silt is present. Below this layer the composition of the River Bend Fm. changes to a fine to medium grained sand with trace amounts of silts and shells. The River Bend Fm. overlies the Castle Hayne Fm., which is encountered at a depth of approximately 110 ft bgs at Site 73.

In general, groundwater flow direction within the surficial and Castle Hayne aquifers is to the southeast. Downward vertical hydraulic potentials were calculated between the surficial and Castle Hayne aquifers. In-situ aquifer testing has estimated the hydraulic conductivity for the surficial aquifer to be 12 ft/day, and 3.6 ft/day for the Castle Hayne aquifer. The horizontal seepage velocity within the surficial aquifer was calculated to be in the range of 0.137 ft/day to 0.192 ft/day, and 0.021 ft/day to 0.029 ft/day for the Castle Hayne aquifer.

Potable water for MCB Camp Lejeune and the surrounding residential area is provided by public water supply wells that pump groundwater from the Castle Hayne aquifer. Although fresh water is present within the surficial, Castle Hayne, Beaufort, and Peedee aquifers, all of which are located below MCB Camp Lejeune, only the Castle Hayne aquifer is used by MCB Camp Lejeune as a water supply source.

9.1.2 Nature and Extent of Contamination

Groundwater

During the April 2006 groundwater sampling event, VOCs including benzene, TCE, 1,1-DCE, cis-1,2-DCE, and VC exceeded their respective NCGWQS and/or MCL in one or more of the monitoring wells. Other CVOCs were detected at concentrations below their respective NCGWQS and are therefore not considered contaminants of concern.

VC was frequently detected in both aquifers, and had the greatest number of detections exceeding the NCGWQS, with five samples exceeding standards in the surficial aquifer and 14 samples exceeding standards in the Castle Hayne aquifer. The greatest concentrations of VC were detected in samples collected from the Castle Hayne aquifer; the maximum concentration of VC within the Castle Hayne aquifer was reported at IR73-MW44DW (130 µg/L). As indicated in **Figures 5-10, 5-11,** and **5-12**, the maximum vertical extent of the VC plume has been delineated.

TCE and cis-1,2-DCE were detected above their respective NCGWQS in multiple samples collected from monitoring wells screened in the Castle Hayne aquifer. The majority of TCE and cis-1,2-DCE detections in the Castle Hayne aquifer is occurred between Building A47 and Courthouse Bay. The greatest TCE concentration was detected at IR73-MW49DW (840 µg/L), and the greatest cis-1,2-DCE concentration was detected at IR73-MW49IW (1,300 µg/L). As indicated in **Figures 5-2**, **5-3**, and **5-4** and **Figures 5-6**, **5-7**, and **5-8**, the maximum vertical extent of the TCE and cis-1,2-DCE plumes have been delineated.

Benzene was detected at concentrations above the NCGWQS/L in three monitoring wells screened in the surficial aquifer and nine monitoring wells screened in the Castle Hayne aquifer. The distribution of benzene within the surficial aquifer is limited to the area northeast of Building A47. The benzene plume within the Castle Hayne aquifer extends from the paved area associated with Building A47 to Courthouse Bay, and is concentrated between Building A47 and the approximate location of the former maintenance building and the suspected location of UST A47-1. The greatest benzene concentration detected in the Castle Hayne aquifer was reported in a groundwater sample collected from monitoring well IR73-MW44DW at a concentration of 8.9 µg/L. As indicated in **Figures 5-14**, **5-15**, and **5-16**, the maximum vertical extent of the benzene plume has been delineated.

Based upon the data collected during the SRI, the greatest VOC concentrations are located beneath the paved area associated with Building A47. Contaminants detected in the surficial aquifer (TCE, VC, and benzene) appear to originate in the vicinity of UST A47-3. The greatest concentrations of VOCs (TCE, 1,1-DCE, cis-1,2-DCE, VC, and benzene) detected within the Castle Hayne aquifer were generally detected in samples collected from IR73-MW44DW or IR73-MW49DW, located between Building A47 and the approximate footprint of the former maintenance building and in the suspected vicinity of UST A47-1.

Historical groundwater monitoring data indicate decreasing concentrations of TCE and cis-1,2-DCE within source area wells and a corresponding increase in VC, indicating that reductive dechlorination is occurring at Site 73. The data also shows that benzene concentrations are gradually approaching the NCGWQS.

Evaluation of NAIPs (including DO, ORP, nitrate, iron, sulfate, alkalinity, methane, TOC, and chloride) indicates that conditions for natural attenuation are favorable or that natural attenuation is currently occurring in both the surficial and Castle Hayne aquifers. Both fuel-related hydrocarbons and chlorinated solvents are capable of being depleted by natural processes in each aquifer.

Soil

CH2M HILL collected at total of 40 subsurface soil samples from the area surrounding monitoring well IR73-MW14 (which frequently contains measurable free-phase petroleum product), with the intent of delineating the extent of petroleum-impacted soil. As shown on **Figure 3-1**, the horizontal extents of the POL-impacted soils have been generally delineated. Laboratory analytical data and field observations suggest that the POL-impacted soils are likely the result of multiple surficial spills, rather than a single event, that occurred prior to the construction of the concrete paved parking area.

Within the POL-impacted area in the vicinity IR73-MW14, historical groundwater level measurements indicate that seasonal fluctuations in the water table result in the cyclical submergence of the previously described concrete layer. Discovery of elevated concentrations of O&G and TPH-DRO beneath the concrete layer, suggests that rise and fall of the water table may have led to the lateral migration of product along the upper and lower surfaces of the concrete layer.

The POL-impacted area is delineated to the south and east, as indicated by TPH-DRO and O&G concentrations less than the NC Action Levels in soil samples collected from borings IS-117, IS-138, and IS-139. TPH-DRO and O&G concentrations in exceedance of the NC Action Levels were observed in the soil sample collected from boring IS-133; however, this is interpreted to be independent of the main POL-impacted area.

During an investigation of the UST A47/3 area in 1993, GSI advanced seven soil borings from which seven soil samples were collected for TPH analysis (method not stated). TPH was detected in the soils at a range of 440 to 3,000 mg/kg. Further, the TPH-DRO and O&G concentrations in soil samples collected from IS-136 and IS-137 increase with proximity to the UST. Impacts observed in the borings installed in the northeast portion of the concrete pad (IS-136 and IS-137) are likely a result of the identified impacts associated with UST A47/3 rather than the historic disposal of used oil.

As previously stated, soil samples could not be collected from borings IS-130 and IS-131 due to the presence of a secondary layer of concrete beneath Building A47; therefore, the northwest portion of the POL-impacted area is not fully delineated.

Surface Water and Sediment

RI activities completed by Baker between 1995 and 1996 included surface water and sediment sampling in Courthouse Bay and it surrounding tributaries. The original RI concluded that Courthouse Bay is not impacted by CVOCs and benzene detected in groundwater at Site 73. Therefore, impact to surface water and sediment was not further evaluated in the SRI.

9.1.3 Fate and Transport

Source Areas

The areal extent of the 'total VOC' plume is approximately 19 acres; vertically, the plume extends to a depth of approximately 110 ft bgs, with the greatest concentrations detected between 60 and 75 ft bgs.

Based on the chemical and physical data gathered during the various phases of investigation conducted at Site 73, the CVOCs detected in groundwater samples are likely to be the result of historical disposal activities. Specifically, the impacts to groundwater appear to be related to USTs A47-3 and A47-1, and the historical vehicle maintenance activities.

Contaminant Transport

Shallow groundwater flow upgradient of the Site 73 source area is generally to the south to southeast towards Courthouse Bay; however, water table mounding has been detected around Buildings A3 and A11, resulting in radial groundwater flow. However, it is presumed that the observed mounding is a temporary response to groundwater recharge following precipitation. Groundwater flow within the Castle Hayne aquifer is generally southeast towards Courthouse Bay.

The presence of VOCs in groundwater samples collected from wells screened within the Castle Hayne aquifer provides evidence of downward vertical gradients at Site 73. Benzene and VC concentrations above their respective NCGWQS are reported as deep as 110 ft bgs in monitoring well IR73-MW41DW, located on the tank trail adjacent to Courthouse Bay. VOCs were not detected above laboratory reporting limits in monitoring wells IR73-MW38DW and IR73-MW42DW, located in the vicinity of 73-MW41DW and also screened to 110 ft bgs. No contaminants were detected above laboratory detection limits in samples collected from the deepest Site 73 monitoring wells, screened from 145 to 150 ft bgs (IR73-MW26DW, IR73-MW51, IR73-MW52, and IR73-MW53). During this SRI, three deep monitoring wells were installed to specifically to delineate the vertical extent of contamination in the vicinity of Building A47 [IR73-MW11DW and IR73-MW17DW (screened from 81 to 86 ft bgs) and IR73-MW49DWA (screened from 121 to 126 ft bgs)]. No target analytes were detected above their respective NCGWQS in these three newly installed monitoring wells.

Groundwater Predictive Modeling

BIOCHLOR groundwater modeling predicts that TCE, cis-1,2-DCE, and VC will each attenuate below their respective NCGWQS within the next 40 to 80 years. It should be noted, however, the presence of petroleum compounds within the aquifer may speed reductive dechlorination by acting as an additional carbon source.

In addition, modeling indicates TCE, cis-1,2-DCE, and VC may reach Courthouse Bay at concentrations of 3 µg/L, 1 µg/L, and 1 µg/L, respectively. These predicted concentrations are well below the surface water standards for TCE (92.4 µg/L), cis-1,2-DCE (13,000 µg/L), and VC (2.4 µg/L). Therefore, the contaminant concentrations present at Site 73 are not expected to reach Courthouse Bay above surface water standards in the future.

9.1.4 HHRA

A HHRA was completed as part of the RI (Baker, 1997a) evaluating the projected impact of COCs on human health and/or the environment now and in the future. Current and future receptors evaluated included: current military personnel, current trespassers, current adult fisherman, current child receptor for aquatic biota ingestion, future residents, and future construction workers. Exposure scenarios evaluated included: exposure to surface soil, surface water, and sediment for current receptors; ingestion of fish and crab tissue for adult fisherman and child receptor; and surface soil, groundwater, surface water, and sediment exposure for future receptors. The results of the HHRA concluded the following:

- There was no unacceptable risk to human health and/or the environment under current use scenarios.
- The risk from ingestion of groundwater for future adult and child residential receptors exceeds the USEPA's acceptable risk range. The primary driver for the elevated risk was VC in groundwater.

9.1.5 ERA

No unacceptable risks to the environment were identified in the ERA. An addendum to the ERA was prepared to evaluate if there have been any changes in exposure pathways since the completion of the ERA, to compare the concentrations of site-related constituents to current legally enforceable water quality standards, and to evaluate whether the conclusions of the ERA are still valid.

Site features and characteristics have changed since the ERA, including the covering of surface soils with concrete, the delineation of free product and TPH, O&G contamination, and the identification of a wetland. These features and characteristics were considered in conjunction with the most recent surface water and groundwater analytical data to provide an updated evaluation of ecological risks at Site 73.

The results of the evaluation support the original conclusions of the ERA that aquatic receptors are unlikely to be significantly at risk from Site 73 releases. The review also indicated that the modest risks identified for terrestrial receptors in the ERA have likely been reduced through a reduction in exposure to contaminated soils.

9.2 Recommendations

Based on the results and conclusions of SRI activities at Site 73, An FS is recommended to evaluate appropriate remedial alternatives to reduce the VOC concentrations in an effort to reduce the time required to reach the remedial goals for Site 73, and prevent contaminant migration to Courthouse Bay or water supply wells across Courthouse Bay.

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Appendix A
Historical Site 73 Aerial Photography
(1956-2004)

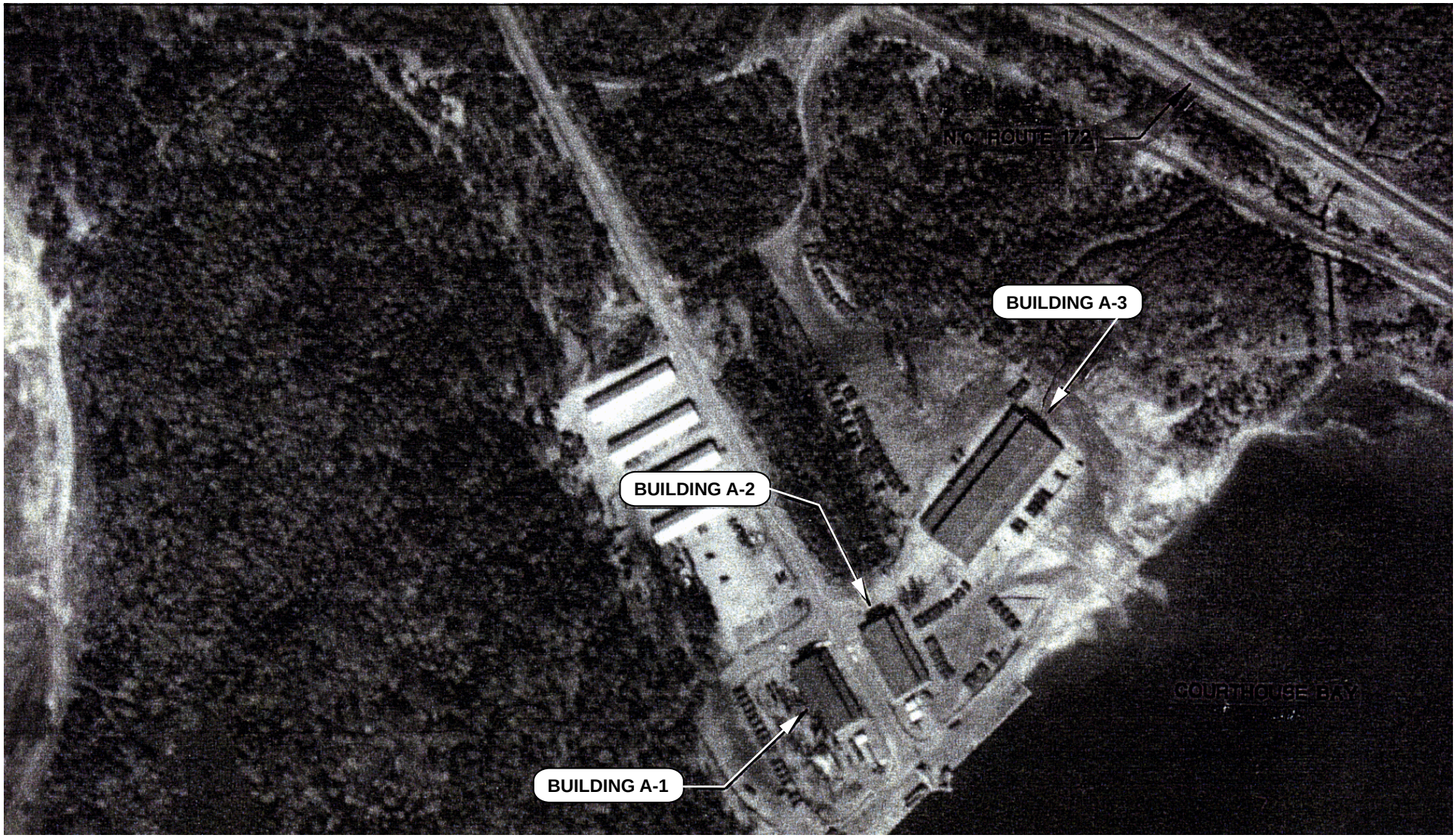


FIGURE A-1
Historical Aerial Photograph (1956)
Appendix A
Site 73 Supplemental Remedial Investigation
MCB Camp Lejeune, North Carolina

FIGURE A-2
Historical Aerial Photograph (1970)
Appendix A
Site 73 Supplemental Remedial Investigation
MCB Camp Lejeune, North Carolina

FIGURE A-3
Historical Aerial Photograph (1983)
Appendix A
Site 73 Supplemental Remedial Investigation
MCB Camp Lejeune, North Carolina

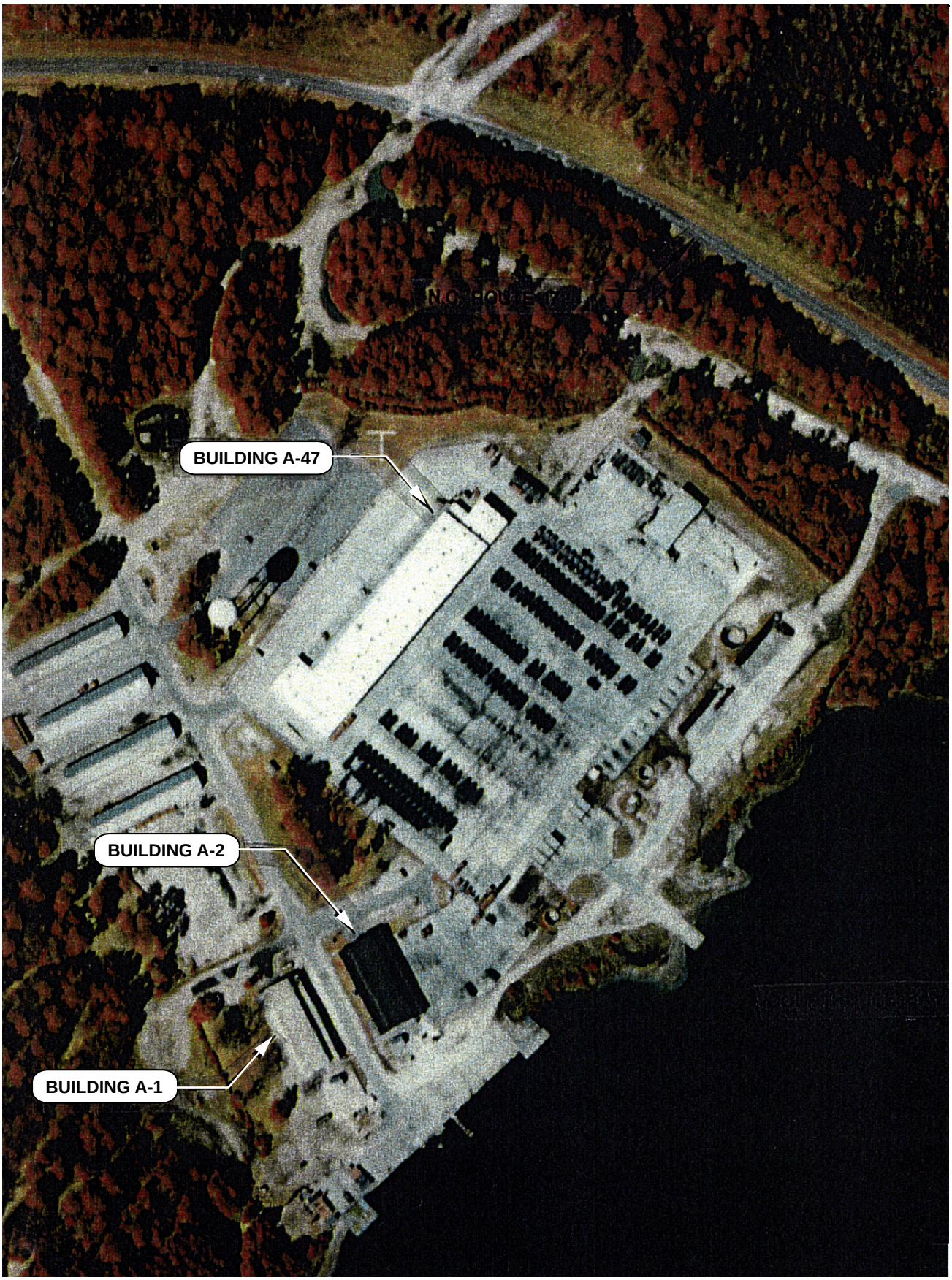


FIGURE A-4
Historical Aerial Photograph (1993)
Appendix A
Site 73 Supplemental Remedial Investigation
MCB Camp Lejeune, North Carolina

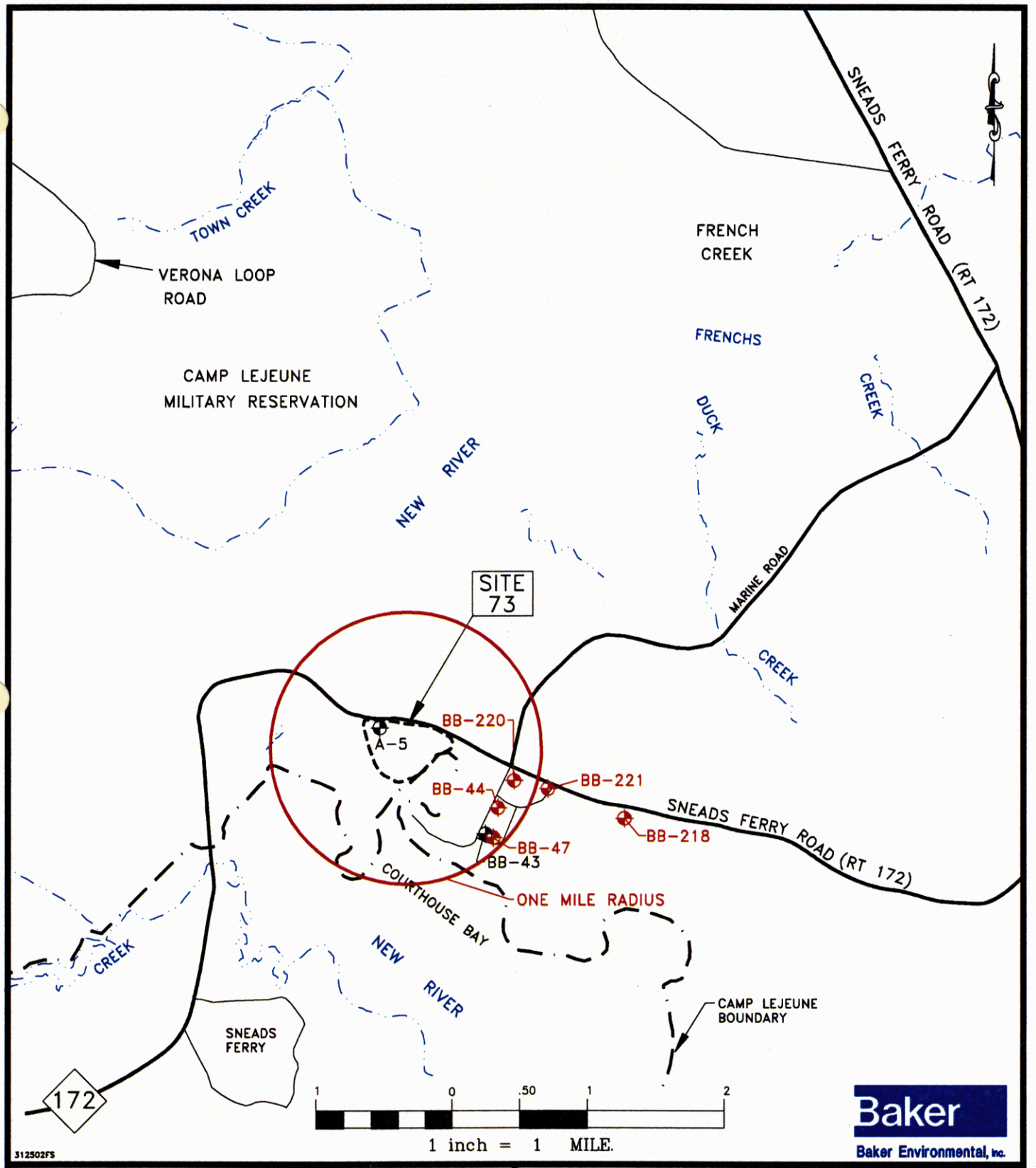
FIGURE A-5
Historical Aerial Photograph (2004)
Appendix A
Site 73 Supplemental Remedial Investigation
MCB Camp Lejeune, North Carolina

CH2MHILL

ES072007006ATL CL105.ai

Appendix B
Historical Analytical Data

Feasibility Study (Baker 1998)



LEGEND

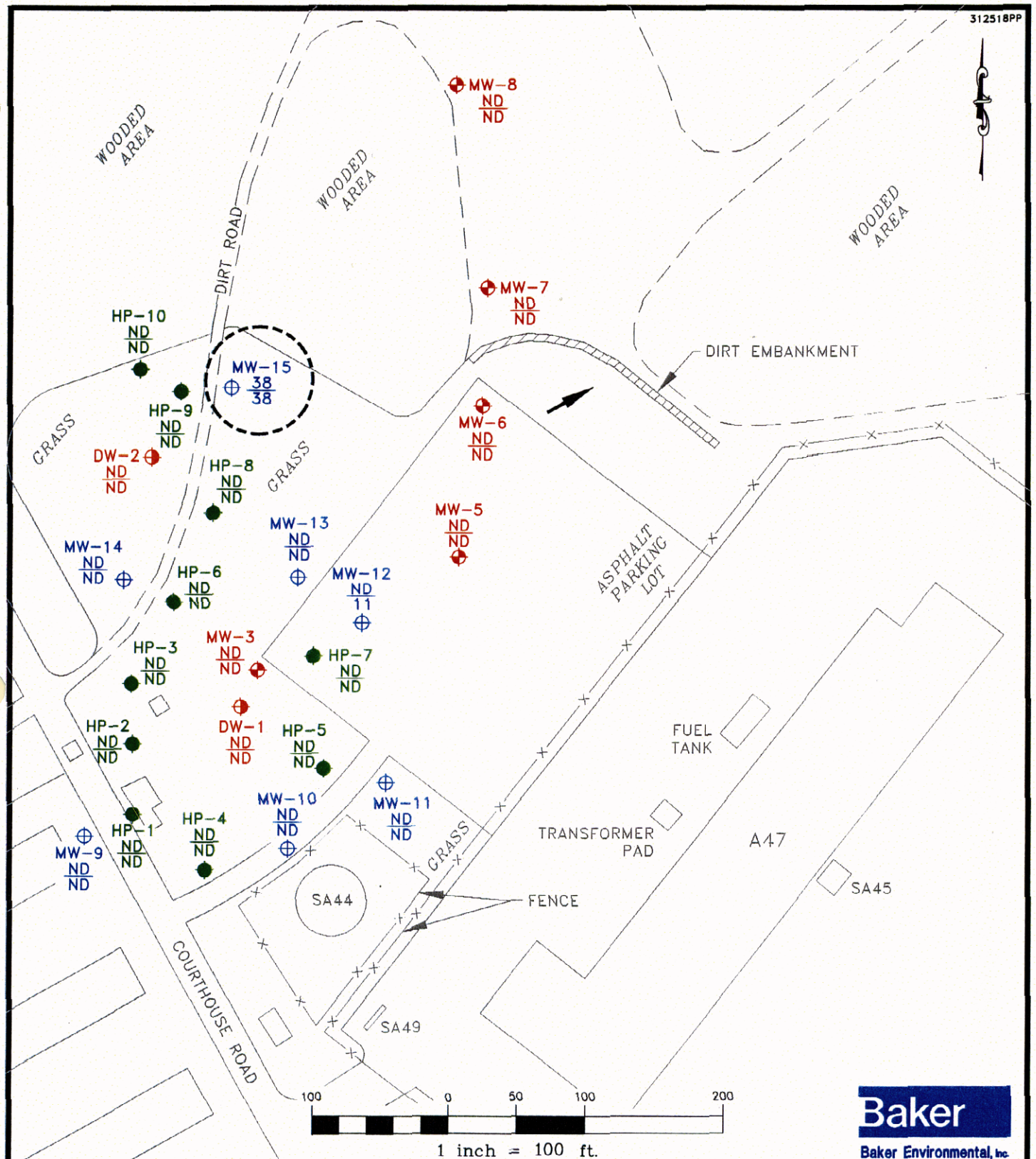
- SITE
- BB-221 – ACTIVE SUPPLY WELL
- BB-43 – DEACTIVATED SUPPLY WELL (1991)

SOURCE: GEOPHEX, 1983.

FIGURE 2-6
SUPPLY WELL LOCATION MAP
SITE 73 – AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
FEASIBILITY STUDY, CTO-0312
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

02590GG04Y

UST Investigation (Baker 1992)



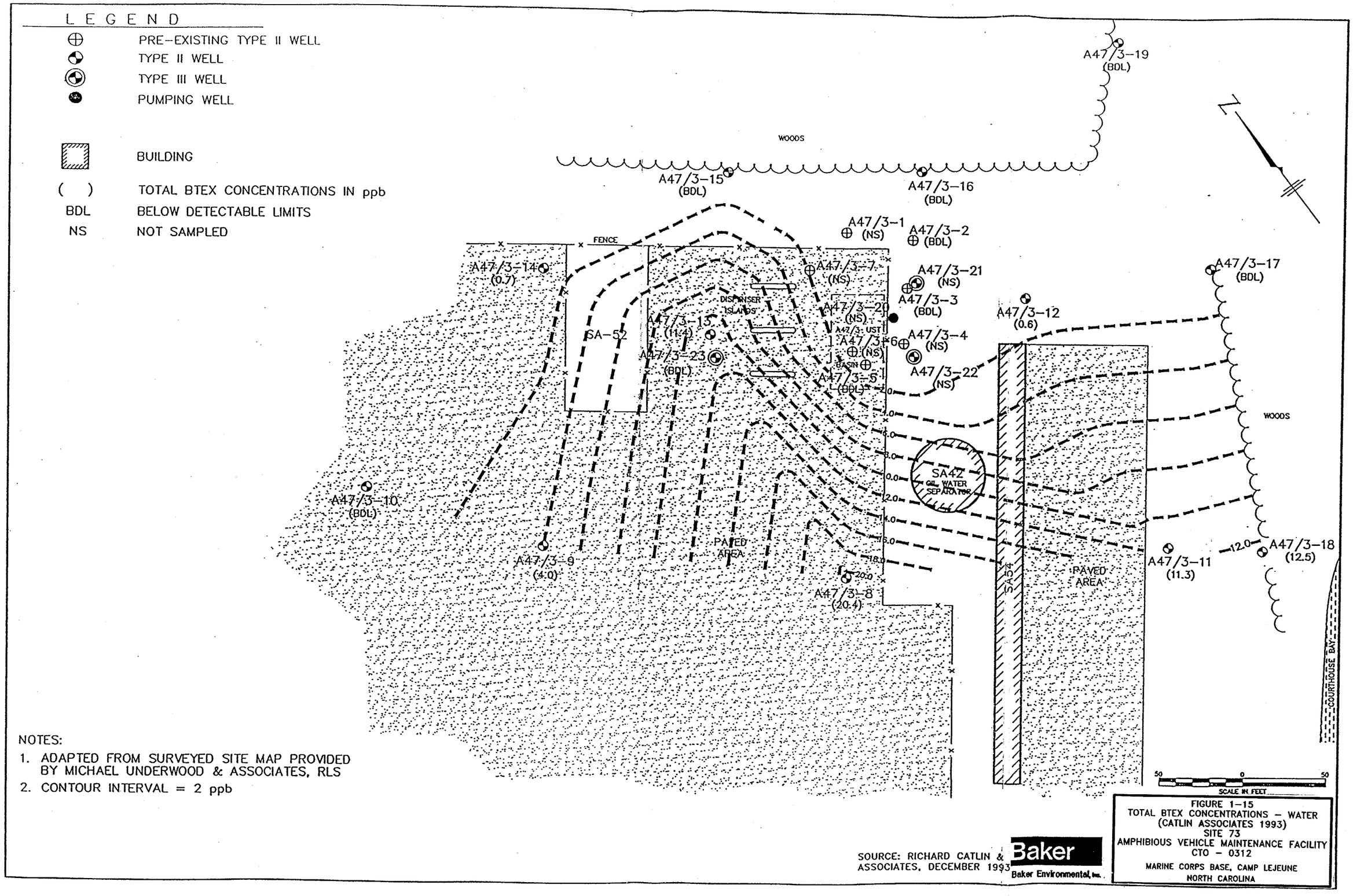
LEGEND

- MW-1 EXISTING TYPE II GROUNDWATER MONITORING WELL INSTALLED BY ATEC ASSOC., AUGUST 1991
- MW-9 SHALLOW TYPE II GROUNDWATER MONITORING WELL INSTALLED BY BAKER ENVIRONMENTAL, INC., MAY 1992
- DW-1 DEEP TYPE III GROUNDWATER MONITORING WELL INSTALLED BY BAKER ENVIRONMENTAL, INC., MAY 1992
- HP-3 HYDROPUNCH PENETROMETER INSTALLED BY BAKER ENVIRONMENTAL, INC., MAY 1992
- 38/38 BENZENE CONCENTRATION IN ug/l (ppb) / TOTAL VOC CONCENTRATION IN ug/l (ppb)
- ND NOT DETECTED AT METHOD DETECTION LIMITS
- ESTIMATED GROUNDWATER FLOW DIRECTION
- ESTIMATED EXTENT OF BENZENE CONTAMINATION (> 5.0 ug/l)

SOURCE: LANTDIV, OCT. 1991

FIGURE 1-9
BENZENE AND TOTAL VOC CONCENTRATIONS IN GROUNDWATER (BAKER, 1992)
SITE 73
AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
CTO - 0312
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

UST Investigation (Law-Catlin 1993)



NOTES:

1. ADAPTED FROM SURVEYED SITE MAP PROVIDED BY MICHAEL UNDERWOOD & ASSOCIATES, RLS
2. CONTOUR INTERVAL = 2 ppb

SOURCE: RICHARD CATLIN & ASSOCIATES, DECEMBER 1993

Baker
Baker Environmental, Inc.

FIGURE 1-15
TOTAL BTEX CONCENTRATIONS – WATER
(CATLIN ASSOCIATES 1993)
SITE 73
AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
CTO – 0312
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

Supplemental Remedial Investigation (CH2M HILL 2007)

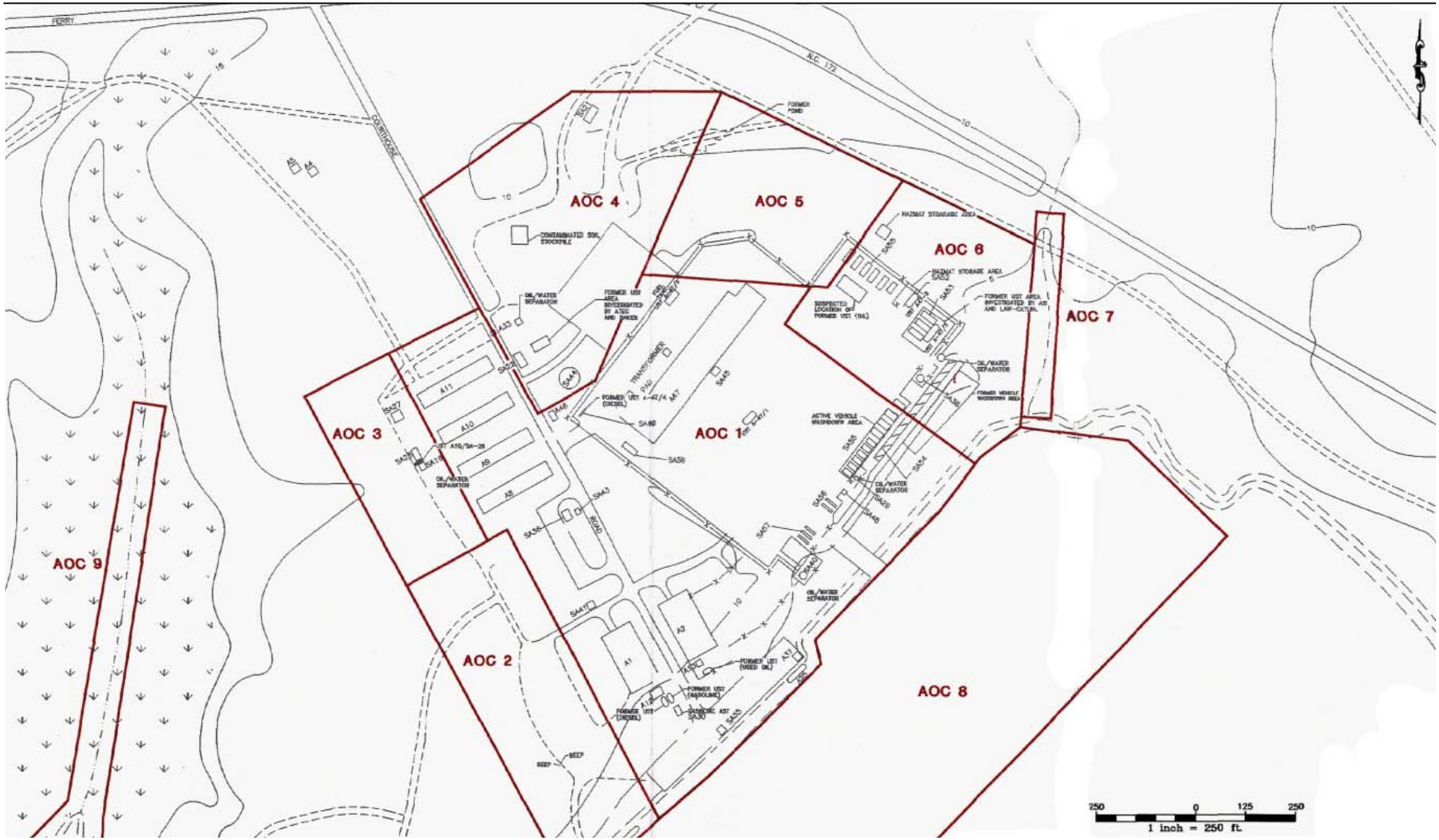
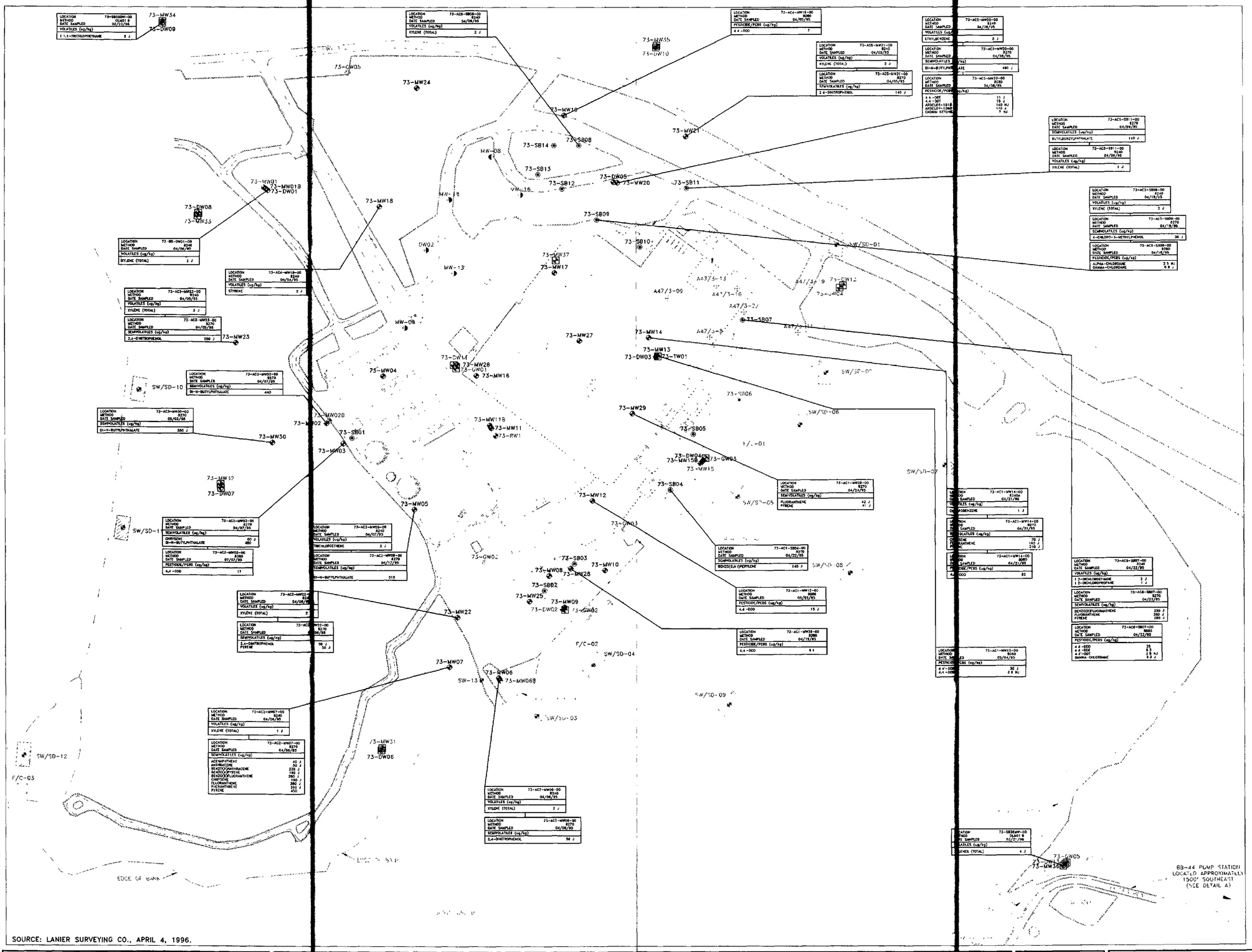


FIGURE B-1
Location of Previous Areas of Concern (AOCs) at Site 73
Site 73 Supplemental Remedial Investigation
MCB Camp Lejeune, North Carolina

CH2MHILL

ES072007006ATL CL101.ai

Remedial Investigation (Baker 1996)



SOURCE: LANIER SURVEYING CO., APRIL 4, 1996.

LEGEND

73-SB01	SOIL BORINGS ADVANCED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
73-MW01	MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
73-MW31	MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE II (FEBRUARY-MARCH, 1996)
A47/3-8	MONITORING WELLS INSTALLED DURING UST INVESTIGATION BY GSI AND LAW-CATLIN AND ASSOCIATES (1993)
MW-18	MONITORING WELLS INSTALLED BY BAKER DURING UST INVESTIGATION (1992 AND 1993)
MW-08	MONITORING WELLS INSTALLED DURING A UST INVESTIGATION BY ATEC AND ASSOCIATES (1991)
73GW-02	MONITORING WELLS INSTALLED BY ESE DURING CONFIRMATORY SAMPLING (1990)
SW/SD-01	SURFACE WATER/SEDIMENT LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
F/C-01	FISH/CRAB LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)

DETAIL A

REVISIONS			
	DRAWN	WJH	NORTH
	REVIEWED	JSC	
	S.O.#	62470-312-0000-07000	
	CADD#	312560PP	

SITE 73 – AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

DETECTED VOLATILES (METHODS 8240 AND CLP), SEMIVOLATILES (METHOD 8270), AND PESTICIDES/PCBs (METHOD 8080) IN SURFACE SOILS

SCALE 1" = 150'

DATE NOVEMBER 1996

FIGURE NO. 4-1

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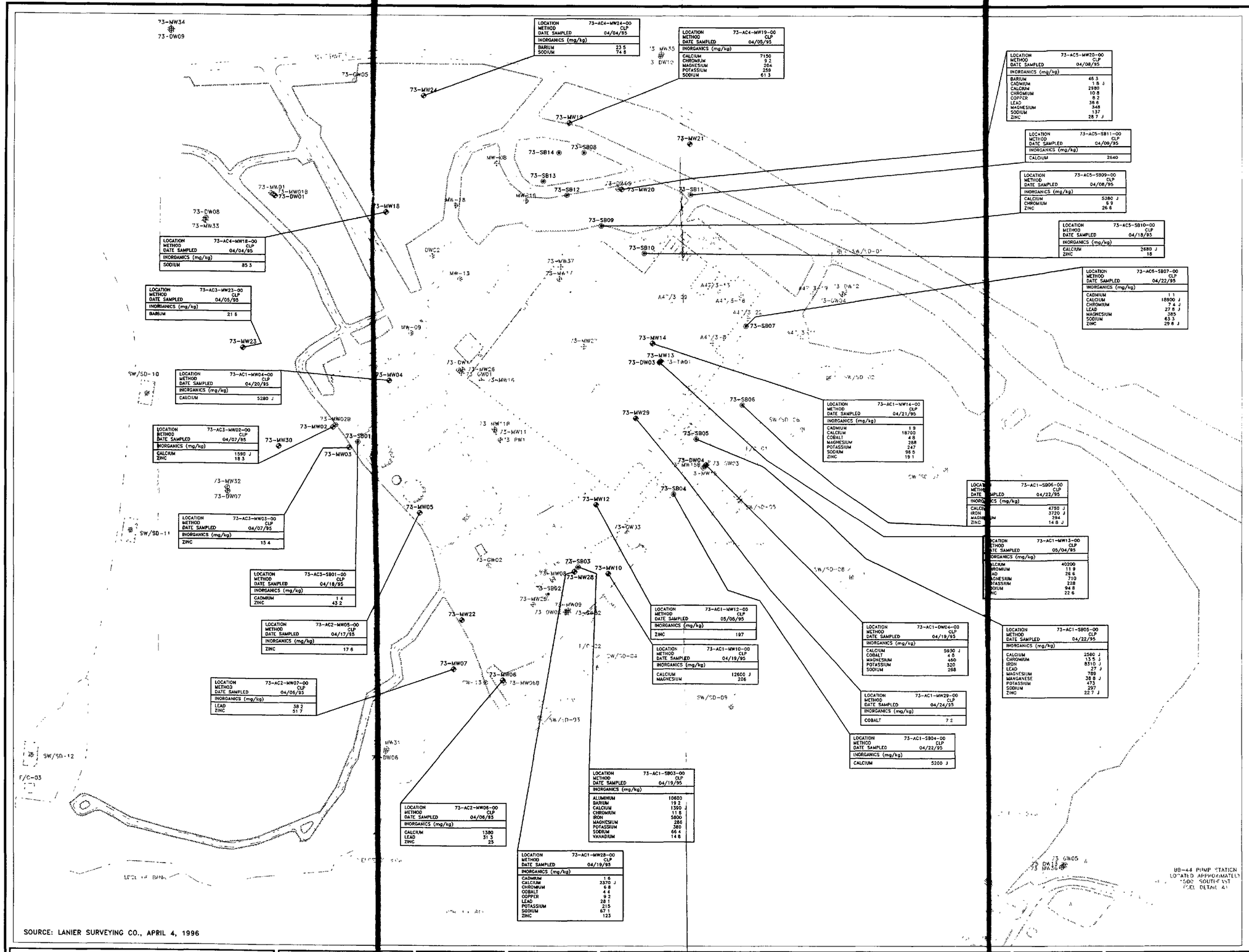


LOCATION	73-AC4-MW24-00
METHOD	CLP
DATE SAMPLED	04/04/95
INORGANICS (mg/kg)	
BARIUM	23.5
SODIUM	74.8

LOCATION	73-AC4-MW19-00
METHOD	CLP
DATE SAMPLED	04/05/95
INORGANICS (mg/kg)	
CALCIUM	7150
CHROMIUM	9.2
MAGNESIUM	204
POTASSIUM	259
SODIUM	61.3

LOCATION	73-AC5-MW20-00
METHOD	CLP
DATE SAMPLED	04/08/95
INORGANICS (mg/kg)	
BARIUM	46.3
CADMIUM	1.9 J
CALCIUM	2930
CHROMIUM	10.8
COPPER	8.2
LEAD	36.6
MAGNESIUM	348
SODIUM	137
ZINC	28.7 J

LOCATION	73-AC5-SB11-00
METHOD	CLP
DATE SAMPLED	04/09/95
INORGANICS (mg/kg)	
CALCIUM	2640

LOCATION	73-AC5-SB09-00
METHOD	CLP
DATE SAMPLED	04/08/95
INORGANICS (mg/kg)	
CALCIUM	5380 J
CHROMIUM	6.9
ZINC	26.6

LOCATION	73-AC5-SB10-00
METHOD	CLP
DATE SAMPLED	04/18/95
INORGANICS (mg/kg)	
CALCIUM	2680 J
ZINC	18

LOCATION	73-AC5-SB07-00
METHOD	CLP
DATE SAMPLED	04/22/95
INORGANICS (mg/kg)	
CADMIUM	1.1
CALCIUM	18900 J
CHROMIUM	7.4 J
LEAD	27.8 J
MAGNESIUM	585
SODIUM	63.3
ZINC	29.6 J

LOCATION	73-AC4-MW18-00
METHOD	CLP
DATE SAMPLED	04/04/95
INORGANICS (mg/kg)	
SODIUM	85.3

LOCATION	73-AC3-MW23-00
METHOD	CLP
DATE SAMPLED	04/05/95
INORGANICS (mg/kg)	
BARIUM	21.6

LOCATION	73-AC1-MW04-00
METHOD	CLP
DATE SAMPLED	04/20/95
INORGANICS (mg/kg)	
CALCIUM	5280 J

LOCATION	73-AC3-MW02-00
METHOD	CLP
DATE SAMPLED	04/07/95
INORGANICS (mg/kg)	
CALCIUM	1590 J
ZINC	18.3

LOCATION	73-AC3-MW03-00
METHOD	CLP
DATE SAMPLED	04/07/95
INORGANICS (mg/kg)	
ZINC	15.4

LOCATION	73-AC3-SB01-00
METHOD	CLP
DATE SAMPLED	04/19/95
INORGANICS (mg/kg)	
CADMIUM	1.4
ZINC	43.2

LOCATION	73-AC2-MW05-00
METHOD	CLP
DATE SAMPLED	04/17/95
INORGANICS (mg/kg)	
ZINC	17.6

LOCATION	73-AC2-MW07-00
METHOD	CLP
DATE SAMPLED	04/06/95
INORGANICS (mg/kg)	
LEAD	38.2
ZINC	51.7

LOCATION	73-AC2-MW06-00
METHOD	CLP
DATE SAMPLED	04/06/95
INORGANICS (mg/kg)	
CALCIUM	1380
LEAD	31.3
ZINC	25

LOCATION	73-AC1-MW28-00
METHOD	CLP
DATE SAMPLED	04/19/95
INORGANICS (mg/kg)	
CADMIUM	1.6
CALCIUM	2370 J
CHROMIUM	6.8
COBALT	4.4
COPPER	9.2
LEAD	28.1
POTASSIUM	215
SODIUM	67.1
ZINC	123

LOCATION	73-AC1-SB03-00
METHOD	CLP
DATE SAMPLED	04/19/95
INORGANICS (mg/kg)	
ALUMINUM	10600
BARIUM	19.2
CALCIUM	1390 J
CHROMIUM	11.8
IRON	5800
MAGNESIUM	286
POTASSIUM	380
SODIUM	66.4
VANADIUM	14.8

LOCATION	73-AC1-MW12-00
METHOD	CLP
DATE SAMPLED	05/05/95
INORGANICS (mg/kg)	
ZINC	197

LOCATION	73-AC1-MW10-00
METHOD	CLP
DATE SAMPLED	04/19/95
INORGANICS (mg/kg)	
CALCIUM	12600 J
MAGNESIUM	206

LOCATION	73-AC1-MW14-00
METHOD	CLP
DATE SAMPLED	04/21/95
INORGANICS (mg/kg)	
CADMIUM	1.9
CALCIUM	18700
COBALT	4.8
MAGNESIUM	288
POTASSIUM	247
SODIUM	96.5
ZINC	19.1

LOCATION	73-AC1-SB06-00
METHOD	CLP
DATE SAMPLED	04/22/95
INORGANICS (mg/kg)	
CALCIUM	4750 J
IRON	3720 J
MAGNESIUM	294
ZINC	14.8 J

LOCATION	73-AC1-MW13-00
METHOD	CLP
DATE SAMPLED	05/04/95
INORGANICS (mg/kg)	
CALCIUM	40200
CHROMIUM	11.9
LEAD	26.6
MAGNESIUM	710
POTASSIUM	228
SODIUM	94.8
ZINC	22.6

LOCATION	73-AC1-DW04-00
METHOD	CLP
DATE SAMPLED	04/19/95
INORGANICS (mg/kg)	
CALCIUM	5930 J
COBALT	4.8
MAGNESIUM	460
POTASSIUM	320
SODIUM	268

LOCATION	73-AC1-SB05-00
METHOD	CLP
DATE SAMPLED	04/22/95
INORGANICS (mg/kg)	
CALCIUM	2560 J
CHROMIUM	13.5 J
IRON	8310 J
LEAD	27 J
MAGNESIUM	789
MANGANESE	38.8 J
POTASSIUM	473
SODIUM	297
ZINC	22.7 J

LOCATION	73-AC1-MW29-00
METHOD	CLP
DATE SAMPLED	04/24/95
INORGANICS (mg/kg)	
COBALT	7.2

LOCATION	73-AC1-SB04-00
METHOD	CLP
DATE SAMPLED	04/22/95
INORGANICS (mg/kg)	
CALCIUM	5200 J

SOURCE: LANIER SURVEYING CO., APRIL 4, 1996

REVISIONS

DRAWN	WJH
REVIEWED	JSC
S.O.#	62470-312-00[illegible]-07000
CADD#	312559F

NORTH

SITE 73 – AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

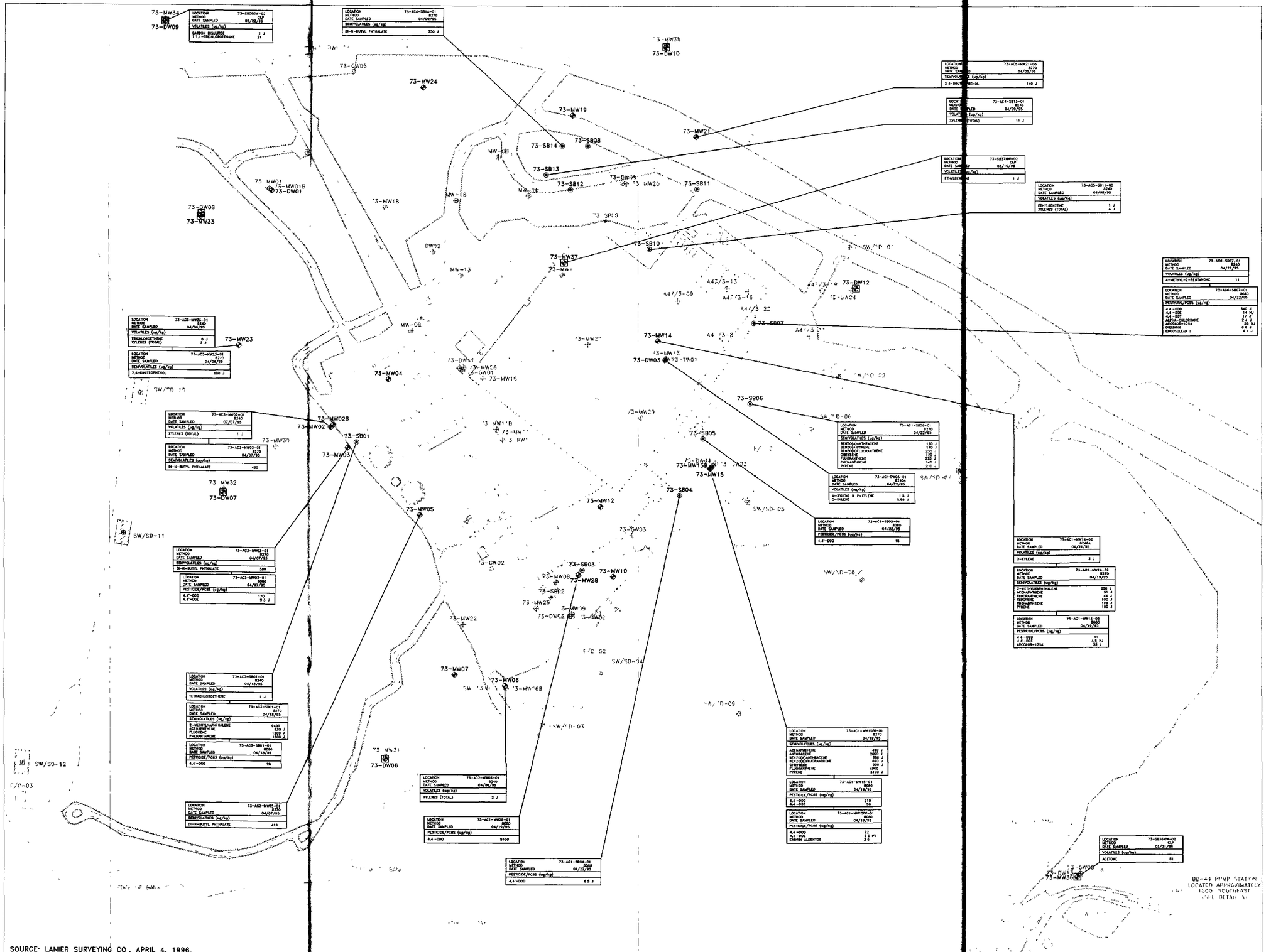
Baker
Baker Environmental, Inc.

DETECTED INORGANICS EXCEEDING 2x BASE BACKGROUND IN SURFACE SOILS

SCALE 1" = 150'

DATE NOVEMBER 1996

FIGURE NO
4-2



LOCATION	73-SB09W-02
METHOD	/30
DATE SAMPLED	05/22/95
VOLATILES (ug/kg)	
CARBON DISULFIDE	2 J
1,1,1-TRICHLOROETHANE	21

LOCATION	73-AC4-SB14-01
METHOD	8270
DATE SAMPLED	04/06/95
SEMIVOLATILES (ug/kg)	
DI-N-BUTYL PHTHALATE	300 J

LOCATION	73-AC5-MW21-03
METHOD	8270
DATE SAMPLED	04/05/95
SEMIVOLATILES (ug/kg)	
2,4-DIMETHYLPHENOL	140 J

LOCATION	73-AC4-SB13-01
METHOD	8240
DATE SAMPLED	04/06/95
VOLATILES (ug/kg)	
XYLENES (TOTAL)	11 J

LOCATION	73-SB37MW-02
METHOD	GLP
DATE SAMPLED	03/16/96
VOLATILES (ug/kg)	
ETHYLBENZENE	1 J

LOCATION	73-AC5-SB11-02
METHOD	8240
DATE SAMPLED	04/06/95
VOLATILES (ug/kg)	
ETHYLBENZENE	1 J
XYLENES (TOTAL)	4 J

LOCATION	73-AC6-SB07-04
METHOD	8240
DATE SAMPLED	04/22/95
VOLATILES (ug/kg)	
4-METHYL-2-PENTANONE	11

LOCATION	73-AC6-SB07-01
METHOD	8080
DATE SAMPLED	04/22/95
PESTICIDE/PCBS (ug/kg)	
4,4-DDD	540 J
4,4-DDE	14 NJ
4,4-DDT	17 J
ALPHA-BENZENEHEXACHLORIDE	2 J
AROCLOR-1254	38 NJ
DIELDRIN	6.9 J
ENDOSULFAN I	4.1 J

LOCATION	73-AC3-MW23-01
METHOD	8240
DATE SAMPLED	04/06/95
VOLATILES (ug/kg)	
TRICHLOROETHENE	8 J
XYLENES (TOTAL)	5 J

LOCATION	73-AC3-MW23-01
METHOD	8270
DATE SAMPLED	04/06/95
SEMIVOLATILES (ug/kg)	
2,4-DINITROPHENOL	180 J

LOCATION	73-AC3-MW03-03
METHOD	8240
DATE SAMPLED	07/07/95
VOLATILES (ug/kg)	
XYLENES (TOTAL)	1 J

LOCATION	73-AC3-MW03-01
METHOD	8270
DATE SAMPLED	04/07/95
SEMIVOLATILES (ug/kg)	
DI-N-BUTYL PHTHALATE	430

LOCATION	73-AC1-SB06-01
METHOD	8270
DATE SAMPLED	04/22/95
SEMIVOLATILES (ug/kg)	
BENZO(A)ANTHRACENE	120 J
BENZO(A)PYRENE	140 J
BENZO(B)FLUORANTHENE	250 J
CHRYSENE	120 J
FLUORANTHENE	220 J
PHENANTHRENE	140 J
PYRENE	210 J

LOCATION	73-AC1-DW05-01
METHOD	8240A
DATE SAMPLED	04/22/95
VOLATILES (ug/kg)	
M-XYLENE & P-XYLENE	1.5 J
O-XYLENE	0.68 J

LOCATION	73-AC1-SB05-01
METHOD	8080
DATE SAMPLED	04/22/95
PESTICIDE/PCBS (ug/kg)	
4,4-DDD	18

LOCATION	73-AC1-MW14-02
METHOD	8240A
DATE SAMPLED	04/21/95
VOLATILES (ug/kg)	
O-XYLENE	3 J

LOCATION	73-AC1-MW14-03
METHOD	8270
DATE SAMPLED	04/19/95
SEMIVOLATILES (ug/kg)	
2-METHYLNAPHTHALENE	250 J
ACENAPHTHENE	51 J
FLUORANTHENE	150 J
FLUORENE	100 J
PHENANTHRENE	180 J
PYRENE	150 J

LOCATION	73-AC1-MW14-03
METHOD	8080
DATE SAMPLED	04/19/95
PESTICIDE/PCBS (ug/kg)	
4,4-DDD	41
4,4-DDE	4.5 NJ
AROCLOR-1254	35 J

LOCATION	73-AC3-SB01-01
METHOD	8240
DATE SAMPLED	04/18/95
VOLATILES (ug/kg)	
TETRACHLOROETHENE	1 J

LOCATION	73-AC3-SB01-01
METHOD	8270
DATE SAMPLED	04/18/95
SEMIVOLATILES (ug/kg)	
2-METHYLNAPHTHALENE	9400
ACENAPHTHENE	830 J
FLUORENE	1300 J
PHENANTHRENE	1900 J

LOCATION	73-AC3-SB01-01
METHOD	8080
DATE SAMPLED	04/18/95
PESTICIDE/PCBS (ug/kg)	
4,4-DDD	28

LOCATION	73-AC2-MW05-01
METHOD	8270
DATE SAMPLED	04/27/95
SEMIVOLATILES (ug/kg)	
DI-N-BUTYL PHTHALATE	410

LOCATION	73-AC2-MW05-01
METHOD	8240
DATE SAMPLED	04/06/95
VOLATILES (ug/kg)	
XYLENES (TOTAL)	2 J

LOCATION	73-AC1-MW06-01
METHOD	8080
DATE SAMPLED	04/19/95
PESTICIDE/PCBS (ug/kg)	
4,4-DDD	5100

LOCATION	73-AC1-SB04-01
METHOD	8080
DATE SAMPLED	04/22/95
PESTICIDE/PCBS (ug/kg)	
4,4-DDD	69 J

LOCATION	73-AC1-MW15W-01
METHOD	8270
DATE SAMPLED	04/19/95
SEMIVOLATILES (ug/kg)	
ACENAPHTHENE	480 J
FLUORENE	400 J
BENZO(A)ANTHRACENE	930 J
BENZO(B)FLUORANTHENE	660 J
CHRYSENE	930 J
FLUORANTHENE	4900
PYRENE	3100 J

LOCATION	73-AC1-MW15-01
METHOD	8080
DATE SAMPLED	04/19/95
PESTICIDE/PCBS (ug/kg)	
4,4-DDD	210
4,4-DDE	50

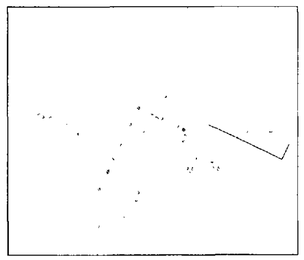
LOCATION	73-AC1-MW15W-01
METHOD	8080
DATE SAMPLED	04/19/95
PESTICIDE/PCBS (ug/kg)	
4,4-DDD	72
4,4-DDE	2.3 NJ
ENDRIN ALDEHYDE	3.6

LOCATION	73-SB36MW-02
METHOD	GLP
DATE SAMPLED	03/21/96
VOLATILES (ug/kg)	
ACETONE	51

SOURCE: LANIER SURVEYING CO. APRIL 4, 1996.

LEGEND

- 73-SB01 — SOIL BORINGS ADVANCED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW01 — MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW31 — MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE II (FEBRUARY-MARCH, 1996)
- A47/3-8 — MONITORING WELLS INSTALLED DURING UST INVESTIGATION BY GSI AND LAW-CATLIN AND ASSOCIATES (1993)
- MW-18 — MONITORING WELLS INSTALLED BY BAKER DURING UST INVESTIGATION (1992 AND 1993)
- MW-08 — MONITORING WELLS INSTALLED DURING A UST INVESTIGATION BY ATEC AND ASSOCIATES (1991)
- 730W-02 — MONITORING WELLS INSTALLED BY ESE DURING CONFIRMATORY SAMPLING (1990)
- SW/SD-01 — SURFACE WATER/SEDIMENT LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- F/C-01 — FISH/CRAB LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)



DETAIL A

REVISIONS			
DRAWN	WJH	NORTH	SITE 73 – AMPHIBIOUS VEHICLE MAINTENANCE FACILITY REMEDIAL INVESTIGATION, CTO-0312 MARINE CORPS BASE, CAMP LEJEUNE NORTH CAROLINA
REVIEWED	JSC		
S.O.#	62470-312-0000-07000		BAKER ENVIRONMENTAL, Inc. Coraopolis, Pennsylvania
CADD#	312547PP		

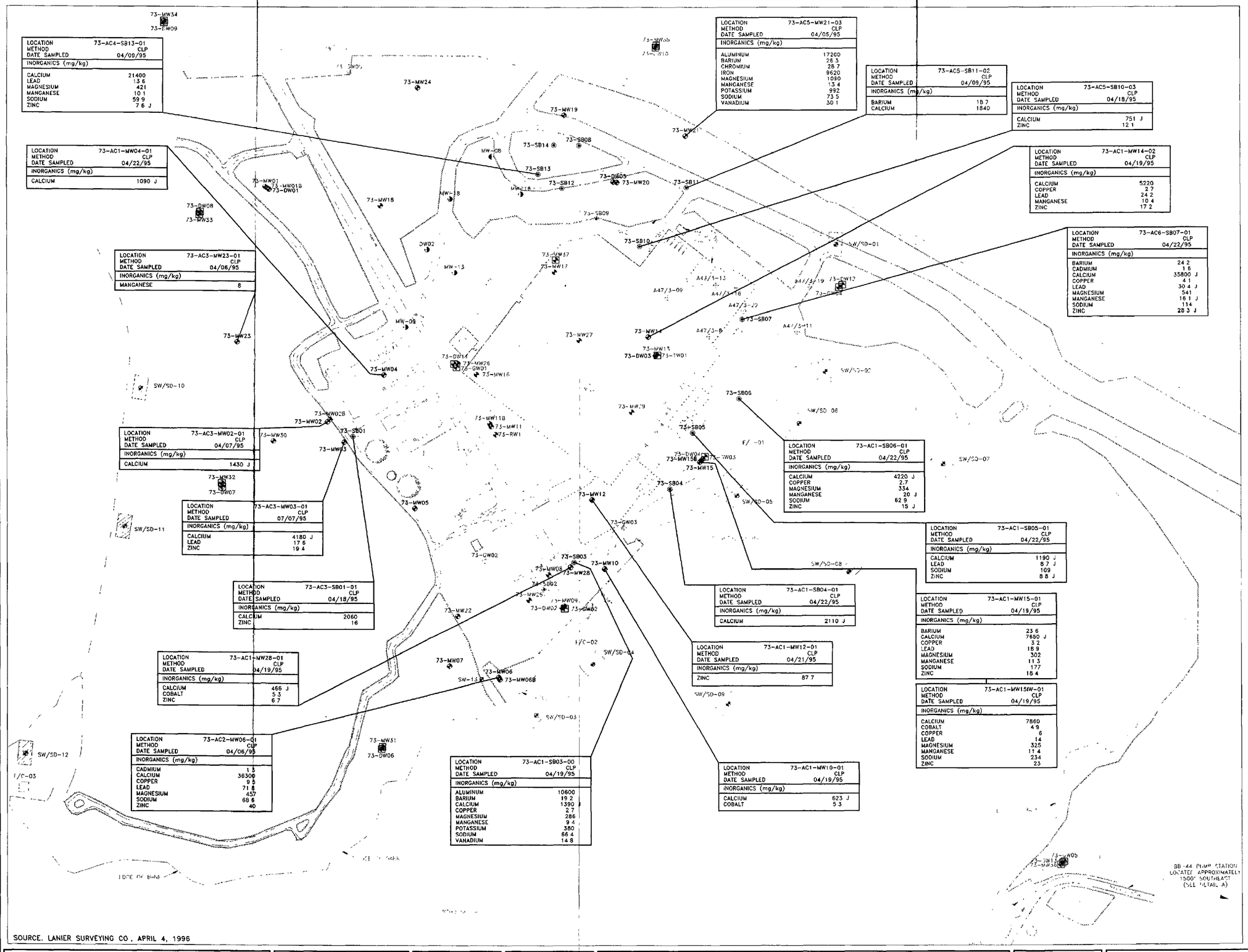
Baker
Baker Environmental, Inc.

DETECTED VOLATILES (METHOD 8240/8240A), SEMIVOLATILES (METHOD 8270), AND PESTICIDES/PCBs (METHOD 8080) IN SUBSURFACE SOILS

SCALE 1" = 150'

DATE NOVEMBER 1996

FIGURE NO 4-3



LOCATION	73-AC4-SB13-01
METHOD	CLP
DATE SAMPLED	04/09/95
INORGANICS (mg/kg)	
CALCIUM	21400
LEAD	13 6
MAGNESIUM	421
MANGANESE	10 1
SODIUM	59 9
ZINC	7 6 J

LOCATION	73-AC5-MW21-03
METHOD	CLP
DATE SAMPLED	04/05/95
INORGANICS (mg/kg)	
ALUMINUM	17200
BARIUM	26 3
CHROMIUM	28 7
IRON	9620
MAGNESIUM	1090
MANGANESE	13 4
POTASSIUM	992
SODIUM	73 5
VANADIUM	30 1

LOCATION	73-AC5-SB11-02
METHOD	CLP
DATE SAMPLED	04/09/95
INORGANICS (mg/kg)	
BARIUM	18 7
CALCIUM	1840

LOCATION	73-AC5-SB10-03
METHOD	CLP
DATE SAMPLED	04/18/95
INORGANICS (mg/kg)	
CALCIUM	751 J
ZINC	12 1

LOCATION	73-AC1-MW04-01
METHOD	CLP
DATE SAMPLED	04/22/95
INORGANICS (mg/kg)	
CALCIUM	1090 J

LOCATION	73-AC1-MW14-02
METHOD	CLP
DATE SAMPLED	04/19/95
INORGANICS (mg/kg)	
CALCIUM	5220
COPPER	2 7
LEAD	24 2
MANGANESE	10 4
ZINC	17 2

LOCATION	73-AC6-SB07-01
METHOD	CLP
DATE SAMPLED	04/22/95
INORGANICS (mg/kg)	
BARIUM	24 2
CADMIUM	1 6
CALCIUM	35800 J
COPPER	4 1
LEAD	30 4 J
MAGNESIUM	541
MANGANESE	16 1 J
SODIUM	114
ZINC	28 3 J

LOCATION	73-AC3-MW23-01
METHOD	CLP
DATE SAMPLED	04/06/95
INORGANICS (mg/kg)	
MANGANESE	8

LOCATION	73-AC3-MW02-01
METHOD	CLP
DATE SAMPLED	04/07/95
INORGANICS (mg/kg)	
CALCIUM	1430 J

LOCATION	73-AC3-MW03-01
METHOD	CLP
DATE SAMPLED	07/07/95
INORGANICS (mg/kg)	
CALCIUM	4180 J
LEAD	17 6
ZINC	19 4

LOCATION	73-AC3-SB01-01
METHOD	CLP
DATE SAMPLED	04/18/95
INORGANICS (mg/kg)	
CALCIUM	2060
ZINC	16

LOCATION	73-AC1-SB06-01
METHOD	CLP
DATE SAMPLED	04/22/95
INORGANICS (mg/kg)	
CALCIUM	4220 J
COPPER	2.7
MAGNESIUM	334
MANGANESE	20 J
SODIUM	62 9
ZINC	15 J

LOCATION	73-AC1-SB05-01
METHOD	CLP
DATE SAMPLED	04/22/95
INORGANICS (mg/kg)	
CALCIUM	1190 J
LEAD	8 7 J
SODIUM	109
ZINC	8 8 J

LOCATION	73-AC1-SB04-01
METHOD	CLP
DATE SAMPLED	04/22/95
INORGANICS (mg/kg)	
CALCIUM	2110 J

LOCATION	73-AC1-MW15-01
METHOD	CLP
DATE SAMPLED	04/19/95
INORGANICS (mg/kg)	
BARIUM	23 6
CALCIUM	7650 J
COPPER	3 2
LEAD	18 9
MAGNESIUM	302
MANGANESE	11 3
SODIUM	177
ZINC	18 4

LOCATION	73-AC1-MW12-01
METHOD	CLP
DATE SAMPLED	04/21/95
INORGANICS (mg/kg)	
ZINC	87 7

LOCATION	73-AC1-MW15W-01
METHOD	CLP
DATE SAMPLED	04/19/95
INORGANICS (mg/kg)	
CALCIUM	7860
COBALT	4 9
COPPER	6
LEAD	14
MAGNESIUM	325
MANGANESE	11 4
SODIUM	234
ZINC	23

LOCATION	73-AC1-MW28-01
METHOD	CLP
DATE SAMPLED	04/19/95
INORGANICS (mg/kg)	
CALCIUM	466 J
COBALT	5 3
ZINC	6 7

LOCATION	73-AC2-MW06-01
METHOD	CLP
DATE SAMPLED	04/06/95
INORGANICS (mg/kg)	
CADMIUM	1 3
CALCIUM	36300
COPPER	9 5
LEAD	71 8
MAGNESIUM	457
SODIUM	68 6
ZINC	40

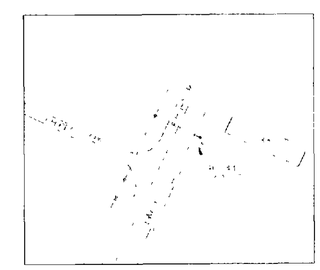
LOCATION	73-AC1-SB03-00
METHOD	CLP
DATE SAMPLED	04/19/95
INORGANICS (mg/kg)	
ALUMINUM	10600
BARIUM	19 2
CALCIUM	1390 J
COPPER	2 7
MAGNESIUM	286
MANGANESE	9 4
POTASSIUM	380
SODIUM	86 4
VANADIUM	14 8

LOCATION	73-AC1-MW10-01
METHOD	CLP
DATE SAMPLED	04/19/95
INORGANICS (mg/kg)	
CALCIUM	623 J
COBALT	5 3

SOURCE. LANIER SURVEYING CO , APRIL 4, 1996

LEGEND

- 73-SB01 — SOIL BORINGS ADVANCED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL–MAY, 1995)
- 73-MW01 — MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL–MAY, 1995)
- 73-MW31 — MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE II (FEBRUARY–MARCH, 1996)
- A47/3-8 — MONITORING WELLS INSTALLED DURING UST INVESTIGATION BY GSI AND LAW–CATLIN AND ASSOCIATES (1993)
- MW-18 — MONITORING WELLS INSTALLED BY BAKER DURING UST INVESTIGATION (1992 AND 1993)
- MW-08 — MONITORING WELLS INSTALLED DURING A UST INVESTIGATION BY ATEC AND ASSOCIATES (1991)
- 73GW-02 — MONITORING WELLS INSTALLED BY ESE DURING CONFIRMATORY SAMPLING (1990)
- SW/SD-01 — SURFACE WATER/SEDIMENT LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL–MAY, 1995)
- F/C-01 — FISH/CRAB LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL–MAY, 1995)



DETAIL A

REVISIONS

DRAWN	WJH
REVIEWED	JSC
S.O.#	62470-312-0000-07000
CADD#	312562PP

NORTH

SITE 73 – AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

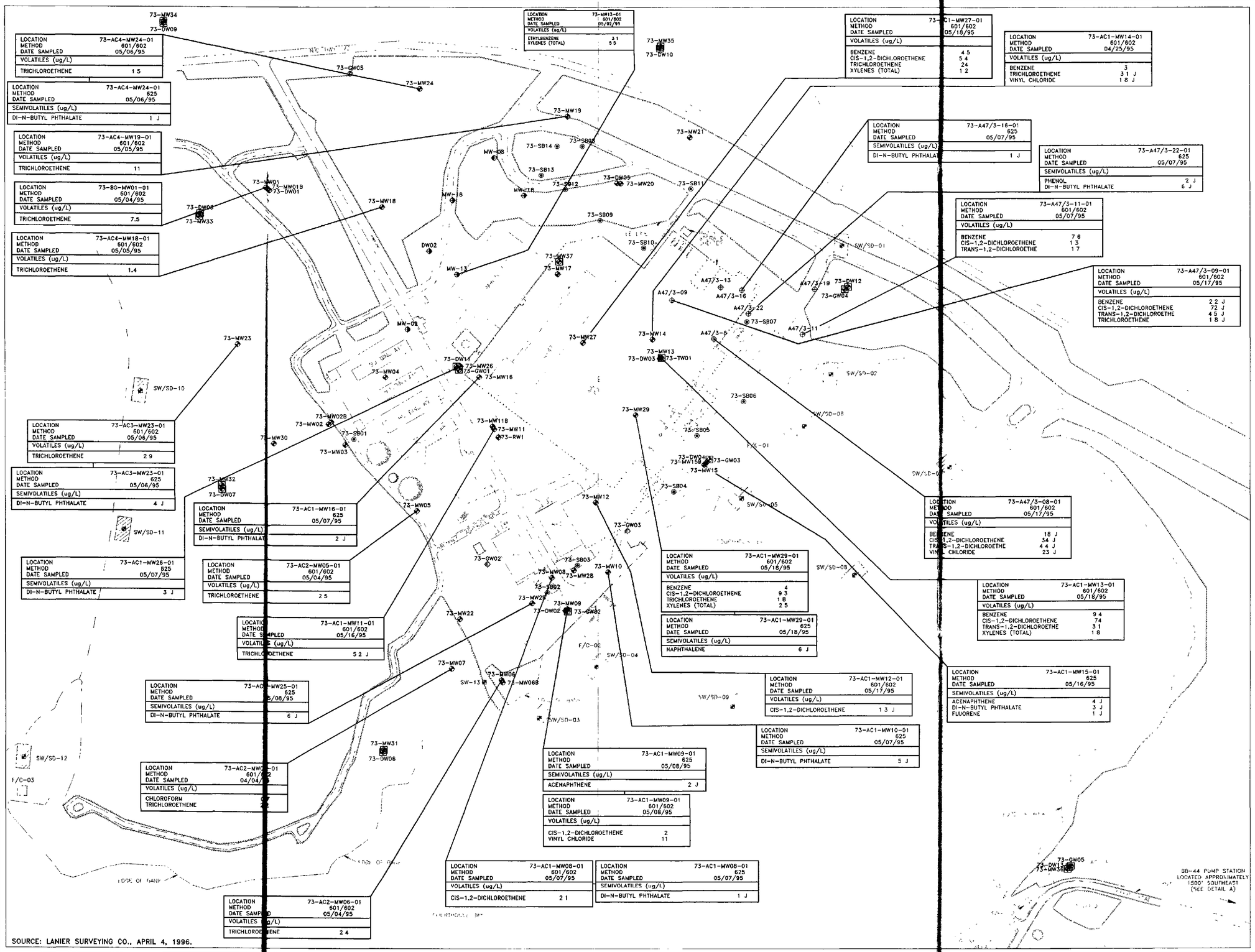
Baker
Baker Environmental, Inc.

DETECTED INORGANICS EXCEEDING 2X BASE BACKGROUND IN SUBSURFACE SOILS

SCALE 1" = 150'

DATE NOVEMBER 1996

FIGURE NO
4-4



LOCATION	73-AC4-MW24-01
METHOD	601/602
DATE SAMPLED	05/06/95
VOLATILES (ug/L)	
TRICHLOROETHENE	1 5

LOCATION	73-AC4-MW24-01
METHOD	625
DATE SAMPLED	05/06/95
SEMIVOLATILES (ug/L)	
DI-N-BUTYL PHTHALATE	1 J

LOCATION	73-AC4-MW19-01
METHOD	601/602
DATE SAMPLED	05/05/95
VOLATILES (ug/L)	
TRICHLOROETHENE	11

LOCATION	73-BG-MW01-01
METHOD	601/602
DATE SAMPLED	05/04/95
VOLATILES (ug/L)	
TRICHLOROETHENE	7.5

LOCATION	73-AC4-MW18-01
METHOD	601/602
DATE SAMPLED	05/05/95
VOLATILES (ug/L)	
TRICHLOROETHENE	1.4

LOCATION	73-AC3-MW23-01
METHOD	601/602
DATE SAMPLED	05/06/95
VOLATILES (ug/L)	
TRICHLOROETHENE	2 9

LOCATION	73-AC3-MW23-01
METHOD	625
DATE SAMPLED	05/06/95
SEMIVOLATILES (ug/L)	
DI-N-BUTYL PHTHALATE	4 J

LOCATION	73-AC1-MW26-01
METHOD	625
DATE SAMPLED	05/07/95
SEMIVOLATILES (ug/L)	
DI-N-BUTYL PHTHALATE	3 J

LOCATION	73-AC1-MW16-01
METHOD	625
DATE SAMPLED	05/07/95
SEMIVOLATILES (ug/L)	
DI-N-BUTYL PHTHALATE	2 J

LOCATION	73-AC2-MW05-01
METHOD	601/602
DATE SAMPLED	05/04/95
VOLATILES (ug/L)	
TRICHLOROETHENE	2 5

LOCATION	73-AC1-MW11-01
METHOD	601/602
DATE SAMPLED	05/16/95
VOLATILES (ug/L)	
TRICHLOROETHENE	5 2 J

LOCATION	73-AC1-MW25-01
METHOD	625
DATE SAMPLED	05/08/95
SEMIVOLATILES (ug/L)	
DI-N-BUTYL PHTHALATE	6 J

LOCATION	73-AC2-MW[illegible]-01
METHOD	601/[illegible]
DATE SAMPLED	04/04/[illegible]
VOLATILES (ug/L)	
CHLOROFORM	[illegible]
TRICHLOROETHENE	[illegible]

LOCATION	73-AC2-MW06-01
METHOD	601/602
DATE SAMPLED	05/04/95
VOLATILES (ug/L)	
TRICHLOROETHENE	2 4

LOCATION	73-MW13-01
METHOD	601/602
DATE SAMPLED	05/02/95
VOLATILES (ug/L)	
ETHYLBENZENE	3 1
XYLENES (TOTAL)	5 5

LOCATION	73-AC1-MW27-01
METHOD	601/602
DATE SAMPLED	05/18/95
VOLATILES (ug/L)	
BENZENE	4 5
CIS-1,2-DICHLOROETHENE	5 4
TRICHLOROETHENE	24
XYLENES (TOTAL)	1 2

LOCATION	73-AC1-MW14-01
METHOD	601/602
DATE SAMPLED	04/25/95
VOLATILES (ug/L)	
BENZENE	3
TRICHLOROETHENE	3 1 J
VINYL CHLORIDE	1 8 J

LOCATION	73-A47/3-16-01
METHOD	625
DATE SAMPLED	05/07/95
SEMIVOLATILES (ug/L)	
DI-N-BUTYL PHTHALATE	1 J

LOCATION	73-A47/3-22-01
METHOD	625
DATE SAMPLED	05/07/95
SEMIVOLATILES (ug/L)	
PHENOL	2 J
DI-N-BUTYL PHTHALATE	6 J

LOCATION	73-A47/3-11-01
METHOD	601/602
DATE SAMPLED	05/07/95
VOLATILES (ug/L)	
BENZENE	7 6
CIS-1,2-DICHLOROETHENE	1 3
TRANS-1,2-DICHLOROETHE	1 7

LOCATION	73-A47/3-09-01
METHOD	601/602
DATE SAMPLED	05/17/95
VOLATILES (ug/L)	
BENZENE	2 2 J
CIS-1,2-DICHLOROETHENE	72 J
TRANS-1,2-DICHLOROETHE	4 5 J
TRICHLOROETHENE	1 8 J

LOCATION	73-A47/3-08-01
METHOD	601/602
DATE SAMPLED	05/17/95
VOLATILES (ug/L)	
BENZENE	18 J
CIS-1,2-DICHLOROETHENE	34 J
TRANS-1,2-DICHLOROETHE	4 4 J
VINYL CHLORIDE	23 J

LOCATION	73-AC1-MW29-01
METHOD	601/602
DATE SAMPLED	05/16/95
VOLATILES (ug/L)	
BENZENE	4
CIS-1,2-DICHLOROETHENE	9 3
TRICHLOROETHENE	1 8
XYLENES (TOTAL)	2 5

LOCATION	73-AC1-MW29-01
METHOD	625
DATE SAMPLED	05/16/95
SEMIVOLATILES (ug/L)	
NAPHTHALENE	6 J

LOCATION	73-AC1-MW13-01
METHOD	601/602
DATE SAMPLED	05/16/95
VOLATILES (ug/L)	
BENZENE	9 4
CIS-1,2-DICHLOROETHENE	74
TRANS-1,2-DICHLOROETHE	3 1
XYLENES (TOTAL)	1 8

LOCATION	73-AC1-MW12-01
METHOD	601/602
DATE SAMPLED	05/17/95
VOLATILES (ug/L)	
CIS-1,2-DICHLOROETHENE	1 3 J

LOCATION	73-AC1-MW15-01
METHOD	625
DATE SAMPLED	05/16/95
SEMIVOLATILES (ug/L)	
ACENAPHTHENE	4 J
DI-N-BUTYL PHTHALATE	3 J
FLUORENE	1 J

LOCATION	73-AC1-MW10-01
METHOD	625
DATE SAMPLED	05/07/95
SEMIVOLATILES (ug/L)	
DI-N-BUTYL PHTHALATE	5 J

LOCATION	73-AC1-MW09-01
METHOD	625
DATE SAMPLED	05/08/95
SEMIVOLATILES (ug/L)	
ACENAPHTHENE	2 J

LOCATION	73-AC1-MW09-01
METHOD	601/602
DATE SAMPLED	05/08/95
VOLATILES (ug/L)	
CIS-1,2-DICHLOROETHENE	2
VINYL CHLORIDE	11

LOCATION	73-AC1-MW08-01
METHOD	601/602
DATE SAMPLED	05/07/95
VOLATILES (ug/L)	
CIS-1,2-DICHLOROETHENE	2 1

LOCATION	73-AC1-MW08-01
METHOD	625
DATE SAMPLED	05/07/95
SEMIVOLATILES (ug/L)	
DI-N-BUTYL PHTHALATE	1 J

SOURCE: LANIER SURVEYING CO., APRIL 4, 1996.

LEGEND

- 73-SB01 — SOIL BORINGS ADVANCED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
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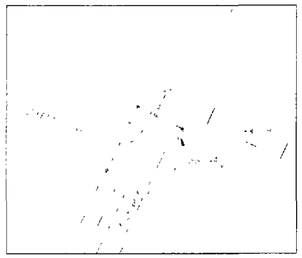


DETAIL A

REVISIONS

DRAWN	WJH
REVIEWED	JSC
S.O.#	62470-312-0000-07000
CADD#	312556PP

NORTH

SITE 73 – AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

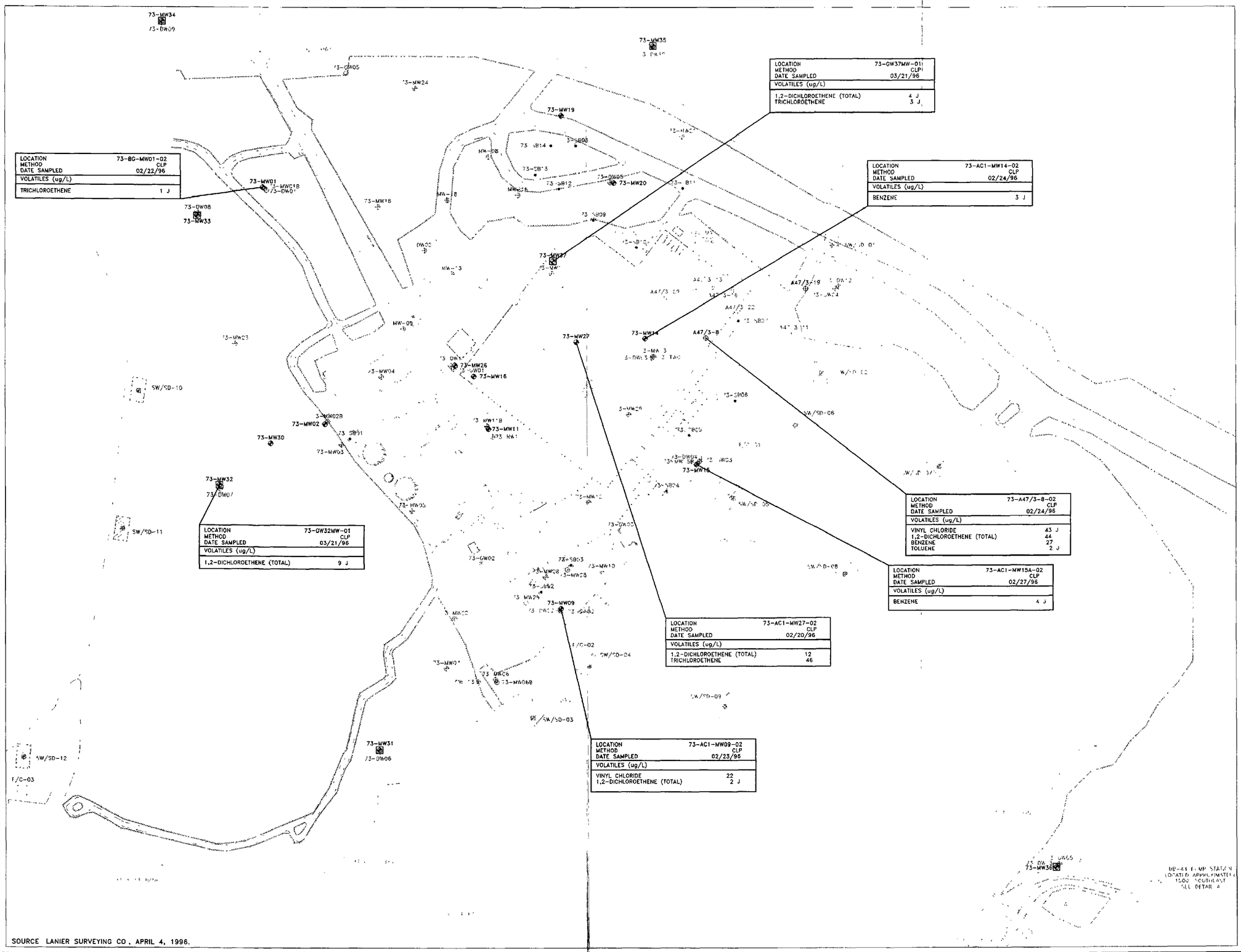
Baker
Baker Environmental, Inc.

DETECTED VOLATILES (METHODS 601/602) AND SEMIVOLATILES (METHOD 625) IN THE UPPERMOST PORTION OF THE SURFICIAL AQUIFER (PHASE I)

SCALE 1" = 150'

DATE NOVEMBER 1996

FIGURE NO. 4-5



SOURCE LANIER SURVEYING CO., APRIL 4, 1996.

LEGEND

- 73-SB01 — SOIL BORINGS ADVANCED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
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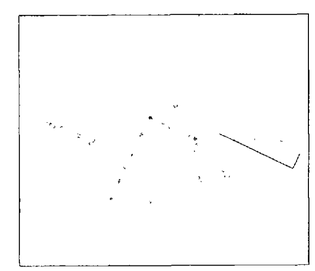
- F/C-01 — FISH/CRAB LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)



DETAIL A

REVISIONS			
	DRAWN WJH	NORTH	
	REVIEWED JSC		
	S.O.# 62470-312-0000-07000		
	CADD# 312528PP		

SITE 73 – AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

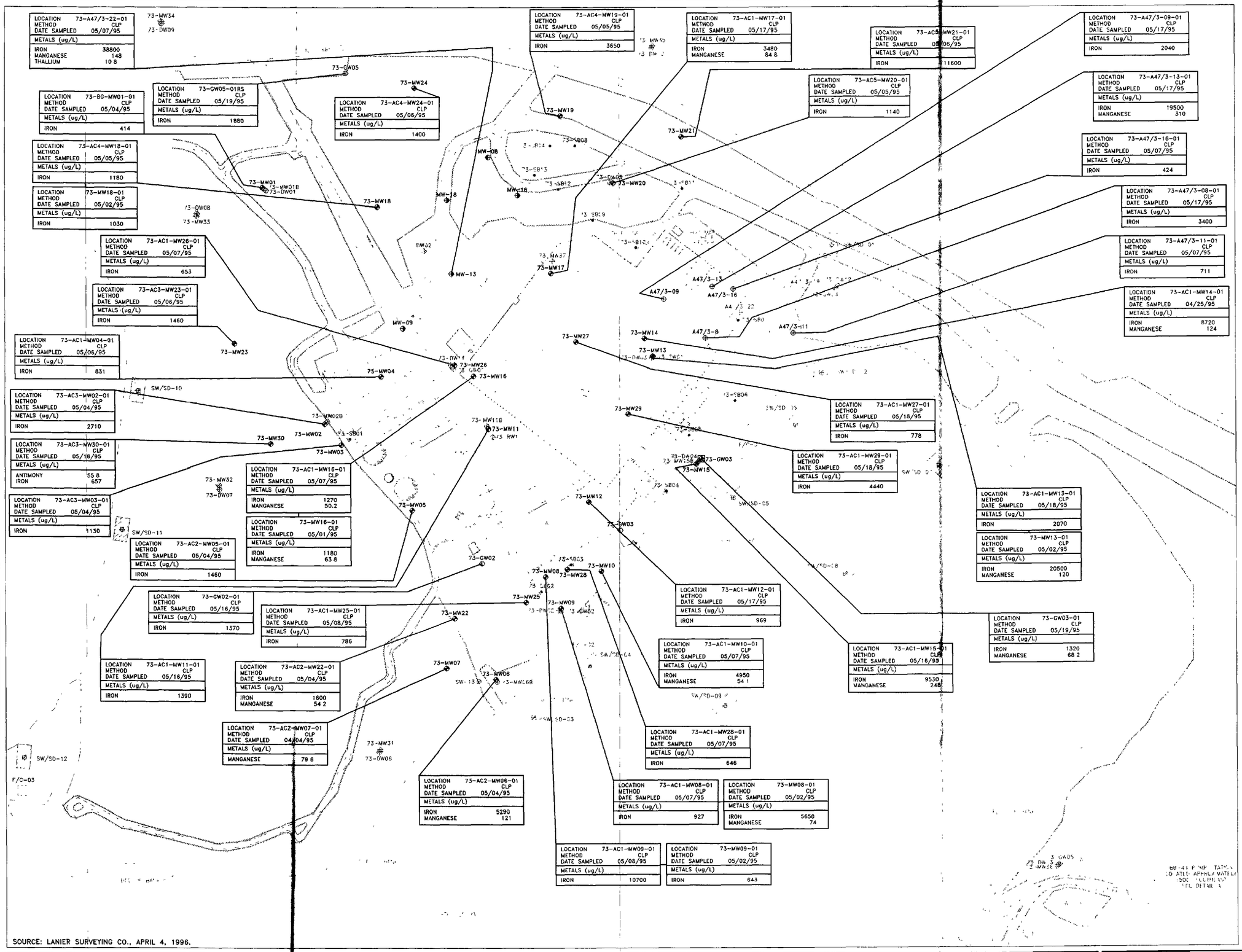
Baker
Baker Environmental, Inc.

DETECTED VOLATILES IN THE UPPERMOST PORTION OF THE SURFICIAL AQUIFER VIA CLP METHOD (PHASE II)

SCALE 1" = 150'

DATE NOVEMBER 1996

FIGURE NO. 4-6



LOCATION	73-A47/3-22-01
METHOD	CLP
DATE SAMPLED	05/07/95
METALS (ug/L)	
IRON	38800
MANGANESE	148
THALLIUM	10 8

LOCATION	73-BG-MW01-01
METHOD	CLP
DATE SAMPLED	05/04/95
METALS (ug/L)	
IRON	414

LOCATION	73-GW05-01RS
METHOD	CLP
DATE SAMPLED	05/19/95
METALS (ug/L)	
IRON	1880

LOCATION	73-AC4-MW24-01
METHOD	CLP
DATE SAMPLED	05/06/95
METALS (ug/L)	
IRON	1400

LOCATION	73-AC4-MW18-01
METHOD	CLP
DATE SAMPLED	05/05/95
METALS (ug/L)	
IRON	1180

LOCATION	73-MW18-01
METHOD	CLP
DATE SAMPLED	05/02/95
METALS (ug/L)	
IRON	1030

LOCATION	73-AC1-MW26-01
METHOD	CLP
DATE SAMPLED	05/07/95
METALS (ug/L)	
IRON	653

LOCATION	73-AC3-MW23-01
METHOD	CLP
DATE SAMPLED	05/06/95
METALS (ug/L)	
IRON	1460

LOCATION	73-AC1-MW04-01
METHOD	CLP
DATE SAMPLED	05/06/95
METALS (ug/L)	
IRON	831

LOCATION	73-AC3-MW02-01
METHOD	CLP
DATE SAMPLED	05/04/95
METALS (ug/L)	
IRON	2710

LOCATION	73-AC3-MW30-01
METHOD	CLP
DATE SAMPLED	05/16/95
METALS (ug/L)	
ANTIMONY	55 8
IRON	657

LOCATION	73-AC3-MW03-01
METHOD	CLP
DATE SAMPLED	05/04/95
METALS (ug/L)	
IRON	1130

LOCATION	73-AC1-MW16-01
METHOD	CLP
DATE SAMPLED	05/07/95
METALS (ug/L)	
IRON	1270
MANGANESE	50.2

LOCATION	73-MW16-01
METHOD	CLP
DATE SAMPLED	05/01/95
METALS (ug/L)	
IRON	1180
MANGANESE	63 8

LOCATION	73-AC2-MW05-01
METHOD	CLP
DATE SAMPLED	05/04/95
METALS (ug/L)	
IRON	1460

LOCATION	73-GW02-01
METHOD	CLP
DATE SAMPLED	05/16/95
METALS (ug/L)	
IRON	1370

LOCATION	73-AC1-MW25-01
METHOD	CLP
DATE SAMPLED	05/08/95
METALS (ug/L)	
IRON	786

LOCATION	73-AC1-MW11-01
METHOD	CLP
DATE SAMPLED	05/16/95
METALS (ug/L)	
IRON	1390

LOCATION	73-AC2-MW22-01
METHOD	CLP
DATE SAMPLED	05/04/95
METALS (ug/L)	
IRON	1600
MANGANESE	54 2

LOCATION	73-AC2-MW07-01
METHOD	CLP
DATE SAMPLED	04/04/95
METALS (ug/L)	
MANGANESE	79 6

LOCATION	73-AC2-MW06-01
METHOD	CLP
DATE SAMPLED	05/04/95
METALS (ug/L)	
IRON	5290
MANGANESE	121

LOCATION	73-AC4-MW19-01
METHOD	CLP
DATE SAMPLED	05/05/95
METALS (ug/L)	
IRON	3650

LOCATION	73-AC1-MW17-01
METHOD	CLP
DATE SAMPLED	05/17/95
METALS (ug/L)	
IRON	3480
MANGANESE	84 8

LOCATION	73-AC5-MW21-01
METHOD	CLP
DATE SAMPLED	05/06/95
METALS (ug/L)	
IRON	11600

LOCATION	73-AC5-MW20-01
METHOD	CLP
DATE SAMPLED	05/05/95
METALS (ug/L)	
IRON	1140

LOCATION	73-A47/3-09-01
METHOD	CLP
DATE SAMPLED	05/17/95
METALS (ug/L)	
IRON	2040

LOCATION	73-A47/3-13-01
METHOD	CLP
DATE SAMPLED	05/17/95
METALS (ug/L)	
IRON	19500
MANGANESE	310

LOCATION	73-A47/3-16-01
METHOD	CLP
DATE SAMPLED	05/07/95
METALS (ug/L)	
IRON	424

LOCATION	73-A47/3-08-01
METHOD	CLP
DATE SAMPLED	05/17/95
METALS (ug/L)	
IRON	3400

LOCATION	73-A47/3-11-01
METHOD	CLP
DATE SAMPLED	05/07/95
METALS (ug/L)	
IRON	711

LOCATION	73-AC1-MW14-01
METHOD	CLP
DATE SAMPLED	04/25/95
METALS (ug/L)	
IRON	8720
MANGANESE	124

LOCATION	73-AC1-MW27-01
METHOD	CLP
DATE SAMPLED	05/18/95
METALS (ug/L)	
IRON	778

LOCATION	73-AC1-MW29-01
METHOD	CLP
DATE SAMPLED	05/18/95
METALS (ug/L)	
IRON	4440

LOCATION	73-AC1-MW13-01
METHOD	CLP
DATE SAMPLED	05/18/95
METALS (ug/L)	
IRON	2070

LOCATION	73-MW13-01
METHOD	CLP
DATE SAMPLED	05/02/95
METALS (ug/L)	
IRON	20500
MANGANESE	120

LOCATION	73-AC1-MW12-01
METHOD	CLP
DATE SAMPLED	05/17/95
METALS (ug/L)	
IRON	969

LOCATION	73-GW03-01
METHOD	CLP
DATE SAMPLED	05/19/95
METALS (ug/L)	
IRON	1320
MANGANESE	68 2

LOCATION	73-AC1-MW10-01
METHOD	CLP
DATE SAMPLED	05/07/95
METALS (ug/L)	
IRON	4950
MANGANESE	54 1

LOCATION	73-AC1-MW15-01
METHOD	CLP
DATE SAMPLED	05/16/95
METALS (ug/L)	
IRON	9530
MANGANESE	248

LOCATION	73-AC1-MW28-01
METHOD	CLP
DATE SAMPLED	05/07/95
METALS (ug/L)	
IRON	646

LOCATION	73-AC1-MW08-01
METHOD	CLP
DATE SAMPLED	05/07/95
METALS (ug/L)	
IRON	927

LOCATION	73-MW08-01
METHOD	CLP
DATE SAMPLED	05/02/95
METALS (ug/L)	
IRON	5650
MANGANESE	74

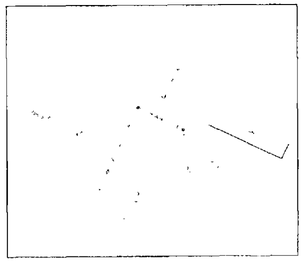
LOCATION	73-AC1-MW09-01
METHOD	CLP
DATE SAMPLED	05/08/95
METALS (ug/L)	
IRON	10700

LOCATION	73-MW09-01
METHOD	CLP
DATE SAMPLED	05/02/95
METALS (ug/L)	
IRON	643

SOURCE: LANIER SURVEYING CO., APRIL 4, 1996.

LEGEND

- 73-SB01 — SOIL BORINGS ADVANCED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW01 — MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW31 — MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE II (FEBRUARY-MARCH, 1996)
- A47/3-8 — MONITORING WELLS INSTALLED DURING UST INVESTIGATION BY GSI AND LAW-CATLIN AND ASSOCIATES (1993)
- MW-18 — MONITORING WELLS INSTALLED BY BAKER DURING UST INVESTIGATION (1992 AND 1993)
- MW-08 — MONITORING WELLS INSTALLED DURING A UST INVESTIGATION BY ATEC AND ASSOCIATES (1991)
- 73GW-02 — MONITORING WELLS INSTALLED BY ESE DURING CONFIRMATORY SAMPLING (1990)
- SW/SD-01 — SURFACE WATER/SEDIMENT LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- F/C-01 — FISH/CRAB LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)



DETAIL A

REVISIONS

DRAWN	WJH
REVIEWED	JSC
S.O.#	62470-312-0000-07000
CADD#	312558PP

NORTH

SITE 73 – AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

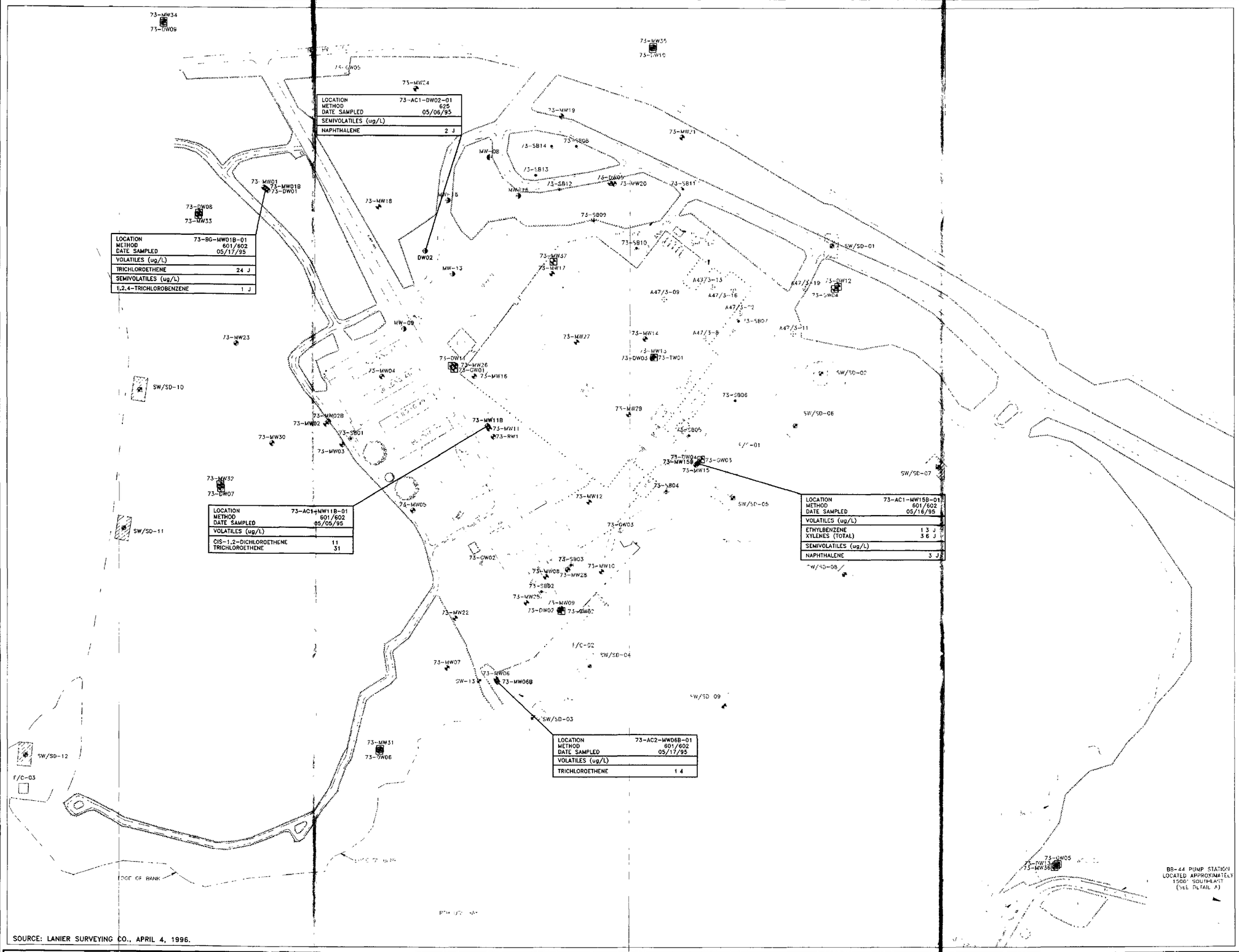
Baker
Baker Environmental, Inc.

DETECTED INORGANICS EXCEEDING NCWQS AND/OR FEDERAL MCLs IN THE UPPERMOST PORTION OF THE SURFICIAL AQUIFER (PHASE I)

SCALE 1" = 150'

DATE NOVEMBER 1996

FIGURE NO.
4-7



LOCATION	73-AC1-DW02-01
METHOD	625
DATE SAMPLED	05/06/95
SEMIVOLATILES (ug/L)	
NAPHTHALENE	2 J

LOCATION	73-BG-MW01B-01
METHOD	601/602
DATE SAMPLED	05/17/95
VOLATILES (ug/L)	
TRICHLOROETHENE	24 J
SEMIVOLATILES (ug/L)	
1,2,4-TRICHLOROBENZENE	1 J

LOCATION	73-AC1-MW11B-01
METHOD	601/602
DATE SAMPLED	05/05/95
VOLATILES (ug/L)	
CIS-1,2-DICHLOROETHENE	11
TRICHLOROETHENE	31

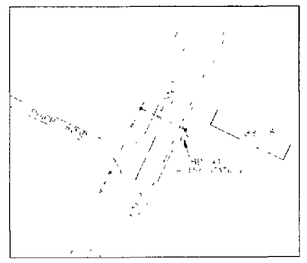
LOCATION	73-AC1-MW15B-01
METHOD	601/602
DATE SAMPLED	05/16/95
VOLATILES (ug/L)	
ETHYLBENZENE	1 3 J
XYLENES (TOTAL)	3 6 J
SEMIVOLATILES (ug/L)	
NAPHTHALENE	3 J

LOCATION	73-AC2-MW06B-01
METHOD	601/602
DATE SAMPLED	05/17/95
VOLATILES (ug/L)	
TRICHLOROETHENE	1 4

SOURCE: LANIER SURVEYING CO., APRIL 4, 1996.

LEGEND

73-SB01	SOIL BORINGS ADVANCED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
73-MW01	MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
73-MW31	MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE II (FEBRUARY-MARCH, 1996)
A47/3-8	MONITORING WELLS INSTALLED DURING UST INVESTIGATION BY GSI AND LAW-CATLIN AND ASSOCIATES (1993)
MW-18	MONITORING WELLS INSTALLED BY BAKER DURING UST INVESTIGATION (1992 AND 1993)
MW-08	MONITORING WELLS INSTALLED DURING A UST INVESTIGATION BY ATEC AND ASSOCIATES (1991)
73GW-02	MONITORING WELLS INSTALLED BY ESE DURING CONFIRMATORY SAMPLING (1990)
SW/SD-01	SURFACE WATER/SEDIMENT LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
F/C-01	FISH/CRAB LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)



DETAIL A

REVISIONS			
DRAWN	WJH	NORTH	
REVIEWED	JSC		
S.O.#	62470-312-0000-07000		
CADD#	312533PP		

SITE 73 – AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

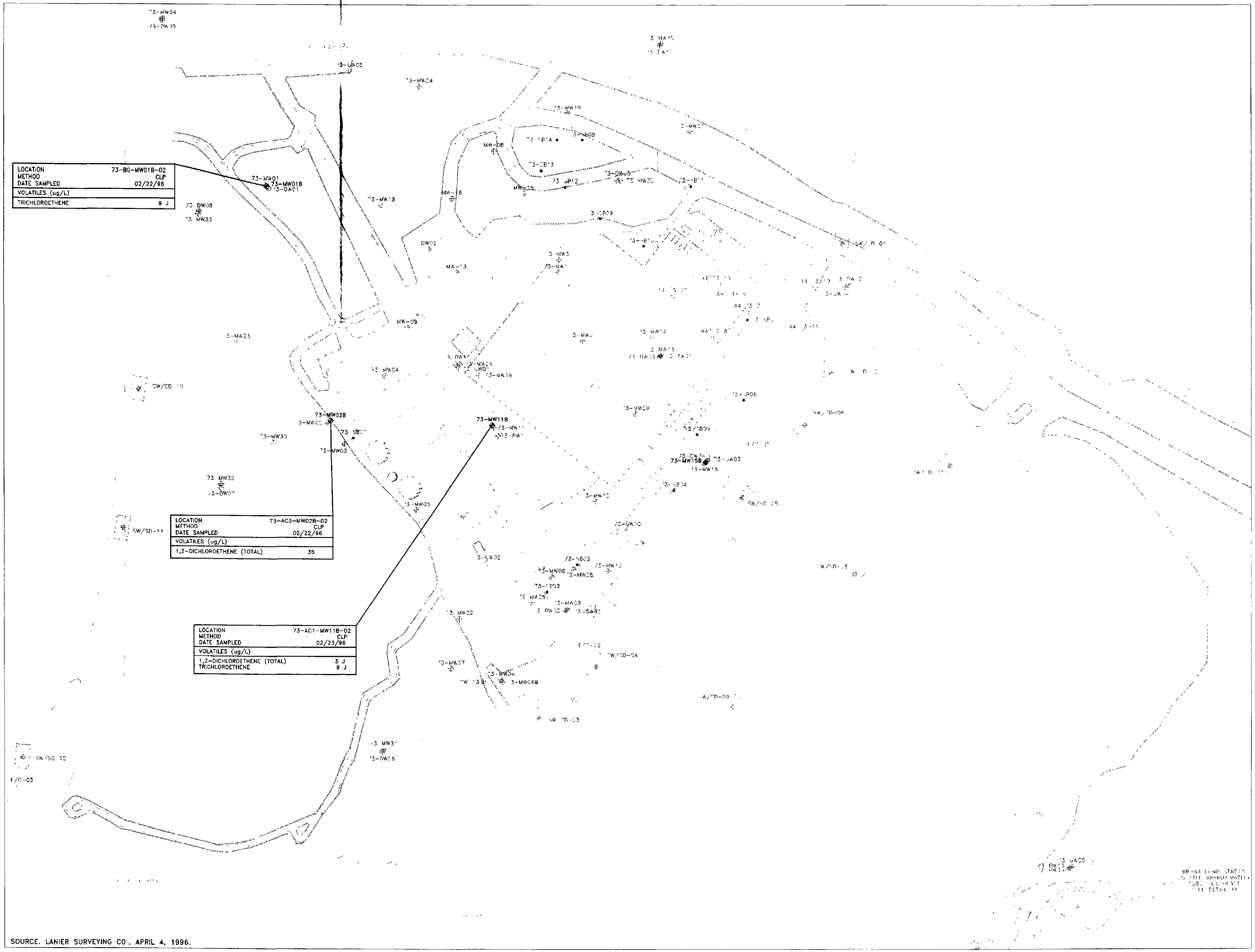
Baker
Baker Environmental, Inc.

DETECTED VOLATILES (MERTHOD 601/602) AND SEMIVOLATILES (METHOD 625) IN THE LOWERMOST PORTION OF THE SURFICIAL AQUIFER (PHASE I)

SCALE 1" = 150'

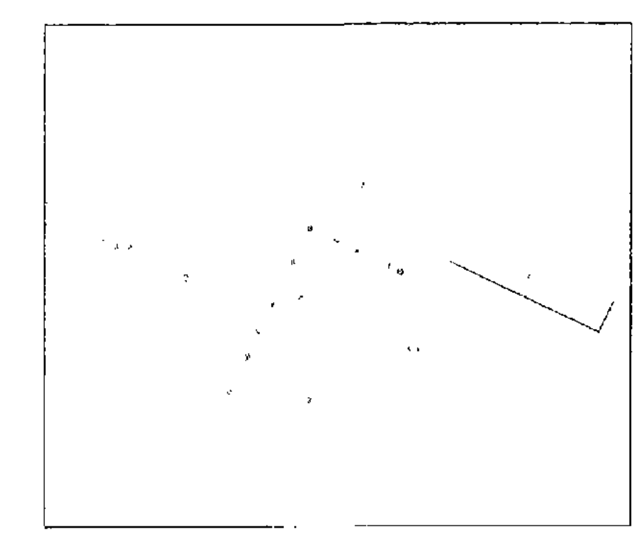
DATE NOVEMBER 1996

FIGURE NO.
4-8



LEGEND

73-SB01	SOIL BORINGS ADVANCED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL–MAY, 1995)
73-MW01	MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL–MAY, 1995)
73-MW31	MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE II (FEBRUARY–MARCH, 1996)
A47/3-8	MONITORING WELLS INSTALLED DURING UST INVESTIGATION BY GSI AND LAW-CATLIN AND ASSOCIATES (1993)
MW-18	MONITORING WELLS INSTALLED BY BAKER DURING UST INVESTIGATION (1992 AND 1993)
MW-08	MONITORING WELLS INSTALLED DURING A UST INVESTIGATION BY ATEC AND ASSOCIATES (1991)
73GW-02	MONITORING WELLS INSTALLED BY ESE DURING CONFIRMATORY SAMPLING (1990)
SW/SD-01	SURFACE WATER/SEDIMENT LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL–MAY, 1995)
F/C-01	FISH/CRAB LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL–MAY, 1995)



DETAIL A

REVISIONS

DRAWN WJH
REVIEWED JSC
S.O.# 62470-312-0000-07000
CADD# 312538PP

NORTH

SITE 73 – AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

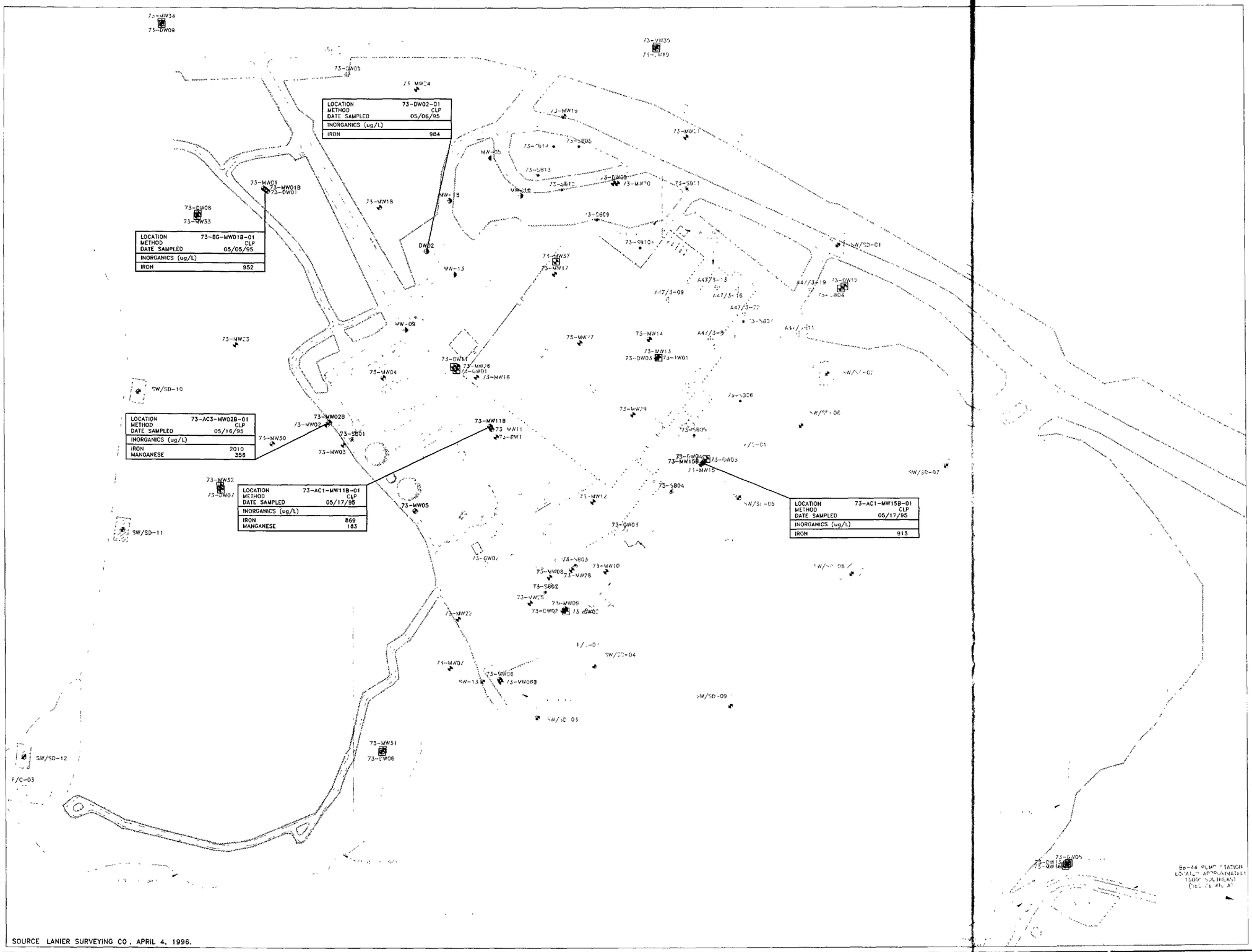
Baker
Baker Environmental, Inc.

DETECTED VOLATILES IN THE LOWERMOST PORTION OF THE SURFICIAL AQUIFER VIA CLP METHOD (PHASE II)

SCALE 1" = 150'

DATE NOVEMBER 1996

FIGURE NO. 4-9



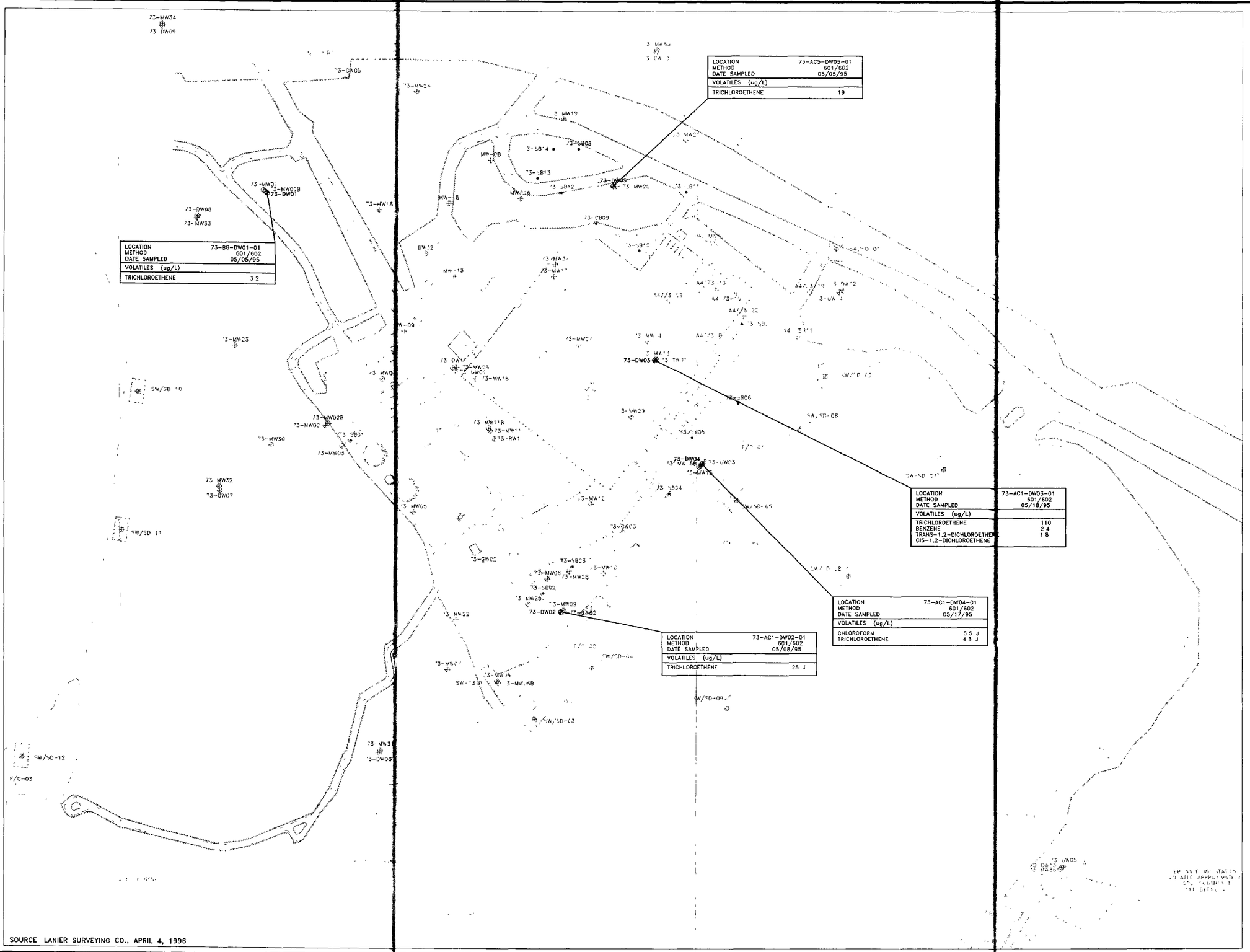
SOURCE LANIER SURVEYING CO. APRIL 4, 1996.

LEGEND

73-SB01	SOIL BORINGS ADVANCED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
73-MW01	MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
73-MW31	MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE II (FEBRUARY-MARCH, 1996)
A47/3-8	MONITORING WELLS INSTALLED DURING UST INVESTIGATION BY GSI AND LAW-CATLIN AND ASSOCIATES (1993)
MW-18	MONITORING WELLS INSTALLED BY BAKER DURING UST INVESTIGATION (1992 AND 1993)
MW-08	MONITORING WELLS INSTALLED DURING A UST INVESTIGATION BY ATEC AND ASSOCIATES (1991)
73GW-02	MONITORING WELLS INSTALLED BY ESE DURING CONFIRMATORY SAMPLING (1990)
SW/SD-01	SURFACE WATER/SEDIMENT LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
F/C-01	FISH/CRAB LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)

DETAIL A

REVISIONS		NORTH		SITE 73 – AMPHIBIOUS VEHICLE MAINTENANCE FACILITY REMEDIAL INVESTIGATION, CTO-0312 MARINE CORPS BASE, CAMP LEJEUNE NORTH CAROLINA	Baker Baker Environmental, Inc.	INORGANICS EXCEEDING NCWQS AND/OR FEDERAL MCLs IN LOWERMOST PORTION OF THE SURFICIAL AQUIFER (PHASE I)	FIGURE NO
	DRAWN WJH REVIEWED JSC S.O.# 62470-312-0000-07000 CADD# 312537PP			BAKER ENVIRONMENTAL, Inc. Coraopolis, Pennsylvania		SCALE 1" = 150' / DATE NOVEMBER 1996	4-10



SOURCE LANIER SURVEYING CO., APRIL 4, 1996

LEGEND

- 73-SB01 — SOIL BORINGS ADVANCED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW01 — MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW31 — MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE II (FEBRUARY-MARCH, 1996)
- A47/3-8 — MONITORING WELLS INSTALLED DURING UST INVESTIGATION BY GSI AND LAW-CATLIN AND ASSOCIATES (1993)
- MW-18 — MONITORING WELLS INSTALLED BY BAKER DURING UST INVESTIGATION (1992 AND 1993)
- MW-08 — MONITORING WELLS INSTALLED DURING A UST INVESTIGATION BY ATEC AND ASSOCIATES (1991)
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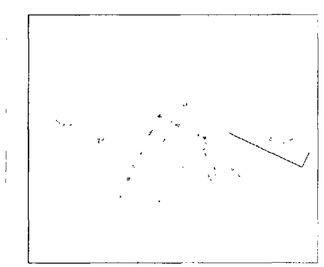
- F/C-01 — FISH/CRAB LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)



DETAIL A

REVISIONS			
	DRAWN WJH	NORTH	
	REVIEWED JSC		
	S.O.# 62470-312-0000-07000		
	CADD# 312524PP		

SITE 73 – AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

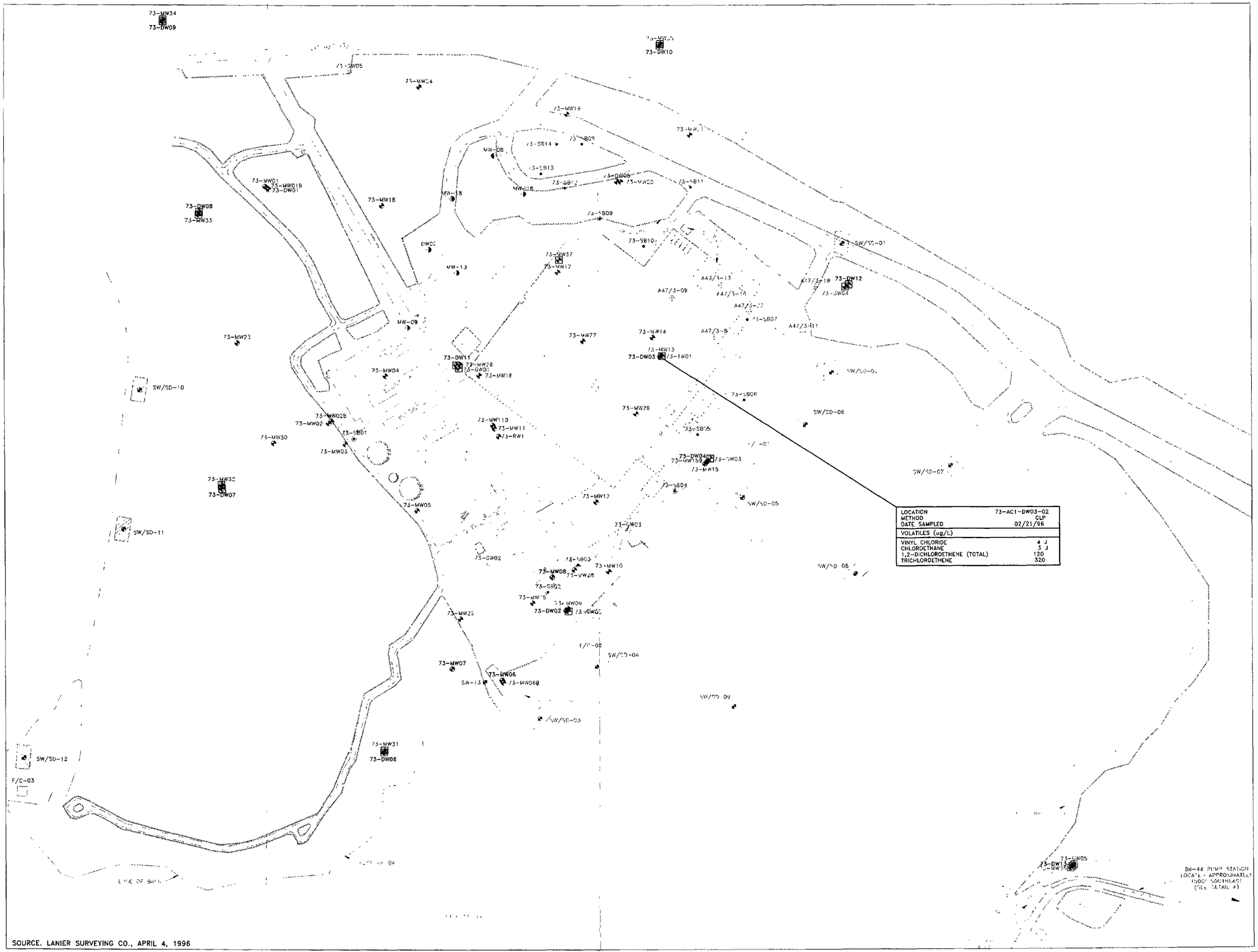
Baker
Baker Environmental, Inc.

DETECTED VOLATILES IN THE UPPERMOST PORTION OF CASTLE HAYNE VIA METHOD 601/602 (PHASE I)

SCALE 1" = 150'

DATE NOVEMBER 1996

FIGURE NO 4-11



LOCATION	73-AC1-DW03-02
METHOD	CLP
DATE SAMPLED	02/21/96
VOLATILES (ug/L)	
VINYL CHLORIDE	4 J
CHLOROETHANE	3 J
1,2-DICHLOROETHENE (TOTAL)	120
TRICHLOROETHENE	320

SOURCE. LANIER SURVEYING CO., APRIL 4, 1996

LEGEND

- 73-SB01 — SOIL BORINGS ADVANCED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW01 — MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW31 — MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE II (FEBRUARY-MARCH, 1996)
- A47/3-8 — MONITORING WELLS INSTALLED DURING UST INVESTIGATION BY GSI AND LAW-CATLIN AND ASSOCIATES (1993)
- MW-18 — MONITORING WELLS INSTALLED BY BAKER DURING UST INVESTIGATION (1992 AND 1993)
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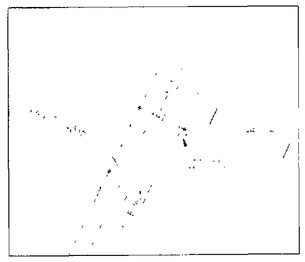
- 73GW-02 — MONITORING WELLS INSTALLED BY ESE DURING CONFIRMATORY SAMPLING (1990)
- SW/SD-01 — SURFACE WATER/SEDIMENT LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- F/C-01 — FISH/CRAB LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)



DETAIL A

REVISIONS			
	DRAWN WJH	NORTH	
	REVIEWED JSC		
	S.O.# 62470-312-0000-07000		
	CADD# 312530PP		

SITE 73 – AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

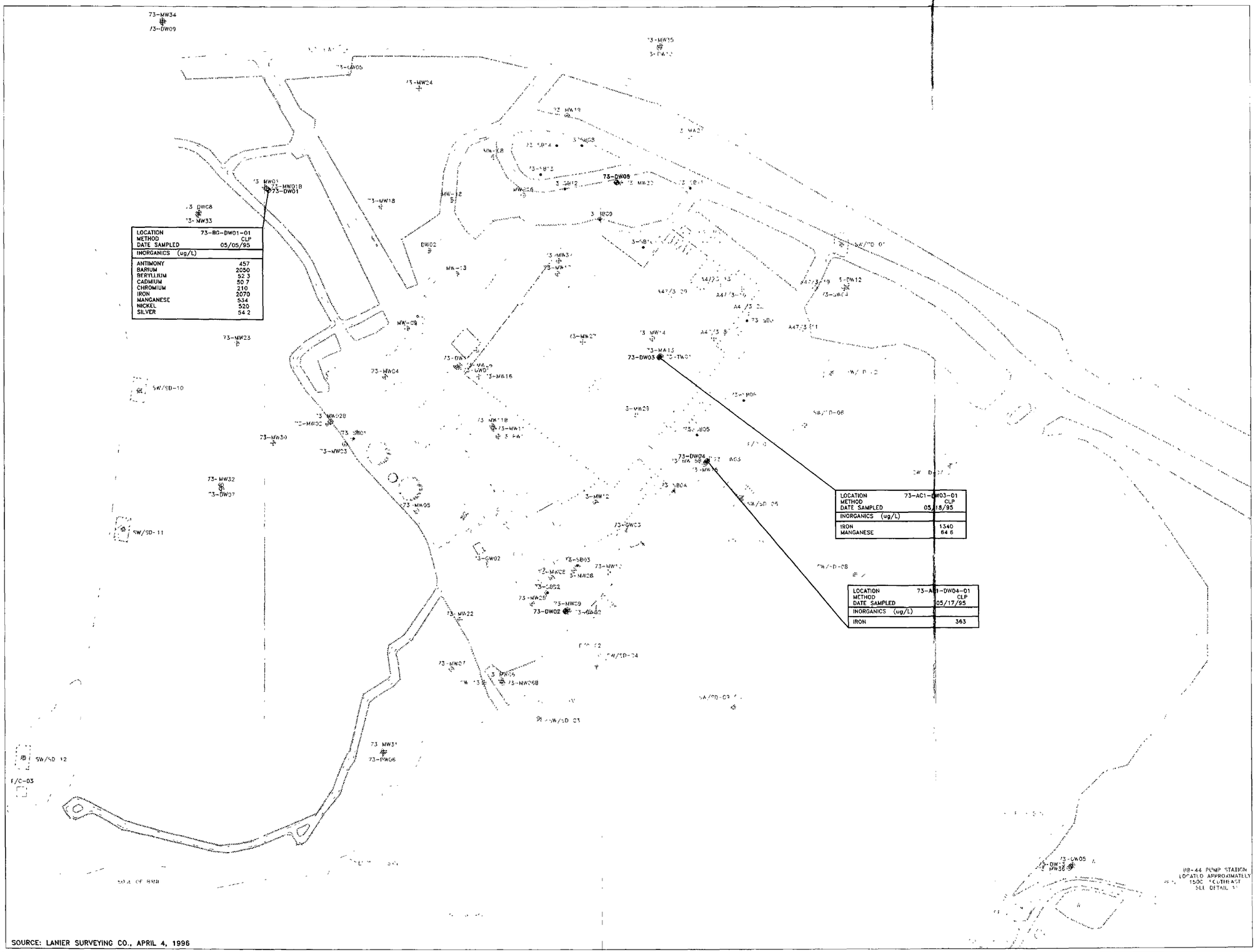
Baker
Baker Environmental, Inc.

DETECTED VOLATILES IN UPPERMOST PORTION OF THE CASTLE HAYNE AQUIFER VIA CLP METHOD (PHASE II)

SCALE 1" = 150'

DATE NOVEMBER 1996

FIGURE NO. 4-12



SOURCE: LANIER SURVEYING CO., APRIL 4, 1996

LEGEND

73-SB01	SOIL BORINGS ADVANCED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
73-MW01	MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
73-MW31	MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE II (FEBRUARY-MARCH, 1996)
A47/3-8	MONITORING WELLS INSTALLED DURING UST INVESTIGATION BY GSI AND LAW-CATLIN AND ASSOCIATES (1993)
MW-18	MONITORING WELLS INSTALLED BY BAKER DURING UST INVESTIGATION (1992 AND 1993)
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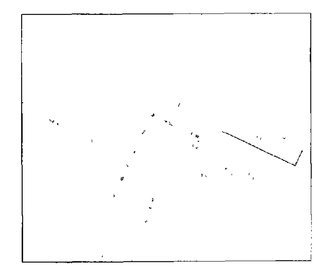
F/C-01	FISH/CRAB LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)



DETAIL A

REVISIONS

DRAWN	WJH
REVIEWED	JSC
S.O.#	62470-312-0000-07000
CADD#	312527PP

NORTH

SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

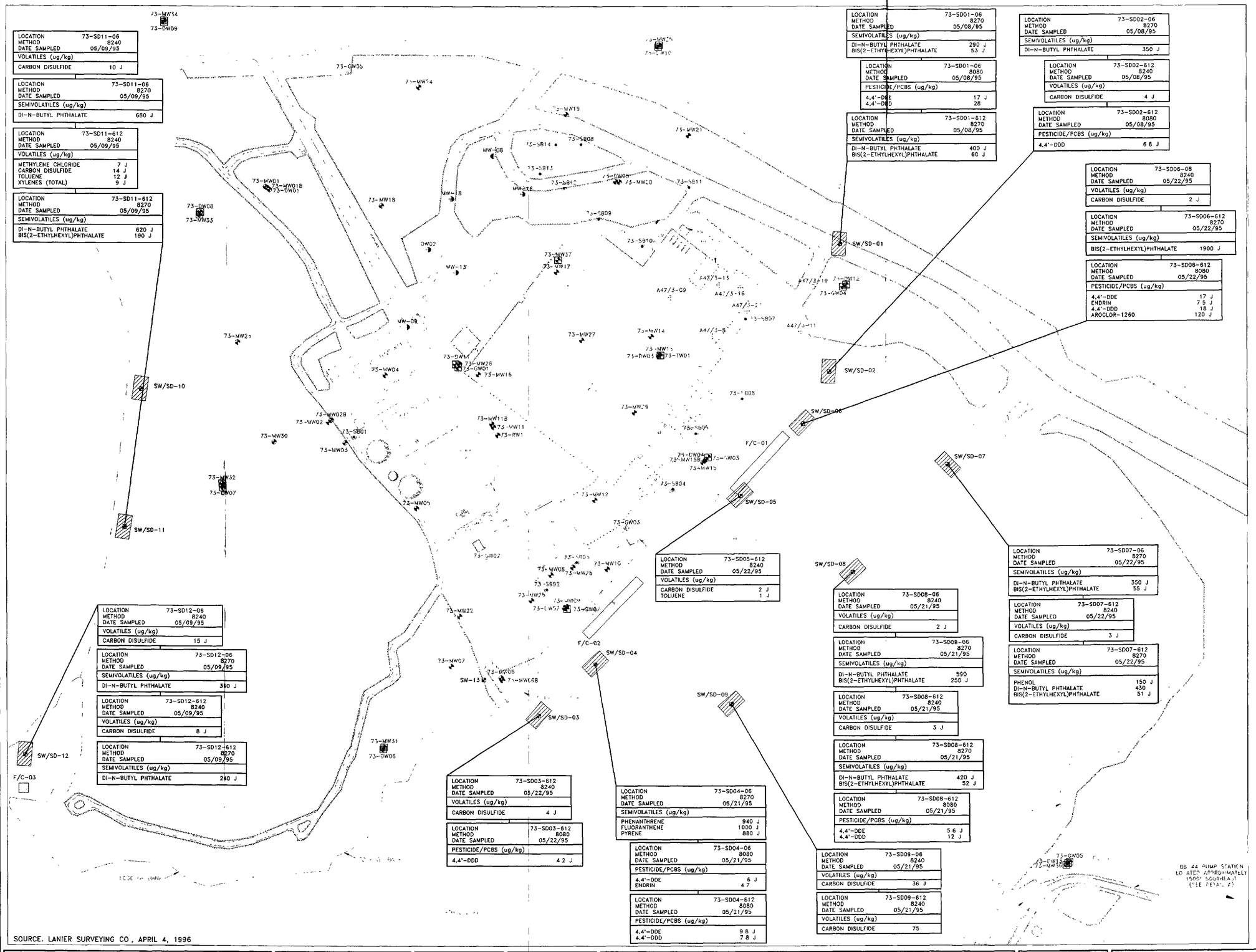
Baker
Baker Environmental, Inc.

DETECTED INORGANICS EXCEEDING NCWQS AND/OR FEDERAL MCLs IN THE UPPERMOST PORTION OF THE CASTLE HAYNE AQUIFER (PHASE I)

SCALE 1" = 150'

DATE NOVEMBER 1996

FIGURE NO
4-13



LOCATION	73-SD11-06
METHOD	8240
DATE SAMPLED	05/09/95
VOLATILES (ug/kg)	
CARBON DISULFIDE	10 J

LOCATION	73-SD11-06
METHOD	8270
DATE SAMPLED	05/09/95
SEMIVOLATILES (ug/kg)	
DI-N-BUTYL PHTHALATE	680 J

LOCATION	73-SD11-612
METHOD	8240
DATE SAMPLED	05/09/95
VOLATILES (ug/kg)	
METHYLENE CHLORIDE	7 J
CARBON DISULFIDE	14 J
TOLUENE	12 J
XYLENES (TOTAL)	9 J

LOCATION	73-SD11-612
METHOD	8270
DATE SAMPLED	05/09/95
SEMIVOLATILES (ug/kg)	
DI-N-BUTYL PHTHALATE	620 J
BIS(2-ETHYLHEXYL)PHTHALATE	190 J

LOCATION	73-SD01-06
METHOD	8270
DATE SAMPLED	05/08/95
SEMIVOLATILES (ug/kg)	
DI-N-BUTYL PHTHALATE	290 J
BIS(2-ETHYLHEXYL)PHTHALATE	53 J

LOCATION	73-SD01-06
METHOD	8080
DATE SAMPLED	05/08/95
PESTICIDE/PCBS (ug/kg)	
4,4'-DDE	17 J
4,4'-DDD	28

LOCATION	73-SD01-612
METHOD	8270
DATE SAMPLED	05/08/95
SEMIVOLATILES (ug/kg)	
DI-N-BUTYL PHTHALATE	400 J
BIS(2-ETHYLHEXYL)PHTHALATE	60 J

LOCATION	73-SD02-06
METHOD	8270
DATE SAMPLED	05/08/95
SEMIVOLATILES (ug/kg)	
DI-N-BUTYL PHTHALATE	350 J

LOCATION	73-SD02-612
METHOD	8240
DATE SAMPLED	05/08/95
VOLATILES (ug/kg)	
CARBON DISULFIDE	4 J

LOCATION	73-SD02-612
METHOD	8080
DATE SAMPLED	05/08/95
PESTICIDE/PCBS (ug/kg)	
4,4'-DDD	6.8 J

LOCATION	73-SD06-06
METHOD	8240
DATE SAMPLED	05/22/95
VOLATILES (ug/kg)	
CARBON DISULFIDE	2 J

LOCATION	73-SD06-612
METHOD	8270
DATE SAMPLED	05/22/95
SEMIVOLATILES (ug/kg)	
BIS(2-ETHYLHEXYL)PHTHALATE	1900 J

LOCATION	73-SD06-612
METHOD	8080
DATE SAMPLED	05/22/95
PESTICIDE/PCBS (ug/kg)	
4,4'-DDE	17 J
ENDRIN	7.5 J
4,4'-DDD	18 J
AROCLOR-1260	120 J

LOCATION	73-SD12-06
METHOD	8240
DATE SAMPLED	05/09/95
VOLATILES (ug/kg)	
CARBON DISULFIDE	15 J

LOCATION	73-SD12-06
METHOD	8270
DATE SAMPLED	05/09/95
SEMIVOLATILES (ug/kg)	
DI-N-BUTYL PHTHALATE	340 J

LOCATION	73-SD12-612
METHOD	8240
DATE SAMPLED	05/09/95
VOLATILES (ug/kg)	
CARBON DISULFIDE	8 J

LOCATION	73-SD12-612
METHOD	8270
DATE SAMPLED	05/09/95
SEMIVOLATILES (ug/kg)	
DI-N-BUTYL PHTHALATE	240 J

LOCATION	73-SD05-612
METHOD	8240
DATE SAMPLED	05/22/95
VOLATILES (ug/kg)	
CARBON DISULFIDE	2 J
TOLUENE	1 J

LOCATION	73-SD03-612
METHOD	8240
DATE SAMPLED	05/22/95
VOLATILES (ug/kg)	
CARBON DISULFIDE	4 J

LOCATION	73-SD03-612
METHOD	8080
DATE SAMPLED	05/22/95
PESTICIDE/PCBS (ug/kg)	
4,4'-DDD	4.2 J

LOCATION	73-SD04-06
METHOD	8270
DATE SAMPLED	05/21/95
SEMIVOLATILES (ug/kg)	
PHENANTHRENE	940 J
FLUORANTHENE	1000 J
PYRENE	880 J

LOCATION	73-SD04-06
METHOD	8080
DATE SAMPLED	05/21/95
PESTICIDE/PCBS (ug/kg)	
4,4'-DDE	6 J
ENDRIN	4.7

LOCATION	73-SD04-612
METHOD	8080
DATE SAMPLED	05/21/95
PESTICIDE/PCBS (ug/kg)	
4,4'-DDE	9.8 J
4,4'-DDD	7.8 J

LOCATION	73-SD08-06
METHOD	8240
DATE SAMPLED	05/21/95
VOLATILES (ug/kg)	
CARBON DISULFIDE	2 J

LOCATION	73-SD08-06
METHOD	8270
DATE SAMPLED	05/21/95
SEMIVOLATILES (ug/kg)	
DI-N-BUTYL PHTHALATE	590
BIS(2-ETHYLHEXYL)PHTHALATE	250 J

LOCATION	73-SD08-612
METHOD	8240
DATE SAMPLED	05/21/95
VOLATILES (ug/kg)	
CARBON DISULFIDE	3 J

LOCATION	73-SD08-612
METHOD	8270
DATE SAMPLED	05/21/95
SEMIVOLATILES (ug/kg)	
DI-N-BUTYL PHTHALATE	420 J
BIS(2-ETHYLHEXYL)PHTHALATE	52 J

LOCATION	73-SD08-612
METHOD	8080
DATE SAMPLED	05/21/95
PESTICIDE/PCBS (ug/kg)	
4,4'-DDE	5.6 J
4,4'-DDD	12 J

LOCATION	73-SD09-06
METHOD	8240
DATE SAMPLED	05/21/95
VOLATILES (ug/kg)	
CARBON DISULFIDE	36 J

LOCATION	73-SD09-612
METHOD	8240
DATE SAMPLED	05/21/95
VOLATILES (ug/kg)	
CARBON DISULFIDE	75

LOCATION	73-SD07-06
METHOD	8270
DATE SAMPLED	05/22/95
SEMIVOLATILES (ug/kg)	
DI-N-BUTYL PHTHALATE	350 J
BIS(2-ETHYLHEXYL)PHTHALATE	55 J

LOCATION	73-SD07-612
METHOD	8240
DATE SAMPLED	05/22/95
VOLATILES (ug/kg)	
CARBON DISULFIDE	3 J

LOCATION	73-SD07-612
METHOD	8270
DATE SAMPLED	05/22/95
SEMIVOLATILES (ug/kg)	
PHENOL	150 J
DI-N-BUTYL PHTHALATE	430
BIS(2-ETHYLHEXYL)PHTHALATE	51 J

SOURCE: LANIER SURVEYING CO., APRIL 4, 1996

LEGEND

- 73-SB01 — SOIL BORINGS ADVANCED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW01 — MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW31 — MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE II (FEBRUARY-MARCH, 1996)
- A47/3-8 — MONITORING WELLS INSTALLED DURING UST INVESTIGATION BY GSI AND LAW-CATLIN AND ASSOCIATES (1993)
- MW-18 — MONITORING WELLS INSTALLED BY BAKER DURING UST INVESTIGATION (1992 AND 1993)
- MW-08 — MONITORING WELLS INSTALLED DURING A UST INVESTIGATION BY ATEC AND ASSOCIATES (1991)
- 73GW-02 — MONITORING WELLS INSTALLED BY ESE DURING CONFIRMATORY SAMPLING (1990)
- SW/SD-01 — SURFACE WATER/SEDIMENT LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- F/C-01 — FISH/CRAB LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)

DETAIL A

REVISIONS			
	DRAWN	WJH	NORTH
	REVIEWED	JSC	
	S.O.#	62470-312-0000-07000	
	CADD#	312565PP	

SITE 73 – AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

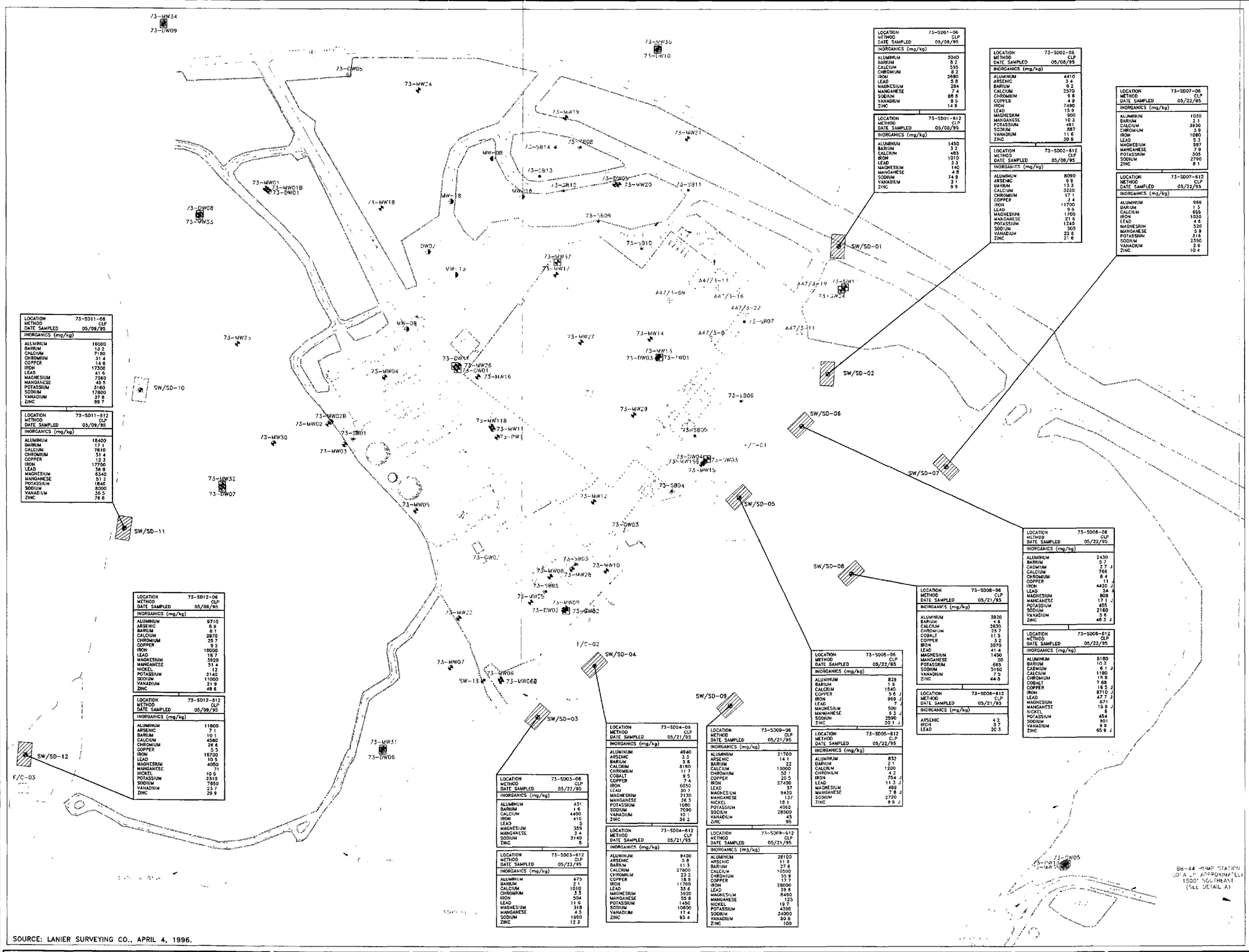
Baker
Baker Environmental, Inc.

DETECTED VOLATILES (8240), SEMIVOLATILES (METHOD 8270), PESTICIDES/PCBs (METHOD 8080) IN SEDIMENT

SCALE 1" = 150'

DATE NOVEMBER 1996

FIGURE NO. 4-14



LOCATION	73-SD01-06
METHOD	CLP
DATE SAMPLED	05/08/95
INORGANICS (mg/kg)	
ALUMINUM	5040
BARIUM	8.2
CALCIUM	555
CHROMIUM	8.2
IRON	2680
LEAD	5.8
MAGNESIUM	284
MANGANESE	7.4
SODIUM	88.8
VANADIUM	8.5
ZINC	14.9

LOCATION	73-SD01-612
METHOD	CLP
DATE SAMPLED	05/08/95
INORGANICS (mg/kg)	
ALUMINUM	1450
BARIUM	3.2
CALCIUM	453
IRON	1010
LEAD	3.3
MAGNESIUM	140
MANGANESE	4.6
SODIUM	74.8
VANADIUM	3.1
ZINC	9.9

LOCATION	73-SD02-06
METHOD	CLP
DATE SAMPLED	05/08/95
INORGANICS (mg/kg)	
ALUMINUM	4410
ARSENIC	3.4
BARIUM	6.2
CALCIUM	2570
CHROMIUM	9.6
COPPER	4.9
IRON	7490
LEAD	15.9
MAGNESIUM	900
MANGANESE	10.3
POTASSIUM	491
SODIUM	887
VANADIUM	11.6
ZINC	30.6

LOCATION	73-SD02-612
METHOD	CLP
DATE SAMPLED	05/08/95
INORGANICS (mg/kg)	
ALUMINUM	8090
ARSENIC	6.9
BARIUM	13.3
CALCIUM	3220
CHROMIUM	17.1
COPPER	3.4
IRON	11700
LEAD	9.6
MAGNESIUM	1700
MANGANESE	21.6
POTASSIUM	1240
SODIUM	505
VANADIUM	22.8
ZINC	21.6

LOCATION	73-SD07-06
METHOD	CLP
DATE SAMPLED	05/22/95
INORGANICS (mg/kg)	
ALUMINUM	1030
BARIUM	2.1
CALCIUM	3930
CHROMIUM	3.9
IRON	1060
LEAD	5.3
MAGNESIUM	587
MANGANESE	7.9
POTASSIUM	305
SODIUM	2790
ZINC	8.1

LOCATION	73-SD07-612
METHOD	CLP
DATE SAMPLED	05/22/95
INORGANICS (mg/kg)	
ALUMINUM	969
BARIUM	1.5
CALCIUM	655
IRON	1030
LEAD	4.6
MAGNESIUM	526
MANGANESE	5.9
POTASSIUM	316
SODIUM	2390
VANADIUM	2.8
ZINC	10.4

LOCATION	73-SD11-06
METHOD	CLP
DATE SAMPLED	05/09/95
INORGANICS (mg/kg)	
ALUMINUM	18000
BARIUM	13.2
CALCIUM	7150
CHROMIUM	31.4
COPPER	14.6
IRON	17300
LEAD	41.6
MAGNESIUM	7560
MANGANESE	45.5
POTASSIUM	3160
SODIUM	17800
VANADIUM	37.5
ZINC	89.7

LOCATION	73-SD11-612
METHOD	CLP
DATE SAMPLED	05/09/95
INORGANICS (mg/kg)	
ALUMINUM	18400
BARIUM	17.1
CALCIUM	7610
CHROMIUM	31.4
COPPER	12.3
IRON	17700
LEAD	36.8
MAGNESIUM	6340
MANGANESE	51.2
POTASSIUM	1840
SODIUM	8000
VANADIUM	36.5
ZINC	76.8

LOCATION	73-SD12-06
METHOD	CLP
DATE SAMPLED	05/09/95
INORGANICS (mg/kg)	
ALUMINUM	9710
ARSENIC	6.9
BARIUM	8.1
CALCIUM	2970
CHROMIUM	25.7
COPPER	9.2
IRON	16000
LEAD	18.7
MAGNESIUM	3920
MANGANESE	51.4
NICKEL	12
POTASSIUM	2140
SODIUM	11000
VANADIUM	21.9
ZINC	49.6

LOCATION	73-SD12-612
METHOD	CLP
DATE SAMPLED	05/09/95
INORGANICS (mg/kg)	
ALUMINUM	11800
ARSENIC	7.1
BARIUM	10.1
CALCIUM	4580
CHROMIUM	26.6
COPPER	5.5
IRON	16700
LEAD	10.5
MAGNESIUM	4060
MANGANESE	71
NICKEL	10.6
POTASSIUM	2310
SODIUM	7850
VANADIUM	23.7
ZINC	29.9

LOCATION	73-SD03-06
METHOD	CLP
DATE SAMPLED	05/22/95
INORGANICS (mg/kg)	
ALUMINUM	431
BARIUM	1.6
CALCIUM	4400
IRON	416
LEAD	5
MAGNESIUM	389
MANGANESE	3.4
SODIUM	2140
ZINC	8

LOCATION	73-SD03-612
METHOD	CLP
DATE SAMPLED	05/22/95
INORGANICS (mg/kg)	
ALUMINUM	675
BARIUM	2.1
CALCIUM	1010
CHROMIUM	3.3
IRON	504
LEAD	11.6
MAGNESIUM	318
MANGANESE	4.5
SODIUM	1690
ZINC	12.3

LOCATION	73-SD04-06
METHOD	CLP
DATE SAMPLED	05/21/95
INORGANICS (mg/kg)	
ALUMINUM	4940
ARSENIC	3.3
BARIUM	5.8
CALCIUM	3180
CHROMIUM	11.7
COBALT	9.5
COPPER	7.4
IRON	6050
LEAD	30.7
MAGNESIUM	2130
MANGANESE	26.3
POTASSIUM	1080
SODIUM	7090
VANADIUM	10.1
ZINC	36.2

LOCATION	73-SD04-612
METHOD	CLP
DATE SAMPLED	05/21/95
INORGANICS (mg/kg)	
ALUMINUM	9400
ARSENIC	5.8
BARIUM	11.5
CALCIUM	27800
CHROMIUM	23.2
COPPER	18.8
IRON	11700
LEAD	33.6
MAGNESIUM	3920
MANGANESE	55.8
POTASSIUM	1450
SODIUM	10600
VANADIUM	17.4
ZINC	95.4

LOCATION	73-SD09-06
METHOD	CLP
DATE SAMPLED	05/21/95
INORGANICS (mg/kg)	
ALUMINUM	21700
ARSENIC	14.1
BARIUM	22
CALCIUM	13000
CHROMIUM	52.1
COPPER	20.5
IRON	27400
LEAD	37
MAGNESIUM	9430
MANGANESE	137
NICKEL	18.1
POTASSIUM	4060
SODIUM	28500
VANADIUM	45
ZINC	95

LOCATION	73-SD09-612
METHOD	CLP
DATE SAMPLED	05/21/95
INORGANICS (mg/kg)	
ALUMINUM	28100
ARSENIC	11.9
BARIUM	27.8
CALCIUM	10500
CHROMIUM	55.9
COPPER	17.7
IRON	26000
LEAD	39.6
MAGNESIUM	8490
MANGANESE	125
NICKEL	19.7
POTASSIUM	4390
SODIUM	24000
VANADIUM	50.8
ZINC	100

LOCATION	73-SD05-06
METHOD	CLP
DATE SAMPLED	05/22/95
INORGANICS (mg/kg)	
ALUMINUM	828
BARIUM	1.5
CALCIUM	1540
COPPER	5.6 J
IRON	969 J
LEAD	7 J
MAGNESIUM	500
MANGANESE	6.3 J
SODIUM	2590
ZINC	20.1 J

LOCATION	73-SD05-612
METHOD	CLP
DATE SAMPLED	05/22/95
INORGANICS (mg/kg)	
ALUMINUM	832
BARIUM	2.1
CALCIUM	1200
CHROMIUM	4.2
IRON	754 J
LEAD	11.3 J
MAGNESIUM	469
MANGANESE	7.8 J
SODIUM	2720
ZINC	9.6 J

LOCATION	73-SD08-06
METHOD	CLP
DATE SAMPLED	05/21/95
INORGANICS (mg/kg)	
ALUMINUM	3920
BARIUM	4.8
CALCIUM	2630
CHROMIUM	25.7
COBALT	11.5
COPPER	3.2
IRON	3570
LEAD	41.4
MAGNESIUM	1450
MANGANESE	20
POTASSIUM	685
SODIUM	5160
VANADIUM	7.5
ZINC	44.9

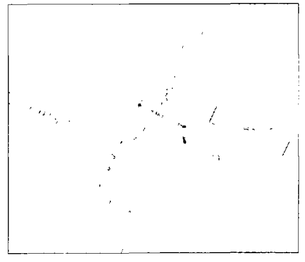
LOCATION	73-SD08-612
METHOD	CLP
DATE SAMPLED	05/21/95
INORGANICS (mg/kg)	
ARSENIC	4.2
IRON	3.7
LEAD	20.3

LOCATION	73-SD06-06
METHOD	CLP
DATE SAMPLED	05/22/95
INORGANICS (mg/kg)	
ALUMINUM	2430
BARIUM	5.7
CADMIUM	2.7 J
CALCIUM	766
CHROMIUM	8.4
COPPER	11 J
IRON	4420 J
LEAD	24 J
MAGNESIUM	808
MANGANESE	17.1 J
POTASSIUM	455
SODIUM	2160
VANADIUM	5.6
ZINC	48.3 J

LOCATION	73-SD06-612
METHOD	CLP
DATE SAMPLED	05/22/95
INORGANICS (mg/kg)	
ALUMINUM	5180
BARIUM	10.3
CADMIUM	6.1 J
CALCIUM	1180
CHROMIUM	15.8
COBALT	7.68
COPPER	16.5 J
IRON	8710 J
LEAD	47.7 J
MAGNESIUM	671
MANGANESE	15.9 J
NICKEL	6
POTASSIUM	454
SODIUM	951
VANADIUM	9.9
ZINC	65.9 J

LEGEND

- 73-SB01 — SOIL BORINGS ADVANCED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW01 — MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW31 — MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE II (FEBRUARY-MARCH, 1996)
- A47/3-8 — MONITORING WELLS INSTALLED DURING UST INVESTIGATION BY GSI AND LAW-CATLIN AND ASSOCIATES (1993)
- MW-18 — MONITORING WELLS INSTALLED BY BAKER DURING UST INVESTIGATION (1992 AND 1993)
- MW-08 — MONITORING WELLS INSTALLED DURING A UST INVESTIGATION BY ATEC AND ASSOCIATES (1991)
- 73GW-02 — MONITORING WELLS INSTALLED BY ESE DURING CONFIRMATORY SAMPLING (1990)
- SW/SD-01 — SURFACE WATER/SEDIMENT LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- F/C-01 — FISH/CRAB LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)



DETAIL A

SOURCE: LANIER SURVEYING CO., APRIL 4, 1996.

REVISIONS	
DRAWN	WJH
REVIEWED	JSC
S.O.#	62470-312-0000-07000
CADD#	312568PP

NORTH

SITE 73 – AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

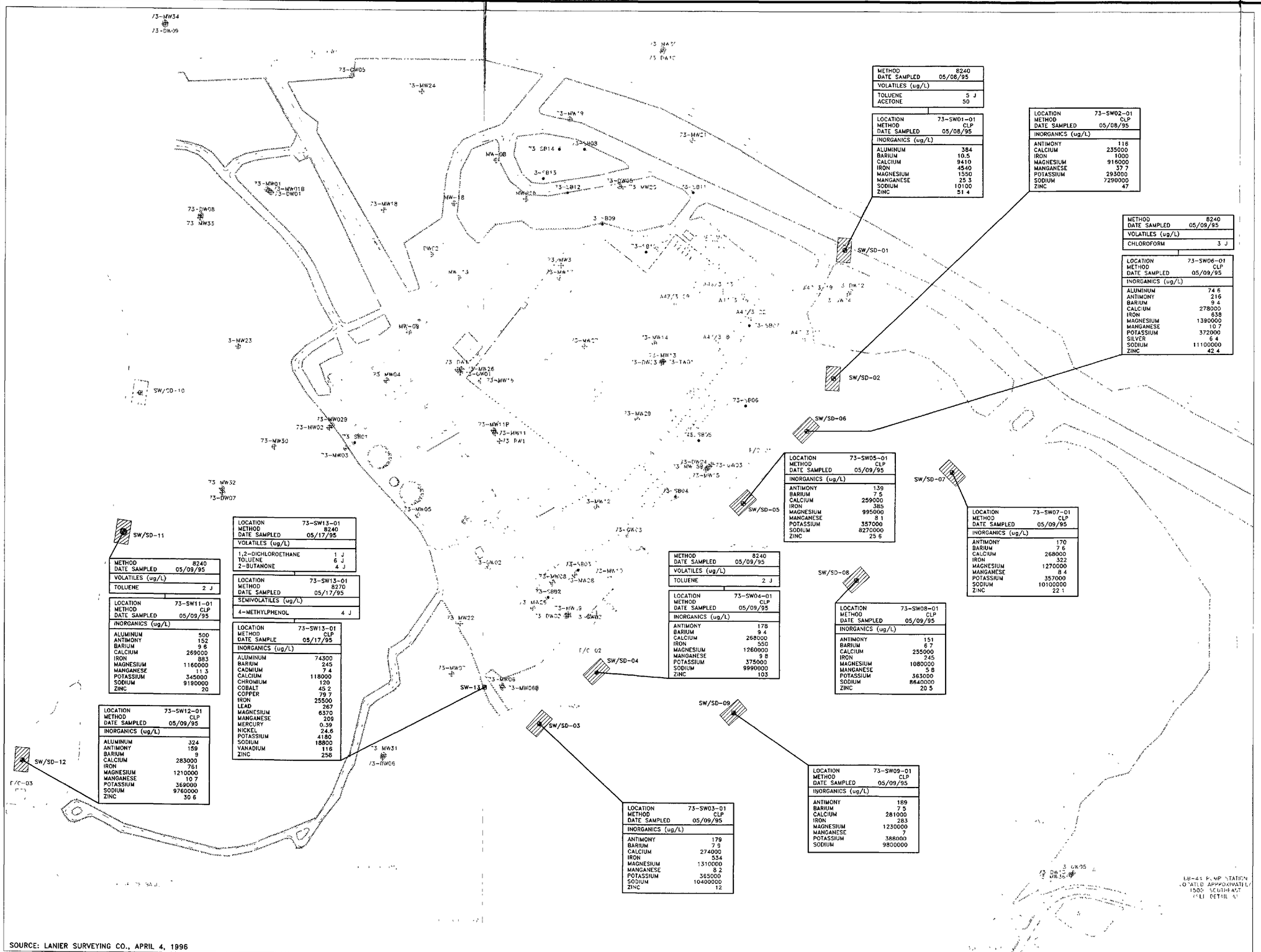
Baker
Baker Environmental, Inc.

DETECTED INORGANICS IN SEDIMENT VIA CLP METHOD

SCALE 1" = 150'

DATE NOVEMBER 1996

FIGURE NO
4-15



METHOD	8240
DATE SAMPLED	05/08/95
VOLATILES (ug/L)	
TOLUENE	5 J
ACETONE	50

LOCATION	73-SW01-01
METHOD	CLP
DATE SAMPLED	05/08/95
INORGANICS (ug/L)	
ALUMINUM	384
BARIUM	10.5
CALCIUM	9410
IRON	4540
MAGNESIUM	1550
MANGANESE	25.3
SODIUM	10100
ZINC	51.4

LOCATION	73-SW02-01
METHOD	CLP
DATE SAMPLED	05/08/95
INORGANICS (ug/L)	
ANTIMONY	116
CALCIUM	235000
IRON	1000
MAGNESIUM	916000
MANGANESE	37.7
POTASSIUM	293000
SODIUM	7290000
ZINC	47

METHOD	8240
DATE SAMPLED	05/09/95
VOLATILES (ug/L)	
CHLOROFORM	3 J

LOCATION	73-SW06-01
METHOD	CLP
DATE SAMPLED	05/09/95
INORGANICS (ug/L)	
ALUMINUM	74.6
ANTIMONY	216
BARIUM	9.4
CALCIUM	278000
IRON	638
MAGNESIUM	1390000
MANGANESE	10.7
POTASSIUM	372000
SILVER	6.4
SODIUM	11100000
ZINC	42.4

LOCATION	73-SW05-01
METHOD	CLP
DATE SAMPLED	05/09/95
INORGANICS (ug/L)	
ANTIMONY	139
BARIUM	7.5
CALCIUM	259000
IRON	385
MAGNESIUM	995000
MANGANESE	8.1
POTASSIUM	357000
SODIUM	8270000
ZINC	25.6

LOCATION	73-SW07-01
METHOD	CLP
DATE SAMPLED	05/09/95
INORGANICS (ug/L)	
ANTIMONY	170
BARIUM	7.6
CALCIUM	268000
IRON	322
MAGNESIUM	1270000
MANGANESE	8.4
POTASSIUM	357000
SODIUM	10100000
ZINC	22.1

METHOD	8240
DATE SAMPLED	05/09/95
VOLATILES (ug/L)	
TOLUENE	2 J

LOCATION	73-SW04-01
METHOD	CLP
DATE SAMPLED	05/09/95
INORGANICS (ug/L)	
ANTIMONY	178
BARIUM	9.4
CALCIUM	268000
IRON	550
MAGNESIUM	1260000
MANGANESE	9.8
POTASSIUM	375000
SODIUM	9990000
ZINC	103

LOCATION	73-SW08-01
METHOD	CLP
DATE SAMPLED	05/09/95
INORGANICS (ug/L)	
ANTIMONY	151
BARIUM	6.7
CALCIUM	255000
IRON	245
MAGNESIUM	1080000
MANGANESE	5.8
POTASSIUM	363000
SODIUM	8640000
ZINC	20.5

LOCATION	73-SW09-01
METHOD	CLP
DATE SAMPLED	05/09/95
INORGANICS (ug/L)	
ANTIMONY	189
BARIUM	7.5
CALCIUM	281000
IRON	283
MAGNESIUM	1230000
MANGANESE	7
POTASSIUM	388000
SODIUM	9800000

LOCATION	73-SW03-01
METHOD	CLP
DATE SAMPLED	05/09/95
INORGANICS (ug/L)	
ANTIMONY	179
BARIUM	7.9
CALCIUM	274000
IRON	534
MAGNESIUM	1310000
MANGANESE	8.2
POTASSIUM	365000
SODIUM	10400000
ZINC	12

METHOD	8240
DATE SAMPLED	05/17/95
VOLATILES (ug/L)	
1,2-DICHLOROETHANE	1 J
TOLUENE	6 J
2-BUTANONE	4 J

LOCATION	73-SW13-01
METHOD	8270
DATE SAMPLED	05/17/95
SEMIVOLATILES (ug/L)	
4-METHYLPHENOL	4 J

LOCATION	73-SW13-01
METHOD	CLP
DATE SAMPLE	05/17/95
INORGANICS (ug/L)	
ALUMINUM	74300
BARIUM	245
CADMIUM	7.4
CALCIUM	118000
CHROMIUM	120
COBALT	45.2
COPPER	79.7
IRON	25500
LEAD	267
MAGNESIUM	6370
MANGANESE	209
MERCURY	0.39
NICKEL	24.6
POTASSIUM	4180
SODIUM	18800
VANADIUM	116
ZINC	258

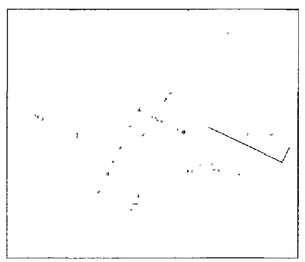
METHOD	8240
DATE SAMPLED	05/09/95
VOLATILES (ug/L)	
TOLUENE	2 J

LOCATION	73-SW11-01
METHOD	CLP
DATE SAMPLED	05/09/95
INORGANICS (ug/L)	
ALUMINUM	500
ANTIMONY	152
BARIUM	9.6
CALCIUM	269000
IRON	883
MAGNESIUM	1160000
MANGANESE	11.3
POTASSIUM	345000
SODIUM	9190000
ZINC	20

LOCATION	73-SW12-01
METHOD	CLP
DATE SAMPLED	05/09/95
INORGANICS (ug/L)	
ALUMINUM	324
ANTIMONY	159
BARIUM	9
CALCIUM	283000
IRON	761
MAGNESIUM	1210000
MANGANESE	10.7
POTASSIUM	369000
SODIUM	9760000
ZINC	30.6

LEGEND

- 73-SB01 — SOIL BORINGS ADVANCED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW01 — MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW31 — MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE II (FEBRUARY-MARCH, 1996)
- A47/3-8 — MONITORING WELLS INSTALLED DURING UST INVESTIGATION BY GSI AND LAW-CATLIN AND ASSOCIATES (1993)
- MW-18 — MONITORING WELLS INSTALLED BY BAKER DURING UST INVESTIGATION (1992 AND 1993)
- MW-08 — MONITORING WELLS INSTALLED DURING A UST INVESTIGATION BY ATEC AND ASSOCIATES (1991)
- 73GW-02 — MONITORING WELLS INSTALLED BY ESE DURING CONFIRMATORY SAMPLING (1990)
- SW/SD-01 — SURFACE WATER/SEDIMENT LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- F/C-01 — FISH/CRAB LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)



DETAIL A

SOURCE: LANIER SURVEYING CO., APRIL 4, 1996

REVISIONS

DRAWN	WJH
REVIEWED	JSC
S.O.#	62470-312-0000-07000
CADD#	312561PP

NORTH

SITE 73 – AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

ANALYTICAL RESULTS FOR SURFACE WATER

SCALE 1" = 150'

DATE NOVEMBER 1996

FIGURE NO.
4-16

Supplemental Groundwater Investigation (Baker 1998)

TABLE 1

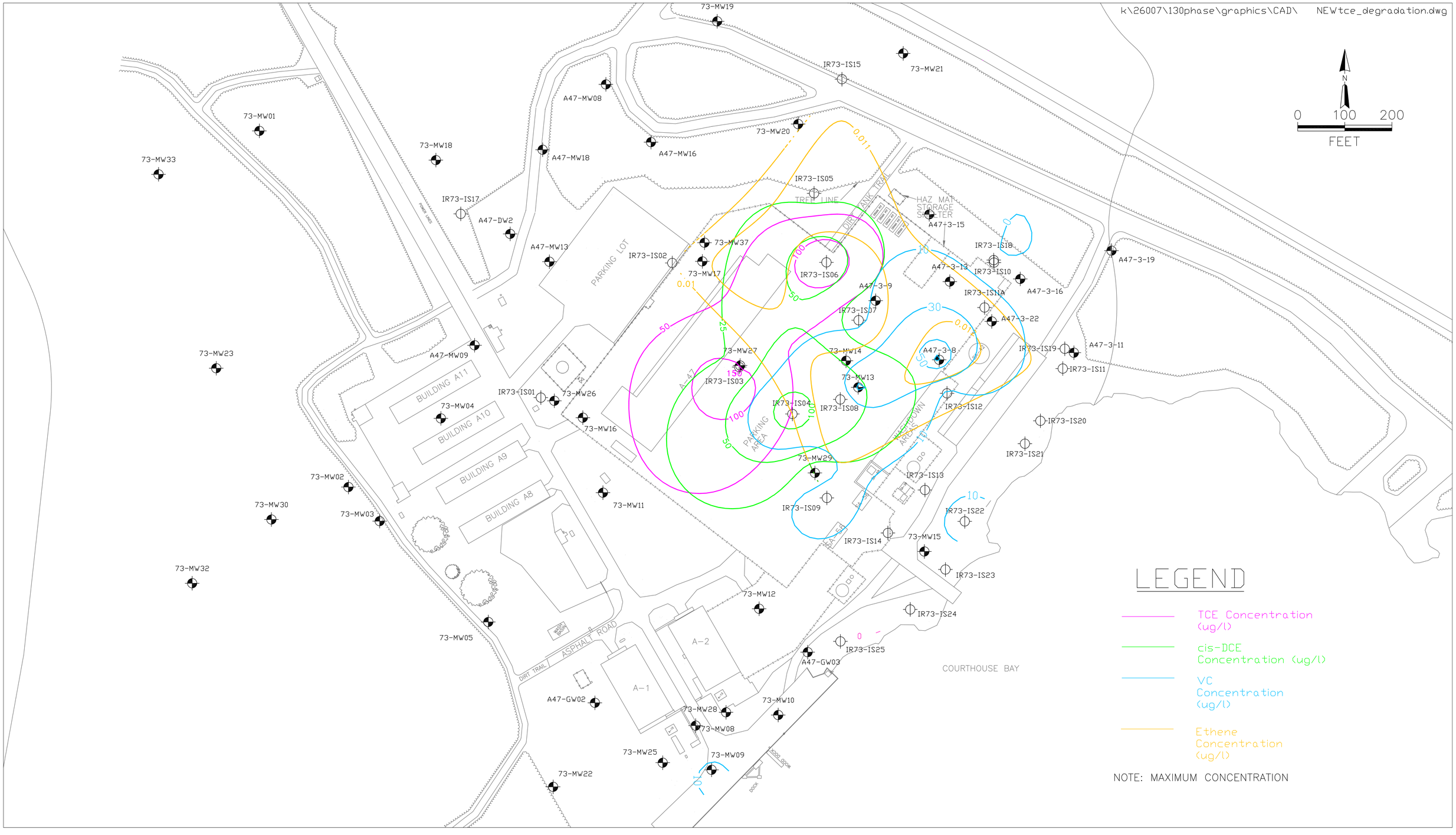
CONCENTRATION COMPARISON
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
SUPPLEMENTAL GROUNDWATER INVESTIGATION, CTO-0312

Monitoring Well	Phase I Results (µg/L)	Phase II Results (µg/L)	Supplemental Groundwater Investigation Sampling Results (µg/L)	Trends/Comments
73-MW09				
- cis-1,2-Dichloroethene	2	NS	ND	Concentration decreasing
- 1,2-Dichloroethene (total)	NS	2J	NS	No trend established; Methods 601/602 and SW846 8260A do not report total 1,2-dichloroethene
- Vinyl Chloride	11	22	37	Concentration increasing
- Benzene	ND	3J	ND	Only one detection; suspect result in Phase II
73-DW02				
- Chloroform	1J	ND	ND	Non-site related contaminant
- Trichloroethene	25J	ND	ND	Contaminant concentration decreased over time
73-DW03				
- 1,2-Dichloroethane	0.7	ND	ND	Concentration decreasing
- Trichloroethene	110	320	180	Fluctuating concentrations, changes in concentrations may be due to differences in analytical methods
- Benzene	2.4	ND	2.2	Fluctuating concentrations, changes in concentration may be due to differences in analytical methods
- trans-1,2-Dichloroethene	1.8	NS	2.5	Concentration increasing
- cis-1,2-Dichloroethene	67	NS	94	Concentration increasing
-Vinyl chloride	ND	4J	4.7	Concentration increasing
- Chloroethane	ND	3J	ND	Fluctuating concentration
- Dichloroethene (total)	NS	120	NS	No trend established; Methods 601/602 and SW846 8260A do not report total 1,2-dichloroethene
73-DW04				
- Chloroform	5.5J	ND	ND	Non-site related contaminant
- 1,2-Dichloroethane	0.6	ND	ND	Concentration decreasing
- Trichloroethene	4.3J	ND	ND	Concentration decreasing
- cis-1,2-Dichloroethene	ND	NS	1.9	Concentration increasing
73-DW05				
- Trichloroethene	19	ND	ND	Concentration decreasing; suspect result in Phase I
73-DW10	NS	ND	ND	No contaminants detected

Notes:

(1) Phase I samples were analyzed per Method 601/602.
(2) Phase II samples were analyzed per CLP Methods.
(3) Supplemental Groundwater Investigation samples were analyzed per Method SW846 8260A.
(4) ND = Not detected above method detection limits.
(5) NS = Not sampled.

Natural Attenuation Evaluation (Baker 2002)



Baker

TITLE:
TCE and Degradation Products in Upper Surficial Unit, 1998–2001
OU21 – Site 73, Amphibious Vehicle Maintenance Area, MCB Camp Lejeune, NC
Natural Attenuation Evaluation Report, CTO–0130

DWN: CLH	DES.: CLH	PROJECT NO.: CTO 130
CHKD: DSF	APPD:	FIGURE NO.: 4–2
DATE: 12/28/01	REV.: 3	

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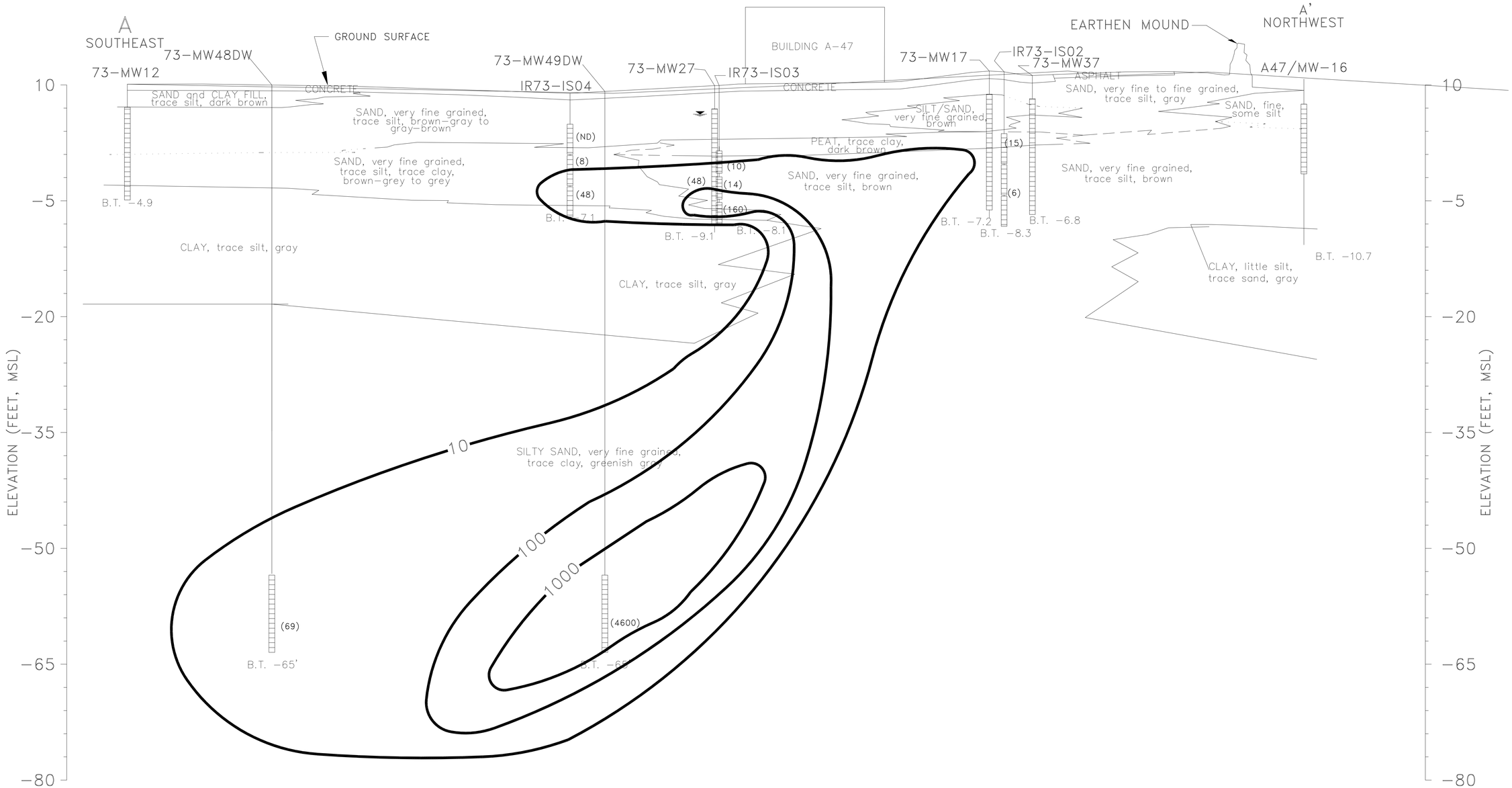

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LEGEND

———	ESTIMATED CONTACT
— — —	PROJECTED CONTACT
- - - - - - -	GRADATIONAL CONTACT
▯	WELL SCREEN INTERVAL
B.T. -4.9'	BORING TERMINATED, ELEVATION MSL, UNLESS OTHERWISE NOTED
▼	GROUNDWATER LEVEL

100 0 50 100 200

Horizontal Scale: 1 inch = 100 ft.

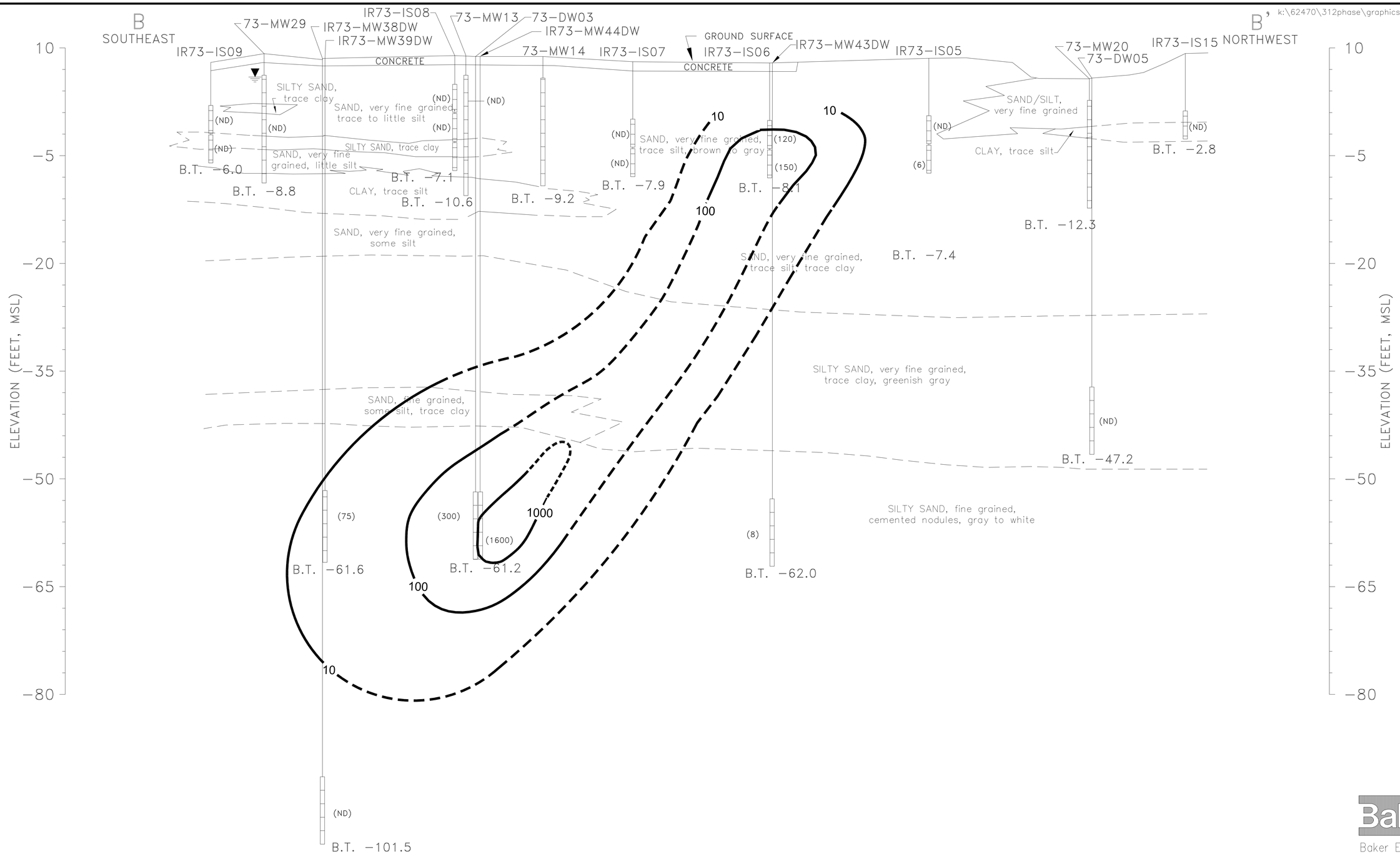
15 0 7.5 15 30

Vertical Scale: 1 inch = 15 ft.

THE SOIL BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS. SUBSURFACE CONDITIONS INTERPOLATED BETWEEN BORINGS ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.

FIGURE 4-3
TCE, HYDROGEOLOGIC CROSS-SECTION A-A'
SITE 73, AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
NATURAL ATTENUATION EVALUATION, CTO - 0130
1998 - 2001

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



Baker
Baker Environmental Inc.

LEGEND

- ESTIMATED CONTACT
- PROJECTED CONTACT
- WELL SCREEN INTERVAL
- B.T. -2.8' BORING TERMINATED, ELEVATION MSL
- GROUNDWATER LEVEL
- —10— APPROXIMATE ISOCONCENTRATION CONTOUR (ug/L)

NOTE: MAXIMUM CONCENTRATION SHOWN

100 0 50 100 200

Horizontal Scale: 1 inch = 100 ft.

15 0 7.5 15 30

Vertical Scale: 1 inch = 15 ft.

THE SOIL BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS. SUBSURFACE CONDITIONS INTERPOLATED BETWEEN BORINGS ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.

FIGURE 4-6
TCE, HYDROGEOLOGIC CROSS-SECTION B-B'
SITE 73, AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
NATURAL ATTENUATION EVALUATION, CTO - 0130
1998 - 2001

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

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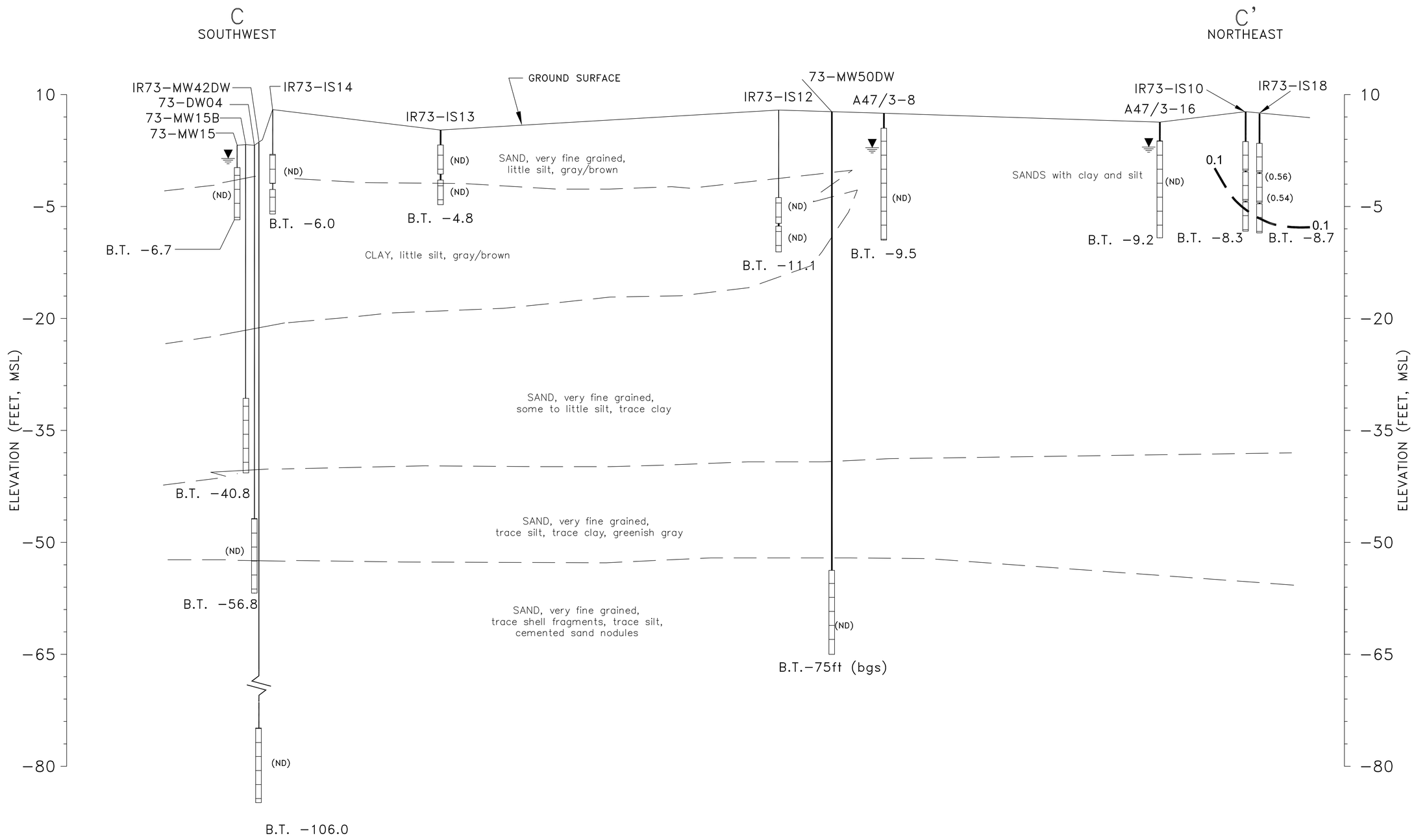

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Baker Environmental Inc.

LEGEND

- ESTIMATED CONTACT
- PROJECTED CONTACT
- WELL SCREEN INTERVAL
- B.T. X' — BORING TERMINATED, ELEVATION MSL, UNLESS OTHERWISE NOTED
- GROUNDWATER LEVEL
- —0.1— APPROXIMATE ISOCONCENTRATION CONTOUR (ug/L)

NOTE: MAXIMUM CONCENTRATION SHOWN

70 0 35 70 140

Horizontal Scale: 1 inch = 70 ft.

15 0 7.5 15 30

Vertical Scale: 1 inch = 15 ft.

THE SOIL BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS. SUBSURFACE CONDITIONS INTERPOLATED BETWEEN BORINGS ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.

FIGURE 4-9
TCE, HYDROGEOLOGIC CROSS-SECTION C-C'
SITE 73, AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
NATURAL ATTENUATION EVALUATION, CTO - 0130
1998-2001

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

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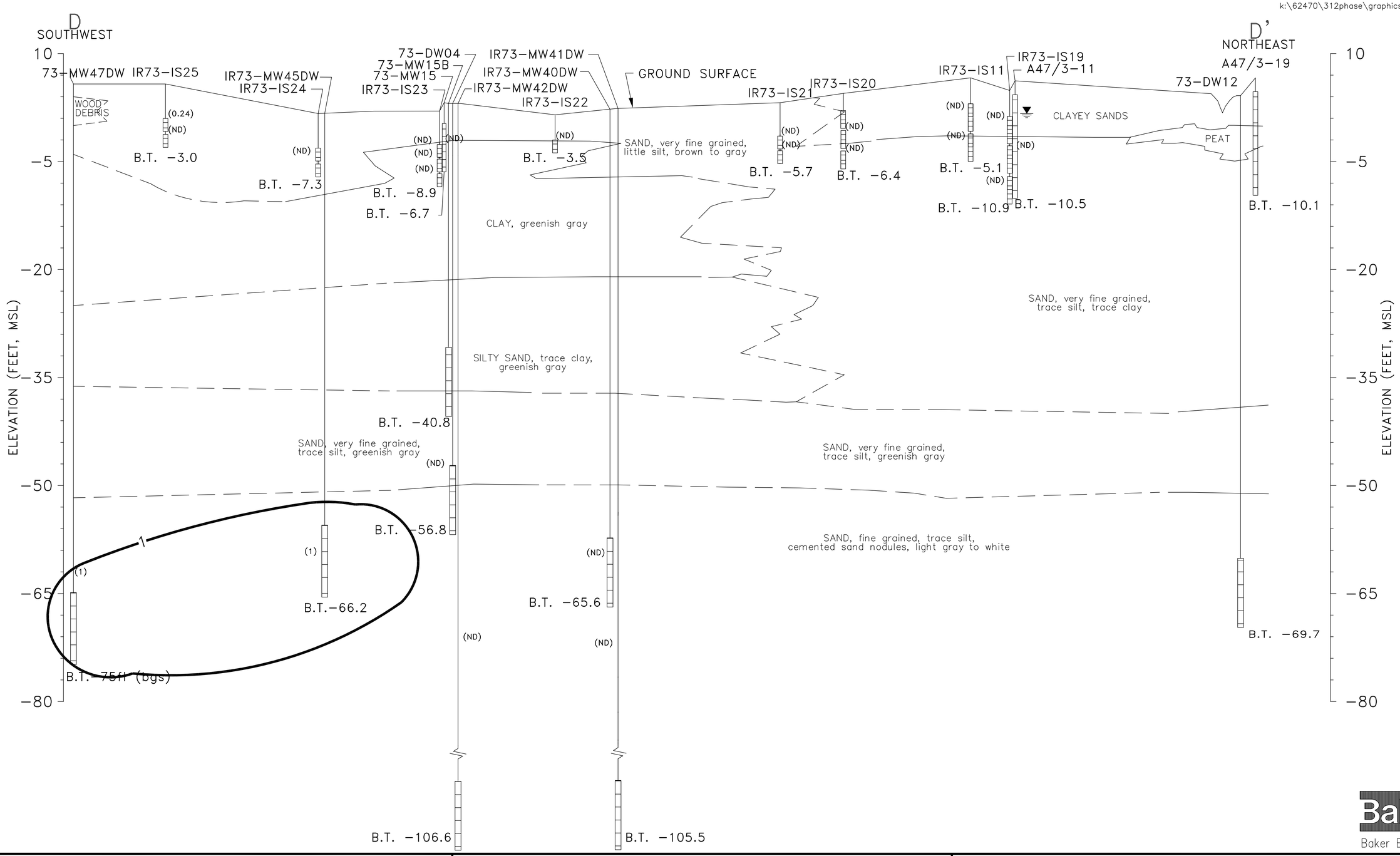

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LEGEND

- ESTIMATED CONTACT
- PROJECTED CONTACT
- WELL SCREEN INTERVAL
- B.T. 3.0' BORING TERMINATED, ELEVATION MSL, UNLESS OTHERWISE NOTED
- GROUNDWATER LEVEL

100 0 50 100 200
Horizontal Scale: 1 inch = 100 ft.

15 0 7.5 15 30
Vertical Scale: 1 inch = 15 ft.

THE SOIL BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS. SUBSURFACE CONDITIONS INTERPOLATED BETWEEN BORINGS ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.

FIGURE 4-12
TCE, HYDROGEOLOGIC CROSS-SECTION D-D'
SITE 73, AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
NATURAL ATTENUATION EVALUATION, CTO - 0130
1998-2001

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

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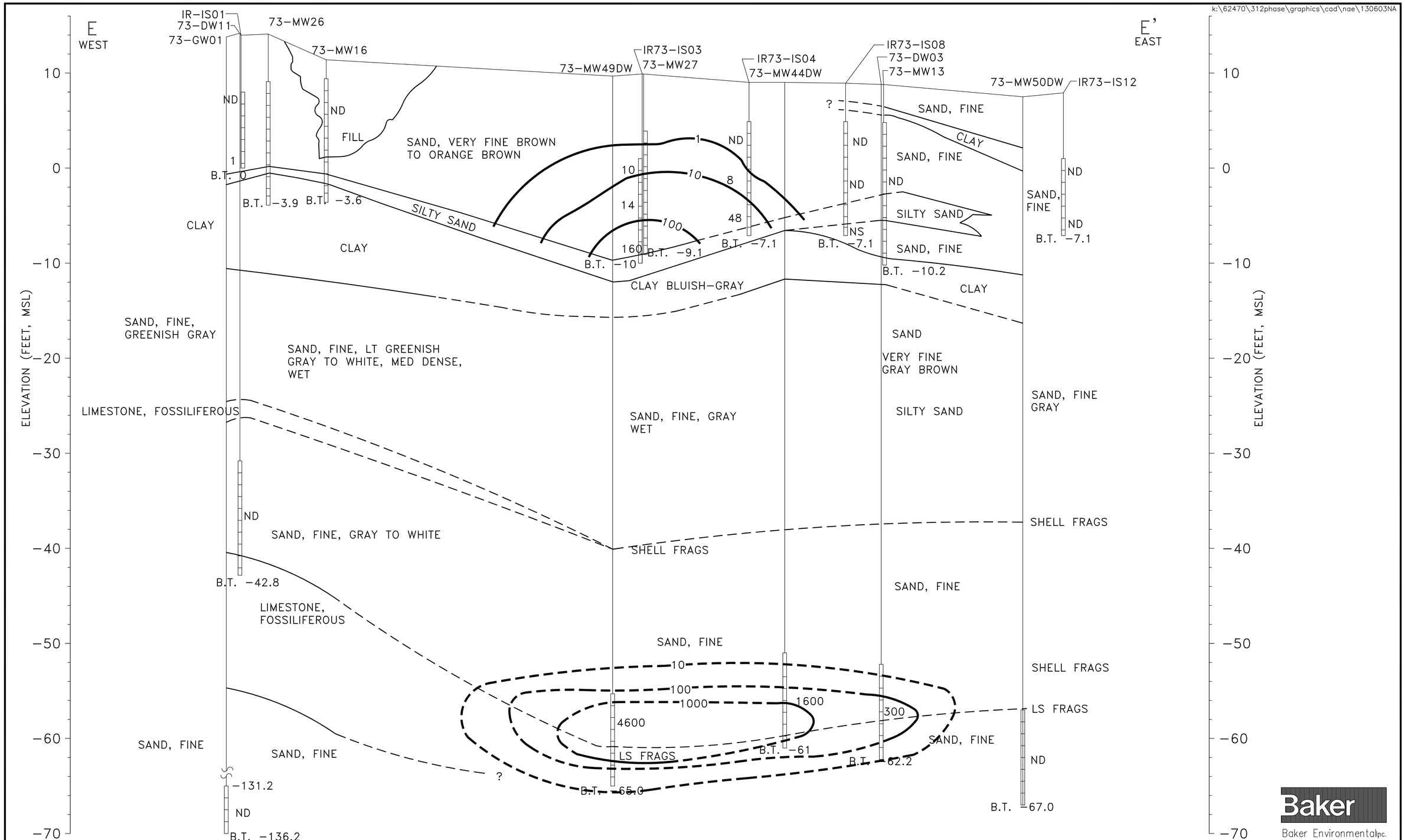


LEGEND

———	ESTIMATED CONTACT
— — —	PROJECTED CONTACT
▯	WELL SCREEN INTERVAL
B.T. -2.8'	BORING TERMINATED, ELEVATION MSL
	GROUNDWATER LEVEL
NS	NO SAMPLE

NOTE: MAXIMUM CONCENTRATION SHOWN

100 0 50 100 200

Horizontal Scale: 1 inch = 100 ft.

10 0 5 10 20

Vertical Scale: 1 inch = 10 ft.

THE SOIL BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS. SUBSURFACE CONDITIONS INTERPOLATED BETWEEN BORINGS ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.

FIGURE 4-15
TCE HYDROGEOLOGIC CROSS-SECTION E-E'
SITE 73, AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
NATURAL ATTENUATION EVALUATION, CTO - 0130

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

Baker
Baker Environmental Inc.

Appendix C
Boring Logs and Well Construction Diagrams

CH2MHILL

Boring Number: 73-MW11DW

Client:
Project: Site 73 Amended RI/CTO 105/MW Installation
Location: MCB Camp Lejeune Site 73
Project Number: 328432.FI.MW.73

Driller: Prosonic Corp / Probe Tech
Drilling Method: Rotosonic
Sampling Method:
Logged by: J. Frank/RDU
Start/Finish Date: 04/04/06

Depth (ft)	Sample #	Sample Type	Recovery (%)	SPT (6"-6"-6")	Soil Log	Soil Description	Depth / Elev (ft)	Comments
						Ground Surface	0	
0						**SM** Brown/gray silty sand, loose, moist	0	PID = 0.9 ppm
			100	Hand Auge			-4	PID = 1.0 ppm
5						**SM** Brown (light to medium), silty sand, organic rich, loose, damp	4 / -6	PID = 1.0 ppm
			100	Sonic		**SP** Tan to light gray, fine to medium sand, little silt, medium dense, wet	6	PID = 0.9 ppm PID = 12.0 ppm
10								PID = 25.9 ppm
							-12	
						SM Light to medium brown, silty sand, medium dense, wet	12	PID = 4.2 ppm
			100			**SM** Gray, silty sand, little clay, medium stiff, moist	-15	PID = 2.7 ppm
15						**ML** Dark gray, silt with clay, stiff, little plasticity, moist	15	PID = 5.2 ppm PID = 1.5 ppm
							-19	PID = 4.3 ppm
			100			**ML** Darky gray, silt, little to no clay, 40% shell materials, medium dense, damp	19	PID = 2.7 ppm PID = 1.1 ppm
20						**CL** Dark gray, silty clay, stiff, some plasticity, moist		PID = 6.3 ppm
			100					PID = 1.3 ppm PID = 2.1 ppm
25								PID = 1.2 ppm
							-26	PID = 1.2 ppm
			100			**SM** Brown, silty sand, medium dense, moist	26	PID = 4.5 ppm
			100			**SW** Light gray to gray, fine sand, little silt, loose, wet		PID = 2.1 ppm PID = 26.2 ppm
30								

CH2MHILL

Boring Number: 73-MW11DW

Client:
Project: Site 73 Amended RI/CTO 105/MW Installation
Location: MCB Camp Lejeune Site 73
Project Number: 328432.FI.MW.73

Driller: Prosonic Corp / Probe Tech
Drilling Method: Rotosonic
Sampling Method:
Logged by: J. Frank/RDU
Start/Finish Date: 04/04/06

Depth (ft)	Sample Information: Sample #	Sample Type	Recovery (%)	SPT (6"-6"-6")	Soil Log	Soil Description	Depth / Elev (ft)	Comments
								PID = 2.1 ppm
								PID = 1.9 ppm
			100	Sonic			-33	
						SW-SP Dark gray, fine sand with some silt, loose, wet.	33	PID = 2.0 ppm
							-35	
35						**SW** Light gray to gray, fine to medium sand with trace silt, loose, wet, little cementation	35	PID = 7.2 ppm
							-37	PID = 4.7 ppm
						SW Light green to gray, fine sand, little cementation	37	PID = 3.6 ppm
							-39	
						SM Light green to gray, silty sand, medium dense, moist	39	PID = 1.2 ppm
40								
			100					PID = 5.2 ppm
								PID = 4.2 ppm
								PID = 1.5 ppm
45								PID = 3.3 ppm
								PID = 3.4 ppm
							-47	PID = 4.6 ppm
						Wet	47	
						SP Light gray, fine to medium cemented sands, moist to wet		PID = 2.8 ppm
							-49	PID = 1.8 ppm
							49	
50						**SP-SW** Light gray, fine to medium sands, little silt, moist		PID = 6.7 ppm
								PID = 1.9 ppm
			100					PID = 1.4 ppm
								PID = 1.4 ppm
55							-56	PID = 2.5 ppm
						SP Light gray, fine cemented sands, moist	56	7" Temporary Casing PID = 1.8 ppm
								PID = 1.7 ppm
			100					
							-60	PID = 3.3 ppm
60							60	

CH2MHILL

Boring Number: 73-MW11DW

Client:
Project: Site 73 Amended RI/CTO 105/MW Installation
Location: MCB Camp Lejeune Site 73
Project Number: 328432.FI.MW.73

Driller: Prosonic Corp / Probe Tech
Drilling Method: Rotosonic
Sampling Method:
Logged by: J. Frank/RDU
Start/Finish Date: 04/04/06

Depth (ft)	Sample Information: Sample #	Sample Type	Recovery (%)	SPT (6"-6"-6")	Soil Log	Soil Description	Depth / Elev (ft)	Comments
			100	Sonic		**SP** Light gray, fine to medium cemented sands, moist	-67	PID = 3.7 ppm PID = 2.5 ppm PID = 1.6 ppm PID = 3.5 ppm PID = 2.6 ppm
65								
						SP Light gray, fine to medium sand, trace silt, loose, wet	67 -70	PID = 3.0 ppm PID = 1.6 ppm PID = 3.0 ppm
70						**SM** Brown to green to gray, silty sand, medium dense, wet	70 -72	PID = 1.4 ppm PID = 2.5 ppm
			100			**SP** Green to gray, fine cemented sands, wet	72	PID = 1.3 ppm PID = 3.4 ppm
75						**SP** Green to gray, fine to medium sand, little silt, medium dense, moist	-77	PID = 3.2 ppm PID = 3.3 ppm PID = 1.9 ppm
						SM Green to gray, fine to medium silty sand, trace shell fragments, medium dense, moist	77 -80	PID = 7.3 ppm PID = 1.3 ppm PID = 1.5 ppm
80						**SP-SW** Light green to gray, fine cemented sands (gravelly), wet	80 -83	PID = 1.1 ppm Top of 5 ft 0.010" Slot Screen Interval PID = 2.5 ppm
			100			**SM** Green to gray, fine to medium silty sand, some shell fragments, medium dense, moist to wet	83 -87	PID = 1.2 ppm PID = 1.1 ppm PID = 1.5 ppm PID = 1.7 ppm Bottom of Screen Interval
85								
						TERMINATED BOREHOLE @ 87' End of Log	87	PID = 1.5 ppm
90								

CH2MHILL

Boring Number: 73-MW17DW

Client:
Project: Site 73 Amended RI/CTO 105/MW Installation
Location: MCB Camp Lejeune Site 73
Project Number: 328432.FI.MW.73

Driller: Prosonic Corp / Probe Tech
Drilling Method: Rotosonic
Sampling Method:
Logged by: J. Frank/RDU
Start/Finish Date: 04/04/06

Depth (ft)	Sample #	Sample Type	Recovery (%)	SPT (6"-6"-6")	Soil Log	Soil Description	Depth / Elev (ft)	Comments
						Ground Surface	0	
0						**SM** Dark brown, organic rich, silty sand, loose, moist	0 / -3	
			100	Hang Auge		**SM** Dark brown, silty sand, wood debris, loose, moist	3 / -5	PID = 4.2 ppm
5						**SW** Light gray, fine sand, loose, wet	5	
						SM Dark brown to black, silty sand, stained, loose, wet	-9	PID = 6.4 ppm PID = 7.8 ppm
10						**SM** Brown to dark brown, silty sand, stained, loose, moist	9 / -11	PID = 3.6 ppm PID = 6.9 ppm
			100	Sonic		**SW** Brown to tan, fine sand, loose, damp to moist	11 / -17	PID = 19.0 ppm PID = 17.5 ppm PID = 40.9 ppm PID = 10.1 ppm PID = 11.7 ppm
15						**SC** Gray to dark gray, clayey, silty sand, some plasticity, wet	17 / -19	PID = 23.4 ppm PID = 15.2 ppm
20						**SM** Gray, silty sand with trace clay, loose, wet	19 / -21	PID = 40.4 ppm PID = 20.7 ppm
			100			**SW** Gray to light gray, fine sand, loose, wet	21 / -27	PID = 8.2 ppm PID = 10.7 ppm PID = 3.0 ppm PID = 8.6 ppm PID = 1.4 ppm
25						Moist, little silt	27	PID = 8.6 ppm
			100			**SC** Light gray to gray, clayey sands, little plasticity, wet, clay in lenses	-30	PID = 8.8 ppm PID = 14.9 ppm
30							30	

CH2MHILL

Boring Number: 73-MW17DW

Client:
Project: Site 73 Amended RI/CTO 105/MW Installation
Location: MCB Camp Lejeune Site 73
Project Number: 328432.FI.MW.73

Driller: Prosonic Corp / Probe Tech
Drilling Method: Rotosonic
Sampling Method:
Logged by: J. Frank/RDU
Start/Finish Date: 04/04/06

Depth (ft)	Sample Information: Sample #	Sample Type	Recovery (%)	SPT (6"-6"-6")	Soil Log	Soil Description	Depth / Elev (ft)	Comments
						SC Brown to gray, clayey, silty sand, some plasticity, wet	-32	PID = 14.8 ppm
						SW Light gray, fine sand, loose, saturated	32 -34	PID = 15.5 ppm; PID = 15.4 ppm
			100	Sonic		**SP** Gray, fine to medium sand, little silt, loose, saturated	34 -36	PID = 22.2 ppm; PID = 21.9 ppm
35						**SP** Light gray, fine sand, some cementation, loose, moist to wet	36	PID = 21.8 ppm
						SW Light gray, fine sand, some cementation, loose, moist to wet	-40	PID = 4.8 ppm; PID = 3.8 ppm; PID = 4.6 ppm
40						**SP** Light gray, gravelly cemented sands, wet	40 -44	PID = 3.6 ppm; PID = 6.6 ppm; PID = 11.4 ppm; PID = 14.1 ppm
			100			**SW** Light gray, fine sand, loose, moist	44 -49	PID = 6.2 ppm; PID = 11.5 ppm; PID = 14.3 ppm; PID = 8.7 ppm
45						**SP** Light gray, gravelly cemented sands, moist to wet	49 -57	PID = 15.4 ppm; PID = 13.1 ppm; PID = 10.7 ppm; PID = 23.9 ppm; PID = 40.2 ppm; PID = 24.4 ppm; PID = 22.6 ppm 7" Temp Casing
50			100			**SP** Light gray to green to gray gravelly cemented sands, wet	57	PID = 2.8 ppm; PID = 7.3 ppm; PID = 7.2 ppm
55								
60								

CH2MHILL

Boring Number: 73-MW17DW

Client:
Project: Site 73 Amended RI/CTO 105/MW Installation
Location: MCB Camp Lejeune Site 73
Project Number: 328432.FI.MW.73

Driller: Prosonic Corp / Probe Tech
Drilling Method: Rotosonic
Sampling Method:
Logged by: J. Frank/RDU
Start/Finish Date: 04/04/06

Depth (ft)	Sample Information: Sample #	Sample Type	Recovery (%)	SPT (6"-6"-6")	Soil Log	Soil Description	Depth / Elev (ft)	Comments
								PID = 12.8 ppm
								PID = 12.0 ppm
								PID = 10.9 ppm
								PID = 24.2 ppm
65								PID = 22.5 ppm
								PID = 14.7 ppm
							-67	PID = 18.9 ppm
						SM Green to gray, silty sand, little cementation, medium dense, wet	67	PID = 1.6 ppm
							-70	PID = 1.8 ppm
70						**SP** Light green to gray, fine to medium cemented sands, wet	70	PID = 3.6 ppm
								PID = 9.3 ppm
						SM Light green to gray, silty sand, medium dense, moist to wet	-73	PID = 1.7 ppm
				Sonic			73	PID = 2.0 ppm
						same With little cementation		PID = 1.8 ppm
75								PID = 2.3 ppm
								PID = 1.6 ppm
								PID = 1.7 ppm
								PID = 1.5 ppm
80							-80	PID = 1.3 ppm
						SP Light green to gray, fine to medium cemented sands, moist to wet	80	PID = 1.5 ppm Top of Screen
							-82	PID = 1.6 ppm
						SM Light green to gray, silty sand, medium dense, moist	82	PID = 1.9 ppm
							-84	PID = 1.3 ppm
85						**SP** Light green to gray, gravelly cemented sands, wet	84	PID = 1.5 ppm
							-86	PID = 1.5 ppm
						SM Light green to gray, silty sand, medium dense, moist	86	PID = 1.6 ppm Bottom of Screen
						TERMINATED BOREHOLE @ 87'		
90						End of Log		

CH2MHILL

Boring Number: 73-MW49DWA

Client:
Project: Site 73 Amended RI/CTO 105/MW Installation
Location: MCB Camp Lejeune Site 73
Project Number: 328432.FI.MW.73

Driller: Prosonic Corp / Probe Tech
Drilling Method: Rotosonic
Sampling Method:
Logged by: J. Frank/RDU
Start/Finish Date: 04/05/06

Depth (ft)	Sample #	Sample Type	Recovery (%)	SPT (6"-6"-6")	Soil Log	Soil Description	Depth / Elev (ft)	Comments
						Ground Surface	0	
0						**SP** Brown, fine sand, some silt, loose, damp	0 / -3	
			100	Hand Auge		**SM** Brown, fine silty sand, loose, moist	3 / -8	PID = 12.9 ppm
5								PID = 16.4 ppm
								PID = 8.5 ppm
								PID = 20.5 ppm
						same	8	
						SM Brown, silty sand, loose, wet		PID = 2.6 ppm
10								PID = 4.9 ppm
								PID = 4.5 ppm
			100	Sonic			-13	PID = 5.1 ppm
						SP Gray, fine to medium sand, trace silt, loose, wet	13 / -15	PID = 2.8 ppm
								PID = 3.6 ppm
15						**SP** Gray, fine to medium sand, trace silt, loose, wet	15	PID = 3.9 ppm
								PID = 3.3 ppm
						SW Gray, fine sand, loose, wet		PID = 2.0 ppm
						same		PID = 1.4 ppm
						SC Dark brown, clayey, silty, sand, medium stiff, moist to wet	-20 / 20	PID = 2.8 ppm
20								PID = 2.5 ppm
						SM Dark brown-black, organic rich, silty sand, medium dense, wood debris		PID = 2.3 ppm
			100					PID = 2.0 ppm
						CL Gray-brown, sandy, silty clay, stiff, some plasticity, moist	-23 / 23	PID = 2.5 ppm
								PID = 4.6 ppm
25							-26	PID = 1.5 ppm
						CL Blue-gray, silty clay, stiff, moist	26 / -27	PID = 1.4 ppm
						same	27 / -29	PID = 1.8 ppm
			100					PID = 1.1 ppm
						SM Gray-brown, silty sand, medium dense, wet	29	PID = 1.2 ppm
30								

CH2MHILL

Boring Number: 73-MW49DWA

Client:
Project: Site 73 Amended RI/CTO 105/MW Installation
Location: MCB Camp Lejeune Site 73
Project Number: 328432.FI.MW.73

Driller: Prosonic Corp / Probe Tech
Drilling Method: Rotosonic
Sampling Method:
Logged by: J. Frank/RDU
Start/Finish Date: 04/05/06

Depth (ft)	Sample #	Sample Type	Recovery (%)	SPT (6"-6"-6")	Soil Log	Soil Description	Depth / Elev (ft)	Comments
						SW Green-gray, fine to medium sand, little silt, loose, wet	-33	PID = 1.3 ppm PID = 2.0 ppm
			100	Sonic		**SW** Light green-gray, fine gravelly cemented sands, moist to wet	33 -36	PID = 1.5 ppm PID = 1.4 ppm PID = 1.2 ppm
35						**SW** Light green-gray, fine to medium sand with little cementation, wet	36 -37	PID = 1.2 ppm PID = 1.5 ppm
						same With some shell fragments	37 -39	PID = 1.8 ppm PID = 2.1 ppm
40			20			**NA** Not available	39	
45							-47	
						SW Light green-gray, fine to medium sands, with little cementation, loose, wet	47 -49	PID = 2.0 ppm PID = 5.6 ppm
50			100			**SW** Light green-gray, fine to medium sand, loose, wet	49 -53	PID = 5.4 ppm PID = 5.8 ppm PID = 6.2 ppm PID = 10.6 ppm
55						**SW** Light green-gray, fine gravelly cemented sands, moist to wet	53 -57	PID = 5.5 ppm PID = 7.3 ppm PID = 7.9 ppm PID = 5.5 ppm 8" Temporary Casing
			100			**same**	57 -60	PID = 6.3 ppm PID = 8.8 ppm
60							60	

CH2MHILL

Boring Number: 73-MW49DWA

Client:
Project: Site 73 Amended RI/CTO 105/MW Installation
Location: MCB Camp Lejeune Site 73
Project Number: 328432.FI.MW.73

Driller: Prosonic Corp / Probe Tech
Drilling Method: Rotosonic
Sampling Method:
Logged by: J. Frank/RDU
Start/Finish Date: 04/05/06

Depth (ft)	Sample Information: Sample #	Sample Type	Recovery (%)	SPT (6"-6"-6")	Soil Log	Soil Description	Depth / Elev (ft)	Comments
			100	Sonic		**same** With trace shell fragments		PID = 6.4 ppm PID = 4.5 ppm PID = 6.5 ppm PID = 6.4 ppm
65						**SM** Green-gray, silty sand, medium dense, moist, shell fragments	-65 65 -67	PID = 2.5 ppm PID = 3.1 ppm
			100			**SM** Green-gray, silty sand, with little "spotty" cementation, medium dense, moist to wet, shell fragments	67 -74	PID = 3.0 ppm PID = 3.1 ppm PID = 2.7 ppm PID = 2.0 ppm PID = 2.7 ppm PID = 1.7 ppm PID = 2.6 ppm PID = 2.0 ppm
70								
75						**SM** Green-gray, fine to medium silty gravelly cemented sand, wet	74	PID = 1.3 ppm PID = 2.2 ppm
						SM Green-gray, silty sand, medium dense, moist, trace shell fragments	-77 77	PID = 2.8 ppm PID = 0.8 ppm
			100			**same** With shell casts		PID = 1.4 ppm PID = 1.9 ppm PID = 3.4 ppm PID = 2.3 ppm PID = 2.9 ppm PID = 1.9 ppm
80								
85							-86 86	PID = 1.7 ppm
						SM Green-gray, fine to medium sitly gravelly sands, wet		PID = 1.9 ppm 7" Temporary Casing
			100			**SM** Green-gray, fine silty sand, medium dense, moist		PID = 1.9 ppm PID = 1.7 ppm
90								

CH2MHILL

Boring Number: 73-MW49DWA

Client:
Project: Site 73 Amended RI/CTO 105/MW Installation
Location: MCB Camp Lejeune Site 73
Project Number: 328432.FI.MW.73

Driller: Prosonic Corp / Probe Tech
Drilling Method: Rotosonic
Sampling Method:
Logged by: J. Frank/RDU
Start/Finish Date: 04/05/06

Depth (ft)	Sample Information: Sample #	Sample Type	Recovery (%)	SPT (6"-6"-6")	Soil Log	Soil Description	Depth / Elev (ft)	Comments
								PID = 1.8 ppm
							-92	PID = 1.5 ppm
						SP Light green-gray, fine to medium gravelly cemented sands, wet, shell (bivalve) casts	92	PID = 2.0 ppm
			100	Sonic				PID = 1.7 ppm
95								PID = 2.6 ppm
								PID = 1.6 ppm
							-97	PID = 1.7 ppm
						SP Light green-gray, fine to medium sand, some cementation, loose, wet	97	PID = 2.5 ppm
								PID = 3.2 ppm
							-100	PID = 2.8 ppm
100						**SP** Light green-gray, fine to medium gravelly cemented sands, wet, bivalve casts	100	PID = 3.0 ppm
			100					PID = 1.7 ppm
								PID = 1.4 ppm
								PID = 1.8 ppm
105								PID = 2.0 ppm
								PID = 1.5 ppm
							-107	PID = 1.8 ppm
						SM Green-gray, fine silty sand, medium dense, moist	107	PID = 2.0 ppm
								PID = 2.3 ppm
110								PID = 1.9 ppm
								PID = 1.8 ppm
			100					PID = 1.7 ppm
								PID = 1.9 ppm
								PID = 1.9 ppm
115								PID = 2.3 ppm
								PID = 2.0 ppm
							-117	PID = 1.6 ppm
						SW Green-gray, fine sand with some silt, slightly dense, moist to wet	117	PID = 1.8 ppm
			100					PID = 2.0 ppm
120								Top of 5 ft 0.010" slotted screen interval

CH2MHILL

Boring Number: 73-MW49DWA

Client:
Project: Site 73 Amended RI/CTO 105/MW Installation
Location: MCB Camp Lejeune Site 73
Project Number: 328432.FI.MW.73

Driller: Prosonic Corp / Probe Tech
Drilling Method: Rotosonic
Sampling Method:
Logged by: J. Frank/RDU
Start/Finish Date: 04/05/06

Depth (ft)	Sample Information: Sample #	Sample Type	Recovery (%)	SPT (6"-6"-6")	Soil Log	Soil Description	Depth / Elev (ft)	Comments
			100	Sonic				
125								Bottom of 5 ft 0.010" slotted screen interval
							-127	
						TERMINATED BORING @ 127'	127	Bottom of 2 ft of sand under riser
						End of Log		
130								
135								
140								
145								
150								

PROJECT NUMBER	WELL NUMBER	
328432.FI.MW.73	**73-MW11DW**	SHEET 1 OF 1

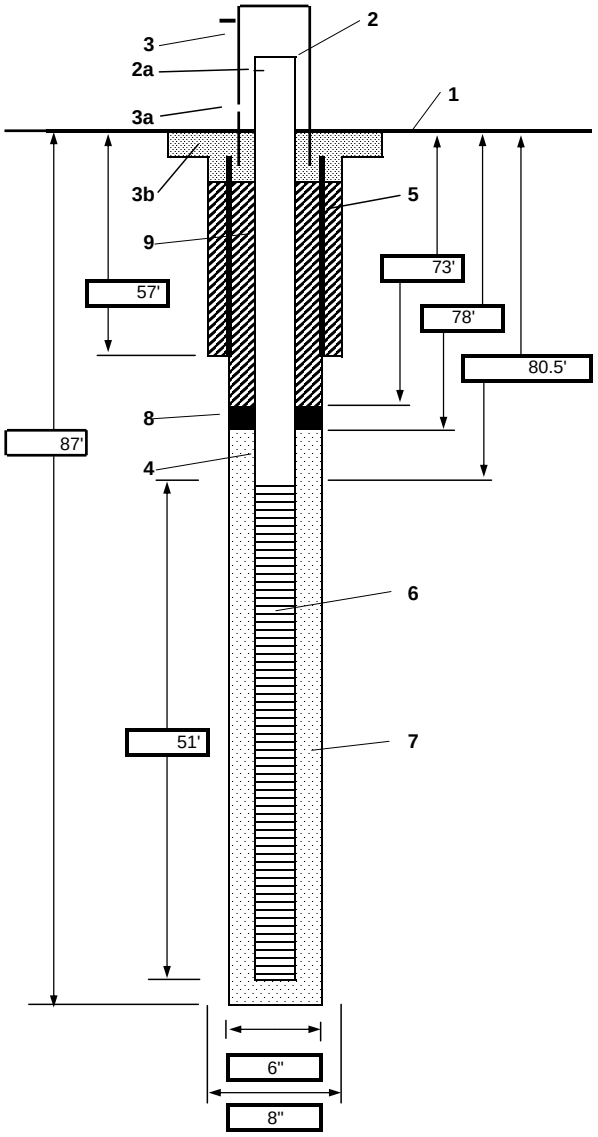
WELL COMPLETION DIAGRAM

PROJECT : Site 73 Amended RI / CTO-105/ MW Installation LOCATION : MCB Camp Lejeune Site 73

DRILLING CONTRACTOR : Prosonic Corp / Probe Tech

DRILLING METHOD AND EQUIPMENT USED : Rotosonic

WATER LEVELS : START : 4/4/2006 730 END : 1430 LOGGER : J. Frank/RDU



1-	Ground elevation at well	NA
2-	Top of casing elevation	
	a) vent hole?	
3-	Wellhead protection cover type	2 ft 4"x4" stick up
	a) weep hole?	
	b) concrete pad dimensions	2'x2'
4-	Dia./type of well casing	2" Schedule 40 PVC
5-	Dia./type of surface casing	Temporary 7" steel casing
6-	Type/slot size of screen	2" Schedule 40 PVC
		0.010" Slot
7-	Type screen filter	Type 1 Sand
	a) Quantity used	3.0 50-pound bags
8-	Type of seal	3/8" Bariod bentonite chips
	a) Quantity used	2.0 50-pound bags
9-	Grout	
	a) Grout mix used	Portland Type I + Bentonite powder
	b) Method of placement	Tremie pipe
	c) Vol. of surface casing grout	100 gallons
	d) Vol. of well casing grout	18 gallons
	Development method	
	Development time	
	Estimated purge volume	

Comments

PROJECT NUMBER	WELL NUMBER	
328432.FI.MW.73	73-MW17DW	SHEET 1 OF 1

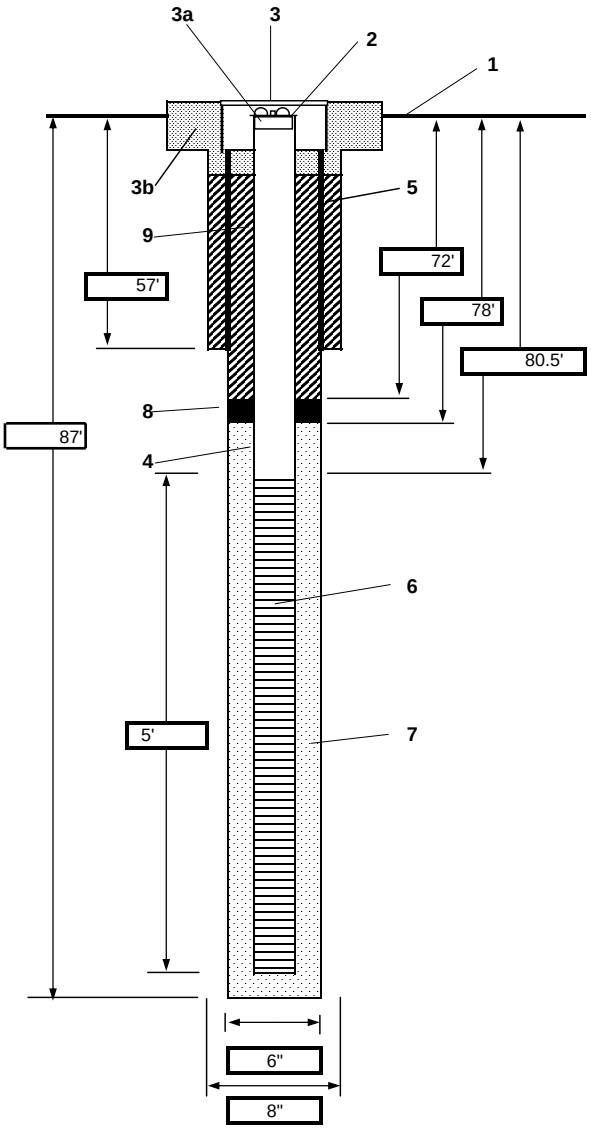
WELL COMPLETION DIAGRAM

PROJECT : Site 73 Amended RI / CTO 105 / MW Installation LOCATION : MCB Camp Lejeune Site 73

DRILLING CONTRACTOR : Prosonic Corp / Probe Tech

DRILLING METHOD AND EQUIPMENT USED : Rotosonic

WATER LEVELS : START : 4/4/2006 1530 END : LOGGER : J. Frank/RDU



1- Ground elevation at well: NA

2- Top of casing elevation:
a) vent hole?:

3- Wellhead protection cover type: 8" Diameter steel manhole
a) weep hole?:
b) concrete pad dimensions: 2' x 2'

4- Dia./type of well casing: 2" ID Schedule 40 PVC

5- Dia./type of surface casing: Temporary
7" steel casing

6- Type/slot size of screen: 2" Schedule 40 PVC
0.010" Slot

7- Type screen filter: Type 1 Sand
a) Quantity used: 3.0 50-poung bags

8- Type of seal: 3/8" Bariod bentonite chips
a) Quantity used: 2.0 50-pound bags

9- Grout
a) Grout mix used: Portland Type I
b) Method of placement: Tremie
c) Vol. of surface casing grout: 100 gallons
d) Vol. of well casing grout: 20 gallons

Development method:

Development time:

Estimated purge volume:

Comments:

PROJECT NUMBER	WELL NUMBER	
328432.FI.MW.73	73-MW49DWA	SHEET 1 OF 1

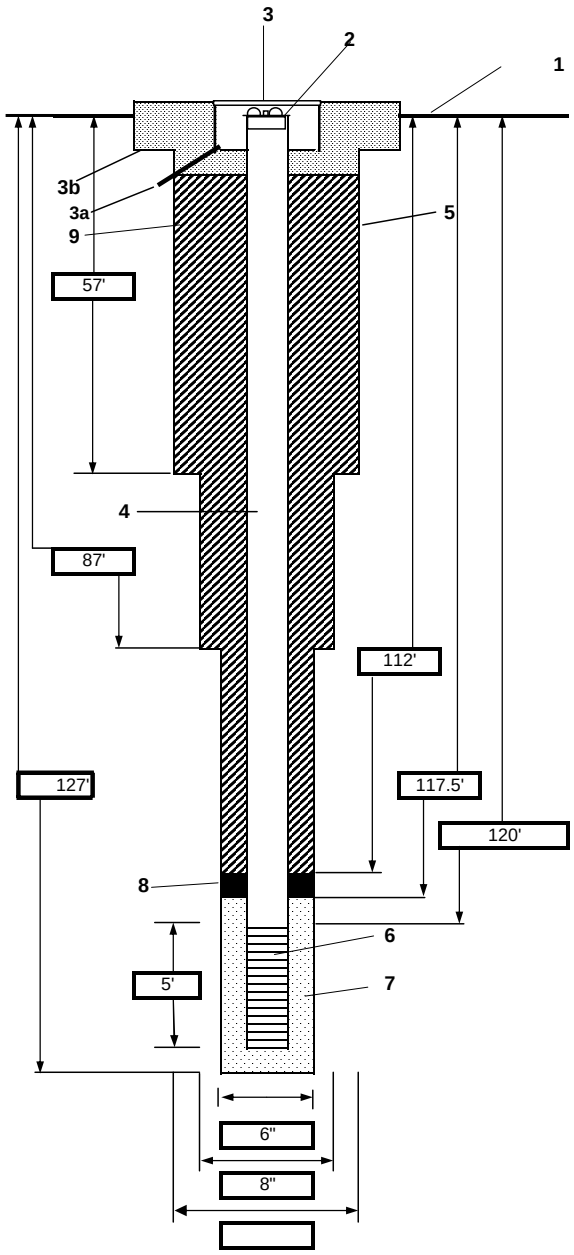
WELL COMPLETION DIAGRAM

PROJECT : Site 73 Amended RI/CTO-105/MW Installation LOCATION : MCB Camp Lejeune Site 73

DRILLING CONTRACTOR : Prosonic Corp / Probe Tech

DRILLING METHOD AND EQUIPMENT USED : Rotosonic

WATER LEVELS : START : 4/5/2006 1030 END : LOGGER : J. Frank/RDU



1- Ground elevation at well: NA

2- Top of casing elevation:

3- Wellhead protection cover type: 8-inch diameter steel casing
- a) locking expansion plug?:
- b) concrete pad dimensions: 2'X2'X4" concrete

4- Dia./type of well casing: 2" 10 schedule 40 PVC

5- Dia./type of surface casing: Temporary 7" steel casing; 8" steel casing

6- Type/slot size of screen: 2" Sch 40 PVC; 0.010- inch slot

7- Type screen filter: Type 1 sandpack
- a) Quantity used: 3.5 50-pound bags

8- Type of seal: 3/8" Bariod bentonite chips
- a) Quantity used: 2.0 50-pound bags

9- Grout
- a) Grout mix used: Portland Type I
- b) Method of placement: Tremie Pipe
- c) Vol. of surface casing grout:
- d) Vol. of well casing grout:

Development method: Surge and overpump

Development time:

Estimated purge volume:

Comments:

Appendix D
Groundwater Sampling Sheets from April 2006 Monitoring Well Sampling Event

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client:
Location: IR73
Event: B
Date: 4/10/06
Weather: Clear, Breeze, 50°F

Well ID: 73-A47/3-8
Sample ID: IR73-A47/3-8-06B

Sample Team: Bob T.; MATT W.

Total Depth: 16.78 FT.(BTOC) Measuring Device:
Depth to water: (-) 4.75 FT.(BTOC) Date and Time:
Water Column: 12.03 FT.
(x) .163 GAL/FT.
Well Volume: 2.1 GAL.
Total Purge Volume: 2.4 GAL.
Purge Device: peristaltic pump with new HDPE tubing ✓

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color	Odor / Comments
0855	0	12.6	1.06	0.93	7.66	-37	29.3	4.40	Clear/Pol Odor
0901	.3	18.9	1.04	0.00	8.10	-72	25.2	4.52	Clear/Fuel Odor
0907	.6	19.0	1.02	0.00	8.26	-88	16.5	4.55	Clear/Fuel Odor
0913	.9	18.9	1.00	0.00	8.31	-92	14.8	4.58	Clear/Fuel Odor
0919	1.2	19.2	0.98	0.00	8.32	-96	10.2	4.60	Clear/Fuel Odor
0925	1.5	19.1	0.96	0.00	8.33	-98	9.35	4.60	Clear/Fuel Odor
0931	1.8	19.2	0.94	0.00	8.32	-100	7.74	4.60	Clear/Fuel Odor
0937	2.1	19.2	0.92	0.00	8.31	-101	6.47	4.60	Clear/Fuel Odor

Sample information: method, container number, size, and type, preservative used.

Sample Time 0945
Sample Appearance Clear, Fuel Odor

DUPLICATE - IR73-A47/3-8-06BDUP-0950

Notes:
0855 START Purged .05 GPM

Ferrous IRON = 3.4
Ferrous IRON DUP = 3.8

Signed by: [signature]

4/10/06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVFAC
Location: IR73
Event: LTM
Date: 4-9-06
Weather: Sunny 55°F

Well ID: A47/3-9
Sample ID: IR73-GWA47/3-9

Sample Team: Matt W.

Total Depth: 16.20 FT.(BTOC) Measuring Device:
Depth to water: (-) 3.60 FT.(BTOC) Date and Time:
Water Column: 12.60 FT.
(x) 0.163 GAL/FT.
Well Volume: 2.053 GAL X 3
Total Purge Volume: 6.161 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color / Odor / Comments
1155	.5	19.69	0.085	0.00	5.26	-56	5.72	3.72
1205	1.5	19.84	0.162	0.00	5.38	-117	10.94	3.95
1215	2.5	19.89	0.083	0.00	5.37	-143	8.42	3.95
1225	3.5	19.95	0.082	0.00	5.35	-150	5.77	3.95
1235	4.5	19.89	0.082	0.00	5.32	-149	4.41	3.95

Sample information: method, container number, size, and type, preservative used.

Sample Time 1235 / 4-10-06 @ 0840
Sample Appearance Clear / Alkalinity

Notes: Fe^{2+} = 3.2

Signed by: Matt J. Westerhof

4-9-06
Date

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVFAC
Location: IR73
Event: LTM
Date: 4-12-06
Weather: Clear 75°F

Well ID: A47/3-12
Sample ID: IR73-GWA47/3-12-06B

Sample Team: Matt W.

Total Depth: 18.96 FT.(BTOC) Measuring Device:
Depth to water: (-) 5.49 FT.(BTOC) Date and Time:
Water Column: 13.47 FT.
(x) 0.163 GAL/FT.
Well Volume: 2.195 GAL. x 3
Total Purge Volume: 6.586 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Draw Down ~~Color / Odor / Comments~~
1300	.5	18.35	0.419	0.00	7.12	-94	69.7	5.89
1320	1.5	18.22	0.421	0.00	7.04	-107	33.1	
1330	2.5	18.14	0.419	0.00	7.05	-122	19.2	5.94
1340	3.5	18.43	0.415	0.00	7.08	-132	9.17	
1350	4.5	18.21	0.413	0.00	7.06	-136	5.74	5.94
1400	5.5	18.25	0.415	0.00	7.06	-137	5.92	5.94

Sample information: method, container number, size, and type, preservative used.

Sample Time 1400
Sample Appearance Clear / Black suspended particals / Heavy odor

Notes:
$Fe^{2+} = 5$

Signed by: Matt W. Westerdal

4-12-06
Date

910 2511005

CH2M HILL Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVFAC
Location: IR73
Event: LTM
Date: 4-12-06
Weather: Sunny 72°F

Well ID: MW-A47/3-15
Sample ID: IR73-GWA47/3-15-Ø6B
Sample Team: Matt W.

Total Depth: 16.78 FT.(BTOC) Measuring Device:
Depth to water: (-) 5.96 FT.(BTOC) Date and Time:
Water Column: 10.82 FT.
(x) 0.163 GAL/FT.
Well Volume: 1.763 GAL. X3
Total Purge Volume: 5.290 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color / Odor / Comments
1205	.5	17.68	1.01	0.00	6.24	-79	33.7	
1215	1.5	17.44	0.970	0.00	6.47	-103	24.2	
1225	2.5	17.35	0.382	0.00	6.63	-117	30.2	
1235	3.5	17.34	0.362	0.00	6.65	-123	12.4	
1245	4.5	17.33	0.364	0.00	6.66	-124	10.9	

Sample information: method, container number, size, and type, preservative used.

Sample Time 1245
Sample Appearance Clear

Notes: $Fe^{2+} = 4.4$

Signed by: Matt P. Westendorf 4-12-06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: IR73
Event: 02nd quarter 2006
Date: 04/19/06
Weather: Sunny 60's

Well ID: IR73-A4713-16 ~~A~~B
Sample ID: IR73-A4713-16-06B

Sample Team: M Harris
R Deleon

Total Depth: 18.96 FT.(BTOC) Measuring Device:
Depth to water: (-) 5.0 FT.(BTOC) Date and Time:
Water Column: 13.96 FT.
(x) 0.163 GAL/FT.
Well Volume: 2.28 GAL.
Total Purge Volume: 3.0 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color / Odor / Comments
0801	0.25	16.3	1.0	0.08	6.44	-79	14.1	5.0
0812	~~[illegible]~~ 1.5	16.4	1.0	0.0	6.45	-96	6.5	5.0
0819	2	16.4	1.0	0.0	6.57	-95	1.5	5.0
0824	2.5	16.4	1.0	0.0	6.57	-96	1.4	5.0

Sample information: method, container number, size, and type, preservative used.
(2) VOC (2) RSK-175 (1) TOC (1) Alkalinity (1) Sulfide (1) Ferric Iron

Sample Time 0830
Sample Appearance

Notes:
· Flow Rate: 300 mL/min
Ferrous Iron: 3 mg
OVM 0 ppm

Signed by: Mindy C. Harris 04/19/06
Date

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: ~~CH2M~~ NAVY
Location: ~~CTO~~ IR73
Event: 2ND QTR 06
Date: 4-19-06
Weather:

Well ID: IR73-A4713-19
Sample ID: IR73-A4713-19-06B
Sample Team: R Dolan

Total Depth: 19.18 FT.(BTOC) Measuring Device: HERON
Depth to water: (-) 6.34 FT.(BTOC) Date and Time: 4-19-06 0935
Water Column: 12.84 FT.
(x) .163 GAL/FT. WELL DIAMETER [(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
Well Volume: 2.09 GAL. (1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)
Total Purge Volume: GAL.
Purge Device: peristaltic pump with new HDPE tubing

200ml purge

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color / Odor / Comments	DTW
1000	500ml	16.80	.51	1.23	6.35	+25	11.0	Clear	6.20
1005	.5gal	16.90	.50	.39	6.31	+39	5.61	Clear	6.20
1010	1gal	17.00	.49	.48	6.30	+48	6.64	Clear	6.20
1015	1.5gal	17.00	.49	.00	6.30	-57	5.29	Clear	6.20
1020	2.0gal	17.00	.50	.00	6.30	-64	6.68	Clear	6.20
1025	2.5gal	17.10	.50	.00	6.30	-71	5.00	Clear	6.20
1030	3.0gal	17.10	.51	.00	6.30	-76	4.56	Clear	6.20
1035	Sampled								

Sample information: method, container number, size, and type, preservative used.

Sample Time 10:35
Sample Appearance Clear

Notes:
.5 mg/L Ferros Iron

Signed by: R Dolan 4-19-06
Date

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CH2M HILL Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client:
Location: IR73
Event: 2nd Quarter 2006
Date: 04/21/06
Weather: Sunny 70's

Well ID: IR73-A47/3-19B
Sample ID: IR73-A47/3-19B-06B

Sample Team: M. Harris
B. Trebble

Total Depth: 19.36 FT.(BTOC) Measuring Device:
Depth to water: (-) 5.83 FT.(BTOC) Date and Time:
Water Column: 13.53 FT.
(x) 0.163 GAL/FT.
Well Volume: 2.21 GAL.
Total Purge Volume: GAL.
Purge Device: peristaltic pump with new HDPE tubing ✓

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color	Odor / Comments
0914	0	17.06	1.73	3.65	6.1	-79	19.2	5.97	Clear/organic
0921	.3	16.49	1.71	2.05	5.8	-123	20.3	5.97	Clear/organic
0929	.6	16.55	1.72	1.84	6.0	-194	18.4	6.10	Clear/organic
0936	.9	16.59	1.72	1.51	6.0	-222	21.8	6.12	Clear/organic
0944	1.2	16.59	1.71	1.21	6.0	-235	16.3	6.14	Clear/organic
0951	1.5	16.60	1.70	1.04	6.1	-242	11.5	6.2	Clear/organic
0959	1.8	16.71	1.70	0.74	6.1	-245	10.7	6.2	Clear/organic
1006	2.1	17.03	1.72	0.59	6.1	-247	10.2	6.2	Clear/organic
1014	2.5	17.1	1.71	0.54	6.2	-248	7.59	6.14	Clear/organic

Sample information: method, container number, size, and type, preservative used.

0914 START Purge @ .04 GPM

Sample Time @1015 @1025 DUP IR73-GWA47/3-19B-06BDUP
Sample Appearance Yellowish, Heavy Organic/Sulfur Odor

Notes:
Flow Rate:
Ferrous Iron: 2.6mg → DUP 2.6mg, unmarked
NOTE- Previous 3-19 Sampled is approx 140' SW of Marked A47/3-19

Signed by: Meredith C. Harris 04/21/06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVFAC
Location: IR73
Event: LTM
Date: 4-10-06
Weather: sunny 70°F

Well ID: IR73-MW49DW
Sample ID: IR73-GW49DW-06A

Sample Team: Matt W.

Total Depth: 74.42 FT.(BTOC) Measuring Device:
Depth to water: (-) 6.32 FT.(BTOC) Date and Time:
Water Column: 68.10 FT.
(x) 0.163 GAL/FT.
Well Volume: 11.100 GAL. x3
Total Purge Volume: 33.300 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Draw Down ~~Color / Odor / Comments~~
1305	.5	20.61	0.430	0.00	7.01	-121	28.50	
1315	1.5	20.67	0.486	0.00	6.78	-126	13.57	6.51
1325	2.5	20.78	0.646	0.00	6.73	-130	23.63	6.51
1335	3.5	20.86	0.694	0.00	6.92	-144	20.24	
1345	4.5	20.85	0.743	0.00	7.03	-150	4.61	6.51
1405	6.5	20.85	0.773	0.00	7.04	-153	19.17	6.51
1420	8.0	20.87	0.773	0.00	7.05	-155	2.72	
1440	10.0	20.91	0.779	0.00	7.06	-156	5.41	6.51
1450	11.0	20.93	0.779	0.00	7.05	-156	4.32	

Sample information: method, container number, size, and type, preservative used.

Sample Time 1450
Sample Appearance

Notes: $Fe^{2+} = 3.6$

Signed by: Matt Westerdorf

4-10-06
Date

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVFAC

Location: IR73

Event: LTM

Date: 4-10-06

Weather: Sunny 60°F

74.42
49.6.32

Well ID: MW-49IW

Sample ID: ~~MW-49DWA~~ IR73-GW49~~DWA~~ IW - 06B MW

Sample Team: Matt W

Total Depth: 55.28 FT.(BTOC) Measuring Device:

Depth to water: (-) 6.52 FT.(BTOC) Date and Time:

Water Column: 48.76 FT.

(x) 0.163 GAL/FT.

Well Volume: 7.947 GAL x 3

Total Purge Volume: 23.843 GAL.

Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER

[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]

(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DRAW DOWN ~~Color / Odor / Comments~~
1110	.5	20.51	0.226	1.59	6.54	130	4.77	6.60
1120	1.5	20.65	0.226	1.01	6.74	120	6.47	6.61
1130	2.5	20.73	0.226	1.16	6.80	126	4.11	6.61
1140	3.5	20.85	0.227	0.69	6.82	123	6.92	6.61
1150	4.5	20.93	0.314	0.00	7.50	-44	6.46	
1200	5.5	20.94	0.396	0.00	7.63	-107	9.74	
1210	6.5	20.94	0.572	0.00	7.25	-113	1.87	
1220	7.5	20.98	0.594	0.00	7.23	-119	2.17	
1230	8.5	20.99	0.599	0.00	7.22	-120	1.59	
1240	9.5	20.97	0.601	0.00	7.22	-127	1.74	

Sample information: method, container number, size, and type, preservative used.

Sample Time 1240

Sample Appearance Clear

Notes: $Fe^{2+} = 2.2$

Signed by: Matt J Westendorf

4-10-06

Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVFAC
Location: IR73
Event: LTM
Date: 4-10-06
Weather: Sunny 60°F

Well ID: MW-49DWA
Sample ID: IR73-GW49DWA-06B
Sample Team: Matt W.

Total Depth: 125.93 FT.(BTOC) Measuring Device:
Depth to water: (-) 6.47 FT.(BTOC) Date and Time:
Water Column: 119.46 FT.
(x) 0.163 GAL/FT.
Well Volume: 19.471 GAL. x 3
Total Purge Volume: 58.415 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Draw Down ~~Color / Odor / Comments~~
1110	.5	21.26	0.597	0.00	7.68	-162	130.27	6.75
1120	1.5	21.66	0.527	0.00	8.00	-170	47.62	6.77
1130	2.5	21.64	0.499	0.00	8.09	-177	46.64	6.77
1140	3.5	21.72	0.485	0.00	8.14	-182	91.91	6.77
1150	4.5	21.79	0.480	0.00	8.19	-192	73.94	
1200	5.5	21.81	0.488	0.00	8.20	-204	100.12	
1220	7.5	22.00	0.489	0.00	8.26	-208	28.20	
1240	9.5	22.14	0.488	0.00	8.30	-209	17.19	
1300	11.5	22.30	0.479	0.00	8.34	-211	18.91	
1320	13.5	22.32	0.478	0.00	8.31	-211	40.62	
1340	15.5	22.28	0.481	0.00	8.32	-212	21.21	
1400	17.5	22.33	0.486	0.00	8.30	-210	26.76	
1420	19.5	22.40	0.480	0.00	8.32	-209	27.16	

Sample information: method, container number, size, and type, preservative used.

Sample Time 1420
Sample Appearance

Notes:
$Fe^{2+} = 2$

Signed by: Matt J. Westendorf

4-10-06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client:
Location: IR73
Event: B
Date: 4/9/06 / 4/10/06
Weather: Sunny, 60°F, Light Breeze

Well ID: 73-MW 50 DW
Sample ID: IR73-GW 50 DW-06B
Sample Team: Bob T., MATT W.

Total Depth: 74.57 FT.(BTOC) Measuring Device:
Depth to water: (-) 4.80 FT.(BTOC) Date and Time:
Water Column: 69.77 FT.
(x) .163 GAL/FT.
Well Volume: 11.4 GAL.
Total Purge Volume: 12 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color	Odor / Comments
1313	0	20.5	0.945	3.00	8.09	-39	4.70	5.0	Clear / Light organic
1346	2	20.5	1.54	0.00	8.42	-92	4.73	5.0	Clear —
1419	4	20.9	1.66	0.00	8.31	-87	2.12	5.0	Clear —
1442	6	21.0	1.65	0.00	8.40	-95	1.53	5.0	Clear —
1515	8	21.0	1.66	0.00	8.39	-97	0.94	5.0	Clear —
1531 1538	9	20.9	1.68	0.00	8.39	-98	0.59	5.0	Clear —
1547 1547	10	20.9	1.67	0.00	8.38	-100	0.49	5.0	Clear —
1603 1603	11	21.0	1.67	0.00	8.37	-101	0.40	5.0	Clear —
1619 1619	12	20.9	1.67	0.00	8.36	-101		5.0	Clear —

Sample information: method, container number, size, and type, preservative used.
Will Collect ALK, ANIONS, Ferrous 4/10/06 AM Due to Short holding times

Sample Time Reg 4/9/06 1630 | 4/10/06 0825 ALK, ANIONS, Ferrous
Sample Appearance Clear

Notes:
1312 START Purge @ .06 GPM
Ferrous IRON = 4.6

Signed by: [signature] 4/9/06 | 4/10/06
Date

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client:
Location: IR73
Event: B
Date: 4/18/06
Weather: Sunny, 52°F, Calm

Well ID: 73-MW51
Sample ID: IR73-GW51-06B
Sample Team: Bob T. MARKO.

Total Depth: 154.00 FT.(BTOC)
Depth to water: (-) 3.33 FT.(BTOC)
Water Column: 150.67 FT.
(x) 0.163 GAL/FT.
Well Volume: 24.55 GAL.
Total Purge Volume: ~~25.00~~ GAL. 22.50
Purge Device: peristaltic pump with new HDPE tubing ✓

Measuring Device:
Date and Time: 300 ML/Min

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

RERUN 73 GAW51

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color / Odor / Comments	DTW (GL)
0916	1	17.5	0.572	0.00	8.46	-63	~~9.70~~ 82.0	clr	3.8' btc
0926	2	17.6	0.543	0.00	9.14	~~-105~~	~~13.2~~ 82.2	clr	4.0' btc
0936	3	17.5	0.531	0.00	10.29	-58	52.4	clr	3.95' btc
0946	4	17.6	0.529	0.00	10.75	-80	35.3	clr	3.95' btc
0956	5	17.7	0.529	0.00	11.03	-95	24.3	clr	3.95' btc
1046	7.5	18.2	0.511	0.00	11.91	-150	16.0	clr	3.95' btc
1120	10.0	18.5	0.500	0.00	12.40	-170	10.5	clr	3.94' btc
1200	12.5	18.5	0.493	0.00	12.66	-183	13.3	clr	3.95' btc
1230	15.0	18.2	0.488	0.00	12.58	-187	8.82	clr	3.95' btc
1306	17.5	18.2	0.485	0.00	12.78	-194	7.55	clr	3.95' btc
1339	20.0	18.3	0.484	0.00	12.94	-201	5.14	clr	3.95' btc
1414	~~22.5~~	18.4	0.482	0.00	13.03	-205		clr	3.95' btc
	~~25.0~~ 22.50								

Sample information: method, container number, size, and type, preservative used.

Sample Time 1420
Sample Appearance

Notes:
START Purge @ 0PM 300 ML/Min ~0.19 / Min
Ferrous Iron = 1.0
At 0955 Shifted Readings Interval to Every 2.5 Gallons

Signed by: [signature]
Date 4/18/06

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client:
Location: IR73
Event: B
Date: 4/18/06
Weather: Sunny, Calm, 52°F

Well ID: 73-MW51DW
Sample ID: IR73MW51DW-06B
Sample Team: Bob T. MARKO.

Total Depth: 76.35 FT.(BTOC) Measuring Device:
Depth to water: (-) 4.00 FT.(BTOC) Date and Time:
Water Column: 72.35 FT.
(x) .163 GAL/FT.
Well Volume: 11.8 GAL.
Total Purge Volume: 12 GAL.
Purge Device: peristaltic pump with new HDPE tubing ✓

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

READY DW12

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color /	Odor / Comments
0908	0	16.85	0.571	8.19	10.9	40	55.7	4.60	Clear
0932	2	17.33	0.348	8.56	10.0	42	—	4.70	Clear
0986	4	17.47	0.324	3.57	8.6	81	15.7	4.65	Clear
1020	6	17.56	0.325	1.60	8.1	42	8.33	4.70	Clear
1044	8	17.68	0.328	1.11	7.9	9	6.02	4.70	Clear
1056 1068	9	17.69	0.326	0.40	7.8	-10	5.10	4.70	Clear
1108	10	17.70	0.327	0.37	7.8	-19	4.80	4.70	Clear
1120	11	17.74	0.327	0.35	7.8	-32	4.13	4.70	Clear
1132	12	17.73	0.327	0.31	7.7	-45	2.98	4.70	Clear

Sample information: method, container number, size, and type, preservative used.

Sample Time 1135
Sample Appearance Clear

Notes:
0908 START Purge @ .07 GPM
Ferrous Iron =

Signed by: [signature]
Date 4/18/06

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client:
Location: IR73
Event: B
Date: 4/19/06
Weather: Sunny, Calm 55°F

Well ID: 73-MW52
Sample ID: IR73-GW52-06B
Sample Team: Bob T. Mark O.

Total Depth: 152.76 FT.(BTOC) Measuring Device:
Depth to water: (-) 2.94 FT.(BTOC) Date and Time:
Water Column: 150.02 FT.
(x) .163 GAL/FT.
Well Volume: 24.4 GAL.
Total Purge Volume: 25.0 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW	Color / Odor / Comments
0838	0	18.68	0.493	6.42	10.12	45	20.1	—	Clear
0935	4	19.84	0.867	0.00	9.40	-261	13.7	5.05	Clear
1032	8	20.14	2.33	0.00	9.05	-286	3.76	6.00	Clear
1124 ~~1129~~	12	20.00	2.46	0.00	8.12	-271	3.24	6.00	Clear
1226 ~~1226~~	16	20.06	3.14	0.00	8.09	-294	2.84	6.00	Clear
1324 ~~1324~~	20	20.40	~~4.16~~	0.00	8.02	-306	2.41	6.00	Clear
1352 ~~1352~~	22	20.37	2.49	0.00	8.07	-314	1.75	6.00	Clear
1420 ~~1420~~	24	20.40	2.50	0.00	8.07	-316	1.69	6.00	Clear
~~1448~~ 1452	~~28~~	20.37	2.50	0.00	8.06	-315	1.80	6.02	Clear

Sample information: method, container number, size, and type, preservative used.
1324 - COND = 2.52 µS/CM

Sample Time 1450
Sample Appearance Clear

Notes:
0838 START Purge @ .07 GPM
Ferrous IRON = .2

Signed by: [signature]

4/19/06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client:
Location: IR73
Event: B
Date: 4/19/06
Weather: Sunny, Light breeze, 50°F

Well ID: 73-MW52DW
Sample ID: IR73-GW52DW-06B
Sample Team: Bob T., MARK OST

Total Depth: 61.14 FT.(BTOC) Measuring Device:
Depth to water: (-) 2.20 FT.(BTOC) Date and Time:
Water Column: 58.94 FT.
(x) 0.163 GAL/FT.
Well Volume: 9.6 GAL.
Total Purge Volume: 10.0 GAL.
Purge Device: peristaltic pump with new HDPE tubing ✓

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color /	Odor / Comments
0822	0	18.18	0.721	6.34	6.6	192	4.82	2.25	Clear
0846	2	19.05	0.660	0.30	7.1	-153	2.05	2.25	Clear
0910	4	19.08	0.664	0.39	7.2	-163	3.46	2.25	Clear
0934	6	19.35	0.660	0.28	7.2	-169	1.85	2.25	Clear
1000	8	19.41	0.661	0.26	7.2	-171	1.19	2.26	Clear
1012	9	19.23	0.662	0.28	7.2	-169	1.27	2.25	Clear
1024	10	19.37	0.659	0.27	7.2	-169	1.09	2.26	Clear

Sample information: method, container number, size, and type, preservative used.

Sample Time 1030
Sample Appearance Clear

Notes: 0822 START Purge @ .07 GPM
Ferrous IRON = 2.0

Signed by: [signature] Date 4/19/06

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVI

Location: CTU 73

Event: 2ND QTR

Date: 4-21-06

Weather: Prtly Cloudy, Humid

Well ID: IR73MW53

Sample ID: IR73GW5306B

Sample Team: R Deleon, M. OST

Total Depth: 27.75 FT.(BTOC) Measuring Device:

Depth to water: (-) 4.79 FT.(BTOC) Date and Time:

Water Column: 22.96 FT.

(x) .163 GAL/FT. [(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]

WELL DIAMETER

(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

Well Volume: 3.7 GAL.

Total Purge Volume: GAL.

Purge Device: peristaltic pump with new HDPE tubing

300 ML Purge Rate

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color / Odor / Comments	DTW
0834	.5gal	15.30	0.050	0.05	4.86	174	8.53	Clear	5.34
0839	1gal	15.10	0.056	0.00	5.51	143	5.72	Clear	5.34
0844	1.5gal	15.10	0.057	0.00	5.88	127	3.85	Clear	5.34
0849	2gal	15.00	0.059	0.00	6.80	85	2.61	Clear	5.34
0854	2.5gal	15.00	0.060	0.00	7.05	74	2.01	Clear	5.34
0859	3gal	15.00	0.061	0.00	7.21	67	2.06	Clear	5.34
0904	3.5gal	15.00	0.062	0.00	7.38	59	4.15	Clear	5.34
~~0910~~	Sample Time								

Sample information: method, container number, size, and type, preservative used.

Sampled for - VOC, RSK-175, TOC
ALK, ZINC, ACETATE, SULFIDE, NaOH
Ferric Iron

Sample Time 0910

Sample Appearance

Notes: Ferrous Iron = 1.2 Mg/L

Signed by: RH Deleon 4-21-06

Date

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620W1115

CH2M HILL Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client:
Location: IR73
Event: B
Date: 4/12/06
Weather: Sunny, Calm, 58°F

Well ID: 73-MW54
Sample ID: IR73-GW54-06B
Sample Team: Bob T. MATTW.

Total Depth: 17.35 FT.(BTOC) Measuring Device:
Depth to water: (-) 6.90 FT.(BTOC) Date and Time:
Water Column: 10.45 FT.
(x) .653 GAL/FT. WELL DIAMETER [(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
Well Volume: 6.8 GAL. (1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)
Total Purge Volume: 7 GAL.
Purge Device: peristaltic pump with new HDPE tubing ✓

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW	Color / Odor / Comments
1013	0	16.7	0.379	1.44	8.50	-16	33.1	7.05	Orange ish
1029	1	16.1	0.333	0.00	9.37	-74	7.78	7.15	Clear
1045	2	16.3	0.299	0.00	9.54	-94	5.64	7.19	Clear/organic
1101	3	16.3	0.286	0.00	9.61	-104	4.37	7.20	Clear
1117	4	16.5	0.283	0.00	9.68	-112	2.57	7.20	Clear
1133	5	16.8	0.280	0.00	9.66	-117	2.44	7.18	Clear
1149	6	17.0	0.273	0.00	9.68	-121	2.97	7.19	Clear
1205	7	16.7	0.277	0.00	9.71	-124	2.23	7.20	Clear

Sample information: method, container number, size, and type, preservative used.

Sample Time 1205
Sample Appearance Clear, organic odor

Notes: 1013 START Purge @ .6 GPM
*Ferrous IRON = 4.4

Signed by: [signature] Date 4/12/06

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CH2M HILL Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client:
Location: IR73
Event: B
Date: 4/11/06
Weather: Sunny, Calm, 70°F

Well ID: 73-MW55
Sample ID: IR73-GW55-06B
Sample Team: Bob T. MATTW

Total Depth: 17.35 FT.(BTOC) Measuring Device:
Depth to water: (-) 6.70 FT.(BTOC) Date and Time:
Water Column: 10.65 FT.
(x) 0.163 GAL/FT. [(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
Well Volume: 1.7 GAL. (1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)
Total Purge Volume: 2.0 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color / Odor / Comments
1333	0	17.2	1.05	1.02	8.57	-107	80.1	6.30 suspended orange flakes
1339	.3	16.7	1.01	0.00	9.03	-85	55.7	6.40
1345	.6	16.8	0.99	0.00	9.09	-92	40.8	6.41
1351	.9	16.7	0.98	0.00	9.13	-98	30.9	6.42
1357	1.2	16.7	0.96	0.00	9.21	-109	16.8	6.41
1403	1.5	16.8	0.94	0.00	9.26	-114	14.0	6.41
1409	1.8	16.9	0.93	0.00	9.29	-121	11.8	6.40
1415	2.1	17.1	0.91	0.00	9.34	~~-125~~ -124	9.22	6.40

Sample information: method, container number, size, and type, preservative used.

Sample Time 1415
Sample Appearance

Notes: 1333 Start Purge @ .05 GPM
Ferrous Iron = 6.0

Signed by: R. Mitchell 4/11/06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client:
Location: IR73
Event: B
Date: 4/11/00
Weather: Sunny, breezy, 65°F

Well ID: 73-MW56
Sample ID: IR73-MW56-06KS
Sample Team: Bob T. MATTW.

Total Depth: 15.98 FT.(BTOC) Measuring Device:
Depth to water: (-) 7.39 FT.(BTOC) Date and Time:
Water Column: 8.59 FT.
(x) .163 GAL/FT.
Well Volume: 1.4 GAL.
Total Purge Volume: 1.8 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW	Color / Odor / Comments
1233	0	16.7	0.243	2.67	8.47	-69	6.59	7.58	clear/organic
1237	.2	16.3	0.235	0.39	8.50	-83	5.77	7.60	clear
1241	.4	16.2	0.227	0.21	8.60	-100	3.31	7.60	clear
1245	.6	16.1	0.223	0.00	8.72	-114	4.89	7.60	clear
1249	.8	16.1	0.220	0.00	8.80	-123	3.04	7.60	clear
1253	1.0	16.1	0.217	0.00	8.87	-133	2.62	7.60	clear
1257	1.2	16.1	0.217	0.00	8.91	-138	2.40	7.60	clear
1301	1.4	16.1	0.218	0.00	8.95	-142	4.57	7.60	clear
1305	1.6	16.1	0.217	0.00	8.98	-145	2.55	7.60	clear
1309	1.8	16.1	0.218	0.00	8.98	-147	2.06	7.60	clear

Sample information: method, container number, size, and type, preservative used.

Sample Time @ ~~1305~~ 1310
Sample Appearance Clear w/organic odor

Notes:
1233 Start Purge @ .05 GPM
Ferrous Iron = 1.2

Signed by: 4/11/00 [signature]
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: IR73
Event: 2nd Quarter 2006
Date: 4/11/06
Weather: Sunny ~ 70's

Well ID: IR73-~~04~~W58
Sample ID: IR73-GW58-06B

Sample Team: Meredith Harris
Rick DeLeon

Total Depth: 11.98 FT.(BTOC) Measuring Device:
Depth to water: (-) 6.50 FT.(BTOC) Date and Time:
Water Column: 5.48 FT.
(x) 0.163 GAL/FT.
Well Volume: 0.89 GAL.
Total Purge Volume: 1.5 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual) NTU	DTW Color / Odor / Comments
1323	0.5	23.30	0.0	8.90	6.84	70	8.33	6.50
1328	1	23.8	0.0	8.83	6.82	73	17.6	6.50
1333	1.5	24.70	0.0	8.77	6.80	74	12.7	6.50

Sample information: method, container number, size, and type, preservative used.
(3) VOC (2) PSL 1 TS (1) VOC (1) Alkalinity (1) Sulfide (1) Ferric Iron

Sample Time 1338
Sample Appearance

Notes:
OVM: 0ppm
Flow Rate 300 ml/min
Ferrous Iron 1mg

Signed by: Meredith C Harris 04/11/06
Date

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: C70-73
Event: 2ND QTR
Date: 4-20-06
Weather:

Well ID: IR73 MW 0061
Sample ID: IR73 MW 0006B
Sample Team: R Deleon

Total Depth: 21.94 FT.(BTOC) Measuring Device:
Depth to water: (-) 11.60 FT.(BTOC) Date and Time:
Water Column: 10.34 FT.
(x) .163 GAL/FT.
Well Volume: 1.68 GAL.
Total Purge Volume: GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

100 ML purge rate

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color / Odor / Comments	DTW
1138	.2 gal	20.60	.473	.14	9.36	-26	4.24	Clear	12.32
1143	.5 gal	20.40	.470	.09	9.34	-27	9.84	Clear	12.45
1148	.7 gal	20.40	.498	.00	9.31	-26	7.95	Clear	12.45
1153	1 gal	20.40	.514	.00	9.31	-26	10.2	Clear	12.45
1158	1.2 gal	20.50	.490	.00	9.31	-27	8.24	Clear	12.45
1203	1.5 gal	20.50	.456	.00	9.36	-29	7.75	Clear	12.45
1208	1.7 gal	20.70	.448	.00	9.41	-33	6.64	Clear	12.45
1215	sample time								

Sample information: method, container number, size, and type, preservative used.

Sample Time 1215
Sample Appearance

Notes: Ferrous Iron = 1.4 mg/L

Signed by: R H [illegible] 4-20-06
Date

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CH2M HILL Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVFAC
Location: IR73
Event: LTM
Date: 4-12-06
Weather: sunny 65°F

Well ID: IR73-MW62DW ~~-06B~~
Sample ID: IR73-BW62DW-06B

Sample Team: MattW

Total Depth: 32.06 FT.(BTOC) Measuring Device:
Depth to water: (-) 12.18 FT.(BTOC) Date and Time:
Water Column: 19.88 FT.
(x) 0.163 GAL/FT.
Well Volume: 3.240 GAL X 3
Total Purge Volume: 9.721 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	~~Color / Odor / Comments~~
1025 ~~0825~~	.5	19.44	0.061	0.00	6.26	-38	113.0	
1035 ~~0835~~	1.5	19.46	0.068	0.00	6.42	-102	41.9	12.79
1045 ~~08~~	2.5	19.44	0.068	0.00	6.70	-122	54.3	12.80
1055	3.5	19.47	0.067	0.00	6.78	-130	34.9	12.80
1105	4.5	19.52	0.068	0.00	6.80	-139	49.7	
1115	5.5	19.60	0.068	0.00	6.81	-140	52.1	12.80

Sample information: method, container number, size, and type, preservative used.

Sample Time 1115
Sample Appearance Slightly cloudy

Notes: $Fe^{2+} = 4.2$

Signed by: Matt J. Westerdal 4-12-06
Date

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CH2M HILL Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVFAC
Location: IR73
Event: LTM
Date: 4-11-06
Weather: sunny 65°F

Well ID: IR73-MW63DW
Sample ID: IR73-GW63DW-06B
Sample Team: Matt W.

Total Depth: 74.64 FT.(BTOC) Measuring Device:
Depth to water: (-) 6.07 FT.(BTOC) Date and Time:
Water Column: 68.57 FT.
(x) 0.163 GAL/FT. [(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
Well Volume: 11.176 GAL. x3 (1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)
Total Purge Volume: 33.530 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Draw Down ~~Color / Odor / Comments~~
1120	.5	21.35	0.160	0.00	7.93	-133	22.6	6.23
1135	2.0	21.41	0.177	0.00	7.45	-141	13.2	6.23
1155	4.0	21.47	0.243	0.00	7.58	-143	18.8	6.23
1215	6.0	21.24	0.295	0.00	7.55	-138	15.4	
1235	8.0	21.38	0.300	0.00	7.54	-137	16.8	
1245	9.0	21.39	0.303	0.00	7.54	-136	12.2	
1255	10.0	21.41	0.309	0.00	7.54	-136	18.7	
1305	11.0	21.39	0.309	0.00	7.54	-136	12.1	

Sample information: method, container number, size, and type, preservative used.

Sample Time 1305
Sample Appearance Clear

Notes: $Fe^{2+} = 2.4$

Signed by: Matt P. Westerdal 4-11-06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: Navy
Location: IR73
Event: 2nd Quarter 2006
Date: 04/19/06
Weather:

Well ID: IR73-~~AB~~ A4713-22
Sample ID: IR73-A4713-22-06B

Sample Team: Meredith Harris
Rick DeLeon

Total Depth: 20.47 FT.(BTOC) Measuring Device: Geo Pump
Depth to water: (-) 7.59 FT.(BTOC) Date and Time: 04-19-06 0745
Water Column: 12.88 FT.
(x) 0.163 GAL/FT. [(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)] WELL DIAMETER
Well Volume: 2.09 GAL. (1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)
Total Purge Volume: 2.5 GAL.
Purge Device: peristaltic pump with new HDPE tubing

100 mL purge rate

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color / Odor / Comments	DTW
0753	.5	16.04	1.60	.15	8.86	-46	49.3	Clear	10.26
0758	.6	16.29	1.64	.16	8.93	-47	81.6	Hazy	10.93
0803	.8	16.33	1.64	.15	8.89	-47	98.7	Hazy	11.75
0808	1gal	16.39	1.64	.14	9.02	-48	112	Hazy	12.63
0813	1.2gal	16.42	1.64	.14	9.03	-47	107	Hazy	13.39
0818	1.4gal	16.49	1.63	.14	9.05	-46	103	Hazy	14.12
0823	1.6gal	16.51	1.63	.21	9.04	-46	98.3	Clear	14.85
0828	1.9gal	16.61	1.62	.28	9.10	-47	104	Clear	15.48
0833	2.1gal	16.80	1.62	.27	9.07	-47	96.5	Clear	16.19
0838	2.3gal	16.95	1.61	.27	9.09	-48	90.9	Clear	16.88
0843	2.5gal	17.02	1.60	.30	9.06	-47	86.6	Clear	17.50
0848		Sampled	WELL						

Sample information: method, container number, size, and type, preservative used.

240mL VOC
240mL RSK-175
140mL TOC
1500 mL ALK, ANIONS, Ferrous
1250 mL ZINC ACETATE, NaOH
1250 mL HNO3

Sample Time 0848
Sample Appearance Clear

Notes:
Fe = 4 mg/L

Signed by: [signature] 4-19-06
Date

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY

Location: IR73

Event: 2nd Quarter 2006

Date: 4/12/06

Weather: Sunny 70's

Well ID: IR73-MW06

Sample ID: IR73-G-W06-06B

Sample Team: Meredith Harris
Rick DeLeon

Total Depth: 11.72 FT.(BTOC) Measuring Device:

Depth to water: (-) 5.25 FT.(BTOC) Date and Time:

Water Column: 6.47 FT.

(x) 0.163 GAL/FT.

WELL DIAMETER

[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]

(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

Well Volume: 1.05 GAL.

Total Purge Volume: 1.5 GAL.

Purge Device: peristaltic pump with new HDPE tubing

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual) NTU	DTW Color / Odor / Comments
0835	0.25	16.77	0.65	1.92	10.07	-67	101	
0846	1.0	17.07	0.622	1.80	9.76	-74	17.0	Sheen on water
0851	1.5	17.12	0.621	1.91	9.91	-81	8.07	
~~0855~~								

Sample information: method, container number, size, and type, preservative used.

Sample Time 0855

Sample Appearance

Notes:

OVM=0 ppm
Flow Rate 300ml/min
Fluids Flow Hmy

Signed by: Meredith C. Harris 04/12/06

Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: Area 73
Event: Second Quarter 2006
Date: 4/10/06
Weather: Sunny 40's-50's

Well ID: 73-MW01
Sample ID: 73-~~M~~W01-06B
G

Sample Team: Meredith Harris
Rick De Leon

Total Depth: 17.78 FT.(BTOC) Measuring Device:
Depth to water: (-) 4.95 FT.(BTOC) Date and Time:
Water Column: 12.83 FT.
(x) 0.163 GAL/FT.
Well Volume: 2.09 GAL.
Total Purge Volume: 6.0 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW	Color / Odor / Comments
0839	0.5	18.00	0.26	7.81	5.41	38	~~158~~ 114	5.78	Hazy w/suspended particles
0845	1	17.90	0.26	6.92	5.40	39	65.5	5.89	Hazy
0850	~~1.52~~	17.60	0.27	6.39	5.30	48	42.7	5.91	Clear
0855	2 ~~2.00~~	17.90	0.28	5.88	5.24	53	28.6	5.95	Clear
0900	2.75	18.0	0.27	4.24	5.21	54	18.7	5.97	Clear
0907	3.5	18.10	0.27	3.42	5.17	52	15.4	6.0	
0917	4	18.00	0.28	2.51	5.11	54	7.55	6.04	
0926	5.0	17.9	0.28	1.80	5.07	53	4.36	6.05	
0932	5.25	18.00	0.28	1.43	5.04	55	3.05	6.09	clear
0937	5.75	18.10	0.28	1.18	5.03	51	4.54	6.05	
0942	6	18.00	0.28	0.98	5.01	51	4.75	6.05	
~~0948~~									

Sample information: method, container number, size, and type, preservative used.

Sample Time 0948
Sample Appearance

Notes:
Flow Rate : 300ml/min
Ferrous Iron : 4mg

Signed by: Meredith C. Harris 4/10/06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: Area 73
Event: Second Quarter 2006
Date: 04/10/06
Weather: Sunny 50's

Well ID: 73-MW01IW
Sample ID: 73-MW01IW-06B
Sample Team: Meredith Harris
Rick DeLoon

Total Depth: 34.29 FT.(BTOC) Measuring Device:
Depth to water: (-) 10.10 FT.(BTOC) Date and Time:
Water Column: 24.19 FT.
(x) 0.163 GAL/FT.
Well Volume: 3.94 GAL.
Total Purge Volume: 4.5 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color / Odor / Comments	
0839	0.75	18.93	0.032	1.82	10.77	-97	20.~~10.1~~	10.25	clear w/ suspended particles
0845	1.5	19.22	0.032	1.92	10.99	-105	9.29	10.25	clear w/ suspended particle
0905	3.75	19.49	0.031	2.56	11.36	-114	2.95	10.31	
0911	4.25	19.56	0.031	2.69	11.46	-115	2.13	10.28	clear
0916	4.5	19.45	0.031	2.78	11.51	-115	2.09	10.30	clear

Sample information: method, container number, size, and type, preservative used.
All constituents

Sample Time 0921
Sample Appearance

Notes:
Flow Rate: 300ml/min
Ferrous Iron 2.2mg

Signed by: Meredith C. Harris 04/10/06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: Area 73
Event: Second Quarter 2006
Date: 04/10/06
Weather: clear, ~50's

Well ID: 73-MW01DW
Sample ID: 73-GW01DW-06B

Sample Team: Meredith Harris
Rick DeLeon

Total Depth: 56.47 FT.(BTOC) Measuring Device:
Depth to water: (-) 10.24 FT.(BTOC) Date and Time:
Water Column: 46.23 FT.
(x) ~~7.53~~ 0.163 GAL/FT.
Well Volume: 7.53 GAL.
Total Purge Volume: 8.5 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color /	Odor / Comments
1001	3.0	19.29	0.083	5.47	10.05	-41	9.26	10.28	
1016	5.0	19.15	0.092	3.9	8.81	+10	~~3.9~~ 12.9	10.28	
1036	~~8.5~~ 7.0	19.05	0.104	3.36	9.01	11	10.0	10.30	
1042	7.5	19.05	0.105	3.22	9.09	~~4.81~~	10.0	10.30	
1047	8.0	19.05	0.106	3.10	9.13	11	5.71	10.30	clear
1052	8.5	19.14	0.106	3.12	9.20	11	4.21	10.30	

Sample information: method, container number, size, and type, preservative used.

took Duplicate @ this location.
Sampled for all designated parameters.
73-GW01DW-06BDUP

Sample Time 1052
Sample Appearance

Notes:
Flow Rate = 400 ml/min
Ferrous Iron = 0 mg

Signed by: Meredith C Harris 4/10/06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: IR73
Event: 2nd Quarter 2006
Date: 04/11/06
Weather: Sunny high 60's

Well ID: IR73-MW02
Sample ID: IR73-GW02-0606B

Sample Team: Meredith Harris
Rick DeLeon.

Total Depth: 19.99 FT.(BTOC) Measuring Device:
Depth to water: (-) 6.68 FT.(BTOC) Date and Time:
Water Column: 13.31 FT.
(x) 0.163 GAL/FT.
Well Volume: 2.16 GAL.
Total Purge Volume: 3.5 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color / Odor / Comments
1213	0.5	17.80	0.35	0.16	6.83	-45	16.1	6.68
1233	2.5	17.90	0.33	0.0	6.81	-117	11.3	6.68
1238	3.0	18.00	0.32	0.0	6.84	-128	8.07	6.68
1243	3.5	18.00	0.32	0.0	6.86	-135	6.61	6.68

Sample information: method, container number, size, and type, preservative used.
(2) VOC (2) RSK-175 (1) TOC (1) Alkalinity (1) Sulfide (1) Ferric Iron

Sample Time 1248
Sample Appearance

Notes:
OVM 0ppm
Flow Rate: 300 ml/min
Ferrous Iron: 1mg

Signed by: Meredith Harris 04/11/06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: IR73
Event: 2nd Quarter 2006
Date: 04/11/06
Weather: Sunny High 60's

Well ID: IR73-MW02IW
Sample ID: IR73-GW02IW-0606B

Sample Team: Meredith Harris
Rick DeLeon

Total Depth: 31.66 FT.(BTOC) Measuring Device:
Depth to water: (-) 11.50 FT.(BTOC) Date and Time:
Water Column: 20.16 FT.
(x) 0.163 GAL/FT.
Well Volume: 3.29 GAL.
Total Purge Volume: 5.0 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color / Odor / Comments
1213	0.25	18.85	0.053	2.60	9.23	-14	16.8	11.50
1233	2	18.84	0.053	2.34	10.18	-55	11.6	11.50
1246	4	19.12	0.057	2.26	10.39	-62	~~0.~~ 5.29	11.50
1251	5	19.17	0.057	2.46	10.48	-66	8.33	11.50

Sample information: method, container number, size, and type, preservative used.
(2) VOC (2) RSK-175 (1) TOC (1) Alkalinity (1) Sulfide (1) Ferric Iron

Sample Time 1256
Sample Appearance

Notes:
OVM = 0ppm
Flow Rate: 300ml/min
Ferrous Iron: 1mg

Signed by: Meredith C. Harris 04/11/06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: IR73
Event: 2nd Quarter 2006
Date: 04/11/06
Weather: Sunny 60's

Well ID: IR73-MW03
Sample ID: IR73-GW03-06B

Sample Team: Meredith Harris
Rick DeLeon

Total Depth: 20.19 FT.(BTOC) Measuring Device:
Depth to water: (-) 6.75 FT.(BTOC) Date and Time:
Water Column: 13.44 FT.
(x) 0.163 GAL/FT.
Well Volume: 2.19 GAL.
Total Purge Volume: 4.0 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color / Odor / Comments
1092	0.5	16.37	0.251	1.52	9.93	-44	25.0	6.75
1101	2.5	16.02	0.266	1.59	11.35	-102	5.72	6.25
1108	3.5	16.07	0.271	1.56	11.65	-116	2.33	6.25
1113	4.0	16.13	0.276	1.58	11.90	-126	3.15	6.25

Sample information: method, container number, size, and type, preservative used.
(2) VOC (2) RSK-175 (1) TOC (1) Alkalinity (1) Sulfide (1) Ferric Iron

Sample Time 1118
Sample Appearance

Notes:
Flowrate 300ml/min
OVM: 0ppm
Ferrous Iron: 4.0mg

Signed by: Meredith C. Harris 04/11/06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: IR73
Event: 2nd Quarter 2006
Date: 04/12/06
Weather: Sunny 40's

Well ID: IR73-MW06 IW
Sample ID: IR73-GW06 IW-0603

Sample Team: Meredith Harris
Rick DeLeon

Total Depth: 43.35 FT.(BTOC) Measuring Device:
Depth to water: (-) 5.72 FT.(BTOC) Date and Time:
Water Column: 37.63 FT.
(x) 0.163 GAL/FT.
Well Volume: 6.13 GAL.
Total Purge Volume: 6.25 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color / Odor / Comments
0837	0.25	18.6	0.32	2.51	7.23	197	5.95	
0849	1	19.0	0.31	1.41	7.43	162	4.58	
0914	3.5	19.9	0.33	0.13	7.40	-126	5.32	
0937	5	20.3	0.33	0.0	7.40	-137	6.56	
0950	6	20.7	0.33	0.0	7.39	-147	2.09	
0956	6.25	20.70	0.33	0.0	7.34	-142	1.51	

Sample information: method, container number, size, and type, preservative used.
2 VOC (2) RSK-175 (1) TOC (1) Alkalinity (1) Sulfide (1) Ferric Iron

Sample Time 1001
Sample Appearance

Notes:
· Flow Rate: 200ml/min
Ferrous Iron: 0mg
DVM 0.20M

Signed by: Meredith C Harris 04/12/06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: IR73
Event: 2nd Quarter 2006
Date: 04/18/06
Weather: Sunny 60's

Well ID: IR73-MW08
Sample ID: IR73-GW08-06B

Sample Team: Meredith Harris
Rick DeLeon

Total Depth: 13.18 FT.(BTOC) Measuring Device:
Depth to water: (-) 4.92 FT.(BTOC) Date and Time:
Water Column: 8.26 FT.
(x) 0.163 GAL/FT.
Well Volume: 1.35 GAL.
Total Purge Volume: 5.5 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color / Odor / Comments	
1155	–	17.16	0.108	1.77	7.70	16	14.3	4.92	suspended particles
1208	~1	17.46	0.102	0.35	9.17	-60	2.50	~~4.92~~ <5.15	
1213	~2	17.45	0.103	1.17	9.10	-59	0.75	5.15	clear
1219	2.5	17.48	0.103	1.58	9.02	-57	0.67	5.15	clear
1230	3.5	17.58	0.104	2.48	8.88	-54	0.63	5.15	
1242	4.5	17.70	0.105	1.99	8.97	-60	0.58	5.22	clear
1248	5.0	17.81	0.105	1.93	8.89	-55	0.76	5.22	
1253	5.5	17.73	0.105	1.81	8.99	-58	0.68	5.22	

Sample information: method, container number, size, and type, preservative used.
(2) VOC (2) RSK-175 (1) TOC (1) Alkalinity (1) Ferric Iron (1) Sulfide

Sample Time 1300
Sample Appearance Clear

Notes:
Flow Rate: 300 ml/min

Signed by: Meredith C. Harris 04/18/06
Date

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: IR73
Event: 2nd Quarter 2006
Date: 04/18/06
Weather: Sunny 60's

Well ID: IR73-MW09
Sample ID: IR73-GW09-0603

Sample Team: Meredith Harris
Rick DeLeon

Total Depth: 10.50 FT.(BTOC) Measuring Device:
Depth to water: (-) 7.10 FT.(BTOC) Date and Time:
Water Column: 3.4 FT.
(x) 0.163 GAL/FT.
Well Volume: 0.55 GAL.
Total Purge Volume: 2.5 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW	Color / Odor / Comments
1310	—	19.14	0.148	1.77	7.17	12	8.51	7.19	clear
1315	0.5	19.95	0.150	0.49	7.51	0	3.20	7.30	clear
1320	1.0	20.59	0.146	0.35	8.07	-23	4.67	7.30	clear
1325	1.5	20.71	0.143	0.35	9.05	-61	1.26	7.30	clear
1330	2	20.77	0.145	0.44	9.30	-68	0.36	7.34	clear
1335	2.5	20.72	0.145	0.49	9.36	-71		7.34	clear

Sample information: method, container number, size, and type, preservative used.
(2) VOC (2) RSK-175 (1) TOC (1) Alkalinity (1) Sulfide (1) Ferric Iron

Sample Time 1340
Sample Appearance clear

Notes:
Flow Rate: 200 ml/min
Ferrous IRON: 1mg
OVM 0ppm

Signed by: Meredith C. Harris 04/18/06
Date

35
0.35
3.83

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAV 1
Location: CTO-73
Event: 2ND QTR
Date: 4-20-06
Weather:

Well ID: IR73 GW10
Sample ID: IR73 GW10 06B
Sample Team: R Dolcon

Total Depth: 11.00 FT.(BTOC) Measuring Device:
Depth to water: (-) 6.79 FT.(BTOC) Date and Time:
Water Column: 4.21 8.11 FT.
(x) .163 GAL/FT.
Well Volume: ~~4.3~~ GAL.
Total Purge Volume: 0.69 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

100 ML Purge rate

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color / Odor / Comments	DTW
1250	.1gal	20.60	.434	.04	10.36	-74	74.1	Clear	6.81
1255	.2gal	20.70	.431	.00	10.61	-83	83.4	HAZY	6.81
1300	.5gal	20.90	.425	.00	10.63	-86	93.8	HAZY	6.81
1305	.7gal	21.20	.427	.00	10.68	-91	53.7	HAZY	6.81
1310	1gal	21.10	.544	.00	10.92	-105	20.4	HAZY	6.81
1315	1.2gal	21.20	.510	.00	10.97	-108	11.3	HAZY	6.81
1320	1.4gal	21.30	.454	.06	10.96	-109	8.23	HAZY	6.81
1325	SAMPLE TIME								

Sample information: method, container number, size, and type, preservative used.

Sampled for - VOC RSK-175 TOC
ACK, HNO_3, NaOH

Sample Time 1325
Sample Appearance HAZY

Notes:
Ferrous Iron => 1mg/L

Signed by: R.H. [illegible] 4-20-06
Date

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client:
Location: IR73
Event: B
Date: 4/10/06
Weather: Cloudy, Sunny, Breeze, 55°F

Well ID: 73-MW11
Sample ID: IR73-GW11-06B
Sample Team: Bob T., MATT W.

Total Depth: 20.11 FT.(BTOC) Measuring Device:
Depth to water: (-) 5.80 FT.(BTOC) Date and Time:
Water Column: 14.31 FT.
(x) .163 GAL/FT.
Well Volume: 2.3 GAL.
Total Purge Volume: 2.7 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color	/ Odor / Comments
1145	0	16.9	0.256	2.30	8.07	-15	6.52	5.92	Clear
1151	.3	16.8	0.255	0.00	8.32	-44	4.98	5.96	Clear
1157	.6	16.7	0.245	0.00	8.41	-61	2.75	5.97	Clear
1203	.9	16.8	0.226	0.00	8.50	-81	4.16	6.00	Clear
1209	1.2	16.8	0.221	0.00	8.55	-101	2.35	6.00	Clear
1215	1.5	16.8	0.192	0.00	8.58	-110	2.25	6.00	Clear
1221	1.8	16.8	0.184	0.00	8.60	-117	1.85	6.01	Clear
1227	2.1	16.9	0.179	0.00	8.61	-123	2.43	6.01	Clear
1233	2.4	16.8	0.175	0.00	8.63	-130	1.58	6.02	Clear
1239	2.7	16.9	0.174	0.00	8.64	-131	1.79	6.01	Clear

Sample information: method, container number, size, and type, preservative used.

Sample Time ~~1235~~ @ 1245
Sample Appearance

Notes:
1143 START Purge @ .05 GPM
Ferrous IRON = 1.5

Signed by: [signature] 4/10/06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client:

Location: IR73

Event: 13

Date: 4/10/06

Weather: Sunny, Calm, 60°F

Well ID: 73-MW11IW

Sample ID:

Sample Team: Bob T MATW

Total Depth: 38.8' FT.(BTOC) Measuring Device:

Depth to water: (-) 9.95' FT.(BTOC) Date and Time:

Water Column: 28.85 FT.

(x) 0.163 GAL/FT.

Well Volume: 4.7 GAL.

Total Purge Volume: GAL.

Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER

[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]

(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW	Color / Odor / Comments
1256	0	19.2	0.157	3.84	8.68	-77	29.9	10.05	Clear
1306	1.5	19.2	0.161	0.00	9.23	-125	11.5	10.06	Clear
1316	1.0	19.2	0.162	0.00	9.26	-128	12.5	10.06	Clear
1326	1.5	19.3	0.168	0.00	9.37	-140	10.2	10.06	Clear
1336	2.0	19.4	0.169	0.00	9.42	-144	7.96	10.06	Clear
1346	2.5	19.1	0.170	0.00	9.46	-151	9.52	10.06	Clear
1356	3.0	19.5	0.171	0.00	9.49	-155	5.61	10.06	Clear
1406	3.5	19.5	0.173	0.00	9.53	-160	4.24	10.07	Clear
1416	4.0	19.5	0.173	0.00	9.55	-163	4.64	10.07	Clear
1426	4.5	19.5	0.173	0.00	9.57	-164	4.07	10.06	Clear
1431	4.7	19.5	0.178	0.00	9.57	-164		10.07	Clear

Sample information: method, container number, size, and type, preservative used.

Sample Time 1435

Sample Appearance

Notes: 1256 Start Purge @ .05 GPM

Ferrous Iron = 4.0

Signed by: [signature]

4/10/06

Date

CH2M HILL Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVFAC
Location: IR73
Event: R3
Date: 4/11/06
Weather: Sunny, Calm, 50F

Well ID: 73-MW11DW
Sample ID: IR73-GW11DW-06B3
Sample Team: Bob T, Matt W.

Total Depth: 89.20 FT.(BTOC) Measuring Device:
Depth to water: (-)12.6 FT.(BTOC) Date and Time:
Water Column: 76.6 FT.
(x) .163 GAL/FT.
Well Volume: 12.5 GAL.
Total Purge Volume: 13.0 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color /	Odor / Comments
0847	0	18.5	0.395	1.25	7.53	90	>1000	13.45	Cloudy/Light Silts
0917	2	19.2	0.373	0.00	9.65	-66	44.3	14.90	Slight Cloudy
0947	4	19.3	0.371	0.00	9.85	-89	12.8	14.75	Clear
1017	6	19.6	0.371	0.00	9.94	-102	8.48	14.83	Clear
1047	8	19.4	0.371	0.00	9.99	-111	4.93	15.00	Clear
1117	10	19.5	0.371	0.00	10.04	-116	3.91	15.46	Clear
1147	12	19.5	0.370	0.00	10.08	-121	2.21	15.79	Clear
1202	13	19.6	0.370	0.00	10.09	-124	1.77	15.90	Clear

Sample information: method, container number, size, and type, preservative used.

DUPLICATE SAMPLE Collected ALSO

Sample Time 1205 | 1210 = IR73-GW11DW-06BDUP
Sample Appearance Clear

Notes:
0847 - START Purge @ .06 GPM (Possible grout contamination - High PH =
Ferrous IRON = .3
Ferrous IRON DUP = .3

Signed by: [signature] 4/11/06
Date

1450

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVFAC
Location: IR73
Event: LTM
Date: ~~4-9-06~~ 4-10-06
Weather: cloudy cool 45°F 20mph wind

Well ID: IR73-GW12
Sample ID: IR73-GW12-06B
Sample Team: MattW.

Total Depth: 14.86 FT.(BTOC) Measuring Device:
Depth to water: (-) 4.38 FT.(BTOC) Date and Time:
Water Column: 10.48 FT.
(x) 0.163 GAL/FT.
Well Volume: 1.708 GAL. x 3
Total Purge Volume: 5.124 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color / Odor / Comments
0925	.5	18.49	0.243	0.00	6.23	-101	23.31	4.74
0935	1.5	18.53	0.243	0.00	6.50	-145	26.11	4.85
0945	2.5	18.41	0.244	0.00	6.53	-161	14.72	4.85
0955	3.5	18.45	0.246	0.00	6.56	-179	5.40	4.85
1005	4.5	18.50	0.245	0.00	6.57	-180	4.32	4.85
1015	5.5	18.53	0.245	0.00	6.58	-184	2.11	

Sample information: method, container number, size, and type, preservative used.

Sample Time 1015
Sample Appearance Clear

Notes:
$Fe^{2+} = 1$

Signed by: Matt P. Westenberg

~~4-9-06~~ 4-10-06
Date

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client:
Location: IR73
Event: B
Date: 4/9/06 / 4/10/06
Weather: Clear, 45°F, Breezy

Well ID: IR73-MW13
Sample ID: IR73-GW13-0613

Sample Team: Bob T. MATT W.

Total Depth: 17.98 FT.(BTOC) Measuring Device:
Depth to water: (-) 3.40 FT.(BTOC) Date and Time:
Water Column: 14.58 FT.
(x) .163 GAL/FT. [(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
Well Volume: 2.4 GAL. (1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)
Total Purge Volume: 2.4 GAL.
Purge Device: peristaltic pump with new HDPE tubing ✓

WELL DIAMETER

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color /	Odor / Comments
1140	0	19.0	0.328	3.24	7.59	-79	3.72	3.60	Clear / Sulfur
1148	.4	19.0	0.290	0.00	7.52	-99	1.88	3.65	Clear / Sulfur
1156	.8	18.9	0.286	0.00	7.58	-111	1.42	3.67	Clear / Sulfur
1204	1.2	19.0	0.281	0.00	7.59	-119	1.11	3.69	Clear / Organic
1212	1.6	18.9	0.278	0.00	7.61	-126	1.00	3.69	Clear / Organic
1220	2.0	18.8	0.274	0.00	7.62	-132	0.95	3.69	Clear / Organic
1228	2.4	19.0	0.270	0.00	7.61	-136	1.16	3.69	Clear / Organic

Sample information: method, container number, size, and type, preservative used.

Due to Holding Time - Alk, Anions, Ferrous will be collected on 4/10/06 AM

Sample Time Reg 4/9/06 1230 | 4/10/06 0810 Alk, Anions, Ferrous
Sample Appearance

Notes:
1136 Start Purge @ .05 GPM
Ferrous Iron = 2.0

Signed by: [signature] 4/9/06 / 4/10/06
Date

CH2M HILL Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client:
Location: IR73 B.
Event:
Date: 4/9/06 / 4/10/06
Weather: Clear, Windy, 45°F

Well ID: IR73-MW13DW
Sample ID: IR73-GW13DW-0613
Sample Team: Bob T. MATTW.

Total Depth: 109.23 FT.(BTOC) Measuring Device:
Depth to water: (-) 5.51 FT.(BTOC) Date and Time:
Water Column: 103.72 FT.
(x) 0.163 GAL/FT. WELL DIAMETER [(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
Well Volume: 10.4 GAL. (1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)
Total Purge Volume: 10.5 GAL.
Purge Device: peristaltic pump with new HDPE tubing

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color	Odor / Comments
0833	0	19.6	0.176	0.88	7.50	-22	2.45	5.52	Clear
0849	1	20.0	0.194	0.00	8.64	-107	2.17	5.54	Clear
0905	2	20.1	0.608	0.00	8.75	-118	1.12	5.54	Clear
0921	3	20.0	0.614	0.00	8.78	-122	2.87	5.54	Clear
0937	4	20.1	0.617	0.00	8.80	-123	0.52	5.54	Clear
0953	5	20.2	0.619	0.00	8.78	-124	0.38	5.55	Clear
1009	6	20.2	0.619	0.00	8.78	-125	0.29	5.56	Clear
1025	7	20.3	0.620	0.00	8.78	-126	0.37	5.57	Clear
1041	8	20.3	0.619	0.00	8.78	-127	0.30	5.60	Clear
1057	9	20.4	0.619	0.00	8.78	-128	0.46	5.60	Clear
1115	10.4	20.4	0.619	0.00	8.78	-129	0.40	5.61	Clear

Sample information: method, container number, size, and type, preservative used.

NOTE - ALK, ANIONS, Ferrous will be collect 4/10/06 AM Due to Holding Time

Sample Time Req 1115 on 4/9/06 | 4/10/06 0812 ALK, ANIONS, Ferrous
Sample Appearance Clear

Notes:
0833 START Purge .06 GPM
Ferrous IRON = 3.0

Signed by: [signature] 4/9/06 | 4/10/06
Date

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CH2M HILL Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client:
Location: IR73
Event: B
Date: 4/12/06
Weather: Clear, Sunny, 50°F

Well ID: 73-MW15N
Sample ID: IR73-GW15N06B
Sample Team: Bob T., Matt W.

Total Depth: 14.50 FT.(BTOC) Measuring Device:
Depth to water: (-) 7.65 FT.(BTOC) Date and Time:
Water Column: 6.85 FT.
(x) 0.163 GAL/FT.
Well Volume: 1.1 GAL.
Total Purge Volume: 1.2 GAL.
Purge Device: peristaltic pump with new HDPE tubing ✓

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color /	Odor / Comments
0832	0	16.22	1.31	2.24	5.54	35	41.7	7.70	Slight Cloudy
0836	.2	16.20	0.90	0.55	6.08	-43	8.56	7.75	Clear Organic?
0840	.4	16.25	0.90	0.50	6.14	-53	7.01	7.77	Slight Fuel Odor
0844	.6	16.27	0.745	0.51	6.04	-60	9.19	7.79	"
0848	.8	16.31	—	0.45	6.07	-71	3.68	7.80	"
0852	1.0	16.30	—	0.37	6.09	-77	3.70	7.81	"
0856	1.2	16.29	—	0.36	6.06	-79	4.43	7.82	"

Sample information: method, container number, size, and type, preservative used.

NOTE - CONDUCTIVITY PROBE NOT FUNCTIONING - WILL TRADE OUT Horiba's. Other water quality parameters questionable (BW)

Sample Time 0900
Sample Appearance

Notes:
0832 START Purge @ .05 GPM
Ferrous Iron = 5.6

Signed by: [signature] 4/12/06
Date

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CH2M HILL Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVFAC
Location: IR73
Event: B
Date: 4/12/06
Weather: Overcast, Breezy, 65°F

Well ID: 73-MW15
Sample ID: IR73-GW15-06B
Sample Team: MATT W. Bob J

Total Depth: 11.95 FT.(BTOC) Measuring Device:
Depth to water: (-) 3.92 FT.(BTOC) Date and Time:
Water Column: 8.03 FT.
(x) .163 GAL/FT.
Well Volume: 1.3 GAL.
Total Purge Volume: 1.6 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color /	Odor / Comments
1315	0	16.4	4.42	0.36	9.64	-76	50.1	4.25	yellowish
1320 ~~1310~~	.2	16.2	3.68	0.00	9.75	-86	46.4	4.44	suspended particles
1325 ~~1319~~	.4	—	—	—	—	—	—	—	
1330 ~~1321~~	.6	16.1	2.28	0.00	9.95	-102	100	4.60	orangish
1335 ~~1323~~	.8	16.4	1.85	0.00	9.93	-103	102	4.60	
1340 ~~1325~~	1.0	16.5	1.77	0.00	9.96	-107	56.5	4.63	
1345 ~~1327~~	1.2	16.4	1.68	0.00	10.02	-112	29.5	4.64	
1350 ~~1329~~	1.4	16.5	1.66	0.00	10.03	-115	18.3	4.64	clear
~~1355~~ 1355	1.6	16.7	1.62	0.00	10.02	-115	11.5	4.63	Clear

Sample information: method, container number, size, and type, preservative used.

Sample Time 1400
Sample Appearance Clear

Notes: 1315 START Purge @ .04 GPM
Ferrous IRON = 5.0
DRAWDOWN CONTINUES at SLOW Purge RATE!

Signed by: [signature] 4/12/06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: IR73
Event: 2nd Quarter 2006
Date: 04/19/06
Weather: Sunny 60's

Well ID: IR73-MW15IW
Sample ID: IR73-GW15IW-06B

Sample Team: Meredith Harris
Rick DeLeon

Total Depth: 45.22 FT.(BTOC)
Depth to water: (-)2.22 FT.(BTOC)
Water Column: 43.0 FT.
(x) 0.163 GAL/FT.
Well Volume: 7.00 GAL.
Total Purge Volume: 9.00 GAL.
Purge Device: peristaltic pump with new HDPE tubing

Measuring Device:
Date and Time:

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color / Odor / Comments
0940	—	18.48	0.218	5.37	7.79	9	0.0	6.35
1000	1.5	18.64	0.224	2.85	8.48	-25	0.0	6.28
1020	4.0	18.92	0.232	0.98	8.98	-49	0.0	6.28
1040	6.0	19.05	0.234	1.06	9.50	-75	0.0	6.26
1050	7.0	19.15	0.237	0.86	9.50	-77	0.0	6.25
1055	7.5	19.08	0.236	0.98	9.51	-77	0.0	6.25
1100	8.0	19.19	0.235	1.25	9.40	-75	0.0	6.25
1105	8.5	19.27	0.237	1.30	9.46	-79	0.0	6.25
1110	9.0	19.21	0.238	1.02	9.60	-84	0.0	6.25

Sample information: method, container number, size, and type, preservative used.

(2)VOC (2)RSK-175 (1)TOC (1) Alkalinity (1)Sulfide (1)Ferrous Iron

Sample Time 1115
Sample Appearance

Notes:
Flow Rate: 300 ml/min
Ferrous Iron: 1mg

Signed by: Meredith C. Harris 04/19/06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: Area 73
Event: Second Quarter 2006
Date: 04/09/06
Weather: partly Cloudy, ~45°F

Well ID: 73-MW16
Sample ID: 73-~~MW~~16-0613

Sample Team: Meredith Harris
Rick DeLeon

Total Depth: 13.84 FT.(BTOC) Measuring Device:
Depth to water: (-) 3.60 FT.(BTOC) Date and Time:
Water Column: 10.24 FT.
(x) 0.163 GAL/FT.
Well Volume: 1.67 GAL.
Total Purge Volume: 2.0 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color / Odor / Comments
0810	0.5	15.78	0.225	2.77	13.10	-167	1.2	3.64
0815	0.75	15.78	0.227	3.05	13.47	-179	1.1	
0821	1.0	15.70	0.233	2.65	13.71	-189	1.2	3.65
0826	~1.5	16.04	0.236	2.54	13.73	-189	1.3	3.70
0831	2.0	16.09	0.237	2.54	13.80	-191	1.2	3.66

Sample information: method, container number, size, and type, preservative used.
(2) VOC (HCl) (2) RSK-175 (HCl) (1) TOC (HCl) (1) Sulfide (NaOH/ZnAc) (1) Ferric Iron (HNO_3)

~~All~~ (1) Alkalinity collected 04/10/06 due to holding time issue.

Sample Time Reg 0838 4/9/06 | Alkalinity @0753 4/10/06
Sample Appearance

Notes:
Ferrous Iron: 3mg
OVM: 0ppm
FLOW Rate: 200ml/min

Signed by: Meredith C. Harris 04/09/06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVFAC
Location: IR73
Event: LTM
Date: 4-9-06
Weather: Cloudy cool 45°F

Well ID: IR73 - MW17
Sample ID: IR73 - GW17 - Ø6B

Sample Team: Matt W.

Total Depth: 18.03 FT.(BTOC) Measuring Device:
Depth to water: (-) 5.71 FT.(BTOC) Date and Time:
Water Column: 12.32 FT.
(x) 0.163 GAL/FT.
Well Volume: 2.008 GAL. x 3
Total Purge Volume: 6.024 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Draw Down ~~Color / Odor / Comments~~
0825 ~~0830~~	+.5	19.27	0.662	0.00	6.55	-160	1.47	5.88
0835	1.5	19.18	0.655	0.00	6.74	-186	0	
0845	2.5	19.28	0.655	0.00	6.81	-197	1.17	5.90
0855	3.5	19.31	0.655	0.00	6.83	-203	2.25	5.90
0905	4.5	19.33	0.655	0.00	6.83	-206	1.79	5.90

Sample information: method, container number, size, and type, preservative used.

Sample Time 0905 / 0800 / 4-10-06
Sample Appearance Clear / Alkalinity sample

Notes: Fe^{2+} = 1.6

Signed by: Matt Q. Westendorf 4-9-06
Date

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVFAC
Location: IR73
Event: LTM
Date: 4-9-06
Weather: Cloudy cool 45°F

Well ID: IR73-MW17DW
Sample ID: IR73-~~MW~~17DW-06B GW
Sample Team: Matt W

Total Depth: 86.00 FT.(BTOC) Measuring Device:
Depth to water: (-) 10.21 FT.(BTOC) Date and Time:
Water Column: 75.79 FT.
(x) 0.163 GAL/FT.
Well Volume: 12.353 GAL. x 3
Total Purge Volume: 37.061 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Draw Down ~~Color / Odor / Comments~~
0825	.5	20.54	0.174	6.41	7.80	-162	54.14	11.62
0845	2.5	20.74	0.168	1.24	8.20	-200	57.72	12.11
0905	4.5	20.84	0.166	0.00	8.29	-208	10.41	12.20
0925	6.5	20.81	0.166	0.00	8.31	-210	11.40	13.57
0935	7.5	20.93	0.166	0.00	8.31	-211	5.11	13.60
0940	8.0	20.91	0.166	0.00	8.32	-212	4.74	13.60
0950	9.0	20.96	0.165	0.00	8.32	-212	2.42	13.61
1000	10.0	20.96	0.165	0.00	8.33	-213	2.01	13.61
1010	11.0	21.07	0.165	0.00	8.32	-213	1.97	13.61
1020	12.0	21.12	0.165	0.00	8.32	-213	1.74	13.61

Sample information: method, container number, size, and type, preservative used.

Sample Time 1020 / 4-10-06 @ 0805
Sample Appearance clear / Alkalinity

Notes: $Fe^{2+} = 1$

Signed by: Matt J. Westendorf

4-9-06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: IR73
Event: 2nd Quarter 2006
Date: 04/13/06
Weather: Sunny 60's

Well ID: IR73-MW18
Sample ID: IR73-GW18-063

Sample Team: Meredith Harris
Rick Dekeon

Total Depth: 22.10 FT.(BTOC)
Depth to water: (-) 6.44 FT.(BTOC)
Water Column: 15.66 FT.
(x) 0.163 GAL/FT.
Well Volume: 2.55 GAL.
Total Purge Volume: 3.5 GAL.
Purge Device: peristaltic pump with new HDPE tubing

Measuring Device:
Date and Time:

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color / Odor / Comments
1043	~1	16.30	0.142	0.93	8.06	-17	9.12	6.44
1053	1.5	16.24	0.139	0.65	8.63	-34	5.58	6.44 Clear
1103	2.5	16.27	0.139	0.33	8.84	-47	3.59	6.44 clear
1108	3	16.19	0.138	0.36	9.07	-56	2.57	6.44 clear
1113	3.5	16.38	0.138	0.38	9.39	-68	3.14	6.44

Sample information: method, container number, size, and type, preservative used.

(2) VOC HCl (2) RSK-175 HCl (1) TOC HCl (1) Alkalinity NONE (1) Ferric Iron HNO3 (1) Sulfide NaOH/ZnAc

Sample Time 1120
Sample Appearance

Notes:
Ferrous IRON:
OVM: 0
Flow Rate: 200 ml/min

Signed by: Meredith C. Harris 04/18/06
Date

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CH2M HILL Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVFAC
Location: IR73
Event: LTM
Date: 4-11-06
Weather: sunny 70°F

Well ID: IR73-GW19
Sample ID: IR73-GW19-0606
Sample Team: Matt W.

Total Depth: 20.11 FT.(BTOC) Measuring Device:
Depth to water: (-) 6.~~X~~08 FT.(BTOC) Date and Time:
Water Column: 14.03 FT.
(x) 0.163 GAL/FT.
Well Volume: 2.286 GAL x 3
Total Purge Volume: 6.860 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color / Odor / Comments
1350	.5	17.24	0.998	0.00	7.71	-84	107.2	6.32
1400	1.5	17.02	1.67	0.00	6.42	-121	88.4	
1410	2.5	17.12	1.74	0.00	6.49	-159	47.2	6.50
1420	3.5	17.16	2.20	0.00	6.50	-178	92.1	
1430	4.5	17.20	1.74	0.00	6.52	-182	59.7	6.50
1440	5.5	17.26	1.75	0.00	6.54	-180	48.6	6.50

Sample information: method, container number, size, and type, preservative used.

Sample Time 1440
Sample Appearance yellow-ish Heavy odor

Notes: $Fe^{2+} = 3.6$

Signed by: Matt J. Westerdorf 4-11-06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: IR73
Event: 2nd Quarter 2006
Date: 04/19/06
Weather: Sunny 70's

Well ID: IR73-MW20
Sample ID: IR73-GW20-0606B

Sample Team: M Harris
R Delean

Total Depth: 20.07 FT.(BTOC) Measuring Device:
Depth to water: (-) 6.25 FT.(BTOC) Date and Time:
Water Column: 13.88 FT.
(x) 0.163 GAL/FT.
Well Volume: 2.26 GAL.
Total Purge Volume: 4.5 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color	Odor / Comments
1216	0.5	15.40	0.097	1.20	9.90	~~-127~~	0.7	6.25	
1236	2.5	15.36	0.090	1.21	11.45	-153	0.6	6.59	
1241	4.0	15.35	0.089	1.01	11.51	-157	0.7	6.59	
1245	4.5	15.36	0.087	1.00	11.52	-157	0.5	6.59	

Sample information: method, container number, size, and type, preservative used.
(2) VOC (2) RSK-175 (1) TOC (1) Alkalinity (1) Sulfate (1) Ferric Iron

Sample Time 1250
Sample Appearance Clear

Notes:
Flow Rate: 500 ml/min
Ferrous Iron: 1.5

Signed by: M Harris

04/19/06
Date

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: IR73
Event: 3rd Quarter 2006
Date: 04/19/06
Weather: Sunny 60's

Well ID: IR73-MW20DW
Sample ID: IR73-MW20DW-06B

Sample Team: M Harris
R DeLeon

Total Depth: 55.19 FT.(BTOC) Measuring Device:
Depth to water: (-) 4.34 FT.(BTOC) Date and Time:
Water Column: 50.85 FT.
(x) 0.163 GAL/FT.
Well Volume: 8.28 GAL.
Total Purge Volume: 8.5 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color	/ Odor / Comments
1215	0.5	17.40	0.37	5.49	7.41	75	3.20	4.34	clear
1236	3	17.60	0.38	1.90	7.38	-78	0.82	4.34	clear
1300	5.5	17.70	0.38	0.52	7.39	-113	0.60	4.34	clear
1313	7	17.80	0.38	0.38	7.41	-117	0.59	4.34	clear
1318	7.5	17.90	0.38	0.21	7.43	-121	0.60	4.34	clear
1323	8.0	18.00	0.38	0.28	7.42	-119	0.44	4.34	clear
	8.5	SAMPLED							

Sample information: method, container number, size, and type, preservative used.

(2) VOC (2) RSK-175 (1) TOC (1) Alkalinity (1) Sulfide (1) Ferric Iron

Sample Time 1330
Sample Appearance

Notes:
Ferrous Iron = 0mg
Flow Rate: 300mL/min

Signed by: M Harris 04/19/06
Date

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVI

Location: CTO 73

Event: 2ND QTR

Date: 4-21-06

Weather: Partly Cloudy, humid

Well ID: IR73MW21

Sample ID: IR73GW2106B

Sample Team: R Deleon, M. Ost.

Total Depth: 22.0' FT.(BTOC) Measuring Device:

Depth to water: (-) 3.80 FT.(BTOC) Date and Time:

Water Column: 18.2 FT.

(x) .163 GAL/FT.

Well Volume: 2.96 GAL.

Total Purge Volume: 2.5 GAL.

WELL DIAMETER

[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]

(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

Purge Device: peristaltic pump with new HDPE tubing 200 ML Purge rate

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color / Odor / Comments	DTW
0735	.5 gal	15.50	0.302	0.00	3.87	217	148	Hazy	3.80
0740	1 gal	15.50	0.279	0.00	4.22	205	122	Cloudy	3.80
0745	1.5 gal	15.50	0.270	0.00	4.62	185	88.2	Cloudy	3.80
0750	1.9 gal	15.50	0.262	0.00	4.74	179	68.9	Cloudy	3.80
0755	2 gal	15.50	0.251	0.00	4.97	168	63.0	Cloudy	3.80
0800	2.5 gal	15.50	0.248	0.00	5.07	164	47.5	Cloudy	3.80
0810	Sample Time								

Sample information: method, container number, size, and type, preservative used.

Sampled FOR: VOC, RSK-175, TOC
ALK, FERRIC IRON, ~~ZINC~~ NITRATE, sulfide
NaOH

Sample Time 0810

Sample Appearance

Notes: Ferrous Iron = 4 mg/L

Signed by: RHDeleon 4-21-06

Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: IR73
Event: Second Quarter 2006
Date: 04/11/06
Weather: Sunny 40's

Well ID: IR73-MW23
Sample ID: IR73-GW23-06B

Sample Team: Meredith Harris
Rick Deleon

Total Depth: 20.07 FT.(BTOC) Measuring Device:
Depth to water: (-) 5.45 FT.(BTOC) Date and Time:
Water Column: 14.62 FT.
(x) 0.163 GAL/FT.
Well Volume: 2.38 GAL.
Total Purge Volume: 4.0 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color	Odor / Comments
0816	0.25	15.80	0.16	0.36	4.24	263	31.0 NTU	5.45	
0836	2.5	15.70	0.12	0.0	4.20	218	15.9	5.45	
0841	~3.0	15.90	0.12	0.0	4.19	202	10.9	5.45	
0847	~4.0	15.80	0.12	0.0	4.19	188	8.90	5.45	

Sample information: method, container number, size, and type, preservative used.
Sampled for All constituents (2) VOC (2) RSK-175 (1) TOC (1) Alkalinity (1) Sulfide (1) Ferric Iron

Sample Time 0852
Sample Appearance

Notes:
Flow Rate = 300ml/min
OVM 0ppm
Ferrous Iron = 1.2mg

Signed by: Meredith C. Harris 4/11/06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: IR73
Event: 2ND Quarter 2006
Date: 04/12/06
Weather:

Well ID: IR73-MW25
Sample ID: IR73-GW25-06B
IR73-GW25-06BDUP
Sample Team: Meredith Harris
Rick DeLeon

Total Depth: 10.70 FT.(BTOC) Measuring Device:
Depth to water: (-) 8.23 FT.(BTOC) Date and Time:
Water Column: ~~10.70~~ 1.47 FT.
(x) 0.13 GAL/FT.
Well Volume: 0.3 GAL.
Total Purge Volume: GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual) NTU	Color / Odor / Comments
1327	0.25	16.33	0.126	4.07	10.04	-47	16.8	
1333	0.5	16.74	0.126	3.87	9.45	-60	13.9	
1339	1 gal	16.74	0.126	3.20	10.21	-92	9.09	
1344	1.5	16.79	0.125	3.22	10.55	-109	4.39	
1349	2	16.50	0.126	3.39	10.75	-121	4.39	

Sample information: method, container number, size, and type, preservative used.
(2) VOC (2) RSK-175 (1) TOC (1) Alkalinity (1) Ferric Iron (1) Sulfide

Sample Time 1355
Sample Appearance

Notes:
OVM 0ppm
Flow Rate: 300 mL/min
Ferrous Iron: 4mg

Signed by: Meredith C. Harris 04/12/06
Date

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: Navsea
Location: Camp Lejeune
Event: 3
Date: 4/19/06
Weather: clr 75°

Well ID: IR 23 - MW 26DW
Sample ID: IR 23 - GW 26 - 0606 DW
Sample Team: M. OET

Total Depth: 153.5 FT.(BTOC)
Depth to water: (-) 12.95 FT.(BTOC)
Water Column: 140.55 FT.
(x) .163 GAL/FT.
Well Volume: 22.9 GAL.
Total Purge Volume: 18.0 GAL.
Purge Device: peristaltic pump with new HDPE tubing

Measuring Device: 300 ml/min Measuring Cup
Date and Time: 2" WELL DIAMETER

[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color / Odor / Comments	DTW
0815	0	19.9	2.31	0.15	12.77	-150	8.09	clr	14.15 btc
0904	2.5	20.3	2.56	0.00	12.63	-176	5.56	clr	15.50' btc
0945	5.0	20.6	2.41	0.00	13.22	-198	~~10.1~~ 5.07	clr	15.5' btc
1035	7.5	20.6	2.36	0.00	13.25	-190	2.25	clr	15.5' btc
1117	10.0	20.7	2.34	0.00	12.92	-193	2.05	clr	15.5' btc
1211	12.5	20.7	2.34	0.00	12.89	-196	2.70	clr	15.5' btc
1257	15.0	20.6	2.36	0.00	13.50	-200	3.14	clr	15.5' btc
1341	17.5	21.0	2.35	0.00	13.11	-208	1.94	clr	15.5' btc

Sample information: method, container number, size, and type, preservative used.

Sample Time 1400
Sample Appearance Clear

Notes:
Purge low flow 300 ml/min
Reached at 2.5 Gal. Pump lost suction to ~200 ml/min due to large column of water for 6 ft ~148 ft. Tube 5 feet off Bottom of well
Fe = 0.8 mg/L

Signed by: [signature] 4/19/06
Date

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: 73
Event: Second Quarter 2006
Date: 4/09/06
Weather: Sunny 50's

Well ID: 73-MW27
Sample ID: 73-MW27-060B
Sample Team: Meredith Harris
Rick Doleon

Total Depth: 16.38 FT.(BTOC) Measuring Device:
Depth to water: (-) 3.42 FT.(BTOC) Date and Time:
Water Column: 12.96 FT.
(x) 0.163 GAL/FT.
Well Volume: 2.11 GAL.
Total Purge Volume: 2.5 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color	Odor / Comments
1247	1gal	18.05	0.395	2.11	~~15.83~~	-239	0.0	3.55	
1255	2	18.06	0.388	2.12	flashing 16.00	-249	0.0	3.55	
1301	2.5	18.39	0.382	2.14	flashing 14.00	-251	0.0	3.55	
~~1330~~									

Sample information: method, container number, size, and type, preservative used.
All constituents except Alkalinity.
Alkalinity will be sampled 04/10/06 b/c of short hold time issues.

Sample Time Reg 1306 4/09/06 | Alkalinity @ 0810 4/10/06
Sample Appearance

Notes:
Flow Rate: 200ml/min
Ferrous Iron: 0mg
OVM: 0ppm

Signed by: Meredith Harris

Date 4/10/06

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: 73
Event: Second Quarter 2006
Date: 04/09/06
Weather: Sunny, ~50's

Well ID: 73-MW27DW
Sample ID: 73-MW27DW-06B
Sample Team: Meredith Harris
Rick DeLeon

Total Depth: 72.05 FT.(BTOC) Measuring Device:
Depth to water: (-) 6.72 FT.(BTOC) Date and Time:
Water Column: 65.33 FT.
(x) 0.163 GAL/FT.
Well Volume: 10.65 GAL.
Total Purge Volume: 11.0 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color / Odor / Comments
1247		20.90	0.70	0.33	8.88	51	3.3	6.85
1256	3	20.90	0.70	0.12	8.87	45	7.7	6.86
1314	4.9	21.20	0.70	0.0	8.86	32	4.9	6.91
1331	5.25	21.00	0.71	0.0	8.72	28	3.7	6.90
1351	8.00	21.10	0.84	0.0	6.96	-94	0.6	6.90
1411	10.0	20.90	0.85	0.0	6.86	-86	6.9	6.90
1416	10.25	20.90	0.84	0.0	6.86	-86	6.9	6.90
1421	10.5	21.10	0.84	0.0	6.86	-87	6.2	6.90
1426	11.0	21.20	0.84	0.0	6.85	-87	11.6	6.90

Sample information: method, container number, size, and type, preservative used.

Sample Time Reg 1431 4/9/06 | Alkalinity @ 0810 4/10/06
Sample Appearance

Notes:
Flow Rate: 300 mL
Ferrous Iron: 0mg
OVM = 0.0 ppm

Signed by: Meredith C. Harris 04/10/06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client:
Location: IR73
Event: B
Date: 4/20/06
Weather: Sunny, 75°F, Calm

Well ID: 73-GW28
Sample ID: IR73-GW28-06B
Sample Team: Bob T. Maradeth H.

Total Depth: 13.15 FT.(BTOC) Measuring Device:
Depth to water: (-) 6.30 FT.(BTOC) Date and Time:
Water Column: 6.85 FT.
(x) .163 GAL/FT.
Well Volume: 1.1 GAL.
Total Purge Volume: 1.6 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color	Odor / Comments
1242	0	17.75	0.149	0.95	7.67	-39	38.6	6.51	orangish 54 gal barrels
1247	.2	17.68	0.145	1.03	6.85	-44	30.1	6.60	Clear
1252	.4	17.76	0.144	1.39	7.71	-81	15.4	6.70	Clear
1257	.6	17.84	0.143	1.33	8.58	-105	7.90	6.72	Clear
1302	.8	17.56	0.141	1.17	8.87	-107	3.83	6.75	Clear
1307	1.0	17.57	0.141	0.95	8.73	-104	2.79	6.76	Clear
1312	1.2	17.62	0.141	0.90	8.66	-102	2.23	6.77	Clear
1317	1.4	17.58	0.141	0.83	8.59	-101	2.22	6.79	Clear
1322	1.6	17.56	0.141	0.79	8.56	-101	2.01	6.80	Clear

Sample information: method, container number, size, and type, preservative used.

PH Reading 1307 = 8.73
1312 = 8.66
NOTE Conductivity Readings Suspect?

Sample Time 1315
Sample Appearance Clear

Notes:
1242 Start Purge @ .04 GPM
Ferrous Iron = 1.0

Signed by: [signature] 4/20/06
Date

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVI

Location: CTO 73

Event: 2ND QTR

Date: 4-21-06

Weather: Partly Cloudy, humid

Well ID: IR73MW21

Sample ID: IR73GW2106B

Sample Team: R Deleon, M. Ost.

Total Depth: 22.0' FT.(BTOC) Measuring Device:

Depth to water: (-) 3.80 FT.(BTOC) Date and Time:

Water Column: 18.2 FT.

(x) .163 GAL/FT.

Well Volume: 2.96 GAL.

Total Purge Volume: 2.5 GAL.

WELL DIAMETER

[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]

(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

Purge Device: peristaltic pump with new HDPE tubing 200 ML Purge rate

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color / Odor / Comments	DTW
0735	.5 gal	15.50	0.302	0.00	3.87	217	148	Hazy	3.80
0740	1 gal	15.50	0.279	0.00	4.22	205	122	Cloudy	3.80
0745	1.5 gal	15.50	0.270	0.00	4.62	185	88.2	Cloudy	3.80
0750	1.9 gal	15.50	0.262	0.00	4.74	179	68.9	Cloudy	3.80
0755	2 gal	15.50	0.251	0.00	4.97	168	63.0	Cloudy	3.80
0800	2.5 gal	15.50	0.248	0.00	5.07	164	47.5	Cloudy	3.80
0810	Sample Time								

Sample information: method, container number, size, and type, preservative used.

Sampled FOR: VOC, RSK-175, TOC
ALK, FERRIC IRON, ~~ZINC~~ NITRATE, sulfide
NaOH

Sample Time 0810

Sample Appearance

Notes: Ferrous Iron = 4 mg/L

Signed by: RHDeleon 4-21-06

Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: IR73
Event: Second Quarter 2006
Date: 04/11/06
Weather: Sunny 40's

Well ID: IR73-MW23
Sample ID: IR73-GW23-06B

Sample Team: Meredith Harris
Rick Deleon

Total Depth: 20.07 FT.(BTOC) Measuring Device:
Depth to water: (-) 5.45 FT.(BTOC) Date and Time:
Water Column: 14.62 FT.
(x) 0.163 GAL/FT.
Well Volume: 2.38 GAL.
Total Purge Volume: 4.0 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color	Odor / Comments
0816	0.25	15.80	0.16	0.36	4.24	263	31.0 NTU	5.45	
0836	2.5	15.70	0.12	0.0	4.20	218	15.9	5.45	
0841	~3.0	15.90	0.12	0.0	4.19	202	10.9	5.45	
0847	~4.0	15.80	0.12	0.0	4.19	188	8.90	5.45	

Sample information: method, container number, size, and type, preservative used.
Sampled for All constituents (2) VOC (2) RSK-175 (1) TOC (1) Alkalinity (1) Sulfide (1) Ferric Iron

Sample Time 0852
Sample Appearance

Notes:
Flow Rate = 300ml/min
OVM 0ppm
Ferrous Iron = 1.2mg

Signed by: Meredith C. Harris 4/11/06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: IR73
Event: 2ND Quarter 2006
Date: 04/12/06
Weather:

Well ID: IR73-MW25
Sample ID: IR73-GW25-06B
IR73-GW25-06BDUP
Sample Team: Meredith Harris
Rick DeLeon

Total Depth: 10.70 FT.(BTOC) Measuring Device:
Depth to water: (-) 8.23 FT.(BTOC) Date and Time:
Water Column: ~~10.70~~ 1.47 FT.
(x) 0.13 GAL/FT.
Well Volume: 0.3 GAL.
Total Purge Volume: GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual) NTU	Color / Odor / Comments
1327	0.25	16.33	0.126	4.07	10.04	-47	16.8	
1333	0.5	16.74	0.126	3.87	9.45	-60	13.9	
1339	1 gal	16.74	0.126	3.20	10.21	-92	9.09	
1344	1.5	16.79	0.125	3.22	10.55	-109	4.39	
1349	2	16.50	0.126	3.39	10.75	-121	4.39	

Sample information: method, container number, size, and type, preservative used.
(2) VOC (2) RSK-175 (1) TOC (1) Alkalinity (1) Ferric Iron (1) Sulfide

Sample Time 1355
Sample Appearance

Notes:
OVM 0ppm
Flow Rate: 300 mL/min
Ferrous Iron: 4mg

Signed by: Meredith C. Harris 04/12/06
Date

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: Navsea
Location: Camp Lejeune
Event: 3
Date: 4/19/06
Weather: clr 75°

Well ID: IR 23 - MW 26DW
Sample ID: IR 23 - GW 26 - 0606 DW
Sample Team: M. OET

Total Depth: 153.5 FT.(BTOC)
Depth to water: (-) 12.95 FT.(BTOC)
Water Column: 140.55 FT.
(x) .163 GAL/FT.
Well Volume: 22.9 GAL.
Total Purge Volume: 18.0 GAL.
Purge Device: peristaltic pump with new HDPE tubing

Measuring Device: 300 ml/min Measuring Cup
Date and Time: 2" WELL DIAMETER

[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color / Odor / Comments	DTW
0815	0	19.9	2.31	0.15	12.77	-150	8.09	clr	14.15 btc
0904	2.5	20.3	2.56	0.00	12.63	-176	5.56	clr	15.50' btc
0945	5.0	20.6	2.41	0.00	13.22	-198	~~10.1~~ 5.07	clr	15.5' btc
1035	7.5	20.6	2.36	0.00	13.25	-190	2.25	clr	15.5' btc
1117	10.0	20.7	2.34	0.00	12.92	-193	2.05	clr	15.5' btc
1211	12.5	20.7	2.34	0.00	12.89	-196	2.70	clr	15.5' btc
1257	15.0	20.6	2.36	0.00	13.50	-200	3.14	clr	15.5' btc
1341	17.5	21.0	2.35	0.00	13.11	-208	1.94	clr	15.5' btc

Sample information: method, container number, size, and type, preservative used.

Sample Time 1400
Sample Appearance Clear

Notes:
Purge low flow 300 ml/min
Reached at 2.5 Gal. Pump lost suction to ~200 ml/min due to large column of water for 6 ft ~148 ft. Tube 5 feet off Bottom of well
Fe = 0.8 mg/L

Signed by: [signature] 4/19/06
Date

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: 73
Event: Second Quarter 2006
Date: 4/09/06
Weather: Sunny 50's

Well ID: 73-MW27
Sample ID: 73-MW27-060B
Sample Team: Meredith Harris
Rick Doleon

Total Depth: 16.38 FT.(BTOC) Measuring Device:
Depth to water: (-) 3.42 FT.(BTOC) Date and Time:
Water Column: 12.96 FT.
(x) 0.163 GAL/FT.
Well Volume: 2.11 GAL.
Total Purge Volume: 2.5 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color	Odor / Comments
1247	1gal	18.05	0.395	2.11	~~15.83~~	-239	0.0	3.55	
1255	2	18.06	0.388	2.12	flashing 16.00	-249	0.0	3.55	
1301	2.5	18.39	0.382	2.14	flashing 14.00	-251	0.0	3.55	
~~1330~~									

Sample information: method, container number, size, and type, preservative used.
All constituents except Alkalinity.
Alkalinity will be sampled 04/10/06 b/c of short hold time issues.

Sample Time Reg 1306 4/09/06 | Alkalinity @ 0810 4/10/06
Sample Appearance

Notes:
Flow Rate: 200ml/min
Ferrous Iron: 0mg
OVM: 0ppm

Signed by: Meredith Harris

Date 4/10/06

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: 73
Event: Second Quarter 2006
Date: 04/09/06
Weather: Sunny, ~50's

Well ID: 73-MW27DW
Sample ID: 73-MW27DW-06B
Sample Team: Meredith Harris
Rick DeLeon

Total Depth: 72.05 FT.(BTOC) Measuring Device:
Depth to water: (-) 6.72 FT.(BTOC) Date and Time:
Water Column: 65.33 FT.
(x) 0.163 GAL/FT.
Well Volume: 10.65 GAL.
Total Purge Volume: 11.0 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color / Odor / Comments
1247		20.90	0.70	0.33	8.88	51	3.3	6.85
1256	3	20.90	0.70	0.12	8.87	45	7.7	6.86
1314	4.9	21.20	0.70	0.0	8.86	32	4.9	6.91
1331	5.25	21.00	0.71	0.0	8.72	28	3.7	6.90
1351	8.00	21.10	0.84	0.0	6.96	-94	0.6	6.90
1411	10.0	20.90	0.85	0.0	6.86	-86	6.9	6.90
1416	10.25	20.90	0.84	0.0	6.86	-86	6.9	6.90
1421	10.5	21.10	0.84	0.0	6.86	-87	6.2	6.90
1426	11.0	21.20	0.84	0.0	6.85	-87	11.6	6.90

Sample information: method, container number, size, and type, preservative used.

Sample Time Reg 1431 4/9/06 | Alkalinity @ 0810 4/10/06
Sample Appearance

Notes:
Flow Rate: 300 mL
Ferrous Iron: 0mg
OVM = 0.0 ppm

Signed by: Meredith C. Harris 04/10/06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client:
Location: IR73
Event: B
Date: 4/20/06
Weather: Sunny, 75°F, Calm

Well ID: 73-GW28
Sample ID: IR73-GW28-06B
Sample Team: Bob T. Maradeth H.

Total Depth: 13.15 FT.(BTOC) Measuring Device:
Depth to water: (-) 6.30 FT.(BTOC) Date and Time:
Water Column: 6.85 FT.
(x) .163 GAL/FT.
Well Volume: 1.1 GAL.
Total Purge Volume: 1.6 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color	Odor / Comments
1242	0	17.75	0.149	0.95	7.67	-39	38.6	6.51	orangish 54 gal barrels
1247	.2	17.68	0.145	1.03	6.85	-44	30.1	6.60	Clear
1252	.4	17.76	0.144	1.39	7.71	-81	15.4	6.70	Clear
1257	.6	17.84	0.143	1.33	8.58	-105	7.90	6.72	Clear
1302	.8	17.56	0.141	1.17	8.87	-107	3.83	6.75	Clear
1307	1.0	17.57	0.141	0.95	8.73	-104	2.79	6.76	Clear
1312	1.2	17.62	0.141	0.90	8.66	-102	2.23	6.77	Clear
1317	1.4	17.58	0.141	0.83	8.59	-101	2.22	6.79	Clear
1322	1.6	17.56	0.141	0.79	8.56	-101	2.01	6.80	Clear

Sample information: method, container number, size, and type, preservative used.

PH Reading 1307 = 8.73
1312 = 8.66
NOTE Conductivity Readings Suspect?

Sample Time 1315
Sample Appearance Clear

Notes:
1242 Start Purge @ .04 GPM
Ferrous Iron = 1.0

Signed by: [signature] 4/20/06
Date

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: CTO-73
Event: 2ND QTR.
Date: 4-20-06
Weather:

Well ID: IR 73 GW 35 06 B
Sample ID: IR73GW 35 06B

Sample Team: R Dela — MARK OST

.4 gpm

Total Depth: 20.80 FT.(BTOC) Measuring Device: 300 ml/min
Depth to water: (-) 8.41 FT.(BTOC) Date and Time:
Water Column: 12.39 FT.
WELL DIAMETER 2"
(x) .163 GAL/FT. [(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
Well Volume: 2.01 GAL. (1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)
Total Purge Volume: 2.0 GAL.
Purge Device: peristaltic pump with new HDPE tubing

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color / Odor / Comments	DTW
0905	.5	16.70	.18	.90	4.58	295	6.33	clr	8.41' btc
0910	.9	16.70	.15	.58	4.71	265	6.13	clr	8.41' btc
0915	1.3	16.70	.13	.50	4.74	258	4.65	clr	8.41' btc
0920	2.0	16.70	.12	.41	4.82	246	3.60	clr	8.41' btc
0925	SAMPLE TIME								

Sample information: method, container number, size, and type, preservative used.

SAMPLED FOR 8 VOC's RSK-175, HNO_3, ALKALITY, ACETATE, NaOH, FERRIC IRON, ZINC, SULFIDE.

Sample Time 0925
Sample Appearance Clear

Notes:

Signed by: [signature] Date 4/20/06

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVI

Location: CTO-73

Event: 2ND QTR

Date: 4-20-06

Weather:

Well ID: IR73GW35DW

Sample ID: IR73GW35DW06B

Sample Team: R. Dell / MARK OST

300 ml/min

Total Depth: 64.70 FT.(BTOC) Measuring Device:

Depth to water: (-) 13.97 FT.(BTOC) Date and Time: 1.5/20 min

Water Column: 50.73 FT.

(x) .163 GAL/FT.

Well Volume: 8.27 GAL.

Total Purge Volume: 8.2 GAL.

Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER

[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]

(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color / Odor / Comments	DTW
0907	1	18.30	.224	5.70	8.03	58	1.68	clear	13.97
0927	3gal	18.50	.219	4.81	7.82	69	~~6.9~~ 1.01	Clear	13.97
0947	5gal	18.50	0.219	2.91	8.06	56	.93	Clear	13.97
1007	6gal	18.60	0.224	1.27	11.99	-141	.91	Clear	13.97
1027	7gal	18.60	0.228	0.85	12.35	-160	1.56	clear	13.97
1038	8gal	18.60	0.232	0.35	12.50	-169	1.26	Clear	13.97
1043	8.2gal	18.60	0.232	0.46	12.47	-169	1.09	Clear	13.97
1048	Sampled	Time							

Sample information: method, container number, size, and type, preservative used.

Sampled FOR - VOC's, RSK-175, TOC
ALK
HNO_3
NaOH

Sample Time 1048 sampled

Sample Appearance

Notes:

Signed by: R.H. Dell 4-20-06

Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVFAC
Location: IR73
Event: LTM
Date: 4-9-06
Weather: Sunny 50°F

Well ID: IR73-MW37
Sample ID: IR73-GW37-06B

Sample Team: Matt W

Total Depth: 17.37 FT.(BTOC) Measuring Device:
Depth to water: (-) 5.70 FT.(BTOC) Date and Time:
Water Column: 11.67 FT.
(x) 0.163 GAL/FT.
Well Volume: 1.902 GAL. x 3
Total Purge Volume: 5.706 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Draw Down Color / Odor / Comments
0950	.5	19.18	0.286	0.00	5.12	-77	4.22	5.91
1000	1.5	19.14	0.287	0.00	5.27	-91	3.17	5.92
1010	2.5	19.17	0.288	0.00	5.33	-109	2.51	5.92
1020	3.5	19.14	0.289	0.00	5.35	-120	5.21	5.92
1030	4.5	19.18	0.289	0.00	5.40	-123	4.31	5.92
1040	5.5	19.17	0.289	0.00	5.42	-139	4.57	5.92

Sample information: method, container number, size, and type, preservative used.

Sample Time 1040 / 4-10-06 @ 0810
Sample Appearance clear / Alkalinity

Notes: $Fe^{2+} = 2.4$

Signed by: Matt G. Westenberg

4-9-06
Date

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CH2M HILL Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: 73
Event: Second Quarter 2004
Date: ~~06/09~~ 04/09/06
Weather: Partly cloudy, ~45°F

Well ID: 73-MW38DW
Sample ID: 73-MW38DW-06B
Sample Team: Meredith Harris CT
Rick DeLeon

Total Depth: 109.70 FT.(BTOC) Measuring Device:
Depth to water: (-) 5.36 FT.(BTOC) Date and Time:
Water Column: 104.34 FT.
(x) 0.163 GAL/FT.
Well Volume: 17.00 GAL.
Total Purge Volume: 18.5 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color	Odor / Comments
0906		19.00	0.26	4.26	8.64	138	27.9	5.35	
0926	3	19.30	0.25	3.64	8.60	118	35.1	5.35	
0946	4.5	19.20	0.24	3.28	8.58	111	19.4	5.36	
1006	7	19.60	0.24	3.05	8.56	106	18.5	5.40	
1026	9.5	19.50	0.24	2.88	8.49	104	28.1	5.40	
1046	12.5	19.80	0.29	1.87	7.86	112	24.1	5.43	
1116	15.0	19.60	0.38	0.15	7.46	-97	27.1		
1124	16.5	19.80	0.39	0.02	7.46	-104	26.8	5.43	
1137	17.5	19.80	0.41	0.00	7.45	-111	39.3	5.42	
1142	18.5	19.9	0.41	0.00	7.44	-112	49.4	5.42	

Sample information: method, container number, size, and type, preservative used.
All constituents except Alkalinity.

(1) Alkalinity collected @ 4/10/06 due to hold time issues.

Sample Time: Reg 1147 | Alkalinity 04/10/06 @ 0802
Sample Appearance:

Notes:
Flow Rate: 300ml/min
OVM: 0ppm
Ferrous Iron: 0mg

Signed by: Meredith C. Harris 04/10/06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: Area 73
Event: Second Quarter
Date: 04/09/06
Weather: Partly Cloudy, ~45°F

Well ID: ~~MW-39DW~~ 73-MW39DW
Sample ID: 73-~~MW~~ 39DW-~~06~~B

Sample Team: Meredith Harris
Rick Deleon

Total Depth: 70.83 FT.(BTOC) Measuring Device:
Depth to water: (-) 5.30 FT.(BTOC) Date and Time:
Water Column: 65.53 FT.
(x) 0.163 GAL/FT.
Well Volume: 10.68 GAL.
Total Purge Volume: 13.0 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color	Odor / Comments
0906		18.35	0.084	2.50	11.68	-103	1.3	5.35	
0926	3	18.75	0.082	2.34	11.63	-100	1.4	5.35	
0946	4.75	19.01	0.078	2.34	11.72	-97	1.4	5.35	
1006	6.0	19.16	0.079	2.34	11.91	-98	1.3	5.40	
1026	8.0	19.31	0.291	2.33	12.55	-123	1.2	5.42	
1046	10.0	19.45	0.302	2.26	12.41	-116	1.2		
1056	11.5	19.53	0.320	2.36	12.39	-114	1.2		
1101	12.5	19.37	0.375	2.32	12.52	-116	1.2		
1106	13.0	19.52	0.379	2.18	12.55	-116	1.2	5.40	

Sample information: method, container number, size, and type, preservative used.

MS/MSD @ 1116
73-MW 39 DW-06 DUP @ 1116

(1) Alkalinity collected 4/10/06 Due to hold time issues

Sample Time @ 1116
Sample Appearance

Alk. linuity 4/10/06 @ 0802
Dup 4/10/06 @ 1120

Notes:
Flow Rate 300mL/min
OVM: 0ppm
Ferrous Iron: 0ppm

Signed by: Meredith C. Harris 04/10/06
Date

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client:
Location: IR73
Event: B
Date: 4/20/06
Weather: Sunny, Calm, 55°F

Well ID: 23-MW40DW
Sample ID: IR73-GW40DW-0608
Sample Team: Bob T. Marvel th H.

Total Depth: 110.86 FT.(BTOC) Measuring Device:
Depth to water: (-) 3.01 FT.(BTOC) Date and Time:
Water Column: 107.85 FT.
(x) .163 GAL/FT. [(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
Well Volume: 17.6 GAL. (1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)
Total Purge Volume: GAL.
Purge Device: peristaltic pump with new HDPE tubing 0837 started pumping

WELL DIAMETER

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW	Color / Odor / Comments
0839	0	19.48	0.265	3.82	6.65	-99	275	3.02	turbid
0929	3	19.88	0.193	0.0	8.02	-161	16.5	3.07	clear
1019	6	20.08	0.190	0.0	7.93	-167	6.77	3.10	clear
1109	9	20.28	0.190	0.0	7.92	-169	3.95	3.10	clear
1159	12	20.64	0.188	0.0	7.91	-163	2.47	3.10	clear
1249	15	20.71	0.187	0.0	7.91	-160	4.2	3.10	clear
1314	16	20.93	0.191	0.0	7.95	-165	3.3	3.10	clear
1339	17	21.00	0.190	0.0	7.94	-164	1.58	3.10	clear
1404	18	21.21	0.188	0.0	7.93	-163	1.49	3.10	clear

Sample information: method, container number, size, and type, preservative used.

Sample Time 1410
Sample Appearance

Notes:
START Purge 0837 @ .06GPM
Ferrous IRON = 1.0

Signed by: [signature] Date 4/20/06

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client:
Location: IR73
Event: B
Date: 4/20/06
Weather: Sunny, Calm, 55°F

Well ID: 73-MW41DW
Sample ID: IR73-GW41DW-06B
Sample Team: Bob T. Marabeth H

Total Depth: 71.00 FT.(BTOC) Measuring Device:
Depth to water: (-) 3.38 FT.(BTOC) Date and Time:
Water Column: 67.62 FT.
(x) 0.163 GAL/FT.
Well Volume: 11.0 GAL.
Total Purge Volume: 12.0 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW	Color / Odor / Comments
0845	0	19.32	0.777	1.17	10.00	-50	—	3.55	Clear
0914	2	19.43	0.90	0.35	7.1	-153	33.4	3.55	Clear
0943	4	19.39	0.945	0.27	7.1	-155	12.7	3.51	Clear
1002	6	19.23	0.471	0.08	9.22	-129	8.39	3.52	Clear
1041	8	19.32	0.481	0.25	9.06	-119	5.58	3.52	Clear
1056	9	19.35	0.486	0.00	8.98	-120	4.07	3.52	Clear
1111	10	19.40	0.488	0.00	8.97	-121	3.22	3.52	Clear
1126	11	19.48	0.456	0.00	8.92	-118	2.96	3.52	Clear

Sample information: method, container number, size, and type, preservative used.

Change Horiba's @ 0950 Due To Cond. Probe MALFunction Readings Quite Different. Horiba Calibrated OK

IR73-GW41DW-06BDUP

Sample Time 1130 | DUPLICATE SAMPLE @ 1140
Sample Appearance Clear

Notes:
0845 START Purged .07 GPM
Ferrous IRON = 2.0 mg
DUPLICATE Ferrous IRON = 2.0 mg

Signed by: [signature] 4/20/06
Date

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CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client:
Location: IR73
Event: B
Date: 4/18/06
Weather: Sunny, Breeze, 60°F

Well ID: 73-MW42DW
Sample ID: IR73-GW42DW-06B
Sample Team: Bob T. MARK O.

Total Depth: 112.77 FT.(BTOC) Measuring Device:
Depth to water: (-) 2.86 FT.(BTOC) Date and Time:
Water Column: 109.91 FT.
(x) 0.163 GAL/FT.
Well Volume: 18 GAL.
Total Purge Volume: 18 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color	Odor / Comments
1234	0	19.86	0.450	3.15	7.5	-103	104	2.75	Cloudy
1258	2	19.64	0.446	0.39	7.0	-131	10.9	2.80	Clear
1322	4	19.84	0.441	0.34	7.4	-163	1.55	2.80	Clear
1346	6	—	—	—	—	—	—	—	—
1410	8	20.17	0.434	0.24	7.4	-167	1.64	2.80	Clear
1434	10	20.15	0.448	0.25	7.4	-172	1.34	2.80	Clear
1458	12	20.18	0.446	0.24	7.4	-173	1.61	2.85	Clear
1522	14	20.00	0.437	0.21	7.4	-171	1.64	2.85	Clear
1546	16	19.91	0.435	0.20	7.4	-170	1.77	2.85	Clear
1610	18	19.87	0.446	0.22	7.4	-175		2.85	Clear

Sample information: method, container number, size, and type, preservative used.

DUE TO TIME CONSTRAINT - WILL BE purged 4/18/06 and SAMPLED 4/19/06 AM

Sample Time ~~04~~ 04/19/06 - 0745
Sample Appearance

Notes:
1234 Start Purge @ .08 GPM
04/19/06 Ferrous Iron = 1.0

Signed by: [signature] 4/18/06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVFAC
Location: IR73
Event: LTM
Date: 4-9-06
Weather: Sunny 55°F

Well ID: IR73-GW43DW-
Sample ID: IR73-GW43DW-06B

Sample Team: Matt W.

Total Depth: 70.03 FT.(BTOC) Measuring Device:
Depth to water: (-) 4.55 FT.(BTOC) Date and Time:
Water Column: 65.48 FT.
(x) 0.163 GAL/FT.
Well Volume: 10.673 GAL. x 3
Total Purge Volume: 32.019 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Draw Down ~~Color / Odor / Comments~~
1140	.5	20.10	0.321	0.00	7.23	-119	24.17	4.66
1155	2.0	20.16	0.321	0.00	7.40	-131	10.72	4.66
1205	3.0	20.19	0.321	0.00	7.44	-135	5.63	4.66
1215	4.0	20.30	0.321	0.00	7.45	-139	2.91	4.66
1235	6.0	20.31	0.323	0.00	7.55	-146	2.87	4.66
1245	7.0	20.25	0.323	0.00	7.54	-150	1.98	4.66
1255	8.0	20.30	0.323	0.00	7.55	-151	2.14	4.66
1305	9.0	20.30	0.325	0.00	7.55	-151	1.91	4.66
1320	10.5	20.38	0.324	0.00	7.56	-153	2.26	4.66

Sample information: method, container number, size, and type, preservative used.

Sample Time 1320 / 4-10-06 @ 0820
Sample Appearance Clear / Alkalinity

Notes: Fe^{2+} = .8

Signed by: Matt G. Westendorf

4-9-06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVFAC
Location: IR73
Event: LTM
Date: 4-9-06
Weather: sunny 55°F

Well ID: IR73-GW44DW-
Sample ID: IR73-GW44DW-06B
Sample Team: Matt W.

Total Depth: 70.14 FT.(BTOC) Measuring Device:
Depth to water: (-) 5.65 FT.(BTOC) Date and Time:
Water Column: 64.49 ~~0.163~~ FT.
(x) 0.163 GAL/FT.
Well Volume: 10.511 GAL X3
Total Purge Volume: 31.535 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color / Odor / Comments
1400	.5	20.90	0.457	0.00	6.37	-84	12.42	5.83
1420	2.5	20.87	0.456	0.00	6.85	-129	21.73	5.83
1440	4.5	20.91	0.457	0.00	7.02	-141	10.01	5.83
1500	6.5	21.16	0.464	0.00	7.06	-143	25.72	5.83
1510	7.5	21.11	0.466	0.00	7.07	-143	17.97	5.83
1520	8.5	21.13	0.467	0.00	7.07	-145	15.22	
1530	9.5	21.22	0.465	0.00	7.06	-145	10.12	
1540	10.5	21.19	0.465	0.00	7.07	-146	9.17	5.83

Sample information: method, container number, size, and type, preservative used.

Sample Time 1540 / 4-10-06 @ 0830
Sample Appearance Clear / Alkalinity

Notes: $Fe^{2+} = 3.6$

Signed by: Matt J. Westerdorf

4-9-06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVY
Location: 73
Event: 2nd Quarter 2006
Date: 04/18/06
Weather: Sunny 50's

Well ID: IR73-MW45
Sample ID: IR73-GW45-06B
IR73-GW45-06BDUP
Sample Team: M Harris
R DeLeon

Total Depth: 69.3 FT.(BTOC) Measuring Device:
Depth to water: (-) 0.83 FT.(BTOC) Date and Time:
Water Column: 68.47 FT.
(x) 0.163 GAL/FT.
Well Volume: 11.16 GAL.
Total Purge Volume: 11.5 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	DTW Color / Odor / Comments
0806	~	16.98	0.245	0.84	9.07	-67	34.1	0.83
0826	2	17.64	0.231	0.40	10.13	-103	35.2	0.83 clear
0846	4	17.77	0.229	0.54	10.28	-124	27.9	0.83 clear w/ particles
0906	6	18.00	0.224	0.52	10.89	-125	22.5	0.83 clear
0926	8 7.5	18.21	0.224	0.65	10.95	-128	14.6	0.83 clear
0946	10	18.38	0.222	0.54	10.88	-129	10.3	0.83 clear
0956	11	18.39	0.222	0.52	10.93	-130	9.21	0.83 clear
1001	11.5	18.51	0.221	0.45	10.94	-131	7.47	0.83 clear

Sample information: method, container number, size, and type, preservative used.

(2) VOC HCl (2) RSK-175 HCl (1) TOC HCl (1) Alkalinity NONE (1) Sulfide NaOH/ZnAc (1) Ferric Iron HNO3

Sample Time 1005 DUP @ 1005
Sample Appearance clear

Notes:
Ferrous Iron: 1Mg
NVM: 0ppm
Flow Rate 300mL/min

Signed by: Meredith C Harris 04/18/06
Date

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CH2M HILL Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVFAC
Location: IR73
Event: LTM
Date: 4-12-06
Weather: Sunny 55°F

Well ID: IR73-MW46DW
Sample ID: IR73-GW46DW-06B
Sample Team: Matt W.

Total Depth: 74.00 FT.(BTOC) Measuring Device:
Depth to water: (-) 12.18 FT.(BTOC) Date and Time:
Water Column: 61.82 FT.
(x) 0.163 GAL/FT.
Well Volume: 10.076 GAL x3
Total Purge Volume: 30.229 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Draw Down ~~Color / Odor / Comments~~
0810	.5	19.26	0.201	5.49	7.53	-54	88.7	6.96
0825	2.0	19.37	0.199	3.38	7.83	-60	15.3	
0845	4.0	19.49	0.200	1.87	7.90	-77	5.91	
0905	6.0	19.61	0.203	0.46	7.91	-88	7.34	
0925	8.0	19.85	0.200	0.00	8.00	-94	3.63	
0935	9.0	19.82	0.200	0.00	7.99	-95	7.14	
0945	10.0	19.84	0.200	0.00	8.00	-99	5.43	

Sample information: method, container number, size, and type, preservative used.

Sample Time 0945
Sample Appearance Clear

Notes: $Fe^{2+} = .2$

Signed by: Matt Westendorf 4-12-06
Date

CH2M HILL

Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVSEA

Location: IR73 - ~~MW35~~

Event: 06

Date: 4/20/06

Weather: Clr 50

Well ID: IR73-MW47DW

Sample ID: IR73-GW47-06B

Sample Team: M. OST

Total Depth: 74.49 ~~20.50~~ FT.(BTOC) Measuring Device: cup 300mL/min

Depth to water: (-) 6.25 FT.(BTOC) Date and Time:

Water Column: 68.24 FT.

2" WELL DIAMETER

(x) .163 GAL/FT. [(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]

Well Volume: 11.12 GAL. (1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

Total Purge Volume: 12 GAL.

Purge Device: peristaltic pump with new HDPE tubing

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color / Odor / Comments	
1122	0	20.2	0.59	1.86	7.34	-70	6.81	clr	6.34' BTC
1145	2	20.5	0.54	0.49	7.41	-77	2.99	clr	6.34' BTC
1207	4	20.6	0.54	0.12	7.56	-78	8.02	clr	6.34' BTC
1223	6	20.7	0.53	0.12	7.51	-84	1.66	clr	6.35' BTC
1241	8	20.7	0.53	0.05	7.52	-93	1.42	clr	6.35' BTC
1300	10	20.7	0.53	0.00	7.59	-93	1.41	clr	6.35' BTC
1320	12	20.8	0.53	0.00	7.53	-97	1.40	clr	6.35' BTC

Sample information: method, container number, size, and type, preservative used:

Sample Time 1325

Sample Appearance Clear

Notes:

Fe = 1.0 by HACH 300 ml/min Purge

Signed by: [signature] 4/20/06

Date

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CH2M HILL Project Number:

GROUNDWATER SAMPLING DATA SHEET

Client: NAVFAC
Location: IR73
Event: LTM
Date: 4-11-06
Weather: sunny 50°F

Well ID: MW-48DW
Sample ID: IR73-GW48DW-06B
Sample Team: Matt W

Total Depth: 74.20 FT.(BTOC) Measuring Device:
Depth to water: (-) 5.22 FT.(BTOC) Date and Time:
Water Column: 68.98 FT.
(x) 0.163 GAL/FT.
Well Volume: 11.243 GAL. x 3
Total Purge Volume: 33.731 GAL.
Purge Device: peristaltic pump with new HDPE tubing

WELL DIAMETER
[(2" DIA.= 0.163 GAL/FT.) (4" DIA. = 0.653 GAL/FT.)]
(1" DIA.= 0.041 GAL/FT.) (1 1/4 " DIA.= 0.064 GAL/FT.)

FIELD PARAMETERS

Time	Purge Vol. (gals)	Temp., °C	Cond. (µS/cm)	DO (mg/L)	pH	Redox (mV)	Turbidity (visual)	Color / Odor / Comments
0845	.5	19.62	0.211	0.00	7.33	-112	312.01	5.15
0900	2.0	19.95	0.203	0.00	7.47	-141	24.6	5.22
0920	4.0	20.54	0.213	0.00	7.89	-150	20.4	5.22
0935	5.5	20.66	0.213	0.00	7.90	-152	18.6	
0950	7.0	20.84	0.215	0.00	7.89	-154	15.7	5.22
1010	9.0	20.93	0.216	0.00	7.91	-155	4.91	
1020	10.0	20.90	0.215	0.00	7.90	-156	3.17	
1030	11.0	20.95	0.216	0.00	7.89	-155	4.21	5.22

Sample information: method, container number, size, and type, preservative used.

Sample Time 1030
Sample Appearance clear

Notes: $Fe^{2+} = 1.2$

Signed by: Matt J. Westendorf 4-11-06
Date

Appendix E
Laboratory Reports

To review a paper copy of the Raw Analytical Data associated with this report please contact:

Public Affairs Office
NAVFAC Atlantic
6506 Hampton Boulevard
Norfolk, VA 23598-1278

757-322-8005
NFECL PAO@navy.mil

Appendix F
Laboratory Reports from April 2006 Monitoring Well Sampling Event
Site 73 Amended Remedial Investigation
MCB Camp Lejeune, North Carolina

Station ID	IR73-A47/3-09		IR73-A47/3-12	IR73-A47/3-15	IR73-A47/3-16	IR73-A47/3-19		IR73-A47/3-22	IR73-A47/3-8		IR73-MW01	IR73-MW02	IR73-MW02IW	IR73-MW03	IR73-MW06	IR73-MW08	IR73-MW09
Sample ID	IR73-A47/3-9-06B	IR73-A47/3-9-06B2	IR73-A47/3-12-06B	IR73-A47/3-15-06B	IR73-A47/3-16-06B	IR73-GWA47/3-19-06B	IR73-GWA47/3-19-06BDUP	IR73-A47/3-22-06B	IR73-GWA47/3-8-06B	IR73-GWA47/3-8-06BDUP	IR73-GW01-06B	IR73-GW02-06B	IR73-GW02IW-06B	IR73-GW03-06B	IR73-GW06-06B	IR73-GW08-06B	IR73-GW09-06B
Sample Date	04/09/06	04/10/06	04/12/06	04/12/06	04/19/06	04/21/06	04/21/06	04/19/06	04/10/06	04/10/06	04/10/06	04/11/06	04/11/06	04/11/06	04/12/06	04/18/06	04/18/06
Chemical Name																	
Volatile Organic Compounds (UG/L)																	
1,1,1-Trichloroethane	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2,2-Tetrachloroethane	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	0.5 U	NA	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U
1,1,2-Trichloroethane	0.5 UJ	NA	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 U	0.5 R	0.5 U	0.5 UJ	0.5 UJ
1,1-Dichloroethane	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethene	0.45 J	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,3-Trichlorobenzene	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,4-Trichlorobenzene	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dibromo-3-chloropropane	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dibromoethane	0.5 UJ	NA	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
1,2-Dichlorobenzene	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethane	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloropropane	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,3-Dichlorobenzene	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,4-Dichlorobenzene	0.5 U	NA	0.33 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-Butanone	5 U	NA	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	5 U	5 U
2-Hexanone	5 U	NA	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	5 U	5 U
4-Methyl-2-pentanone	5 U	NA	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	5 U	5 U
Acetone	5 U	NA	5 U	5 UJ	5 UJ	5 U	5 U	5 UJ	5 U	5 U	5 U	5 UJ	5 U	5 U	5 UJ	5 UJ	5 UJ
Benzene	3.3	NA	0.33 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2.8	2.7	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromochloromethane	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromodichloromethane	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromoform	0.5 UJ	NA	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
Bromomethane	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Carbon disulfide	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Carbon tetrachloride	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chlorobenzene	0.5 U	NA	6.7	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroethane	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroform	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloromethane	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Cyclohexane	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2.9	3	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Dibromochloromethane	0.5 UJ	NA	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
Dichlorodifluoromethane (Freon-12)	0.5 U	NA	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 UJ	0.5 UJ
Ethylbenzene	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1.3	1.3	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methyl acetate	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methyl-tert-butyl ether (MTBE)	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methylcyclohexane	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	4.6	4.5	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methylene chloride	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Styrene	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Tetrachloroethene	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	0.5	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.42 J	0.41 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Trichloroethene	3.1	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.32 J	0.5 U	0.5 U	0.5 U	0.5 U
Trichlorofluoromethane(Freon-11)	0.5 UJ	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Vinyl chloride	6.2	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	3.7	3.8	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	3.5
Xylene, total	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1.2	1.2	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
cis-1,2-Dichloroethene	52	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.65	0.61	0.5 U	0.5 U	20	0.5 U	0.5 U	0.5 U	0.32 J
cis-1,3-Dichloropropene	0.5 UJ	NA	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 R	0.5 U	0.5 UJ	0.5 UJ
isopropylbenzene	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	13	12	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
trans-1,2-Dichloroethene	2.1	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.38 J	0.5 U	0.5 U	2	0.5 U	0.5 U	0.5 U	0.5 U
trans-1,3-Dichloropropene	0.5 UJ	NA	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 U	0.5 R	0.5 U	0.5 UJ	0.5 UJ

Station ID	IR73-MW10	IR73-MW11	IR73-MW12	IR73-MW13		IR73-MW15	IR73-MW15N	IR73-MW16		IR73-MW17		IR73-MW18	IR73-MW19	IR73-MW20	IR73-MW21	IR73-MW23	IR73-MW25		IR73-MW27	
Sample ID	IR73-GW10-06B	IR73-GW11-06B	IR73-GW12-06B	IR73-GW13-06B	IR73-GW13-06B2	IR73-GW15-06B	IR73-GW15N-06B	IR73-GW16-06B	IR73-GW16-06B2	IR73-GW17-06B	IR73-GW17-06B2	IR73-GW18-06B	IR73-GW19-06B	IR73-GW20-06B	IR73-GW21-06B	IR73-GW23-06B	IR73-GW25-06B	IR73-GW25-06BDUP	IR73-GW27-06B	IR73-GW27-06B2
Sample Date	04/20/06	04/10/06	04/10/06	04/09/06	04/10/06	04/12/06	04/12/06	04/09/06	04/10/06	04/09/06	04/10/06	04/18/06	04/11/06	04/19/06	04/21/06	04/11/06	04/12/06	04/12/06	04/09/06	04/10/06
Chemical Name																				
Volatile Organic Compounds (UG/L)																				
1,1,1-Trichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
1,1,2,2-Tetrachloroethane	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	0.5 U	0.5 U	0.5 U	0.5 UJ	NA	0.5 U	0.5 UJ	0.5 UJ	NA	0.5 UJ	NA	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
1,1,2-Trichloroethane	0.5 UJ	0.5 R	0.5 UJ	0.5 UJ	NA	0.5 UJ	0.5 UJ	0.5 UJ	NA	0.5 UJ	NA	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U	NA
1,1-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
1,1-Dichloroethene	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
1,2,3-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
1,2,4-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
1,2-Dibromo-3-chloropropane	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
1,2-Dibromoethane	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	NA	0.5 U	0.5 U	0.5 U	NA	0.5 UJ	NA	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
1,2-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
1,2-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
1,2-Dichloropropane	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
1,3-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
1,4-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
2-Butanone	5 U	5 U	5 U	5 U	NA	5 U	5 U	5 U	NA	5 U	NA	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	NA
2-Hexanone	5 U	5 U	5 U	5 U	NA	5 U	5 U	5 U	NA	5 U	NA	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	NA
4-Methyl-2-pentanone	5 U	5 U	5 U	5 U	NA	5 U	5 U	5 U	NA	5 U	NA	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	NA
Acetone	5 U	5 U	5 U	5 U	NA	5 U	5 UJ	5 U	NA	5 U	NA	5 UJ	5 UJ	5 U	5 U	5 U	5 UJ	5 U	5 U	NA
Benzene	0.5 U	0.5 U	0.5 U	2.9	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.51	NA
Bromochloromethane	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
Bromodichloromethane	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
Bromoform	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	NA	0.5 U	0.5 U	0.5 U	NA	0.5 UJ	NA	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
Bromomethane	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
Carbon disulfide	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.79	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
Carbon tetrachloride	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
Chlorobenzene	0.5 U	0.5 U	0.5 U	0.5 UJ	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
Chloroethane	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
Chloroform	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
Chloromethane	0.5 U	0.5 U	0.5 U	0.5 UJ	NA	0.5 U	0.5 U	0.5 UJ	NA	0.5 UJ	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
Cyclohexane	0.5 U	0.5 U	0.5 U	0.43 J	NA	0.36 J	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
Dibromochloromethane	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 UJ	NA	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
Dichlorodifluoromethane (Freon-12)	0.5 UJ	0.5 U	0.5 U	0.5 U	NA	0.5 UJ	0.5 U	0.5 U	NA	0.5 U	NA	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 UJ	0.5 U	NA
Ethylbenzene	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
Methyl acetate	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
Methyl-tert-butyl ether (MTBE)	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
Methylcyclohexane	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.41 J	NA
Methylene chloride	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
Styrene	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
Tetrachloroethene	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
Toluene	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
Trichloroethene	0.5 U	0.62	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
Trichlorofluoromethane(Freon-11)	0.5 U	0.5 U	0.5 U	0.5 UJ	NA	0.5 U	0.5 U	0.5 UJ	NA	0.5 UJ	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
Vinyl chloride	0.5 U	0.5 U	0.38 J	7.8 J	NA	0.5 U	0.5 U	0.5 UJ	NA	0.5 UJ	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
Xylene, total	0.5 U	0.5 U	0.5 U	0.5 UJ	NA	0.5 U	0.5 U	0.5 UJ	NA	0.5 UJ	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
cis-1,2-Dichloroethene	0.5 U	3.1	1.8	6.8	NA	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1	NA
cis-1,3-Dichloropropene	0.5 UJ	0.5 R	0.5 UJ	0.5 UJ	NA	0.5 UJ	0.5 UJ	0.5 UJ	NA	0.5 UJ	NA	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U	NA
isopropylbenzene	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.3 J	0.62	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
trans-1,2-Dichloroethene	0.5 U	0.5 U	0.5 U	1.5	NA	0.5 U	0.5 U	0.5 U	NA	0.33 J	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA
trans-1,3-Dichloropropene	0.5 UJ	0.5 R	0.5 UJ	0.5 UJ	NA	0.5 UJ	0.5 UJ	0.5 UJ	NA	0.5 UJ	NA	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U	NA

Appendix F
Laboratory Reports from April 2006 Monitoring Well Sampling Event
Site 73 Amended Remedial Investigation
MCB Camp Lejeune, North Carolina

Station ID	IR73-MW28	IR73-MW29		IR73-MW30	IR73-MW31	IR73-MW34	IR73-MW35	IR73-MW37		IR73-MW54	IR73-MW55	IR73-MW56	IR73-MW58	IR73-MW61	IR73-MW62DW
Sample ID	IR73-GW28-06B	IR73-GW29-06B	IR73-GW29-06B2	IR73-GW30-06B	IR73-GW31-06B	IR73-GW34-06B	IR73-GW35-06B	IR73-GW37-06B	IR73-GW37-06B2	IR73-GW54-06B	IR73-GW55-06B	IR73-GW56-06B	IR73-GW58-06B	IR73-GW61-06B	IR73-GW62DW-06B
Sample Date	04/20/06	04/09/06	04/10/06	04/11/06	04/12/06	04/21/06	04/20/06	04/09/06	04/10/06	04/12/06	04/11/06	04/11/06	04/11/06	04/20/06	04/12/06
Chemical Name															
Volatile Organic Compounds (UG/L)															
1,1,1-Trichloroethane	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2,2-Tetrachloroethane	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 UJ	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U
1,1,2-Trichloroethane	0.5 UJ	0.5 UJ	NA	0.5 R	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	NA	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U
1,1-Dichloroethane	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethene	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,3-Trichlorobenzene	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,4-Trichlorobenzene	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dibromo-3-chloropropane	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dibromoethane	0.5 U	0.5 UJ	NA	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	NA	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U
1,2-Dichlorobenzene	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethane	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloropropane	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,3-Dichlorobenzene	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,4-Dichlorobenzene	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-Butanone	5 U	5 R	NA	5 U	5 U	5 U	5 U	5 U	NA	5 U	5 U	5 U	5 U	5 U	5 U
2-Hexanone	5 U	5 U	NA	5 U	5 U	5 U	5 U	5 U	NA	5 U	5 U	5 U	5 U	5 U	5 U
4-Methyl-2-pentanone	5 U	5 U	NA	5 U	5 U	5 U	5 U	5 U	NA	5 U	5 U	5 U	5 U	5 U	5 U
Acetone	5 U	5 R	NA	5 U	5 UJ	5 U	5 U	5 U	NA	5 UJ	5 U	5 U	5 UJ	5 U	5 U
Benzene	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromochloromethane	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromodichloromethane	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromoform	0.5 U	0.5 UJ	NA	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	NA	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U
Bromomethane	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Carbon disulfide	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Carbon tetrachloride	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chlorobenzene	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroethane	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroform	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloromethane	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Cyclohexane	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Dibromochloromethane	0.5 U	0.5 UJ	NA	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	NA	0.5 U	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U
Dichlorodifluoromethane (Freon-12)	0.5 UJ	0.5 U	NA	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U
Ethylbenzene	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methyl acetate	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methyl-tert-butyl ether (MTBE)	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methylcyclohexane	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methylene chloride	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Styrene	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Tetrachloroethene	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Trichloroethene	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	1.5	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Trichlorofluoromethane(Freon-11)	0.5 U	0.5 UJ	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Vinyl chloride	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Xylene, total	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
cis-1,2-Dichloroethene	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	1.9	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
cis-1,3-Dichloropropene	0.5 UJ	0.5 UJ	NA	0.5 R	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	NA	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U
isopropylbenzene	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
trans-1,2-Dichloroethene	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.94	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
trans-1,3-Dichloropropene	0.5 UJ	0.5 UJ	NA	0.5 R	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	NA	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U

Station ID	IR73-A47/3-09		IR73-A47/3-12	IR73-A47/3-15	IR73-A47/3-16	IR73-A47/3-19		IR73-A47/3-22	IR73-A47/3-8		IR73-MW01	IR73-MW02	IR73-MW02IW	IR73-MW03	IR73-MW06	IR73-MW08	IR73-MW09
Sample ID	IR73-A47/3-9-06B	IR73-A47/3-9-06B2	IR73-A47/3-12-06B	IR73-A47/3-15-06B	IR73-A47/3-16-06B	IR73-GWA47/3-19-06B	IR73-GWA47/3-19-06BDUP	IR73-A47/3-22-06B	IR73-GWA47/3-8-06B	IR73-GWA47/3-8-06BDUP	IR73-GW01-06B	IR73-GW02-06B	IR73-GW02IW-06B	IR73-GW03-06B	IR73-GW06-06B	IR73-GW08-06B	IR73-GW09-06B
Sample Date	04/09/06	04/10/06	04/12/06	04/12/06	04/19/06	04/21/06	04/21/06	04/19/06	04/10/06	04/10/06	04/10/06	04/11/06	04/11/06	04/11/06	04/12/06	04/18/06	04/18/06
Chemical Name																	
Total Metals (UG/L)																	
Iron	2,500	NA	4,100	23,000	20,000	5,100	4,200	62,000	15,000	15,000	17,000	4,700	7,500	9,500	51,000	3,700	1,300
Wet Chemistry (MG/L)																	
Alkalinity	NA	40	410	340	460	440	450	440	420	420	90	150	32	240	670	94	150
Chloride	NA	55 J	96 J	68 J	49 J	530 J	580 J	560 J	62 J	56 J	35 J	10 J	16 J	14 J	46 J	15 J	20 J
Ethane	0.026 U	NA	0.026 U	0.026 U	0.026 U	0.026 U	0.026 U	0.026 U	0.026 U	0.026 U	0.026 U	0.026 U	0.026 U	0.025 U	0.026 U	0.026 U	0.026 U
Ethene	0.034 U	NA	0.034 U	0.034 U	0.035 U	0.035 U	0.035 U	0.035 U	0.035 U	0.034 U	0.035 U	0.035 U	0.035 U	0.033 U	0.035 U	0.034 U	0.034 U
Ferric iron	NA	10 U	10 U	20	16	10 U	10 U	47	12	11	16	10 U	10 U	10 U	47	10 U	10 U
Ferrous iron	NA	2.2 J	1.3	3.7	4.8 J	2.3 J	2.2	15 J	3.6 J	4.4 J	1 J	1 U	1 U	1 UJ	4.3 J	1 UJ	1 UJ
Methane	5.9	NA	0.075	4.8	4.3	7	7.3	4.7	5.2	5.7	0.49	0.1 U	0.58 U	1.2 U	2.2	1.7	0.43
Nitrate	NA	0.13 UJ	0.13 U	0.13 U	1.9 J	0.13 U	0.24 J	0.44 J	0.13 U	0.13 U	0.13 U	0.28	0.19 U	0.15	0.17	0.3 J	0.52 J
Nitrite	NA	0.43 J	0.44 J	0.44 J	0.13 U	0.13 U	0.13 U	0.13 U	0.68	0.84	0.14	0.17 J	0.13 UJ	0.21	0.86 J	0.13 U	0.13 U
Sulfate	NA	5 U	5 U	5 U	5 U	5 U	5 U	5 U	14 J	9.6 J	95 J	18	5 U	5 UJ	5 U	7.2	5 U
Sulfide	0.03 U	NA	0.03 U	0.03 U	0.03 U	0.03 UJ	0.03 UJ	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
Total organic carbon (TOC)	24	NA	27	31	29	45	44	19	28	22	10 U	10	10 U	26	58	10 U	10 U

Notes:
U- Analyte not detected
J- Reported value is estimated
UJ- Analyte not detected. Quantitation limit is imprecise
NA- Not analyzed
R- Unreliable result

Station ID	IR73-MW10	IR73-MW11	IR73-MW12	IR73-MW13		IR73-MW15	IR73-MW15N	IR73-MW16		IR73-MW17		IR73-MW18	IR73-MW19	IR73-MW20	IR73-MW21	IR73-MW23	IR73-MW25		IR73-MW27	
Sample ID	IR73-GW10-06B	IR73-GW11-06B	IR73-GW12-06B	IR73-GW13-06B	IR73-GW13-06B2	IR73-GW15-06B	IR73-GW15N-06B	IR73-GW16-06B	IR73-GW16-06B2	IR73-GW17-06B	IR73-GW17-06B2	IR73-GW18-06B	IR73-GW19-06B	IR73-GW20-06B	IR73-GW21-06B	IR73-GW23-06B	IR73-GW25-06B	IR73-GW25-06BDUP	IR73-GW27-06B	IR73-GW27-06B2
Sample Date	04/20/06	04/10/06	04/10/06	04/09/06	04/10/06	04/12/06	04/12/06	04/09/06	04/10/06	04/09/06	04/10/06	04/18/06	04/11/06	04/19/06	04/21/06	04/11/06	04/12/06	04/12/06	04/09/06	04/10/06
Chemical Name																				
Total Metals (UG/L)																				
Iron	4,100	1,100	700	1,400	NA	16,000	13,000	17,000	NA	280	NA	1,800	10,000	2,800	20,000	2,600	13,000	13,000	910	NA
Wet Chemistry (MG/L)																				
Alkalinity	290	95	120	NA	150	490	270	NA	250	NA	320	75	430	61	20 U	20 U	100	92	NA	310
Chloride	28 J	17 J	28 J	NA	71 J	340 J	55 J	NA	19 J	NA	31 J	35 J	170 J	16 J	140 J	34 J	25 J	23 J	NA	87 J
Ethane	0.026 U	0.026 U	0.026 U	0.026 U	NA	0.026 U	0.026 U	0.026 U	NA	0.026 U	NA	0.026 U	0.026 U	0.027 U	0.026 U	0.026 U	0.026 U	0.026 U	0.026 U	NA
Ethene	0.034 U	0.035 U	0.035 U	0.035 U	NA	0.034 U	0.034 U	0.035 U	NA	0.035 U	NA	0.034 U	0.035 U	0.036 U	0.035 U	0.035 U	0.035 U	0.035 U	0.034 U	NA
Ferric iron	10 U	10 U	10 U	NA	10 U	12	10 U	NA	16	NA	10 U	10 U	10 U	10 U	17	10 U	12	13	NA	10 U
Ferrous iron	1 U	1 U	1 UJ	NA	1.3 J	4.6	3.5 J	NA	1 UJ	NA	1 UJ	1 UJ	4.5	2.9	3.1 J	1 UJ	1 U	1 U	NA	1 UJ
Methane	1.3	0.84	0.82	3.1	NA	7.5	1.5	0.97	NA	3	NA	0.15	3.6 U	0.38	0.028	0.18 U	0.46	0.38	3.9	NA
Nitrate	0.13 U	0.17	0.13 U	NA	0.13 UJ	0.13 U	0.13 U	NA	0.13 UJ	NA	0.13 UJ	1.8 J	0.13 U	0.13 U	0.13 U	0.35	0.13 U	0.28 J	NA	0.13 UJ
Nitrite	0.13 U	0.26	0.62	NA	0.36 J	0.13 U	0.4 J	NA	0.64 J	NA	0.57 J	0.13 U	0.13 UJ	0.13 U	0.13 U	0.13 U	0.15 J	0.14	NA	0.39 J
Sulfate	27	24 J	7.9 J	NA	5 U	5.3	5 U	NA	28	NA	5 U	80	5 U	56	40	6.4 J	26	17	NA	130
Sulfide	0.03 UJ	0.03 U	0.03 U	0.56	NA	0.03 U	0.03 U	0.03 U	NA	0.03 U	NA	0.03 U	0.095	0.03 UJ	0.03 UJ	0.056	0.03 U	0.03 U	0.66	NA
Total organic carbon (TOC)	10	10 U	10 U	30	NA	18	41	14	NA	25	NA	20 U	42	20 U	10 U	21	10 U	12	29	NA

Notes:
U- Analyte not detected
J- Reported value is estimated
UJ- Analyte not detected. Quantitation limit is imprecise
NA- Not analyzed
R- Unreliable result

Appendix F
Laboratory Reports from April 2006 Monitoring Well Sampling Event
Site 73 Amended Remedial Investigation
MCB Camp Lejeune, North Carolina

Station ID	IR73-MW28	IR73-MW29		IR73-MW30	IR73-MW31	IR73-MW34	IR73-MW35	IR73-MW37		IR73-MW54	IR73-MW55	IR73-MW56	IR73-MW58	IR73-MW61	IR73-MW62DW
Sample ID	IR73-GW28-06B	IR73-GW29-06B	IR73-GW29-06B2	IR73-GW30-06B	IR73-GW31-06B	IR73-GW34-06B	IR73-GW35-06B	IR73-GW37-06B	IR73-GW37-06B2	IR73-GW54-06B	IR73-GW55-06B	IR73-GW56-06B	IR73-GW58-06B	IR73-GW61-06B	IR73-GW62DW-06B
Sample Date	04/20/06	04/09/06	04/10/06	04/11/06	04/12/06	04/21/06	04/20/06	04/09/06	04/10/06	04/12/06	04/11/06	04/11/06	04/11/06	04/20/06	04/12/06
Chemical Name															
Total Metals (UG/L)															
Iron	280	1,100	NA	18,000	4,500	65,000	3,500	2,100	NA	5,200	13,000	840	20,000	1,600	3,600
Wet Chemistry (MG/L)															
Alkalinity	140	NA	69	37	220	20 U	20 U	NA	110	160	400	100	62	270	51
Chloride	14 J	NA	38 J	16 J	24 J	68 J	34 J	NA	31 J	17 J	55 J	31 J	18 J	33 J	24 J
Ethane	0.026 U	0.026 U	NA	0.026 U	0.027 U	0.026 U	0.026 U	0.026 U	NA	0.026 U	0.026 U	0.027 U	0.027 U	0.026 U	0.026 U
Ethene	0.035 U	0.034 U	NA	0.035 U	0.036 U	0.035 U	0.035 U	0.035 U	NA	0.035 U	0.035 U	0.036 U	0.036 U	0.035 U	0.035 U
Ferric iron	10 U	NA	10 U	18	10 U	65	10 U	NA	10 U	10 U	11	10 U	20	10 U	10 U
Ferrous iron	1 U	NA	1 UJ	1 UJ	1 UJ	1 U	1 UJ	NA	2.6 J	3 J	2.1	1 U	1 U	1 UJ	1.2 J
Methane	0.046	0.62	NA	0.5 U	0.1	0.014 U	0.081	1.1	NA	2.2	1.5	1	0.014 U	2.7	2.3
Nitrate	0.13 U	NA	0.31 J	0.13 U	0.13 U	0.66 J	0.13 U	NA	0.13 UJ	0.13 U	0.13 U	0.13 U	3	0.31 J	0.13 U
Nitrite	0.13 U	NA	0.38 J	0.13 U	0.4 J	0.13 U	0.13 U	NA	0.37 J	0.24 J	0.58 J	0.13 U	0.13 UJ	0.13 U	0.13 UJ
Sulfate	11	NA	11	5.8 J	130	23	12	NA	6.8	5 U	8.1	6.5 J	70	5 U	5 U
Sulfide	0.03 UJ	0.03 U	NA	0.03 U	0.03 U	0.03 UJ	0.03 UJ	0.03 U	NA	0.03 U	0.03 U	0.4	0.03 U	0.03 UJ	0.03 U
Total organic carbon (TOC)	10 U	11	NA	46	10 U	230	10 U	13	NA	16	25	20	10 U	23	10 U

Notes:
U- Analyte not detected
J- Reported value is estimated
UJ- Analyte not detected. Quantitation limit is imprecise
NA- Not analyzed
R- Unreliable result

Station ID	IR73-MW01DW		IR73-MW01IW	IR73-MW06IW	IR73-MW11DW		IR73-MW11IW	IR73-MW13DW		IR73-MW15IW	IR73-MW17DW		IR73-MW20DW	IR73-MW26DW	IR73-MW27DW	
Sample ID	IR73-GW01DW-06BDUP	IR73-GW01DW-06B	IR73-GW01IW-06B	IR73-GW06IW-06B	IR73-GW11DW-06B	IR73-GW11DW-06BDUP	IR73-GW11IW-06B	IR73-GW13DW-06B	IR73-GW13DW-06B2	IR73-GW15IW-06B	IR73-GW17DW-06B	IR73-GW17DW-06B2	IR73-GW20DW-06B	IR73-GW26DW-06B	IR73-GW27DW-06B	IR73-GW27DW-06B2
Sample Date	04/10/06	04/10/06	04/10/06	04/12/06	04/11/06	04/11/06	04/10/06	04/09/06	04/10/06	04/19/06	04/09/06	04/10/06	04/19/06	04/19/06	04/09/06	04/10/06
Chemical Name																
Volatile Organic Compounds (UG/L)																
1,1,1-Trichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
1,1,2,2-Tetrachloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
1,1,2-Trichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 UJ	NA	0.5 U	0.5 UJ	0.5 U	NA
1,1-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
1,1-Dichloroethene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	4.2	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.63	NA
1,2,3-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
1,2,4-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
1,2-Dibromo-3-chloropropane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
1,2-Dibromoethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 UJ	0.5 U	NA
1,2-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
1,2-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
1,2-Dichloropropane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
1,3-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
1,4-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
2-Butanone	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	NA	5 U	5 U	NA	5 U	5 U	5 U	NA
2-Hexanone	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	NA	5 U	5 U	NA	5 U	5 U	5 U	NA
4-Methyl-2-pentanone	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	NA	5 U	5 U	NA	5 U	5 U	5 U	NA
Acetone	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	NA	5 UJ	5 U	NA	5 UJ	5 UJ	5 U	NA
Benzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	3.7	NA	0.5 U	0.5 U	NA	0.56	0.5 U	0.73	NA
Bromochloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
Bromodichloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
Bromoform	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 UJ	0.5 U	NA
Bromomethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
Carbon disulfide	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
Carbon tetrachloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
Chlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
Chloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
Chloroform	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
Chloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
Cyclohexane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
Dibromochloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 UJ	0.5 U	NA
Dichlorodifluoromethane (Freon-12)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 UJ	0.5 U	NA	0.5 UJ	0.5 UJ	0.5 U	NA
Ethylbenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
Methyl acetate	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
Methyl-tert-butyl ether (MTBE)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
Methylcyclohexane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
Methylene chloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
Styrene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
Tetrachloroethene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
Toluene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
Trichloroethene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	200	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	52	NA
Trichlorofluoromethane(Freon-11)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	NA	0.5 U	0.5 UJ	NA	0.5 U	0.5 U	0.5 UJ	NA
Vinyl chloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	32	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	3.1	NA
Xylene, total	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	2.5 R	NA
cis-1,2-Dichloroethene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	130	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	29	NA
cis-1,3-Dichloropropene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	NA	0.5 U	0.5 UJ	NA	0.5 U	0.5 UJ	0.5 U	NA
isopropylbenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	NA
trans-1,2-Dichloroethene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2.9	NA	0.5 U	0.5 U	NA	0.5 U	0.5 U	1.3	NA
trans-1,3-Dichloropropene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	NA	0.5 U	0.5 UJ	NA	0.5 U	0.5 UJ	0.5 U	NA

Station ID	IR73-MW31DW	IR73-MW33DW	IR73-MW34DW	IR73-MW35DW	IR73-MW38DW		IR73-MW39DW				IR73-MW40DW	IR73-MW41DW		IR73-MW42DW	IR73-MW43DW
Sample ID	IR73-GW31DW-06B	IR73-GW33DW-06B	IR73-GW34DW-06B	IR73-GW35DW-06B	IR73-GW38DW-06B	IR73-GW38DW-06B2	IR73-GW39DW-06B	IR73-GW39DW-06BDUP	IR73-GW39DW-06B2	IR73-GW39DW-06BDUP2	IR73-GW40DW-06B	IR73-GW41DW-06BDUP	IR73-GW41DW-06B	IR73-GW42DW-06B	IR73-GW43DW-06B
Sample Date	04/12/06	04/10/06	04/21/06	04/20/06	04/09/06	04/19/06	04/09/06	04/09/06	04/10/06	04/10/06	04/20/06	04/20/06	04/20/06	04/19/06	04/09/06
Chemical Name															
Volatile Organic Compounds (UG/L)															
1,1,1-Trichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2,2-Tetrachloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	0.5 U	0.5 R	0.5 U	0.5 U	0.5 UJ	NA	0.5 U	0.5 UJ	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-Trichloroethane	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 U	NA	0.5 UJ	0.5 U	NA	NA	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ
1,1-Dichloroethane	0.5 U	0.5 R	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethene	0.5 U	0.5 R	0.5 U	0.5 U	0.5 U	NA	2.7 J	0.36 J	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,3-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,4-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dibromo-3-chloropropane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dibromoethane	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	NA	0.5 UJ	0.5 U	NA	NA	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U
1,2-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloropropane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U
1,3-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,4-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-Butanone	5 U	5 R	5 U	5 U	5 U	NA	5 R	5 U	NA	NA	5 U	5 U	5 U	5 U	5 U
2-Hexanone	5 U	5 UJ	5 U	5 U	5 U	NA	5 U	5 U	NA	NA	5 U	5 U	5 U	5 U	5 U
4-Methyl-2-pentanone	5 U	5 UJ	5 U	5 U	5 U	NA	5 U	5 U	NA	NA	5 U	5 U	5 U	5 U	5 U
Acetone	5 UJ	5 R	5 U	5 U	5 U	NA	5 R	5 U	NA	NA	5 U	5 U	5 U	5 UJ	5 U
Benzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	5.5 J	0.87 J	NA	NA	0.5 U	1.7	1.6	0.5 U	0.5 U
Bromochloromethane	0.5 U	0.5 R	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromodichloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U
Bromoform	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	NA	0.5 UJ	0.5 U	NA	NA	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U
Bromomethane	0.5 U	0.5 R	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Carbon disulfide	0.5 U	0.5 R	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Carbon tetrachloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroethane	0.5 U	0.5 R	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroform	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloromethane	0.5 U	0.5 R	0.5 U	0.5 U	0.5 UJ	NA	0.5 U	0.5 UJ	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Cyclohexane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U
Dibromochloromethane	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	NA	0.5 UJ	0.5 U	NA	NA	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U
Dichlorodifluoromethane (Freon-12)	0.5 U	0.5 R	0.5 UJ	0.5 UJ	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U
Ethylbenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methyl acetate	0.5 U	0.5 R	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methyl-tert-butyl ether (MTBE)	0.5 U	0.5 R	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methylcyclohexane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U
Methylene chloride	0.5 U	0.5 R	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Styrene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Tetrachloroethene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U	NA	0.4 J	0.27 J	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Trichloroethene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	20 J	4.8 J	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Trichlorofluoromethane(Freon-11)	0.5 U	0.5 R	0.5 U	0.5 U	0.5 UJ	NA	0.5 UJ	0.5 UJ	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ
Vinyl chloride	0.5 U	0.5 R	0.5 U	0.5 U	0.5 UJ	NA	14 J	1.9 J	NA	NA	0.5 U	5.1	5	0.5 U	0.5 U
Xylene, total	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	NA	0.5 U	0.5 UJ	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
cis-1,2-Dichloroethene	0.5 U	0.35 J	0.5 U	0.5 U	0.5 U	NA	15 J	4.1 J	NA	NA	0.5 U	13	12	0.5 U	0.5 U
cis-1,3-Dichloropropene	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	NA	0.5 UJ	0.5 U	NA	NA	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ
isopropylbenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
trans-1,2-Dichloroethene	0.5 U	0.5 R	0.5 U	0.5 U	0.5 U	NA	0.71 J	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
trans-1,3-Dichloropropene	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	NA	0.5 UJ	0.5 U	NA	NA	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ

Station ID	IR73-MW43DW	IR73-MW44DW		IR73-MW45DW		IR73-MW46DW	IR73-MW47DW	IR73-MW48DW	IR73-MW49DW	IR73-MW49DWA	IR73-MW49IW	IR73-MW50DW		IR73-MW51	IR73-MW51DW	IR73-MW52
Sample ID	IR73-GW43DW-06B2	IR73-GW44DW-06B	IR73-GW44DW-06B2	IR73-GW45DW-06BDUP	IR73-GW45DW-06B	IR73-GW46DW-06B	IR73-GW47DW-06B	IR73-GW48DW-06B	IR73-GW49DW-06B	IR73-GW49DWA-06B	IR73-GW49IW-06B	IR73-GW50DW-06B	IR73-GW50DW-06B2	IR73-GW51-06B	IR73-GW51DW-06B	IR73-GW52-06B
Sample Date	04/10/06	04/09/06	04/10/06	04/18/06	04/18/06	04/12/06	04/20/06	04/11/06	04/10/06	04/10/06	04/10/06	04/09/06	04/10/06	04/18/06	04/18/06	04/19/06
Chemical Name																
Volatile Organic Compounds (UG/L)																
1,1,1-Trichloroethane	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
1,1,2,2-Tetrachloroethane	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	NA	0.5 U	NA	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
1,1,2-Trichloroethane	NA	0.5 UJ	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	NA	0.5 UJ	0.5 U	0.5 UJ
1,1-Dichloroethane	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
1,1-Dichloroethene	NA	21	NA	0.5 U	0.5 U	0.36 J	0.5 U	1.8	13	0.5 U	4	0.5 U	NA	0.5 U	0.5 U	0.5 U
1,2,3-Trichlorobenzene	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
1,2,4-Trichlorobenzene	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
1,2-Dibromo-3-chloropropane	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
1,2-Dibromoethane	NA	0.5 UJ	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U	NA	0.5 UJ	0.5 U	0.5 UJ
1,2-Dichlorobenzene	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
1,2-Dichloroethane	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
1,2-Dichloropropane	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
1,3-Dichlorobenzene	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
1,4-Dichlorobenzene	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
2-Butanone	NA	5 UJ	NA	5 U	5 U	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	NA	5 U	5 U	5 U
2-Hexanone	NA	5 U	NA	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	NA	5 U	5 U	5 U
4-Methyl-2-pentanone	NA	5 U	NA	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	NA	5 U	5 U	5 U
Acetone	NA	5 UJ	NA	5 UJ	5 UJ	5 UJ	5 U	5 U	5 UJ	5 U	5 U	5 U	NA	5 UJ	5 UJ	5 UJ
Benzene	NA	8.9	NA	0.31 J	0.73	0.5 U	0.5 U	1.7	8.1	0.5 U	5.1	5.7	NA	0.5 U	0.5 U	0.5 U
Bromochloromethane	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
Bromodichloromethane	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
Bromoform	NA	0.5 UJ	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U	NA	0.5 UJ	0.5 U	0.5 UJ
Bromomethane	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
Carbon disulfide	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
Carbon tetrachloride	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
Chlorobenzene	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
Chloroethane	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
Chloroform	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
Chloromethane	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
Cyclohexane	NA	0.82	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
Dibromochloromethane	NA	0.5 UJ	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U	NA	0.5 UJ	0.5 U	0.5 UJ
Dichlorodifluoromethane (Freon-12)	NA	0.5 U	NA	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 UJ	0.5 UJ	0.5 UJ
Ethylbenzene	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
Methyl acetate	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
Methyl-tert-butyl ether (MTBE)	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
Methylcyclohexane	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
Methylene chloride	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.64	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
Styrene	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
Tetrachloroethene	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
Toluene	NA	0.6	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.36 J	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
Trichloroethene	NA	290	NA	3.1	7.1	9	1.8	82	840	0.5 U	170	0.5 U	NA	0.5 U	0.5 U	0.5 U
Trichlorofluoromethane(Freon-11)	NA	0.5 UJ	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 U	NA	0.5 U	0.5 U	0.5 U
Vinyl chloride	NA	130 J	NA	1.4	1.2	2.9	0.5 U	4	70 J	0.5 U	57 J	37 J	NA	0.5 U	0.5 U	0.5 U
Xylene, total	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
cis-1,2-Dichloroethene	NA	400	NA	7.5	16	18	2.1	77	550	0.5 U	1,300	14	NA	0.5 U	0.5 U	0.5 U
cis-1,3-Dichloropropene	NA	0.5 UJ	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	NA	0.5 UJ	0.5 U	0.5 UJ
isopropylbenzene	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U
trans-1,2-Dichloroethene	NA	23	NA	0.5 U	0.5 U	2.1	0.5 U	0.5 U	14	0.5 U	39 J	0.5 U	NA	0.5 U	0.5 U	0.5 U
trans-1,3-Dichloropropene	NA	0.5 UJ	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	NA	0.5 UJ	0.5 U	0.5 UJ

Station ID	IR73-MW52DW	IR73-MW53	IR73-MW63DW	
Sample ID	IR73-GW52DW-06B	IR73-GW53-06B	IR73-GW63DW-06BDUP	IR73-GW63DW-06B
Sample Date	04/19/06	04/21/06	04/11/06	04/11/06
Chemical Name				
Volatile Organic Compounds (UG/L)				
1,1,1-Trichloroethane	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2,2-Tetrachloroethane	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	0.5 U	0.5 U	0.5 UJ	0.5 UJ
1,1,2-Trichloroethane	0.5 U	0.5 UJ	0.5 U	0.5 U
1,1-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethene	0.5 U	0.5 U	4.3	3.8
1,2,3-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U
1,2,4-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dibromo-3-chloropropane	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dibromoethane	0.5 U	0.5 UJ	0.5 U	0.5 U
1,2-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloropropane	0.5 U	0.5 U	0.5 U	0.5 U
1,3-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U
1,4-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U
2-Butanone	5 U	5 U	5 U	5 U
2-Hexanone	5 U	5 U	5 U	5 U
4-Methyl-2-pentanone	5 U	5 U	5 U	5 U
Acetone	5 UJ	5 U	5 UJ	5 UJ
Benzene	0.51	0.5 U	5	4.4
Bromochloromethane	0.5 U	0.5 U	0.5 U	0.5 U
Bromodichloromethane	0.5 U	0.5 U	0.5 U	0.5 U
Bromoform	0.5 U	0.5 UJ	0.5 U	0.5 U
Bromomethane	0.5 U	0.5 U	0.5 U	0.5 U
Carbon disulfide	0.5 U	0.5 U	0.5 U	0.5 U
Carbon tetrachloride	0.5 U	0.5 U	0.5 U	0.5 U
Chlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U
Chloroethane	0.5 U	0.5 U	0.5 U	0.5 U
Chloroform	0.5 U	0.5 U	0.5 U	0.5 U
Chloromethane	0.5 U	0.5 U	0.5 U	0.5 U
Cyclohexane	0.5 U	0.5 U	0.5 U	0.5 U
Dibromochloromethane	0.5 U	0.5 UJ	0.5 U	0.5 U
Dichlorodifluoromethane (Freon-12)	0.5 UJ	0.5 UJ	0.5 U	0.5 U
Ethylbenzene	0.5 U	0.5 U	0.5 U	0.5 U
Methyl acetate	0.5 U	0.5 U	0.5 U	0.5 U
Methyl-tert-butyl ether (MTBE)	0.5 U	0.5 U	0.5 U	0.5 U
Methylcyclohexane	0.5 U	0.5 U	0.5 U	0.5 U
Methylene chloride	0.5 U	0.5 U	1 U	0.5 U
Styrene	0.5 U	0.5 U	0.5 U	0.5 U
Tetrachloroethene	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	0.5 U	0.5 U	0.5 U	0.5 U
Trichloroethene	0.87	0.5 U	540	520
Trichlorofluoromethane(Freon-11)	0.5 U	0.5 U	0.5 U	0.5 U
Vinyl chloride	2.1	0.5 U	11	10
Xylene, total	0.5 U	0.5 U	0.5 U	0.5 U
cis-1,2-Dichloroethene	5.9	0.5 U	210	200
cis-1,3-Dichloropropene	0.5 U	0.5 UJ	0.5 U	0.5 U
isopropylbenzene	0.5 U	0.5 U	0.5 U	0.5 U
trans-1,2-Dichloroethene	0.5 U	0.5 U	7.8	6.5
trans-1,3-Dichloropropene	0.5 U	0.5 UJ	0.5 U	0.5 U

Station ID	IR73-MW01DW		IR73-MW01IW	IR73-MW06IW	IR73-MW11DW		IR73-MW11IW	IR73-MW13DW		IR73-MW15IW	IR73-MW17DW		IR73-MW20DW	IR73-MW26DW	IR73-MW27DW	
Sample ID	IR73-GW01DW-06BDUP	IR73-GW01DW-06B	IR73-GW01IW-06B	IR73-GW06IW-06B	IR73-GW11DW-06B	IR73-GW11DW-06BDUP	IR73-GW11IW-06B	IR73-GW13DW-06B	IR73-GW13DW-06B2	IR73-GW15IW-06B	IR73-GW17DW-06B	IR73-GW17DW-06B2	IR73-GW20DW-06B	IR73-GW26DW-06B	IR73-GW27DW-06B	IR73-GW27DW-06B2
Sample Date	04/10/06	04/10/06	04/10/06	04/12/06	04/11/06	04/11/06	04/10/06	04/09/06	04/10/06	04/19/06	04/09/06	04/10/06	04/19/06	04/19/06	04/09/06	04/10/06
Chemical Name																
Total Metals (UG/L)																
Iron	420	210	3,900	1,900	240	280	4,700	2,500	NA	1,800	820	NA	900	200 U	670	NA
Wet Chemistry (MG/L)																
Alkalinity	200	200	47	20 U	180	170	100	NA	140	190	NA	120	200	190	NA	320
Chloride	28 J	28 J	30 J	19 J	37 J	14 J	13 J	NA	120 J	95 J	NA	32 J	43 J	1,100 J	NA	69 J
Ethane	0.026 U	0.027 U	0.026 U	0.026 U	0.026 U	0.026 U	0.026 U	0.026 U	NA	0.026 U	0.027 U	NA	0.026 U	0.026 U	0.026 U	NA
Ethene	0.035 U	0.036 U	0.035 U	0.035 U	0.035 U	0.034 U	0.035 U	0.035 U	NA	0.034 U	0.036 U	NA	0.035 U	0.035 U	0.035 U	NA
Ferric iron	10 U	10 U	10 U	10 U	10 U	10 U	10 U	NA	10 U	10 U	NA	10 U	10 U	10 U	NA	10 U
Ferrous iron	1 UJ	1 UJ	1 UJ	1 UJ	1 U	1 U	1 U	NA	1 UJ	1 UJ	NA	1 UJ	1 U	1 U	NA	1 UJ
Methane	0.014 U	0.014 U	2.4	1.6	0.014 U	0.031 U	5	1.8	NA	0.58	0.014 U	NA	0.036 J	0.082	1.8	NA
Nitrate	0.44	0.45	0.72	2.2	0.13 U	0.13 U	0.13 U	NA	0.13 UJ	0.17 J	NA	0.13 UJ	0.13 U	0.13 U	NA	0.6 J
Nitrite	0.32	0.36	0.23	0.33 J	0.13 U	0.13 U	0.27	NA	0.23 J	0.13 U	NA	0.37 J	0.13 U	0.13 U	NA	0.39 J
Sulfate	18 J	16 J	27 J	5 U	5 UJ	5 UJ	18 J	NA	7.4	5 U	NA	7	5 U	33	NA	22
Sulfide	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	NA	0.03 U	0.03 U	NA	0.03 U	0.03 U	0.03 U	NA
Total organic carbon (TOC)	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	NA	10 U	10 U	NA	10 U	10 U	10 U	NA

Notes:
U- Analyte not detected
J- Reported value is estimated
UJ- Analyte not detected. Quantitation limit is imprecise
NA- Not analyzed
R- Unreliable result

Station ID	IR73-MW31DW	IR73-MW33DW	IR73-MW34DW	IR73-MW35DW	IR73-MW38DW		IR73-MW39DW				IR73-MW40DW	IR73-MW41DW		IR73-MW42DW	IR73-MW43DW
Sample ID	IR73-GW31DW-06B	IR73-GW33DW-06B	IR73-GW34DW-06B	IR73-GW35DW-06B	IR73-GW38DW-06B	IR73-GW38DW-06B2	IR73-GW39DW-06B	IR73-GW39DW-06BDUP	IR73-GW39DW-06B2	IR73-GW39DW-06BDUP2	IR73-GW40DW-06B	IR73-GW41DW-06BDUP	IR73-GW41DW-06B	IR73-GW42DW-06B	IR73-GW43DW-06B
Sample Date	04/12/06	04/10/06	04/21/06	04/20/06	04/09/06	04/19/06	04/09/06	04/09/06	04/10/06	04/10/06	04/20/06	04/20/06	04/20/06	04/19/06	04/09/06
Chemical Name															
Total Metals (UG/L)															
Iron	200 U	630	710	1,500	630	NA	2,800	2,600	NA	NA	600	2,300	2,300	890	680
Wet Chemistry (MG/L)															
Alkalinity	150	110	82	130	NA	170	NA	NA	140	100	170	260	270	190	NA
Chloride	84 J	33 J	41 J	23 J	NA	42 J	NA	NA	41 J	28 J	52 J	280 J	300 J	49 J	NA
Ethane	0.026 U	0.027 U	0.026 U	0.026 U	0.026 U	NA	0.026 U	0.026 U	NA	NA	0.026 U	0.026 U	0.027 U	0.026 U	0.026 U
Ethene	0.035 U	0.036 U	0.035 U	0.035 U	0.034 U	NA	0.034 U	0.035 U	NA	NA	0.035 U	0.035 U	0.036 U	0.035 U	0.034 U
Ferric iron	10 U	10 U	10 U	10 U	NA	10 U	NA	NA	10 U	10 U	10 U	10 U	10 U	10 U	NA
Ferrous iron	1 U	1 U	1 U	1 UJ	NA	1 UJ	NA	NA	1 UJ	1 UJ	1 U	1 UJ	1 UJ	1 UJ	NA
Methane	0.014 U	0.014 U	0.014 U	0.029	0.035	NA	1.7 J	0.15 J	NA	NA	0.039	1.3	1.6	0.041	0.095
Nitrate	0.39	0.13 UJ	0.13 U	0.16 J	NA	0.13 UJ	NA	NA	0.13 UJ	0.13 UJ	0.33 J	0.13 U	0.23 J	0.13 U	NA
Nitrite	0.14 J	0.21 J	0.13 U	0.13 U	NA	0.3 J	NA	NA	0.29 J	0.17 J	0.13 U	0.13 U	0.13 U	0.13 U	NA
Sulfate	10	14	66	8.8	NA	5 U	NA	NA	5 U	8.6	5 U	5 U	5 U	5 U	NA
Sulfide	0.03 U	0.03 U	0.03 UJ	0.03 UJ	0.03 U	NA	0.03 U	0.03 U	NA	NA	0.03 UJ	0.03 UJ	0.03 UJ	0.03 U	0.03 U
Total organic carbon (TOC)	10 U	10 U	10 U	10 U	10 U	NA	10 U	10 U	NA	NA	10 U	65	20 U	10 U	10 U

Notes:
U- Analyte not detected
J- Reported value is estimated
UJ- Analyte not detected. Quantitation limit is imprecise
NA- Not analyzed
R- Unreliable result

Station ID	IR73-MW43DW	IR73-MW44DW		IR73-MW45DW		IR73-MW46DW	IR73-MW47DW	IR73-MW48DW	IR73-MW49DW	IR73-MW49DWA	IR73-MW49IW	IR73-MW50DW		IR73-MW51	IR73-MW51DW	IR73-MW52
Sample ID	IR73-GW43DW-06B2	IR73-GW44DW-06B	IR73-GW44DW-06B2	IR73-GW45DW-06BDUP	IR73-GW45DW-06B	IR73-GW46DW-06B	IR73-GW47DW-06B	IR73-GW48DW-06B	IR73-GW49DW-06B	IR73-GW49DWA-06B	IR73-GW49IW-06B	IR73-GW50DW-06B	IR73-GW50DW-06B2	IR73-GW51-06B	IR73-GW51DW-06B	IR73-GW52-06B
Sample Date	04/10/06	04/09/06	04/10/06	04/18/06	04/18/06	04/12/06	04/20/06	04/11/06	04/10/06	04/10/06	04/10/06	04/09/06	04/10/06	04/18/06	04/18/06	04/19/06
Chemical Name																
Total Metals (UG/L)																
Iron	NA	4,700	NA	1,600	1,700	200 U	230	770	3,200	1,600	1,900	5,500	NA	240	200 U	200 U
Wet Chemistry (MG/L)																
Alkalinity	180	NA	470	200	200	180	210	180	360	200	320	NA	320	230	180	190
Chloride	39 J	NA	98 J	70 J	71 J	71 J	71 J	58 J	91 J	350 J	130 J	NA	450 J	140 J	22 J	1,300 J
Ethane	NA	0.026 U	NA	0.026 U	0.026 U	0.026 U	0.026 U	0.025 U	0.025 U	0.026 U	0.026 U	0.026 U	NA	0.027 U	0.026 U	0.026 U
Ethene	NA	0.034 U	NA	0.034 U	0.035 U	0.035 U	0.035 U	0.033 U	0.033 U	0.035 U	0.034 U	0.035 U	NA	0.036 U	0.034 U	0.035 U
Ferric iron	10 U	NA	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	NA	10 U	10 U	10 U	10 U
Ferrous iron	1 UJ	NA	2 J	1 UJ	1 UJ	1 UJ	1 U	1 UJ	1.5	1 U	1 U	NA	1.6 J	1 U	1 UJ	1 U
Methane	NA	4.8	NA	0.12	0.14	0.27	0.25	0.25 U	2.2	0.16	1.4	3.8	NA	0.12	0.041	0.041
Nitrate	0.13 UJ	NA	0.13 UJ	1.1 J	1.2 J	0.13 U	0.13 U	0.13 U	0.13 UJ	0.13 UJ	0.13 UJ	NA	0.13 UJ	0.13 U	0.13 U	0.13 U
Nitrite	0.38 J	NA	0.52 J	0.13 U	0.13 U	0.18 J	0.13 U	0.2	0.34 J	0.13 UJ	0.25 J	NA	0.13 UJ	0.13 U	0.13 U	0.13 U
Sulfate	8.8	NA	54	19	19	5 U	5 U	5 UJ	33	12	9.3	NA	5 U	5.6	5 U	50
Sulfide	NA	0.03 U	NA	0.03 U	0.03 U	0.03 U	0.03 UJ	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	NA	0.03 U	0.03 U	0.03 U
Total organic carbon (TOC)	NA	16	NA	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	NA	10 U	10 U	10 U

Notes:
U- Analyte not detected
J- Reported value is estimated
UJ- Analyte not detected. Quantitation limit is imprecise
NA- Not analyzed
R- Unreliable result

Appendix F
Laboratory Reports for the April 2006 Monitoring Well Sampling Event
Site 73 Amended Remedial Investigation
MCB Camp Lejeune, North Carolina

Station ID	IR73-MW52DW	IR73-MW53	IR73-MW63DW	
Sample ID	IR73-GW52DW-06B	IR73-GW53-06B	IR73-GW63DW-06BDUP	IR73-GW63DW-06B
Sample Date	04/19/06	04/21/06	04/11/06	04/11/06
Chemical Name				
Total Metals (UG/L)				
Iron	1,400	5,900	1,900	2,000
Wet Chemistry (MG/L)				
Alkalinity	190	24	280	280
Chloride	170 J	25 J	15 J	62 J
Ethane	0.026 U	0.026 U	0.026 U	0.026 U
Ethene	0.035 U	0.035 U	0.035 U	0.035 U
Ferric iron	10 U	10 U	10 U	10 U
Ferrous iron	1 UJ	1.6 J	1 U	1 U
Methane	0.51	0.064	0.53 U	0.58 U
Nitrate	0.13 U	0.13 U	0.13 U	0.13 U
Nitrite	0.13 U	0.13 U	0.13 UJ	0.27 J
Sulfate	5 U	11	7.3 J	24 J
Sulfide	0.03 U	0.03 UJ	0.03 U	0.03 U
Total organic carbon (TOC)	10 U	16	10 U	20 U

Notes:
U- Analyte not detected
J- Reported value is estimated
UJ- Analyte not detected. Quantitation limit is imprecise
NA- Not analyzed
R- Unreliable result

Appendix F
April 2006 Monitoring Well Sampling Event Chain of Custody Forms and Data Validation Summary Reports

CH2M HILL-VBO
5700 Cleveland Street
Suite 101
Virginia Beach, VA 23462

July 7, 2006
SDG#s E0443, E0444, E0450, E0458 and E0492 –Site 73, Mitkem Corporation
MCB Camp Lejeune, Jacksonville, NC

Dear Ms. Arroyo,

The following Data Validation report is provided as requested for the parameters noted in the table below for SDG #s E0443, E0444, E0450, E0458 and E0492. The data validation was performed in accordance with the EPA CLP Statement of Work, Document OLC03.2 for Low Concentration VOCs and the USEPA CLP National Functional Guidelines for Low Concentration Organic Data Review (June, 2001), and the various methods utilized by the laboratory for the non-CLP parameters. All areas of concern are discussed in the body of the report and a summary of data qualifications is provided.

Sample ID	Lab ID	Matrix	LC-VOA	RSK-175	Alk	IC	SUL	Ferric Fe	Ferrous Fe	TOC
SDG# E0443										
IR73-GW13DW-06B(2)	E0443-01	water	X	X	X	X	X	X	X	X
IR73-GW13DW-06B(2)MS	E0443-01MS	water			X		X		X	
IR73-GW13DW-06B(2)MSD	E0443-01MSD	water			X		X		X	
IR73-GW13-06B(2)	E0443-02	water	X	X	X	X	X	X	X	X
IR73-GW16-06B(2)	E0443-03	water	X	X	X	X	X	X	X	X
IR73-GW38DW-06B(2)	E0443-04	water	X	X	X	X	X	X	X	X
IR73-GW39DW-06B(2)	E0443-05	water	X	X	X	X	X	X	X	X
IR73-GW39DW-06BMS	E0443-05MS	water	X							
IR73-GW39DW-06BMSD	E0443-05MSD	water	X							
IR73-GW39DW-06BDUP(2)	E0443-06	water	X	X	X	X	X	X	X	X
IR73-GW17-06B(2)	E0443-07	water	X	X	X	X	X	X	X	X
IR73-GW17DW-06B(2)	E0443-08	water	X	X	X	X	X	X	X	X
IR73-GW37-06B(2)	E0443-09	water	X	X	X	X	X	X	X	X
IR73-GW43DW-06B(2)	E0443-10	water	X	X	X	X	X	X	X	X
IR73-GWA47/3-9-06B(2)	E0443-11	water	X	X	X	X	X	X	X	X
IR73-GW50DW-06B(2)	E0443-12	water	X	X	X	X	X	X	X	X
IR73-FB040906	E0443-13	water	X							
IR73-EB040906	E0443-14	water	X							
IR73-GW27DW-06B(2)	E0443-15	water	X	X	X	X	X	X	X	X
IR73-GW27-06B(2)	E0443-16	water	X	X	X	X	X	X	X	X
IR73-GW44DW-06B(2)	E0443-17	water	X	X	X	X	X	X	X	X
IR73-GW29-06B(2)	E0443-18	water	X	X	X	X	X	X	X	X
IR73-GW49DWA-06B	E0443-19	water	X	X	X	X	X	X	X	X
IR73-GW49IW-06B	E0443-20	water	X	X	X	X	X	X	X	X
IR73-GW33DW-06B	E0443-21	water	X	X	X	X	X	X	X	X
IR73-GW49DW-06B	E0443-22	water	X	X	X	X	X	X	X	X
IR73-GW49DW-06BMS	E0443-22MS	water				X				

Sample ID	Lab ID	Matrix	LC-VOA	RSK-175	Alk	IC	SUL	Ferric Fe	Ferrous Fe	TOC
IR73-GW49DW-06BMSD	E0443-22MSD	water				X				
SDG# E0444										
IR73-GWA47/3-8-06B	E0444-01	water	X	X	X	X	X	X	X	X
IR73-GWA47/3-8-06BMS	E0444-01MS	water			X		X			
IR73-GWA47/3-8-06BMD	E0444-01MD	water			X		X			
IR73-GWA47/3-8-06BDUP	E0444-02	water	X	X	X	X	X	X	X	X
IR73-GW12-06B	E0444-03	water	X	X	X	X	X	X	X	X
IR73-GW01DW-06B	E0444-04	water	X	X	X	X	X	X	X	X
IR73-GW01DW-06BDUP	E0444-05	water	X	X	X	X	X	X	X	X
IR73-GW01-06B	E0444-06	water	X	X	X	X	X	X	X	X
IR73-GW01IW-06B	E0444-07	water	X	X	X	X	X	X	X	X
IR73-GW11-06B	E0444-08	water	X	X	X	X	X	X	X	X
IR73-GW11IW-06B	E0444-09	water	X	X	X	X	X	X	X	X
IR73-GW11IW-06BMS	E0444-09MS	water				X			X	
IR73-GW11IW-06BMSD	E0444-09MSD	water				X			X	
IR73-TB041006	E0444-10	water	X	X						
IR73-EB041006	E0444-11	water	X							
IR73-TB041106	E0444-12	water	X	X						
IR73-GW11DW-06B	E0444-13	water	X	X	X	X	X	X	X	X
IR73-GW11DW-06BDUP	E0444-14	water	X	X	X	X	X	X	X	X
IR73-EB041106	E0444-15	water	X							
IR73-GW23-06B	E0444-16	water	X	X	X	X	X	X	X	X
IR73-GW30-06B	E0444-17	water	X	X	X	X	X	X	X	X
IR73-GW03-06B	E0444-18	water	X	X	X	X	X	X	X	X
IR73-GW48DW-06B	E0444-19	water	X	X	X	X	X	X	X	X
IR73-GW56-06B	E0444-20	water	X	X	X	X	X	X	X	X
SDG# E0450										
IR73-GW55-06B	E0450-01	water	X	X	X	X	X	X	X	X
IR73-GW55-06BMS	E0450-01MS	water			X	X	X			
IR73-GW55-06BMSD	E0450-01MSD	water			X	X	X			
IR73-GW63DW-06B	E0450-02	water	X	X	X	X	X	X	X	X
IR73-GW63DW-06BDUP	E0450-03	water	X	X	X	X	X	X	X	X
IR73-GW02IW-06B	E0450-04	water	X	X	X	X	X	X	X	X
IR73-GW58-06B	E0450-05	water	X	X	X	X	X	X	X	X
IR73-GW02-06B	E0450-06	water	X	X	X	X	X	X	X	X
IR73-GW02-06BMS	E0450-06MS	water							X	
IR73-GW02-06BMD	E0450-06MD	water							X	
IR73-GW19-06B	E0450-07	water	X	X	X	X	X	X	X	X
IR73-GW15N-06B	E0450-08	water	X	X	X	X	X	X	X	X
IR73-GW54-06B	E0450-09	water	X	X	X	X	X	X	X	X
IR73-EB041206	E0450-10	water	X							
IR73-TB041206	E0450-11	water	X	X						
IR73-GW06-06B	E0450-12	water	X	X	X	X	X	X	X	X
IR73-GW06IW-06B	E0450-13	water	X	X	X	X	X	X	X	X
IR73-GW06IW-06BMS	E0450-13MS	water							X	
IR73-GW06IW-06BMD	E0450-13MD	water							X	
IR73-GW46DW-06B	E0450-14	water	X	X	X	X	X	X	X	X
IR73-GW62DW-06B	E0450-15	water	X	X	X	X	X	X	X	X
IR73-GW62DW-06BMS	E0450-15MS	water	X							
IR73-GW62DW-06BMSD	E0450-15MSD	water	X							

Sample ID	Lab ID	Matrix	LC-VOA	RSK-175	Alk	IC	SUL	Ferric Fe	Ferrous Fe	TOC
IR73-GWA47/3-15-06B	E0450-16	water	X	X	X	X	X	X	X	X
IR73-GWA47/3-12-06B	E0450-17	water	X	X	X	X	X	X	X	X
IR73-GW31DW-06B	E0450-18	water	X	X	X	X	X	X	X	X
IR73-GW31-06B	E0450-19	water	X	X	X	X	X	X	X	X
IR73-GW25-06B	E0450-20	water	X	X	X	X	X	X	X	X
SDG# E0458										
IR73-GW25-06BDUP	E0458-01	water	X	X	X	X	X	X	X	X
IR73-GW25-06BDUPMS	E0458-01MS	water				X	X			
IR73-GW25-06BDUPMSD	E0458-01MSD	water				X	X			
IR73-GW15-06B	E0458-02	water	X	X	X	X	X	X	X	X
IR73-GW51DW-06B	E0458-03	water	X	X	X	X	X	X	X	X
IR73-GW51DW-06BMS	E0458-03MS	water			X				X	
IR73-GW51DW-06BMD	E0458-03MD	water			X				X	
IR73-GW51-06B	E0458-04	water	X	X	X	X	X	X	X	X
IR73-GW45DW-06B	E0458-05	water	X	X	X	X	X	X	X	X
IR73-GW45DW-06BDUP	E0458-06	water	X	X	X	X	X	X	X	X
IR73-GW18-06B	E0458-07	water	X	X	X	X	X	X	X	X
IR73-GW08-06B	E0458-08	water	X	X	X	X	X	X	X	X
IR73-GW09-06B	E0458-09	water	X	X	X	X	X	X	X	X
IR73-GW09-06BMS	E0458-09MS	water				X				
IR73-GW09-06BMSD	E0458-09MSD	water				X				
IR73-TB041806	E0458-10	water	X	X						
IR73-EB041806	E0458-11	water	X							
IR73-GW42DW-06B	E0458-12	water	X	X	X	X	X	X	X	X
IR73-GW42DW-06BMS	E0458-12MS	water			X		X		X	
IR73-GW42DW-06BMD	E0458-12MD	water			X		X		X	
IR73-GW52DW-06B	E0458-13	water	X	X	X	X	X	X	X	X
IR73-GW52-06B	E0458-14	water	X	X	X	X	X	X	X	X
IR73-GWA47/3-16-06B	E0458-15	water	X	X	X	X	X	X	X	X
IR73-GWA47/3-22-06B	E0458-16	water	X	X	X	X	X	X	X	X
IR73-GW15IW-06B	E0458-17	water	X	X	X	X	X	X	X	X
IR73-GW26-06B	E0458-19	water	X	X	X	X	X	X	X	X
IR73-GW20DW-06B	E0458-20	water	X	X	X	X	X	X	X	X
IR73-GW20DW-06BMS	E0458-20MS	water	X	X						
IR73-GW20DW-06BMSD	E0458-20MSD	water	X	X						
SDG# E0492										
IR73-TB041906	E0492-01	water	X	X						
IR73-EB041906	E0492-02	water	X							
IR73-GW20-06B	E0492-03	water	X	X	X	X	X	X	X	X
IR73-GW20-06BMS	E0492-03MS	water			X	X	X			
IR73-GW20-06BMSD	E0492-03MSD	water			X	X	X			
IR73-GW41DW-06B	E0492-04	water	X	X	X	X	X	X	X	X
IR73-GW41DW-06BMS	E0492-04MS	water					X		X	
IR73-GW41DW-06BMD	E0492-04MD	water					X		X	
IR73-GW41DW-06BDUP	E0492-05	water	X	X	X	X	X	X	X	X
IR73-GW40DW-06B	E0492-06	water	X	X	X	X	X	X	X	X
IR73-GW35-06B	E0492-07	water	X	X	X	X	X	X	X	X
IR73-GW35DW-06B	E0492-08	water	X	X	X	X	X	X	X	X
IR73-GW61-06B	E0492-09	water	X	X	X	X	X	X	X	X
IR73-GW28-06B	E0492-10	water	X	X	X	X	X	X	X	X
IR73-GW10-06B	E0942-11	water	X	X	X	X	X	X	X	X
IR73-GW47DW-06B	E0942-12	water	X	X	X	X	X	X	X	X
IR73-GW47DW-06BMS	E0942-12MS	water				X				
IR73-GW47DW-06BMSD	E0942-12MSD	water				X				
IR73-TB042006	E0492-13	water	X	X						
IR73-EB042006	E0492-14	water	X							

Sample ID	Lab ID	Matrix	LC-VOA	RSK-175	Alk	IC	SUL	Ferric Fe	Ferrous Fe	TOC
IR73-EB042106	E0942-15	water	X							
IR73-GWA47/3-19-06B	E0942-16	water	X	X	X	X	X	X	X	X
IR73-GWA47/3-19-06BDUP	E0492-17	water	X	X	X	X	X	X	X	X
IR73-GW34-06B	E0942-18	water	X	X	X	X	X	X	X	X
IR73-GW34-06BMS	E0942-18MS	water							X	
IR73-GW34-06BMD	E0942-18MD	water							X	
IR73-GW34DW-06B	E0492-19	water	X	X	X	X	X	X	X	X
IR73-GW21-06B	E0492-20	water	X	X	X	X	X	X	X	X
IR73-GW53-06B	E0492-21	water	X	X	X	X	X	X	X	X
IR73-TB042106	E0492-22	water	X	X						

(2) – indicates that there were 2 aliquots of each of these samples taken in the field.

The following field quality control blanks were provided with these SDGs: samples IR73-TB041006, IR73-TB041106, IR73-TB041206, IR73-TB041806, IR73-TB041906, IR73-042006, and IR73-TB042106 -trip blanks; sample IR73-FB040906-field blank; samples IR73-EB040906, IR73-EB041006, IR73-EB041106, IR73-EB041206, IR73-EB041806, IR73-EB041906, IR73-EB042006 and IR73-EB042106-equipment blanks. The following field duplicate pairs were provided with these SDGs: sample IR73-GW13DW-06BDUP-field duplicate of IR73-GW13DW-06B; sample IR73-GW13DW-06B2DUP-field duplicate of IR73-GW13DW-06B2; sample IR73-GW39DW-06BDUP-field duplicate of IR73-GW39DW-06B; sample IR73-GW39DW-06BDUP2-field duplicate of IR73-GW39DW-06B2; sample IR73-GWA47/3-8-06BDUP-field duplicate of IR73-GWA47/3-8-06B; sample IR73-GW01DW-06BDUP-field duplicate of IR73-GW01DW-06B; sample IR73-GW11DW-06BDUP-field duplicate of IR73-GW11DW-06B; sample IR73-GW63DW-06BDUP-field duplicate of IR73-GW63DW-06B; sample IR73-GW25-06BDUP-field duplicate of IR73-GW25-06B; sample IR73-GW45DW-06BDUP-field duplicate of IR73-GW45DW-06B; sample IR73-GW41DW-06BDUP-field duplicate of IR73-GW41DW-06B; and sample IR73-GWA47/3-19-06BDUP-field duplicate of IR73-GWA47/3-19-06B. The samples were evaluated based on the following criteria:

- Data Completeness *
- Technical Holding Times
- GC/MS Tuning *
- GC Performance *
- Initial/Continuing Calibrations
- Internal Standards
- Blanks
- Surrogate Recoveries
- Laboratory Control Samples *
- Matrix Spike Recoveries
- Matrix Duplicate RPDs *
- Field Duplicates
- Identification/Quantitation
- Reporting Limits *
- Tentatively Identified Compounds *

* - indicates that no qualifications were required based on this criteria

Overall Evaluation of Data/Potential Usability Issues

A summary of qualifications applied to the sample results are noted below for the fractions validated. Specific details regarding qualification of the data are addressed in the Specific Evaluation section of this narrative. If an issue is not addressed there were no actions required based on unmet quality criteria.

LC-VOA

SDG# E0443

The continuing calibration standards associated with the samples exhibited non-compliant %Ds for some compounds. Qualifications were added to the data.

One sample exhibited low internal standard area recoveries for one standard that resulted in qualifying all associated positive results as estimated and non-detected compounds as rejected.

Several samples exhibited non-compliant recoveries for one or two deuterated compounds which resulted in qualifying associated compounds as estimated.

A field duplicate was submitted for one of the associated field sample in the data package. Due to non-comparable results all compounds with positive results were qualified as estimated.
Several samples required a dilution to obtain positive results within the calibration range. In the diluted analysis for three of these samples one of the compounds of interest was diluted out. The result for these compounds was used in the initial analysis and was qualified as estimated.

SDG# E0444

Blank contamination was noted in the field QC blanks associated with samples in this batch. Qualifications were added to the data.

Several samples exhibited non-compliant recoveries for one or two deuterated compounds which resulted in qualifying associated compounds as estimated.

One sample required a dilution to obtain positive results within the calibration range.

SDG# E0450

The continuing calibration standards associated with the samples exhibited non-compliant %Ds for some compounds. Qualifications were added to the data.

Blank contamination was noted in the field QC blanks associated with samples in this batch. Qualifications were added to the data.

Several samples exhibited non-compliant recoveries for one or two deuterated compounds which resulted in qualifying associated compounds as estimated.

Several samples required a dilution to obtain positive results within the calibration range.

SDG# E0458

The continuing calibration standards associated with the samples exhibited non-compliant %Ds for some compounds. Qualifications were added to the data.

Several samples exhibited non-compliant recoveries for one or two deuterated compounds which resulted in qualifying associated compounds as estimated.

The field duplicate sample and the associated field sample did not exhibited comparable results for one compound that resulted in qualifying the results as estimated.

SDG# E0492

The continuing calibration standards associated with the samples exhibited non-compliant %Ds for some compounds. Qualifications were added to the data.
Several samples exhibited non-compliant recoveries for one or two deuterated compounds which resulted in qualifying associated compounds as estimated.

RSK-175

SDG # E0443

Eleven samples required dilutions to obtain positive results within the calibration range. Reported E flagged results were rejected in favor of corresponding results from the dilution analyses.

The field duplicate pair of sample IR73-GW39DW-06B exhibited an RPD greater than 100% (168%) for the compound methane in the RSK-175 analysis. The reported results for methane in the field duplicate pair were qualified as estimated J.

SDG # E0444

Four samples required dilutions to obtain positive results within the calibration range. Reported E flagged results were rejected in favor of corresponding results from the dilution analyses.

Blank contamination was noted in one of the trip blanks associated with samples in this batch. Qualifications were added to the data.

SDG # E0450

Eight samples required dilutions to obtain positive results within the calibration range. Reported E flagged results were rejected in favor of corresponding results from the dilution analyses.

SDG # E0458

Four samples required dilutions to obtain positive results within the calibration range. Reported E flagged results were rejected in favor of corresponding results from the dilution analyses.

The associated MS/MSD pair of sample IR73-GW20-06B exhibited recoveries for methane that were above the QC limit. The reported positive result for methane in the native sample is qualified as estimated J.

SDG # E0492

Six samples required dilutions to obtain positive results within the calibration range. Reported E flagged results were rejected in favor of corresponding results from the dilution analyses.

Wet Chemistry Parameters

SDG #E0443

Samples analyzed outside the 24 hour holding time allowed by the lab (flagged H by the lab) for the Ferrous iron analysis were qualified as estimated J/UJ.

The associated MS/MSD analysis for the IC parameters nitrate and nitrite exhibited recoveries below the lower QC limit of 90%. The analytes were qualified as estimated J/UJ in all samples. The associated MS/MSD analysis for the IC parameter chloride exhibited recoveries above the upper QC limit of 110%. Positive results for the analyte were qualified as estimated J in all samples.

SDG #E0444

Samples analyzed outside the 24 hour holding time allowed by the lab (flagged H by the lab) for the Ferrous iron analysis were qualified as estimated J/UJ.

The associated MS/MSD analyses for the IC parameters chloride and sulfate exhibited recoveries a below the lower QC limit of 90%. The analytes were qualified as estimated J/UJ in all samples.

SDG #E0450

Samples analyzed outside the 24 hour holding time allowed by the lab (flagged H by the lab) were qualified as estimated J/UJ for the Ferrous iron analysis.

The associated MS/MSD analysis for the IC parameters chloride and nitrite exhibited recoveries below the lower QC limit of 90%. Positive and non-detect results for nitrite were qualified as estimated J/UJ. Positive results for chloride were qualified as estimated J and should be considered extremely biased low because the MS/MSD pair exhibited 0% spike recovery for the analyte.

The field duplicate pair of sample IR73-GW63DW-06B exhibited RPDs greater than 100% for the analytes chloride and sulfate in the IC analysis. The reported results for chloride and sulfate in the field duplicate pair were qualified as estimated J with a qualifier code of FD.

SDG #E0458

Samples analyzed outside the 24 hour holding time allowed by the lab (flagged H by the lab) were qualified as estimated J/UJ for the Ferrous iron analysis.

The associated MS/MSD analyses for the IC parameters chloride and nitrate exhibited recoveries above the upper QC limit of 110%. Positive results for chloride and nitrate were qualified as estimated J in all samples.

SDG #E0492

Samples analyzed outside the 24 hour holding time allowed by the lab (flagged H by the lab) were qualified as estimated J/UJ for the Ferrous iron analysis.

One of the associated MS/MSD analyses for the IC parameters chloride and nitrate exhibited recoveries above the upper QC limit of 110%. Positive results for chloride and nitrate were qualified as estimated J in all samples. The associated MS/MSD analysis for sulfide exhibited recoveries below the lower QC limit of 75%. Positive and non-detect results were qualified as estimated J/UJ in all samples.

Specific Evaluation of Data

Data Completeness

Resubmissions were required for the IC and TOC fractions. Calibration data (raw data and/or summaries) were missing from the data package. Sample data was missing from the data package for the IC fraction. This information was requested from the laboratory. All information requested was received from the lab with the exception of the raw data for the TOC initial calibrations. According to an e-mail response from the lab, the instrument does not print out raw data for standards injected as part of the initial calibration sequence. The system processes the results of the standard injections and provides a calibration curve summary. The summary was provided by the lab. Corrected ferrous/ferric results were received from the laboratory for an incorrectly reported result. It was noted that some of the ferrous iron samples were filtered prior to analysis. A general question regarding this was sent to the lab. Samples were filtered due to significant suspended solids. Copies of all e-mail correspondence are included in the validation worksheets portion of this validation report.

Technical Holding Times

According to chain of custody records, sampling was performed on 04/09-21/06 and samples were received at the laboratory 04/11-22/06. All sample preparation and analysis was performed within CLP holding time requirements with the exception of those listed below.

VOA

SDG# E0443

Sample IR73-GW50DW-06B was analyzed at a dilution on 04/26/06 and had been sampled on 04/09/06; therefore the analysis exceeded the 14-day analysis holding time by three days. All positive results were qualified as estimated (J) and non-detected results are rejected (R).

Wet Chemistry

SDGs # E0443, E0444, E0450, E0458, and E0492

For the ferrous iron fraction, all samples analyzed outside of the 24 hour holding time used by the laboratory were qualified as estimated J/UJ with a qualifier code of HT. These samples were analyzed as soon as possible after receipt. The laboratory used an H flag to indicate these results on the data results forms. The following samples were flagged as estimated J/UJ due to the holding time violation:

SDG E0443: IR73-GW13DW-06B2, IR73-GW13-06B2, IR73-GW16-06B2, IR73-GW38DW-06B2, IR73-GW39DW-06B2, IR73-GW39DW-06B2DUP, IR73-GW17-

06B2, IR73-GW17DW-06B2, IR73-GW37-06B2, IR73-GW43DW-06B2, IR73-A47/3-9-06B2, IR73-GW50DW-06B2, IR73-GW27DW-06B2, IR73-GW27-06B2, IR73-GW44DW-06B2, and IR73-GW29-06B2.

SDG E0444: IR73-GWA47/3-8-06B, IR73-GWA47/3-8-06BDUP, IR73-GW12-06B, IR73-GW01DW-06B, IR73-GW01DW-06BDUP, IR73-GW01-06B, IR73-GW01IW-06B, IR73-GW23-06B, IR73-GW30-06B, IR73-GW03-06B, and IR73-GW48DW-06B.

SDG E0450: IR73-GW15N-06B, IR73-GW54-06B, IR73-GW06-06B, IR73-GW06IW-06B, IR73-GW46DW-06B, IR73-GW62DW-06B, and IR73-GW31-06B.

SDG E0458: IR73-GW51DW-06B, IR73-GW45DW-06B, IR73-GW45DW-06BDUP, IR73-GW18-06B, IR73-GW08-06B, IR73-GW09-06B, IR73-GW42DW-06B, IR73-GW52DW-06B, IR73-GWA47/3-16-06B, IR73-GWA47/3-22-06B, and IR73-GW15IW-06B.

SDG E0492: IR73-GW41DW-06B, IR73-GW41DW-06BDUP, IR73-GW35-06B, IR73-GW35DW-06B, IR73-GW61-06B, IR73-GWA47/3-19-06B, IR73-GW21-06B, and IR73-GW53-06B.

Initial/Continuing Calibration

VOA

SDG# E0443

Calibration standards exhibited %Ds that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results were qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag	Qualifier Code
CC 04/12/06	chloromethane vinyl chloride trichlorofluoromethane 1,1,2-trichloro-1,2,2-trifluoroethane xylene (totals)	59.4% 38.1% 515% 30.4% 246.3%	IR73-GW13DW-06B, IR73-GW13-06B, IR73-GW16-06B, IR73-GW38DW-06B, IR73-GW39DW-06BDUP, IR73-GW17-06B	J/UJ	CCH
CC 04/12/06	trichlorofluoromethane	32.4%	IR73-GW39DW-06B, IR73-GW17DW-06B, IR73-GW43DW-06B, IR73-GWA47/3-9-06B, IR73-FB040906, IR73-EB040906, IR73-GW27DW-06B, IR73-GW44DW-06B, IR73-GW29-06B, IR73-GW49DWA-06B, IR73-GW49IW-06B, IR73-GW33DW-06B	J/UJ	CCH

SDG# E0450

Calibration standards exhibited %Ds that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results were qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag	Qualifier Code
CC 04/15/06	1,1,2-trichloro-1,2,2-trifluoroethane acetone	36.4% 57.1%	IR73-TB041206, IR73-GW63DW-06B, IR73-GW63DW-06BDUP, IR73-GW58-06B, IR73-GW02-06B, IR73-GW19-06B, IR73-GW15N-06B, IR73-GW54-06B, IR73-EB041206, IR73-GW06-06B, IR73-GW06IW-06B, IR73-GW46DW-06B, IR73-GWA47/3-15-06B	J/UJ	CCH
CC 04/16/06	dichlorodifluoromethane	42.2%	IR73-GW02IW-06B, IR73-GWA47/3-12-06B	J/UJ	CCH
CC 04/17/06	acetone	57.1%	IR73-GW31DW-06B, IR73-GW31-06B, IR73-GW25-06B	J/UJ	CCH

SDG# E0458

Calibration standards exhibited %Ds that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results were qualified as indicated.

Standard ID	Compound(s)	%D	Samples	Q Flag	Qual Code
CC 04/18/06 CC 04/22/06	dichlorodifluoromethane	37.8%, 52.0%	IR73-GW25-06BDUP, IR73-GW15-06B	J/UJ	CCH
CC 04/19/06	dichlorodifluoromethane acetone	37.3% 61.9%	IR73-GW51DW-06B, IR73-GW51-06B, IR73-GW45DW-06B, IR73-GW45DW-06BDUP, IR73-GW18-06B, IR73-GW08-06B, IR73-GW09-06B, IR73-TB041806, IR73-EB041806, IR73-GW42DW-06B, IR73-GW52DW-06B, IR73-GW52-06B, IR73-GWA47/3-16-06B, IR73-GWA47/3-22-06B, IR73-GW15IW-06B, IR73-GW26DW-06B, IR73-GW20DW-06B	J/UJ	CCH

SDG# E0492

Calibration standards exhibited %Ds that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results were qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag	Qualifier Code
CC 04/22/06 CC 04/23/06 Cc 04/26/06	dichlorodifluoromethane	52.0%, 52.3% 47.0%	all samples	J/UJ	CCH
CC 04/26/06	trichlorofluoromethane 1,1-dichloroethene 1,1,2-trichloro-1,2,2-trifluoroethene acetone methylene chloride 1,2,3-trichlorobenzene	42.3% 39.2% 70.1% 85.7% 32.4% 32.3%	IR73-EB042006	J/UJ	CCH

Internal Standards

VOA

SDG# E0443

Sample IR73-GW33DW-06B exhibited low recoveries for one internal standard, 1,4-dichlorobenzene; therefore all associated positive results were qualified as estimated (J) and non-detected compounds as rejected (R), qualifier code: ISL.

Blanks

VOA

SDG# E0444

The associated field QC blanks exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table.

Blank ID	Compound	Concentration	Reporting Limit
IR73-TB041006	methylene chloride	0.33J ug/L	0.50 ug/L
IR73-TB041106	methylene chloride	0.49J ug/L	0.50 ug/L
IR73-EB041106	methylene chloride	0.4J ug/L	0.50 ug/L
IR73-EB041006	methylene chloride	0.37J ug/L	0.50 ug/L
IR73-FB040905	methylene chloride	0.39J ug/L	0.50 ug/L

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag	Qual Code
IR73-GW12-06B	methylene chloride	CRQL	BL

SDG# E0450

The associated field QC blanks exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table. The method blanks associated with field QC blanks exhibited some contamination but the QC blanks were not qualified, per the request of the client.

Blank ID	Compound	Concentration	Reporting Limit
IR73-TB041106	methylene chloride	0.49J ug/L	0.50 ug/L
IR73-TB041206	methylene chloride	0.45J ug/L	0.50 ug/L
IR73-EB041106	methylene chloride	0.4J ug/L	0.50 ug/L
IR73-EB041206	methylene chloride	0.46J ug/L	0.50 ug/L
IR73-FB040905	methylene chloride	0.39J ug/L	0.50 ug/L

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag	Qual Code
IR73-GW15N-06B	methylene chloride	CRQL	BL
IR73-GW63DW-06BDUP	methylene chloride	U	BL

RSK-175

SDG # E0444

One of the associated trip blanks exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table.

Blank ID	Compound	Concentration	Reporting Limit	Action Level
IR73-TB041106	methane	190 ug/L	13 ug/L	950 ug/L

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag	Qual Code
IR73-GW11DW-06BDUP, IR73-GW23-06B, IR73-GW30-06B, IR73-GW48DW-06B, IR73-GW03-06BDL	methane	U	BL

SDG # E0450

One of the associated trip blanks exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table.

Blank ID	Compound	Concentration	Reporting Limit	Action Level
IR73-TB041106	methane	190 ug/L	13 ug/L	950 ug/L

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag	Qual Code
IR73-GW63DW-06B, IR73-GW63DW-06BDUP, IR73-GW02IW-06B, IR73-GW02-06B, IR73-GW19-06BDL	methane	U	BL

Surrogates

VOA

SDG# E0443

The samples listed in the table below exhibited non-compliant surrogate (deuterated monitoring compounds) recovery for the surrogates listed, qualifications were applied as listed.

Sample ID	Non-compliant DMC	% Rec	QC Limit	Q Flag	Qual Code
IR73-GW39DW-06B	2-butanone-d5	0%	42-171%	J/R	SSL
	trans-1,3-dichloropropene-d4	68%	80-128%	J/UJ	SSL
	bromoform-d	64%	76-135%		
IR73-GW44DW-06B	2-butanone-d5	24%	42-171%	J/UJ	SSL
	trans-1,3-dichloropropene-d4	50%	80-128%		
	bromoform-d	46%	76-135%		
IR73-GW29-06B	2-butanone-d5	0%	42-171%	J/R	SSL
	trans-1,3-dichloropropene-d4	36%	80-128%	J/UJ	SSL
	bromoform-d	48%	76-135%		
IR73-GW49DW-06B	2-butanone-d5	30%	42-171%	J/UJ	SSL
	bromoform-d	66%	76-135%		
IR73-GW13-06B	trans-1,3-dichloropropene-d4	68%	80-128%	J/UJ	SSL
	bromoform-d	72%	76-135%		
IR73-GW16-06B	trans-1,3-dichloropropene-d4	66%	80-128%	J/UJ	SSL
IR73-GW17-06B	trans-1,3-dichloropropene-d4	68%	80-128%	J/UJ	SSL
	bromoform-d	74%	76-135%		
IR73-GW17DW-06B	trans-1,3-dichloropropene-d4	72%	80-128%	J/UJ	SSL
IR73-GW43DW-06B	trans-1,3-dichloropropene-d4	76%	80-128%	J/UJ	SSL
IR73-GWA47/3-9-06B	trans-1,3-dichloropropene-d4	38%	80-128%	J/UJ	SSL
	bromoform-d	58%	76-135%		
IR73-GW49DWA-06B	trans-1,3-dichloropropene-d4	72%	80-128%	J/UJ	SSL
IR73-GW33DW-06B	trans-1,3-dichloropropene-d4	66%	80-128%	J/UJ	SSL
	2-hexanone-d5	36%	37-169%		
IR73-GW37-06B	trans-1,3-dichloropropene-d4	50%	80-128%	J/UJ	SSL
	bromoform-d	56%	76-135%		

SDG# E0444

The samples listed in the table below exhibited non-compliant surrogate (deuterated monitoring compounds) recovery for the surrogates listed, qualifications were applied as listed.

Sample ID	Non-compliant DMC	% Rec	QC Limit	Q Flag	Qual Code
IR73-GW12-06B	trans-1,3-dichloropropene-d4	38%	80-128%	J/UJ	SSL
	bromoform-d	72%	76-135%		
IR73-GW01-06B	trans-1,3-dichloropropene-d4	72%	80-128%	J/UJ	SSL
IR73-GW11-06B	trans-1,3-dichloropropene-d4	18%	80-128%	J/R	SSL
	bromoform-d	52%	76-135%	J/UJ	SSL
IR73-GW11IW-06B	trans-1,3-dichloropropene-d4	54%	80-128%	J/UJ	SSL
	bromoform-d	70%	76-135%		
IR73-GW23-06B	trans-1,3-dichloropropene-d4	72%	80-128%	J/UJ	SSL
IR73-GW30-06B	trans-1,3-dichloropropene-d4	18%	80-128%	J/R	SSL
	bromoform-d	46%	76-135%	J/UJ	SSL
IR73-GW03-06B	trans-1,3-dichloropropene-d4	14%	80-128%	J/R	SSL
	bromoform-d	32%	76-135%	J/UJ	SSL
IR73-GW56-06B	trans-1,3-dichloropropene-d4	24%	80-128%	J/UJ	SSL
	bromoform-d	42%	76-135%		

SDG# E0450

The samples listed in the table below exhibited non-compliant surrogate (deuterated monitoring compounds) recovery for the surrogates listed, qualifications were applied as listed.

Sample ID	Non-compliant DMC	% Rec	QC Limit	Q Flag	Qual Code
IR73-GW55-06B	trans-1,3-dichloropropene-d4	68%	80-128%	J/UJ	SSL
	bromoform-d	66%	76-135%		
IR73-GW02-06B	1,2-dichloropropane-d6	82%	84-123%	J/UJ	SSL
	trans-1,3-dichloropropene-d4	38%	80-128%		
	bromoform-d	52%	76-135%		
IR73-GW19-06B	trans-1,3-dichloropropene-d4	32%	80-128%	J/UJ	SSL
	bromoform-d	66%	76-135%		
IR73-GW15N-06B	trans-1,3-dichloropropene-d4	62%	80-128%	J/UJ	SSL
IR73-GW54-06B	trans-1,3-dichloropropene-d4	30%	80-128%	J/UJ	SSL
	bromoform-d	52%	76-135%		
IR73-GWA47/3-15-06B	trans-1,3-dichloropropene-d4	66%	80-128%	J/UJ	SSL
IR73-GWA47/3-12-06B	trans-1,3-dichloropropene-d4	64%	80-128%	J/UJ	SSL

SDG# E0458

The samples listed in the table below exhibited non-compliant surrogate (deuterated monitoring compounds) recovery for the surrogates listed, qualifications were applied as listed.

Sample ID	Non-compliant DMC	% Rec	QC Limit	Q Flag	Qual Code
IR73-GW15-06B	trans-1,3-dichloropropene-d4	76%	80-128%	J/UJ	SSL
IR73-GW51-06B	trans-1,3-dichloropropene-d4	42%	80-128%	J/UJ	SSL
	bromoform-d	68%	76-135%		
IR73-GW18-06B	trans-1,3-dichloropropene-d4	40%	80-128%	J/UJ	SSL
	bromoform-d	72%	76-135%		
IR73-GW08-06B	trans-1,3-dichloropropene-d4	54%	80-128%	J/UJ	SSL
IR73-GW09-06B	trans-1,3-dichloropropene-d4	70%	80-128%	J/UJ	SSL
IR73-EB041806	toluene-d8	74%	77-120%	J/UJ	SSL
IR73-GW42DW-06B	1,2-dichloropropane-d6	82%	84-123%	J/UJ	SSL
	trans-1,3-dichloropropene-d4	78%	80-128%		
IR73-GW52-06B	trans-1,3-dichloropropene-d4	22%	80-128%	J/UJ	SSL
	bromoform-d	60%	76-135%		
IR73-GWA47/3-22-06B	trans-1,3-dichloropropene-d4	70%	80-128%	J/UJ	SSL
	bromoform-d	64%	76-135%		
IR73-GW26DW-06B	trans-1,3-dichloropropene-d4	58%	80-128%	J/UJ	SSL
	bromoform-d	66%	76-135%		

SDG# E0492

The samples listed in the table below exhibited non-compliant surrogate (deuterated monitoring compounds) recovery for the surrogates listed, qualifications were applied as listed.

Sample ID	Non-compliant DMC	% Rec	QC Limit	Q Flag	Qual Code
IR73-EB041906	trans-1,3-dichloropropene-d4	78%	80-128%	J/UJ	SSL
IR73-GW20-06B	trans-1,3-dichloropropene-d4	78%	80-128%	J/UJ	SSL
	bromoform-d	52%	76-135%		
IR73-GW41DW-06B	trans-1,3-dichloropropene-d4	74%	80-128%	J/UJ	SSL
	bromoform-d	72%	76-135%		
IR73-GW35-06B	trans-1,3-dichloropropene-d4	74%	80-128%	J/UJ	SSL
	bromoform-d	74%	76-135%		
IR73-GW35DW-06B	trans-1,3-dichloropropene-d4	78%	80-128%	J/UJ	SSL
	bromoform-d	74%	76-135%		
IR73-GW28-06B	trans-1,3-dichloropropene-d4	60%	80-128%	J/UJ	SSL
IR73-GW10-06B	trans-1,3-dichloropropene-d4	48%	80-128%	J/UJ	SSL
	bromoform-d	58%	76-135%		
IR73-GWA47/3-19-06B	trans-1,3-dichloropropene-d4	28%	80-128%	J/UJ	SSL
	bromoform-d	58%	76-135%		
IR73-GWA47/3-19-06BDUP	trans-1,3-dichloropropene-d4	34%	80-128%	J/UJ	SSL
	bromoform-d	54%	76-135%		
IR73-GW34-06B	trans-1,3-dichloropropene-d4	56%	80-128%	J/UJ	SSL
	bromoform-d	64%	76-135%		
IR73-GW34DW-06B	trans-1,3-dichloropropene-d4	78%	80-128%	J/UJ	SSL
IR73-GW53-06B	trans-1,3-dichloropropene-d4	36%	80-128%	J/UJ	SSL
	bromoform-d	56%	76-135%		

Matrix Spike Recoveries

RSK-175

SDG #E0458

The MS/MSD pair of sample IR73-GW20DW-06B exhibited spike recoveries above the upper QC limit for methane. Required qualifications are noted in the following table.

MS/MSD ID	compound	% R	QC Limit	Affected Samples	Q Flag	Qual Code
IR73-GW20DW-06B	methane	187/198	75-125%	IR73-GW20DW-06B	J+	MSH

Wet Chemistry

SDG #E0443

The MS/MSD pair of sample IR73-GW49DW-06B analyzed for the IC fraction exhibited spike recoveries above the upper QC limit of 110% for chloride below the lower QC limit of 90% for nitrate and nitrite in both the MS and the MSD. Associated samples, non-compliant analytes and required qualifications are noted in the following table.

MS/MSD ID	Analyte	% R	QC Limit	Affected Samples	Q Flag	Qual Code
IR73-GW49DW-06B	chloride	193/171	90-110%	all samples	J+	MSH
	nitrate	87.4/84.6			J/UJ	MSL
	nitrite	77/77.9				

SDG #E0444

The MS/MSD pair of sample IR73-GW11IW-06B analyzed for the IC fraction exhibited spike recoveries below the lower QC limit of 90% for chloride and sulfate. Associated samples, non-compliant analytes and required qualifications are noted in the following table.

MS/MSD ID	Analyte	% R	QC Limit	Affected Samples	Q Flag	Qual Code
IR73-GW11IW-06B	chloride sulfate	89.8/89.5 86.4/89.2	90-110%	all samples	J/UJ	MSL

SDG #E0450

The MS/MSD pair of sample IR73-GW55-06B analyzed for the IC fraction exhibited spike recoveries below the lower QC limit of 90% for chloride and nitrite. Associated samples, non-compliant analytes and required qualifications are noted in the following table.

MS/MSD ID	Analyte	% R	QC Limit	Affected Samples	Q Flag	Qual Code
IR73-GW55-06B	chloride	0/0	90-110%	all samples	J/R	MSL
	nitrite	67.3/73.7			J/UJ	

SDG #E0458

The MS/MSD pairs of samples IR73-GW25-06BDUP and IR73-GW09-06B analyzed for the IC fraction exhibited spike recoveries above the upper QC limit of %110 for chloride and nitrate. Associated samples, non-compliant analytes and required qualifications are noted in the following table.

MS/MSD ID	Analyte	% R	QC Limit	Affected Samples	Q Flag	Qual Code
IR73-GW25-06BDUP	chloride nitrate	117/127 114/141	90-110%	all samples	J	MSH
IR73-GW09-06B	chloride nitrate	116/119 111/112				

SDG #E0492

The MS/MSD pair of sample IR73-GW20-06B analyzed for the IC fraction exhibited spike recoveries above the upper QC limit of 110% for chloride and nitrate. The MS/MSD pair of sample IR73-GW41DW-06B analyzed for the sulfide fraction exhibited spike recoveries below the lower QC limit of 75%. Associated samples, non-compliant analytes and required qualifications are noted in the following table.

MS/MSD ID	Analyte	% R	QC Limit	Affected Samples	Q Flag	Qual Code
IR73-GW20-06B	chloride nitrate	119/118 155/161	90-110%	all samples	J+	MSH
IR73-GW41DW-06B	sulfide	63.3/50	75-125%	all samples	J/UJ	MSL

Field Duplicates

VOA

SDG# E0443

A field duplicate was submitted for sample IR73-GW39DW-06B. High percent RPDs were exhibited for vinyl chloride (152%), 1,1-dichloroethene (153%), trans-1,2-dichloroethene (200%), cis-1,2-dichloroethene (114%), benzene (145%), trichloroethene (123%) and toluene (39%). Due to non-comparable results all compounds with positive results were qualified as estimated (J), qualifier code: FD.

RSK-175

SDG# E0443

The field duplicate pair of sample IR73-GW39DW-06B exhibited an RPD greater than 100% (168%) for the compound methane in the RSK-175 analysis. The reported results for methane in the field duplicate pair were qualified as estimated J with a qualifier code of FD.

Wet Chemistry

SDG# E0450

The field duplicate pair of sample IR73-GW63DW-06B exhibited RPDs greater than 100% for the analytes chloride and sulfate in the IC analysis. The reported results for chloride and sulfate in the field duplicate pair were qualified as estimated J with a qualifier code of FD.

Identification/Quantitation

VOA

SDG# E0443

A dilution was required for samples IR73-GW13DW-06B, IR73-GW39DW-06B, IR73-GW50DW-06B, IR73-GWA47/3-9-06B, IR73-GW27DW-06B, IR73-GW44DW-06B, IR73-GW49IW-06B and IR73-GW49DW-06B; therefore, the E-flagged compound results were not used in the initial analysis in favor of the corresponding D-flagged compound result in the dilution (qualifier code: DL).

Samples IR73-GW44DW-06B, IR73-GW49IW-06B and IR73-GW49DW-06B were analyzed at a dilution to obtain results within the calibration for several compounds including vinyl chloride. However, the diluted analysis for each of these sample was at such a dilution that vinyl chloride was diluted out. The laboratory was contacted via e-mail concerning this issue and asked if there was an analysis for each of these samples at a less dilution that resulted in vinyl chloride exhibiting a result within the calibration range. According to the laboratory there were no additional runs for these samples. Therefore, the vinyl chloride result is used from the initial analysis and is qualified as estimated since the result is above the calibration range (qualifier code: LR).

SDG# E0444

A dilution was required for sample IR73-GW48DW-06B; therefore, the E-flagged compound results were not used in the initial analysis in favor of the corresponding D-flagged compound result in the dilution (qualifier code: DL).

SDG# E0450

A dilution was required for samples IR73-GW63DW-06B and IR73-GW63DW-06BDUP; therefore, the E-flagged compound results were not used in the initial analysis in favor of the corresponding D-flagged compound result in the dilution (qualifier code: DL).

RSK-175

SDG# E0443

Samples IR73-GW13DW-06B, IR73-GW13-06B, IR73-GW39DW-06B, IR73-GW17-06B, IR73-GWA47/3-9-06B, IR73-GW50DW-06B, IR73-GW27DW-06B, IR73-GW27-06B, IR73-GW44DW-06B, IR73-GW49IW-06B and IR73-GW49DW-06B required dilutions to accurately quantitate target compounds. All E-flagged results in the initial analysis of these samples are rejected in favor of the corresponding result reported in the dilution analysis with a qualifier code of DL.

SDG# E0444

Samples IR73-GWA47/3-8-06B, IR73-GWA47/3-8-06BDUP, IR73-GW01IW-06B, and IR73-GW11IW-06B required dilutions to accurately quantitate target compounds. All E-flagged results in the initial analysis of these samples are rejected in favor of the corresponding result reported in the dilution analysis with a qualifier code of DL.

SDG# E0450

Samples IR73-GW55-06B, IR73-GW19-06B, IR73-GW15N-06B, IR73-GW54-06B, IR73-GW06-06B, IR73-GW06IW-06B, IR73-GW62DW-06B, and IR73-GWA47/315-06B required dilutions to accurately quantitate target compounds. All E-flagged results in the initial analysis of these samples are rejected in favor of the corresponding result reported in the dilution analysis with a qualifier code of DL.

SDG# E0458

Samples IR73-GW15-06B, IR73-GW08-06BDUP, IR73-GWA47/3-16-06B, and IR73-GWA47/3-22-06B required dilutions to accurately quantitate target compounds. All E-flagged results in the initial analysis of these samples are rejected in favor of the corresponding result reported in the dilution analysis with a qualifier code of DL.

SDG# E0492

Samples IR73-GW41DW-06B, IR73-GW41DW-06BDUP, IR73-GW61-06B, IR73-GW10-06B, IR73-GWA47/3-19-06B, and IR73-GWA47/3-19-06BDUP required dilutions to accurately quantitate target compounds. All E-flagged results in the initial analysis of these samples are rejected in favor of the corresponding result reported in the dilution analysis with a qualifier code of DL.

A summary of qualifications required is provided on the following page. Please do not hesitate to contact DataQual ES with any questions regarding this validation report.

Sincerely,

Laura Maschhoff
President

Jacqueline Cleveland
Vice President

Summary of Data Qualifications

VOA

SDG# E0443

Sample ID	Compound	Results	Q-Flag	Qualifier Code
IR73-GW50DW-06BDL	all results	+/-	J/R	HT
IR73-GW13DW-06B, IR73-GW13-06B, IR73-GW16-06B, IR73-GW38DW-06B, IR73-GW39DW-06BDUP, IR73-GW17-06B	chloromethane vinyl chloride trichlorofluoromethane 1,1,2-trichloro-1,2,2-trifluoroethane xylene (totals)	+/-	J/UJ	CCH
IR73-GW39DW-06B, IR73-GW17DW-06B, IR73-GW43DW-06B, IR73-GWA47/3-9-06B, IR73-FB040906, IR73-EB040906, IR73-GW27DW-06B, IR73-GW44DW-06B, IR73-GW29-06B, IR73-GW49DWA-06B, IR73-GW49IW-06B, IR73-GW33DW-06B	trichlorofluoromethane	+/-	J/UJ	CCH
IR73-GW33DW-06B	all associated compounds with: 1,4-dichlorobenzene	+/-	J/R	ISL
IR73-GW39DW-06B	2-butanone-d5	+/-	J/R	SSL
	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW44DW-06B	2-butanone-d5	+/-	J/UJ	SSL
	trans-1,3-dichloropropene-d4			
	bromoform-d			
IR73-GW29-06B	2-butanone-d5	+/-	J/R	SSL
	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW49DW-06B	2-butanone-d5	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW13-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW16-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GW17-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW17DW-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GW43DW-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GWA47/3-9-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW49DWA-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GW33DW-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	2-hexanone-d5			
IR73-GW37-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW39DW-06B, IR73-GW39DW-06BDUP	all positive results	+	J	FD

Summary of Data Qualifications

VOA

SDG# E0443

Sample ID	Compound	Results	Q-Flag	Qualifier Code
IR73-GW13DW-06B, IR73-GW39DW-06B, IR73-GW50DW-06B, IR73-GWA47/3-9-06B, IR73-GW27DW-06B, IR73-GW44DW-06B, IR73-GW49IW-06B, IR73-GW49DW-06B	all E-flagged compounds	+	R	DL
IR73-GW13DW-06BDL, IR73-GW39DW-06BDL, IR73-GW50DW-06BDL, IR73-GWA47/3-9-06BDL, IR73-GW27DW-06BDL, IR73-GW44DW-06BDL, IR73-GW49IW-06BDL, IR73-GW49DW-06BDL	all results except D-flagged compounds	+/-	R	DL
IR73-GW44DW-06B, IR73-GW49IW-06B, IR73-GW49DW-06B	vinyl chloride	+	J	LR

SDG# E0444

Sample ID	Compound	Results	Q-Flag	Qualifier Code
IR73-GW12-06B	methylene chloride	+	CRQL	BL
IR73-GW12-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW01-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GW11-06B	trans-1,3-dichloropropene-d4	+/-	J/R	SSL
	bromoform-d	+/-	J/UJ	SSL
IR73-GW11IW-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW23-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GW30-06B	trans-1,3-dichloropropene-d4	+/-	J/R	SSL
	bromoform-d	+/-	J/UJ	SSL
IR73-GW03-06B	trans-1,3-dichloropropene-d4	+/-	J/R	SSL
	bromoform-d	+/-	J/UJ	SSL
IR73-GW56-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW48DW-06B	all E-flagged compounds	+	R	DL
IR73-GW48DW-06BDL	all results except D-flagged compounds	+/-	R	DL

Summary of Data Qualifications

VOA

SDG# E0450

Sample ID	Compound	Results	Q-Flag	Qualifier Code
IR73-TB041206, IR73-GW63DW-06B, IR73-GW63DW-06BDUP, IR73-GW58-06B, IR73-GW02-06B, IR73-GW19-06B, IR73-GW15N-06B, IR73-GW54-06B, IR73-EB041206, IR73-GW06-06B, IR73-GW06IW-06B, IR73-GW46DW-06B, IR73-GWA47/3-15-06B	1,1,2-trichloro-1,2,2-trifluoroethane acetone	+/-	J/UJ	CCH
IR73-GW02IW-06B, IR73-GWA47/3-12-06B	dichlorodifluoromethane	+/-	J/UJ	CCH
IR73-GW31DW-06B, IR73-GW31-06B, IR73-GW25-06B	acetone	+/-	J/UJ	CCH
IR73-GW15N-06B	methylene chloride	+	CRQL	BL
IR73-GW63DW-06BDUP	methylene chloride	+	U	BL
IR73-GW55-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW02-06B	1,2-dichloropropane-d6	+/-	J/UJ	SSL
	trans-1,3-dichloropropene-d4			
	bromoform-d			
IR73-GW19-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW15N-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GW54-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GWA47/3-15-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GWA47/3-12-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GW63DW-06B, IR73-GW63DW-06BDUP	all E-flagged compounds	+	R	DL
IR73-GW63DW-06BDL, IR73-GW63DW-06BDUPDL	all results except D-flagged compounds	+/-	R	DL

SDG# E0458

Sample ID	Compound	Results	Q-Flag	Qualifier Code
IR73-GW25-06BDUP, IR73-GW15-06B	dichlorodifluoromethane	+/-	J/UJ	CCH
IR73-GW51DW-06B, IR73-GW51-06B, IR73-GW45DW-06B, IR73-GW45DW-06BDUP, IR73-GW18-06B, IR73-GW08-06B, IR73-GW09-06B, IR73-TB041806, IR73-EB041806, IR73-GW42DW-06B, IR73-GW52DW-06B, IR73-GW52-06B, IR73-GWA47/3-16-06B, IR73-GWA47/3-22-06B, IR73-GW15IW-06B, IR73-GW26DW-06B, IR73-GW20DW-06B	dichlorodifluoromethane acetone	+/-	J/UJ	CCH
IR73-GW15-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL

Summary of Data Qualifications

Summary of Data Qualifications

VOA

SDG# E0458

Sample ID	Compound	Results	Q-Flag	Qualifier Code
IR73-GW51-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW18-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW08-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GW09-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-EB041806	toluene-d8	+/-	J/UJ	SSL
IR73-GW42DW-06B	1,2-dichloropropane-d6	+/-	J/UJ	SSL
	trans-1,3-dichloropropene-d4			
IR73-GW52-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GWA47/3-22-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW26DW-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			

SDG# E0492

Sample ID	Compound	Results	Q-Flag	Qualifier Code
all samples	dichlorodifluoromethane	+/-	J/UJ	CCH
IR73-EB042006	trichlorofluoromethane 1,1-dichloroethene 1,1,2-trichloro-1,2,2-trifluoroethene acetone methylene chloride 1,2,3-trichlorobenzene	+/-	J/UJ	CCH
IR73-EB041906	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GW20-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW41DW-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW35-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW35DW-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW28-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GW10-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GWA47/3-19-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GWA47/3-19-06BDUP	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW34-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW34DW-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GW53-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			

Summary of Data Qualifications

RSK-175

SDG# E0443

Sample ID	Compound	Results	Q-Flag	Qual Code
IR73-GW13DW-06B, IR73-GW13-06B, IR73-GW39DW-06B, IR73-GW17-06B, IR73-A47/3-9-06B, IR73-GW50DW-06B, IR73-GW27DW-06B, IR73-GW27-06B, IR73-GW44DW-06B, IR73-GW49IW-06B, IR73-GW49DW-06B.	methane	+E	R	DL
IR73-GW13DW-06BDL, IR73-GW13-06BDL, IR73-GW39DW-06BDL, IR73-GW17-06BDL, IR73-A47/3-9-06BDL, IR73-GW50DW-06BDL, IR73-GW27DW-06BDL, IR73-GW27-06BDL, IR73-GW44DW-06BDL, IR73-GW49IW-06BDL, IR73-GW49DW-06BDL	ethane ethene	+/-	R	DL
IR73-GW39DW-06B	methane	+	J	FD

SDG# E0444

Sample ID	Compound	Results	Q-Flag	Qual Code
IR73-GW11DW-06BDUP, IR73-GW23-06B, IR73-GW30-06B, IR73-GW48DW-06B, IR73-GW03-06BDL	methane	+	U	BL
IR73-GWA47/3-8-06B, IR73-GWA47/3-8-06BDUP, IR73-GW01IW-06B, IR73-GW11IW-06B	methane	+E	R	DL
IR73-GWA47/3-8-06BDL, IR73-GWA47/3-8-06BDUPDL, IR73-GW01IW-06BDL, IR73-GW11IW-06BDL	ethane ethene	+/-	R	DL

SDG# E0450

Sample ID	Compound	Results	Q-Flag	Qual Code
IR73-GW63DW-06B, IR73-GW63DW-06BDUP, IR73-GW02IW-06B, IR73-GW02-06B, IR73-GW19-06BDL	methane	+	U	BL
IR73-GW55-06B, IR73-GW19-06B, IR73-GW15N-06B, IR73-GW54-06B, IR73-GW06-06B, IR73-GW06IW-06B, IR73-GW62DW-06B, IR73-GWA47/315-06B	methane	+E	R	DL
IR73-GW55-06BDL, IR73-GW19-06BDL, IR73-GW15N-06BDL, IR73-GW54-06BDL, IR73-GW06-06BDL, IR73-GW06IW-06BDL, IR73-GW62DW-06BDL, IR73-GWA47/315-06BDL	ethane ethene	+/-	R	DL

SDG# E0458

Sample ID	Compound	Results	Q-Flag	Qual Code
IR73-GW15-06B, IR73-GW08-06BDUP, IR73-GWA47/3-16-06B, IR73-GWA47/3-22-06B	methane	+E	R	DL
IR73-GW15-06BDL, IR73-GW08-06BDUPDL, IR73-GWA47/3-16-06BDL, IR73-GWA47/3-22-06BDL	ethane ethene	+/-	R	DL
IR73-GW20DW-06B	methane	+	J	MSH

Summary of Data Qualifications

RSK-175

SDG# E0492

Sample ID	Compound	Results	Q-Flag	Qual Code
IR73-GW41DW-06B, IR73-GW41DW-06BDUP, IR73-GW61-06B, IR73-GW10-06B, IR73-GWA47/3-19-06B, IR73-GWA47/3-19-06BDUP	methane	+E	R	DL
IR73-GW41DW-06BDL, IR73-GW41DW-06BDUPDL, IR73-GW61-06BDL, IR73-GW10-06BDL, IR73-GWA47/3-19-06BDL, IR73-GWA47/3-19-06BDUPDL	ethane ethene	+/-	R	DL

Wet Chemistry Parameters

SDG # E0443

Sample ID	Analyte	Results	Q-Flag	Qual Code
IR73-GW13DW-06B2, IR73-GW13-06B2, IR73-GW16-06B2, IR73-GW38DW-06B2, IR73-GW39DW-06B2, IR73-GW39DW-06B2DUP, IR73-GW17-06B2, IR73-GW17DW-06B2, IR73-GW37-06B2, IR73-GW43DW-06B2, IR73-A47/3-9-06B2, IR73-GW50DW-06B2, IR73-GW27DW-06B2, IR73-GW27-06B2, IR73-GW44DW-06B2, IR73-GW29-06B2.	Ferrous Fe	+/- H	J/UJ	HT
all samples	chloride	+	J	MSH
all samples	nitrate nitrite	+/-	J/UJ	MSL

SDG # E0444

Sample ID	Analyte	Results	Q-Flag	Qual Code
IR73-GWA47/3-8-06B, IR73-GWA47/3-8-06BDUP, IR73-GW12-06B, IR73-GW01DW-06B, IR73-GW01DW-06BDUP, IR73-GW01-06B, IR73-GW01IW-06B, IR73-GW23-06B, IR73-GW30-06B, IR73-GW03-06B, IR73-GW48DW-06B.	Ferrous Fe	+/- H	J/UJ	HT
all samples	chloride sulfate	+/-	J/UJ	MSL

SDG # E0450

Sample ID	Analyte	Results	Q-Flag	Qual Code
IR73-GW15N-06B, IR73-GW54-06B, IR73-GW06-06B, IR73-GW06IW-06B, IR73-GW46DW-06B, IR73-GW62DW-06B, IR73-GW31-06B	Ferrous Fe	+/- H	J/UJ	HT
all samples	chloride	+/-	J/R	MSL
	nitrite	+/-	J/UJ	MSL
IR73-GW63DW-06B, IR73-GW63DW-06BDUP	chloride	+	J	FD
	sulfate			

Summary of Data Qualifications

Wet Chemistry Parameters

SDG # E0458

Sample ID	Analyte	Results	Q-Flag	Qual Code
IR73-GW51DW-06B, IR73-GW45DW-06B, IR73-GW45DW-06BDUP, IR73-GW18-06B, IR73-GW08-06B, IR73-GW09-06B, IR73-GW42DW-06B, IR73-GW52DW-06B, IR73-GWA47/3-16-06B, IR73-GWA47/3-22-06B, IR73-GW15IW-06B	Ferrous Fe	+/- H	J/UJ	HT
all samples	chloride	+	J	MSH
	nitrate			

SDG # E0492

Sample ID	Analyte	Results	Q-Flag	Qual Code
IR73-GW41DW-06B, IR73-GW41DW-06BDUP, IR73-GW35-06B, IR73-GW35DW-06B, IR73-GW61-06B, IR73-GWA47/3-19-06B, IR73-GW21-06B, IR73-GW53-06B	Ferrous Fe	+/- H	J/UJ	HT
all samples	chloride	+	J	MSH
	nitrate			
all samples	sulfide	+/-	J/UJ	MSL

Glossary of Qualification Flags and Abbreviations

Qualification Flags (Q-Flags)

U	not detected above the reported sample quantitation limit
J	estimated value
UJ	reported quantitation limit is qualified as estimated
R	result is rejected; the presence or absence of the analyte cannot be verified
D	result value is based on dilution analysis result
NJ	analyte has been tentatively identified, estimated value
L	analyte present, biased low
UL	not detected, quantitation limit is probably higher
K	analyte present, biased high

Method/Preparation Blank Qualification Flags (Q-Flags)

NA	The sample result for the blank contaminant is greater than the sample RL and is greater than 5X (10X for common laboratory contaminants) the blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.
U	The sample result for the blank contaminant is greater than the sample RL and is less than 5X (10X for common laboratory contaminants) the blank value.
RL	The sample result for the blank contaminant is less than the sample RL and is less than 5X (10X for common laboratory contaminants) the blank value.

General Abbreviations

RL	reporting limit
+	positive result
-	non-detect result

QUALIFIER CODE REFERENCE

Qualifier	Description
TN	Tune
BSL	Blank Spike/LCS - High Recovery
BSH	Blank Spike/LCS - Low Recovery
BD	Blank Spike/Blank Spike Duplicate (LCS/LCSD) Precision
BRL	Below Reporting Limit
ISL	Internal Standard - Low Recovery
ISH	Internal Standard - High Recovery
MSL	Matrix Spike and/or Matrix Spike Duplicate - Low Recovery
MSH	Matrix Spike and/or Matrix Spike Duplicate - High Recovery
MI	Matrix interference obscuring the raw data
MDP	Matrix Spike/Matrix Spike Duplicate Precision
2S	Second Source - Bad reproducibility between tandem detectors
SSL	Spiked Surrogate - Low Recovery
SSH	Spiked Surrogate - High Recovery
SD	Serial Dilution Reproducibility
ICL	Initial Calibration - Low Relative Response Factors (RRF)
ICH	Initial Calibration - High Relative Response Factors (RRF)
ICB	Initial Calibration - Bad Linearity or Curve Function
CCL	Continuing Calibration - Low Recovery or %Difference
CCH	Continuing Calibration - High Recovery or %Difference
LD	Lab Duplicate Reproducibility
HT	Holding Time
PD	Pesticide Degradation
2C	Second Column - Poor Dual Column Reproducibility
LR	Concentration Exceeds Linear Range
BL	Blank Contamination
RE	Redundant Result - due to Re-analysis or Re-extraction
DL	Redundant Result - due to Dilution
FD	Field Duplicate
OT	Other - explained in data validation report

DataQual

Environmental Services, LLC

CH2M HILL-VBO
5700 Cleveland Street
Suite 101
Virginia Beach, VA 23462

July 7, 2006
SDG#s E0443, E0444, E0450, E0458 and E0492 –Site 73, Mitkem Corporation
MCB Camp Lejeune, Jacksonville, NC

Dear Ms. Arroyo,

The following Data Validation report is provided as requested for the parameters noted in the table below for SDG #s E0443, E0444, E0450, E0458 and E0492. The data validation was performed in accordance with the EPA CLP Statement of Work, Document OLC03.2 for Low Concentration VOCs and the USEPA CLP National Functional Guidelines for Low Concentration Organic Data Review (June, 2001), and the various methods utilized by the laboratory for the non-CLP parameters. All areas of concern are discussed in the body of the report and a summary of data qualifications is provided.

Sample ID	Lab ID	Matrix	LC-VOA	RSK-175	Alk	IC	SUL	Ferric Fe	Ferrous Fe	TOC
SDG# E0443										
IR73-GW13DW-06B(2)	E0443-01	water	X	X	X	X	X	X	X	X
IR73-GW13DW-06B(2)MS	E0443-01MS	water			X		X		X	
IR73-GW13DW-06B(2)MSD	E0443-01MSD	water			X		X		X	
IR73-GW13-06B(2)	E0443-02	water	X	X	X	X	X	X	X	X
IR73-GW16-06B(2)	E0443-03	water	X	X	X	X	X	X	X	X
IR73-GW38DW-06B(2)	E0443-04	water	X	X	X	X	X	X	X	X
IR73-GW39DW-06B(2)	E0443-05	water	X	X	X	X	X	X	X	X
IR73-GW39DW-06BMS	E0443-05MS	water	X							
IR73-GW39DW-06BMSD	E0443-05MSD	water	X							
IR73-GW39DW-06BDUP(2)	E0443-06	water	X	X	X	X	X	X	X	X
IR73-GW17-06B(2)	E0443-07	water	X	X	X	X	X	X	X	X
IR73-GW17DW-06B(2)	E0443-08	water	X	X	X	X	X	X	X	X
IR73-GW37-06B(2)	E0443-09	water	X	X	X	X	X	X	X	X
IR73-GW43DW-06B(2)	E0443-10	water	X	X	X	X	X	X	X	X
IR73-GWA47/3-9-06B(2)	E0443-11	water	X	X	X	X	X	X	X	X
IR73-GW50DW-06B(2)	E0443-12	water	X	X	X	X	X	X	X	X
IR73-FB040906	E0443-13	water	X							
IR73-EB040906	E0443-14	water	X							
IR73-GW27DW-06B(2)	E0443-15	water	X	X	X	X	X	X	X	X
IR73-GW27-06B(2)	E0443-16	water	X	X	X	X	X	X	X	X
IR73-GW44DW-06B(2)	E0443-17	water	X	X	X	X	X	X	X	X
IR73-GW29-06B(2)	E0443-18	water	X	X	X	X	X	X	X	X
IR73-GW49DWA-06B	E0443-19	water	X	X	X	X	X	X	X	X
IR73-GW49IW-06B	E0443-20	water	X	X	X	X	X	X	X	X
IR73-GW33DW-06B	E0443-21	water	X	X	X	X	X	X	X	X
IR73-GW49DW-06B	E0443-22	water	X	X	X	X	X	X	X	X
IR73-GW49DW-06BMS	E0443-22MS	water				X				

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Sample ID	Lab ID	Matrix	LC-VOA	RSK-175	Alk	IC	SUL	Ferric Fe	Ferrous Fe	TOC
IR73-GW49DW-06BMSD	E0443-22MSD	water				X				
SDG# E0444										
IR73-GWA47/3-8-06B	E0444-01	water	X	X	X	X	X	X	X	X
IR73-GWA47/3-8-06BMS	E0444-01MS	water			X		X			
IR73-GWA47/3-8-06BMD	E0444-01MD	water			X		X			
IR73-GWA47/3-8-06BDUP	E0444-02	water	X	X	X	X	X	X	X	X
IR73-GW12-06B	E0444-03	water	X	X	X	X	X	X	X	X
IR73-GW01DW-06B	E0444-04	water	X	X	X	X	X	X	X	X
IR73-GW01DW-06BDUP	E0444-05	water	X	X	X	X	X	X	X	X
IR73-GW01-06B	E0444-06	water	X	X	X	X	X	X	X	X
IR73-GW01IW-06B	E0444-07	water	X	X	X	X	X	X	X	X
IR73-GW11-06B	E0444-08	water	X	X	X	X	X	X	X	X
IR73-GW11IW-06B	E0444-09	water	X	X	X	X	X	X	X	X
IR73-GW11IW-06BMS	E0444-09MS	water				X			X	
IR73-GW11IW-06BMSD	E0444-09MSD	water				X			X	
IR73-TB041006	E0444-10	water	X	X						
IR73-EB041006	E0444-11	water	X							
IR73-TB041106	E0444-12	water	X	X						
IR73-GW11DW-06B	E0444-13	water	X	X	X	X	X	X	X	X
IR73-GW11DW-06BDUP	E0444-14	water	X	X	X	X	X	X	X	X
IR73-EB041106	E0444-15	water	X							
IR73-GW23-06B	E0444-16	water	X	X	X	X	X	X	X	X
IR73-GW30-06B	E0444-17	water	X	X	X	X	X	X	X	X
IR73-GW03-06B	E0444-18	water	X	X	X	X	X	X	X	X
IR73-GW48DW-06B	E0444-19	water	X	X	X	X	X	X	X	X
IR73-GW56-06B	E0444-20	water	X	X	X	X	X	X	X	X
SDG# E0450										
IR73-GW55-06B	E0450-01	water	X	X	X	X	X		X	
IR73-GW55-06BMS	E0450-01MS	water			X	X	X			
IR73-GW55-06BMSD	E0450-01MSD	water			X	X	X			
IR73-GW63DW-06B	E0450-02	water	X	X	X	X	X	X	X	X
IR73-GW63DW-06BDUP	E0450-03	water	X	X	X	X	X	X	X	X
IR73-GW02IW-06B	E0450-04	water	X	X	X	X	X	X	X	X
IR73-GW58-06B	E0450-05	water	X	X	X	X	X	X	X	X
IR73-GW02-06B	E0450-06	water	X	X	X	X	X	X	X	X
IR73-GW02-06BMS	E0450-06MS	water							X	
IR73-GW02-06BMD	E0450-06MD	water							X	
IR73-GW19-06B	E0450-07	water	X	X	X	X	X	X	X	X
IR73-GW15N-06B	E0450-08	water	X	X	X	X	X	X	X	X
IR73-GW54-06B	E0450-09	water	X	X	X	X	X	X	X	X
IR73-EB041206	E0450-10	water	X							
IR73-TB041206	E0450-11	water	X	X	X	X	X	X	X	X
IR73-GW06-06B	E0450-12	water	X	X	X	X	X	X	X	X
IR73-GW06IW-06B	E0450-13	water	X	X	X	X	X	X	X	X
IR73-GW06IW-06BMS	E0450-13MS	water							X	
IR73-GW06IW-06BMD	E0450-13MD	water							X	
IR73-GW46DW-06B	E0450-14	water	X	X	X	X	X	X	X	X
IR73-GW62DW-06B	E0450-15	water	X	X	X	X	X	X	X	X
IR73-GW62DW-06BMS	E0450-15MS	water	X							
IR73-GW62DW-06BMSD	E0450-15MSD	water	X							

Sample ID	Lab ID	Matrix	LC-VOA	RSK-175	Alk	IC	SUL	Ferric Fe	Ferrous Fe	TOC
IR73-GWA47/3-15-06B	E0450-16	water	X	X	X	X	X	X	X	X
IR73-GWA47/3-12-06B	E0450-17	water	X	X	X	X	X	X	X	X
IR73-GW31DW-06B	E0450-18	water	X	X	X	X	X	X	X	X
IR73-GW31-06B	E0450-19	water	X	X	X	X	X	X	X	X
IR73-GW25-06B	E0450-20	water	X	X	X	X	X	X	X	X
SDG# E0458										
IR73-GW25-06BDUP	E0458-01	water	X	X	X	X	X	X	X	X
IR73-GW25-06BDUPMS	E0458-01MS	water				X	X			
IR73-GW25-06BDUPMSD	E0458-01MSD	water				X	X			
IR73-GW15-06B	E0458-02	water	X	X	X	X	X	X	X	X
IR73-GW51DW-06B	E0458-03	water	X	X	X	X	X	X	X	X
IR73-GW51DW-06BMS	E0458-03MS	water			X				X	
IR73-GW51DW-06BMD	E0458-03MD	water			X				X	
IR73-GW51-06B	E0458-04	water	X	X	X	X	X	X	X	X
IR73-GW45DW-06B	E0458-05	water	X	X	X	X	X	X	X	X
IR73-GW45DW-06BDUP	E0458-06	water	X	X	X	X	X	X	X	X
IR73-GW18-06B	E0458-07	water	X	X	X	X	X	X	X	X
IR73-GW08-06B	E0458-08	water	X	X	X	X	X	X	X	X
IR73-GW09-06B	E0458-09	water	X	X	X	X	X	X	X	X
IR73-GW09-06BMS	E0458-09MS	water				X				
IR73-GW09-06BMSD	E0458-09MSD	water				X				
IR73-TB041806	E0458-10	water	X	X						
IR73-EB041806	E0458-11	water	X							
IR73-GW42DW-06B	E0458-12	water	X	X	X	X	X	X	X	X
IR73-GW42DW-06BMS	E0458-12MS	water			X		X		X	
IR73-GW42DW-06BMD	E0458-12MD	water			X		X		X	
IR73-GW52DW-06B	E0458-13	water	X	X	X	X	X	X	X	X
IR73-GW52-06B	E0458-14	water	X	X	X	X	X	X	X	X
IR73-GWA47/3-16-06B	E0458-15	water	X	X	X	X	X	X	X	X
IR73-GWA47/3-22-06B	E0458-16	water	X	X	X	X	X	X	X	X
IR73-GW15IW-06B	E0458-17	water	X	X	X	X	X	X	X	X
IR73-GW26-06B	E0458-19	water	X	X	X	X	X	X	X	X
IR73-GW20DW-06B	E0458-20	water	X	X	X	X	X	X	X	X
IR73-GW20DW-06BMS	E0458-20MS	water	X	X						
IR73-GW20DW-06BMSD	E0458-20MSD	water	X	X						
SDG# E0492										
IR73-TB041906	E0492-01	water	X	X						
IR73-EB041906	E0492-02	water	X							
IR73-GW20-06B	E0492-03	water	X	X	X	X	X	X	X	X
IR73-GW20-06BMS	E0492-03MS	water			X	X	X			
IR73-GW20-06BMSD	E0492-03MSD	water			X	X	X			
IR73-GW41DW-06B	E0492-04	water	X	X	X	X	X	X	X	X
IR73-GW41DW-06BMS	E0492-04MS	water					X	X	X	X
IR73-GW41DW-06BMD	E0492-04MD	water					X	X	X	X
IR73-GW41DW-06BDUP	E0492-05	water	X	X	X	X	X	X	X	X
IR73-GW40DW-06B	E0492-06	water	X	X	X	X	X	X	X	X
IR73-GW35-06B	E0492-07	water	X	X	X	X	X	X	X	X
IR73-GW35DW-06B	E0492-08	water	X	X	X	X	X	X	X	X
IR73-GW61-06B	E0492-09	water	X	X	X	X	X	X	X	X
IR73-GW28-06B	E0492-10	water	X	X	X	X	X	X	X	X
IR73-GW10-06B	E0942-11	water	X	X	X	X	X	X	X	X
IR73-GW47DW-06B	E0942-12	water	X	X	X	X	X	X	X	X
IR73-GW47DW-06BMS	E0942-12MS	water				X				
IR73-GW47DW-06BMSD	E0942-12MSD	water				X				
IR73-TB042006	E0492-13	water	X	X						
IR73-EB042006	E0492-14	water	X							

Sample ID	Lab ID	Matrix	LC-VOA	RSK-175	Alk	IC	SUL	Ferric Fe	Ferrous Fe	TOC
IR73-EB042106	E0942-15	water	X							
IR73-GWA47/3-19-06B	E0942-16	water	X	X	X	X	X	X	X	X
IR73-GWA47/3-19-06BDUP	E0492-17	water	X	X	X	X	X	X	X	X
IR73-GW34-06B	E0942-18	water	X	X	X	X	X	X	X	X
IR73-GW34-06BMS	E0942-18MS	water							X	
IR73-GW34-06BMD	E0942-18MD	water							X	
IR73-GW34DW-06B	E0492-19	water	X	X	X	X	X	X	X	X
IR73-GW21-06B	E0492-20	water	X	X	X	X	X	X	X	X
IR73-GW53-06B	E0492-21	water	X	X	X	X	X	X	X	X
IR73-TB042106	E0492-22	water	X	X						

(2) – indicates that there were 2 aliquots of each of these samples taken in the field.

The following field quality control blanks were provided with these SDGs: samples IR73-TB041006, IR73-TB041106, IR73-TB041206, IR73-TB041806, IR73-TB041906, IR73-042006, and IR73-TB042106 -trip blanks; sample IR73-FB040906-field blank; samples IR73-EB040906, IR73-EB041006, IR73-EB041106, IR73-EB041206, IR73-EB041806, IR73-EB041906, IR73-EB042006 and IR73-EB042106-equipment blanks. The following field duplicate pairs were provided with these SDGs: sample IR73-GW13DW-06BDUP-field duplicate of IR73-GW13DW-06B; sample IR73-GW13DW-06B2DUP-field duplicate of IR73-GW13DW-06B2; sample IR73-GW39DW-06BDUP-field duplicate of IR73-GW39DW-06B; sample IR73-GW39DW-06BDUP2-field duplicate of IR73-GW39DW-06B2; sample IR73-GWA47/3-8-06BDUP-field duplicate of IR73-GWA47/3-8-06B; sample IR73-GW01DW-06BDUP-field duplicate of IR73-GW01DW-06B; sample IR73-GW11DW-06BDUP-field duplicate of IR73-GW11DW-06B; sample IR73-GW63DW-06BDUP-field duplicate of IR73-GW63DW-06B; sample IR73-GW25-06BDUP-field duplicate of IR73-GW25-06B; sample IR73-GW45DW-06BDUP-field duplicate of IR73-GW45DW-06B; sample IR73-GW41DW-06BDUP-field duplicate of IR73-GW41DW-06B; and sample IR73-GWA47/3-19-06BDUP-field duplicate of IR73-GWA47/3-19-06B. The samples were evaluated based on the following criteria:

- Data Completeness *
- Technical Holding Times
- GC/MS Tuning *
- GC Performance *
- Initial/Continuing Calibrations
- Internal Standards
- Blanks
- Surrogate Recoveries
- Laboratory Control Samples *
- Matrix Spike Recoveries
- Matrix Duplicate RPDs *
- Field Duplicates
- Identification/Quantitation
- Reporting Limits *
- Tentatively Identified Compounds *

* - indicates that no qualifications were required based on this criteria

Overall Evaluation of Data/Potential Usability Issues

A summary of qualifications applied to the sample results are noted below for the fractions validated. Specific details regarding qualification of the data are addressed in the Specific Evaluation section of this narrative. If an issue is not addressed there were no actions required based on unmet quality criteria.

LC-VOA

SDG# E0443

The continuing calibration standards associated with the samples exhibited non-compliant %Ds for some compounds. Qualifications were added to the data.

One sample exhibited low internal standard area recoveries for one standard that resulted in qualifying all associated positive results as estimated and non-detected compounds as rejected.

Several samples exhibited non-compliant recoveries for one or two deuterated compounds which resulted in qualifying associated compounds as estimated.

A field duplicate was submitted for one of the associated field sample in the data package. Due to non-comparable results all compounds with positive results were qualified as estimated.
Several samples required a dilution to obtain positive results within the calibration range. In the diluted analysis for three of these samples one of the compounds of interest was diluted out. The result for these compounds was used in the initial analysis and was qualified as estimated.

SDG# E0444

Blank contamination was noted in the field QC blanks associated with samples in this batch. Qualifications were added to the data.

Several samples exhibited non-compliant recoveries for one or two deuterated compounds which resulted in qualifying associated compounds as estimated.

One sample required a dilution to obtain positive results within the calibration range.

SDG# E0450

The continuing calibration standards associated with the samples exhibited non-compliant %Ds for some compounds. Qualifications were added to the data.

Blank contamination was noted in the field QC blanks associated with samples in this batch. Qualifications were added to the data.

Several samples exhibited non-compliant recoveries for one or two deuterated compounds which resulted in qualifying associated compounds as estimated.

Several samples required a dilution to obtain positive results within the calibration range.

SDG# E0458

The continuing calibration standards associated with the samples exhibited non-compliant %Ds for some compounds. Qualifications were added to the data.

Several samples exhibited non-compliant recoveries for one or two deuterated compounds which resulted in qualifying associated compounds as estimated.

The field duplicate sample and the associated field sample did not exhibited comparable results for one compound that resulted in qualifying the results as estimated.

SDG# E0492

The continuing calibration standards associated with the samples exhibited non-compliant %Ds for some compounds. Qualifications were added to the data. Several samples exhibited non-compliant recoveries for one or two deuterated compounds which resulted in qualifying associated compounds as estimated.

RSK-175

SDG # E0443

Eleven samples required dilutions to obtain positive results within the calibration range. Reported E flagged results were rejected in favor of corresponding results from the dilution analyses.

The field duplicate pair of sample IR73-GW39DW-06B exhibited an RPD greater than 100% (168%) for the compound methane in the RSK-175 analysis. The reported results for methane in the field duplicate pair were qualified as estimated J.

SDG # E0444

Four samples required dilutions to obtain positive results within the calibration range. Reported E flagged results were rejected in favor of corresponding results from the dilution analyses.

Blank contamination was noted in one of the trip blanks associated with samples in this batch. Qualifications were added to the data.

SDG # E0450

Eight samples required dilutions to obtain positive results within the calibration range. Reported E flagged results were rejected in favor of corresponding results from the dilution analyses.

SDG # E0458

Four samples required dilutions to obtain positive results within the calibration range. Reported E flagged results were rejected in favor of corresponding results from the dilution analyses.

The associated MS/MSD pair of sample IR73-GW20-06B exhibited recoveries for methane that were above the QC limit. The reported positive result for methane in the native sample is qualified as estimated J.

SDG # E0492

Six samples required dilutions to obtain positive results within the calibration range. Reported E flagged results were rejected in favor of corresponding results from the dilution analyses.

Wet Chemistry Parameters

SDG #E0443

Samples analyzed outside the 24 hour holding time allowed by the lab (flagged H by the lab) for the Ferrous iron analysis were qualified as estimated J/UJ.

The associated MS/MSD analysis for the IC parameters nitrate and nitrite exhibited recoveries below the lower QC limit of 90%. The analytes were qualified as estimated J/UJ in all samples. The associated MS/MSD analysis for the IC parameter chloride exhibited recoveries above the upper QC limit of 110%. Positive results for the analyte were qualified as estimated J in all samples.

SDG #E0444

Samples analyzed outside the 24 hour holding time allowed by the lab (flagged H by the lab) for the Ferrous iron analysis were qualified as estimated J/UJ.

The associated MS/MSD analyses for the IC parameters chloride and sulfate exhibited recoveries a below the lower QC limit of 90%. The analytes were qualified as estimated J/UJ in all samples.

SDG #E0450

Samples analyzed outside the 24 hour holding time allowed by the lab (flagged H by the lab) were qualified as estimated J/UJ for the Ferrous iron analysis.

The associated MS/MSD analysis for the IC parameters chloride and nitrite exhibited recoveries below the lower QC limit of 90%. Positive and non-detect results for nitrite were qualified as estimated J/UJ. Positive results for chloride were qualified as estimated J and should be considered extremely biased low because the MS/MSD pair exhibited 0% spike recovery for the analyte.

The field duplicate pair of sample IR73-GW63DW-06B exhibited RPDs greater than 100% for the analytes chloride and sulfate in the IC analysis. The reported results for chloride and sulfate in the field duplicate pair were qualified as estimated J with a qualifier code of FD.

SDG #E0458

Samples analyzed outside the 24 hour holding time allowed by the lab (flagged H by the lab) were qualified as estimated J/UJ for the Ferrous iron analysis.

The associated MS/MSD analyses for the IC parameters chloride and nitrate exhibited recoveries above the upper QC limit of 110%. Positive results for chloride and nitrate were qualified as estimated J in all samples.

SDG #E0492

Samples analyzed outside the 24 hour holding time allowed by the lab (flagged H by the lab) were qualified as estimated J/UJ for the Ferrous iron analysis.

One of the associated MS/MSD analyses for the IC parameters chloride and nitrate exhibited recoveries above the upper QC limit of 110%. Positive results for chloride and nitrate were qualified as estimated J in all samples. The associated MS/MSD analysis for sulfide exhibited recoveries below the lower QC limit of 75%. Positive and non-detect results were qualified as estimated J/UJ in all samples.

Specific Evaluation of Data

Data Completeness

Resubmissions were required for the IC and TOC fractions. Calibration data (raw data and/or summaries) were missing from the data package. Sample data was missing from the data package for the IC fraction. This information was requested from the laboratory. All information requested was received from the lab with the exception of the raw data for the TOC initial calibrations. According to an e-mail response from the lab, the instrument does not print out raw data for standards injected as part of the initial calibration sequence. The system processes the results of the standard injections and provides a calibration curve summary. The summary was provided by the lab. Corrected ferrous/ferric results were received from the laboratory for an incorrectly reported result. It was noted that some of the ferrous iron samples were filtered prior to analysis. A general question regarding this was sent to the lab. Samples were filtered due to significant suspended solids. Copies of all e-mail correspondence are included in the validation worksheets portion of this validation report.

Technical Holding Times

According to chain of custody records, sampling was performed on 04/09-21/06 and samples were received at the laboratory 04/11-22/06. All sample preparation and analysis was performed within CLP holding time requirements with the exception of those listed below.

VOA

SDG# E0443

Sample IR73-GW50DW-06B was analyzed at a dilution on 04/26/06 and had been sampled on 04/09/06; therefore the analysis exceeded the 14-day analysis holding time by three days. All positive results were qualified as estimated (J) and non-detected results are rejected (R).

Wet Chemistry

SDGs # E0443, E0444, E0450, E0458, and E0492

For the ferrous iron fraction, all samples analyzed outside of the 24 hour holding time used by the laboratory were qualified as estimated J/UJ with a qualifier code of HT. These samples were analyzed as soon as possible after receipt. The laboratory used an H flag to indicate these results on the data results forms. The following samples were flagged as estimated J/UJ due to the holding time violation:

SDG E0443: IR73-GW13DW-06B2, IR73-GW13-06B2, IR73-GW16-06B2, IR73-GW38DW-06B2, IR73-GW39DW-06B2, IR73-GW39DW-06B2DUP, IR73-GW17-

06B2, IR73-GW17DW-06B2, IR73-GW37-06B2, IR73-GW43DW-06B2, IR73-A47/3-9-06B2, IR73-GW50DW-06B2, IR73-GW27DW-06B2, IR73-GW27-06B2, IR73-GW44DW-06B2, and IR73-GW29-06B2.

SDG E0444: IR73-GWA47/3-8-06B, IR73-GWA47/3-8-06BDUP, IR73-GW12-06B, IR73-GW01DW-06B, IR73-GW01DW-06BDUP, IR73-GW01-06B, IR73-GW01IW-06B, IR73-GW23-06B, IR73-GW30-06B, IR73-GW03-06B, and IR73-GW48DW-06B.

SDG E0450: IR73-GW15N-06B, IR73-GW54-06B, IR73-GW06-06B, IR73-GW06IW-06B, IR73-GW46DW-06B, IR73-GW62DW-06B, and IR73-GW31-06B.

SDG E0458: IR73-GW51DW-06B, IR73-GW45DW-06B, IR73-GW45DW-06BDUP, IR73-GW18-06B, IR73-GW08-06B, IR73-GW09-06B, IR73-GW42DW-06B, IR73-GW52DW-06B, IR73-GWA47/3-16-06B, IR73-GWA47/3-22-06B, and IR73-GW15IW-06B.

SDG E0492: IR73-GW41DW-06B, IR73-GW41DW-06BDUP, IR73-GW35-06B, IR73-GW35DW-06B, IR73-GW61-06B, IR73-GWA47/3-19-06B, IR73-GW21-06B, and IR73-GW53-06B.

Initial/Continuing Calibration

VOA

SDG# E0443

Calibration standards exhibited %Ds that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results were qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag	Qualifier Code
CC 04/12/06	chloromethane vinyl chloride trichlorofluoromethane 1,1,2-trichloro-1,2,2-trifluoroethane xylene (totals)	59.4% 38.1% 515% 30.4% 246.3%	IR73-GW13DW-06B, IR73-GW13-06B, IR73-GW16-06B, IR73-GW38DW-06B, IR73-GW39DW-06BDUP, IR73-GW17-06B	J/UJ	CCH
CC 04/12/06	trichlorofluoromethane	32.4%	IR73-GW39DW-06B, IR73-GW17DW-06B, IR73-GW43DW-06B, IR73-GWA47/3-9-06B, IR73-FB040906, IR73-EB040906, IR73-GW27DW-06B, IR73-GW44DW-06B, IR73-GW29-06B, IR73-GW49DWA-06B, IR73-GW49IW-06B, IR73-GW33DW-06B	J/UJ	CCH

SDG# E0450

Calibration standards exhibited %Ds that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results were qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag	Qualifier Code
CC 04/15/06	1,1,2-trichloro-1,2,2-trifluoroethane acetone	36.4% 57.1%	IR73-TB041206, IR73-GW63DW-06B, IR73-GW63DW-06BDUP, IR73-GW58-06B, IR73-GW02-06B, IR73-GW19-06B, IR73-GW15N-06B, IR73-GW54-06B, IR73-EB041206, IR73-GW06-06B, IR73-GW06IW-06B, IR73-GW46DW-06B, IR73-GWA47/3-15-06B	J/UJ	CCH
CC 04/16/06	dichlorodifluoromethane	42.2%	IR73-GW02IW-06B, IR73-GWA47/3-12-06B	J/UJ	CCH
CC 04/17/06	acetone	57.1%	IR73-GW31DW-06B, IR73-GW31-06B, IR73-GW25-06B	J/UJ	CCH

SDG# E0458

Calibration standards exhibited %Ds that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results were qualified as indicated.

Standard ID	Compound(s)	%D	Samples	Q Flag	Qual Code
CC 04/18/06 CC 04/22/06	dichlorodifluoromethane	37.8%, 52.0%	IR73-GW25-06BDUP, IR73-GW15-06B	J/UJ	CCH
CC 04/19/06	dichlorodifluoromethane acetone	37.3% 61.9%	IR73-GW51DW-06B, IR73-GW51-06B, IR73-GW45DW-06B, IR73-GW45DW-06BDUP, IR73-GW18-06B, IR73-GW08-06B, IR73-GW09-06B, IR73-TB041806, IR73-EB041806, IR73-GW42DW-06B, IR73-GW52DW-06B, IR73-GW52-06B, IR73-GWA47/3-16-06B, IR73-GWA47/3-22-06B, IR73-GW15IW-06B, IR73-GW26DW-06B, IR73-GW20DW-06B	J/UJ	CCH

SDG# E0492

Calibration standards exhibited %Ds that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results were qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag	Qualifier Code
CC 04/22/06 CC 04/23/06 Cc 04/26/06	dichlorodifluoromethane	52.0%, 52.3% 47.0%	all samples	J/UJ	CCH
CC 04/26/06	trichlorofluoromethane 1,1-dichloroethene 1,1,2-trichloro-1,2,2-trifluoroethene acetone methylene chloride 1,2,3-trichlorobenzene	42.3% 39.2% 70.1% 85.7% 32.4% 32.3%	IR73-EB042006	J/UJ	CCH

Internal Standards

VOA

SDG# E0443

Sample IR73-GW33DW-06B exhibited low recoveries for one internal standard, 1,4-dichlorobenzene; therefore all associated positive results were qualified as estimated (J) and non-detected compounds as rejected (R), qualifier code: ISL.

Blanks

VOA

SDG# E0444

The associated field QC blanks exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table.

Blank ID	Compound	Concentration	Reporting Limit
IR73-TB041006	methylene chloride	0.33J ug/L	0.50 ug/L
IR73-TB041106	methylene chloride	0.49J ug/L	0.50 ug/L
IR73-EB041106	methylene chloride	0.4J ug/L	0.50 ug/L
IR73-EB041006	methylene chloride	0.37J ug/L	0.50 ug/L
IR73-FB040905	methylene chloride	0.39J ug/L	0.50 ug/L

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag	Qual Code
IR73-GW12-06B	methylene chloride	CRQL	BL

SDG# E0450

The associated field QC blanks exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table. The method blanks associated with field QC blanks exhibited some contamination but the QC blanks were not qualified, per the request of the client.

Blank ID	Compound	Concentration	Reporting Limit
IR73-TB041106	methylene chloride	0.49J ug/L	0.50 ug/L
IR73-TB041206	methylene chloride	0.45J ug/L	0.50 ug/L
IR73-EB041106	methylene chloride	0.4J ug/L	0.50 ug/L
IR73-EB041206	methylene chloride	0.46J ug/L	0.50 ug/L
IR73-FB040905	methylene chloride	0.39J ug/L	0.50 ug/L

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag	Qual Code
IR73-GW15N-06B	methylene chloride	CRQL	BL
IR73-GW63DW-06BDUP	methylene chloride	U	BL

RSK-175

SDG # E0444

One of the associated trip blanks exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table.

Blank ID	Compound	Concentration	Reporting Limit	Action Level
IR73-TB041106	methane	190 ug/L	13 ug/L	950 ug/L

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag	Qual Code
IR73-GW11DW-06BDUP, IR73-GW23-06B, IR73-GW30-06B, IR73-GW48DW-06B, IR73-GW03-06BDL	methane	U	BL

SDG # E0450

One of the associated trip blanks exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table.

Blank ID	Compound	Concentration	Reporting Limit	Action Level
IR73-TB041106	methane	190 ug/L	13 ug/L	950 ug/L

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag	Qual Code
IR73-GW63DW-06B, IR73-GW63DW-06BDUP, IR73-GW02IW-06B, IR73-GW02-06B, IR73-GW19-06BDL	methane	U	BL

Surrogates

VOA

SDG# E0443

The samples listed in the table below exhibited non-compliant surrogate (deuterated monitoring compounds) recovery for the surrogates listed, qualifications were applied as listed.

Sample ID	Non-compliant DMC	% Rec	QC Limit	Q Flag	Qual Code
IR73-GW39DW-06B	2-butanone-d5	0%	42-171%	J/R	SSL
	trans-1,3-dichloropropene-d4	68%	80-128%	J/UJ	SSL
	bromoform-d	64%	76-135%		
IR73-GW44DW-06B	2-butanone-d5	24%	42-171%	J/UJ	SSL
	trans-1,3-dichloropropene-d4	50%	80-128%		
	bromoform-d	46%	76-135%		
IR73-GW29-06B	2-butanone-d5	0%	42-171%	J/R	SSL
	trans-1,3-dichloropropene-d4	36%	80-128%	J/UJ	SSL
	bromoform-d	48%	76-135%		
IR73-GW49DW-06B	2-butanone-d5	30%	42-171%	J/UJ	SSL
	bromoform-d	66%	76-135%		
IR73-GW13-06B	trans-1,3-dichloropropene-d4	68%	80-128%	J/UJ	SSL
	bromoform-d	72%	76-135%		
IR73-GW16-06B	trans-1,3-dichloropropene-d4	66%	80-128%	J/UJ	SSL
IR73-GW17-06B	trans-1,3-dichloropropene-d4	68%	80-128%	J/UJ	SSL
	bromoform-d	74%	76-135%		
IR73-GW17DW-06B	trans-1,3-dichloropropene-d4	72%	80-128%	J/UJ	SSL
IR73-GW43DW-06B	trans-1,3-dichloropropene-d4	76%	80-128%	J/UJ	SSL
IR73-GWA47/3-9-06B	trans-1,3-dichloropropene-d4	38%	80-128%	J/UJ	SSL
	bromoform-d	58%	76-135%		
IR73-GW49DWA-06B	trans-1,3-dichloropropene-d4	72%	80-128%	J/UJ	SSL
IR73-GW33DW-06B	trans-1,3-dichloropropene-d4	66%	80-128%	J/UJ	SSL
	2-hexanone-d5	36%	37-169%		
IR73-GW37-06B	trans-1,3-dichloropropene-d4	50%	80-128%	J/UJ	SSL
	bromoform-d	56%	76-135%		

SDG# E0444

The samples listed in the table below exhibited non-compliant surrogate (deuterated monitoring compounds) recovery for the surrogates listed, qualifications were applied as listed.

Sample ID	Non-compliant DMC	% Rec	QC Limit	Q Flag	Qual Code
IR73-GW12-06B	trans-1,3-dichloropropene-d4	38%	80-128%	J/UJ	SSL
	bromoform-d	72%	76-135%		
IR73-GW01-06B	trans-1,3-dichloropropene-d4	72%	80-128%	J/UJ	SSL
IR73-GW11-06B	trans-1,3-dichloropropene-d4	18%	80-128%	J/R	SSL
	bromoform-d	52%	76-135%	J/UJ	SSL
IR73-GW11IW-06B	trans-1,3-dichloropropene-d4	54%	80-128%	J/UJ	SSL
	bromoform-d	70%	76-135%		
IR73-GW23-06B	trans-1,3-dichloropropene-d4	72%	80-128%	J/UJ	SSL
IR73-GW30-06B	trans-1,3-dichloropropene-d4	18%	80-128%	J/R	SSL
	bromoform-d	46%	76-135%	J/UJ	SSL
IR73-GW03-06B	trans-1,3-dichloropropene-d4	14%	80-128%	J/R	SSL
	bromoform-d	32%	76-135%	J/UJ	SSL
IR73-GW56-06B	trans-1,3-dichloropropene-d4	24%	80-128%	J/UJ	SSL
	bromoform-d	42%	76-135%		

SDG# E0450

The samples listed in the table below exhibited non-compliant surrogate (deuterated monitoring compounds) recovery for the surrogates listed, qualifications were applied as listed.

Sample ID	Non-compliant DMC	% Rec	QC Limit	Q Flag	Qual Code
IR73-GW55-06B	trans-1,3-dichloropropene-d4	68%	80-128%	J/UJ	SSL
	bromoform-d	66%	76-135%		
IR73-GW02-06B	1,2-dichloropropane-d6	82%	84-123%	J/UJ	SSL
	trans-1,3-dichloropropene-d4	38%	80-128%		
	bromoform-d	52%	76-135%		
IR73-GW19-06B	trans-1,3-dichloropropene-d4	32%	80-128%	J/UJ	SSL
	bromoform-d	66%	76-135%		
IR73-GW15N-06B	trans-1,3-dichloropropene-d4	62%	80-128%	J/UJ	SSL
IR73-GW54-06B	trans-1,3-dichloropropene-d4	30%	80-128%	J/UJ	SSL
	bromoform-d	52%	76-135%		
IR73-GWA47/3-15-06B	trans-1,3-dichloropropene-d4	66%	80-128%	J/UJ	SSL
IR73-GWA47/3-12-06B	trans-1,3-dichloropropene-d4	64%	80-128%	J/UJ	SSL

SDG# E0458

The samples listed in the table below exhibited non-compliant surrogate (deuterated monitoring compounds) recovery for the surrogates listed, qualifications were applied as listed.

Sample ID	Non-compliant DMC	% Rec	QC Limit	Q Flag	Qual Code
IR73-GW15-06B	trans-1,3-dichloropropene-d4	76%	80-128%	J/UJ	SSL
IR73-GW51-06B	trans-1,3-dichloropropene-d4	42%	80-128%	J/UJ	SSL
	bromoform-d	68%	76-135%		
IR73-GW18-06B	trans-1,3-dichloropropene-d4	40%	80-128%	J/UJ	SSL
	bromoform-d	72%	76-135%		
IR73-GW08-06B	trans-1,3-dichloropropene-d4	54%	80-128%	J/UJ	SSL
IR73-GW09-06B	trans-1,3-dichloropropene-d4	70%	80-128%	J/UJ	SSL
IR73-EB041806	toluene-d8	74%	77-120%	J/UJ	SSL
IR73-GW42DW-06B	1,2-dichloropropane-d6	82%	84-123%	J/UJ	SSL
	trans-1,3-dichloropropene-d4	78%	80-128%		
IR73-GW52-06B	trans-1,3-dichloropropene-d4	22%	80-128%	J/UJ	SSL
	bromoform-d	60%	76-135%		
IR73-GWA47/3-22-06B	trans-1,3-dichloropropene-d4	70%	80-128%	J/UJ	SSL
	bromoform-d	64%	76-135%		
IR73-GW26DW-06B	trans-1,3-dichloropropene-d4	58%	80-128%	J/UJ	SSL
	bromoform-d	66%	76-135%		

SDG# E0492

The samples listed in the table below exhibited non-compliant surrogate (deuterated monitoring compounds) recovery for the surrogates listed, qualifications were applied as listed.

Sample ID	Non-compliant DMC	% Rec	QC Limit	Q Flag	Qual Code
IR73-EB041906	trans-1,3-dichloropropene-d4	78%	80-128%	J/UJ	SSL
IR73-GW20-06B	trans-1,3-dichloropropene-d4	78%	80-128%	J/UJ	SSL
	bromoform-d	52%	76-135%		
IR73-GW41DW-06B	trans-1,3-dichloropropene-d4	74%	80-128%	J/UJ	SSL
	bromoform-d	72%	76-135%		
IR73-GW35-06B	trans-1,3-dichloropropene-d4	74%	80-128%	J/UJ	SSL
	bromoform-d	74%	76-135%		
IR73-GW35DW-06B	trans-1,3-dichloropropene-d4	78%	80-128%	J/UJ	SSL
	bromoform-d	74%	76-135%		
IR73-GW28-06B	trans-1,3-dichloropropene-d4	60%	80-128%	J/UJ	SSL
IR73-GW10-06B	trans-1,3-dichloropropene-d4	48%	80-128%	J/UJ	SSL
	bromoform-d	58%	76-135%		
IR73-GWA47/3-19-06B	trans-1,3-dichloropropene-d4	28%	80-128%	J/UJ	SSL
	bromoform-d	58%	76-135%		
IR73-GWA47/3-19-06BDUP	trans-1,3-dichloropropene-d4	34%	80-128%	J/UJ	SSL
	bromoform-d	54%	76-135%		
IR73-GW34-06B	trans-1,3-dichloropropene-d4	56%	80-128%	J/UJ	SSL
	bromoform-d	64%	76-135%		
IR73-GW34DW-06B	trans-1,3-dichloropropene-d4	78%	80-128%	J/UJ	SSL
IR73-GW53-06B	trans-1,3-dichloropropene-d4	36%	80-128%	J/UJ	SSL
	bromoform-d	56%	76-135%		

Matrix Spike Recoveries

RSK-175

SDG #E0458

The MS/MSD pair of sample IR73-GW20DW-06B exhibited spike recoveries above the upper QC limit for methane. Required qualifications are noted in the following table.

MS/MSD ID	compound	% R	QC Limit	Affected Samples	Q Flag	Qual Code
IR73-GW20DW-06B	methane	187/198	75-125%	IR73-GW20DW-06B	J+	MSH

Wet Chemistry

SDG #E0443

The MS/MSD pair of sample IR73-GW49DW-06B analyzed for the IC fraction exhibited spike recoveries above the upper QC limit of 110% for chloride below the lower QC limit of 90% for nitrate and nitrite in both the MS and the MSD. Associated samples, non-compliant analytes and required qualifications are noted in the following table.

MS/MSD ID	Analyte	% R	QC Limit	Affected Samples	Q Flag	Qual Code
IR73-GW49DW-06B	chloride	193/171	90-110%	all samples	J+	MSH
	nitrate	87.4/84.6			J/UJ	MSL
	nitrite	77/77.9				

SDG #E0444

The MS/MSD pair of sample IR73-GW11IW-06B analyzed for the IC fraction exhibited spike recoveries below the lower QC limit of 90% for chloride and sulfate. Associated samples, non-compliant analytes and required qualifications are noted in the following table.

MS/MSD ID	Analyte	% R	QC Limit	Affected Samples	Q Flag	Qual Code
IR73-GW11IW-06B	chloride sulfate	89.8/89.5 86.4/89.2	90-110%	all samples	J/UJ	MSL

SDG #E0450

The MS/MSD pair of sample IR73-GW55-06B analyzed for the IC fraction exhibited spike recoveries below the lower QC limit of 90% for chloride and nitrite. Associated samples, non-compliant analytes and required qualifications are noted in the following table.

MS/MSD ID	Analyte	% R	QC Limit	Affected Samples	Q Flag	Qual Code
IR73-GW55-06B	chloride	0/0	90-110%	all samples	J/R	MSL
	nitrite	67.3/73.7			J/UJ	

SDG #E0458

The MS/MSD pairs of samples IR73-GW25-06BDUP and IR73-GW09-06B analyzed for the IC fraction exhibited spike recoveries above the upper QC limit of %110 for chloride and nitrate. Associated samples, non-compliant analytes and required qualifications are noted in the following table.

MS/MSD ID	Analyte	% R	QC Limit	Affected Samples	Q Flag	Qual Code
IR73-GW25-06BDUP	chloride nitrate	117/127 114/141	90-110%	all samples	J	MSH
IR73-GW09-06B	chloride nitrate	116/119 111/112				

SDG #E0492

The MS/MSD pair of sample IR73-GW20-06B analyzed for the IC fraction exhibited spike recoveries above the upper QC limit of 110% for chloride and nitrate. The MS/MSD pair of sample IR73-GW41DW-06B analyzed for the sulfide fraction exhibited spike recoveries below the lower QC limit of 75%. Associated samples, non-compliant analytes and required qualifications are noted in the following table.

MS/MSD ID	Analyte	% R	QC Limit	Affected Samples	Q Flag	Qual Code
IR73-GW20-06B	chloride nitrate	119/118 155/161	90-110%	all samples	J+	MSH
IR73-GW41DW-06B	sulfide	63.3/50	75-125%	all samples	J/UJ	MSL

Field Duplicates

VOA

SDG# E0443

A field duplicate was submitted for sample IR73-GW39DW-06B. High percent RPDs were exhibited for vinyl chloride (152%), 1,1-dichloroethene (153%), trans-1,2-dichloroethene (200%), cis-1,2-dichloroethene (114%), benzene (145%), trichloroethene (123%) and toluene (39%). Due to non-comparable results all compounds with positive results were qualified as estimated (J), qualifier code: FD.

RSK-175

SDG# E0443

The field duplicate pair of sample IR73-GW39DW-06B exhibited an RPD greater than 100% (168%) for the compound methane in the RSK-175 analysis. The reported results for methane in the field duplicate pair were qualified as estimated J with a qualifier code of FD.

Wet Chemistry

SDG# E0450

The field duplicate pair of sample IR73-GW63DW-06B exhibited RPDs greater than 100% for the analytes chloride and sulfate in the IC analysis. The reported results for chloride and sulfate in the field duplicate pair were qualified as estimated J with a qualifier code of FD.

Identification/Quantitation

VOA

SDG# E0443

A dilution was required for samples IR73-GW13DW-06B, IR73-GW39DW-06B, IR73-GW50DW-06B, IR73-GWA47/3-9-06B, IR73-GW27DW-06B, IR73-GW44DW-06B, IR73-GW49IW-06B and IR73-GW49DW-06B; therefore, the E-flagged compound results were not used in the initial analysis in favor of the corresponding D-flagged compound result in the dilution (qualifier code: DL).

Samples IR73-GW44DW-06B, IR73-GW49IW-06B and IR73-GW49DW-06B were analyzed at a dilution to obtain results within the calibration for several compounds including vinyl chloride. However, the diluted analysis for each of these sample was at such a dilution that vinyl chloride was diluted out. The laboratory was contacted via e-mail concerning this issue and asked if there was an analysis for each of these samples at a less dilution that resulted in vinyl chloride exhibiting a result within the calibration range. According to the laboratory there were no additional runs for these samples. Therefore, the vinyl chloride result is used from the initial analysis and is qualified as estimated since the result is above the calibration range (qualifier code: LR).

SDG# E0444

A dilution was required for sample IR73-GW48DW-06B; therefore, the E-flagged compound results were not used in the initial analysis in favor of the corresponding D-flagged compound result in the dilution (qualifier code: DL).

SDG# E0450

A dilution was required for samples IR73-GW63DW-06B and IR73-GW63DW-06BDUP; therefore, the E-flagged compound results were not used in the initial analysis in favor of the corresponding D-flagged compound result in the dilution (qualifier code: DL).

RSK-175

SDG# E0443

Samples IR73-GW13DW-06B, IR73-GW13-06B, IR73-GW39DW-06B, IR73-GW17-06B, IR73-GWA47/3-9-06B, IR73-GW50DW-06B, IR73-GW27DW-06B, IR73-GW27-06B, IR73-GW44DW-06B, IR73-GW49IW-06B and IR73-GW49DW-06B required dilutions to accurately quantitate target compounds. All E-flagged results in the initial analysis of these samples are rejected in favor of the corresponding result reported in the dilution analysis with a qualifier code of DL.

SDG# E0444

Samples IR73-GWA47/3-8-06B, IR73-GWA47/3-8-06BDUP, IR73-GW01IW-06B, and IR73-GW11IW-06B required dilutions to accurately quantitate target compounds. All E-flagged results in the initial analysis of these samples are rejected in favor of the corresponding result reported in the dilution analysis with a qualifier code of DL.

SDG# E0450

Samples IR73-GW55-06B, IR73-GW19-06B, IR73-GW15N-06B, IR73-GW54-06B, IR73-GW06-06B, IR73-GW06IW-06B, IR73-GW62DW-06B, and IR73-GWA47/315-06B required dilutions to accurately quantitate target compounds. All E-flagged results in the initial analysis of these samples are rejected in favor of the corresponding result reported in the dilution analysis with a qualifier code of DL.

SDG# E0458

Samples IR73-GW15-06B, IR73-GW08-06BDUP, IR73-GWA47/3-16-06B, and IR73-GWA47/3-22-06B required dilutions to accurately quantitate target compounds. All E-flagged results in the initial analysis of these samples are rejected in favor of the corresponding result reported in the dilution analysis with a qualifier code of DL.

SDG# E0492

Samples IR73-GW41DW-06B, IR73-GW41DW-06BDUP, IR73-GW61-06B, IR73-GW10-06B, IR73-GWA47/3-19-06B, and IR73-GWA47/3-19-06BDUP required dilutions to accurately quantitate target compounds. All E-flagged results in the initial analysis of these samples are rejected in favor of the corresponding result reported in the dilution analysis with a qualifier code of DL.

A summary of qualifications required is provided on the following page. Please do not hesitate to contact DataQual ES with any questions regarding this validation report.

Sincerely,

Laura Maschhoff
President

Jacqueline Cleveland
Vice President

Summary of Data Qualifications

VOA

SDG# E0443

Sample ID	Compound	Results	Q-Flag	Qualifier Code
IR73-GW50DW-06BDL	all results	+/-	J/R	HT
IR73-GW13DW-06B, IR73-GW13-06B, IR73-GW16-06B, IR73-GW38DW-06B, IR73-GW39DW-06BDUP, IR73-GW17-06B	chloromethane vinyl chloride trichlorofluoromethane 1,1,2-trichloro-1,2,2-trifluoroethane xylene (totals)	+/-	J/UJ	CCH
IR73-GW39DW-06B, IR73-GW17DW-06B, IR73-GW43DW-06B, IR73-GWA47/3-9-06B, IR73-FB040906, IR73-EB040906, IR73-GW27DW-06B, IR73-GW44DW-06B, IR73-GW29-06B, IR73-GW49DWA-06B, IR73-GW49IW-06B, IR73-GW33DW-06B	trichlorofluoromethane	+/-	J/UJ	CCH
IR73-GW33DW-06B	all associated compounds with: 1,4-dichlorobenzene	+/-	J/R	ISL
IR73-GW39DW-06B	2-butanone-d5	+/-	J/R	SSL
	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW44DW-06B	2-butanone-d5	+/-	J/UJ	SSL
	trans-1,3-dichloropropene-d4			
	bromoform-d			
IR73-GW29-06B	2-butanone-d5	+/-	J/R	SSL
	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW49DW-06B	2-butanone-d5	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW13-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW16-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GW17-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW17DW-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GW43DW-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GWA47/3-9-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW49DWA-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GW33DW-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	2-hexanone-d5			
IR73-GW37-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW39DW-06B, IR73-GW39DW-06BDUP	all positive results	+	J	FD

Summary of Data Qualifications

VOA

SDG# E0443

Sample ID	Compound	Results	Q-Flag	Qualifier Code
IR73-GW13DW-06B, IR73-GW39DW-06B, IR73-GW50DW-06B, IR73-GWA47/3-9-06B, IR73-GW27DW-06B, IR73-GW44DW-06B, IR73-GW49IW-06B, IR73-GW49DW-06B	all E-flagged compounds	+	R	DL
IR73-GW13DW-06BDL, IR73-GW39DW-06BDL, IR73-GW50DW-06BDL, IR73-GWA47/3-9-06BDL, IR73-GW27DW-06BDL, IR73-GW44DW-06BDL, IR73-GW49IW-06BDL, IR73-GW49DW-06BDL	all results except D-flagged compounds	+/-	R	DL
IR73-GW44DW-06B, IR73-GW49IW-06B, IR73-GW49DW-06B	vinyl chloride	+	J	LR

SDG# E0444

Sample ID	Compound	Results	Q-Flag	Qualifier Code
IR73-GW12-06B	methylene chloride	+	CRQL	BL
IR73-GW12-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW01-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GW11-06B	trans-1,3-dichloropropene-d4	+/-	J/R	SSL
	bromoform-d	+/-	J/UJ	SSL
IR73-GW11IW-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW23-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GW30-06B	trans-1,3-dichloropropene-d4	+/-	J/R	SSL
	bromoform-d	+/-	J/UJ	SSL
IR73-GW03-06B	trans-1,3-dichloropropene-d4	+/-	J/R	SSL
	bromoform-d	+/-	J/UJ	SSL
IR73-GW56-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW48DW-06B	all E-flagged compounds	+	R	DL
IR73-GW48DW-06BDL	all results except D-flagged compounds	+/-	R	DL

Summary of Data Qualifications

VOA

SDG# E0450

Sample ID	Compound	Results	Q-Flag	Qualifier Code
IR73-TB041206, IR73-GW63DW-06B, IR73-GW63DW-06BDUP, IR73-GW58-06B, IR73-GW02-06B, IR73-GW19-06B, IR73-GW15N-06B, IR73-GW54-06B, IR73-EB041206, IR73-GW06-06B, IR73-GW06IW-06B, IR73-GW46DW-06B, IR73-GWA47/3-15-06B	1,1,2-trichloro-1,2,2-trifluoroethane acetone	+/-	J/UJ	CCH
IR73-GW02IW-06B, IR73-GWA47/3-12-06B	dichlorodifluoromethane	+/-	J/UJ	CCH
IR73-GW31DW-06B, IR73-GW31-06B, IR73-GW25-06B	acetone	+/-	J/UJ	CCH
IR73-GW15N-06B	methylene chloride	+	CRQL	BL
IR73-GW63DW-06BDUP	methylene chloride	+	U	BL
IR73-GW55-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW02-06B	1,2-dichloropropane-d6	+/-	J/UJ	SSL
	trans-1,3-dichloropropene-d4			
	bromoform-d			
IR73-GW19-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW15N-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GW54-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GWA47/3-15-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GWA47/3-12-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GW63DW-06B, IR73-GW63DW-06BDUP	all E-flagged compounds	+	R	DL
IR73-GW63DW-06BDL, IR73-GW63DW-06BDUPDL	all results except D-flagged compounds	+/-	R	DL

SDG# E0458

Sample ID	Compound	Results	Q-Flag	Qualifier Code
IR73-GW25-06BDUP, IR73-GW15-06B	dichlorodifluoromethane	+/-	J/UJ	CCH
IR73-GW51DW-06B, IR73-GW51-06B, IR73-GW45DW-06B, IR73-GW45DW-06BDUP, IR73-GW18-06B, IR73-GW08-06B, IR73-GW09-06B, IR73-TB041806, IR73-EB041806, IR73-GW42DW-06B, IR73-GW52DW-06B, IR73-GW52-06B, IR73-GWA47/3-16-06B, IR73-GWA47/3-22-06B, IR73-GW15IW-06B, IR73-GW26DW-06B, IR73-GW20DW-06B	dichlorodifluoromethane acetone	+/-	J/UJ	CCH
IR73-GW15-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL

Summary of Data Qualifications

VOA

SDG# E0458

Sample ID	Compound	Results	Q-Flag	Qualifier Code
IR73-GW51-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW18-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW08-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GW09-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-EB041806	toluene-d8	+/-	J/UJ	SSL
IR73-GW42DW-06B	1,2-dichloropropane-d6	+/-	J/UJ	SSL
	trans-1,3-dichloropropene-d4			
IR73-GW52-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GWA47/3-22-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW26DW-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			

SDG# E0492

Sample ID	Compound	Results	Q-Flag	Qualifier Code
all samples	dichlorodifluoromethane	+/-	J/UJ	CCH
IR73-EB042006	trichlorofluoromethane 1,1-dichloroethene 1,1,2-trichloro-1,2,2-trifluoroethene acetone methylene chloride 1,2,3-trichlorobenzene	+/-	J/UJ	CCH
IR73-EB041906	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GW20-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW41DW-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW35-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW35DW-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW28-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GW10-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GWA47/3-19-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GWA47/3-19-06BDUP	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW34-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			
IR73-GW34DW-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
IR73-GW53-06B	trans-1,3-dichloropropene-d4	+/-	J/UJ	SSL
	bromoform-d			

Summary of Data Qualifications

RSK-175

SDG# E0443

Sample ID	Compound	Results	Q-Flag	Qual Code
IR73-GW13DW-06B, IR73-GW13-06B, IR73-GW39DW-06B, IR73-GW17-06B, IR73-A47/3-9-06B, IR73-GW50DW-06B, IR73-GW27DW-06B, IR73-GW27-06B, IR73-GW44DW-06B, IR73-GW49IW-06B, IR73-GW49DW-06B.	methane	+E	R	DL
IR73-GW13DW-06BDL, IR73-GW13-06BDL, IR73-GW39DW-06BDL, IR73-GW17-06BDL, IR73-A47/3-9-06BDL, IR73-GW50DW-06BDL, IR73-GW27DW-06BDL, IR73-GW27-06BDL, IR73-GW44DW-06BDL, IR73-GW49IW-06BDL, IR73-GW49DW-06BDL	ethane ethene	+/-	R	DL
IR73-GW39DW-06B	methane	+	J	FD

SDG# E0444

Sample ID	Compound	Results	Q-Flag	Qual Code
IR73-GW11DW-06BDUP, IR73-GW23-06B, IR73-GW30-06B, IR73-GW48DW-06B, IR73-GW03-06BDL	methane	+	U	BL
IR73-GWA47/3-8-06B, IR73-GWA47/3-8-06BDUP, IR73-GW01IW-06B, IR73-GW11IW-06B	methane	+E	R	DL
IR73-GWA47/3-8-06BDL, IR73-GWA47/3-8-06BDUPDL, IR73-GW01IW-06BDL, IR73-GW11IW-06BDL	ethane ethene	+/-	R	DL

SDG# E0450

Sample ID	Compound	Results	Q-Flag	Qual Code
IR73-GW63DW-06B, IR73-GW63DW-06BDUP, IR73-GW02IW-06B, IR73-GW02-06B, IR73-GW19-06BDL	methane	+	U	BL
IR73-GW55-06B, IR73-GW19-06B, IR73-GW15N-06B, IR73-GW54-06B, IR73-GW06-06B, IR73-GW06IW-06B, IR73-GW62DW-06B, IR73-GWA47/315-06B	methane	+E	R	DL
IR73-GW55-06BDL, IR73-GW19-06BDL, IR73-GW15N-06BDL, IR73-GW54-06BDL, IR73-GW06-06BDL, IR73-GW06IW-06BDL, IR73-GW62DW-06BDL, IR73-GWA47/315-06BDL	ethane ethene	+/-	R	DL

SDG# E0458

Sample ID	Compound	Results	Q-Flag	Qual Code
IR73-GW15-06B, IR73-GW08-06BDUP, IR73-GWA47/3-16-06B, IR73-GWA47/3-22-06B	methane	+E	R	DL
IR73-GW15-06BDL, IR73-GW08-06BDUPDL, IR73-GWA47/3-16-06BDL, IR73-GWA47/3-22-06BDL	ethane ethene	+/-	R	DL
IR73-GW20DW-06B	methane	+	J	MSH

Summary of Data Qualifications

RSK-175

SDG# E0492

Sample ID	Compound	Results	Q-Flag	Qual Code
IR73-GW41DW-06B, IR73-GW41DW-06BDUP, IR73-GW61-06B, IR73-GW10-06B, IR73-GWA47/3-19-06B, IR73-GWA47/3-19-06BDUP	methane	+E	R	DL
IR73-GW41DW-06BDL, IR73-GW41DW-06BDUPDL, IR73-GW61-06BDL, IR73-GW10-06BDL, IR73-GWA47/3-19-06BDL, IR73-GWA47/3-19-06BDUPDL	ethane ethene	+/-	R	DL

Wet Chemistry Parameters

SDG # E0443

Sample ID	Analyte	Results	Q-Flag	Qual Code
IR73-GW13DW-06B2, IR73-GW13-06B2, IR73-GW16-06B2, IR73-GW38DW-06B2, IR73-GW39DW-06B2, IR73-GW39DW-06B2DUP, IR73-GW17-06B2, IR73-GW17DW-06B2, IR73-GW37-06B2, IR73-GW43DW-06B2, IR73-A47/3-9-06B2, IR73-GW50DW-06B2, IR73-GW27DW-06B2, IR73-GW27-06B2, IR73-GW44DW-06B2, IR73-GW29-06B2.	Ferrous Fe	+/- H	J/UJ	HT
all samples	chloride	+	J	MSH
all samples	nitrate nitrite	+/-	J/UJ	MSL

SDG # E0444

Sample ID	Analyte	Results	Q-Flag	Qual Code
IR73-GWA47/3-8-06B, IR73-GWA47/3-8-06BDUP, IR73-GW12-06B, IR73-GW01DW-06B, IR73-GW01DW-06BDUP, IR73-GW01-06B, IR73-GW01IW-06B, IR73-GW23-06B, IR73-GW30-06B, IR73-GW03-06B, IR73-GW48DW-06B.	Ferrous Fe	+/- H	J/UJ	HT
all samples	chloride sulfate	+/-	J/UJ	MSL

SDG # E0450

Sample ID	Analyte	Results	Q-Flag	Qual Code
IR73-GW15N-06B, IR73-GW54-06B, IR73-GW06-06B, IR73-GW06IW-06B, IR73-GW46DW-06B, IR73-GW62DW-06B, IR73-GW31-06B	Ferrous Fe	+/- H	J/UJ	HT
all samples	chloride	+/-	J/R	MSL
	nitrite	+/-	J/UJ	MSL
IR73-GW63DW-06B, IR73-GW63DW-06BDUP	chloride	+	J	FD
	sulfate			

Summary of Data Qualifications

Wet Chemistry Parameters

SDG # E0458

Sample ID	Analyte	Results	Q-Flag	Qual Code
IR73-GW51DW-06B, IR73-GW45DW-06B, IR73-GW45DW-06BDUP, IR73-GW18-06B, IR73-GW08-06B, IR73-GW09-06B, IR73-GW42DW-06B, IR73-GW52DW-06B, IR73-GWA47/3-16-06B, IR73-GWA47/3-22-06B, IR73-GW15IW-06B	Ferrous Fe	+/- H	J/UJ	HT
all samples	chloride	+	J	MSH
	nitrate			

SDG # E0492

Sample ID	Analyte	Results	Q-Flag	Qual Code
IR73-GW41DW-06B, IR73-GW41DW-06BDUP, IR73-GW35-06B, IR73-GW35DW-06B, IR73-GW61-06B, IR73-GWA47/3-19-06B, IR73-GW21-06B, IR73-GW53-06B	Ferrous Fe	+/- H	J/UJ	HT
all samples	chloride	+	J	MSH
	nitrate			
all samples	sulfide	+/-	J/UJ	MSL

Glossary of Qualification Flags and Abbreviations

Qualification Flags (Q-Flags)

U	not detected above the reported sample quantitation limit
J	estimated value
UJ	reported quantitation limit is qualified as estimated
R	result is rejected; the presence or absence of the analyte cannot be verified
D	result value is based on dilution analysis result
NJ	analyte has been tentatively identified, estimated value
L	analyte present, biased low
UL	not detected, quantitation limit is probably higher
K	analyte present, biased high

Method/Preparation Blank Qualification Flags (Q-Flags)

NA	The sample result for the blank contaminant is greater than the sample RL and is greater than 5X (10X for common laboratory contaminants) the blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.
U	The sample result for the blank contaminant is greater than the sample RL and is less than 5X (10X for common laboratory contaminants) the blank value.
RL	The sample result for the blank contaminant is less than the sample RL and is less than 5X (10X for common laboratory contaminants) the blank value.

General Abbreviations

RL	reporting limit
+	positive result
-	non-detect result

QUALIFIER CODE REFERENCE

Qualifier	Description
TN	Tune
BSL	Blank Spike/LCS - High Recovery
BSH	Blank Spike/LCS - Low Recovery
BD	Blank Spike/Blank Spike Duplicate (LCS/LCSD) Precision
BRL	Below Reporting Limit
ISL	Internal Standard - Low Recovery
ISH	Internal Standard - High Recovery
MSL	Matrix Spike and/or Matrix Spike Duplicate - Low Recovery
MSH	Matrix Spike and/or Matrix Spike Duplicate - High Recovery
MI	Matrix interference obscuring the raw data
MDP	Matrix Spike/Matrix Spike Duplicate Precision
2S	Second Source - Bad reproducibility between tandem detectors
SSL	Spiked Surrogate - Low Recovery
SSH	Spiked Surrogate - High Recovery
SD	Serial Dilution Reproducibility
ICL	Initial Calibration - Low Relative Response Factors (RRF)
ICH	Initial Calibration - High Relative Response Factors (RRF)
ICB	Initial Calibration - Bad Linearity or Curve Function
CCL	Continuing Calibration - Low Recovery or %Difference
CCH	Continuing Calibration - High Recovery or %Difference
LD	Lab Duplicate Reproducibility
HT	Holding Time
PD	Pesticide Degradation
2C	Second Column - Poor Dual Column Reproducibility
LR	Concentration Exceeds Linear Range
BL	Blank Contamination
RE	Redundant Result - due to Re-analysis or Re-extraction
DL	Redundant Result - due to Dilution
FD	Field Duplicate
OT	Other - explained in data validation report

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CHAIN-OF-CUSTODY RECORD

REPORT TO		INVOICE TO		
COMPANY CH2M HILL	PHONE 7043290073	COMPANY	PHONE	LAB PROJECT #:
NAME DAVID DRY / CLT	FAX 7043290141	NAME	FAX	
ADDRESS 4824 Parkway Plaza BLVD STE 200		ADDRESS		TURNAROUND TIME:
CITY/ST/ZIP Charlotte, NC 28217		CITY/ST/ZIP		Per contract

CLIENT PROJECT NAME:	CLIENT PROJECT #:	CLIENT P.O.#:
CTO-105	328432.FI.FQ.73	

REQUESTED ANALYSES

SAMPLE IDENTIFICATION	DATE/TIME SAMPLED	COMPOSITE	GRAB	WATER	SOIL	OTHER	LAB ID	# OF CONTAINERS	VOC w/HCL	MGA w/HCL										COMMENTS
IR73-GW13DW-06B	4/9/06 1115		X	X				4	2	2										
IR73-GW13-06B3	4/9/06 1230		X	X				4	2	2										
IR73-GW16-06B	4/9/06 0838		X	X				4	2	2										
IR73-GW38DW-06B	4/9/06 1147		X	X				4	2	2										
IR73-GW39DW-06B	4/9/06 1116		X	X				8	6	2										MS/MSD ALSO
~~IR73-GW39DW-06BDUP~~	4/9/06 1116		X	X				4	2	2										Duplicate
IR73-GW17-06B	4/9/06 0905		X	X				4	2	2										
IR73-GW17DW-06B	4/9/06 1020		X	X				4	2	2										
IR73GW37-06B3	4/9/06 1040		X	X				4	2	2										
IR73-GW43DW-06B	4/9/06 1320		X	X				4	2	2										
IR73-A47/3-9-06B	4/9/06 1235		X	X				4	2	2										
IR73-GW50DW-06B	4/9/06 1630		X	X				4	2	2										

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ADDRESS 4824 Parkway Plaza BLVD STE 200		ADDRESS		TURNAROUND TIME:
CITY/ST/ZIP Charlotte, NC 28217		CITY/ST/ZIP		Pre Contract

CLIENT PROJECT NAME:	CLIENT PROJECT #:	CLIENT P.O.#:
CTO -105	328432, FI, FQ, 73	

REQUESTED ANALYSES

SAMPLE IDENTIFICATION	DATE/TIME SAMPLED	COMPOSITE	GRAB	WATER	SOIL	OTHER	LAB ID	# OF CONTAINERS	Alk, Anions, Fe(II)	Sulfide	TOC	Ferric Iron									COMMENTS
IR73-GW13DW-06B	4/9/06 / 1115		X	X				3		1	1	1									
IR73-GW13DW-06B	4/10/06 / 0812		X	X				1	1												
IR73-GW13-06B	4/9/06 / 1230		X	X				3		1	1	1									
IR73-GW13-06B	4/10/06 / 0810		X	X				1	1												
IR73-GW38DW-06B	4/9/06 / 1147		X	X				3		1	1	1									
IR73-GW38DW-06B	4/10/06 0802		X	X				1	1												
IR73-GW39DW-06B	4/9/06 / 1116		X	X				3		1	1	1									
IR73-GW39DW-06B	4/10/06 0802		X	X				1	1												
IR73-GW39DW-06BDUP	4/9/06 / 1116		X	X				3		1	1	1									Duplicate
IR73-GW39DW-06BDUP	4/10/06 / 1120		X	X				1	1												Duplicate
IR73-GW17-06B	4/9/06 / 0905		X	X				3		1	1	1									
IR73-GW17-06B	4/10/06 / 0800		X	X				1	1												

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NAME DAVID DRY/CLT	FAX 7043290141	NAME	FAX	
ADDRESS 4824 Parkway Plaza BLVD STE 200		ADDRESS		TURNAROUND TIME:
CITY/ST/ZIP Charlotte, NC 28217		CITY/ST/ZIP		percontact

CLIENT PROJECT NAME:	CLIENT PROJECT #:	CLIENT P.O.#:
CTO-105	328432.FI.FQ.73	

REQUESTED ANALYSES

SAMPLE IDENTIFICATION	DATE/TIME SAMPLED	COMPOSITE	GRAB	WATER	SOIL	OTHER	LAB ID	# OF CONTAINERS	Alkalinity, Carbonate	Sulfide	TOC	Ferric Iron									COMMENTS
IR73-GW17DW-06B	4/9/06 / 1020		X	X				3		1	1	1									
IR73-GW17DW-06B	4/10/06 / 0805		X	X				1	1												
IR73-GW37-06B	4/9/06 / 1040		X	X				3		1	1	1									
IR73-GW37-06B	4/10/06 / 0810		X	X				1	1												
IR73-GW43DW-06B	4/9/06 / 1320		X	X				3		1	1	1									
IR73-GW43DW-06B	4/10/06 / 0820		X	X				1	1												
IR73-GW A47/3-9-06B	4/9/06 / 1235		X	X				3		1	1	1									
IR73-GW A47/3-9-06B	4/10/06 / 0840		X	X				1	1												
IR73-GW50DW-06B	4/9/06 / 1630		X	X				3		1	1	1									
IR73-GW50DW-069	4/10/06 / ~~1630~~ 0825		X	X				1	1												
IR73-GW16-06B	4/10/06 / 0753		X	X				1	1												
IR73-GW29-06B	4/10/06 / 0800		X	X				1	1												

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NAME DAVID DRY / CLT	FAX 7043290141	NAME	FAX	
ADDRESS 4824 Parkway Plaza BLVD STE 200		ADDRESS		TURNAROUND TIME:
CITY/ST/ZIP Charlotte, NC 28217		CITY/ST/ZIP		Per Contract

CLIENT PROJECT NAME:	CLIENT PROJECT #:	CLIENT P.O.#:
CTO-105	328432.FI.FQ73	

REQUESTED ANALYSES

SAMPLE IDENTIFICATION	DATE/TIME SAMPLED	COMPOSITE	GRAB	WATER	SOIL	OTHER	LAB ID	# OF CONTAINERS	VOC's w/HCL	MGA&SE175 w/HCL											COMMENTS
IR73-FB040906	4/9/06 1630		X	X				2	2												
IR73-EB040906	4/9/06 1700		X	X				2	2												
IR73-GW27DW-06B	4/9/06 1431		X	X				4	2	2											
IR73-GW27-06B	4/9/06 1306		X	X				4	2	2											
IR73-GW44DW-06B	4/9/06 1540		X	X				4	2	2											
IR73-GW29-06B	4/9/06 1538		X	X				4	2	2											
IR73-GW49DW-06B	4/10/06 1420		X	X				4	2	2											
IR73-GW49IW-06B	4/10/06 1240		X	X				4	2	2											
IR73-GW33DW-06B	4/10/06 1345		X	X				4	2	2											
IR73-GW49DW-06A	4/10/06 1450		X	X				4	2	2											ADDED ON Chain 4/11/06 RR
	/																				
	/																				

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COMPANY: CH2M HILL	PHONE: 7043290073	COMPANY	PHONE	LAB PROJECT #:
NAME: DAVID DRY/CLT	FAX: 7043290141	NAME	FAX	
ADDRESS: 4824 Parkway Plaza BLVD STE 200		ADDRESS		TURNAROUND TIME:
CITY/ST/ZIP: Charlotte, NC 28217		CITY/ST/ZIP		Per contract

CLIENT PROJECT NAME:	CLIENT PROJECT #:	CLIENT P.O.#:
CTO-105	328432.FI.FQ.73	

REQUESTED ANALYSES

SAMPLE IDENTIFICATION	DATE/TIME SAMPLED 2006	COMPOSITE	GRAB	WATER	SOIL	OTHER	LAB ID	# OF CONTAINERS	Alk, Anions, Anions	Sulfide	TOC	Ferric Iron									COMMENTS
IR73-GW27DW-06B	4/9 / 1431		X	X				3		1	1	1									
IR73-GW27-06B	4/9 / 1306		X	X				3		1	1	1									
IR73-GW27DW-06B	4/10 / 0810		X	X				1	1												
IR73-GW27-06B	4/10 / 0810		X	X				1	1												
IR73-GW44DW-06B	4/9 / 1540		X	X				3		1	1	1									
IR73-GW44DW-06B	4/10 / 0830		X	X				1	1												
IR73-GW29-06B	4/9/06 / 1538		X	X				3		1	1	1									
IR73-GW29-06B	4/10/06 / 0806		X	X				1	1												
IR73-GW49DWA-06B	4/10/06 / 1420		X	X				4	1	1	1	1									
IR73-GW49DW-06B	4/10 / 1240		X	X				4	1	1	1	1									
IR73-GW33DW-06B	4/10 / 1345		X	X				4	1	1	1	1									
IR73GW47DW-06B	4/10 / 1450		X	X				4	1	1	1	1									

TSF#	RELINQUISHED BY	DATE/TIME	ACCEPTED BY	DATE/TIME	ADDITIONAL REMARKS:	COOLER TEMP:
	[illegible]	4/10/06 1700		/		
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email: mitkem@mitkem.com

CHAIN-OF-CUSTODY RECORD

REPORT TO		INVOICE TO		
COMPANY CH2M HILL	PHONE 7043290073	COMPANY	PHONE	LAB PROJECT #:
NAME DAVID DRY/CLT	FAX 7043290141	NAME	FAX	
ADDRESS 4824 Parkway Plaza BLVD STE 200		ADDRESS		TURNAROUND TIME:
CITY/ST/ZIP Charlotte, NC 28217		CITY/ST/ZIP		PO/CONTRACT

CLIENT PROJECT NAME:	CLIENT PROJECT #:	CLIENT P.O.#:
CTO-105	328432.FI.FQ.73	

REQUESTED ANALYSES

SAMPLE IDENTIFICATION	DATE/TIME SAMPLED	COMPOSITE	GRAB	WATER	SOIL	OTHER	LAB ID	# OF CONTAINERS	Alk, Anions, Fe(II)	Sulfide	TOC	Ferric Iron									COMMENTS
IR73-GW47/3-8-06B	4/10/06 0945		X	X				4	1	1	1	1									
IR73-GW47/3-8-06BDUP	4/10/06 0950		X	X				4	1	1	1	1									DUPLICATE
IR73-GW29-06B	4/9/06 1538		X	X				3		1	1	1									
IR73-GW16-06B	4/9/06 0836		X	X				3		1	1	1									
IR73-GW12-06B	4/10/06 1015		X	X				4	1	1	1	1									
IR73-GW01DW-06B	4/10/06 1052		X	X				4	1	1	1	1									
IR73-GW01DW-06BDUP	4/10/06 1052		X	X				4	1	1	1	1									Duplicate
IR73-GW01-06B	4/10/06 0948		X	X				4	1	1	1	1									
IR73-GW01IW-06B	4/10/06 0921		X	X				4	1	1	1	1									
IR73-GW11-06B	4/10/06 1245		X	X				4	1	1	1	1									
IR73-GW11IW-06B	4/10/06 1435		X	X				4	1	1	1	1									
	/																				

TSF#	RELINQUISHED BY	DATE/TIME	ACCEPTED BY	DATE/TIME	ADDITIONAL REMARKS:	COOLER TEMP:
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CHAIN-OF-CUSTODY RECORD

REPORT TO		INVOICE TO		
COMPANY: CH2M HILL	PHONE: 7043290073	COMPANY	PHONE	LAB PROJECT #:
NAME: DAVID DRY / CLT	FAX: 7043290141	NAME	FAX	
ADDRESS: 4824 Parkway Plaza BLVD Ste 200		ADDRESS		TURNAROUND TIME:
CITY/ST/ZIP: Charlotte, NC 28217		CITY/ST/ZIP		Percontract

CLIENT PROJECT NAME:	CLIENT PROJECT #:	CLIENT P.O.#:
CTO-105	328432.FI.FQ.73	

REQUESTED ANALYSES

SAMPLE IDENTIFICATION	DATE/TIME SAMPLED	COMPOSITE	GRAB	WATER	SOIL	OTHER	LAB ID	# OF CONTAINERS	VOC w/HCL	MGK PSK175 w/HCL										COMMENTS
IR73-GWPA17/3-8-06B	4/10/06 / 0945		X	X				4	2	2										
IR73-GWPA17/3-8-06BDUP	4/10/06 / 0950		X	X				4	2	2										Duplicate
IR73-GW12-06B	4/10/06 / 1015		X	X				4	2	2										
IR73-GW01DW-06B	4/10/06 / 1052		X	X				4	2	2										
IR73-GW01DW-06BDUP	4/10/06 / 1052		X	X				4	2	2										Duplicate
IR73-GW01-06B	4/10/06 / 0948		X	X				4	2	2										
IR73-GW01IW-06B	4/10/06 / 0921		X	X				4	2	2										
IR73-GW11-06B	4/10/06 / 1245		X	X				4	2	2										
IR73-GW11IW-06B	4/10/06 / 1435		X	X				4	2	2										
IR73-TB041006	4/10/06 / 0700		X	X				4	2	2										TRIP BLANK
IR73-EB041006	4/10/06 / 1440		X	X				2												EQUIP BLANK
	/																			

TSF#	RELINQUISHED BY	DATE/TIME	ACCEPTED BY	DATE/TIME	ADDITIONAL REMARKS:	COOLER TEMP:
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CHAIN-OF-CUSTODY RECORD

REPORT TO		INVOICE TO		
COMPANY: CH2M HILL	PHONE: 7043290073	COMPANY:	PHONE:	LAB PROJECT #:
NAME: DAVID DRY / CLT	FAX: 7043290141	NAME:	FAX:	
ADDRESS: 4824 Parkway Plaza BLVD STE 200		ADDRESS:		TURNAROUND TIME: Per Contract
CITY/ST/ZIP: Charlotte, NC 28217		CITY/ST/ZIP:		

CLIENT PROJECT NAME: CTO-105

CLIENT PROJECT #: 328432.FI.FQ.73

CLIENT P.O.#:

REQUESTED ANALYSES: Alkalinity, Ferrous, Sulfide, TOC, Ferric Iron

SAMPLE IDENTIFICATION	DATE/TIME SAMPLED	COMPOSITE	GRAB	WATER	SOIL	OTHER	LAB ID	# OF CONTAINERS	Alkalinity	Ferrous	Sulfide	TOC	Ferric Iron							COMMENTS
	2006																			
IR73-GW11DW-06B	4/11 / 1205		X	X				4	1	1	1	1								
IR73-GW11DW-06BDUP	4/11 / 1210		X	X				4	1	1	1	1								Duplicate
IR73-GW23-06B	4/11 / 0852		X	X				4	1	1	1	1								
IR73-GW30-06B	4/11 / 1021		X	X				4	1	1	1	1								
IR73-GW03-06B	4/11 / 1118		X	X				4	1	1	1	1								
IR73-GW48DW-06B	4/11 / 1030		X	X				4	1	1	1	1								
IR73-GW56-06B	4/11 / 1360		X	X				4	1	1	1	1								
IR73-GW55-06B	4/11 / 1415		X	X				4	1	1	1	1								
IR73-GW63DW-06B	4/11 / 1305		X	X				4	1	1	1	1								
IR73-GW63DW-06BDUP	4/11 / 1305		X	X				4	1	1	1	1								
IR73-GW58-06B	4/11 / 1330		X	X				4	1	1	1	1								
IR73-GW02-06B	4/11 / 1248		X	X				4	1	1	1	1								

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CHAIN-OF-CUSTODY RECORD

REPORT TO		INVOICE TO		
COMPANY CH2M HILL	PHONE 7043290073	COMPANY	PHONE	LAB PROJECT #:
NAME DAVID DRY / CLT	FAX 7043290141	NAME	FAX	
ADDRESS 4824 Parkway Plaza BLVD STE 200		ADDRESS		TURNAROUND TIME:
CITY/ST/ZIP Charlotte, NC 28217		CITY/ST/ZIP		Per Contract

CLIENT PROJECT NAME:	CLIENT PROJECT #:	CLIENT P.O.#:
CTO-105	329432.FI.FQ.73	

REQUESTED ANALYSES: VOC w/HCL; MGA VSK175 w/HCL

SAMPLE IDENTIFICATION	DATE/TIME SAMPLED 2006	COMPOSITE	GRAB	WATER	SOIL	OTHER	LAB ID	# OF CONTAINERS	VOC w/HCL	MGA VSK175 w/HCL	COMMENTS
IR73-TB041106	4/11 / 0700		X	X				4	2	2	TRIP BLANK
IR73-GW11DW-06B	4/11 / 1205		X	X				4	2	2	
IR73-GW11DW-06B Dup	4/11 / 1210		X	X				4	2	2	
IR73-EB041106	4/11 / 1000		X	X				2	2		Equip Blank
IR73-GW23-06B	4/11 / 0852		X	X				4	2	2	
IR73-GW30-06B	4/11 / 1021		X	X				4	2	2	
IR73-GW03-06B	4/11 / 1118		X	X				4	2	2	
IR73-GW48DW-06B	4/11 / 1030		X	X				4	2	2	
IR73-GW56-06B	4/11 / 1305		X	X				4	2	2	
IR73-GW55-06B	4/11 / 1305		X	X				4	2	2	
IR73-GW63DW-06B	4/11 / 1305		X	X				4	2	2	
IR73-GW63DW-06B Dup	4/11 / 1305		X	X				4	2	2	Duplicate

TSF#	RELINQUISHED BY	DATE/TIME	ACCEPTED BY	DATE/TIME
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ADDITIONAL REMARKS:

COOLER TEMP:

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CHAIN-OF-CUSTODY RECORD

REPORT TO		INVOICE TO		
COMPANY CH2M HILL	PHONE 7043290073	COMPANY	PHONE	LAB PROJECT #:
NAME DAVID DRY	FAX 7043290141	NAME	FAX	
ADDRESS 4824 Parkway Plaza BLVD STE 200		ADDRESS		TURNAROUND TIME:
CITY/ST/ZIP Charlotte, NC 28217		CITY/ST/ZIP		percentant

CLIENT PROJECT NAME:	CLIENT PROJECT #:	CLIENT P.O.#:
CTO-105	328432.FI.RD.73	

REQUESTED ANALYSES

SAMPLE IDENTIFICATION	DATE/TIME SAMPLED 2006	COMPOSITE	GRAB	WATER	SOIL	OTHER	LAB ID	# OF CONTAINERS	VOC w/HCL	MEK & SB125 w/HCL										COMMENTS
FR73-GW02IW-06B	4/11 / 1256		X	X				4	2	2										
FR73-GW58-06B	4/11 / 1338		X	X				4	2	2										
FR73-GW02-06B	4/11 / 1248		X	X				4	2	2										
FR73-GW19-06B	4/11 / 1440		X	X				4	2	2										
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TSF#	RELINQUISHED BY	DATE/TIME	ACCEPTED BY	DATE/TIME	ADDITIONAL REMARKS:	COOLER TEMP:
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CHAIN-OF-CUSTODY RECORD

REPORT TO		INVOICE TO		
COMPANY CH2M HILL	PHONE 7043290073	COMPANY	PHONE	LAB PROJECT #:
NAME DAVID DRY / CLT	FAX 7043290141	NAME	FAX	
ADDRESS 4824 Parkway Plaza BLVD Ste 200		ADDRESS		TURNAROUND TIME:
CITY/ST/ZIP Charlotte, NC 28217		CITY/ST/ZIP		Per Contract

CLIENT PROJECT NAME:	CLIENT PROJECT #:	CLIENT P.O.#:
CTO-105	328432.FI.FQ.73	

REQUESTED ANALYSES: Alk, Anions, Ferrous, Sulfide, TOC, Ferric Iron

SAMPLE IDENTIFICATION	DATE/TIME SAMPLED 2006	COMPOSITE	GRAB	WATER	SOIL	OTHER	LAB ID	# OF CONTAINERS	Alk	Anions	Ferrous	Sulfide	TOC	Ferric Iron									COMMENTS
IR73-GW02IW-06B	4/11 / 1236		X	X				4	1	1	1	1											
IR73-GW19-06B	4/11 / 1440		X	X				4	1	1	1	1											
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TSF#	RELINQUISHED BY	DATE/TIME	ACCEPTED BY	DATE/TIME	ADDITIONAL REMARKS:	COOLER TEMP:
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CHAIN-OF-CUSTODY RECORD

REPORT TO		INVOICE TO		
COMPANY: CH2M HILL	PHONE: 7043290073	COMPANY:	PHONE:	LAB PROJECT #:
NAME: DAVID DRY/CLT	FAX: 7043290141	NAME:	FAX:	
ADDRESS: 4824 Parkway Plaza BLVD Ste 200		ADDRESS:		TURNAROUND TIME:
CITY/ST/ZIP: Charlotte, NC 28217		CITY/ST/ZIP:		Per Contract

CLIENT PROJECT NAME:	CLIENT PROJECT #:	CLIENT P.O.#:
CTO-105	328432.FI.FP.73	

REQUESTED ANALYSES: VOC w/HCL; MEE RSK175 w/HCL

SAMPLE IDENTIFICATION	DATE/TIME SAMPLED	COMPOSITE	GRAB	WATER	SOIL	OTHER	LAB ID	# OF CONTAINERS	VOC w/HCL	MEE RSK175 w/HCL									COMMENTS
IR73-GW15N-06B	4/12/0900		X	X				4	2	2									NAMED MW15N
IR73-GW54-06B	4/12/1205		X	X				4	2	2									
IR73-EB041206	4/12/1500		X	X				2	X										EQUIPMENT BLANK
IR73-TB041206	4/12/0700		X	X				4	X	X									TRIP BLANK
IR73-GW06-06B	4/12/0855		X	X				4	2	2									
IR73-GW06DW-06B	4/12/1001		X	X				4	2	2									
IR73-GW46DW-06B	4/12/0945		X	X				4	2	2									
IR73-GW62DW-06B	4/12/1115		X	X				8	6	2									MS/MSD ALSO
IR73-GWA47/3-15-06B	4/12/1245		X	X				4	2	2									
~~IR73-GW12-06B~~	~~4/12~~		~~X~~	~~X~~				~~4~~	~~2~~	~~2~~									
IR73-GWA47/3-12-06B	4/12/1400		X	X				4	2	2									
IR73-GW310W-06B	4/12/1236		X	X				4	2	2									

TSF#	RELINQUISHED BY	DATE/TIME	ACCEPTED BY	DATE/TIME	ADDITIONAL REMARKS:	COOLER TEMP:
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CHAIN-OF-CUSTODY RECORD

REPORT TO		INVOICE TO		
COMPANY CH2M HILL	PHONE 7043290073	COMPANY	PHONE	LAB PROJECT #:
NAME DAVID DRYCLT	FAX 7043290141	NAME	FAX	
ADDRESS 4824 Parkway Plaza BLVD STE 200		ADDRESS		TURNAROUND TIME:
CITY/ST/ZIP Charlotte, NC 28217		CITY/ST/ZIP		Per Contact

CLIENT PROJECT NAME:	CLIENT PROJECT #:	CLIENT P.O.#:
CTO-105	328432.FIFG.73	

REQUESTED ANALYSES

SAMPLE IDENTIFICATION	DATE/TIME SAMPLED	COMPOSITE	GRAB	WATER	SOIL	OTHER	LAB ID	# OF CONTAINERS	Alkalinity, Ferrous	Sulfide	TOC	Ferric Iron								COMMENTS
N	2006																			
IR73-GW15-06B	4/12/0900		X	X				4	1	1	1	1								NAMED 73-MW15N
IR73-GW54-06B	4/12/1205		X	X				4	1	1	1	1								
IR73-GW06-06B	4/12/0855		X	X				4	1	1	1	1								
IR73-GW06DW-06B	4/12/1001		X	X				4	1	1	1	1								
IR73-GW46DW-06B	4/12/0945		X	X				4	1	1	1	1								
IR73-GW62DW-06B	4/12/1115		X	X				4	1	1	1	1								
IR73-GWA47/3-15-06B	4/12/1215		X	X				4	1	1	1	1								
~~IR73-GW12-06B~~	~~4/12/~~																			
IR73-GWA47/3-12-06B	4/12/1400		X	X				4	1	1	1	1								
IR73-GW31DW-06B	4/12/1236		X	X				4	1	1	1	1								
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TSF#	RELINQUISHED BY	DATE/TIME	ACCEPTED BY	DATE/TIME	ADDITIONAL REMARKS:	COOLER TEMP:
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	73-MW15	/	14.50 7665 0650	4/12 /	NAMED MW15N	
	73-MW15DW			/		

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CHAIN-OF-CUSTODY RECORD

REPORT TO		INVOICE TO		
COMPANY CH2M HILL	PHONE 7043290073	COMPANY	PHONE	LAB PROJECT #:
NAME DAVID DRYCLT	FAX 7043290141	NAME	FAX	
ADDRESS 4824 Parkway Plaza Blvd Ste 200		ADDRESS		TURNAROUND TIME:
CITY/ST/ZIP Charlotte, NC 28217		CITY/ST/ZIP		Rylcontract

CLIENT PROJECT NAME:	CLIENT PROJECT #:	CLIENT P.O.#:
CTO-105	328432.FI.FQ.73	

REQUESTED ANALYSES: VOC w/HCL; MeG PSK w/HCL

SAMPLE IDENTIFICATION	DATE/TIME SAMPLED 2006	COMPOSITE	GRAB	WATER	SOIL	OTHER	LAB ID	# OF CONTAINERS	VOC w/HCL	MeG PSK w/HCL										COMMENTS
IR73-GW31-06B	4/12 / 1101		X	X				4	2	2										
IR73-GW25-06B	4/12 / 1355		X	X				4	2	2										
IR73-GW25-06B DUP	4/12 / 1355		X	X				4	2	2										DUPLICATE
IR73-GW15-06B	4/12 / 1400		X	X				4	2	2										
	/																			
	/																			
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CHAIN-OF-CUSTODY RECORD

REPORT TO		INVOICE TO		
COMPANY CH2M HILL	PHONE 7043290073	COMPANY	PHONE	LAB PROJECT #:
NAME DAVID DRY/CLT	FAX 7043290141	NAME	FAX	
ADDRESS 4824 Parkway Plaza BLVD STE 200		ADDRESS		TURNAROUND TIME:
CITY/ST/ZIP Charlotte, NC 28217		CITY/ST/ZIP		Percentext

CLIENT PROJECT NAME:	CLIENT PROJECT #:	CLIENT P.O.#:
CTO-105	320432.FI.FQ.73	

REQUESTED ANALYSES

SAMPLE IDENTIFICATION	DATE/TIME SAMPLED 2006	COMPOSITE	GRAB	WATER	SOIL	OTHER	LAB ID	# OF CONTAINERS	Alk, Anions, Formate	Sulfide	TOC	Ferric Iron									COMMENTS
IR73-GW31-06B	4/12 / 1101		X	X				4	1	1	1	1									
IR73-GW25-06B	4/12 / 1355		X	X				4	1	1	1	1									
IR73-GW25-06BDUP	4/12 / 1375		X	X				4	1	1	1	1									DUPLICATE
IR73-GW15-06B	4/12 / 1400		X	X				4	1	1	1	1									
	/																				
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REPORT TO		INVOICE TO		
COMPANY CH2M HILL	PHONE 7043290073	COMPANY	PHONE	LAB PROJECT #:
NAME DAVID DRY	FAX 7043290141	NAME	FAX	
ADDRESS 4824 Parkway Plaza BLVD STE 200		ADDRESS		TURNAROUND TIME:
CITY/ST/ZIP Charlotte, NC 28217		CITY/ST/ZIP		Routine

CLIENT PROJECT NAME:	CLIENT PROJECT #:	CLIENT P.O.#:
CTO-105	328432.FZFG73	

REQUESTED ANALYSES: VOCs by 8260B; MNA Bacteria 25-Hydrocarbons

SAMPLE IDENTIFICATION	DATE/TIME SAMPLED (2006)	COMPOSITE	GRAB	WATER	SOIL	OTHER	LAB ID	# OF CONTAINERS	VOCs by 8260B	MNA Bacteria 25-Hydrocarbons	COMMENTS
IRT3-GW51PW-06B	4/18 / 1135		X	X				4	2	2	ON WELL TAG Reads 73-GW12
IRT3-GW51-06B	4/18 / 1420		X	X				4	2	2	Reads 73-GW04
IRT3-GW45DW-06B	4/18 / 1005		X	X				4	2	2	
IRT3-GW45DW-06BDup	4/18 / 1005		X	X				4	2	2	Duplicate
IRT3-GW18-06B	4/18 / 1120		X	X				4	2	2	
IRT3-GW08-06B	4/18 / 1300		X	X				4	2	2	
IRT3-GW09-06B	4/18 / 1340		X	X				4	2	2	
IRT3-TB041806	4/18 / 0700		X	X				4	2	2	Trip Blank
IRT3-EB041806	4/18 / 1400		X	X				2	2		Equip Blank
~~IRT3-GW42DW-06B~~	~~4/18 / 1560~~	~~Q~~	~~X~~	~~X~~	~~Q~~			~~4~~	~~2~~	~~2~~ (M)	
	/										
	/										

TSF#	RELINQUISHED BY	DATE/TIME	ACCEPTED BY	DATE/TIME	ADDITIONAL REMARKS:	COOLER TEMP:
	[illegible]	4/18/06 / 1700		/		
		/		/		
		/		/		

WHITE: LABORATORY COPY YELLOW: REPORT COPY PINK: CLIENT'S COPY

MITKEM CORPORATION
175 Metro Center Boulevard
Warwick, Rhode Island 02886-1755
(401) 732-3400 • Fax (401) 732-3499
email: mitkem@mitkem.com

CHAIN-OF-CUSTODY RECORD

REPORT TO		INVOICE TO		
COMPANY: CH2M HILL	PHONE: 7043290073	COMPANY	PHONE	LAB PROJECT #:
NAME: DAVID DEY	FAX: 7043290141	NAME	FAX	
ADDRESS: 4824 Parkway Plaza BLVD STE 200		ADDRESS		TURNAROUND TIME: Percentant
CITY/ST/ZIP: Charlotte, NC 28217		CITY/ST/ZIP		

CLIENT PROJECT NAME: CTO-105
CLIENT PROJECT #: 328132.FI.FR.73
CLIENT P.O.#:

REQUESTED ANALYSES: Aluminum, Ferrous, Sulfide, TOC, Metric Iron

SAMPLE IDENTIFICATION	DATE/TIME SAMPLED	COMPOSITE	GRAB	WATER	SOIL	OTHER	LAB ID	# OF CONTAINERS	Aluminum	Ferrous	Sulfide	TOC	Metric Iron								COMMENTS
	2006																				On well Tags
IR73-GW51DW-06B	4/18 / 1135		X	X				4	1	1	1	1									Rock73-DW12
IR73-GW51-06B	4/18 / 1420		X	X				4	1	1	1	1									Rock73-GW04
IR73-GW45DW-06B	4/18 / 1005		X	X				4	1	1	1	1									
IR73-GW45DW-06BDUP	4/18 / 1005		X	X				4	1	1	1	1									Duplicate
IR73-GW08-06B	4/18 / 1120		X	X				4	1	1	1	1									
IR73-GW08-06B	4/18 / 1300		X	X				4	1	1	1	1									
IR73-GW09-06B	4/18 / 1340		X	X				4	1	1	1	1									
~~IR73-GW42DW-06B~~	~~4/18 / 1640~~		~~X~~	~~X~~	~~Q~~			~~4~~	~~1~~	~~1~~	~~1~~	~~1~~	~~W~~								
	/																				
	/																				
	/																				
	/																				

TSF#	RELINQUISHED BY	DATE/TIME	ACCEPTED BY	DATE/TIME	ADDITIONAL REMARKS:	COOLER TEMP:
	[illegible]	4/18/06 / 1700		/		
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CHAIN-OF-CUSTODY RECORD

REPORT TO

COMPANY: CH2M HILL
NAME: DAVID DRY / CLT
PHONE: 7043290073
FAX: 7043290141
ADDRESS: 4824 Parkway Plaza BLVD STE 200
CITY/ST/ZIP: Charlotte, NC 28217

INVOICE TO

COMPANY
NAME
PHONE
FAX
ADDRESS
CITY/ST/ZIP

LAB PROJECT #:

CLIENT PROJECT NAME: CTO-105
CLIENT PROJECT #: 328432.FI.19.73
CLIENT P.O.#:
TURNAROUND TIME:

SAMPLE IDENTIFICATION	DATE/TIME SAMPLED 2006	COMPOSITE	GRAB	WATER	SOIL	OTHER	LAB ID	# OF CONTAINERS	VOC w/HCL	MGE RSK175 w/	COMMENTS
IR73-TB041906	4/19 / 0700		X	X				4	2	2	
IR73-EB041906	4/19 / 1100		X	X				2	2	~~2~~	
IR73-GW52DW-06B	4/19 / 1030		X	X				4	2	2	
IR73-GW52-06B	4/19 / 1450		X	X				4	2	2	
IR73-GW-A47/3-16-06B	4/19 / 0630		X	X				4	2	2	
IR73-GW-A47/3-22-06B	4/19 / 0848		X	X				4	2	2	
IR73-GW15IW-06B	4/19 / 1115		X	X				4	2	2	
IR73-GW-A47/3-19-06B	4/19 / 1035		X	X				4	2	2	
IR73-GW26DW-06B	4/19 / 1400		X	X				4	2	2	
IR73-GW20-06B	4/19 / 1250		X	X				4	2	2	
IR73-GW20DW-06B	4/19 / 1330		X	X				4	2	2	
IR73-GW42DW-06B	4/19 / 0745		X	X				8	6	2	MS/MSD ALSO
								4	2	2	

TSF#	RELINQUISHED BY	DATE/TIME	ACCEPTED BY	DATE/TIME
	[illegible]	4/19/06 / 1700		/
		/		/
		/		/

ADDITIONAL REMARKS:

COOLER TEMP:

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CHAIN-OF-CUSTODY RECORD

REPORT TO		INVOICE TO		
COMPANY CH2M HILL	PHONE 7043290073	COMPANY	PHONE	LAB PROJECT #:
NAME DAVID DRY/CLT	FAX 7043290141	NAME	FAX	
ADDRESS 4824 Parkway Plaza BLVD STE 200		ADDRESS		TURNAROUND TIME:
CITY/ST/ZIP Charlotte, NC 28217		CITY/ST/ZIP		Per contract

CLIENT PROJECT NAME:	CLIENT PROJECT #:	CLIENT P.O.#:
CTO-105	328432.FI.FQ.73	

REQUESTED ANALYSES: Alk, Anions, Ferrous; Sulfide; TOC; Ferric Iron

SAMPLE IDENTIFICATION	DATE/TIME SAMPLED 2006	COMPOSITE	GRAB	WATER	SOIL	OTHER	LAB ID	# OF CONTAINERS	Alk, Anions, Ferrous	Sulfide	TOC	Ferric Iron										COMMENTS
IR73-GW52DW-06B	4/19 / 1030		X	X				4	1	1	1	1										
IR73-GW52-06B	4/19 / 1450		X	X				4	1	1	1	1										
IR73-GWA47/3-16-06B	4/19 / 0830		X	X				4	1	1	1	1										
IR73-GWA47/3-22-06B	4/19 / 0848		X	X				4	1	1	1	1										
IR73-GW15DW-06B	4/19 / 1115		X	X				4	1	1	1	1										
IR73-GWA47/3-19-06B	4/19 / 1035		X	X				4	1	1	1	1										
IR73-GW26DW-06B	4/19 / 1400		X	X				4	1	1	1	1										
IR73-GW20-06B	4/19 / 1250		X	X				4	1	1	1	1										
IR73-GW20DW-06B	4/19 / 1330		X	X				4	1	1	1	1										
IR73-GW42DW-06B	4/19 / 0745		X	X				4	1	1	1	1										
	/																					
	/																					

TSF#	RELINQUISHED BY	DATE/TIME	ACCEPTED BY	DATE/TIME	ADDITIONAL REMARKS:	COOLER TEMP:
	Butler	4/19/06 / 1700		/		
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CHAIN-OF-CUSTODY RECORD

REPORT TO		INVOICE TO		
COMPANY: CH2M HILL	PHONE: 7043290073	COMPANY	PHONE	LAB PROJECT #:
NAME: DAVID DRY / CLT	FAX: 7043290141	NAME	FAX	
ADDRESS: 4824 Parkway Plaza BLVD Ste 200		ADDRESS		TURNAROUND TIME: Per contract
CITY/ST/ZIP: Charlotte, NC 28217		CITY/ST/ZIP		

CLIENT PROJECT NAME:	CLIENT PROJECT #:	CLIENT P.O.#:
CTO-105	328432.FI.FR.73	

REQUESTED ANALYSES: VOC (W/HCL); MNA (W/HCL); BKG25 (W/HCL)

SAMPLE IDENTIFICATION	DATE/TIME SAMPLED (2006)	COMPOSITE	GRAB	WATER	SOIL	OTHER	LAB ID	# OF CONTAINERS	VOC	MNA	BKG25	COMMENTS
FR73-TB042006	4/20 / 0700		X	X				4	2	2		
FR73-EB042006	4/20 / 1200		X	X				2	2			
FR73-GW41DW-06B	4/20 / 1130		X	X				4	2	2		
FR73-GW41DW-06BDUP	4/20 / 1140		X	X				4	2	2		Duplicate
FR73-GW40DW-06B	4/20 / 1440		X	X				4	2	2		
FR73-GW35-06B	4/20 / 0925		X	X				4	2	2		
FR73-GW35DW-06B	4/20 / 1048		X	X				4	2	2		
FR73-GW31-06B	4/20 / 1215		X	X				4	2	2		
FR73-GW28-06B	4/20 / 1315		X	X				4	2	2		
FR73-GW10-06B	4/20 / 1325		X	X				4	2	2		
FR73-GW47DW-06B	4/20 / 1325		X	X				4	2	2		
	/											

TSF#	RELINQUISHED BY	DATE/TIME	ACCEPTED BY	DATE/TIME	ADDITIONAL REMARKS:	COOLER TEMP:
	[illegible]	4/20/06 / 1700		/		
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		/		/		

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Warwick, Rhode Island 02886-1755
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email: mitkem@mitkem.com

CHAIN-OF-CUSTODY RECORD

REPORT TO		INVOICE TO		
COMPANY CH2M HILL	PHONE 7043290073	COMPANY	PHONE	LAB PROJECT #:
NAME DAVID DRYCLT	FAX 7043290141	NAME	FAX	
ADDRESS 4824 Parkway Plaza BLVD Ste 200		ADDRESS		TURNAROUND TIME:
CITY/ST/ZIP Charlotte, NC 28217		CITY/ST/ZIP		Perlontract

CLIENT PROJECT NAME:	CLIENT PROJECT #:	CLIENT P.O.#:
CTO-105	328432.FI.FQ.73	

REQUESTED ANALYSES: Alkalinity, Ferrous, Sulfide, TOC, Ferric Iron

SAMPLE IDENTIFICATION	DATE/TIME SAMPLED 2006	COMPOSITE	GRAB	WATER	SOIL	OTHER	LAB ID	# OF CONTAINERS	Alkalinity	Ferrous	Sulfide	TOC	Ferric Iron								COMMENTS
FR73-GW41DW-06B	4/20 / 1130		X	X				4	1	1	1	1									
FR73-GW41DW-06BDUP	4/20 / 1140		X	X				4	1	1	1	1									Duplicate
FR73-GW40DW-06B	4/20 / 1410		X	X				4	1	1	1	1									
FR73-GW35-06B	4/20 / 0925		X	X				4	1	1	1	1									
FR73-GW35DW-06B	4/20 / 1048		X	X				4	1	1	1	1									
FR73-GW[illegible]-06B	4/20 / 1215		X	X				4	1	1	1	1									
FR73-GW28-06B	4/20 / 1325		X	X				4	1	1	1	1									
FR73-GW10-06B	4/20 / 1325		X	X				4	1	1	1	1									
FR73-GW47DW-06B	4/20 / 1325		X	X				4	1	1	1	1									
	/																				
	/																				
	/																				

TSF#	RELINQUISHED BY	DATE/TIME	ACCEPTED BY	DATE/TIME	ADDITIONAL REMARKS:	COOLER TEMP:
	[illegible]	4/20/06 / 1700		/		
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№ 01703

CHAIN OF CUSTODY

CompuChem
a division of Liberty Analytical Corp.

501 Madison Ave.
Cary, NC 27513
Phone: 919-379-4100 Fax 919-379-4040

Courier 708-A
Airbill No.
Sampling Complete? Y or N

Client/Reporting Information	Project Information
Company Name: CH2M Hill	Project Name:
Address: 4824 Parkway Plaza Blvd	Sampling Location: SITE 73
City: Charlotte, State: NC, Zip: 28217	Turnaround time: Per Contract
Project Contact: DAVID DRY / CLT	Batch QC or Project Specific? If Specific, which Sample ID? ~~WHOL~~ NA
Phone #: 7043290173 / FAX 704-329-0141	Are aqueous samples field filtered for metals? Y or N: NA
Sampler's Name: Maradeth Harris	Are high concentrations expected? Y or N? If yes, which ID(s)? UNKNOWN

Matrices: GW - Ground water; WW - Waste water; SW - Surface water; SO - Soil/Sediment; TB - Trip Blank; RI - Rinsate; WP - Wipe; O - Other

CompuChem No (Lab Use)	Field ID	Collection Date (2006)	Collection Time	Matrix	# of bottles	HCl	NaOH	HNO3	H2SO4	MEOH	Other	VOC's	MGG RSK 175	pH / Sample Info (Lab Use)
	IR73-TB042106	4/21	0650 ~~0702~~	W	4	X						2	2	
	IR73-EB042106	4/21	1030	W	2	X						2		
	IR73-~~GWA47~~/3-19B-06B	4/21	1015	W	4	X						2	2	
	IR73-~~GWA47~~/3-19B-06BDUP	4/21	1025	W	4	X						2	2	
	IR73-GW34-06B	4/21	1025	W	4	X						2	2	
	IR73-GW34DN-06B	4/21	1150	W	4	X						2	2	
	IR73-GW21-06B	4/21	0810	W	4	X						2	2	
	IR73-GW53-06B	4/21	0910	W	4	X						2	2	

Lab Use Only

Sample Unpacked By:
Sample Order Entry By:
Samples Received in Good Condition? Y or N
If no, explain:

Cyanide samples checked for sulfide & chlorine? Y or NA
625 & Phenol samples checked for chlorine? Y or NA
608 samples checked for pH between 5.0-9.0? Y or NA

Comments

Sample Custody

Relinquished by: [signature]	Date/Time: 4/21/06 1700	Received by:	Date/Time:
Relinquished by:	Date/Time:	Received by:	Date/Time:
Subcontact? Y or N If yes, where?	Custody Seal(s) intact? Y or N	On Ice? Y or N	Cooler Temp: °C

Samples stored 60 days after date report mailed at no extra charge.

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№ 01704

Page 2 of 2

CompuChem
a division of Liberty Analytical Corp.

CHAIN OF CUSTODY

501 Madison Ave.
Cary, NC 27513
Phone: 919-379-4100 Fax 919-379-4040

Courier Fed-x
Airbill No.
Sampling Complete? Y or N

Client/Reporting Information	Project Information
Company Name: CH2M HILL	Project Name:
Address: 4824 Parkway Plaza BLVD	Sampling Location: SITE 73
City: Charlotte, State: NC, Zip: 28217	Turnaround time: Per contract
Project Contact: DAVID DRY / CLT	Batch QC or Project Specific? If Specific, which Sample ID?: NA
Phone #: 7043290073 / FAX 7043290141	Are aqueous samples field filtered for metals? Y or N: NA
Sampler's Name: Maradeth Harris	Are high concentrations expected? Y or N? If yes, which ID(s)?: UNKNOWN

Matrices: GW - Ground water; WW - Waste water; SW - Surface water; SO - Soil/Sediment; TB - Trip Blank; RI - Rinsate; WP - Wipe; O - Other

CompuChem No (Lab Use)	Field ID	Collection Date (2006)	Collection Time	Matrix	# of bottles	HCl	NaOH/Zn	HNO3	H2SO4	MEOH	Other Vac	Alk, Anions, ferrous	Sulfide	TOC	Ferric Iron	pH / Sample Info (Lab Use)
	IR73-GWA47/3-19B-06B	4/21	1015	GW	4	1	1	1			1	1	1	1	1	
	IR73GWA47/3-19B-06BDUP	4/21	1025	GW	4	1	1	1			1	1	1	1	1	Duplicate
	IR73-GW34-06B	4/21	1025	GW	4	1	1	1			1	1	1	1	1	
	IR73-GW34DW-06B	4/21	1150	GW	4	1	1	1			1	1	1	1	1	
	IR73-GW21-06B	4/21	0810	GW	4	1	1	1			1	1	1	1	1	
	IR73-GW53-06B	4/21	0910	GW	4	1	1	1			1	1	1	1	1	

Lab Use Only

Sample Unpacked By:
Sample Order Entry By:
Samples Received in Good Condition? Y or N
If no, explain:

Cyanide samples checked for sulfide & chlorine? Y or NA
625 & Phenol samples checked for chlorine? Y or NA
608 samples checked for pH between 5.0-9.0? Y or NA

Comments

Sample Custody

Relinquished by: [signature]	Date/Time: 4/21/06 1700	Received by:	Date/Time:
Relinquished by:	Date/Time:	Received by:	Date/Time:
Subcontact? Y or N If yes, where?	Custody Seal(s) intact? Y or N	On Ice? Y or N	Cooler Temp: °C

Samples stored 60 days after date report mailed at no extra charge.

White & Yellow copy to lab • Pink copy for customer

Appendix G
Base-wide Background Data

Appendix H-1
Base-wide Background Data
Statistical Summary for Inorganics in Surface Soils
MCB Camp Lejeune, North Carolina
CTO-036

SAMPLE ID SAMPLE DATE	Distribution	Frequency of Detection	Range	Arithmetic Mean Half Non-Detects	Arithmetic Mean + 2 Standard Deviations	Log Arithmetic Mean Half Non-Detects	Log Arithmetic Mean + 2 Standard Deviations
METALS (mg/kg)							
Aluminum	Neither	50/50	29.4 - 17600J	2,744	8,965	1,188	34,892
Antimony	Neither	19/50	ND - 0.9J	0.223	0.564	0.179	0.644
Arsenic	Neither	18/50	ND - 1.3J	0.313	0.879	0.232	1.00
Barium	Neither	46/50	ND - 24	7.23	19.4	4.35	51.9
Beryllium	Lognormal	31/50	ND - 0.53J	0.0517	0.205	0.0302	0.252
Cadmium	Neither	5/50	ND - 0.11J	0.0163	0.053	0.0129	0.038
Calcium	Neither	42/50	ND - 105000	3,180	33,240	153	9,605
Chromium	Neither	44/50	ND - 12.6	3.03	8.93	1.67	21.5
Cobalt	Neither	27/50	ND - 0.51J	0.147	0.412	0.100	0.583
Copper	Lognormal	39/50	ND - 38.5	2.42	14.2	0.98	11.2
Iron	Neither	50/50	26.3 - 12200J	1,623	6,097	679	14,765
Lead	Lognormal	50/50	0.45 - 38.5J	6.14	21.0	3.94	25.8
Magnesium	Lognormal	43/50	ND - 1610	119	585	49.90	804
Manganese	Lognormal	45/50	ND - 49	6.87	24.3	3.60	43.8
Mercury	Lognormal	25/50	ND - 0.12J	0.0403	0.0961	0.0327	0.120
Nickel	Neither	37/50	ND - 1.8	0.61	1.65	0.350	4.18
Potassium	Lognormal	41/50	ND - 263J	58.09	178	32.1	384
Selenium	Neither	16/50	ND - 3.4	0.28	1.25	0.183	0.819
Silver	Neither	4/50	ND - 1.1	0.0702	0.372	0.049	0.145
Sodium	Neither	1/50	ND - 307	40.46	123	33.4	98.5
Thallium	Neither	0/50	ND	0.180	0.226	0.179	0.223
Vanadium	Lognormal	48/50	ND - 26.2	4.45	14.4	2.44	28.5
Zinc	Lognormal	34/50	ND - 73.9	5.41	28.0	2.18	31.2

Background range = 2*standard deviation
Log mean + 2 STD was converted after the mean + 2 STD were added together

Appendix H-2
Base-wide Background Data
Statistics Summary for Inorganics in Subsurface Soil
MCB Camp Lejeune, North Carolina
CTO-036

SAMPLE ID SAMPLE DATE	Distribution	Frequency of Detection	Range	Arithmetic Mean Half Non-Detects	Arithmetic Mean + 2 Standard Deviations	Log Arithmetic Mean Half Non-Detects	Log Arithmetic Mean + 2 Standard Deviations
METALS (mg/kg)							
Aluminum	Neither	50/50	260J - 16800	5,185	13,061	3,715	24,343
Antimony	Neither	14/50	ND - 0.5J	0.180	0.392	0.157	0.419
Arsenic	Neither	19/50	ND - 9.3	1.06	5.29	0.35	4.71
Barium	Lognormal	50/50	0.67J - 27.1	8.28	21.66	5.70	37.34
Beryllium	Lognormal	31/50	ND - 0.91	0.0826	0.358	0.0416	0.432
Cadmium	Neither	0/50	ND	0.012	0.0129	0.0116	0.0130
Calcium	Lognormal	36/50	ND - 4950	221	1,689	51.9	944
Chromium	Lognormal	50/50	0.83 - 23.3	7.25	19.7	5.00	30.9
Cobalt	Neither	36/50	ND - 6.8	0.411	2.33	0.188	1.88
Copper	Lognormal	32/50	ND - 6.7	1.28	4.14	0.691	7.03
Iron	Lognormal	50/50	81.5 - 15600	2,719	10,168	1,287	16,984
Lead	Lognormal	50/50	1 - 12.2J	4.24	9.84	3.49	12.6
Magnesium	Lognormal	49/50	ND - 1250	181	616	103	1,022
Manganese	Neither	50/50	0.57J - 67.6	4.62	23.6	2.80	14.7
Mercury	Lognormal	30/50	ND - 0.16J	0.0355	0.086	0.030	0.096
Nickel	Neither	43/50	ND - 12.3	1.13	4.73	0.58	6.96
Potassium	Lognormal	49/50	ND - 869J	181	621	89.12	1,043
Selenium	Neither	21/50	ND - 1.3	0.252	0.682	0.202	0.70
Silver	Neither	7/50	ND - 0.36J	0.064	0.180	0.054	0.142
Sodium	Neither	0/50	ND	34.2	58.8	31.8	68.0
Thallium	Neither	0/50	ND	0.190	0.215	0.190	0.219
Vanadium	Lognormal	50/50	0.35J - 39	8.60	26.7	5.26	44.7
Zinc	Lognormal	25/50	ND - 39.7	3.29	15.1	1.39	21.5

Background range = 2*standard deviation
Log mean + 2 STD was converted after the mean + 2 STD were added together

Appendix H-3
Base-wide Background Data
Statistical Results for Shallow Groundwater Samples
MCB Camp Lejeune, North Carolina
CTO-036

	Minimum Non-Detect	Maximum Non-Detect	Minimum Detected	Maximum Detected	Frequency of Detection	Arithmatic Mean Half Non-Detects	Standard Deviation	Arithmatic Mean Plus 2 Standard Deviations	Log Arithmatic Mean Half Non-Detects	Log Standard Deviation	Log Arithmatic Mean Plus 2 Standard Deviations
METALS (ug/L)											
Aluminum	19.6 U	180 U	294	3650	16/24	942.9	1079.8	3102.6	333.6	6.17	346.0
Antimony	2.2 U	4 U	0	0	0/24	1.64	0.39	2.42	1.58	1.30	4.18
Arsenic	2 U	2.4 U	6.6 J	19	4/24	2.88	4.62	12.1	1.57	2.48	6.54
Barium	22.8 U	55.7 U	9.2 J	143 J	21/24	43.1	33.2	109.4	33.1	2.10	37.31
Beryllium	0.2 U	1.2 U	0	0	0/24	0.15	0.13	0.42	0.13	1.72	3.56
Cadmium	0.3 U	0.4 U	0	0	0/24	0.18	0.03	0.23	0.18	1.15	2.48
Calcium	0	0	501 J	176000 J	24/24	34539.2	48613.0	131765.2	11849.0	4.95	11858.9
Chromium	0.5 UJ	1.7 U	0.66 J	8.4	11/24	1.56	2.10	5.76	0.77	3.25	7.28
Cobalt	0.7 U	2.9 U	0.73 J	5.6 J	10/24	1.70	1.86	5.42	0.95	2.97	6.90
Copper	1 U	4.3 U	5.1 J	5.1 J	1/24	1.38	1.14	3.66	1.01	2.23	5.46
Iron	44.1 U	46.9 U	140 J	32700 J	22/24	2999.6	6623.0	16245.5	943.9	5.31	954.5
Lead	1.1 U	1.8 U	1.5 J	4	10/24	1.40	1.10	3.61	1.08	2.03	5.15
Magnesium	0	0	728 J	11500	24/24	3181.5	2574.6	8330.7	2416.32	2.12	2420.6
Manganese	0	0	4.7 J	359	24/24	106.8	92.2	291.2	66.7	3.10	72.9
Mercury	0.1 U	0.1 U	0	0	0/24	0.05	0	0.05	0.05	1	2.05
Nickel	0.9 U	1.3 U	2 J	16.5 J	15/24	3.99	3.99	12.0	2.25	3.25	8.76
Potassium	353 U	745 U	677 J	4410	22/24	1638.7	892.0	3422.7	1380.2	1.95	1384.1
Selenium	2.1 UJ	4.6 U	0	0	0/24	1.57	0.63	2.83	1.46	1.48	4.42
Silver	0.5 U	0.9 U	0.79 J	0.95 J	2/24	0.39	0.18	0.74	0.35	1.49	3.34
Sodium	0	0	3370	23000	24/24	11254.2	6674.4	24602.9	9509.1	1.82	9512.7
Thallium	2.2 U	6 U	0	0	0/24	1.89	0.96	3.81	1.67	1.67	5.00
Vanadium	0.4 U	3.3 U	0.82 J	11.5 J	11/24	2.36	3.09	8.55	1	4.06	9.11
Zinc	1.6 U	10.1 U	4.6 J	129 J	14/24	21.0	31.04	83.11	8.76	4.06	16.9

U - Not detected.
UJ - Not detected-Quantitation limit is estimated.
J - Analyte present-Report value is estimated.

Appendix H-4
Base-wide Background Data
Statistical Results for Deep Groundwater Samples
MCB Camp Lejeune, North Carolina
CTO-036

	Minimum Non-Detect	Maximum Non-Detect	Minimum Detected	Maximum Detected	Frequency of Detection	Arithmatic Mean Half Non-Detects	Standard Deviation	Arithmatic Mean Plus 2 Standard Deviations	Log Arithmatic Mean Half Non-Detects Converted	Log Standard Deviation Converted	Log Arithmatic Mean Plus 2 Standard Deviations
METALS (ug/L)											
Aluminum	19.6 U	224 U	283	41800 J	14/24	4015.9	9154.3	22324.5	415.7	11.4	438.4
Antimony	2.2 U	4.6 U	0	0	0/24	1.6	0.4	2.37	1.54	1.28	4.1
Arsenic	2 U	2.4 U	2.9 J	28.7 J	5/24	2.6	5.6	13.8	1.46	2.16	5.8
Barium	20.8 U	41.3 U	4.2 J	213 J	20/24	44.6	47.4	139.5	30.6	2.36	35.3
Beryllium	0.2 U	1.4 U	2.2 J	3.2 J	2/24	0.39	0.75	1.89	0.18	2.86	5.9
Cadmium	0.3 U	0.4 U	0.48 J	0.97 J	2/24	0.23	0.17	0.57	0.20	1.51	3.2
Calcium	0	0	717 J	384000 J	24/24	51995.7	78980.4	209956.6	17676.7	5.93	17688.5
Chromium	0.5 U	3.3 U	0.85 J	80.8 J	12/24	6.9	16.7	40.2	1.32	6.17	13.7
Cobalt	0.7 U	2.7 U	1.1 J	42.7 J	7/24	3.0	8.6	20.2	0.83	3.56	7.9
Copper	1 U	4.3 U	1.3 J	47.4 J	7/24	4.7	9.9	24.4	1.54	3.94	9.4
Iron	33 U	41.6 U	193 J	55200 J	22/24	8010.8	14326.4	36663.6	2100.6	7.39	2115.4
Lead	1.1 U	2.2 U	1.1 J	61.7 J	9/24	5.1	12.9	30.9	1.45	3.67	8.8
Magnesium	0	0	825 J	18500 J	24/24	3637.5	3745.0	11127.6	2643.9	2.16	2648.2
Manganese	0	0	4.7 J	1060 J	24/24	137.1	234.4	605.8	56.3	3.82	63.9
Mercury	0.1 U	0.1 U	0	0	0/24	0.05	0.00	0.05	0.05	1	2.0
Nickel	0.9 U	1.3 U	1.7 J	76.5 J	12/24	6.1	15.6	37.4	1.68	4.26	10.2
Potassium	699 U	839 U	475 J	8980 J	21/24	2174.3	1935.2	6044.8	1571.8	2.32	1576.5
Selenium	2.1 UJ	4.6 U	3.8 J	3.8 J	1/24	1.58	0.76	3.10	1.43	1.54	4.5
Silver	0.5 U	0.9 U	0.55 J	0.72 J	2/24	0.35	0.13	0.61	0.33	1.40	3.1
Sodium	0	0	4410 J	95300	24/24	16226.3	21139.3	58504.8	11047.9	2.16	11052.3
Thallium	2.2 U	6 U	0	0	0/24	1.73	0.91	3.56	1.54	1.62	4.8
Vanadium	0.4 U	1.5 U	0.44 J	107 J	14/24	8.66	21.9	52.4	1.65	6.36	14.4
Zinc	1.6 U	14.3 U	2.1 J	333 J	10/24	32.6	73.6	179.8	6.2	6.05	18.3

U - Not Detected.
UJ - Not Detected-Quantitation limit is estimated
J - Analyte present-Report value is estimated

Appendix H
BIOCHLOR Modeling

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel 2000

Camp Lejeune
Site 73
Run Name

Data Input Instructions:

115 → 1. Enter value directly....or
↑ *or* 2. Calculate by filling in gray
0.02 cells. Press Enter, then C
(To restore formulas, hit "Restore Formulas" button)
Variable* → Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation Screening Protocol

TYPE OF CHLORINATED SOLVENT: Ethenes ◉ Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	20.7	(ft/yr)
or			
Hydraulic Conductivity	K	2.0E-03	(cm/sec)
Hydraulic Gradient	i	0.002	(ft/ft)
Effective Porosity	n	0.2	(-)

2. DISPERSION

Alpha x*	18.677	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-99	(-)

Calc. Alpha x

3. ADSORPTION

Retardation Factor* → R

or

Soil Bulk Density, rho	1.6	(kg/L)		
FractionOrganicCarbon, foc	1.0E-3	(-)		
Partition Coefficient	Koc			
PCE	426	(L/kg)	4.41	(-)
TCE	130	(L/kg)	2.04	(-)
DCE	125	(L/kg)	2.00	(-)
VC	30	(L/kg)	1.24	(-)
ETH	302	(L/kg)	3.42	(-)
Common R (used in model)* =			**2.04**	

4. BIOTRANSFORMATION

-1st Order Decay Coefficient*

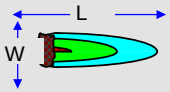
Zone 1	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	0.000		0.79
TCE → DCE	0.277	2.50	0.74
DCE → VC	0.866	0.80	0.64
VC → ETH	1.386	0.50	0.45

Zone 2	λ (1/yr)	half-life (yrs)
PCE → TCE	0.000	
TCE → DCE	0.000	
DCE → VC	0.000	
VC → ETH	0.000	

λ HELP

5. GENERAL

Simulation Time*	40	(yr)
Modeled Area Width*	500	(ft)
Modeled Area Length*	800	(ft)
Zone 1 Length*	800	(ft)
Zone 2 Length*	0	(ft)



Zone 2= L - Zone 1

6. SOURCE DATA

TYPE: Decaying
Single Planar

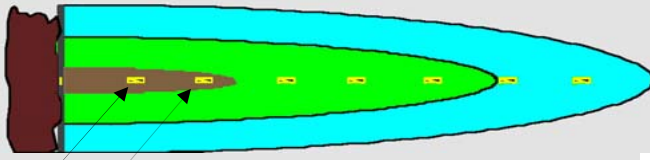
Source Options

Source Thickness in Sat. Zone* 50 (ft)

Width* (ft) Y1 110

Conc. (mg/L)*	C1	k_s* (1/yr)
PCE		0.1
TCE	46.0	0.1
DCE	30.0	0.1
VC	4.0	0.1
ETH		0.1

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations



View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)											
TCE Conc. (mg/L)	.84	.54	.002								
DCE Conc. (mg/L)	.55	.21	.002								
VC Conc. (mg/L)	0.1	.11	.0								
ETH Conc. (mg/L)											
Distance from Source (ft)	0	110	530								
Date Data Collected	2006										

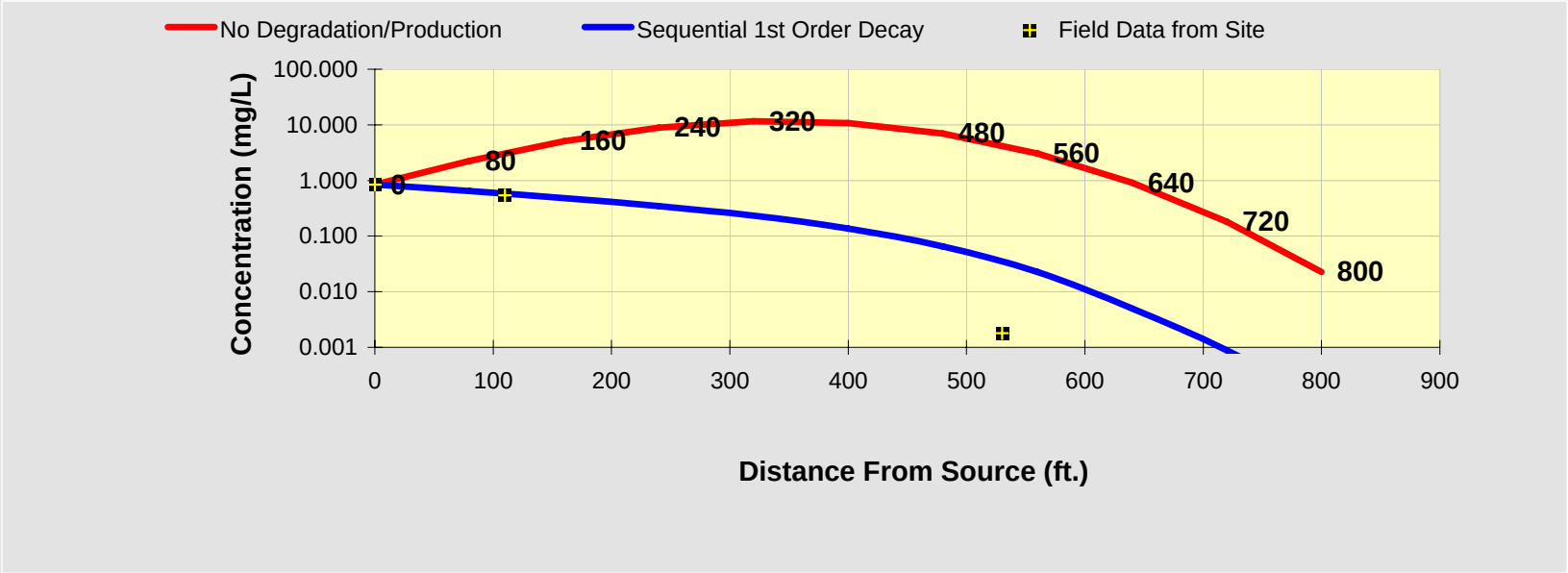
8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | RUN ARRAY | Help | Restore Formulas | RESET | SEE OUTPUT | Paste Example

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

TCE	Distance from Source (ft)										
	0	80	160	240	320	400	480	560	640	720	800
No Degradation	0.843	2.237	5.058	8.928	11.652	10.816	6.962	3.057	0.906	0.180	0.023
Biotransformation	0.8425	0.644	0.481	0.345	0.232	0.137	0.065	0.023	0.005	0.001	0.000

	Monitoring Well Locations (ft)										
	0	110	530								
Field Data from Site	0.840	0.540	0.002								



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

40.0 Years

Log ⇔ Linear

Return to Input

To All

To Array

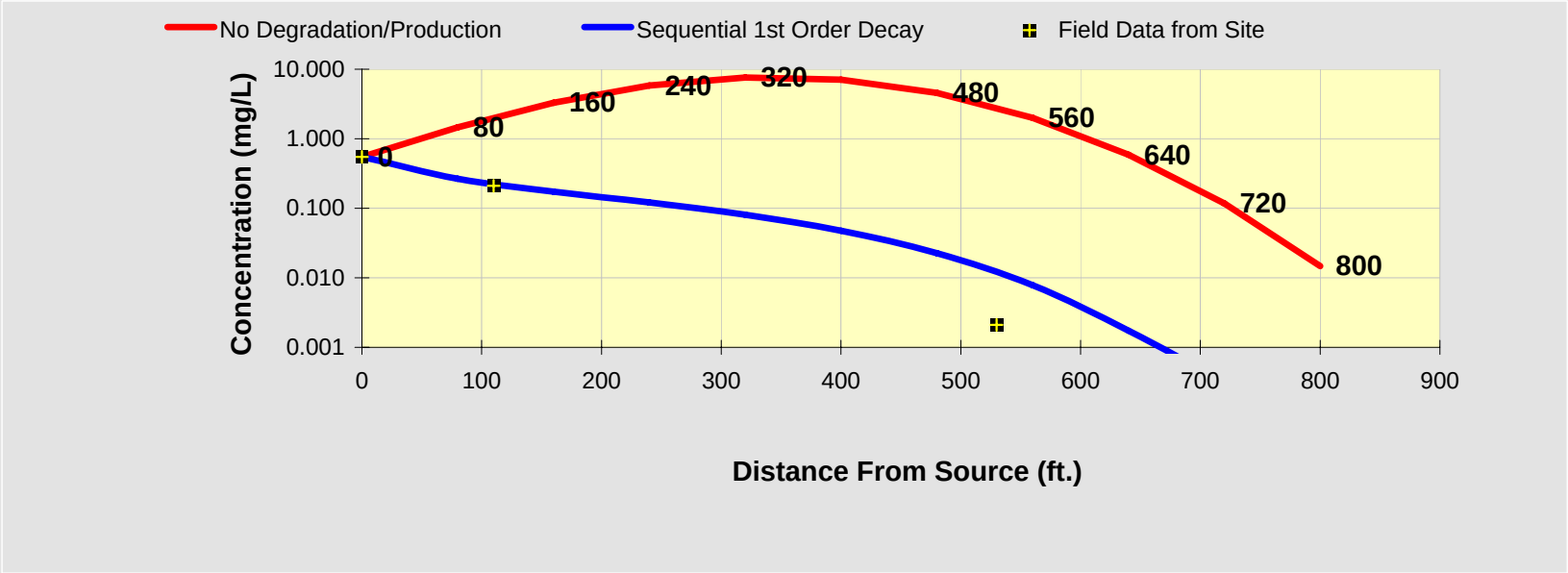
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

DCE	0	80	160	240	320	400	480	560	640	720	800
No Degradation	0.549	1.459	3.299	5.823	7.599	7.054	4.540	1.994	0.591	0.117	0.015
Biotransformation	0.5495	0.266	0.174	0.121	0.081	0.047	0.023	0.008	0.002	0.000	0.000

Monitoring Well Locations (ft)

	0	110	530								
Field Data from Site	0.550	0.210	0.002								



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

40.0 Years

Log ⇔ Linear

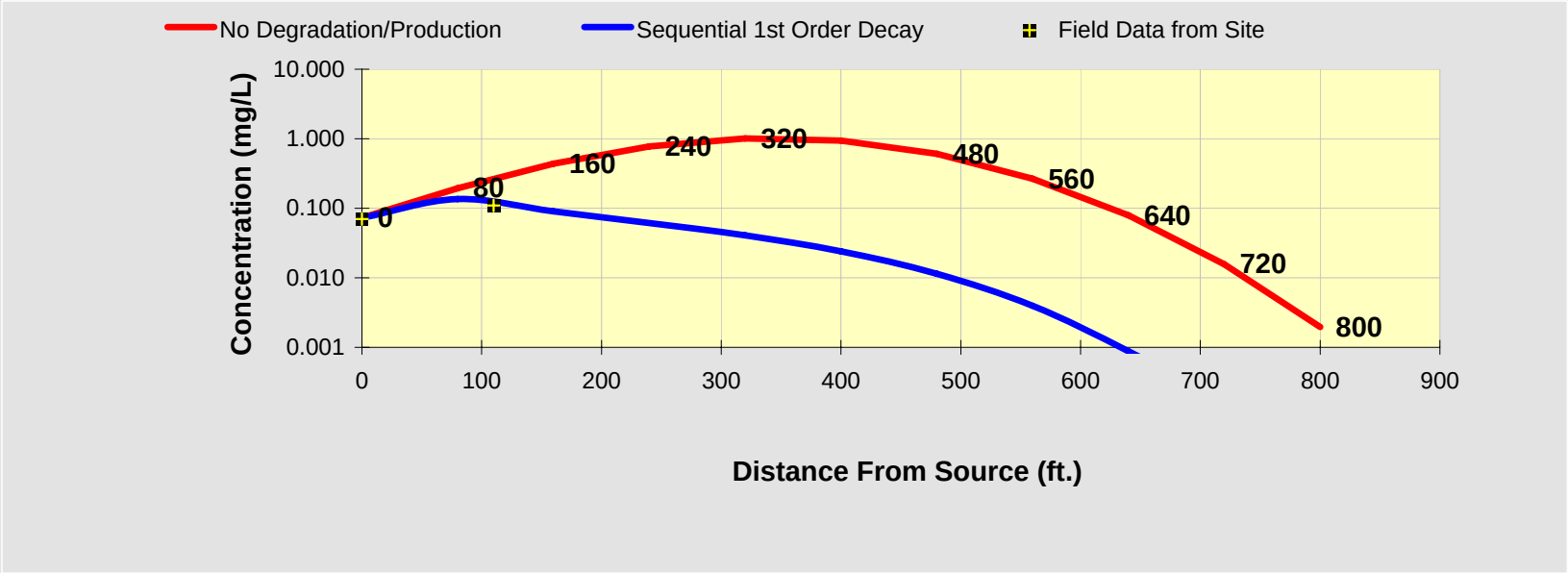
Return to Input

To All

To Array

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

VC	Distance from Source (ft)										
	0	80	160	240	320	400	480	560	640	720	800
No Degradation	0.073	0.195	0.440	0.776	1.013	0.941	0.605	0.266	0.079	0.016	0.002
Biotransformation	0.0733	0.136	0.090	0.061	0.041	0.024	0.011	0.004	0.001	0.000	0.000
	Monitoring Well Locations (ft)										
	0	110	530								
Field Data from Site	0.070	0.110	0.000								



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

40.0 Years

Log ⇔ Linear

Return to Input

To All

To Array

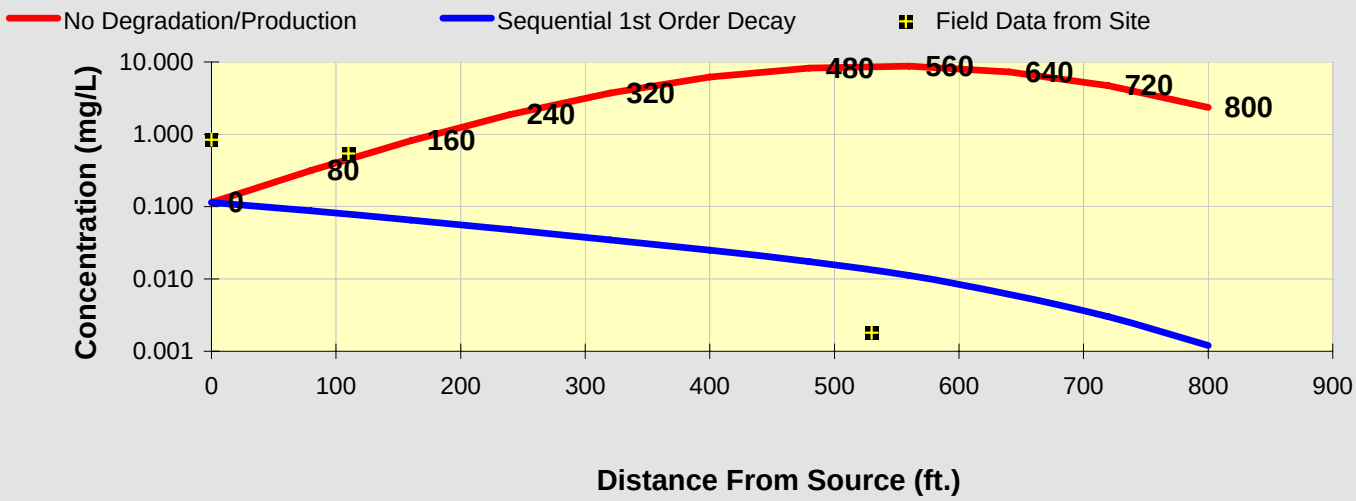
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

TCE	0	80	160	240	320	400	480	560	640	720	800
No Degradation	0.114	0.316	0.818	1.883	3.735	6.170	8.257	8.775	7.307	4.723	2.355
Biotransformation	0.1140	0.087	0.065	0.048	0.035	0.025	0.017	0.011	0.006	0.003	0.001

Monitoring Well Locations (ft)

	0	110	530								
Field Data from Site	0.840	0.540	0.002								



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

60.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

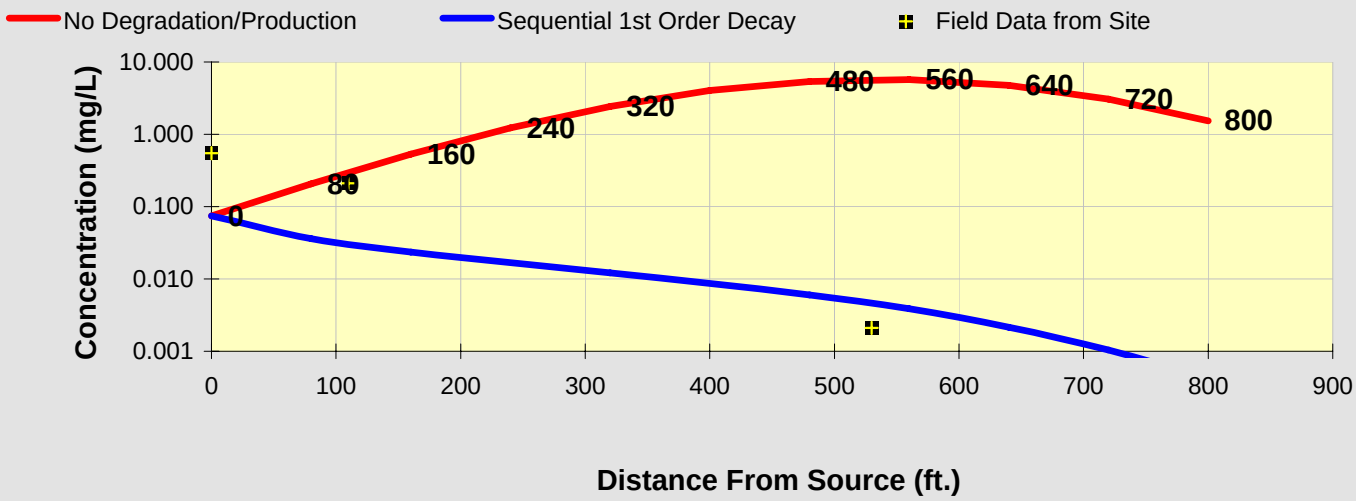
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

DCE	0	80	160	240	320	400	480	560	640	720	800
No Degradation	0.074	0.206	0.533	1.228	2.436	4.024	5.385	5.723	4.766	3.080	1.536
Biotransformation	0.0744	0.036	0.024	0.017	0.012	0.009	0.006	0.004	0.002	0.001	0.000

Monitoring Well Locations (ft)

	0	110	530								
Field Data from Site	0.550	0.210	0.002								



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

60.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

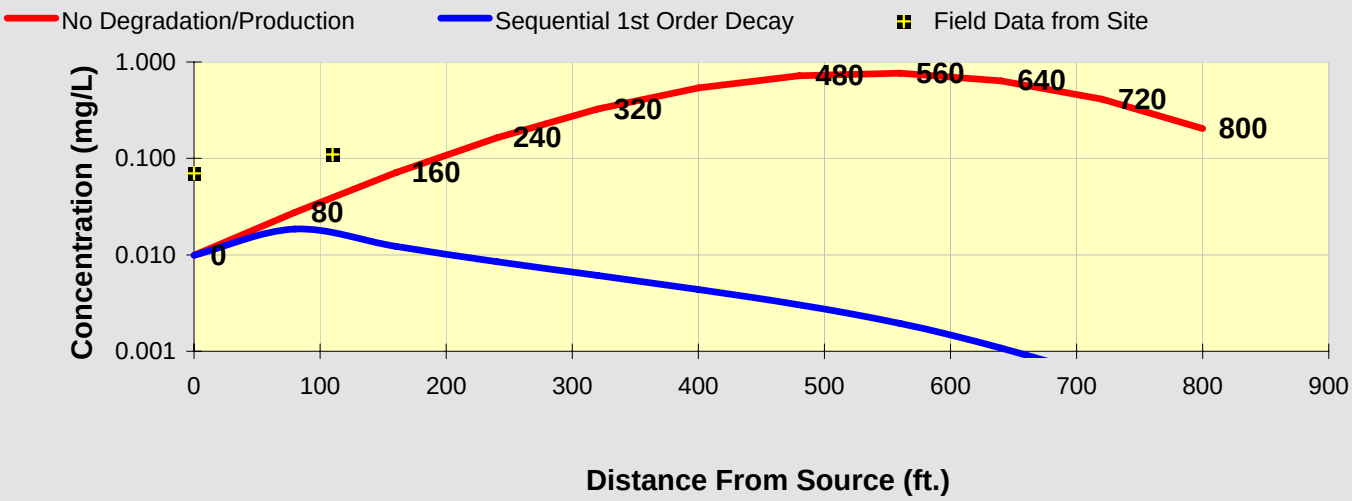
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

VC	0	80	160	240	320	400	480	560	640	720	800
No Degradation	0.010	0.028	0.071	0.164	0.325	0.537	0.718	0.763	0.635	0.411	0.205
Biotransformation	0.0099	0.018	0.012	0.009	0.006	0.004	0.003	0.002	0.001	0.001	0.000

Monitoring Well Locations (ft)

	0	110	530								
Field Data from Site	0.070	0.110	0.000								



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

60.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

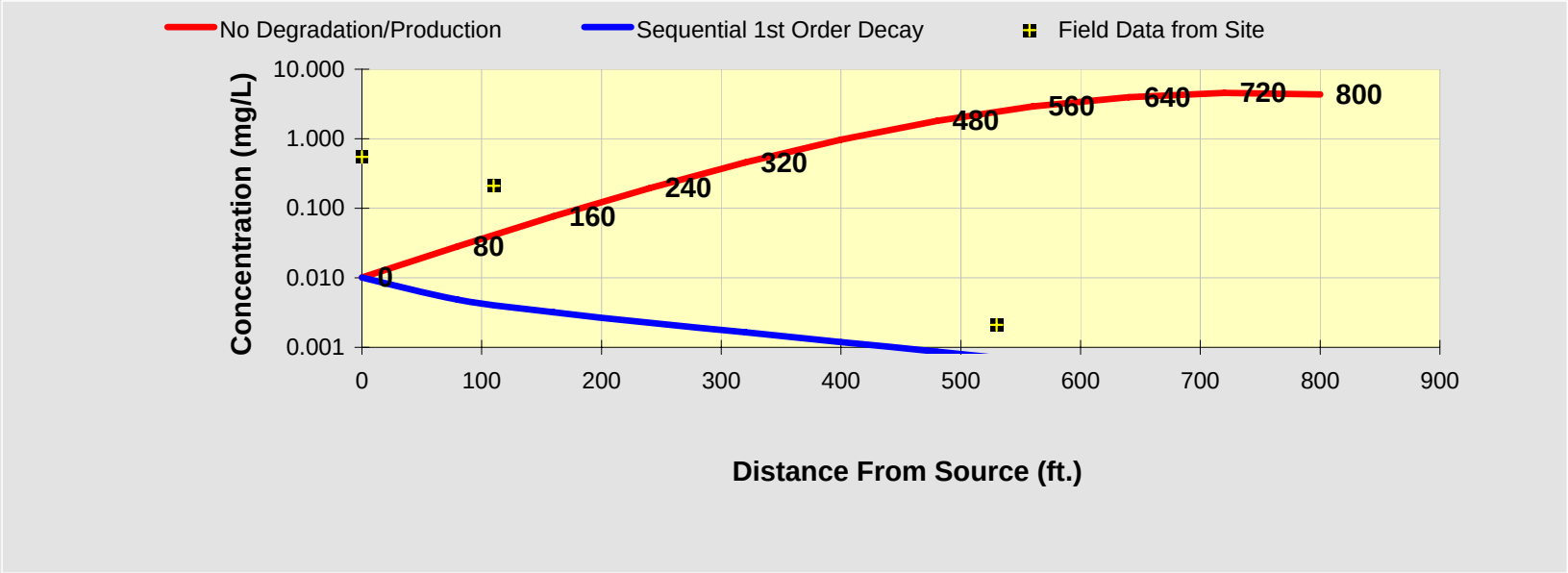
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

DCE	0	80	160	240	320	400	480	560	640	720	800
No Degradation	0.010	0.028	0.076	0.194	0.455	0.966	1.805	2.908	3.977	4.563	4.356
Biotransformation	0.0101	0.005	0.003	0.002	0.002	0.001	0.001	0.001	0.000	0.000	0.000

Monitoring Well Locations (ft)

	0	110	530								
Field Data from Site	0.550	0.210	0.002								



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

80.0 Years

Log ⇔ Linear

Return to Input

To All

To Array

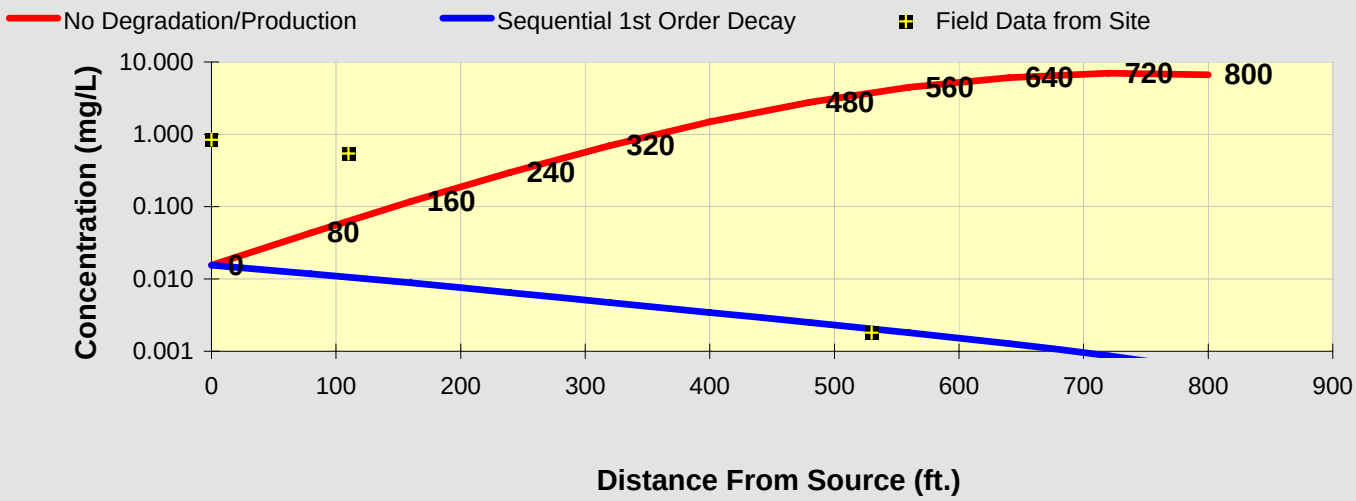
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

TCE	0	80	160	240	320	400	480	560	640	720	800
No Degradation	0.015	0.043	0.117	0.297	0.698	1.481	2.767	4.458	6.097	6.996	6.679
Biotransformation	0.0154	0.012	0.009	0.006	0.005	0.003	0.003	0.002	0.001	0.001	0.001

Monitoring Well Locations (ft)

	0	110	530								
Field Data from Site	0.840	0.540	0.002								



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

80.0 Years

Log ⟺ Linear

Return to Input

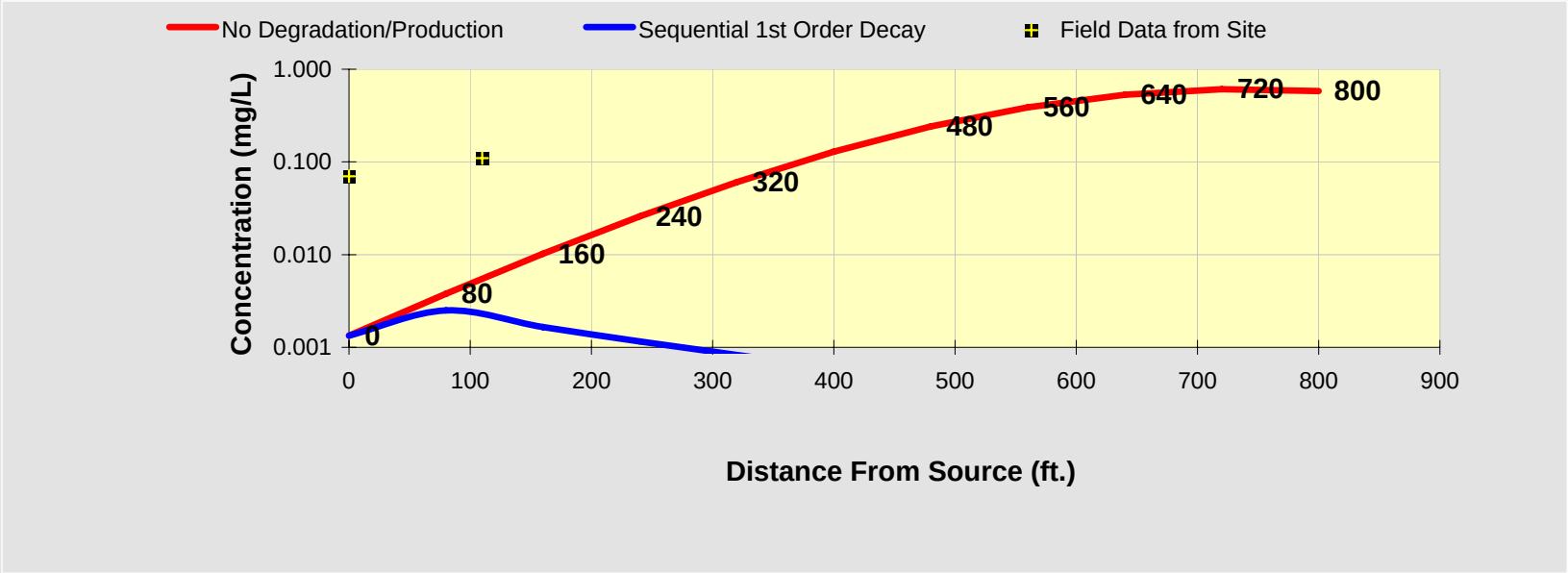
To All

To Array

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

VC	Distance from Source (ft)										
	0	80	160	240	320	400	480	560	640	720	800
No Degradation	0.001	0.004	0.010	0.026	0.061	0.129	0.241	0.388	0.530	0.608	0.581
Biotransformation	0.0013	0.002	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000

	Monitoring Well Locations (ft)										
	0	110	530								
Field Data from Site	0.070	0.110	0.000								



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

80.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

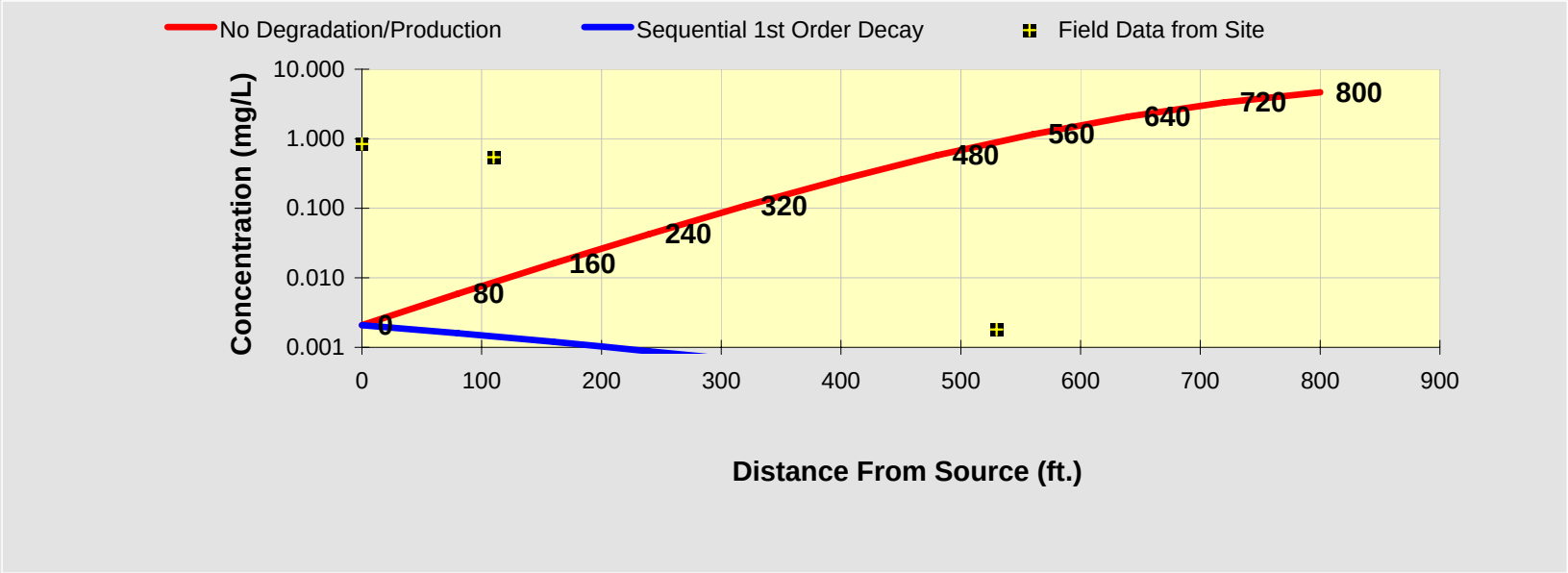
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

TCE	0	80	160	240	320	400	480	560	640	720	800
No Degradation	0.002	0.006	0.016	0.043	0.108	0.259	0.574	1.159	2.092	3.331	4.634
Biotransformation	0.0021	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

	0	110	530								
Field Data from Site	0.840	0.540	0.002								



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

100.0 Years

Log ⇔ Linear

Return to Input

To All

To Array

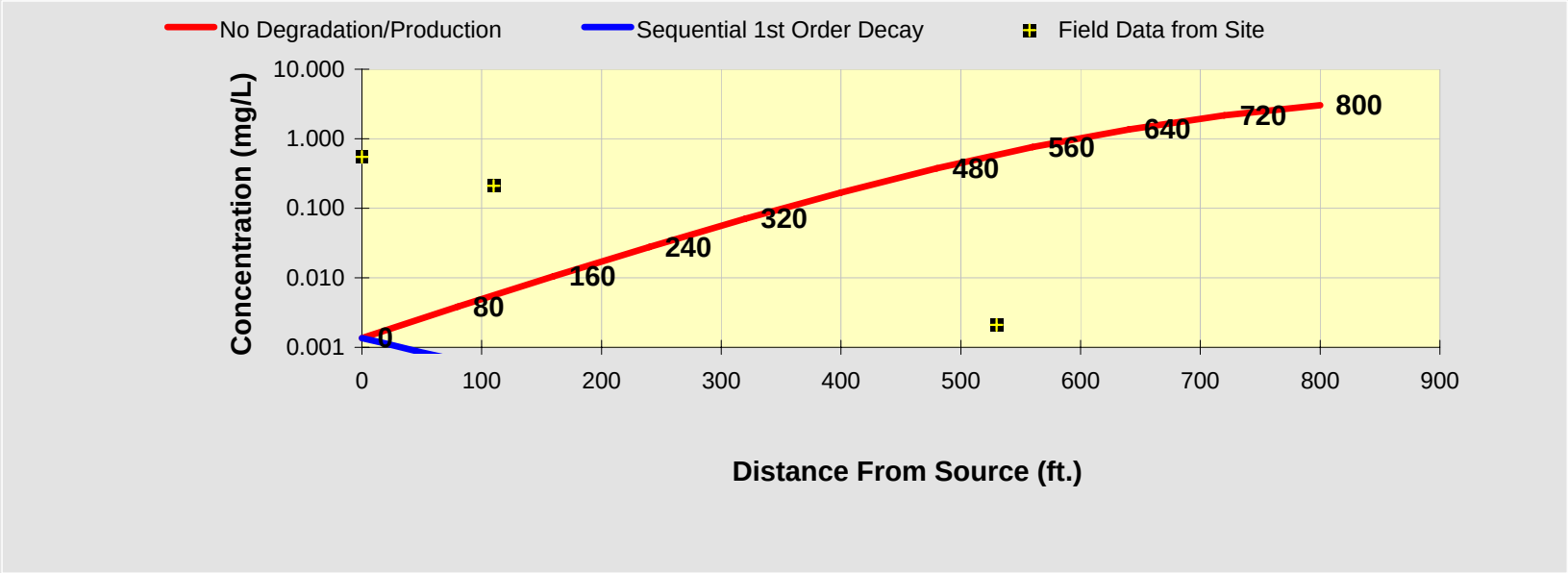
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

DCE	0	80	160	240	320	400	480	560	640	720	800
No Degradation	0.001	0.004	0.011	0.028	0.070	0.169	0.375	0.756	1.364	2.172	3.022
Biotransformation	0.0014	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

	0	110	530								
Field Data from Site	0.550	0.210	0.002								



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

100.0 Years

Log ⇔ Linear

Return to Input

To All

To Array

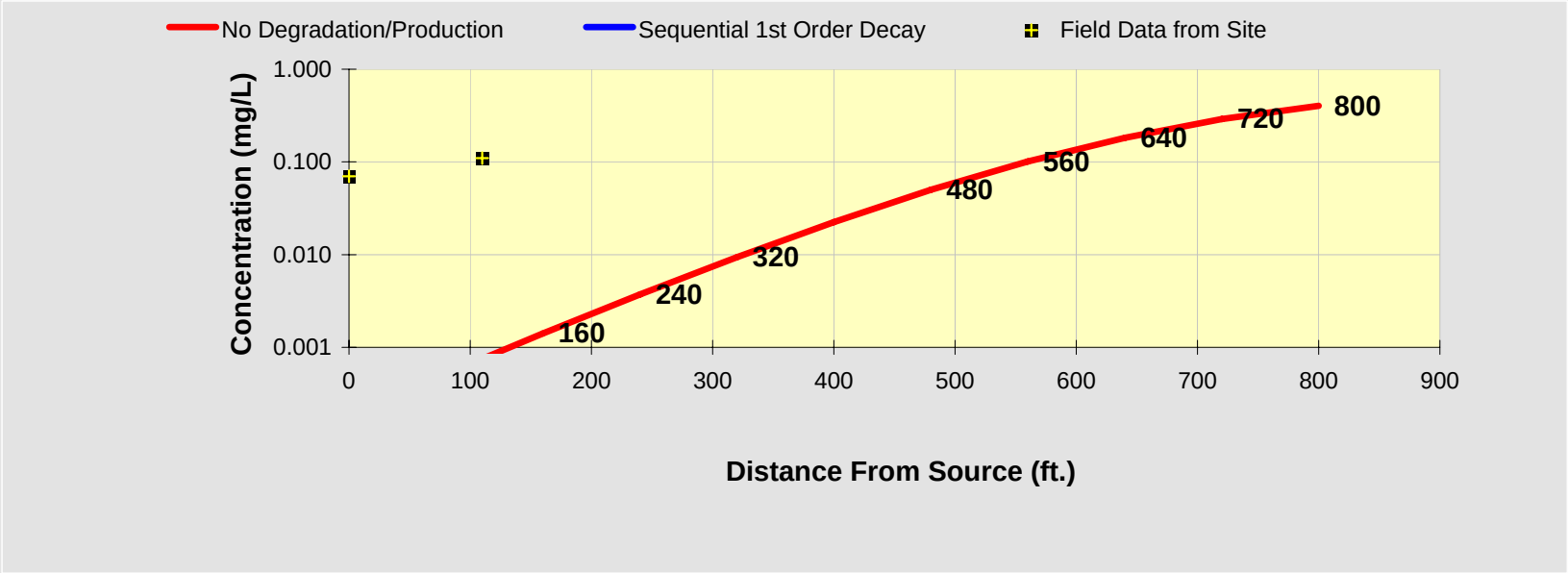
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

VC	0	80	160	240	320	400	480	560	640	720	800
No Degradation	0.000	0.001	0.001	0.004	0.009	0.022	0.050	0.101	0.182	0.290	0.403
Biotransformation	0.0002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

	0	110	530								
Field Data from Site	0.070	0.110	0.000								



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

100.0 Years

Log ⇔ Linear

Return to Input

To All

To Array

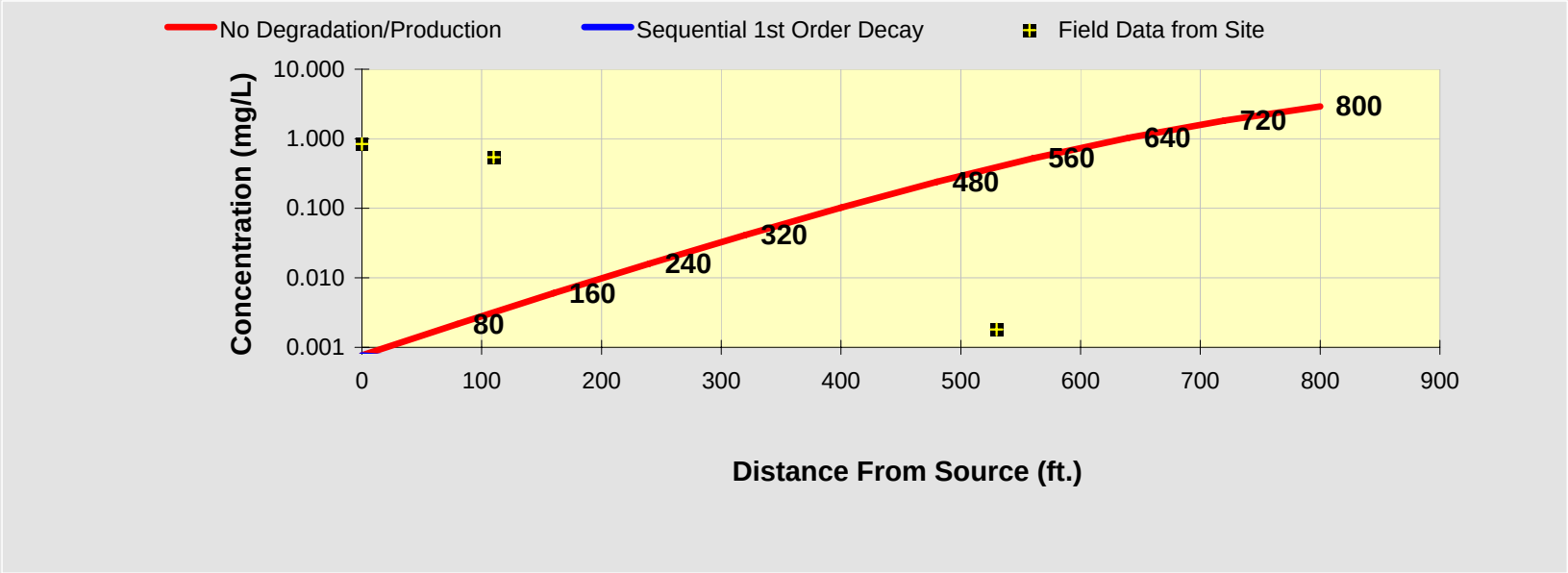
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

TCE	0	80	160	240	320	400	480	560	640	720	800
No Degradation	0.001	0.002	0.006	0.016	0.041	0.102	0.239	0.519	1.028	1.832	2.907
Biotransformation	0.0008	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

	0	110	530								
Field Data from Site	0.840	0.540	0.002								



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

110.0 Years

Log ⇔ Linear

Return to Input

To All

To Array

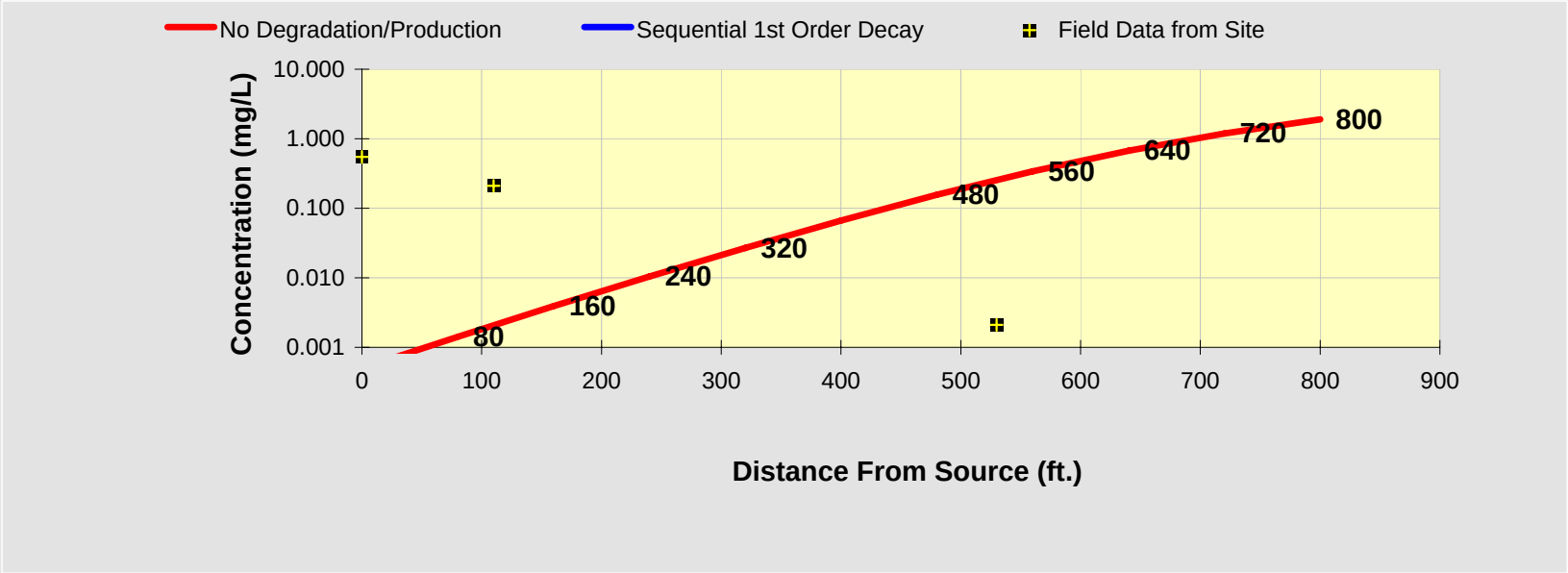
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

DCE	0	80	160	240	320	400	480	560	640	720	800
No Degradation	0.001	0.001	0.004	0.010	0.027	0.067	0.156	0.339	0.671	1.195	1.896
Biotransformation	0.0005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

	0	110	530								
Field Data from Site	0.550	0.210	0.002								



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

110.0 Years

Log ⇔ Linear

Return to Input

To All

To Array

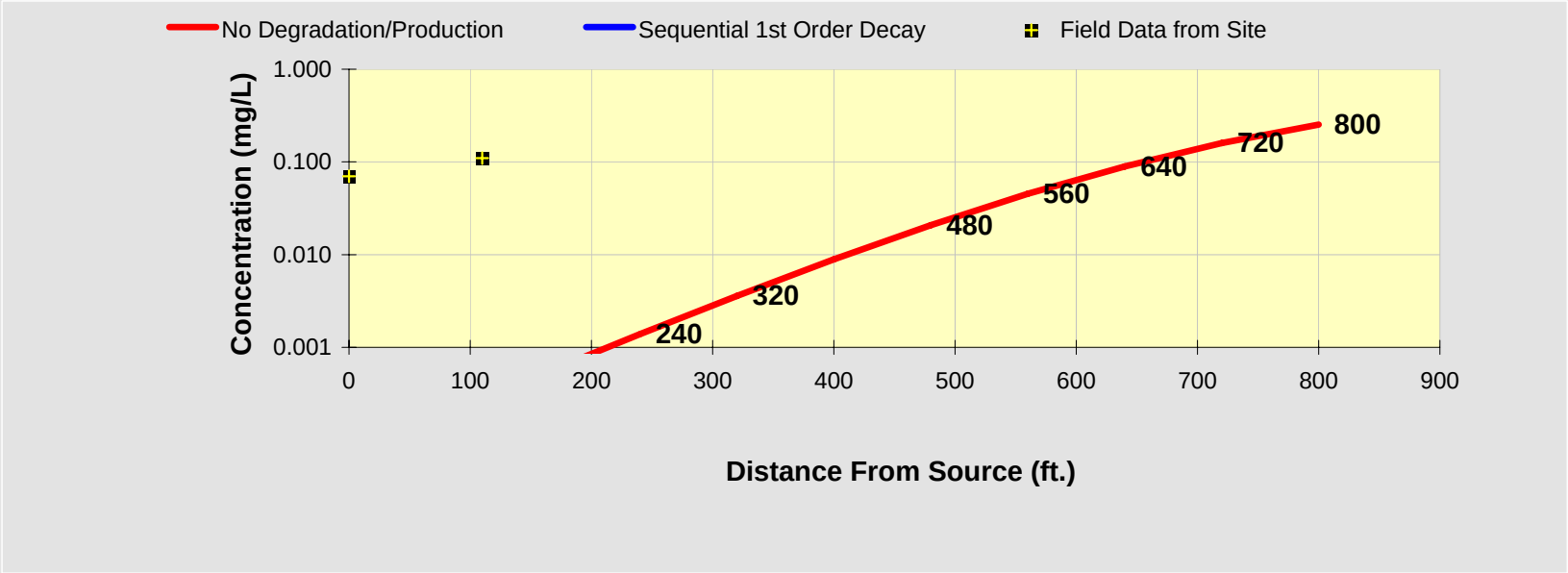
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

VC	0	80	160	240	320	400	480	560	640	720	800
No Degradation	0.000	0.000	0.001	0.001	0.004	0.009	0.021	0.045	0.089	0.159	0.253
Biotransformation	0.0001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

	0	110	530								
Field Data from Site	0.070	0.110	0.000								



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

110.0 Years

Log ⇔ Linear

Return to Input

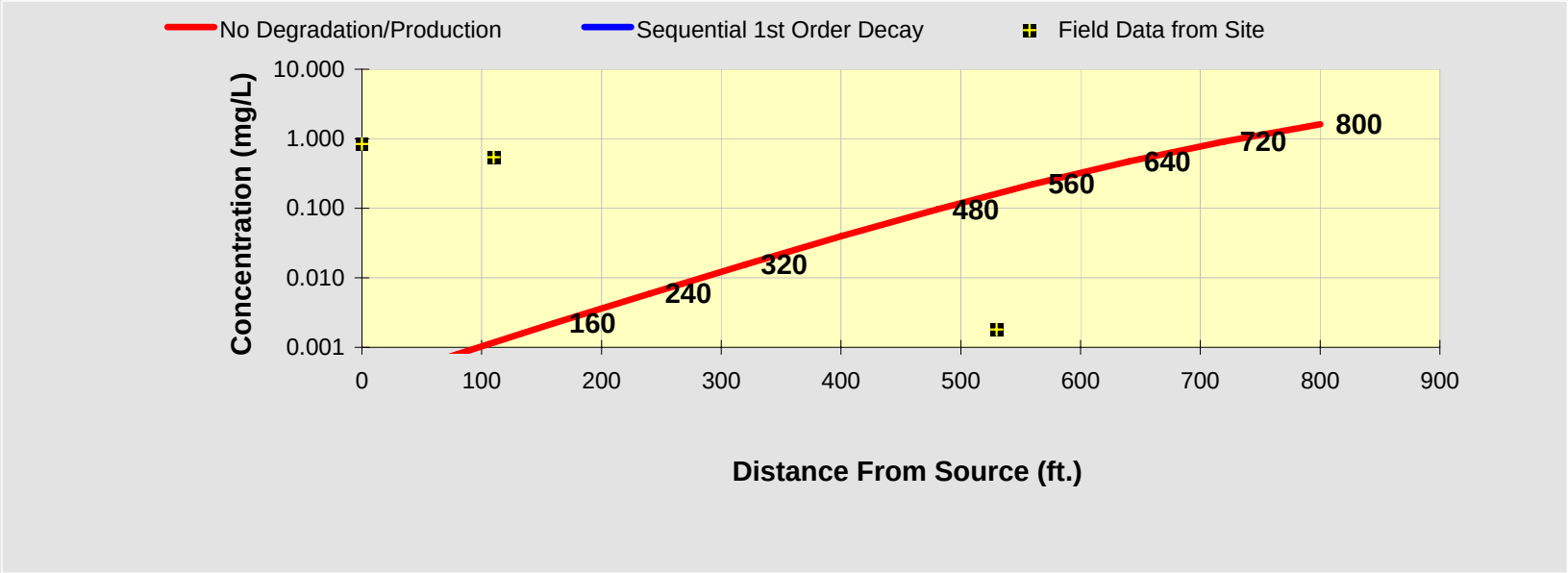
To All

To Array

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

TCE	Distance from Source (ft)										
	0	80	160	240	320	400	480	560	640	720	800
No Degradation	0.000	0.001	0.002	0.006	0.015	0.039	0.096	0.220	0.469	0.914	1.612
Biotransformation	0.0003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	Monitoring Well Locations (ft)										
	0	110	530								
Field Data from Site	0.840	0.540	0.002								



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

120.0 Years

Log ⇔ Linear

Return to Input

To All

To Array

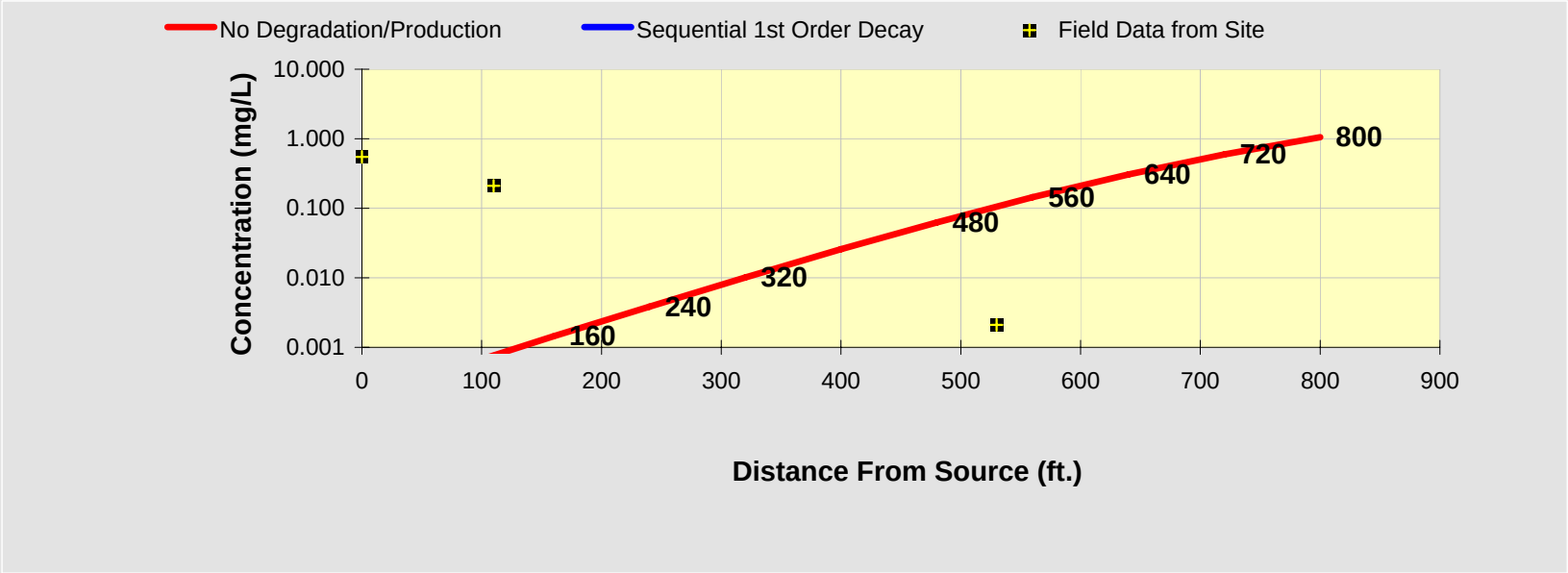
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

DCE	0	80	160	240	320	400	480	560	640	720	800
No Degradation	0.000	0.001	0.001	0.004	0.010	0.026	0.063	0.144	0.306	0.596	1.051
Biotransformation	0.0002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

	0	110	530								
Field Data from Site	0.550	0.210	0.002								



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

120.0 Years

Log ⇔ Linear

Return to Input

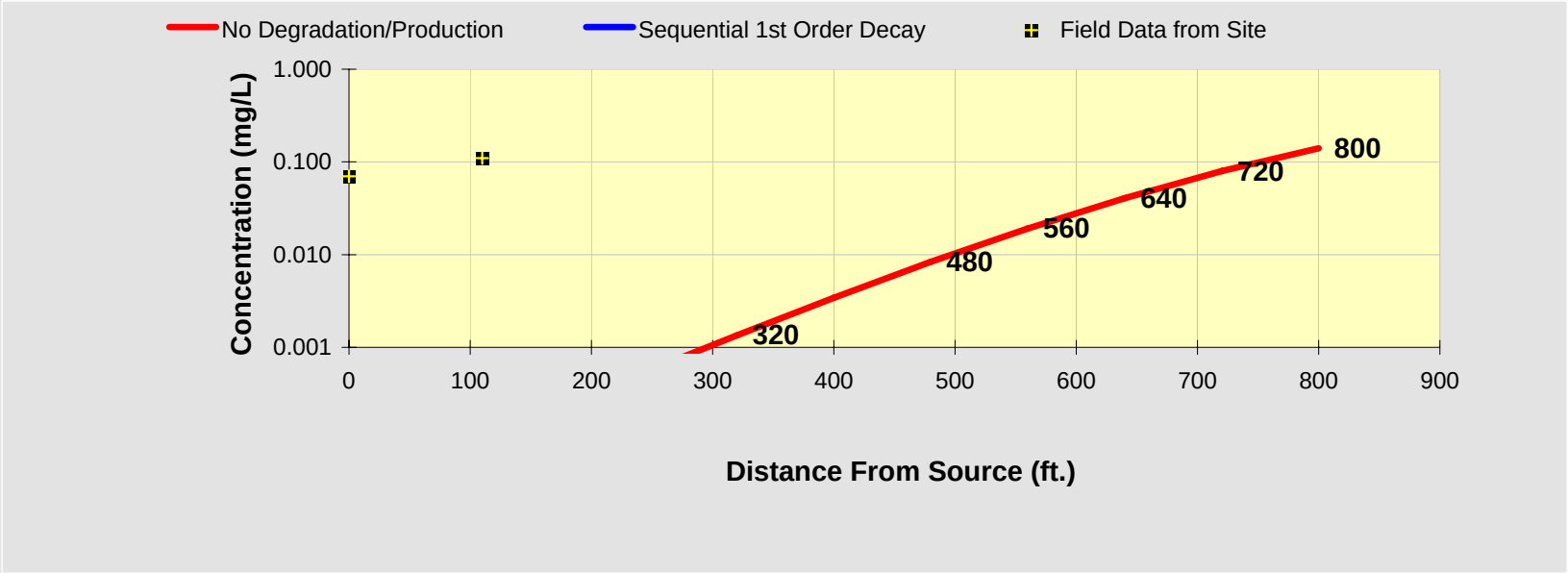
To All

To Array

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

VC	Distance from Source (ft)										
	0	80	160	240	320	400	480	560	640	720	800
No Degradation	0.000	0.000	0.000	0.001	0.001	0.003	0.008	0.019	0.041	0.079	0.140
Biotransformation	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	Monitoring Well Locations (ft)										
	0	110	530								
Field Data from Site	0.070	0.110	0.000								



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

120.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

Appendix I
Human Health Risk Assessment

Feasibility Study (Baker 1998)

FIGURE 6-1

CONCEPTUAL SITE MODEL
FOR CURRENT AND FUTURE HUMAN RECEPTORS
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

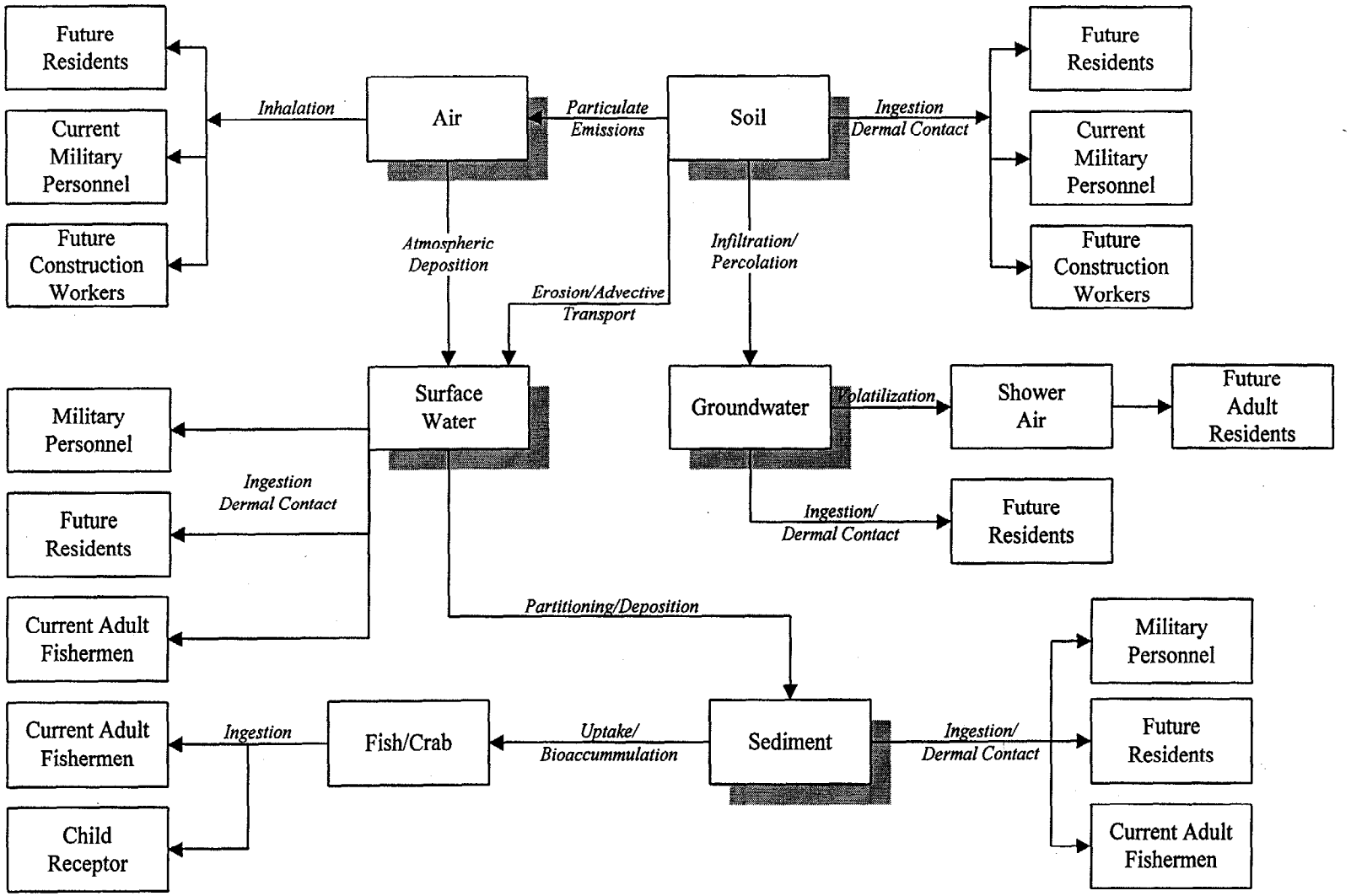


TABLE 6-12

SUMMARY OF COPCs IN ENVIRONMENTAL MEDIA OF CONCERN
SITE 73-AMPHIBIOUS VEHICLE MAINTENANCE AREA
REMEDIAL INVESTIGATION, CTO-0312
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Soil		Subsurface Soil		Phase I Groundwater		Phase II Groundwater		Surface Water		Sediment		Fish Tissue		Crab Tissue	
Volatiles																
Methylene Chloride											●		●	X	●	X
Acetone	●		●				●		●		●		●		●	
Carbon disulfide			●								●					
Chloroform					●		●		●							
1,2-Dichloroethane	●				●	X										
cis-1,2-Dichloroethene					●	X										
trans-1,2-Dichloroethene					●											
1,2-Dichloroethene (total)							●	X								
2-Butanone	●		●								●					
Vinyl Chloride					●	X	●	X								
Trichloroethene	●		●		●	X	●	X								
Tetrachloroethene			●													
Toluene	●				●		●		●		●		●		●	
Benzene					●	X	●	X								
Ethylbenzene	●		●		●											
1,1,1-Trichloroethane	●		●													
1,2-Dichloropropane	●															
Chloroethane							●									
Chlorobenzene	●															
Styrene	●															
4-Methyl-2-pentanone			●													
m-Xylene			●													
o-Xylene			●													
p-Xylene			●													
Xylenes (total)	●		●		●						●					

TABLE 6-12 (Continued)

SUMMARY OF COPCs IN ENVIRONMENTAL MEDIA OF CONCERN
SITE 73-AMPHIBIOUS VEHICLE DUMP
REMEDIAL INVESTIGATION, CTO-0312
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Soil		Subsurface Soil		Phase I Groundwater		Phase II Groundwater		Surface Water		Sediment		Fish Tissue		Crab Tissue	
Semivolatiles																
Phenol					●						●					
1,2,4-Trichlorobenzene					●											
2-Methylnaphthalene			●													
Naphthalene					●											
Acenaphthene	●		●		●											
2,4-Dinitrophenol	●		●													
4-Chloro-3-methylphenol	●															
Fluorene			●		●											
Phenanthrene	●		●								●					
Anthracene	●		●													
Butly benzyl phthalate	●															
Di-n-butylphthalate	●		●		●						●		●		●	
Fluoranthene	●		●								●					
Pyrene	●		●								●					
Benzo(a)anthracene	●		●	X												
Chrysene	●		●													
bis(2-Ethylhexyl)phthalate	●		●		●						●					
Benzo(b)fluoranthene	●		●													
Benzo(a)pyrene	●	X	●	X												
Benzo(g,h,i)perylene	●															
Pesticides/PCBs																
Endosulfan I			●													
Dieldrin			●													
4,4'-DDE	●		●								●					
Endrin											●		●			

TABLE 6-12 (Continued)

SUMMARY OF COPCs IN ENVIRONMENTAL MEDIA OF CONCERN
SITE 73-AMPHIBIOUS VEHICLE DUMP
REMEDIAL INVESTIGATION, CTO-0312
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Soil		Subsurface Soil		Phase I Groundwater		Phase II Groundwater		Surface Water		Sediment		Fish Tissue		Crab Tissue	
4,4'-DDD	●		●	X							●					
4,4'-DDT	●		●													
Endrin Aldehyde			●													
Alpha Chlordane	●		●													
Gamma Chlordane	●															
Endrin Ketone	●															
Aroclor-1016	●															
Aroclor-1254			●													
Aroclor-1260	●										●					
Metals																
Aluminum	●	X	●	X	●	X			●	X	●	X				
Antimony					●				●	X						
Arsenic											●	X	●		●	
Barium	●		●		●	X			●		●		●		●	
Beryllium					●											
Cadmium	●		●		●						●	X				
Calcium	●		●		●				●		●		●		●	
Chromium	●		●		●	X					●	X				
Cobalt	●		●		●	X					●					
Copper	●		●		●	X					●		●		●	X
Iron	●	X	●	X	●	X			●	X	●	X	●		●	
Lead	●		●		●						●		●	X	●	X
Magnesium	●		●		●				●		●		●		●	
Manganese	●		●		●	X			●		●		●		●	
Mercury													●	X	●	X
Nickel					●						●					

TABLE 6-12 (Continued)

SUMMARY OF COPCs IN ENVIRONMENTAL MEDIA OF CONCERN
SITE 73-AMPHIBIOUS VEHICLE DUMP
REMEDIAL INVESTIGATION, CTO-0312
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Soil		Subsurface Soil		Phase I Groundwater		Phase II Groundwater		Surface Water		Sediment		Fish Tissue		Crab Tissue	
Potassium	●		●		●				●		●		●		●	
Selenium													●		●	
Silver					●				●	X					●	
Sodium	●		●		●				●		●		●		●	
Thallium					●											
Vanadium	●		●		●	X					●					
Zinc	●		●		●				●	X	●		●		●	

Notes:

● = Detected in media; compared to relevant criteria and standards.
X = Selected as a COPC for human health risk assessment.

TABLE 6-13

MATRIX OF POTENTIAL HUMAN EXPOSURE
SITE 73-AMPHIBIOUS VEHICLE MAINTENANCE AREA
REMEDIAL INVESTIGATION, CTO-0312
MCB CAMP LEJEUNE, NORTH CAROLINA

Exposure Medium/ Exposure Route	Current Military Personnel	Current Trespassers	Current Fisherman	Future Residential Population	Future Construction Worker
Surface Soil					
Incidental Ingestion	M	A,T	NA	A,C	W
Dermal Contact	M	A,T	NA	A,C	W
Subsurface Soil					
Incidental Ingestion	NA	NA	NA	NA	W
Dermal Contact	NA	NA	NA	NA	W
Groundwater					
Ingestion	NA	NA	NA	A,C	NA
Dermal Contact	NA	NA	NA	A,C	NA
Surface Water					
Ingestion	M	A,T	A	A,C	NA
Dermal Contact	M	A,T	A	A,C	NA
Sediment					
Incidental Ingestion	M	A,T	A	A,C	NA
Dermal Contact	M	A,T	A	A,C	NA
Fish Tissue Incidental Ingestion	NA	NA	A,C	NA	NA
Crab Tissue Incidental Ingestion	NA	NA	A,C	NA	NA
Air					
Inhalation of Vapor Phase Chemicals Indoor	NA	NA	NA	A	NA
Inhalation of Particulates Outdoor	M	A,T	NA	A,C	W

Notes:

A = Lifetime exposure - adults
C = Exposure - children
T = Exposure - adolescents
M = Military exposure during tour of duty
W = Construction duration exposure
NA = Not applicable to receptor group

TABLE 6-19

SUMMARY OF RISKS
CURRENT MILITARY PERSONNEL
SITE 73, AMPHIBIOUS VEHICLE MAINTENANCE AREA
REMEDIAL INVESTIGATION, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Exposure Pathway	Noncarcinogenic Risk	Carcinogenic Risk
Surface Soil		
Ingestion	0.01	6.8E-08
Dermal Contact	<0.01	5.8E-08
Inhalation	NA	8.6E-12
total	0.01	1.3E-07
Surface Water		
Ingestion	0.3	NA
Dermal Contact	0.1	NA
total	0.4	NA
Sediment		
Ingestion	0.06	2.2E-07
Dermal Contact	0.01	4.8E-08
total	0.07	2.7E-07
Total Risk	0.5	4.0E-07

Notes:

NA - Not applicable. No carcinogenic and/or noncarcinogenic COPCs selected.

TABLE 6-20

SUMMARY OF RISKS
CURRENT ADOLESCENT TRESPASSER
SITE 73, AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Exposure Pathway	Noncarcinogenic Risk	Carcinogenic Risk
Surface Soil		
Ingestion	<0.01	5.3E-08
Dermal Contact	<0.01	3.7E-08
Inhalation	NA	6.8E-12
total	<0.01	9.3E-08
Surface Water		
Ingestion	0.25	NA
Dermal Contact	0.09	NA
total	0.34	NA
Sediment		
Ingestion	0.06	4.5E-07
Dermal Contact	0.01	7.9E-08
total	0.07	5.3E-07
Current Risk	0.4	6.2E-07

Notes:

NA = Not applicable. No carcinogenic and/or noncarcinogenic COPCs selected.

TABLE 6-21

SUMMARY OF RISKS
CURRENT ADULT TRESPASSER
SITE 73, AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Exposure Pathway	Noncarcinogenic Risk	Carcinogenic Risk
Surface Soil		
Ingestion	<0.01	9.4E-08
Dermal Contact	<0.01	1.1E-07
Inhalation	NA	1.2E-11
total	<0.01	2.0E-07
Surface Water		
Ingestion	0.13	NA
Dermal Contact	0.08	NA
total	0.21	NA
Sediment		
Ingestion	0.03	8.0E-07
Dermal Contact	0.01	2.3E-07
total	0.04	1.0E-06
Current Risk	0.3	1.3E-06

Notes:

NA = Not applicable. No carcinogenic and/or noncarcinogenic COPCs selected.

TABLE 6-22

SUMMARY OF RISKS
CURRENT ADULT FISHERMAN
SITE 73, AMPHIBIOUS VEHICLE MAINTENANCE AREA
REMEDIAL INVESTIGATION, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Exposure Pathway	Noncarcinogenic Risk	Carcinogenic Risk
Surface Water		
Ingestion	0.13	NA
Dermal Contact	0.08	NA
total	0.21	NA
Sediment		
Ingestion	0.03	8.0E-07
Dermal Contact	0.01	2.3E-07
total	0.04	1.0E-06
Fillet Fish Tissue		
Ingestion	0.05	2.6E-07
Crab Tissue		
Ingestion	0.05	4.0E-06
Current Risk	0.35	5.5E-06

Notes:

NA = Not applicable. No carcinogenic COPCs selected.

TABLE 6-23

SUMMARY OF RISKS
CHILD RECEPTOR - BIOTA INGESTION
SITE 73, AMPHIBIOUS VEHICLE MAINTENANCE AREA
REMEDIAL INVESTIGATION, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Exposure Pathway	Noncarcinogenic Risk	Carcinogenic Risk
Fillet Fish Tissue Ingestion	0.2	2.4E-07
Crab Tissue Ingestion	0.2	3.8E-06
Total Risk	0.4	4.0E-06

TABLE 6-24

SUMMARY OF RISKS
FUTURE CHILD RESIDENT
SITE 73, AMPHIBIOUS VEHICLE MAINTENANCE AREA
REMEDIAL INVESTIGATION, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

	Noncarcinogenic Risk		Carcinogenic Risk	
Exposure Pathway	RME	CT	RME	CT
Surface Soil				
Ingestion	0.2	0.05	1.3E-06	4.3E-07
Dermal Contact	0.01	<0.01	2.9E-07	3.0E-08
Inhalation	NA	NA	6.1E-11	4.1E-11
total	0.21	0.05	1.6E-06	4.6E-07
Phase I Groundwater (Maximum Exposure)				
Ingestion	24	1.3	2.5E-04	1.1E-05
Dermal Contact	0.3	0.01	6.0E-06	1.8E-07
total	24	1.3	2.6E-04	1.1E-05
Phase I Groundwater (Plausible Exposure)				
Ingestion	2.0	1.3	1.6E-05	1.1E-05
Dermal Contact	0.03	0.01	4.0E-07	1.8E-07
total	2.0	1.3	1.6E-05	1.1E-05
Phase II Groundwater (Maximum Exposure)				
Ingestion	26.2	1.4	4.7E-04	4.6E-05
Dermal Contact	0.47	0.01	1.1E-05	7.6E-07
total	27	1.4	4.8E-04	4.7E-05
Phase II Groundwater (Plausible Exposure)				
Ingestion	2.1	1.4	6.9E-05	4.6E-05
Dermal Contact	0.03	0.01	1.6E-06	7.6E-07
total	2.1	1.4	7.1E-05	4.7E-05
Surface Water				
Ingestion	0.62	0.44	NA	NA
Dermal Contact	0.14	0.08	NA	NA
total	0.8	0.5	NA	NA
Sediment				
Ingestion	0.27	0.06	1.5E-06	7.5E-07
Dermal Contact	0.02	<0.01	8.6E-08	1.3E-08
total	0.3	0.06	1.6E-06	7.6E-07
Future Risk - Maximum Phase I Groundwater	25	1.9	2.6E-04	1.2E-05
Future Risk - Plausible Phase I Groundwater	3.3	1.9	1.9E-05	1.2E-05
Future Risk - Maximum Phase II Groundwater	28	2.0	4.8E-04	4.8E-05
Future Risk - Plausible Phase II Groundwater	3.4	2.0	7.4E-05	4.8E-05

Notes:

NA = Not Applicable. No carcinogenic and/or noncarcinogenic COPCs selected.

TABLE 6-25

SUMMARY OF RISKS
FUTURE ADULT RESIDENT
SITE 73, AMPHIBIOUS VEHICLE MAINTENANCE AREA
REMEDIAL INVESTIGATION, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Exposure Pathway	Noncarcinogenic Risk		Carcinogenic Risk	
	RME	CT	RME	CT
Surface Soil				
Ingestion	0.02	0.01	6.9E-07	6.9E-08
Dermal Contact	<0.01	<0.01	8.0E-07	2.8E-08
Inhalation	NA	NA	8.7E-11	1.7E-11
total	0.02	0.01	1.5E-06	1.0E-07
Phase I Groundwater (Maximum Exposure)				
Ingestion	10.1	0.4	5.3E-04	4.9E-06
Dermal Contact	0.2	0.01	1.5E-05	2.0E-07
Inhalation	0.03	<0.01	1.1E-05	1.5E-07
total	10	0.4	5.5E-04	5.3E-06
Phase I Groundwater (Plausible Exposure)				
Ingestion	0.86	0.4	3.5E-05	4.9E-06
Dermal Contact	0.01	0.01	9.7E-07	2.0E-07
Inhalation	<0.01	<0.01	7.5E-07	1.5E-07
total	0.87	0.4	3.7E-05	5.3E-06
Phase II Groundwater (Maximum Exposure)				
Ingestion	11.2	0.4	1.0E-03	2.1E-05
Dermal Contact	0.23	0.01	2.8E-05	8.1E-07
Inhalation	0.05	0.01	2.1E-05	6.0E-07
total	12	0.4	1.0E-03	2.2E-05
Phase II Groundwater (Plausible Exposure)				
Ingestion	0.88	0.4	1.5E-04	2.1E-05
Dermal Contact	0.02	0.01	4.0E-06	8.1E-07
Inhalation	0.01	0.01	3.0E-06	6.0E-07
	1.0	0.4	1.6E-04	2.2E-05
Surface Water				
Ingestion	0.13	0.09	NA	NA
Dermal Contact	0.08	0.05	NA	NA
total	0.21	0.14	NA	NA
Sediment				
Ingestion	0.03	0.01	8.0E-07	1.2E-07
Dermal Contact	0.01	<0.01	2.3E-07	1.2E-08
total	0.04	0.01	1.0E-06	1.3E-07

TABLE 6-25 (continued)

SUMMARY OF RISKS
FUTURE ADULT RESIDENT
SITE 73, AMPHIBIOUS VEHICLE MAINTENANCE AREA
REMEDIAL INVESTIGATION, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Exposure Pathway	Noncarcinogenic Risk		Carcinogenic Risk	
	RME	CT	RME	CT
Future Risk - Maximum Phase I Groundwater	10	0.6	5.5E-04	5.5E-06
Future Risk - Plausible Phase I Groundwater	1.1	0.6	4.0E-05	5.5E-06
Future Risk - Maximum Phase II Groundwater	12	0.6	1.0E-03	2.2E-05
Future Risk - Plausible Phase II Groundwater	1.3	0.6	1.6E-04	2.2E-05

Notes:

NA = Not Applicable. No carcinogenic and/or noncarcinogenic COPCs selected.

TABLE 6-26

SUMMARY OF RISKS
FUTURE CONTSTRUCTION WORKER
SITE 73, AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Exposure Pathway	Noncarcinogenic Risk	Carcinogenic Risk
Surface Soil		
Ingestion	0.02	2.8E-08
Dermal Contact	<0.01	5.1E-09
Inhalation	NA	7.4E-13
total	0.02	3.3E-08
Subsurface Soil		
Ingestion	0.02	5.7E-08
Dermal Contact	<0.01	1.0E-08
Inhalation	NA	1.1E-12
total	0.02	6.7E-08
Future Risk	0.04	1.0E-07

Notes:

NA = Not Applicable. No carcinogenic and/or noncarcinogenic COPCs selected.

Computed by: KTW Checked by: RSP Date: 10/96

EXAMPLE GROUNDWATER INGESTION CALCULATIONS
OPERABLE UNIT NO. 9
CONTRACT TASK ORDER 0312

Purpose: Estimate intake/risk from ingestion of groundwater

$$Intake\ (mg/kg{\cdot}day) = \frac{C \times IR \times EF \times ED}{BW \times AT}$$

Where:			
	C	=	Contaminant concentration in groundwater (mg/L)
	IR	=	Daily intake ingestion rate (L/day)
	EF	=	Exposure frequency (days/year)
	ED	=	Exposure duration (years)
	BW	=	Body weight (kg)
	AT_c	=	Averaging time carcinogen (days)
	AT_{nc}	=	Averaging time noncarcinogen (days)

Risks:

Carcinogens = Intake (mg/kg·day) x CSF $(mg/kg{\cdot}day)^{-1}$
Noncarcinogens = Intake (mg/kg·day)/RfD (mg/kg·day)

Example Carcinogen: Benzene

$$Intake\ (mg/kg{\cdot}day) = \frac{0.002\ mg/L \times 2\ L/day \times 350\ days/yr \times 30\ yrs}{70\ kg \times 25{,}550\ days}$$

= 2.3E-05

Risk = 2.3E-05 mg/kg·day x 2.9E-02 $mg/kg{\cdot}day^{-1}$ = 6.8E-07

Example Noncarcinogen: Barium

$$Intake\ (mg/kg{\cdot}day) = \frac{0.06\ mg/L \times 2\ L/day \times 350\ days/yr \times 30\ yrs}{70\ kg \times 10{,}950\ days}$$

= 1.6E-03

$$Risk = \frac{1.6E{-}03\ mg/kg{\cdot}day}{7.0E{-}02\ mg/kg{\cdot}day} = 2.3E{-}02$$

Re: Site 73 Future Residential Adult

Computed by: KTW Checked by: RSP Date: 10/96

EXAMPLE FISH/CRAB INGESTION CALCULATIONS
OPERABLE UNIT NO. 9
CONTRACT TASK ORDER 0312

Purpose: Estimate intake/risk from ingestion of fish/crab (edible portion):

$$Intake\ (mg/kgday) = \frac{C\ x\ FI\ x\ EF\ x\ ED\ x\ IR}{BW\ x\ AT}$$

Where:			
	C	=	Contaminant concentration in fish/crab tissue (mg/kg)
	FI	=	Fraction ingested
	EF	=	Exposure frequency (meal/year)
	ED	=	Exposure duration (years)
	IR	=	Ingestion rate (kg/meal)
	BW	=	Body weight (kg)
	AT_c	=	Averaging time carcinogen (days)
	AT_{nc}	=	Averaging time noncarcinogen (days)

Risks:

Carcinogens = Intake (mg/kg·day) x CSF $(mg/kg{\cdot}day)^{-1}$
Noncarcinogens = Intake (mg/kg·day)/RfD (mg/kg·day)

Example Carcinogen: Methylene Chloride

$$Intake\ (mg/kgday) = \frac{1.1\ mg/kg\ x\ 0.054\ kg/meal\ x\ 350\ days/yr\ x\ 30\ yrs\ x\ 0.1}{70\ kg\ x\ 25{,}550\ days}$$

$$= 3.5E\text{-}05$$

Risk = 3.5E-05 mg/kg·day x 7.5E-03 $mg/kg{\cdot}day^{-1}$ = 2.6E-07

Example Noncarcinogen: Mercury

$$Intake\ (mg/kgday) = \frac{0.18\ mg/kg\ x\ 0.054\ kg/meal\ x\ 350\ days/yr\ x\ 30\ yrs\ x\ 0.1}{70\ kg\ x\ 10{,}950\ days}$$

$$= 1.3E\text{-}05$$

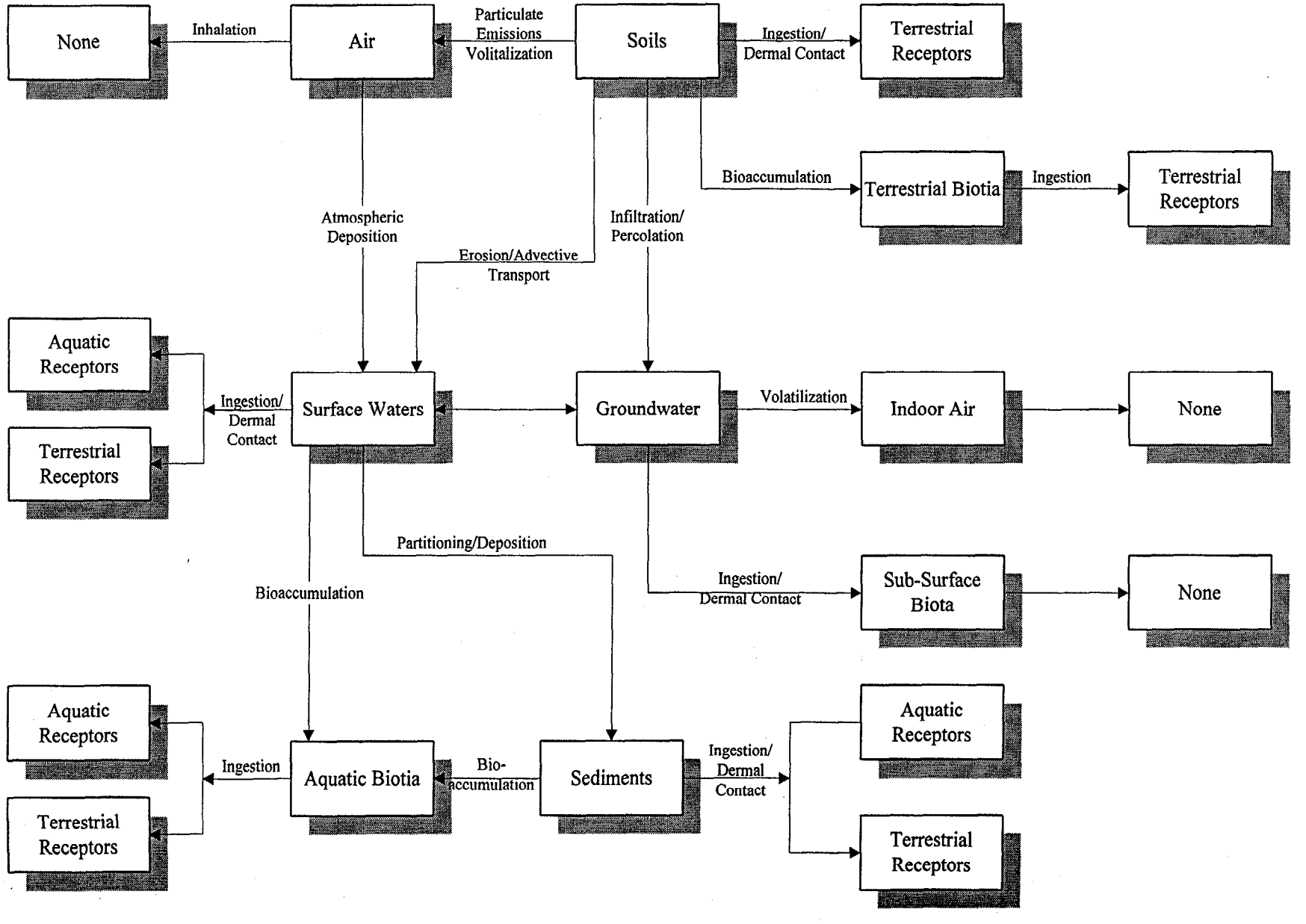
$$Risk = \frac{1.3E\text{-}05\ mg/kgday}{3.0E\text{-}04\ mg/kgday} = 4.4E\text{-}02$$

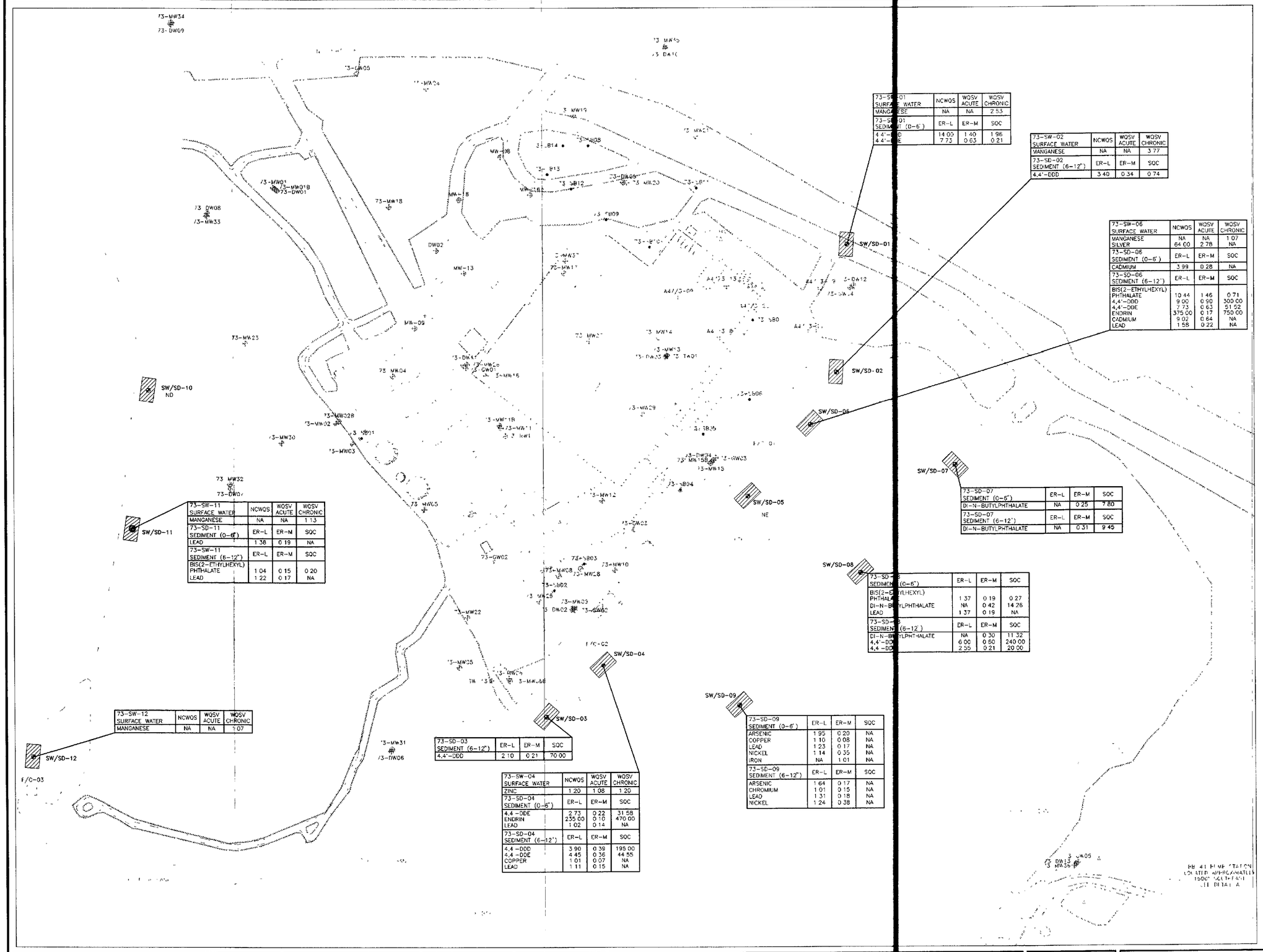
Re: Site 73 Adult Fisherman

Appendix J
Ecological Risk Assessment

FIGURE 7-1

CONCEPTUAL EXPOSURE MODEL FOR ECOLOGICAL RECEPTORS
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA





73-SW-01 SURFACE WATER	NCWQS	WQSV ACUTE	WQSV CHRONIC
MANGANESE	NA	NA	2.53
73-SD-01 SEDIMENT (0-6')	ER-L	ER-M	SQC
4,4'-DDD	14.00	1.40	1.96
4,4'-DDE	7.73	0.63	0.21

73-SW-02 SURFACE WATER	NCWQS	WQSV ACUTE	WQSV CHRONIC
MANGANESE	NA	NA	3.77
73-SD-02 SEDIMENT (6-12")	ER-L	ER-M	SQC
4,4'-DDD	3.40	0.34	0.74

73-SW-06 SURFACE WATER	NCWQS	WQSV ACUTE	WQSV CHRONIC
MANGANESE	NA	NA	1.07
SILVER	64.00	2.78	NA
73-SD-06 SEDIMENT (0-6')	ER-L	ER-M	SQC
CADMIUM	3.99	0.28	NA
73-SD-06 SEDIMENT (6-12')	ER-L	ER-M	SQC
BIS(2-ETHYLHEXYL) PHTHALATE	10.44	1.46	0.71
4,4'-DDD	9.00	0.90	300.00
4,4'-DDE	7.73	0.63	51.52
ENDRIN	375.00	0.17	750.00
CADMIUM	9.02	0.64	NA
LEAD	1.58	0.22	NA

73-SD-07 SEDIMENT (0-6')	ER-L	ER-M	SQC
DI-N-BUTYLPHTHALATE	NA	0.25	7.80
73-SD-07 SEDIMENT (6-12')	ER-L	ER-M	SQC
DI-N-BUTYLPHTHALATE	NA	0.31	9.45

73-SD-08 SEDIMENT (0-6')	ER-L	ER-M	SQC
BIS(2-ETHYLHEXYL) PHTHALATE	1.37	0.19	0.27
DI-N-BUTYLPHTHALATE	NA	0.42	14.26
LEAD	1.37	0.19	NA
73-SD-08 SEDIMENT (6-12')	ER-L	ER-M	SQC
DI-N-BUTYLPHTHALATE	NA	0.30	11.32
4,4'-DDD	6.00	0.60	240.00
4,4'-DDE	2.55	0.21	20.00

73-SW-11 SURFACE WATER	NCWQS	WQSV ACUTE	WQSV CHRONIC
MANGANESE	NA	NA	1.13
73-SD-11 SEDIMENT (0-6')	ER-L	ER-M	SQC
LEAD	1.38	0.19	NA
73-SW-11 SEDIMENT (6-12")	ER-L	ER-M	SQC
BIS(2-ETHYLHEXYL) PHTHALATE	1.04	0.15	0.20
LEAD	1.22	0.17	NA

73-SW-12 SURFACE WATER	NCWQS	WQSV ACUTE	WQSV CHRONIC
MANGANESE	NA	NA	1.07

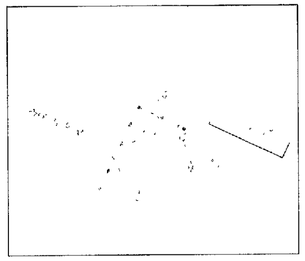
73-SD-03 SEDIMENT (6-12")	ER-L	ER-M	SQC
4,4'-DDD	2.10	0.21	70.00

73-SW-04 SURFACE WATER	NCWQS	WQSV ACUTE	WQSV CHRONIC
ZINC	1.20	1.08	1.20
73-SD-04 SEDIMENT (0-6")	ER-L	ER-M	SQC
4,4'-DDE	2.73	0.22	31.58
ENDRIN	235.00	0.10	470.00
LEAD	1.02	0.14	NA
73-SD-04 SEDIMENT (6-12')	ER-L	ER-M	SQC
4,4'-DDD	3.90	0.39	195.00
4,4'-DDE	4.45	0.36	44.55
COPPER	1.01	0.07	NA
LEAD	1.11	0.15	NA

73-SD-09 SEDIMENT (0-6')	ER-L	ER-M	SQC
ARSENIC	1.95	0.20	NA
COPPER	1.10	0.08	NA
LEAD	1.23	0.17	NA
NICKEL	1.14	0.35	NA
IRON	NA	1.01	NA
73-SD-09 SEDIMENT (6-12")	ER-L	ER-M	SQC
ARSENIC	1.64	0.17	NA
CHROMIUM	1.01	0.15	NA
LEAD	1.31	0.18	NA
NICKEL	1.24	0.38	NA

LEGEND

SW/SD-01	SURFACE WATER/SEDIMENT LOCATION SAMPLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
NA	NOT AVAILABLE (SAMPLE COULD NOT BE ACCESSED)
NE	NO EXCEEDANCES
ND	NO DATA (SAMPLE COULD NOT BE ACCESSED)
NCWQS	NORTH CAROLINA WATER QUALITY STANDARD
WQSV	USEPA WATER QUALITY STANDARD
ER-L	EFFECTS RANGE - LOW
ER-M	EFFECTS RANGE - MEDIAN
SQC	SEDIMENT QUALITY CRITERIA



DETAIL A

REVISIONS

DRAWN WJH/REL
REVIEWED JSC
S.O.# 62470-312-0000-07000
CADD# 312571PP

NORTH

SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

SURFACE WATER AND SEDIMENT QUOTIENT RATIO EXCEEDANCES

SCALE 1" = 150'

DATE NOVEMBER 1996

FIGURE NO. 7-2

01767V10X

TABLE 7-2

FREQUENCY AND RANGE OF CONTAMINANT DETECTIONS COMPARED TO ESTUARINE SURFACE WATER SCREENING VALUES
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Water Screening Values (SWSV)			Average Reference Station Concentration	Contaminant Frequency/Range		No. of Positive Detects Above Lowest SWSV	No. of Positive Detects Above the Average Reference Station Concentration	Ecological Contaminant of Concern?	Comments
	North Carolina Water Quality Standards (WQS)[1]	USEPA Region IV Water Quality Screening Values (WQSV)[2]			No. of Positive Detects/ No. of Samples	Range of Positive Detection				
		Acute	Chronic							
Organics (µg/L):										
Acetone	500	NE	NE	ND	1/11	50	0	1	No	Below SWSL Lab. Contaminant
Chloroform	815	NE	NE	ND	1/11	3J	0	1	Yes	Terrestrial Concern
Toluene	37	NE	NE	ND	3/11	2J-5J	0	3	Yes	Terrestrial Concern
Inorganics (µg/L):										
Aluminum	NE	1,050[3]	5,000[4]	ND	4/11	74.6-500	0	0	Yes	Terrestrial Concern
Antimony	NE	1,050[5]	500[3]	ND	10/11	116-216	0	10	Yes	Terrestrial Concern
Barium	1,400	10,000[3]	NE	24	10/11	6.7-10.5	0	0	No	Below SWSL/ Below Background
Calcium	NE	NE	NE	134,025	11/11	9,410-283,000	NA	10	No	Low Toxicity
Iron	NE	NE	NE	317.8	11/11	245-4,540	NA	9	Yes	
Magnesium	NE	NE	NE	511,200	11/11	1,550-1,390,000	NA	9	No	Low Toxicity
Manganese	NE	NE	10[3]	ND	11/11	5.8-37.7	5	11	Yes	
Potassium	NE	NE	NE	207,250	10/11	293,000-388,000	NA	10	No	Low Toxicity

TABLE 7-2 (Continued)

FREQUENCY AND RANGE OF CONTAMINANT DETECTIONS COMPARED TO ESTUARINE SURFACE WATER SCREENING VALUES
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Water Screening Values (SWSV)			Average Reference Station Concentration	Contaminant Frequency/Range		No. of Positive Detects Above Lowest SWSV	No. of Positive Detects Above the Average Reference Station Concentration	Ecological Contaminant of Concern?	Comments
	North Carolina Water Quality Standards (WQS)[1]	USEPA Region IV Water Quality Screening Values (WQSV)[2]			No. of Positive Detects/ No. of Samples	Range of Positive Detection				
		Acute	Chronic							
Inorganics (µg/L) (continued):										
Silver	0.1	2.3	NE	19.1	1/11	6.4	1	0	No	Below Background
Sodium	NE	NE	NE	3,073,750	11/11	10,100-11,100,000	NA	10	No	Low Toxicity
Zinc	86	95	86	ND	10/11	12-103	1	10	Yes	

Notes:

NE = Not Established
NA = Not Applicable
ND = Not Detected
(1) NC DEHNR, 1994 (North Carolina Water Quality Standards)
(2) USEPA, 1995a (Region IV Toxic Substance Spreadsheet)
(3) USEPA, 1995b (Region III BTAG Screening Levels)
(4) USEPA, 1991 (Wall Chart) Lowest Observed Level
(5) USEPA, 1991 (Wall Chart) Lowest Proposed Value

TABLE 7-3

FREQUENCY AND RANGE OF CONTAMINANT DETECTIONS COMPARED TO ESTUARINE SEDIMENT SCREENING VALUES
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Sediment Screening Values (SSV)			Average Reference Station Concentration	Contaminant Frequency/Range		No. of Positive Detects Above Lowest SSV	No. of Positive Detect Above the Average Reference Concentration	Ecological Contaminant of Concern?	Comments
	ER-L[4]	ER-M[1]	SQC[2]		No. of Positive Detects/ No. of Samples	Range of Positive Detections				
Volatiles (µg/kg):										
Acetone	NE	NE	NE	ND	7/22	5J-280	NA	7	No	Lab. Contaminant
2-Butanone	NE	NE	NE	ND	2/22	4J-13J	NA	2	No	Lab. Contaminant
Carbon Disulfide	NE	NE	NE	ND	13/22	2J-75	NA	13	Yes	
Methylene Chloride	NE	NE	NE	ND	1/22	7J	NA	1	No	Infreq. Detected
Toluene	NE	NE	8.2	ND	2/22	1J-12J	1	2	Yes	
Xylenes (total)	NE	40[3]	38	ND	1/22	9J	0	1	No	Below SSV/ Infreq. Detected
Semivolatiles (µg/kg):										
Bis(2-ethylhexyl)phthalate	182	1,300[3]	940	ND	8/22	51J-1,900J	3	8	Yes	
Di-n-butylphthalate	NE	1,400[3]	15	ND	11/22	240J-680J	11	11	Yes	
Fluoranthene	113	5,100	7.7	ND	1/22	1,000J	1	1	No	Infreq. Detected
Phenanthrene	86.7	1,500	6.2	ND	1/22	940J	1	1	No	Infreq. Detected
Phenol	NE	420[3]	2.2	ND	1/22	150J	1	1	No	Infreq. Detected
Pyrene	153	2,600	298	ND	1/22	880J	1	1	No	Infreq. Detected

TABLE 7-3 (Continued)

FREQUENCY AND RANGE OF CONTAMINANT DETECTIONS COMPARED TO ESTUARINE SEDIMENT SCREENING VALUES
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Sediment Screening Values (SSV)			Average Reference Station Concentration	Contaminant Frequency/Range		No. of Positive Detects Above Lowest SSV	No. of Positive Detect Above the Average Reference Concentration	Ecological Contaminant of Concern?	Comments
	ER-L[4]	ER-M[1]	SQC[2]		No. of Positive Detects/ No. of Samples	Range of Positive Detections				
Inorganics (mg/kg) (continued):										
Lead	30.2	218	NE	5.8	22/22	3.3-47.7J	8	18	Yes	
Magnesium	NE	NE	NE	5,081.4	21/22	140-9,430	NA	4	No	Low Toxicity
Manganese	230[7]	NE	NE	45.7	21/22	3.4-137	0	6	No	Below SSV
Nickel	15.9	51.6	NE	10.2	5/22	6-19.7	2	4	Yes	
Potassium	NE	NE	NE	1,570.0	15/22	305-4,390	NA	6	No	Low Toxicity
Sodium	NE	NE	NE	ND	21/22	74.8-28,500	NA	21	No	Low Toxicity
Vanadium	NE	NE	NE	26.6	16/22	2.6-50.8	NA	4	Yes	
Zinc	124	410	NE	30.7	21/22	8-100	0	10	No	Below SSV

Notes:

NE = Not Established
ER-L - Effects Range Low
ER-M - Effects Range Median
SQC = Sediment Quality Criteria
NA = Not Applicable
[1] Long et.al., 1995
[2] Values were calculated using the following equation: SQC = Foc*Koc*FCV/1,000,000
Where:
Foc = Fraction of organic carbon in the sediments (used 26.1 mg/kg)
Koc = Organic carbon partition coefficient (chemical specific)
FCV = Final water chronic value (chemical specific)
[3] USEPA, 1995c (Region III BTAG Screening Levels)
[4] USEPA, 1995a - (Region IV Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessments), unless otherwise noted
[5] Used Total PCB Value
[6] Sulliven et.al., 1985
[7] Tetra Tech Inc., 1986 (Apparent Effects Threshold Sediment Quality Values)

TABLE 7-3 (Continued)

FREQUENCY AND RANGE OF CONTAMINANT DETECTIONS COMPARED TO ESTUARINE SEDIMENT SCREENING VALUES
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Sediment Screening Values (SSV)			Average Reference Station Concentration	Contaminant Frequency/Range		No. of Positive Detects Above Lowest SSV	No. of Positive Detect Above the Average Reference Concentration	Ecological Contaminant of Concern?	Comments
	ER-L[4]	ER-M[1]	SQC[2]		No. of Positive Detects/ No. of Samples	Range of Positive Detections				
Pesticides/PCBs (µg/kg):										
4,4'-DDD	2[4]	20[4]	0.02	3.4	6/22	4.2J-28	6	6	Yes	
4,4'-DDE	2.2[1]	27	0.11	ND	5/22	5.6J-17J	5	5	Yes	
Endrin	0.02	45[4]	0.004	ND	2/22	4.7-7.5J	2	2	Yes	
Aroclor-1260	22.7[5]	180[5]	0.01	ND	1/22	120J	1	1	No	Infreq. Detected
Inorganics (mg/kg):										
Aluminum	NE	NE	NE	9,864.3	21/22	431-28,100	NA	5	Yes	
Arsenic	7.24	70	NE	ND	9/22	3.3-14.1	2	9	Yes	
Barium	500[6]	NE	NE	12.4	21/22	1.3-27.8	0	5	No	Below SSV
Cadmium	0.676	9.6	NE	0.1	2/22	2.7J-6.1J	2	2	Yes	
Calcium	NE	NE	NE	2,932.9	21/22	483-27,800	NA	11	No	Low Toxicity
Chromium	52.3	370	NE	30.9	17/22	3.3-55.9	1	4	Yes	
Cobalt	NE	NE	NE	3.20	3/22	7.68-11.5	NA	3	Yes	
Copper	18.7	270	NE	ND	14/22	3.2-20.5	2	14	Yes	
Iron	27,000[7]	NE	NE	12,868.6	22/22	3.7-27,400	1	6	Yes	

TABLE 7-5

CONTAMINANTS OF POTENTIAL CONCERN IN EACH MEDIA
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Surface Water		Sediment	Surface Soil	Fish Samples		Crab Samples
	Aquatic Receptor	Terrestrial Receptor			Fillet	Whole Body	
Volatiles:							
Carbon Disulfide			X				
Chloroform		X					
Methylene Chloride					X		X
Toluene		X	X		X		X
Xylenes (total)				X			
Semivolatiles:							
Benzo(b)fluoranthene				X			
Bis(2-ethylhexyl)phthalate			X				
Chrysene				X			
Di-n-Butylphthalate			X	X	X		X
2,4-Dinitrophenol				X			
Fluoranthene				X			
Pyrene				X			
Pesticides/PCBs:							
gamma-Chlordane				X			
4,4'-DDD			X	X			
4,4'-DDE			X	X			
4,4'-DDT				X			
Endrin			X		X		
Inorganics:							
Aluminum	X	X	X	X		X	
Antimony		X					
Arsenic			X		X	X	X
Barium				X	X	X	X
Cadmium			X	X			
Chromium			X	X		X	
Cobalt			X	X			
Copper			X	X	X	X	X
Iron	X	X	X	X	X	X	X
Lead			X	X	X	X	X
Manganese	X	X		X	X	X	X
Nickel			X				
Silver							X
Vanadium			X	X		X	
Zinc	X	X		X	X	X	X

TABLE 7-19

SURFACE WATER QUOTIENT INDICIES PER STATION
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Station	Concentration (µg/L)	Quotient Indicies		
			North Carolina WQS	USEPA SWSV	
				Acute	Chronic
Total Inorganics (µg/L):					
Manganese	73-SW01-01	25.3	NA	NA	2.53
	73-SW02-01	37.7	NA	NA	3.77
	73-SW06-01	10.7	NA	NA	1.07
	73-SW11-01	11.3	NA	NA	1.13
	73-SW12-01	10.7	NA	NA	1.07
Zinc	73-SW04-01	103	1.20	1.08	1.20

Notes:

Shaded boxes are Quotient Indices that exceed "1".

SW = Surface Water
WQS = Water Quality Standard
SWSV = Surface Water Screening Value
µg/L = micrograms per liter
NA = Not Applicable

TABLE 7-20

SURFACE WATER QUOTIENT INDICIES PER CONTAMINANT OF POTENTIAL CONCERN
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION, CTO-312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Log Normal UCL Concentration (µg/L)	UCL Quotient Index		
		North Carolina WQS	USEPA SWSV	
			Acute	Chronic
Total Inorganics (µg/L):				
Manganese	19.24	NA	NA	1.92
Zinc	97.29	1.13	1.02	1.13
Total QI		1.13	2.02	3.05

Notes:

Shaded boxes are Quotient Indices that exceed "1"

SW = Surface Water
WQS = Water Quality Standard
SWSV = Surface Water Screening Value
UCL = Upper Confidence Level
µg/L = micrograms per liter
NA = Not Applicable

TABLE 7-21

SEDIMENT QUOTIENT INDICES PER STATION
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Station	Sample Concentration	Quotient Index		
			ER-L	ER-M	SQC[1]
Semivolatiles (µg/kg):					
Bis(2-ethylhexyl)phthalate	73-SD06-612	1,900J	10.44	1.46	0.71
	73-SD08-06	250J	1.37	0.19	0.27
	73-SD11-612	190J	1.04	0.15	0.20
Di-n-butylphthalate	73-SD07-06	350J	NA	0.25	7.80
	73-SD07-612	430	NA	0.31	9.45
	73-SD08-06	590	NA	0.42	14.26
	73-SD08-612	420J	NA	0.30	11.32
Pesticides (µg/kg):					
4,4'-DDD	73-SD01-06	28	14.00	1.40	1.96
	73-SD02-612	6.8J	3.40	0.34	0.74
	73-SD03-612	4.2J	2.10	0.21	70.00
	73-SD04-612	7.8J	3.90	0.39	195.00
	73-SD06-612	18J	9.00	0.90	300.00
	73-SD08-612	12J	6.00	0.60	240.00
4,4'-DDE	73-SD01-06	17J	7.73	0.63	0.21
	73-SD04-06	6J	2.73	0.22	31.58
	73-SD04-612	9.8J	4.45	0.36	44.55
	73-SD06-612	17J	7.73	0.63	51.52
	73-SD08-612	5.6J	2.55	0.21	20.00
Endrin	73-SD04-06	4.7	235.00	0.10	470.00
	73-SD06-612	7.5J	375.00	0.17	750.00
Inorganics (mg/kg):					
Arsenic	73-SD09-06	14.1	1.95	0.20	NA
	73-SD09-612	11.9	1.64	0.17	NA
Cadmium	73-SD06-06	2.7J	3.99	0.28	NA
	73-SD06-612	6.1J	9.02	0.64	NA
Copper	73-SD04-612	18.8	1.01	0.07	NA
	73-SD09-06	20.5	1.10	0.08	NA
Chromium	73-SD09-612	55.9	1.07	0.15	NA
Iron	73-SD09-06	27400	NA	1.01	NA

TABLE 7-21 (Continued)

SEDIMENT QUOTIENT INDICES PER STATION
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Station	Sample Concentration	Quotient Index		
			ER-L	ER-M	SQC[1]
Lead	73-SD06-612	47.7J	1.58	0.22	NA
	73-SD04-06	30.7	1.02	0.14	NA
	73-SD04-612	33.6	1.11	0.15	NA
	73-SD08-06	41.4	1.37	0.19	NA
	73-SD09-06	37	1.23	0.17	NA
	73-SD09-612	39.6	1.31	0.18	NA
	73-SD11-06	41.6	1.38	0.19	NA
	73-SD11-612	36.8	1.22	0.17	NA
Nickel	73-SD09-06	18.1	1.14	0.35	NA
	73-SD09-612	19.7	1.24	0.38	NA

Notes:

Shaded boxes are Quotient Indices that exceed "1".

[1] Station-specific total organic carbon concentrations used to calculate SQC

SD - Sediment
ER-L - Effects Range - Low
ER-M - Effects Range - Median
µg/kg - Microgram Per Kilogram
mg/kg - Milligram Per Kilogram
SQC - Sediment Quality Criteria
NA - Not Applicable

TABLE 7-22

SEDIMENT QUOTIENT INDICES PER CONTAMINANT OF POTENTIAL CONCERN
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
REMEDIAL INVESTIGATION CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Log Normal UCL Concentration	Quotient Index		
		ER-L	ER-M	SQC
Volatiles (µg/kg):				
Toluene	12*	NA	NA	1.46
Semivolatiles (µg/kg):				
Bis(2-ethylhexyl)phthalate	1,900*	NA	1.46	2.02
Di-n-butylphthalate	680*	NA	0.49	45.33
Pesticides (µg/kg):				
4,4'-DDD	9.65	4.80	0.50	482.5
4,4'-DDE	7.94	3.60	0.30	72.18
Endrin	4.91	245.50	0.10	1,227.5
Inorganics (mg/kg):				
Arsenic	6.63	0.92	0.10	NA
Cadmium	1.9	2.81	0.20	NA
Chromium	55.75	1.07	0.15	NA
Copper	16.74	0.90	0.06	NA
Iron	27,400*	NA	1.01	NA
Lead	36.18	1.20	0.20	NA
Nickel	8.58	0.54	0.17	NA
Total QI		261.34	4.74	1,830.99

Notes:

Shaded boxes are Quotient Indices that exceed "1".
*Maximum value (UCL was higher than the maximum value)

SD = Sediment
ER-L = Effects Range - Low
ER-M = Effects Range - Median
SQC = Sediment Quality Criteria
µg/kg = Microgram Per Kilogram
mg/kg = Milligram Per Kilogram
NA = Not Applicable
UCL = Upper Confidence Level

Table 1. Comparison of Groundwater Concentrations

Camp Lejeune Site 73 (Operable Unit # 21)

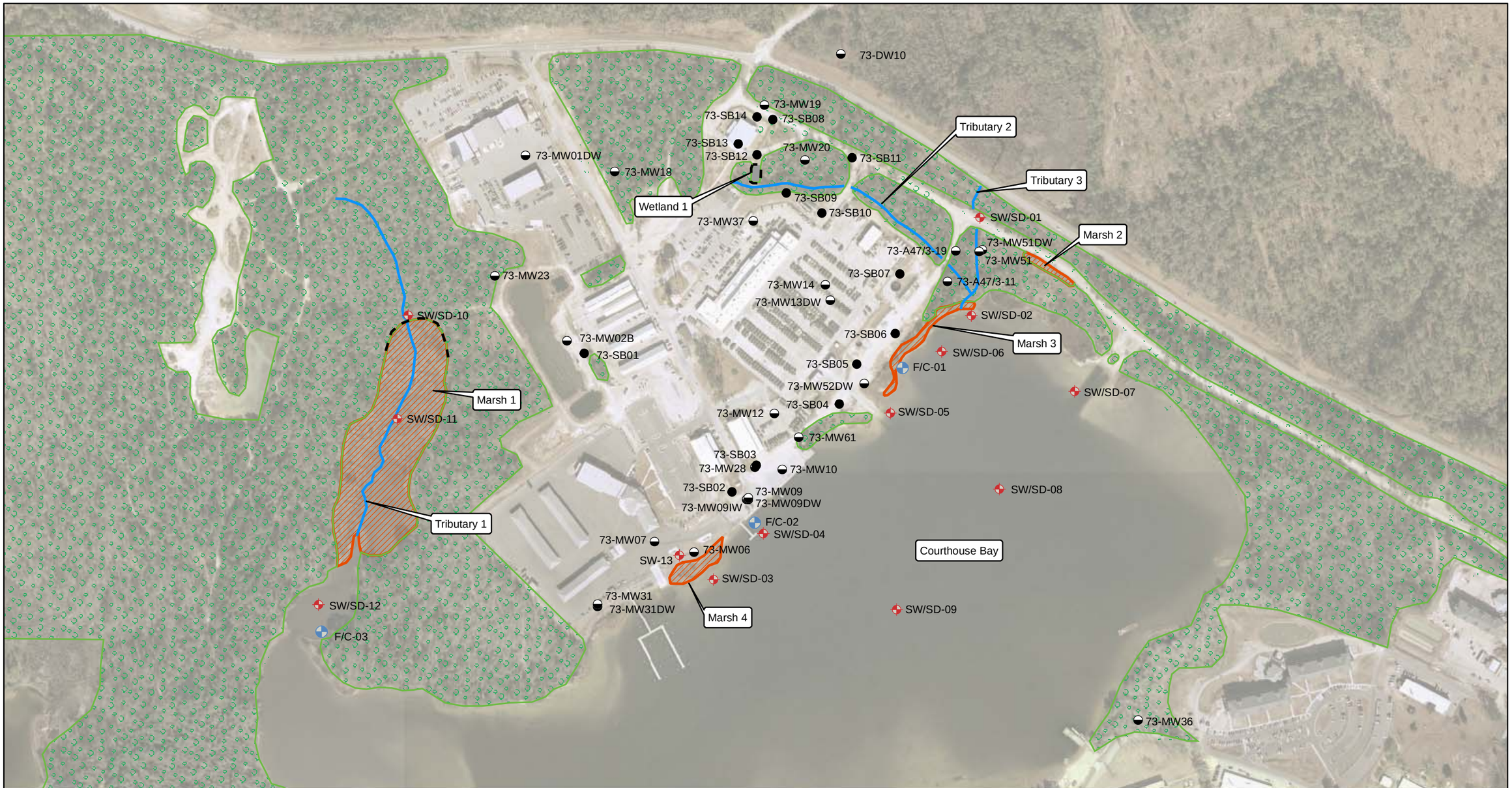
Camp Lejeune, North Carolina

		1995			2006				
Aquifer System	**Analytes**	**MDC (µg/l)**	**Qualifier**	**Location of MDC**	**MDC (µg/l)**	**Qualifier**	**Location of MDC**	**WQC (µg/l)**	**WQC Reference**
	Benzene	18	J	A47/3-08	3.3		IR73-A47/3-9-06B	53	Region IV, 2001
Uppermost Portion of the Surficial Aquifer	Cis-1,2-Dichloroethene	74		73-MW13	52		IR73-A47/3-9-06B	14000	TCEQ, 2006
	Trans-1,2-Dichloroethene	4.5	J	A47/3-09	3.3		IR73-A47/3-9-06B	13500	Region IV, 2001
	Trichloroethene	24		73-MW27	3.1		IR73-A47/3-9-06B	550	TCEQ, 2006
	Vinyl Chloride	23	J	A47/3-08	7.8	J	IR73-GW13-06B	2820	TCEQ, 2006
Lower Surficial Aquifer	Cis-1,2-Dichloroethene	11		73-MW11B	52		IR73-A47/3-9-06B	14000	TCEQ, 2006
	Trichloroethene	31		73-MW11B	3.1		IR73-GW44DW-06B	550	TCEQ, 2006
	Benzene	2.4		73-DW03	8.9		IR73-GW44DW-06B	53	Region IV, 2001
Uppermost Portion of the Castle Hayne Aquifer	Cis-1,2-Dichloroethene	67		73-DW03	1300		IR73-GW49IW-06B	14000	TCEQ, 2006
	Trans-1,2-Dichloroethene	1.8		73-DW03	39	J	IR73-GW49IW-06B	1350	Region IV, 2001
	Trichloroethene	110		73-DW03	840		IR73-GW49DW-06B	550	TCEQ, 2006
	Vinyl Chloride	4	J	73-DW03	130	J	IR73-GW44DW-06B	2820	TCEQ, 2006
	Trichloroethene	320		73-DW03	840		IR73-GW49DW-06B	1350	Region IV, 2001

Notes:

MDC - Maximum Detected Concentration

J - Estimated concentration below the reporting limit and above the method detection limit



Surface Water/Sediment Sample Location
Soil Boring/Monitor Well Location
Soil Boring Location
F/C-01 - BiotaSample

Sample Locations Not to Scale

Forested Area
Marsh Area
Wetland Area
Wetland/Marsh Not Delineated
Tributary

N
W E
S

0 200 400 800
Feet

Figure 1
Site Map
OU No. 9 Site 73
Marine Corps Base, Camp Lejeune
Camp Lejeune, North Carolina

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