

Final Close Out Report

Operable Unit No. 4 - Sites 41 and 74
Marine Corps Base
Camp Lejeune, North Carolina



Prepared for
Department of the Navy
Atlantic Division
Naval Facilities Engineering Command
Norfolk, Virginia

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July 2006

Prepared by

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QC Review Page

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Jacksonville, North Carolina

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Prepared by
CH2M HILL

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Approved by: Christopher Bozzini
Mr. Chris Bozzini, P.E.
Senior Review, CH2M HILL

Date: 7/18/06

Approved by: Matt Louth
Mr. Matt Louth
Activity Manager, CH2M HILL

Date: 7/18/06

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Acronyms and Abbreviations

AOC	Area of Concern
AWQC	Ambient Water Quality Criteria
bgs	below ground surface
CAIS	chemical agent identification sets
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-Term Environmental Action Navy Clean
COC	contaminant of concern
CS	Confirmation Study
CWM	Chemical Warfare Materiel
EPA	U.S. Environmental Protection Agency
ESE	Environmental Science and Engineering, Inc.
FS	Feasibility Study
IAS	Initial Assessment Study
IR	Installation Restoration
LANTDIV	Naval Facilities Engineering Command, Atlantic Division
LTM	Long-Term Monitoring
LUC	Land Use Control
LUCAP	Land Use Control Action Plan
LUCIP	Land Use Control Implementation Plan
µg/L	micrograms per liter
MCAS	Marine Corps Air Station
MCB	Marine Corps Base
MCL	Maximum Concentration Limit
NC DENR	North Carolina Department of Environment and Natural Resources
NCWQS	North Carolina Water Quality Standard
NOAA	National Oceanic and Atmospheric Administration
O&M	Operation and Maintenance
OU	Operable Unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PRAP	Proposed Remedial Action Plan
RAB	Restoration Advisory Board
RAO	Remedial Action Objective
RDX	Royal Demolition eXplosive (cyclotrimethylenetrinitramine)
RI	Remedial Investigation
RL	Remediation Limit
ROD	Record of Decision

TAL	Target Analyte List
TCE	trichloroethene
TCL	Target Compound List
UXO	Unexploded Ordnance
VOC	Volatile Organic Compound

SECTION 1

Introduction

This Final Closeout Report documents all environmental activities for Operable Unit (OU) 4, Sites 41 and 74, at Marine Corps Base (MCB), Camp Lejeune that have been completed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986, and the National Oil and Hazardous Substances Pollution Contingency Plan. This report and the closeout decision is based on the results of a Remedial Investigation (RI), Feasibility Study (FS), Pre-Remedial Action Proposal (PRAP), the Revised Final Record of Decision (ROD), and the completion of the necessary requirements for Long-Term Monitoring (LTM) program as stipulated in the OU 4 ROD.

This document has been prepared by CH2M HILL, Inc., under the Department of the Navy's Comprehensive Long-Term Environmental Action Navy Clean (CLEAN) III contract administered by the Naval Facilities Engineering Command, Mid-Atlantic Division (LANTDIV).

SECTION 2

Overview

This section provides background information, describing site locations and descriptions for the MCB, Camp Lejeune as well as Sites 41 and 74. Investigative activities conducted at these sites are summarized as well.

2.1 Site Location

MCB, Camp Lejeune is located on the coastal plain of North Carolina in Onslow County. The facility is bisected by the New River and encompasses approximately 236 square miles (approximately 40 square miles of this area consists of the New River and its tributaries). The New River flows in a southeasterly direction and forms a large estuary before entering the Atlantic Ocean. The southeastern border of MCB, Camp Lejeune is the Atlantic Ocean shoreline. The western and northeastern boundaries of the base are U.S. Route 17 and State Route 24, respectively. The city of Jacksonville borders MCB, Camp Lejeune to the north (Baker Environmental, Inc., 1995a).

Construction of MCB, Camp Lejeune began in April 1941 at the Hadnot Point Industrial Area, where major functions of the base are still centered today. The facility was designed to be the world's most complete amphibious training Base. The MCB, Camp Lejeune complex consists of six geographical and operational locations under the jurisdiction of the Base Command. These areas include Camp Geiger, Montford Point (which includes Camp Johnson), Courthouse Bay, Main Side, the Rifle Range Area, and the Greater Sandy Run Area. Marine Corps Air Station (MCAS) New River is operationally under the control of MCAS Cherry Point. MCB, Camp Lejeune, however, is responsible for the facilities and environmental management of MCAS New River (Baker Environmental, Inc., 1995a).

OU 4, which consists of Sites 41 and 74, is located in the northwest and northeast portions of the MCB, Camp Lejeune (Figure 2-1). Site 41 is located in the westernmost part of the base near Route 17 and Site 74 on the eastern portion, near Route 24. Site 74 is located in a remote portion of the base in the northeast section. These sites have a reported history of chemical warfare materiel (CWM) disposal. The CWM suspected at MCB, Camp Lejeune is chemical agent identification sets (CAIS). CAIS were produced in large quantities and various configurations by the U.S. Army to train soldiers and sailors in the identification of actual chemical warfare agents and the proper actions upon identification (Baker Environmental, Inc., 1995a). In general, the sets contain vials (ampoules) or bottles of agents. The agents used in these sets could contain blister agents (mustard and lewisite), nerve agents, blood agents (hydrogen cyanide and cyanogens chloride), and choking agents (phosgene). Several types of CAIS exist; however, the type and quantity used at MCB, Camp Lejeune is unknown. A lack of information is evident in regard to the disposal methods associated with the CAIS, particularly as to whether the CWM was destroyed (via burning or detonation) prior to disposal. Existing information, however, mentions the use of drums during disposal (Baker Environmental, Inc., 1995a).

2.2 Site Descriptions

This section provides general physical, hydrologic, geologic, and site use descriptions of Sites 41 and 74.

2.2.1 Site 41

Site 41, the Camp Geiger Dump near the former trailer park, is located east of Highway 17 within the Camp Geiger area of MCB, Camp Lejeune (Figure 2-2). The site encompasses approximately 30 acres and is situated in a topographically elevated area. Most of the site is heavily wooded and vegetated. The surface of the site is littered with construction or demolition debris. Rusted drums, one labeled as “dry cleaning solvent,” were found onsite. Several depressions measuring 5 to 7 feet wide and 2 to 3 feet deep were evaluated by U.S. Army Technical Escort Unit personnel as potentially having been formed by ordnance detonations (Baker Environmental, Inc., 1995a).

Drainage from the site is received by Tank Creek to the south and an unnamed tributary to the north. Two seeps are present at this site and are located along the northern and eastern boundaries of the disposal area. The seeps have an orange-colored appearance resulting from the presence of iron. Water from the seeps flows into the unnamed tributary (Baker Environmental, Inc., 1995a).

Site 41 is underlain by silty sand with discontinuous layers of sand, clayey sand, sandy clay, silt, and clay to a depth between 11 and 29 feet below ground surface (bgs). No continuous, groundwater-retarding layer was encountered beneath the site. The upper unit of the Castle Hayne Aquifer, consisting of shelly sand, was encountered beneath the silty sands. Shallow groundwater flow at the site is radial from the mounded fill area. Groundwater flow within the Castle Hayne Aquifer appears linear and is toward the southeast (Baker Environmental, Inc., 1995a).

From 1946 to 1970, Site 41 was used as an open burn dump. Additionally, the dump received construction debris; petroleum, oil, and lubricant wastes; mirex; solvents; batteries; and ordnance. The ordnance may have been burned prior to disposal but may also be present as unexploded ordnance (UXO). CWM, suspected to be CAIS, was reportedly taken to Site 41 for disposal as well (Baker Environmental, Inc., 1995a). The perimeter of Site 41 has been fenced as part of the MCB, Camp Lejeune’s institutional controls to limit site access (OHM Remediation Services Corp., 1996).

2.2.2 Site 74

Site 74 is located approximately 1/2 mile east of Holcomb Boulevard in the northeast section of MCB, Camp Lejeune (Figure 2-3). This site consists of two areas of concern (AOC) – the former Mess Hall Grease Pit Disposal Area and a former Pest Control Storage Area. Both AOCs are heavily wooded, are overgrown with vegetation, and are flat. Based on historical photographs, the former disposal area encompasses approximately 5 acres and the former pest control storage area less than 1 acre. The areas are separated by a dirt road and are situated approximately 1/4 mile apart. No operational structures associated with these AOCs are located in the area. However, an operational, non-contaminated supply well (HP-654) is located onsite.

Site 74 is underlain by sand and silty sand. No groundwater-retarding layer was encountered beneath the site; however, the subsurface investigations were primarily limited to approximately 20 to 25 feet bgs (Baker Environmental, Inc., 1995a).

The Mess Hall Grease Pit Disposal Area was used from the early 1950s until 1960. Historical photographs of this area depict extensive trenching activities that correspond to the history of this site. No signs of disposal are apparent, except for one area where a small depression in the ground surface was observed. Grease was reportedly disposed of in the trenches, and a volatile substance was sometimes used to ignite the grease (Baker Environmental, Inc., 1995a).

The Former Pest Control Storage Area is believed to have been used for the storage and handling of chemicals for pest control. Historical photographs depict a building that probably served for housing and mixing the pesticides. This building, including the foundation, is currently not discernible. Drums containing polychlorinated biphenyls (PCBs) and pesticide-soaked bags were also reportedly disposed of in trenches. No other information regarding the number or contents of the drums was available, although one internal memorandum reports that drums slated to be taken to Site 69 for disposal were disposed of at Site 74 instead. No other disposal activities are known to have taken place at this site. Contamination at this area is likely a result of routine pesticide storage and handling activities (Baker Environmental, Inc., 1995a).

2.3 Investigative Activities

Basewide environmental investigations began at Sites 41 and 74 in 1983 with the Initial Assessment Study (IAS) conducted by Water and Air Research. The IAS consisted of review of historical records and aerial photo review (Water and Air Research, 1983). The OU 4 sites were identified as areas on base that required further investigative studies. Subsequent investigations at Sites 41 and 74 included: a two-phase Confirmation Study (CS), an RI, and an FS. A pre-RI at Site 74 was also conducted. A PRAP for this OU was issued to solicit public comment on the preferred remedial options considered in the RI/FS reports for this OU. The following subsections provide a summary of these investigations.

2.3.1 Site 41

As discussed above, the conditions at Site 41 have been evaluated through several separate investigative activities, including a groundwater monitoring program. Relevant information associated with these specific events is summarized below and supporting information is contained within Appendixes A, B, and D. A chronological account of these activities is presented in Figure 2-4. This time line provides milestones reached during the 21 years (1984-2005) of environmental activities conducted at this site.

Confirmation Study

A two-part CS was conducted by Environmental Science and Engineering, Inc. (ESE), with the Verification Step being performed in 1984 and the Confirmation Step being conducted from 1986 through 1987 (ESE, 1990). The purpose of the CS, which focused on groundwater,

sediment, and surface water, was to investigate potential contaminant source areas identified in the IAS report. No soil samples were collected.

Four shallow groundwater monitoring wells (24 to 26 feet bgs) were installed in July 1984. At that time, the groundwater samples were analyzed for an abbreviated spectrum of constituents – volatile organic compounds (VOCs), total phenols, organochloride pesticides, mirex, cadmium, chromium, lead, oil and grease, and ordnance compounds. An upgradient well was installed in 1986 and was sampled twice: first with the original wells in January 1987 and again in March 1987. Samples were analyzed for the constituents mentioned earlier but also for hexavalent chromium, tetrachlorodioxin, xylenes, methyl ethyl ketone, and methyl isobutyl ketone. Of the 1984 sample constituents, concentrations of dichlorofluoromethane, vinyl chloride, cadmium, chromium, and lead were found to be above North Carolina Water Quality Standard (NCWQS) limits and/or U.S. Environmental Protection Agency (EPA) Maximum Concentration Limits (MCLs). Other compounds, such as benzene, trans-1,2-dichloroethene, oil and grease, and phenols, were also detected but were not in exceedance of established standards. Samples from 1987 evidenced aldrin, heptachlor, oil and grease, and Royal Demolition explosive (RDX). Detection limits for dichlorofluoromethane, vinyl chloride, and lead were above regulatory limits.

Four surface water and sediment samples were also collected from Tank Creek and an unnamed tributary during the 1987 CS event. Samples were analyzed for the same constituents as groundwater. Methylene chloride, oil and grease, and phenols were detected in all samples. Phenols and aldrin in surface water samples were above North Carolina Surface Water Standards but below federal Ambient Water Quality Criteria (AWQC). Delta-benzene hexachloride was also detected in these samples but not above established standards. Oil and grease, phenols, 2,4,6-TNT, lead, and total and hexavalent chromium were detected in sediment samples but not above established standards. Positive results from the CS sampling events are presented in tabular form in Appendix A. Based on the analytical results, an RI at Site 41 was deemed warranted (Baker Environmental, Inc., 1995a).

Remedial Investigation

The OU 4 Site 41 RI was conducted from January to March of 1994 by Baker Environmental, Inc. The information gathered during this investigation was intended to fill previously existing data gaps identified during the CS to characterize the nature and extent of contamination and to generate information for assessing human health and ecological risks. As part of the RI, a preliminary geophysical survey was conducted to identify possible locations of buried CWM. Soil, sediment, surface water, and groundwater sampling were also conducted. Sampling locations for all media are shown on Figure 2-5. Appendix B provides analytical data summary tables for positive detections in all media for OU 4 RI. (Baker Environmental, Inc., 1995a). The results from this investigation are summarized below.

Surface and subsurface soil samples were collected from 24 test borings and analyzed for full Target Compound List (TCL) and Target Analyte List (TAL) inorganic compounds, chemical surety degradation products, and ordnance constituents. Results from the surface soil sampling showed toluene, polycyclic aromatic hydrocarbons (PAHs), pesticides, Arochlor 1242 and 1260, and some metals (chromium, iron, and vanadium) contamination. Subsurface soils also exhibited PAHs but at lower levels than the surface soils. Benzene,

chlorobenzene, ethylbenzene, trichloroethene (TCE), Arochlor 1254 and 1260, zinc, barium, manganese, arsenic, and lead were detected in the subsurface soils as well (Baker Environmental, Inc., 1995a).

Groundwater samples collected from 12 shallow wells (14 to 21 feet bgs) and six deep wells (42 to 52 feet bgs) exhibited inconsistencies of analytes detected across three sampling rounds. Benzene, chlorobenzene, and several metals were, however, found in the shallow aquifer in both of the first two rounds when samples were analyzed for a full suite of contaminants of concern (COCs) and were present above NCWQS and MCLs. Low levels of pesticides and RDX were also detected but not above regulatory limits. No PCBs or chemical surety degradation compounds were found. Three VOCs were detected in the deep Upper Castle Hayne Aquifer. However, only chloroform was found above the more stringent NCWQS limit. None of these same constituents were detected in other rounds. Iron, manganese, and antimony were detected at or above NCWQS and MCL limits for those constituents in the first two rounds in the deep aquifer (Baker Environmental, Inc., 1995d).

Surface/seep water and sediment samples were collected from 14 locations around Site 41. Surface water samples showed elevated levels of iron, manganese, and lead. Sediment samples contained pesticides above EPA Region IV screening values.

Human health and ecological risk assessments performed for Site 41 showed no areas of concern associated with the sampled media that would require remediation. Human health risks were associated primarily with the possibility of buried CWM. According to the ecological risk assessment, no significant risks to aquatic and terrestrial receptors were detected.

Feasibility Study

Based on the information gathered during the RI at OU 4, Site 41, an FS was conducted from September 1994 through April 1995 by Baker Environmental, Inc., to develop and evaluate remedial alternatives for the site. The results of the baseline human health and ecological risk assessments were evaluated to identify the AOCs within OU 4 that may have warranted remediation or institutional controls to protect public health and the environment. Under the current Site 41 use, groundwater, surface/seep water, and soil (including landfill material) do not present unacceptable risks to human health. However, these media could pose unacceptable future risks. Shallow groundwater and surface/seep water were combined and identified as an AOC at Site 41 because they are thought to be hydraulically connected. Soil and landfill material were combined to form a second AOC. Although none of these media currently present an unacceptable health risk, a future scenario involving residential land use or construction may present such a risk. The suspected presence of UXO and CWM buried at the site also raises concern (Baker Environmental, Inc., 1995b). Selected remedies and costs are discussed in Sections 3.1 and 6.1, respectively.

2.3.2 Site 74

As discussed above, the conditions at Site 74 have been evaluated through several separate investigative activities, including a groundwater monitoring program. Relevant information associated with these specific events is summarized below, and supporting information is contained in Appendices A, B, and F. A chronological account of these investigative

activities for Site 74 is in Figure 2-6. This time line provides milestones reached during the 14 years (1984-1998) of activity conducted at Site 74.

Confirmation Study

A two-part CS was conducted by ESE, with the Verification Step in 1984 and the Confirmation Step from 1986 through 1987 (ESE, 1990). The purpose of the CS was to investigate potential contaminant source areas identified in the IAS report. Only soil and groundwater samples were collected as part of this effort. Soil samples collected at the Pest Control Area were analyzed for organochloride pesticides only. All of the six samples analyzed exhibited 4,4'-DDD, 4,4'-DDE, and/or 4,4'-DDT. Groundwater samples collected from three shallow wells (24 to 26 feet bgs) at various times during the CS were analyzed for organochloride pesticides, chlorinated herbicides, PCBs, tetrachlorodioxin, and VOCs. During the first round of sampling, 4,4'-DDE and 4,4'-DDT were detected, with 4,4'-DDD and methylene chloride detected during the second round. Positive results from the CS sampling events are presented in tabular form in Appendix A of this document (Baker Environmental, Inc., 1995a).

During the Pre-RI conducted at Site 74 in July 1992, groundwater was sampled from two wells, 74GW1 and 74GW2, and analyzed for full TCL VOCs and total and dissolved TAL metals. No organic constituents were detected at that time. Aluminum, barium, iron, magnesium, potassium, and sodium were the only total metals detected. Results did not exceed applicable state or federal criteria, with the exception of iron (301 micrograms per liter [$\mu\text{g}/\text{L}$]), which exceeded the NCWQS of 300 $\mu\text{g}/\text{L}$ (Baker Environmental, Inc., 1995a). Groundwater samples collected from Site 74 during this investigation were used to help characterize site conditions and focus data needs for the RI (Baker Environmental, Inc., 1995d). Positive results from the CS sampling events are presented in tabular form in Appendix A of this document.

Remedial Investigation

The OU 4 RI was conducted from January to March 1994 to fill previously existing data gaps identified during the CS and Pre-RI to better characterize the nature and extent of contamination and to assess the potential human health and environmental risks of OU 4 (Baker Environmental, Inc., 1995a). The RI at Site 74 focused on potential contamination of soil and groundwater at and around the former grease pit disposal area, the pest control storage area, and a potential disposal area due west of the pest control storage area. Limited surface water and sediment samples were also collected. Sampling locations for all media are shown on Figure 2-7. Appendix B presents analytical data tables for positive detections of all media sampled. The results from the RI Report (Baker Environmental, Inc., 1995a) are summarized below.

Surface and subsurface soil samples (between 4 to 19 feet bgs) were collected from 57 locations and analyzed for full TCL organic and TAL inorganic constituents. They were also field screened for munitions constituents by a U.S. Army Technical Escort Unit. Pesticides were detected above base background levels at the former pest control area and were primarily limited to surface soils. Low levels of VOCs (TCE, total xylenes, and toluene) and PAHs were evident at the former grease pit disposal area but their extent was limited. No munitions constituents were detected in soil samples.

Six monitoring wells were installed at Site 74; however, none were installed at the former grease pit disposal area because of the potential for suspected burial of CWM. Groundwater samples were analyzed for full TCL organic and TCL inorganic constituents. A subsequent round of groundwater sampling was conducted in August 1994 at select monitoring wells using low-flow purge techniques to obtain representative groundwater data for total (unfiltered) and dissolved (filtered) metals. Results showed that metals were the primary COCs. Onsite shallow wells exhibited total manganese, lead, and chromium above federal MCLs and NCWQS in only a limited number of wells. Iron, however, exceeded these standards in all wells. Upgradient wells exhibited these constituents at higher concentrations. Results from this sampling event showed much lower total metals concentrations, with iron being the only constituent to exceed its NCWQS and secondary MCL standards.

Three surface water and sediment samples were also collected at Henderson Pond, approximately 0.4 mile from Site 74, and analyzed for the same constituents as soils and groundwater. Results for the surface water samples exhibited metals, but only lead exceeded the federal AWQC. Sediment samples contained low levels of pesticides but at levels below EPA Region IV sediment screening values. TCE was detected in two of the three sediment samples.

Human health and ecological risk assessments performed for Site 74 showed no areas of concern associated with soils that would require remediation. Human health risks were associated primarily with the possibility of buried CWM. There were no significant ecological risks to aquatic and terrestrial receptors.

Feasibility Study

Based on the information gathered during the RI at OU 4, a Site 74 FS was conducted from September 1994 through April 1995 to develop and evaluate remedial alternatives for the site (Baker Environmental, Inc., 1995b). The results of the baseline human health and the ecological risk assessments were evaluated to identify the AOCs within OU 4 that may have warranted remediation or institutional controls to protect the public health and the environment. It was determined that under the current Site 74 use, shallow groundwater and soil (including landfill material) present no unacceptable risks to human health. However, these media could pose unacceptable future risks. Shallow groundwater, which showed elevated total metals, was identified as an AOC at Site 74. Soil and landfill material were combined to form a second AOC. Although this medium currently presents no unacceptable health risk, a future scenario involving residential land use or construction may present such a risk. The suspected presence of CWM within this AOC may also represent a future risk scenario (Baker Environmental, Inc., 1995b). Selected remedies and costs are discussed in Sections 3.2 and 6.2, respectively.

2.4 Other Activities

In 1996, fencing and signs were installed by OHM Remediation Services Corporation around Site 41 to prohibit direct access to the site and protect human health. This action was undertaken because the potential remains for CWM and UXO suspected to be present at the site. A report and photo logs of this work are included as Appendix C.

SECTION 3

Remedial Action Objectives

The Remedial Action Objectives (RAOs) for Sites 41 and 74 were developed during the OU 4 FS (Baker Environmental, Inc., 1995b) and were negotiated for the final revised OU 4 ROD, signed in October 1995 (Baker Environmental, Inc., 1995d). These RAOs are discussed below.

3.1 Site 41 Record of Decision

The primary objective of the selected remedial actions for Site 41 was to address the principal threats associated with the shallow groundwater/seep/surface water and soil/landfill material AOCs as identified in the RI/FS by preventing future potential exposure to these media. The remedies selected for Site 41 were institutional controls and monitoring (Alternative 41GW-2) for the shallow groundwater/seep/surface water AOC and institutional controls (Alternative 41SO-2) for the soil/landfill material AOC. The institutional controls components of the selected remedies for these media of concern included: designating the site as a restricted or limited-use area in the Base Master Plan; prohibiting invasive construction or residential use of the site; restricting groundwater usage and prohibiting the installation of any new potable water supply wells within 500 feet of the site; and implementing a long-term monitoring program to track the groundwater quality of existing site monitoring wells. Under Alternative 41GW-2, a groundwater, surface water, and sediment monitoring program were implemented to observe contaminants over time (Baker Environmental, Inc., 1995d).

The ROD identifies institutional controls and the implementation of an LTM program as the selected remedy for the shallow groundwater/seep/surface water AOC and institutional controls for the soil/landfill material AOC. Final remediation limits (RLs) associated with the Site 41 groundwater COCs (as expressed in micrograms per liter [$\mu\text{g/L}$]) were established in the ROD and are presented in Table 3-1. No COCs or RLs were set for any other media.

TABLE 3-1
Remediation Levels for Groundwater at OU 4, Site 41

Contaminants of Concern	Remediation Level ($\mu\text{g/L}$)
Arsenic	50
Beryllium	4
Cadmium	5
Chromium	50
Lead	15
Nickel	100

3.2 Site 74 Record of Decision

The primary objective of the selected remedial actions for Site 74 was to address the principal threats associated with the groundwater and soil/landfill material AOCs by preventing future potential exposure to these media. The remedies selected for Site 74 were institutional controls and monitoring (Alternative 74GW-2) for the shallow groundwater AOC and institutional controls (Alternative 74SO-2) for the soil/landfill material AOC. The major components of the selected remedies for these media of concern included: designating the site as a restricted area in the Base Master Plan; prohibiting invasive construction or residential use of the site; restricting groundwater usage and prohibiting the installation of any new potable water supply wells within 500 feet of the site; and implementing an LTM program to monitor the groundwater quality of existing site monitoring wells. No COCs or RLs for any media were specified in the ROD for Site 74 (Baker Environmental, Inc., 1995d).

Remedial Actions

The remedial action alternative selected for and documented in the OU 4 ROD for all AOCs for overall protectiveness to prevent future potential exposure is institutional controls. These controls include long-term monitoring of those media and COCs described in the OU 4 ROD and land use controls (LUCs). The remedial actions are discussed below by site.

4.1 Site 41

4.1.1 Long-Term Monitoring

The LTM program began at Site 41 in February 1997 and initially included the sampling of five monitoring wells and eight surface water and sediment locations on a semi-annual basis. Changes that were necessary throughout the life of the LTM program were recommended to and agreed to by the MCB, Camp Lejeune Partnering Team (Partnering Team). This team consisted of representatives from the Base, EPA, North Carolina Department of Environmental Protection (NC DENR), and LANTDIV. The LTM program at this site was conducted by Baker Environmental, Inc., from February 1997 through June 2002. Engineering and Environment, Inc. continued in Baker Environmental, Inc.'s stead from July 2002 to June 2005. Monitoring reports were prepared after each semi-annual sampling event that tracked and documented the progression of the LTM program over time. The most recent Annual Monitoring Report for OU 4, Site 41, Reporting Period July 2004–June 2005 (ESE, 2005) serves as the final LTM monitoring report and gives a complete description of LTM activities for Site 41. This report is included in Appendix D of this document. OU 4 Site 41 was removed from the MCB, Camp Lejeune LTM program after the January 2005 sampling and was moved toward site closeout because the remedial goals, as set forth in the OU 4 ROD, had been achieved, as concluded by the Partnering Team.

The following subsections provide supporting evidence that the remedial goals of LTM at Site 41 have been achieved and are discussed by medium below. Figure 4-1 shows all of the LTM sampling locations at Site 41.

Groundwater

When groundwater portion of the LTM sampling began at Site 41, samples were analyzed for TCL VOCs, TAL metals, total dissolved solids, and total suspended solids. Of four shallow wells (41-GW02, 41-GW10, 41-GW11, and 41-GW12) and one deep well (41-GW-11DW) sampled during the very first round of the program, only two VOCs, benzene and chlorobenzene, were detected in one well, 41-GW11. Benzene, detected at 4J $\mu\text{g}/\text{L}$, exceeded the NCWQS of 1 $\mu\text{g}/\text{L}$ but did not exceed the MCL of 5 $\mu\text{g}/\text{L}$. Chlorobenzene (3J $\mu\text{g}/\text{L}$) did not exceed either standard (50.0 $\mu\text{g}/\text{L}$ NCWQS, 100.0 $\mu\text{g}/\text{L}$ MCL). No RL had been set in the OU 4 ROD for VOCs. Aluminum, iron, lead, and manganese were detected at or above NCWQS or MCL in most of the wells. Of the metals, only lead had a ROD RL (15 $\mu\text{g}/\text{L}$). Throughout the entire the LTM program at Site 41, only benzene and lead were consistently

detected in monitoring well 41-GW11 at or above the NCWQS and/or MCLs (Baker Environmental, Inc., 1997).

As the LTM program continued at Site 41, groundwater monitoring wells and/or COCs were gradually eliminated from the program, as decided by the Partnering Team. The rationale behind the eliminations were based on one of two reasons: 1) over several consecutive sampling events either no COCs were found in the samples or the COCs were found at levels below the NCWQS, MCLs, or ROD RL; or 2) no established RL was set forth in the ROD for a particular COC. On the basis of non-detects for COCs, wells 41-GW02 and 41-GW10 were eliminated after the December 2000 sampling event and, therefore, were not sampled during or after June 2001. The sampling scheme was also changed at that time for the remaining wells: 41-GW11 (TCL VOCs and lead only), 41-GW11DW (TCL VOCs only), and 41-GW12 (TCL VOCs). Wells 41-GW11DW and 41-GW12 were eliminated after the December 2002 sampling event based on COC non-detects. No changes to the program were made in 2003 because well 41-GW11 was the only well being sampled and the groundwater was being analyzed for lead and TCL VOCs.

During 2003, the lead levels spiked from a fairly consistent level of 16.6 µg/L to 499 µg/L and 542 µg/L for the January and July sampling events, respectively. Based on the 2002 Base Background Groundwater Study, the average lead concentration in background groundwater is 30.9 µg/L. Before undertaking the January 2004 sampling, the Partnering Team decided that wells 41-GW01, -02, -03, and -09 would be temporarily returned to the LTM program for 2004. During this 1-year period, these wells were tested for lead to establish whether the 2003 lead results were anomalous or a new data trend and whether lead could be migrating offsite. Additional, non-scheduled sampling of these wells was also conducted in April and October, with well 41-GW11 being sampled as well. Lead was detected only in well 41-GW11 during these four sampling rounds, with 2004 results ranging from 6.4 µg/L to 22.7 µg/L.

Based on the 2004 sampling results, the Partnering Team concluded that no lead was migrating from Site 41. Figure 4-2 illustrates the lead concentrations in this well through time. Also during 2004, the Partnering Team decided to move toward Site 41 closeout. As a precursor to closeout during the July 2004 sampling round, groundwater samples were also analyzed for CWM, CWM degradation products, and explosive constituents, and none of were being detected. The January 2005 sampling result for lead in well 41-GW11 was 3.4 µg/L, which was below both the RL set in the OU 4 ROD and base background levels.

As previously mentioned, benzene had been detected at or above NCWQS (1 µg/L) or MCL (5 µg/L) in well 41-GW11 since the LTM program began in 1997. This COC has been found in 13 of 17 sampling events in amounts ranging from 1 to 5J µg/L. The most recent of several non-detect results for benzene was from the January 2005 sampling. Figure 4-3 illustrates the benzene concentrations in this well through time. While these levels exceeded the standards, no RL was stipulated for benzene in the OU 4 ROD. Additionally, only samples collected from this well, which is situated in the center of the site, have consistently shown this COC, whereas shallow wells at the site perimeter have not. Based on this information, the Partnering Team concluded that Site 41 should be moved to closeout. A more-detailed discussion regarding benzene and lead levels at Site 41 can be found in the July 2004–June 2005 Annual Monitoring Report in Appendix D of this document.

Surface Water

Initial Site 41 LTM program surface water samples were collected from eight locations: three each from Tank Creek (41-TC-SW10, 41-TC-SW11, 41-TC-SW12) and an unnamed tributary to Tank Creek (41-UT-SW01, 41-UT-SW02, 21-UT-SW03), and one each from two separate drainage ditches (41-DD-SW01, 41-DD-SW02). Samples were analyzed for TCL VOCs and TAL metals. No VOCs were detected in any of the samples. Of the metals, iron (up to 3,510 µg/L in four locations), lead (up to 2.6 µg/L in seven locations), and zinc (up to 99.4 µg/L in one location) were detected at or above the North Carolina Class C Nutrient Sensitive Water Standards or the EPA Region IV Freshwater Aquatic Life Criteria (Baker Environmental, Inc., 1997).

Since that first sampling event at Site 41, surface water sampling locations were eliminated based on non-detection of COCs or reduced to a limited suite of analytes at some locations. After six sampling events (through December 2000), all but locations 41-TC-SW12 and 41-UT-SW01 were eliminated. EPA Region IV Surface Water criteria for lead had not been exceeded in Site 41 samples since July 2000. These findings suggest that groundwater at the site was not affecting the surface water and/or drainage ditches at Site 41 and that contaminants are not being transported offsite via surface water (CH2M HILL, Inc., and Baker Environmental, Inc., 2001). These locations were thereafter (June 2001) analyzed for lead only until the LTM program at Site 41 was terminated as recommended by the Partnering Team.

Sediment

Eight sediment samples were collected from Site 41 in locations corresponding to surface water locations. Like the surface water samples, sediment samples were analyzed for TCL VOCs and TAL metals. Only one VOC, 2-butanone, a common laboratory contaminant, was found in only one sample (8 micrograms per kilogram at 41-TC-SD10) during the initial sampling round. Although metals were found in all samples, none exceeded their comparison criteria (Baker Environmental, Inc., 1997).

Sediment sampling locations and analytes were reduced for the June 2001 and subsequent LTM events. Of the eight locations, only one sample was collected from one location, 41-DD-SD02, for limited analysis (cadmium, chromium, lead, and nickel) until the LTM program ceased at Site 41. These metals were detected infrequently and concentrations have been at or below the EPA Region IV or National Oceanic and Atmospheric Administration screening values. These detections are believed to be the result of natural acidic soil conditions at the site. Further, these constituents are not being transported offsite, as evidenced by the non-detections at downgradient locations (CH2M HILL, Inc., and Baker Environmental, Inc., 2001).

4.1.2 Land Use Controls

Site-specific LUCs have been implemented at Sites 41 and 74 to ensure that the selected remedies required by the Final ROD are protective of human health and the environment. These LUCs at both Sites 41 and 74 consist of prohibiting the installation of potable water supply wells within a 500-foot radius of the sites and restricting invasive activities and development in the same area. These controls, as stipulated in the ROD, are implemented through a Land Use Control Implementation Plan (LUCIP) and are evaluated and updated

annually in the Site Management Plan (CH2M HILL, Inc., and Baker Environmental, Inc., 2005). This site is also listed in the Base Master Plan and the LUCs boundaries have been recorded in the Onslow County deed office.

The LUCs restricting invasive activities is of particular importance at Site 41 because of the potential for CWM to have been disposed of and left in place at this site, as previously discussed in Section 2 of this report. Site 41 has been included in the U.S. Army's Site Tracking System for potential buried CWM. It is the Army's responsibility to identify and provide centralized management for Department of Defense non-stockpile CWM disposal areas. Additional information regarding this program is included as Appendix E of this document.

4.2 Site 74

4.2.1 Long-Term Monitoring

The LTM program began at Site 74 in February 1997 and included the sampling of four shallow monitoring wells on a semi-annual basis. Figure 4-4 shows the LTM sampling locations at Site 74. Metals were identified as the COCs and samples were, therefore, analyzed for TAL metals as well as for total dissolved solids and total suspended solids.

Semi-annual and annual monitoring reports that track and document the progression of the LTM program over time have been prepared after each sampling event. Analytical results from three rounds of sampling (February 1997 through January 1998) showed iron above the established 300 µg/L NCWQS limits. No RLs were established for this or any other constituent in groundwater for Site 74. Iron and other metals results are indicative of rich, naturally occurring metals found in the acidic soils of the North Carolina Coastal Plain Physiographic Province (CH2M HILL, Inc., and Baker Environmental, Inc., 2001).

Based on this evidence, in 1998, a recommendation to remove Site 74 wells from the LTM Program was made to and accepted by EPA Region IV and the NC DENR. The Final Monitoring Report for OU 4 Site 74, which includes data collected for Site 74, is provided in Appendix F of this document.

4.2.2 Land Use Controls

LUCs specific to Site 74 as documented within the LUCIP have been implemented. These institutional controls, as stipulated in the OU 4 ROD, prohibit invasive activities and the development of the site and restrict the use of the groundwater as a potable water supply. These controls are implemented through an LUCIP and are evaluated and updated annually in the Site Management Plan (CH2M HILL, Inc., and Baker Environmental, Inc., 2005). This site is also listed in the Base Master Plan and the LUCs boundaries have been recorded in the Onslow County deed office.

The LUCs restricting invasive activities is of particular importance at Site 74 because of the potential for CWM to have been disposed of and left in place at this site, as previously discussed in Section 2 of this report. Site 74 has been included in the U.S. Army's Site Tracking System for potential buried CWM. It is the Army's responsibility to identify and provide centralized management for Department of Defense non-stockpile CWM disposal

areas. Additional information regarding this program is included as Appendix E of this document.

SECTION 5

Demonstration of Completion

Past investigations at Sites 41 and 74 (IAS, CS, Pre-RI, RI) focused on evaluating the extent and the potential for cleanup of contamination. The FS, PRAP, ROD, and LTM reports were prepared in accordance with the data from these investigations to evaluate measures protective of human health and the environment at this OU. A brief summary of the information and data gathered from the sampling at OU 4 to demonstrate protectiveness of human health and the environment and the completion and closeout of these sites is presented below.

5.1 Site 41

The LTM program conducted at Site 41 from February 1997 through January 2005 initially involved the sampling of five monitoring wells (four shallow and one deep) and eight surface water and sediment locations on a semi-annual basis. RLs were set in the OU 4 ROD for groundwater only and included only six metals as COCs. Changes to the LTM program, mainly the elimination of analytes and sampling locations, were necessary throughout the life of the LTM program and were recommended to and agreed to by the Partnering Team. OU 4 Site 41 was removed from the LTM program after the January 2005 sampling and was moved toward site closeout because the remedial goals as set forth in the OU 4 ROD had been achieved, as concluded by the Partnering Team.

Initial Site 41 LTM groundwater analytes included VOCs and TAL metals. Over the life of this program, constituents have been detected in the central portion of the site within the former dump area. Of these detections, lead and benzene have been in evidence more regularly, but not consistently. Of the 14 monitoring wells in and around the approximately 1.4-acre site, only groundwater from well 41GW-11 exhibited lead or benzene above the background levels or NCWQS limits.

Because of the sporadic detections of lead in groundwater, specifically at well 41GW-11, results for this constituent were compiled and evaluated for trends through the entire Site 41 LTM program. During this time frame (February 1997 to January 2005), 19 sampling events were conducted. Data trend factors that may have influenced the lead concentrations in the groundwater from this well, such as groundwater elevations, seasonal variations, and stratigraphy, were also evaluated. Although some trends appeared to be associated with groundwater elevation (July 2001 to July 2003 - as groundwater elevation went down, lead concentrations went up), no other relationship could be determined. Data for lead were also examined to ascertain whether sampling in the summer (July) versus the winter (January) may have been a factor in concentration levels detected. With the exception of 2003, when both seasonal detections were high, the summer lead concentrations were consistently lower than those of the winter sampling events. During the winter, there tends to be less recharge to the aquifer at MBC Camp Lejeune. When recharge slows down, lead may be more likely to be concentrated in the groundwater because of dissolution of any lead found in the solid matrix (ESE, 1990). Although the OU 4 RL for lead is 15 µg/L, lead

concentration in background groundwater at the site is 30.9 µg/L, according to the *Base Background Groundwater Study* (Baker Environmental, Inc., 2002). This is the average concentration plus two standard deviations and is agreed to be an acceptable lead concentration. Although these results were above the RL standard, the acidic soils of the North Carolina Coastal Plain are found to contain high levels of naturally occurring metals and are thought to contribute to the higher background levels of these constituents in groundwater at MCB, Camp Lejeune. When compared to the average background concentration of 30.9 µg/L, only 3 out of 19 samples collected from well 41GW-11 exceeded this value. These levels may have been the result of high turbidity in the samples. Additionally, results from other wells around the perimeter of the site over the course of the sampling program have not shown COCs above detection limits or were found at levels well below regulatory standards. It can, therefore, be reasonable to state that no lead plume is emanating from this site. Surface water and sediment sample results support this and will be discussed further in this section.

Since 1997, Site 41 benzene results for groundwater have ranged from non-detect to 5J µg/L (NCWQS of 1 µg/L and MCL of 5 µg/L) in well 41GW-11. The last sample taken from this well for the LTM program (January 2005) exhibited a non-detect for this constituent. While some of the benzene results exceeded the NCWQS/MCL standards, no RL was set for benzene in the OU 4 ROD. As mentioned previously, this well is located in the middle of the site. Results from other wells around the perimeter of the site over the course of the sampling program have not shown benzene above detection limits. Therefore, there is no evidence that this or other hazardous constituents are moving offsite laterally. Additionally, no VOCs have been detected in groundwater samples from the deep well, 41GW-11D. This is, therefore, evidence that no downward migration into the Upper Castle Hayne Aquifer is occurring, and it is reasonable to state that no benzene plume is emanating from this site. Surface water and sediment sample results support this and will be discussed below.

Initial Site 41 LTM program surface water samples were collected from eight locations in two creeks and two drainage ditches around the site. Samples were analyzed for VOCs and TAL metals. RLs were not established in the OU 4 ROD for this medium. No VOCs were detected in any samples, and iron, lead, and zinc were the only constituents detected at or above the North Carolina Class C Nutrient Sensitive Water Standards or the EPA Region IV Freshwater Aquatic Life Criteria in the initial samples collected (Baker Environmental, Inc., 1997). After six sampling events, all but two surface water sampling locations were eliminated and of those locations, samples were analyzed for a limited suite of constituents. Since July 2000, EPA Region IV Surface Water Criteria for lead has not been exceeded in Site 41 samples. These findings show that constituents from Site 41 are not migrating offsite via groundwater or affecting surface water.

Eight sediment samples were collected from Site 41 for the LTM program in locations corresponding to surface water sampling locations. Samples were analyzed for VOCs and TAL metals. No RLs were set for this medium in the OU 4 ROD. One common VOC laboratory contaminant (2-butanone) was found in one of the initial samples, but no other VOCs were detected in any sample thereafter. Metals were not found to exceed their comparison criteria. From June 2001 until the LTM program ceased at Site 41, only one location (41-DD-SD02) was sampled, and it was analyzed for four metals only (cadmium, chromium, lead, and nickel). These constituents were detected infrequently, were not found

above comparison criteria, and may be attributable to the high metals concentrations in area soils. These data support previous conclusions that there is no offsite migration or negative impact from groundwater at Site 41.

As a precursor to final closeout of this site, additional sampling of seven monitoring wells was conducted in July 2004 to test for CWM constituents, their breakdown products, and explosives. None of these analytes were detected.

The OU 4 LUCIP was completed in 2001. The LUC maps demarcating the control boundaries for Site 41 were established at that time as well. These boundaries are shown on Figure 5-1, and the estimated acreages of these boundaries are presented in Table 5-1. Sites are inspected quarterly in accordance with the Land Use Control Action Plan (LUCAP) to ensure that no violations of LUCs have occurred. OU 4-specific controls were negotiated into the ROD. Institutional controls at this site were also part of the remedies selected for the Site 41 shallow groundwater/seep/surface water AOC as well as the soil/landfill material AOC. These controls, which consist of restricting land and groundwater use and prohibiting invasive construction and residential site use, have been implemented. The Site 41 LUCs are currently in place and remain protective of human health and the environment and are consistent with the requirements outlined in the OU 4 ROD.

TABLE 5-1
LUCIP Boundaries at OU 4, Sites 41

LUCIP Boundary	Estimated Area (acres)
Non-Industrial Land Use Control	36.6
Intrusive Activities-Groundwater	16.4
Intrusive Activities-Soil	36.6
Aquifer Restriction (500 feet)	86.4
Access Control Boundary	30.0

Source: CH2M HILL, Inc., and Baker Environmental, Inc., 2005

Based on the successful application and completion of the required remedies, as stipulated in the OU 4 ROD for Site 41, the Partnering Team concluded that the remedial actions taken are protective of human health and the environment and have achieved the RAOs set out in the OU 4 ROD. Site 41 was therefore moved to closeout.

5.2 Site 74

Two AOCs at Site 74, shallow groundwater and soil/landfill material, were identified in the OU 4 ROD as requiring remedial action. Remedies selected for the AOCs at this site, as previously mentioned in Section 3 of this document, were institutional controls and monitoring for the shallow groundwater AOC, Alternative 74GW-02, and institutional controls for the soil/landfill material AOC, Alternative 74SO-02. No RLs were set in the ROD for any media at Site 74, although metals were identified as COCs in shallow groundwater.

As required under the ROD, shallow groundwater monitoring began at Site 74 under the LTM program in 1997 and was conducted on a semi-annual basis. Of the constituents for which the samples were analyzed, only iron exhibited levels greater than its NCWQS (300 µg/L) limit. Iron results ranged from non-detect to 1,900 µg/L. However, the acidic soils of the North Carolina Coastal Plain are found to contain high levels of naturally occurring metals and are thought to contribute to the higher background levels for these constituents in groundwater at MCB, Camp Lejeune. This is evidenced by the metals found in background shallow groundwater samples taken as part of the 2002 *Base Background Groundwater Study* (Baker Environmental, Inc. 2002), in which iron background levels ranged from 140 to 32,700 µg/L. Therefore, because the levels of iron are not uncharacteristic of the site geology and no RAOs were established, the Partnering Team decided that Site 74 should be removed from the LTM program after three rounds of sampling.

The OU 4 LUCIP was completed in 2001. The initial LUC maps demarcating the control boundaries for Site 74 were established at that time as well. These boundaries are shown on Figure 5-2, and the estimated acreages of these boundaries are presented in Table 5-2. Sites are inspected quarterly in accordance with the Land Use Control Action Plan (LUCAP) to ensure that no violations of LUCs have occurred. OU 4-specific controls were negotiated into the ROD. Institutional controls at this site were also part of the remedy selected for the Site 74 shallow groundwater AOC as well as the soil/landfill material AOC. These controls, which consist of restricting land and groundwater use and prohibiting invasive construction and residential site use, have been implemented. The Site 74 LUCs are currently in place and remain protective of human health and the environment and are consistent with the requirements outlined in the OU 4 ROD.

TABLE 5-2
LUCIP Boundaries at OU 4, Sites 74

LUCIP Boundary	Estimated Area (acres)
Non-Industrial Land Use Control	23.8
Intrusive Activities-Groundwater	13.9
Intrusive Activities-Soil	23.8
Aquifer Restriction (500 feet)	71.2
Access Control Boundary	8.0

Source: CH2M HILL, Inc., and Baker Environmental, Inc., 2005

Based on the successful application and completion of the required remedies, as stipulated in the OU 4 ROD for Site 74, the Partnering Team concluded that the remedial actions taken are protective of human health and the environment and had achieved the RAOs set out in the OU 4 ROD. Site 74 was therefore moved to closeout.

SECTION 6

Summary of Remediation Costs

This section presents the cost of remedial alternatives for Sites 41 and 74, as detailed in the OU 4 FS and stipulated in the OU 4 ROD.

6.1 Site 41

The remedy selected for the groundwater/seep/surface water AOC was institutional controls and monitoring (Alternative 41GW-2). The institutional controls consist of groundwater use restrictions set in the Base Master Plan that prohibit intrusive activities such as the installation of potable water supply wells within a 500-foot radius of Site 41. Monitoring activities under the LTM program of groundwater, seep surface water, and sediment were initiated for this AOC within 1 year of the ROD implementation. Sampling was conducted on a semi-annual basis. The selected remedy for the soil/landfill material AOC was institutional controls (Alternative 41SO-2). These controls, which are included in the Base Master Plan, restrict future land use of and invasive construction at the site.

Costs associated with these remedies were estimated to total \$592,000 (present net worth-1995) over a 30-year period for the groundwater/seep/surface water Alternative 41GW-2 with essentially no capital or operation and maintenance (O&M) for Alternative 41SO-2 (Baker Environmental, Inc., 1995b).

6.2 Site 74

The remedy selected for the groundwater AOC was institutional controls and monitoring (Alternative 74GW-2). The institutional controls consist of groundwater use restrictions set in the Base Master Plan that prohibit the installation of potable water supply wells within a 500-foot radius of Site 74. Monitoring activities for groundwater were initiated for this AOC within 1 year of the ROD implementation. Sampling was conducted on a semi-annual basis under the LTM program. The selected remedy for the soil/landfill material AOC was institutional controls (Alternative 74SO-2). These controls, which are included in the Base Master Plan, restrict future land use of and invasive construction at the site.

Costs associated with these remedies were estimated to total \$342,000 (present net worth-1995) over a 30-year period for the groundwater Alternative 74GW-2 with essentially no capital or O&M for the 74SO-2 alternative (Baker Environmental, Inc., 1995b).

SECTION 7

Ongoing Activities

As previously discussed, Sites 41 and 74 have been designated as restricted use/access areas because of the potential presence of CWM remaining onsite. Because of this, there are ongoing activities involving OU 4 – specifically, the inspection and updating of the sites with respect to LUCs and including the sites in the MCB Camp Lejeune CERCLA Five-Year Plan.

The initial LUC for MCB, Camp Lejeune were implemented in 1999. Site-specific LUCs for OU 4 are documented in the LUCAP and LUCIP completed in 2001. The annual certification of site-specific LUC maps for boundary modification is ongoing.

In 1999, the initial CERCLA Five-Year Review was conducted for all MCB, Camp Lejeune sites. The Five-Year Review is conducted in line with procedures detailed in the NCP and CERCLA. A Five-Year Review is required for a CERCLA site if: 1) a remedial action results in hazardous substances, pollutants, or contaminants remaining at a site; or 2) the ROD was signed on or after October 17, 1986. The Five-Year Review document was submitted to, reviewed, and approved by EPA and NC DENR. The complete document can be referenced as part of the Administrative Record files for MCB, Camp Lejeune. The most recent Five-Year Review was completed in 2005.

SECTION 8

Community Relations

There has been and continues to be several ways through which MCB, Camp Lejeune has communicated with the local and regulatory communities to inform, negotiate, and build consensus for public health issues and environmental actions. These have included the preparation of documents such as a Basewide community relations plan and site-specific PRAP, the community relations interviews associated with these plans, the establishment of the OU 4 Administrative Record files, and the formation of working groups such as the Installation Restoration (IR) Partnering Team and Restoration Advisory Board (RAB). The Base has also sponsored self-guided public tours, tours of IR sites for university students, and open houses to disseminate information, foster understanding, and improve communication.

The Basewide community relations/community involvement plan was initially issued in 1990 to promote and improve communication between the Base and the at-large community. This document was updated as recently as 2005. A PRAP (Baker Environmental, Inc., 1995c) describing the preferred remedial options from the OU 4 RI/FS was issued in May 1995 to identify the preferred alternatives for remedial actions at the sites and to solicit public review and comment. Public participation was also solicited as the ROD for OU 4 was being drafted. These and other documents pertinent to OU 4 CERCLA process are available in the Administrative Record files established for OU 4.

The IR Partnering Team was established to facilitate innovative, cost-effective, and safe ways to clean up sites on the Base that pose a threat to public health and the environment. The team is comprised of personnel from NAVFAC Mid-Atlantic, MCB, Camp Lejeune; EPA; NCDENR; and the Base's environmental support contractors. It also utilizes the RAB to advance the Base's work within the community.

The MCB, Camp Lejeune RAB was formed in 1996 to increase public awareness and interest in environmental restoration, thereby facilitating the execution of human health and environmental remedies at the Base. It is an advisory board made up of community members, local environmental group members, and state and federal officials. The RAB is designed to function as a focal point for the exchange of information between the Base and the local community regarding environmental restoration activities. The RAB focuses on developing a strong relationship with the local residents and environmental groups. These relationships are the foundation for fostering trust and creating an effective environmental community relations program (<http://lejeune.lantops-ir.org/sites/pmweb/PublicOutreach.aspx>, accessed 06/06/06). The RAB meets once a quarter.

SECTION 9

Certification Statement

On behalf of the U.S. Department of the Navy and Marine Corps, I certify that this document memorializes the completion of the remedial action objectives identified in the Revised Final Record of Decision for Operable Unit 4, Sites 41 and 74, signed on October 17, 1995.

Mr. Daniel Hood Date
Remedial Project Manager
Naval Facilities Engineering Command, Mid-Atlantic

Mr. Robert Lowder Date
Installation Restoration Program Manager
Marine Corps Base, Camp Lejeune

Based on the information included in this *Final Closeout Report – Operable Unit 4*, EPA concurs that the remedial action has been completed to meet the remedial action objectives and that this document memorializes the remedial action completion.

Ms. Gena Townsend Date
Remedial Project Manager
U.S. Environmental Protection Agency

Based on the information included in this *Final Closeout Report – Operable Unit 4*, the State of North Carolina concurs that the remedial action has been completed to meet the remedial action objectives and that this document memorializes the remedial action completion.

Mr. Randy McElveen Date
Remedial Project Manager
North Carolina Department of Environment and Natural Resources

SECTION 10

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Figures

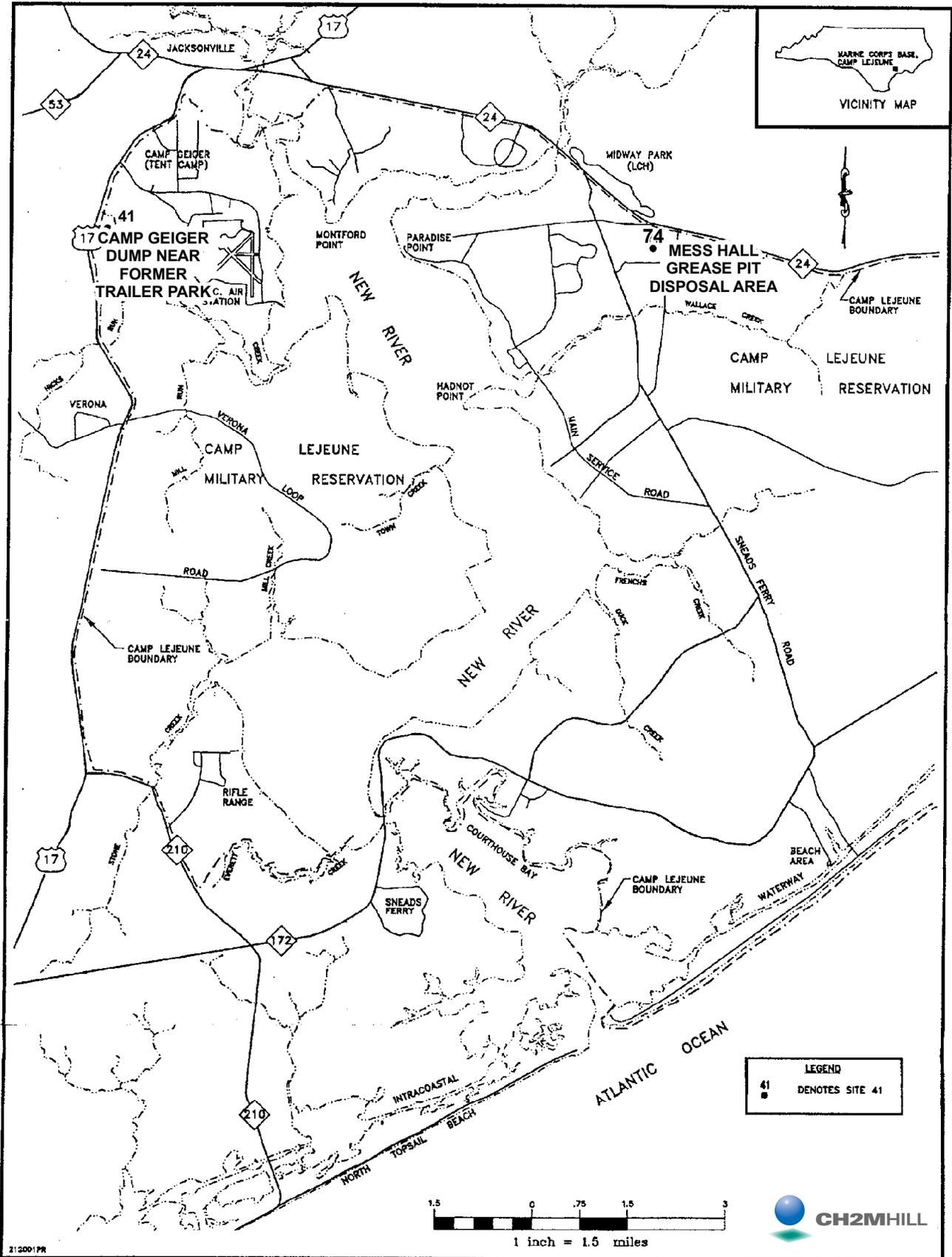
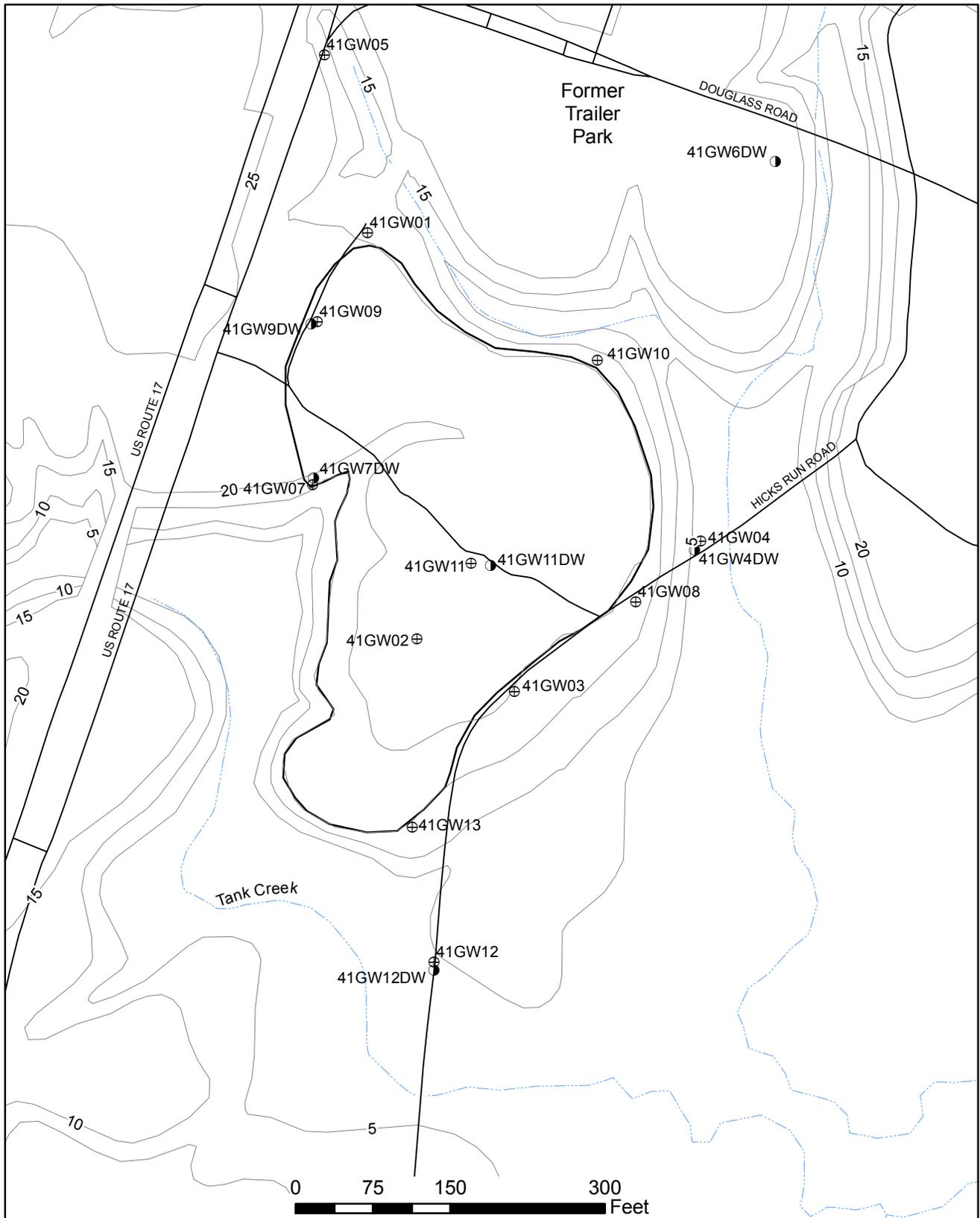


FIGURE 2-1
 OPERABLE UNIT 4
 SITES 41 AND 74
 OU4 CLOSE OUT REPORT
 MARINE CORPS BASE, CAMP LEJEUNE
 NORTH CAROLINA



212001PR



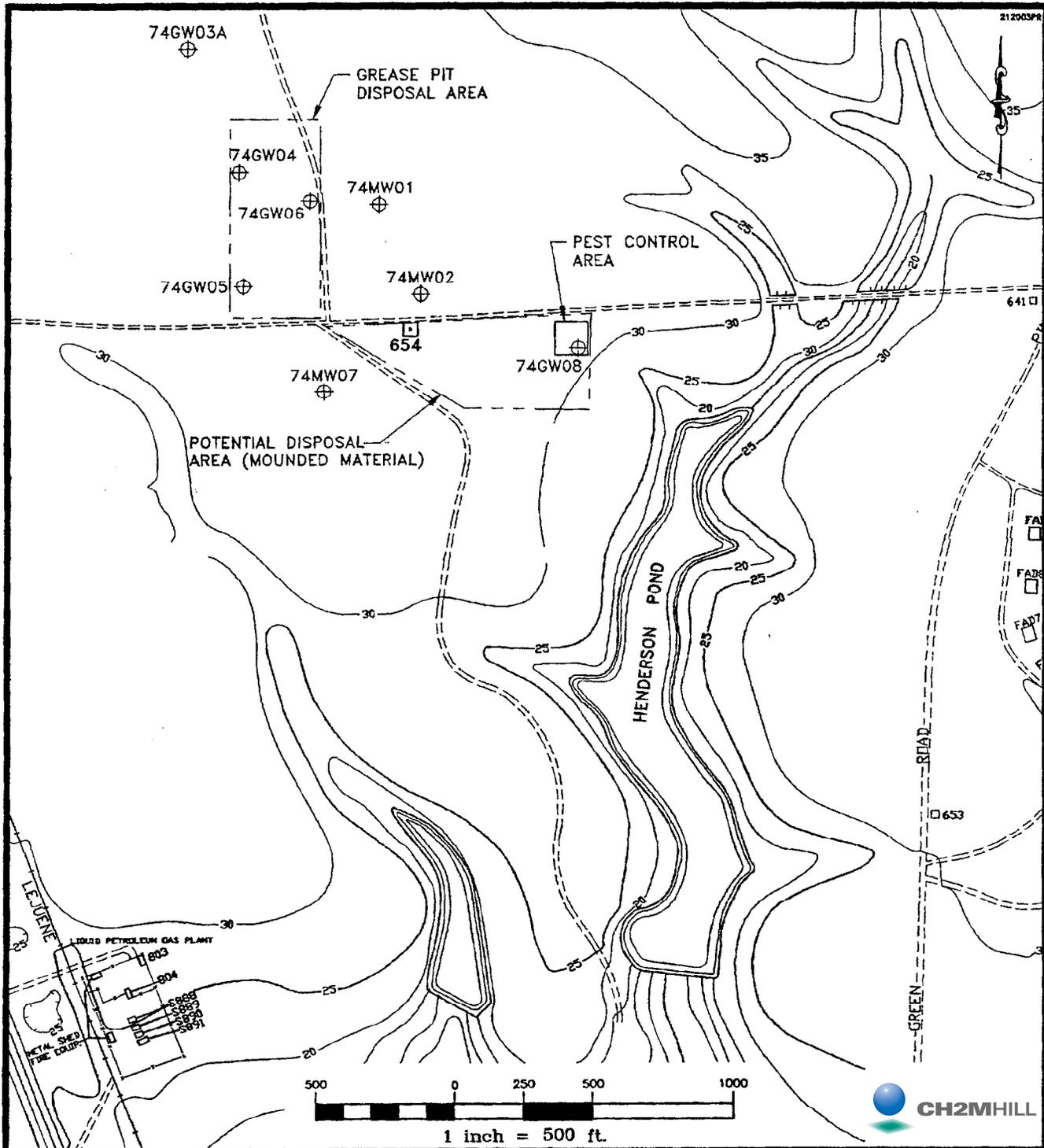
Legend

- Deep Monitoring Well Location
- ⊕ Shallow Monitoring Well Location
- - - Intermittent Stream
- Road
- Topographic Elevation Line
- ▭ Approximate Disposal Area Boundary



Baker Environmental Inc. 1995A

FIGURE 2-2
OPERABLE UNIT 4
SITE 41 - CAMP GEIGER DUMP
NEAR FORMER TRAILER PARK
OU4 CLOSE OUT REPORT
 MARINE CORPS BASE, CAMP LEJEUNE
 NORTH CAROLINA



LEGEND

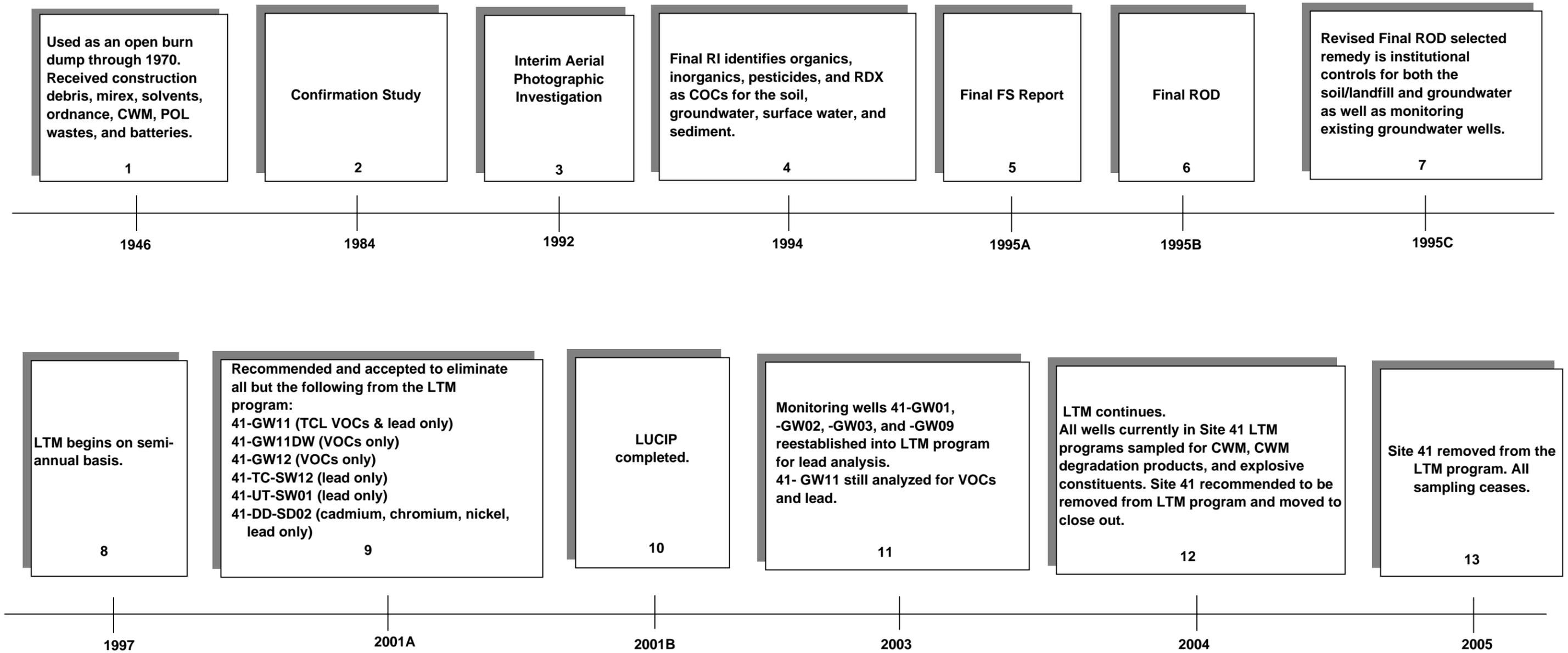
- 74MW01  SHALLOW MONITORING WELL
-  WATER SUPPLY WELL
- 654
-  UNPAVED ROAD
-  TOPOGRAPHIC ELEVATION LINES (FEET, MEAN SEA LEVEL)

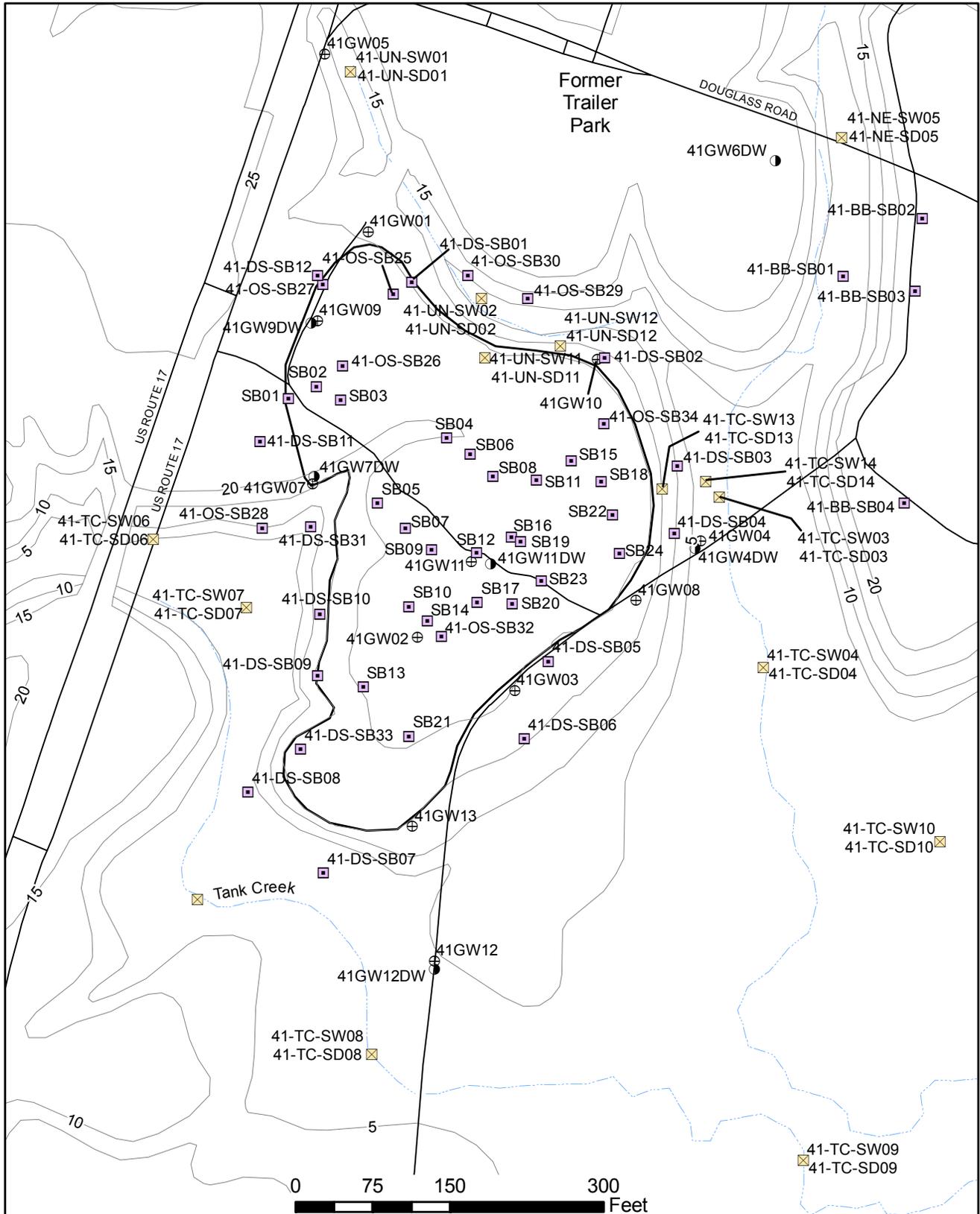
SOURCE: LANTDIV, FEB. 1994

FIGURE 2-3
 OPERABLE UNIT 4
 SITE 74 - MESS HALL
 GREASE PIT DISPOSAL AREA
 OU4 CLOSE OUT REPORT
 MARINE CORPS BASE, CAMP LEJEUNE
 NORTH CAROLINA

FIGURE 2-4

**SITE 41 ACTIVITIES TIMELINE
FINAL CLOSE OUT REPORT
OPERABLE UNIT NO.4
MCB, CAMP LEJEUNE, NORTH CAROLINA**





Legend

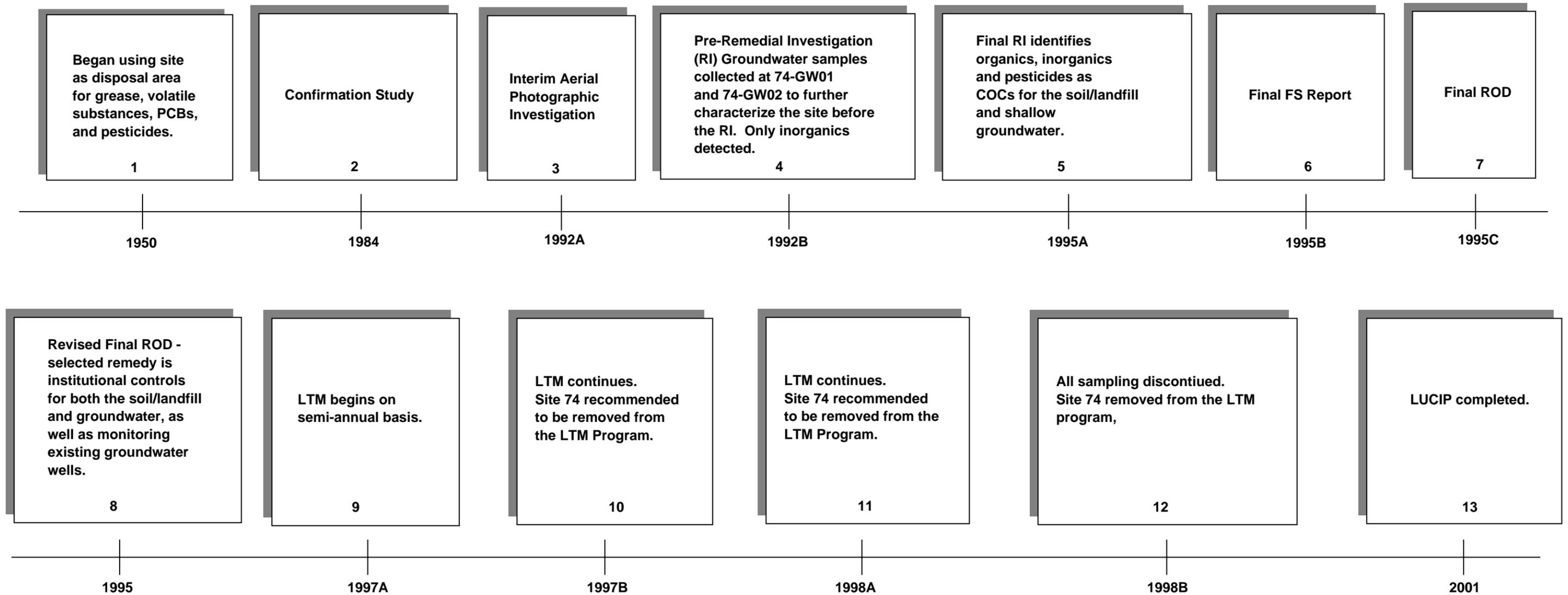
- Deep Monitoring Well Location
- ⊕ Shallow Monitoring Well Location
- ⊠ Soil Boring Location
- ⊠ Surface Water/Sediment Sampling Location
- Intermittent Stream
- Road
- Topographic Elevation Line
- ⬜ Approximate Disposal Area Boundary

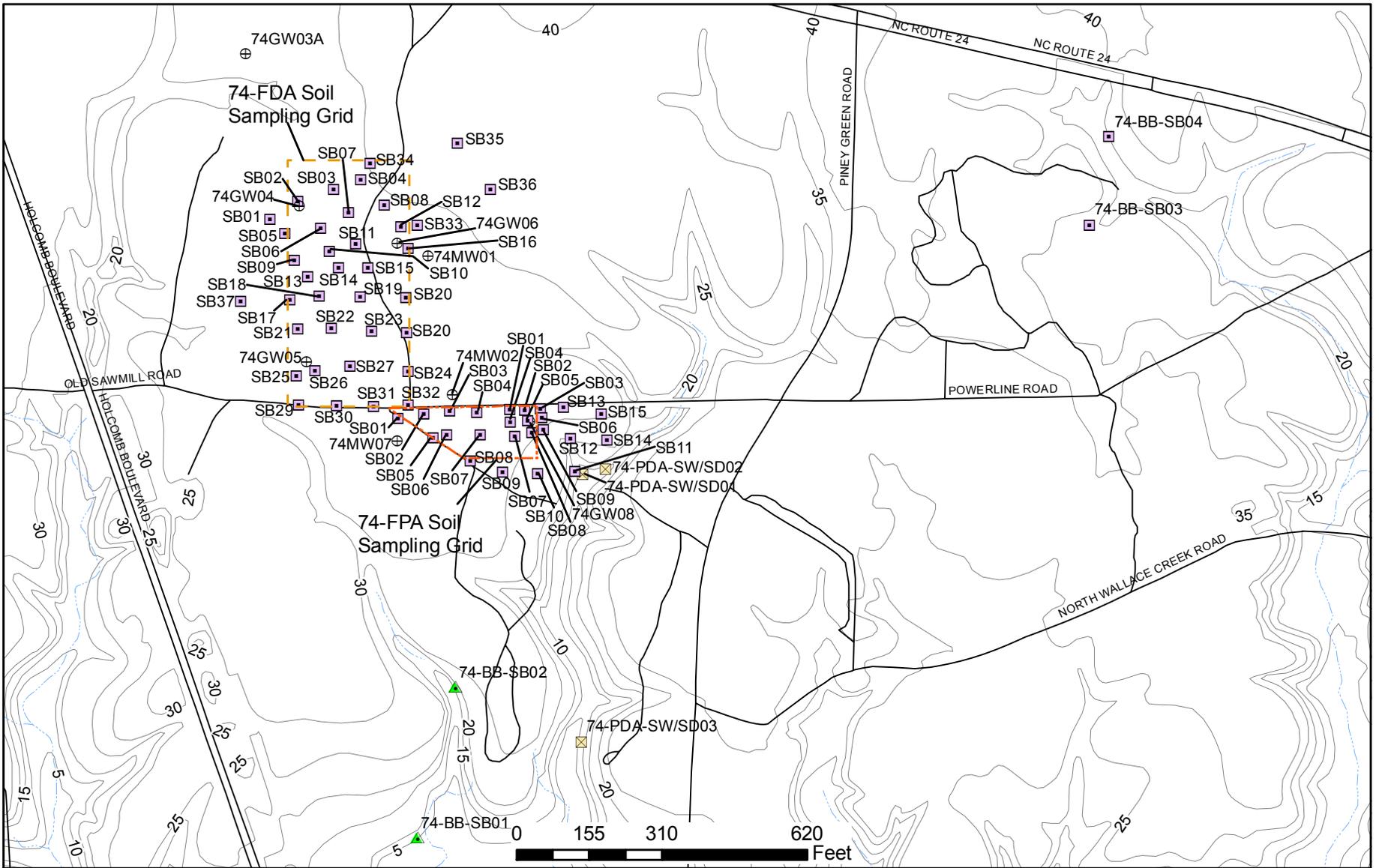


FIGURE 2-5
REMEDIAL INVESTIGATION SAMPLING
LOCATIONS - ALL MEDIA
SITE 41 - CAMP GEIGER DUMP
NEAR FORMER TRAILER PARK
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

FIGURE 2-6

**SITE 74 ACTIVITIES TIME LINE
FINAL CLOSE OUT REPORT
OPERABLE UNIT NO. 4
MCB, CAMP LEJEUNE, NORTH CAROLINA**



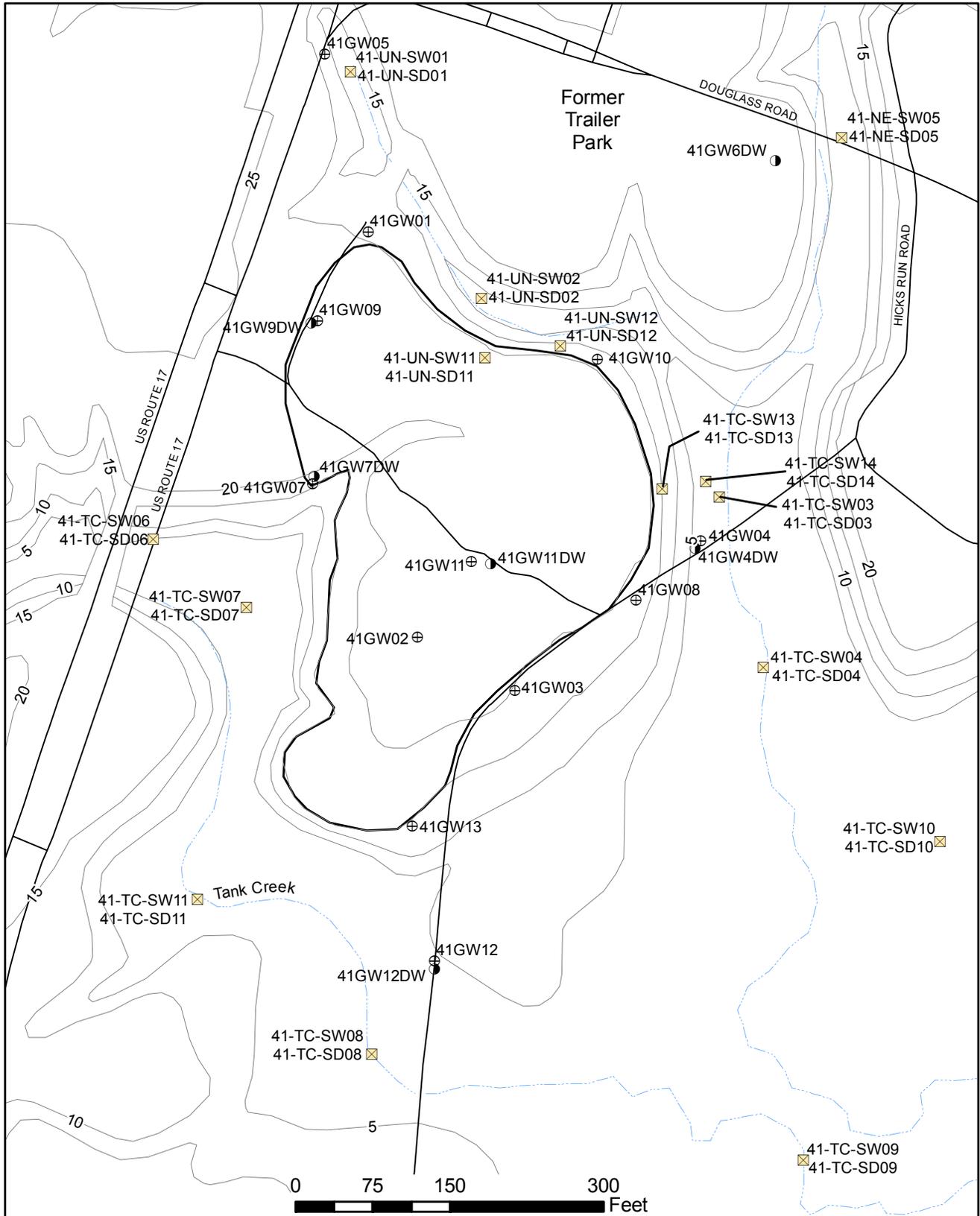


Legend

- Deep Monitoring Well Location
- ⊕ Shallow Monitoring Well Location
- Soil Boring Location
- ⊠ Surface Water/Sediment Sampling Location
- ▲ Background Soil Boring Location
- Intermittent Stream
- Road
- Topographic Elevation Line



FIGURE 2-7
REMEDIAL INVESTIGATION SAMPLING
LOCATIONS - ALL MEDIA
SITE 74 - MESS HALL GREASE PIT
DISPOSAL AREA
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



Legend

- Deep Monitoring Well Location
- ⊕ Shallow Monitoring Well Location
- ⊠ Surface Water/Sediment Sampling Location
- - - Intermittent Stream
- Road
- Topographic Elevation Line
- ▭ Approximate Disposal Area Boundary



FIGURE 4-1
SAMPLING LOCATION MAP
OPERABLE UNIT NO. 4 - SITE 41
LONG TERM MONITORING PROGRAM
 MARINE CORPS BASE, CAMP LEJEUNE
 NORTH CAROLINA

FIGURE 4-2
TIME TREND OF TOTAL LEAD IN GROUNDWATER AT 41-GW11
MCB, CAMP LEJEUNE

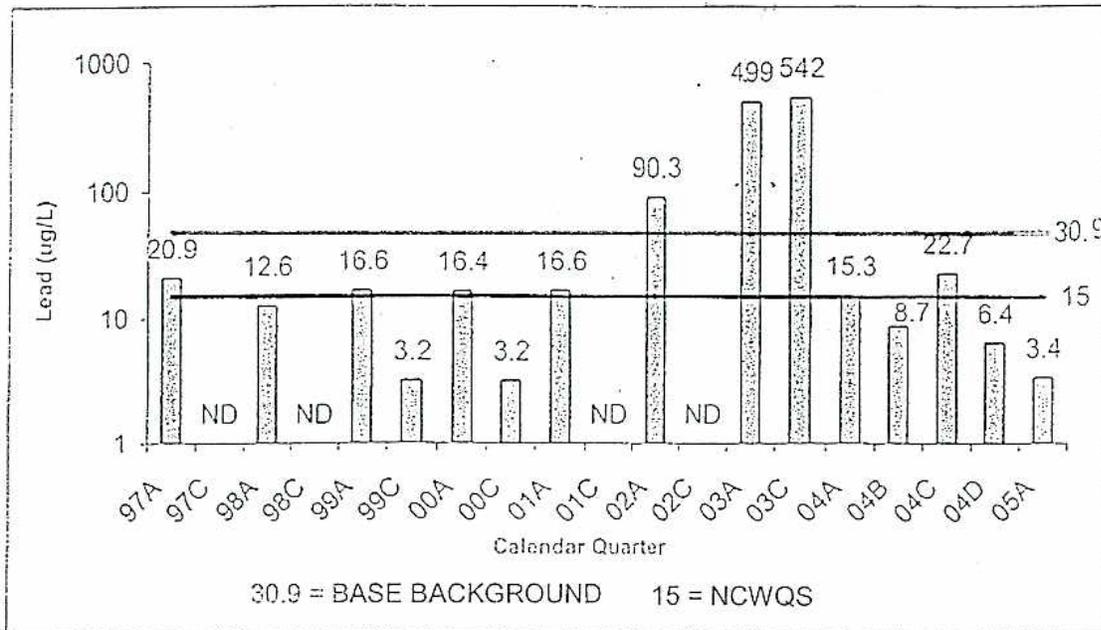
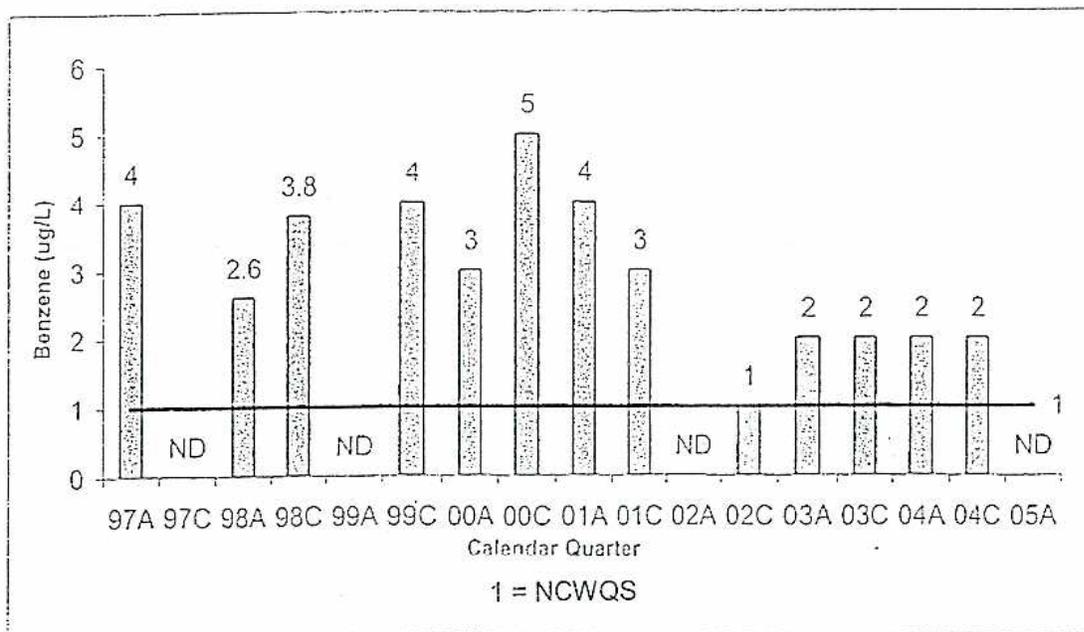
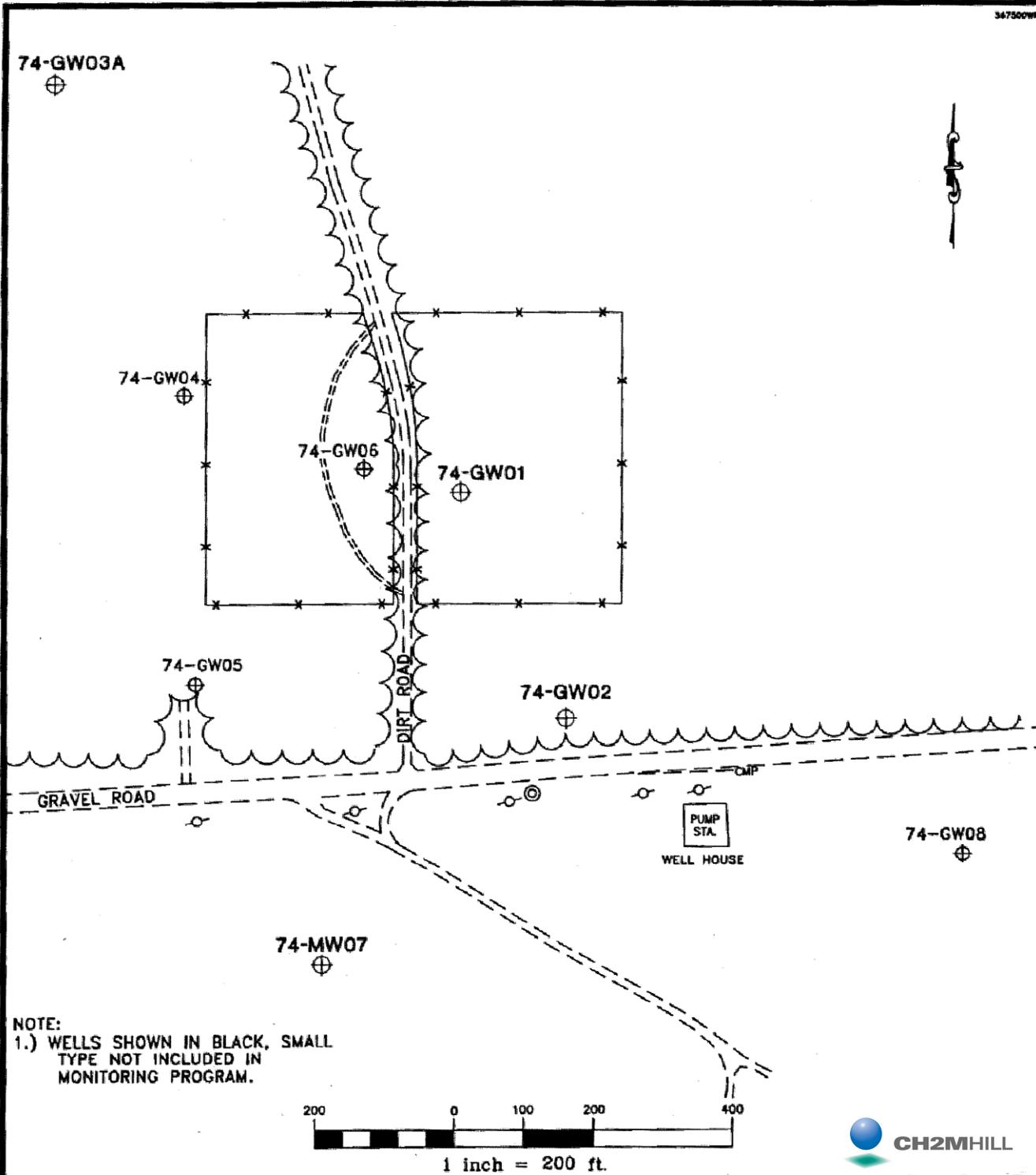


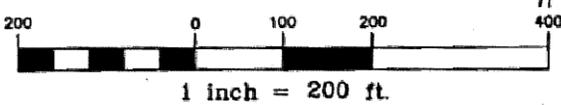
FIGURE 4-3
TIME TREND OF BENZENE IN GROUNDWATER AT 41-GW11
MCB, CAMP LEJEUNE



ND = Not Detected



NOTE:
 1.) WELLS SHOWN IN BLACK, SMALL TYPE NOT INCLUDED IN MONITORING PROGRAM.



LEGEND

- 74-GW01 SHALLOW MONITORING WELL
- SANITARY MANHOLE
- UTILITY POLE
- TREE LINE
- FENCE (APPROXIMATE)

SOURCE: REVISED FROM LANTDIV. OCT. 1991

FIGURE 4-4
 SAMPLING LOCATION MAP
 OPERABLE UNIT NO. 4 - SITE 74
 LONG TERM MONITORING PROGRAM
 MARINE CORPS BASE, CAMP LEJEUNE
 NORTH CAROLINA

Brent A. Laker
 BRENT A. LAKER, INTERIM DIRECTOR
 DIVISION OF WASTE MANAGEMENT
 NORTH CAROLINA
 ONSLOW COUNTY

Sec. 5 Judge
 I, *Sec. 5 Judge*, A NOTARY PUBLIC OF ONSLOW COUNTY AND STATE OF NORTH CAROLINA, DO HEREBY CERTIFY THAT *Sec. 5 Judge* DID PERSONALLY APPEAR AND SIGN BEFORE ME THIS *15* DAY OF *February*, 2001.

Sec. 5 Judge
 NOTARY PUBLIC (SIGNATURE)

MY COMMISSION EXPIRES *October 31, 2005* 2005 AND A SURVEYOR'S CERTIFICATION AND SEAL (USING A PERMANENT NOTARY SEAL) I, BRENT A. LAKER, PROFESSIONAL LAND SURVEYOR NO. 3611, CERTIFY TO ONE OR MORE OF THE FOLLOWING AS INDICATED:

- A. THAT THIS PLAT IS OF A SURVEY THAT CREATED A SUBDIVISION OF LAND WITHIN THE AREA OF A COUNTY OR MUNICIPALITY THAT HAS AN ORDINANCE THAT REGULATES PARCELS OF LAND;
- B. THAT THIS PLAT IS OF A SURVEY THAT IS LOCATED IN SUCH PORTION OF A COUNTY OR MUNICIPALITY THAT IS UNREGULATED AS TO AN ORDINANCE THAT REGULATES PARCELS OF LAND;
- C. THAT THIS PLAT IS OF A SURVEY OF AN EXISTING PARCEL OR PARCELS OF LAND;
- D. THAT THIS PLAT IS OF A SURVEY OF ANOTHER CATEGORY, SUCH AS THE RECOGNITION OF EXISTING PARCELS, A COURT-CREATED SURVEY OR OTHER EXCEPTION TO THE DEFINITION OF SUBDIVISION;
- E. THAT THE INFORMATION AVAILABLE TO THIS SURVEYOR IS SUCH THAT I AM UNABLE TO MAKE A DETERMINATION TO THE BEST OF MY PROFESSIONAL ABILITY AS TO PROVISIONS CONTAINED IN (A) THROUGH (D) ABOVE.

NORTH CAROLINA ONSLOW COUNTY

FILED FOR REGISTRATION AT 11:00 O'CLOCK P.M. ON THE *15* DAY OF *February*, 2001. RECORDED IN MAP BOOK *372*, PAGE *104*. SLOPE *1:243*

Brent A. Laker
 BRENT A. LAKER, REGISTERED LAND SURVEYOR ONSLOW COUNTY

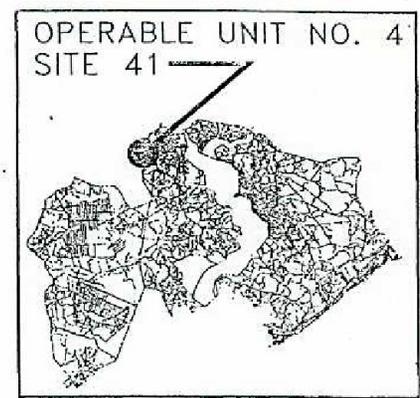
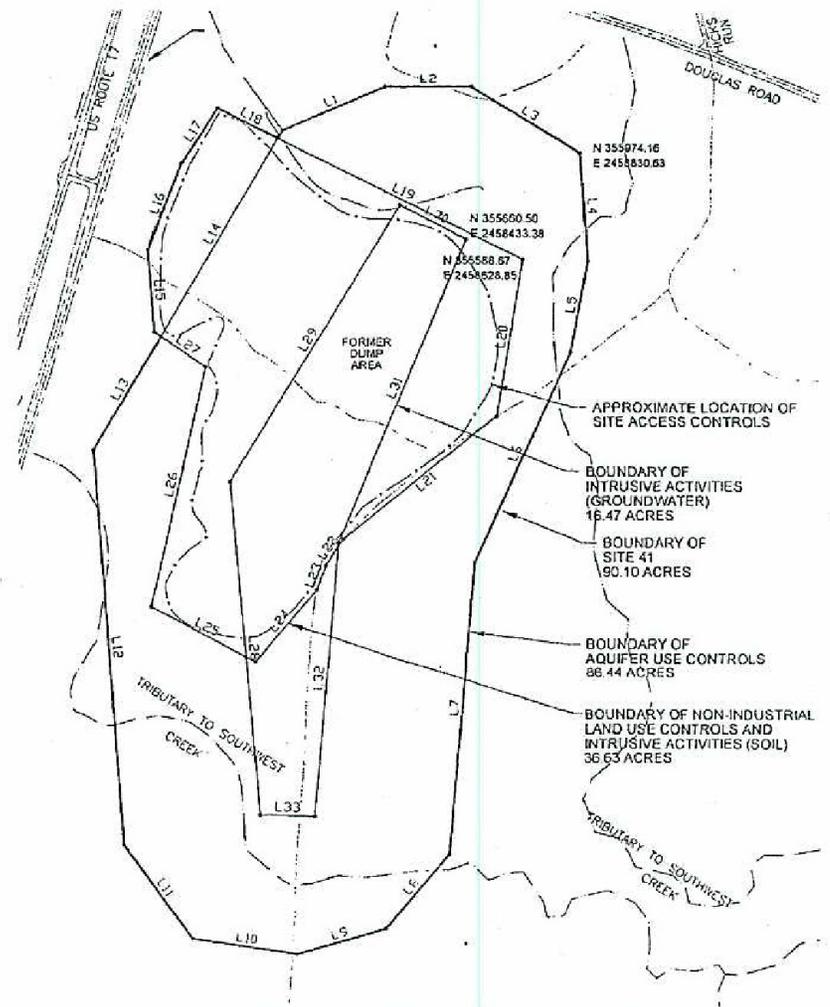
CERTIFICATE OF SURVEY AND ACCURACY

I, BRENT A. LAKER, CERTIFY THAT THIS MAP WAS DRAWN UNDER MY DIRECTION AND SUPERVISION FROM AN ACTUAL SURVEY OF LAND MADE UNDER MY SUPERVISION (DEED DESCRIPTION RECORDED IN: SEE TITLE REFERENCES) THAT THE BOUNDARIES NOT SURVEYED ARE SHOWN AS DOTTED LINES, AND ARE REFERENCED AS SHOWN ON PLAT, THAT THE ERROR OF CLOSURE AS CALCULATED BY LATITUDES AND DEPARTURES IS NOT APPLICABLE. THAT THIS MAP WAS PREPARED IN ACCORDANCE WITH G.S. 47-32 AS AMENDED, WITNESS MY HAND AND SEAL THIS *15* DAY OF *February*, 2001.

Brent A. Laker
 BRENT A. LAKER, P.L.S. L-3611

- LEGEND**
- BOUNDARY OF SITE 41
 - BOUNDARY OF AQUIFER USE CONTROLS
 - BOUNDARY OF INTRUSIVE ACTIVITIES (GROUNDWATER)
 - BOUNDARY OF NON-INDUSTRIAL LAND USE CONTROLS AND INTRUSIVE ACTIVITIES (SOIL)
 - BOUNDARY OF MCB CAMP LEJEUNE PROPERTY
 - WATER COURSE
 - APPROXIMATE LOCATION OF SITE ACCESS CONTROLS

- NOTES:**
- THE AREAS AND TYPE OF CONTAMINATION DEPICTED UPON THE MAP ARE APPROXIMATIONS DERIVED FROM THE BEST AVAILABLE INFORMATION AT THE TIME OF FILING.
 - TYPES OF HAZARDOUS SUBSTANCES KNOWN: GROUNDWATER- METALS; SOIL- CHEMICAL WASTE MATERIAL (CWM)
 - THIS MAP IS NOT FROM AN ACTUAL SURVEY
 - SPECIFIC QUANTITIES OF HAZARDOUS SUBSTANCES UNKNOWN.
 - DATUM: NORTH CAROLINA GRID NAD 83
 - BOUNDARY SOURCE: BAKER ENVIRONMENTAL INC., JUNE 2001
 - MAP SOURCE: VECTOR DATA FROM 1996 FLYOVER OF CAMP LEJEUNE.
 - CONTROL POINT REFERENCE: N.C.G.S. STA. TERRANCE



VICINITY MAP

EXHIBIT MAP
 NOTICE OF INACTIVE HAZARDOUS SUBSTANCE OR WASTE DISPOSAL SITE

PLAT

BOUNDARY OF LAND USE CONTROLS
 SITE 41 - OPERABLE UNIT NO. 4

SHOWING PROPERTY OF:
 MARINE CORPS BASE, CAMP LEJEUNE
 ONSLOW COUNTY, NORTH CAROLINA
 JULY 16, 2001

LINE TABLE			L19	955.05	S62°51'43"E
LINE	LENGTH	BEARING	L20	575.99	S09°06'30"W
L1	391.55	N65°55'00"E	L21	697.85	S50°22'07"W
L2	298.59	N90°00'00"E	L22	112.50	S32°40'04"W
L3	447.99	S57°39'27"E	L23	95.05	S18°56'39"W
L4	391.85	S03°41'31"E	L24	335.15	S40°01'57"W
L5	333.98	S10°53'15"W	L25	413.59	N61°33'15"W
L6	834.26	S23°28'05"W	L26	888.16	N12°28'45"E
L7	1050.68	S04°49'18"W	L27	190.15	N55°00'47"W
L8	349.42	S39°38'03"W	L28	1201.80	N95°04'21"W
L9	320.63	S23°13'54"W	L29	1168.87	N30°50'46"E
L10	369.94	N81°30'11"W	L30	259.98	S61°42'13"E
L11	413.05	N35°28'30"W	L31	1185.40	S22°17'45"W
L12	1425.38	N04°23'58"W	L32	988.44	S04°42'18"W
L13	476.85	N29°57'01"E	L33	191.21	N88°40'52"W
L14	828.08	N29°57'01"E			
L15	298.32	N04°06'57"W			
L16	337.15	N21°12'24"E			
L17	233.73	N32°15'00"E			
L18	237.62	S62°51'43"E			

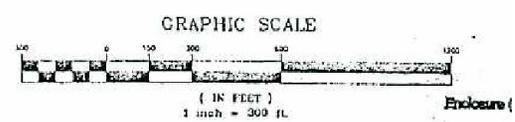


Figure 5-1
 Operable Unit 4
 Site 41-LUC Boundaries
 OU4 Close Out Report
 Marine Corps Base, Camp Lejeune
 North Carolina

Approved FOR THE PURPOSES OF N.C.G.S. 130A-310.6

Steve S. Schlege

DEXTER MATTHEWS, REGISTERED DIRECTOR
DIVISION OF WASTE MANAGEMENT

NORTH CAROLINA
ONSLOW COUNTY

Steve S. Schlege A NOTARY PUBLIC OF SAID COUNTY AND STATE DO HEREBY CERTIFY THAT *DEXTER MATTHEWS* DID PERSONALLY APPEAR AND SIGN BEFORE ME THIS THE 17 DAY OF JULY 2001.

NOTARY PUBLIC (SIGNATURE)



(OFFICIAL SEAL)

MY COMMISSION EXPIRES, 1/21/2003, 2001, AND A SURVEYOR'S CERTIFICATION AND SEAL (USING A PERMANENT INK STAMP). I, BRENT A. LANIER, PROFESSIONAL LAND SURVEYOR NO. 3611, CERTIFY TO ONE OR MORE OF THE FOLLOWING AS INDICATED:

- A. THAT THIS PLAT IS OF A SURVEY THAT CREATES A SUBDIVISION OF LAND WITHIN THE AREA OF A COUNTY OR MUNICIPALITY THAT HAS AN ORDINANCE THAT REGULATES PARCELS OF LAND;
- B. THAT THIS PLAT IS OF A SURVEY THAT IS LOCATED IN SUCH PORTION OF A COUNTY OR MUNICIPALITY THAT IS UNREGULATED AS TO AN ORDINANCE THAT REGULATES PARCELS OF LAND;
- C. THAT THIS PLAT IS OF A SURVEY OF AN EXISTING PARCEL OR PARCELS OF LAND;
- D. THAT THIS PLAT IS OF A SURVEY OF ANOTHER CATEGORY, SUCH AS THE RECONCILIATION OF EXISTING PARCELS, A COURT-ORDERED SURVEY OR OTHER EXCEPTION TO THE DEFINITION OF SUBDIVISION;
- E. THAT THE INFORMATION AVAILABLE TO THIS SURVEYOR IS SUCH THAT I AM UNABLE TO MAKE A DETERMINATION TO THE BEST OF MY PROFESSIONAL ABILITY AS TO PROVISIONS CONTAINED IN (A) THROUGH (D) ABOVE.

NORTH CAROLINA ONSLOW COUNTY

FILED FOR REGISTRATION AT 4:00 O'CLOCK P.M.

ON THE 16TH DAY OF JULY 2001.

RECORDED IN MAP BOOK 112, PAGE 101.

MAILED 17 JULY 2001

Milled M. Thomas
MILLED M. THOMAS, REGISTERED CLERK ONSLOW COUNTY

CERTIFICATE OF SURVEY AND ACCURACY

I, BRENT A. LANIER, CERTIFY THAT THIS MAP WAS DRAWN UNDER MY DIRECTION AND SUPERVISION FROM AN ACTUAL SURVEY OF LAND MADE UNDER MY SUPERVISION (DEED DESCRIPTION RECORDED IN DEED REFERENCE) THAT THE BOUNDARIES NOT SURVEYED ARE SHOWN AS BROKEN LINES, AND ARE REFERENCED AS SHOWN ON PLAT. THAT THE ERROR OF CLOSURE AS CALCULATED BY LATITUDES AND DEPARTURES IS NOT APPLICABLE THAT THIS MAP WAS PREPARED IN ACCORDANCE WITH G.S. 47-30 AS AMENDED, WITH MY HAND AND SEAL THIS THE 21 DAY OF JULY 2001.

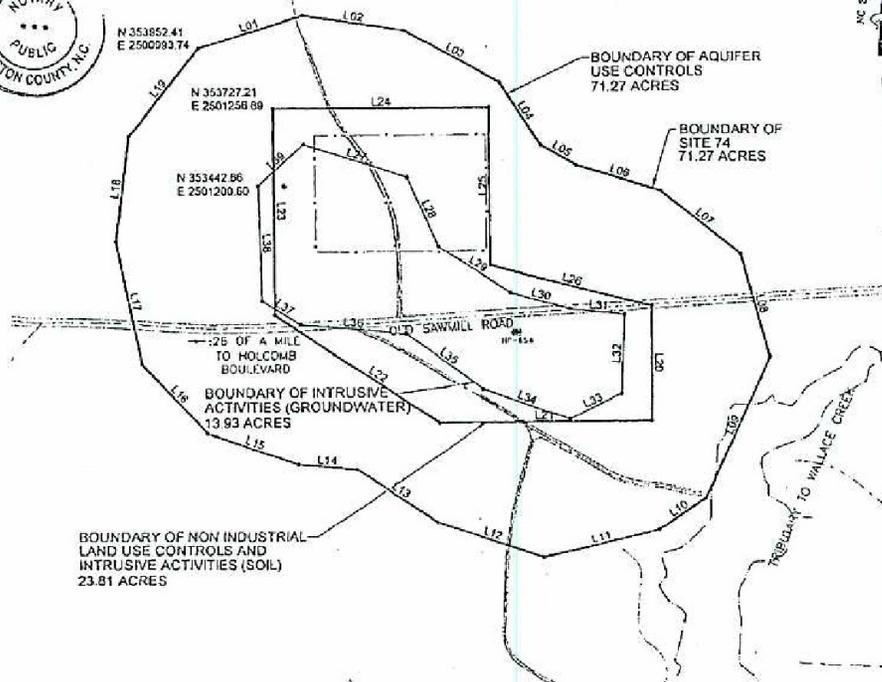
Brent A. Lanier
BRENT A. LANIER, P.L.S. 1-3811

LEGEND

- BOUNDARY OF SITE 74
- BOUNDARY OF AQUIFER USE CONTROLS
- BOUNDARY OF INTRUSIVE ACTIVITIES (GROUNDWATER)
- BOUNDARY OF NON INDUSTRIAL LAND USE CONTROLS AND INTRUSIVE ACTIVITIES (SOIL)
- - - - APPROXIMATE LOCATION OF SITE ACCESS CONTROLS
- — — WATER COURSE
- HP-654 WATER SUPPLY WELL (CURRENTLY ACTIVE)

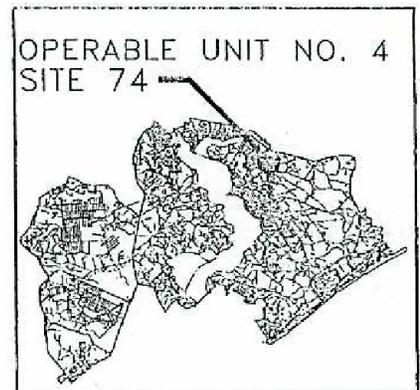
NOTES:

1. THE AREAS AND TYPE OF CONTAMINATION DEPICTED UPON THE MAP ARE APPROXIMATIONS DERIVED FROM THE BEST AVAILABLE INFORMATION AT THE TIME OF FILING.
2. TYPES OF HAZARDOUS SUBSTANCES KNOWN:
GROUNDWATER— METALS, PESTICIDES
SOIL— CHEMICAL WARFARE MATERIAL (CWM)
3. THIS MAP IS NOT FROM AN ACTUAL SURVEY
4. SPECIFIC QUANTITIES OF HAZARDOUS SUBSTANCES UNKNOWN.
5. DATUM: NORTH CAROLINA GRID NAD 83
6. BOUNDARY SOURCE: BAKER ENVIRONMENTAL INC., JUNE 2001
7. MAP SOURCE: VECTOR DATA FROM 1996 FLYOVER OF CAMP LEJEUNE.
8. CONTROL POINT REFERENCE: N.C.G.S. STA. TERRANCE



LINE	LENGTH	BEARING
L01	389.79	N72°13'01"E
L02	356.15	S60°52'27"E
L03	391.46	S59°39'52"E
L04	275.75	S32°12'52"E
L05	138.47	S58°26'21"E
L06	311.04	S72°12'57"E
L07	363.44	S50°31'07"E
L08	389.00	S15°17'27"E
L09	559.03	S24°06'21"W
L10	199.72	S55°39'54"W
L11	412.13	S76°18'52"W
L12	405.71	N71°14'16"W
L13	337.04	N55°26'29"W
L14	206.82	N64°33'43"W
L15	340.61	N70°35'30"W
L16	343.44	N42°42'04"W
L17	454.36	N11°14'54"W
L18	306.84	N07°02'35"E
L19	411.78	N37°34'55"E
L20	418.99	S00°00'01"E

LINE	LENGTH	BEARING
L21	753.09	N89°59'58"W
L22	694.58	N55°25'32"W
L23	752.77	N00°00'01"W
L24	757.70	S89°58'28"E
L25	575.23	S00°00'00"E
L26	587.50	S74°56'10"E
L27	378.40	S71°12'28"E
L28	273.51	S22°50'48"E
L29	309.43	S57°13'11"E
L30	213.86	S73°36'11"E
L31	194.09	S83°09'44"E
L32	287.15	S02°18'28"W
L33	202.58	S63°27'05"W
L34	327.22	N70°23'38"W
L35	339.84	N53°05'08"W
L36	366.79	N84°34'19"W
L37	181.85	N57°39'09"W
L38	417.11	N01°34'59"W
L39	222.24	N47°28'49"E



VICINITY MAP

EXHIBIT MAP
NOTICE OF INACTIVE HAZARDOUS
SUBSTANCE OR WASTE DISPOSAL SITE

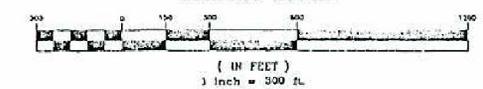
PLAT

BOUNDARY OF LAND USE CONTROLS
SITE 74 - OPERABLE UNIT NO. 4

SHOWING PROPERTY OF:
MARINE CORPS BASE, CAMP LEJEUNE
ONSLOW COUNTY, NORTH CAROLINA
JULY 16, 2001

Figure 5-2
Operable Unit 4
Site 74-LUC Boundaries
OU4 Close Out Report
Marine Corps Base, Camp Lejeune
North Carolina

GRAPHIC SCALE



Appendix A
Sites 41 and 74 Confirmation Study and
Pre-Remedial Investigation Data Tables

TABLE 1-1
CONFIRMATION STUDY
DETECTED TARGET CONTAMINANTS IN GROUNDWATER SAMPLES, SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Parameter	Federal MCLs ⁽¹⁾	North Carolina WQS ⁽²⁾	Sample ID/Date Sampled									
			41GW1 7/16/84	41GW1 1/8/87	41GW2 7/16/84	41GW2 1/8/87	41GW3 7/16/84	41GW3 1/13/87	41GW4 7/16/84	41GW4 1/13/87	41GW5 1/13/87	41GW5 3/5/87
Benzene	5	1	<0.3	<1	0.3	<1	<0.3	<1	<0.3	<1	<1	<1
Dichlorodifluoromethane	NS	0.19	<1	<10	8	<10	<1	<10	<1	<10	<10	<10
trans-1,2-Dichloroethene	100	70	<1	<1.6	1.1	<1.6	<1.1	<1.6	<1.1	<1.6	<1.6	<1.6
Vinyl chloride	2	0.015	<0.7	<1	1	<1	<0.9	<1	<0.9	<1	<1	<1
Aldrin	NS	NS	<0.0008	<0.013	<0.0008	0.017	<0.0008	<0.013	<0.0008	<0.013	<0.013	<0.006
Heptachlor	0.40	0.076	<0.0007	<0.013	<0.0007	<0.013	<0.0007	<0.013	<0.0007	<0.013	<0.013	0.007
Cadmium	NS	5	<6	<2.9	<6	<2.9	7.1	<2.9	<6	<2.9	4	<3.5
Chromium	100	50	76	10	530	43	230	28	32	<9.4	117	17
Lead	15*	50	74.6	<27	196.3	52	119.4	<27	<40	<27	<27	<27
Oil and Grease	NS	NS	2,000	1,000	2,000	1,000	2,000	900	48,000	2,000	1,000	3,000
Phenols	NS	NS	<1	11	4	11	1	<2	2	6	18	<2
RDX	NS	NS	<3.42	<0.745	<3.23	<7.45	<3.3	1.28	<3.3	<0.745	<0.745	<0.745

⁽¹⁾ Federal Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act of 1986.

⁽²⁾ NCWQS - North Carolina Administrative Code, Title 15, N.C. DEHNR, Subchapter 2L, Section .0202 - Water Quality Standards for Groundwater, August 4, 1989. Glass GA standards.

NS = No standard established

*Standard is an action level

Values reported are concentrations in micrograms per liter ($\mu\text{g/L}$); this approximates parts per billion (ppb).

Source: ESE, 1990.

TABLE 1-2
CONFIRMATION STUDY
DETECTED CONTAMINANTS IN SURFACE WATER SAMPLES, SITE 41
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA

Parameter	Federal Ambient Water Quality Criteria		North Carolina Surface Water Standards	Sample ID/Date Sampled			
	Organisms ⁽¹⁾	Health ⁽²⁾		41SW1 1/8/87	41SW2 1/8/87	41SW3 1/8/87	41SW4 1/8/87
Oil and Grease	NS	NS	NS	1,000	500	200	300
Phenols	2,560 ⁽³⁾	3,500	1	4	7	6	10
Aldrin	NS	0.000074	0.002	<0.013	0.013	0.015	0.014
delta-BHC	NS	NS	NS	<0.026	0.047	<0.026	<0.026
Methylene chloride	NS	NS	NS	8.7	5.5	9.7	6.8

⁽¹⁾ Freshwater Chronic Criteria

⁽²⁾ Protection of Human Health - Water and Organisms.

⁽³⁾ Insufficient data to develop criteria value presented in the LOEL.

NS = No standard established

Values reported are concentrations in micrograms per liter ($\mu\text{g/L}$); this approximates parts per billion (ppb).

Source: ESE, 1990.

TABLE 1-3

CONFIRMATION STUDY
 DETECTED CONTAMINANTS IN SEDIMENT SAMPLES, SITE 41
 REMEDIAL INVESTIGATION, CTO-0212
 MCB CAMP LEJEUNE, NORTH CAROLINA

Parameter	Sample ID/Date Sampled			
	41SE1 1/8/87	41SE2 1/8/87	41SE3 1/8/87	41SE4 1/8/87
Chromium	2.66	1.77	1.86	5.09
Chromium (+6)	<1.31	1.36	1.57	3.74
Lead	12.1	4.89	<3.49	<4.63
Oil and Grease	208	111	40	159
Phenols	<0.066	<0.066	0.081	0.118
2,4,6-TNT	<0.00341	<0.00345	0.00459	0.357

Values reported are concentrations in micrograms per gram ($\mu\text{g/g}$); this approximates parts per million (ppm).

Source: ESE, 1990.

TABLE 1-4

CONFIRMATION STUDY
 DETECTED CONTAMINANTS IN THE SOIL, SITE 74
 REMEDIAL INVESTIGATION, CTO-0212
 MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Sample ID/Date Sampled					
	74S1A 08/03/84	74S1B 08/03/84	74S1C 08/03/84	74S2A 08/03/84	74S2B 08/03/84	74S2C 08/03/84
DDD, 4,4	0.0084	<0.0006	0.0006	0.0029	0.0006	0.0006
DDE, 4,4	0.044	0.006	0.0072	0.0051	0.001	0.0004
DDT, 4,4	0.260	0.0086	0.011	<0.0012	<0.0012	<0.0013

Values reported are concentrations in micrograms per gram ($\mu\text{g/g}$); this approximates to parts per million (ppm).

Note: There are no North Carolina pesticide soil standards.

Source: ESE, 1990.

TABLE 1-5

**CONFIRMATION STUDY
DETECTED TARGET CONTAMINANTS IN GROUNDWATER (1984-1987), SITE 74
REMEDIAL INVESTIGATION, CTO-0212
MCB CAMP LEJEUNE, NORTH CAROLINA**

Contaminant	Federal MCLs ⁽¹⁾	North Carolina WQS ⁽²⁾	Sample ID/Date Sampled						
			74GW1 07/04/84	74GW1 12/04/86	74GW2 07/04/84	74GW2 12/04/86	74GW3 12/04/86	74GW3 03/04/87	Supply Well (654) 07/04/84
DDD, 4,4	NS	NS	<0.0008	<0.006	<0.0008	0.029	<0.006	<0.006	<0
DDE, 4,4	NS	NS	<0.0008	<0.006	0.001	<0.006	<0.006	<0.006	<0.006
DDT, 4,4	NS	NS	<0.005	<0.006	0.007	<0.006	<0.006	<0.006	<0.005
Methylene Chloride	NS	5	NA	<2.8	NA	<2.8	3.8	<2.8	NA

⁽¹⁾ Federal Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act of 1986.

⁽²⁾ NCWQS - North Carolina Administrative Code, Title 15, N.C. DEHNR, Subchapter 2L, Section .0202 - Water Quality Standards for Groundwater, August 4, 1989. Class GA Standards.

NS = No standard established.

NA = Not analyzed.

Values reported are concentrations in micrograms per liter (µg/L).

Source: ESE, 1990.

TABLE 1-6

PRE-INVESTIGATION
 DETECTED CONTAMINANTS IN THE GROUNDWATER (1992), SITE 74
 REMEDIAL INVESTIGATION, CTO-0212
 MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Federal MCLs ⁽¹⁾	North Carolina WQS ⁽²⁾	Sample ID/Date Sampled			
			74GW1 07/07/92		74GW2 07/07/92	
			Total	Dissolved	Total	Dissolved
Aluminum	NS	NS	1,980	ND	ND	ND
Barium	2,000 (P)	1,000	28	27	32	32
Iron	NS	300	301	ND	41	ND
Magnesium	NS	NS	1,030	916	957	936
Potassium	NS	NS	923	913	605	703
Sodium	NS	NS	3,860	3,850	2,900	2,970

⁽¹⁾ Federal Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act of 1986.

⁽²⁾ NCWQS - North Carolina Administrative Code, Title 15, N.C. DEHNR, Subchapter 2L, Section .0202 -Water Quality Standards for Groundwater, August 4, 1989. Class GA Standards.

(P) = Proposed

ND = Not Detected at Method Detection Limit

NS = No standard established

Total/Dissolved metal concentrations

Concentrations reported in microgram per liter (µg/L).

Source: Baker Environmental, July 1992.

Appendix B
Sites 41 and 74 Remedial Investigation
Data Tables

SITE 41 REMEDIAL INVESTIGATION

SURFACE SOIL RESULTS

Organic Compounds Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
VOLATILES			
Methylene Chloride	2J - 5J	41-OS-SB09-00	13/46
Acetone	3J - 2,800J	41-OS-SB19-00	11/46
Toluene	1J - 4J	41-OS-SB25-00	3/46
SEMIVOLATILES			
1,4-Dichlorobenzene	180J - 180J	41-OS-SB12-00	1/46
2-Methylnaphthalene	55J - 55J	41-OS-SB12-00	1/46
Acenaphthene	91J - 380J	41-OS-SB10-00	2/46
Anthracene	41J - 510	41-OS-SB10-00	3/46
Benzo(a)anthracene	130J - 2,400	41-OS-SB10-00	4/46
Benzo(a)pyrene	40J - 2,000	41-OS-SB10-00	5/46
Benzo(b)fluoroanthene	38J - 2,500	41-OS-SB10-00	6/46
Benzo(g,h,i)perylene	46J - 1,600	41-OS-SB10-00	4/46
Benzo(k)fluoranthene	50J - 1,700	41-OS-SB10-00	6/46
Bis(2-chloroethyl)ether	57J - 220J	41-OS-SB34-00	6/46
Bis(2-ethylhexyl)phthalate	42J - 580J	41-OS-SB12-00	12/46
Carbazole	44J - 330J	41-OS-SB10-00	2/46
Chrysene	49J - 2,300	41-OS-SB10-00	6/46
Dibenzofuran	130J - 130J	41-OS-SB10-00	1/46
Dibenzo(a,h)anthracene	57J - 57J	41-OS-SB12-00	1/46
Di-n-butylphthalate	42J - 230J	41-OS-SB02-00	13/46
Di-n-octylphthalate	40J - 200J	41-OS-SB18-00	6/46
Fluoranthene	40J - 2,500	41-OS-SB14-00	8/46
Fluorene	79J - 280J	41-OS-SB10-00	2/46
Indeno(1,2,3-cd)pyrene	71J - 76J	41-OS-SB20-00	2/46
Naphthalene	70J - 70J	41-OS-SB12-00	1/46
Phenanthrene	72J - 2,600	41-OS-SB10-00	6/46
Pyrene	50J - 2,300J	41-OS-SB14-00	7/46
PESTICIDES/PCBs			
beta-BHC	4.72NJ - 4.72NJ	41-DS-SB03-00	1/46
delta-BHC	0.03NJ - 0.03NJ	41-OS-SB26-00	1/46
Lindane (gamma-BHC)	0.22NJ - 0.22NJ	41-OS-SB32-00	1/46
Heptachlor	0.3NJ - 7.16	41-OS-SB03-00	5/46

Organic Compounds Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
Heptachlor Epoxide	0.56J - 9.6J	41-OS-SB03-00	5/46
Dieldrin	0.2NJ - 13.03NJ	41-OS-SB08-00	17/46
4,4'-DDE	0.12J - 87.6J	41-OS-SB08-00	34/46
Endrin	1.47J - 2.93J	41-OS-SB03-00	5/46
Endosulfan II	0.45NJ - 5.01J	41-OS-SB22-00	13/46
4,4'-DDD	0.37J - 92J	41-OS-SB12-00	19/46
Endosulfan Sulfate	0.32J - 3.59J	41-OS-SB03-00	5/46
4,4'-DDT	0.37J - 277J	41-OS-SB14-00	29/46
Methoxychlor	1.41J - 3.28NJ	41-OS-SB03-00	3/46
Endrin Ketone	0.44NJ - 0.44NJ	41-OS-SB19-00	1/46
Endrin Aldehyde	0.61J - 1.37J	41-OS-SB12-00	7/46
Alpha-Chlordane	0.08J - 92.7J	41-OS-SB03-00	16/46
Gamma-Chlordane	0.06NJ - 93.5J	41-OS-SB03-00	16/46
Aroclor 1242	82.9J - 82.9J	41-OS-SB19-00	1/46
Aroclor 1260	58.4J - 58.4J	41-OS-SB23-00	1/46
ORDNANCE			
1,3-Di-nitrobenzene	824NJ - 824NJ	41-DS-SB03-00	1/46

Inorganics Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
Aluminum	878 - 17,400J	41-OS-SB12-00	46/46
Antimony	2.18J - 2.57	41-OS-SB11-00	2/46
Arsenic	0.671 - 4.42	41-OS-SB17-00	19/46
Barium	3.14 - 82.2	41-OS-SB12-00	46/46
Beryllium	0.187 - 0.344	41-OS-SB14-00	12/46
Cadmium	0.854 - 7.44	41-OS-SB12-00	5/46
Calcite	32.9 - 40,300	41-OS-SB17-00	42/46
Chromium	2.19 - 41.4	41-OS-SB12-00	41/46
Cobalt	6.46 - 6.46	41-OS-SB12-00	1/46
Copper	4.17 - 132	41-OS-SB12-00	15/46
Iron	397 - 91,600	41-OS-SB12-00	46/46
Lead	2.57J - 341J	41-OS-SB12-00	46/46
Magnesium	28.1 - 1,100	41-OS-SB17-00	46/46
Manganese	1.67J - 6,000J	41-OS-SB12-00	44/46
Mercury	0.073 - 0.768	41-OS-SB12-00	22/46

Inorganics Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
Nickel	7.36 - 35.3	41-OS-SB12-00	4/46
Potassium	184 - 547	41-OS-SB17-00	14/46
Selenium	0.357 - 0.596	41-OS-SB15-00	3/46
Silver	0.096 - 18.3J	41-DS-SB10-00	3/46
Sodium	84.7 - 230	41-OS-SB12-00	8/46
Vanadium	4.62 - 39.8	41-OS-SB14-00	31/46
Zinc	3.77J - 14,600	41-OS-SB12-00	42/46
Total Cyanide	1.09 - 1.57	41-DS-SB07-00	46/46

Source: Baker Environmental, Inc., 1995A

SITE 41 REMEDIAL INVESTIGATION

SUBSURFACE SOIL RESULTS

Organic Compounds Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
VOLATILES			
Chloromethane	2J - 3J	41-OS-SB01-02	2/66
Methylene Chloride	2J - 26J	41-OS-SB14-01	18/66
Acetone	4J - 6,000J	41-GW07-01	34/66
2-Butanone	1J - 15J	41-OS-SB17-02	8/66
Trichloroethene	1J - 1J	41-OS-SB02-02	1/66
Benzene	1J - 1J	41-OS-SB07-02	1/66
Chlorobenzene	4J - 100	41-OS-SB22-03	5/66
Ethylbenzene	7J - 58	41-OS-SB22-03	2/66
SEMIVOLATILES			
1,4-Dichlorobenzene	49J - 49J	41-GW11DW-01	1/66
2-Methylnaphthalene	41J - 550	41-OS-SB22-03	4/66
4-Chloro-3-methylphenol	61J - 61J	41-GW13-03	1/66
4-Methylphenol	53J - 53J	41-OS-SB22-03	1/66
Acenaphthene	52J - 130J	41-OS-SB12-02	3/66
Benzo(a)anthracene	71J - 160	41-GW11DW-01	2/66
Benzo(a)pyrene	74J - 4,700J	41-OS-SB14-01	6/66
Benzo(b)fluoranthene	75J - 150J	41-GW11DW-01	2/66
Benzo(g,h,i)perylene	41J - 4,600J	41-OS-SB14-01	5/66
Benzo(k)fluoranthene	80J - 109	41-GW11DW-01	2/66
Bis(2-chloroethyl)ether	79J - 800J	41-OS-SB03-01	3/66
Bis(2-ethylhexyl)phthalate	39J - 7,200	41-OS-SB14-01	33/66
Butyl benzyl phthalate	88J - 88J	41-GW13-03	1/66
Carbazole	66J - 66J	41-GW13-03	1/66
Chrysene	43J - 170	41-GW11-01	4/66
Dibenzofuran	48J - 48J	41-GW13-03	1/66
Diethylphthalate	110J - 110J	41-GW13-03	1/66
Di-n-butylphthalate	40J - 230J	41-OS-SB02-02	26/66
Di-n-oxyphthalate	40J - 1,600	41-OS-SB17-02	9/66
Fluoranthene	46J - 260J	41-GW11DW-01	5/66

Organic Compounds Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
Fluorene	44J - 120J	41-OS-SB12-02	4/66
Ideno(1,2,3-cd)pyrene	105J - 105J	41-GW11DW-01	1/66
Naphthalene	45J - 290	41-OS-SB22-03	5/66
N-nitrosodiphenylamine	240 - 240	41-GW11DW-06	1/66
Phenanthrene	39J - 260	41-GW11DW-01	5/66
Pyrene	52J - 290	41-GW11DW-01	6/66
PESTICIDES/PCBs			
delta-BHC	0.91J - 0.91J	41-OS-SB19-01	1/66
Lindane (gamma-BHC)	11.9J - 11.9J	41-OS-SB06-03	1/66
Heptachlor	0.68J - 18	41-OS-SB03-01	9/66
Aldrin	0.7J - 12.8J	41-OS-SB06-03	5/66
Heptachlor epoxide	0.4J - 11.5J	41-OS-SB03-01	5/66
Endosulfan I	0.78NJ - 2.92J	41-OS-SB18-01	5/66
Dieldrin	0.32J - 60NJ	41-OS-SB18-01	17/66
4,4'-DDE	0.32NJ - 39.6J	41-OS-SB14-01	27/66
Endrin	0.35J - 28.3J	41-OS-SB06-03	11/66
Endosulfan II	0.5NJ - 25.2NJ	41-OS-SB11-01	14/66
4,4'-DDD	0.34NJ - 1060J	41-OS-SB22-03	26/66
4,4'-DDT	0.68NJ - 302J	41-OS-SB14-01	10/66
Methoxychlor	5.47NJ - 5.47NJ	41-OS-SB14-02	1/66
Endrin Ketone	0.86J - 0.86J	41-OS-SB06-03	1/66
Endrin Aldehyde	0.85NJ - 4.38J	41-OS-SB18-01	9/66
Alpha-Chlordane	0.28J - 160J	41-OS-SB03-01	17/66
gamma-Chlordane	0.31J - 170J	41-OS-SB03-01	13/66
Aroclor 1254	36.7J - 214J	41-GW11-03	5/66
Aroclor 1260	34.6J - 317J	41-OS-SB16-01	5/66
CHEMICAL SURETY DEGRADATION COMPOUND			
Acetophenone	120J - 120J	41-OS-SB21-01	1/66

Inorganics Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
Aluminum	486 - 13,500J	41-GW09DW-05	66/66
Antimony	1.92J - 2.94	41-OS-SB06-01	4/66
Arsenic	0.518 - 3.02	41-OS-SB03-01	33/66
Barium	3.15 - 186	41-OS-SB11-01	63/66
Beryllium	0.187 - 0.31	41-OS-SB30-01	10/66
Cadmium	1.32 - 4.73	41-OS-SB11-01	3/66
Calcium	37.3 - 18,900	41-OS-SB08-01	60/66
Chromium	2.1 - 40.5J	41-OS-SB11-01	64/66
Cobalt	4.53 - 4.53	41-OS-SB18-01	1/66
Copper	3.77 - 39.8	41-OS-SB11-01	15/66
Iron	115J - 41,100	41-OS-SB18-01	66/66
Lead	0.894J - 829	41-OS-SB03-01	66/66
Magnesium	18.4 - 567	41-GW09DW-05	65/66
Manganese	1.63 - 244	41-OS-SB18-01	60/66
Mercury	0.057 - 0.312	41-GW11-01	17/66
Nickel	7.56 - 12.9	41-OS-SB18-01	2/66
Potassium	123 - 562	41-GW09DW-05	26/66
Selenium	0.373J - 0.948	41-OS-SB17-01	11/66
Silver	0.202 - 9.71J	41-GW07DW-06	4/66
Sodium	59.3 - 486	41-OS-SB11-01	10/66
Vanadium	4.79 - 25.7	41-GW07-04	44/66
Zinc	2.81J - 481	41-OS-SB11-01	57/66
Total Cyanide	1.06 - 1.63	41-OS-SB30-01	66/66

Source: Baker Environmental, Inc., 1995A

GROUNDWATER RESULTS

Summary of Round One *Shallow Aquifer*

Organic Compounds Detected Above CRQL	Standards (µg/L)		Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
	Federal MCL	NCWQS			
VOLATILES					
Chloroform	100	0.19	1.36J - 3.17J	41-GW10	2/12
Bromodichloromethane	100	--	1.05J - 1.05J	41-GW09	1/12
Dibromodichloromethane	--	--	1.95J - 1.95J	41-GW09	1/12
Benzene	5	1	2.67J - 2.67J	41-GW11	1/12
Bromoform	100	0.19	1.33 - 1.33	41-GW09	1/12
Chlorobenzene	--	50	1.49J - 1.49J	41-GW11	1/12
SEMIVOLATILES					
Bis(2-ethylhexyl) phthalate	--	--	1J - 1J	41-GW13	1/12
Di-n-butylphthalate	--	700	1J - 2J	41-GW03/ 41-GW04	3/12
Naphthalene	--	--	3J - 3J	41-GW11	1/12
PESTICIDES					
alpha-BHC	--	--	0.01J - 0.01J	41-GW09	1/12
beta-BHC	--	--	0.04J - 0.08J	41-GW09	2/12
4,4'-DDD	--	--	0.01NJ - 0.01NJ	41-GW11	1/12
Metals Detected Above CRQL	Standards (µg/L)		Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
	Federal MCL	NCWQS			
TOTAL METALS					
Antimony	6	--	17.9J - 17.9J	41-GW11	1/12
Beryllium	4	--	4.53 - 42.8	41-GW12	6/12
Cadmium	5	5	6.26 - 110	41-GW11	6/12
Chromium	100	50	54.4 - 176	41-GW10	9/12
Copper	1,000	1,000	1,030 - 1,030	41-GW11	1/12
Iron	300	300	13,600 - 160,000	41-GW12	12/12
Lead	15	15	19.8 - 9,340	41-GW11	10/12
Manganese	50	50	56.6 - 2,110	41-GW11	12/12
Nickel	100	--	68.1J - 137	41-GW11	2/12
Silver	--	50	63.4J - 63.4J	41-GW13	1/12
Zinc	--	2,100	5,180 - 5,180	41-GW11	1/12
DISSOLVED METALS					
Antimony	6	--	11.4 - 19.1	41-GW07	5/12
Iron	300	300	313J - 42,400	41-GW04	5/12
Manganese	50	50	129 - 521	41-GW11	6/12

Summary of Round One *Castle Hayne Aquifer*

Organic Compounds Detected Above CRQL	Standards (µg/L)		Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
	Federal MCL	NCWQS			
VOLATILES					
1,2-Dichloroethene (total)	--	--	1.22J - 1.22J	41-GW11DW	1/6
Chloroform	100	0.19	1.02J - 1.02J	41-GW12DW	1/6
Dibromodichloro- methane	--	--	1.27J - 1.27J	41-GW12DW	1/6
SEMIVOLATILES					
Nitrobenzene	--	--	4J - 4J	41-GW09DW	1/6
PESTICIDES/PCBs					
beta-BHC	--	--	00.4J - 0.06J	41-GW04DW	2/6

Metals Detected Above CRQL	Standards (µg/L)		Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
	Federal MCL	NCWQS			
TOTAL METALS					
Iron	300	300	691J - 15,300	41-GW06DW	6/6
Manganese	50	50	87.5 - 101	41-GW06DW	2/6
Silver	--	50	62.8J - 62.8J	41-GW12DW	1/6
DISSOLVED METALS					
Antimony	6	--	11.4 - 15.6	41-GW06DW	5/6
Manganese	50	50	94 - 94	41-GW11DW	1/6

Summary of Round Two *Surficial Aquifer*

Organic Compounds Detected Above CRQL	Standards (µg/L)		Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
	Federal MCL	NCWQS			
VOLATILES					
Acetone	--	700	4J - 12J	41-GW11	3/12
Benzene	5	1	2J - 2J	41-GW11	1/12
Chlorobenzene	--	50	2J - 2J	41-GW11	1/12
Metals Detected Above CRQL	Standards (µg/L)		Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
	Federal MCL	NCWQS			
TOTAL METALS					
Beryllium	4	--	5.25 - 37.4	41-GW12	5/12
Cadmium	5	5	6.49 - 37.5	41-GW05	4/12
Chromium	100	50	67.1 - 166	41-GW03	7/12
Iron	300	300	890 - 199,000	41-GW05	12/12
Lead	15	15	16.1 - 145	41-GW08	7/12
Manganese	50	50	64.3 - 766	41-GW05	11/12
Nickel	100	--	177 - 177	41-GW05	1/12
DISSOLVED METALS					
Antimony	6	--	7.3 - 7.3	41-GW04	1/12
Iron	300	300	789 - 29,500	41-GW04	4/12
Manganese	50	50	73.8 - 352	41-GW02	7/12

Summary of Round Two *Castle Hayne Aquifer*

Metals Detected Above CRQL	Standards (µg/L)		Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
	Federal MCL	NCWQS			
TOTAL METALS					
Cadmium	5	5	5.38 - 8.68	41-GW09DW	3/6
Chromium	100	50	81 - 81	41-GW09DW	1/6
Iron	300	300	3,900 - 34,100	41-GW09DW	6/6
Lead	15	15	15.2 - 34.8	41-GW09DW	3/6
Manganese	50	50	66.8 - 367	41-GW09DW	4/6
DISSOLVED METALS					
Antimony	6	--	19.3 - 19.3	41-GW06DW	1/6
Manganese	50	50	119 - 119	41-GW11DW	1/6
Organic Compounds Detected Above CRQL	Standards (µg/L)		Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
	Federal MCL	NCWQS			
VOLATILES					
1,1,1-Trichloroethane	200	200	19 - 19	41-GW11DW	1/6

SITE 41 REMEDIAL INVESTIGATION

SURFACE WATER RESULTS

First Sampling Event

Organic Compounds Detected Above CRQL	Criteria (µg/L)		Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
	AWQC	NCWQS			
VOLATILES					
Chlorobenzene	680	488	1.00J - 4.00J	41-UN-SW12	2/14
PESTICIDES					
Lindane	--	--	0.02J - 0.02J	41-UN-SW02	1/14
4,4'-DDT	0.00059	0.00059	0.03J - 0.03J	41-UN-SW02	1/14

Metals Detected Above CRQL	Criteria (µg/L)		Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
	Federal AWQC	NCWQS			
TOTAL METALS					
Aluminum	--	--	178 - 3,390	41-UN-SW13	13/14
Barium	1000	1000	17.9 - 113	41-UN-SW13	14/14
Calcium	--	--	9,980 - 84,200	41-UN-SW14	14/14
Chromium	50	--	8.52 - 8.52	41-TC-SW07	1/14
Iron	300	1000	469 - 14,100	41-UN-SW13	14/14
Lead	50	50	1.13J - 12.1	41-UN-SW13	9/14
Magnesium	--	--	1,550 - 12,700	41-UN-SW13	14/14
Manganese	50	50	12.3 - 209	41-UN-SW14	14/14
Mercury	0.144	--	0.101 - 0.101	41-UN-SW13	1/14
Potassium	--	--	923 - 10,200	41-UN-SW13	14/14
Sodium	--	--	4,760 - 23,600	41-UN-SW14	14/14
Zinc	--	--	16.3 - 33.2	41-NE-SW05	9/14

Second Sampling Event

Metals Detected Above CRQL	Criteria (µg/L)		Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
	Federal AWQC	NCWQS			
TOTAL METALS					
Aluminum	--	--	76.6 - 17,800	41-UN-SW24	12/14
Arsenic	0.0022	--	2.2 - 30.2	41-UN-SW24	9/14
Barium	1000	1000	18.4 - 442	41-UN-SW24	14/14
Cadmium	10	--	6.2 - 6.2	41-UN-SW24	1/14
Calcium	--	--	21,100 - 165,000	41-UN-SW23	14/14
Cobalt	--	--	19.6 - 43.9	41-UN-SW24	3/14
Copper	300	--	13.3 - 41.2	41-UN-SW24	4/14
Iron	300	1000	649 - 278,000	41-UN-SW24	14/14
Lead	50	50	3.1 - 36.8	41-UN-SW25	10/14
Magnesium	--	--	1,850 - 13,500	41-UN-SW22	14/14
Manganese	50	50	17.5 - 1,700	41-UN-SW24	14/14
Mercury	0.144	--	0.21 - 0.56	41-UN-SW23	8/14
Nickel	13.4	25	20 - 20	41-UN-SW24	1/14
Potassium	--	--	1,620 - 13,400	41-UN-SW16	14/14
Sodium	--	--	573 - 67,600	41-UN-SW24	14/14
Vanadium	--	--	35.4 - 51.5	41-UN-SW24	3/14
Zinc	--	--	21.4 - 235	41-UN-SW24	14/14
DISSOLVED METALS					
Arsenic	0.0022	--	2 - 2.9	41-UN-SW28	4/14
Barium	1000	1000	18.2 - 82.4	41-UN-SW16	14/14
Calcium	--	--	23,700 - 154,000	41-UN-SW23	14/14
Cobalt	--	--	15.7 - 15.7	41-UN-SW24	1/14
Copper	300	--	11.2 - 23.8	41-UN-SW26	11/14
Iron	300	1000	118 - 12,800	41-UN-SW24	14/14
Lead	50	50	2.4 - 2.4	41-UN-SW28	1/14
Magnesium	--	--	2,020 - 14,200	41-UN-SW22	14/14
Manganese	50	50	18.1 - 1,360	41-UN-SW22	14/14
Potassium	--	--	1,770 - 15,600	41-UN-SW16	14/14
Sodium	--	--	6,860 - 76,800	41-UN-SW24	14/14
Zinc	--	--	5.4 - 14.1	41-UN-SW27	14/14

SITE 41 REMEDIAL INVESTIGATION

SEDIMENT RESULTS

First Sampling Event

Organic Compounds Detected Above CRQL	Criteria (µg/kg)		Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
	NOAA ER-L	NOAA ER-M			
VOLATILES					
Methylene chloride	--	--	2.00J - 7.00J	41-TC-SD07-06	8/28
Acetone	--	--	4.00J - 190.0	41-TC-SD09-06	11/28
Trichloroethene	--	--	2.00J - 2.00J	41-UN-SD14-612	1/28
Toluene	--	--	2.00J - 2.00J	41-TC-SD07-06	2/28

Organic Compounds Detected Above CRQL	Criteria (µg/kg)		Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
	NOAA ER-L	NOAA ER-M			
SEMIVOLATILES					
Benzo(a)pyrene	400	2500	57.0J - 57.0J	41-TC-SD06-06	1/28
Benzo(b)fluoranthene	--	--	69.0J - 69.0J	41-TC-SD06-06	1/28
Benzo(k)fluoranthene	--	--	58.0J - 58.0J	41-TC-SD06-06	1/28
Bis(2-ethylhexyl) phthalate	--	--	44J - 94J	41-UN-SD10-612	5/28
Di-n-butylphthalate	--	--	48.0J - 370J	41-UN-SD10-06	6/28
Di-n-octylphthalate	--	--	49.0J - 310.0J	41-UN-SD03-612	3/28
Fluoranthene	600	3600	100.0J - 100.0J	41-TC-SD06-06	1/28
Pyrene	350	2200	100.0J - 100.0J	41-TC-SD06-06	1/28
PESTICIDES/PCBs					
Dieldrin	0.02	8	0.46 - 6.39NJ	41-UN-SD13-06	10/28
Endosulfan II	--	--	0.64NJ - 8.22J	41-UN-SD14-06	19/28
4,4'-DDE	2	15	0.53J - 31.3J	41-UN-SD10-612	8/28
4,4'-DDD	2	20	0.38NJ - 73.9J	41-UN-SD10-612	18/28
4,4'-DDT	1	7	0.36NJ - 34.8J	41-TC-SD06-06	15/28
Methoxychlor	--	--	0.91J - 21.7J	41-TC-SD09-06	6/28
Endrin Ketone	--	--	0.66NJ - 0.66NJ	41-UN-SD11-612	1/28
Alpha-Chlordane	--	--	0.34J - 3.72J	41-UN-SD10-06	13/28
Gamma-Chlordane	--	--	0.4J - 6.35J	41-UN-SD10-06	11/28
Aroclor 1248	50	400	63.0J - 140.0J	41-UN-SD13-612	2/28
Aroclor 1254	50	400	68.0J - 68.0J	41-UN-SD13-06	1/28
ORDNANCE					
1,3,5-Trinitrobenzene	--	--	1,390.0 - 1,390.0	41-UN-SD14-06	1/28

Metals Detected Above CRQL	Criteria (mg/kg)		Range of Positive Detections (mg/kg)	Maximum Concentration Sample Location	Frequency
	NOAA ER-L	NOAA ER-M			
TOTAL METALS					
Aluminum	--	--	351 - 18,800	41-TC-SD09-06	28/28
Arsenic	33	85	0.617 - 3.67	41-TC-SD09-06	9/28
Barium	--	--	3.06 - 79.9	41-TC-SD09-06	22/28
Beryllium	--	--	0.235 - 0.413	41-UN-SD10-06	5/28
Calcium	--	--	96.3J - 4,790	41-TC-SD09-06	28/28
Chromium	80	145	2.42 - 16.5J	41-TC-SD09-06	13/28
Copper	70	390	7.34 - 8.34	41-UN-SD13-612	2/28
Iron	--	--	262J - 15,100	41-TC-SD09-06	28/28
Lead	35	110	1.10 - 59.4	41-UN-SD13-06	28/28
Magnesium	--	--	15.3 - 1,590	41-UN-SD10-06	28/28
Manganese	--	--	1.38 - 46.4	41-TC-SD09-06	23/28
Nickel	30	50	3.79 - 5.97	41-UN-SD01-06	6/28
Potassium	--	--	332 - 1,060	41-TC-SD09-06	5/28
Selenium	--	--	0.629J - 0.862J	41-TC-SD06-612	4/28
Silver	1	2.2	1.14 - 29.7	41-UN-SD13-06	3/28
Sodium	--	--	73.6 - 1,480	41-TC-SD09-06	9/28
Thallium	--	--	1.19J - 1.19J	41-UN-SD04-612	1/28
Vanadium	--	--	9.72 - 11.8	41-UN-SD13-612	8/28
Zinc	120	270	13.6 - 85.3	41-TC-SD09-06	11/28

Second Sampling Event

Organic Compounds Detected Above CRQL	Criteria (µg/kg)		Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
	NOAA ER-L	NOAA ER-M			
PESTICIDES/PCBs					
4,4'-DDE	2	15	7.8 - 19	41-UN-SD25-06	3/14
4,4'-DDD	2	20	4.2 - 42	41-UN-SD27-06	4/14
4,4'-DDT	1	7	5.8 - 210	41-UN-SD20-06	2/14

Organic Compounds Detected Above CRQL	Criteria(mg/kg)		Range of Positive Detections (mg/kg)	Maximum Concentration Sample Location	Frequency
	NOAA ER-L	NOAA ER-M			
TOTAL METALS					
Aluminum	--	--	276 - 10,200	41-UN-SD25-06	14/14
Arsenic	33	85	0.6 - 9.3	41-UN-SD25-06	4/14
Barium	--	--	1.4 - 161	41-UN-2D25-06	14/14
Calcium	--	--	48.6 - 8,420	41-UN-SD25-06	14/14
Chromium	80	145	2.3 - 2.8	41-UN-SD24-06	3/14
Cobalt	--	--	2.8 - 2.8	41-UN-SD24-06	1/14
Copper	70	390	6.3 - 19.9	41-UN-SD25-06	2/14
Iron	--	--	300 - 104,000	41-UN-SD25-06	14/14
Lead	35	110	1.5 - 28.1	41-UN-SD25-06	14/14
Magnesium	--	--	24.2 - 321	41-UN-SD25-06	14/14
Manganese	--	--	1.3 - 306	41-UN-SD23-06	14/14
Mercury	0.15	1.3	0.46 - 0.63	41-UN-SD23-06	2/14
Sodium	--	--	29.8 - 410	41-UN-SD25-06	14/14
Vanadium	--	--	3.5 - 30	41-UN-SD25-06	4/14
Zinc	120	270	5.85 - 155	41-UN-SD25-06	14/14

SITE 74 REMEDIAL INVESTIGATION

SURFACE SOIL RESULTS

Organic Compounds Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
VOLATILES			
Methylene Chloride	4J - 23.0J	74-FDA-SB33-00	20/60
Acetone	4J - 210J	74-FDA-SB05-00	22/60
Trichloroethene	2J - 8J	74-FDA-SB18-00	5/60
Toluene	1J - 3J	74-FDA-SB13-00	3/60
Styrene	1J - 1J	74-FDA-SB37-00	1/60
Xylenes (total)	3J - 6J	74-FDA-SB05-00	2/60
SEMIVOLATILES			
4-Chloro-3-Methylphenol	54J - 240J	74-FDA-SB17-00	2/60
Acenaphthene	39J - 39J	74-PDA-SB01-00	1/60
Benzo(a)pyrene	130J - 130J	74-FDA-SB23-00	1/60
Benzo(g,h,i)perylene	61J - 160J	74-FDA-SB31-00	2/60
Bis(2-chloroethyl)ether	12J - 180J	74-FDA-SB02-00	5/60
Bis(2-ethylhexyl)phthalate	240J - 240J	74-FDA-SB14-00	1/60
Diethylphthalate	86J - 866	74-PDA-SB04-00	2/60
Di-n-Butylphthalate	39J - 126J	74-FDA-SB02-00	13/60
Pyrene	38J - 38J	74-PDA-SB01-00	1/60
PESTICIDES/PCBs			
alpha-BHC	0.45J - 0.45J	74-FDA-SB23-00	2/60
Heptachlor	0.2NJ - 298J	74-PDA-SB13-00	8/60
Aldrin	0.41NJ - 0.41NJ	74-FDA-SB04-00	1/60
Heptachlor Epoxide	0.21J - 1.43J	74-FPA-SB03-00	5/60
Dieldrin	0.32J - 706NJ	74-PDA-SB13-00	5/60
4,4'-DDE	0.31J - 1,730J	74-PDA-SB13-00	31/60
Endrin	0.42J - 1.06J	74-FPA-SB06-00	3/60
Endosulfan II	0.44NJ - 1.31NJ	74-FPA-SB03-00	3/60
4,4'-DDD	0.37NJ - 3,700J	74-PDA-SB06-00	17/60
4,4'-DDT	0.81J - 3,840J	74-PDA-SB13-00	22/60
Methoxychlor	166J - 166J	74-PDA-SB13-00	1/60

Organic Compounds Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
Endrin Aldehyde	0.5NJ - 2.29NJ	74-PDA-SB14-00	5/60
Alpha-Chlordane	0.39J - 1,160J	74-PDA-SB13-00	8/60
Gamma-Chlordane	0.45J - 1,680J	74-PDA-SB13-00	8/60
CHEMICAL SURETY DEGRADATION COMPOUNDS			
Hydroxyacetophenone	190J -190J	74-FDA-SB25-00	1/37

Inorganics Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
Aluminum	36.3 - 10,900	74-FDA-SB20-00	60/60
Antimony	1.72 - 3.43	74-PDA-SB08-00	2/60
Arsenic	0.621J - 1.16	74-FDA-SB12-00	9/60
Barium	2.89 - 54.7	74-FPA-SB02-00	54/60
Cadmium	0.543 - 0.686	75-FDA-SB05-00	4/60
Calcium	34.9 - 175,000	74-FPA-SB02-00	53/60
Chromium	1.89 - 10.6	74-FPA-SB02-00	50/60
Copper	5.07 - 22	74-FDA-SB34-00	4/60
Iron	31.2J - 34,200	74-FDA-SB08-00	60/60
Lead	0.878J - 15.4	74-FDA-SB31-00	60/60
Magnesium	16.3 - 2,790	74-FPA-SB02-00	52/60
Manganese	1.44 - 96.2	74-FDA-SB08-00	58/60
Mercury	0.015 - 0.092	74-FPA-SB04-00	8/60
Nickel	3.15 - 4.78	74-FDA-SB08-00	6/60
Potassium	80.7 - 351	74-FPA-SB02-00	16/60
Selenium	0.609 - 1.2	74-FDA-SB17-00	14/60
Silver	0.116J - 0.116J	74-FDA-SB23-00	1/60

Inorganics Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
Sodium	105J - 860	74-FDA-SB29-00	10/60
Vanadium	4.03 - 15.1	74-FDA-SB20-00	34/60
Zinc	2.27 - 33.9	74-FPA-SB02-00	33/60
Total Cyanide	1.05 - 1.37	74-FDA-SB06-00	60/60

SITE 74 REMEDIAL INVESTIGATION

SUBSURFACE SOIL RESULTS

Organic Compounds Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
VOLATILES			
Methylene Chloride	190 - 190	74-FPA-SB04-04	1/47
Acetone	6.00J - 820.0	74-FDA-SB08-04	32/47
SEMIVOLATILES			
Bis(2-ethylhexyl)phthalate	37.0J - 240.0J	74-GW08-03	8/47
Diethylphthalate	874 - 874	74-PDA-SB06-04	1/47
Di-n-Butylphthalate	43.0J - 155.0J	74-FPA-SB02-06	10/47
PESTICIDES/PCBs			
Heptachlor	0.240J - 1.59J	74-GW03A-04	3/47
Aldrin	0.400J - 0.400J	74-PDA-SB09-06	1/47
Heptachlor Epoxide	0.330J - 0.330J	74-PDA-SB08-02	1/47
4,4'-DDE	1.05NJ - 21.3J	74-FPA-SB03-03	5/47
4,4'-DDD	0.590J - 3.61J	74-PDA-SB06-04	5/47
4,4'-DDT	0.340J - 21.37J	74-PDA-SB06-02	9/47
Methoxychlor	7.06J - 7.06J	74-FPA-SB01-03	1/57
Endrin Aldehyde	0.48NJ - 0.77NJ	74-GW03A-03	2/47

Inorganics Detected Above CRQL	Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
Aluminum	349 - 9,380	74-FPA-SB09-07	47/47
Antimony	1.9 - 1.97	74-PDA-SB04-05	2/47
Arsenic	0.538 - 2.76	74-PDA-SB02-03	10/47
Barium	2.77 - 17.5	74-PDA-SB07-01	29/47
Calcium	34 - 2,250	74-FPA-SB04-08	23/47
Chromium	1.92 - 9.91	74-FPA-SB02-03	41/47
Iron	123 - 4,940	74-FPA-SB06-03	47/47
Lead	0.751 - 7.42	74-FPA-SB04-08	47/47
Magnesium	15.4 - 250	74-FPA-SB09-07	45/47
Manganese	1.55 - 21.7	74-PDA-SB05-02	32/47
Mercury	0.056 - 0.056	74-GW04-05	1/47
Potassium	191 - 302	74-PDA-SB10-08	4/47
Selenium	0.818 - 0.818	74-GW07-01	1/47
Vanadium	3.93 - 14.2	74-FPA-SB06-03	16/47
Zinc	2.51 - 11.9	74-FPA-SB04-08	18/47
Total Cyanide	1.05 - 1.25	74-GW08-03	47/47

Source: Baker Environmental, Inc., 1995A

SITE 74 REMEDIAL INVESTIGATION

GROUNDWATER RESULTS

Organic Compounds Detected Above CRQL	Standards (µg/L)		Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
	Federal MCL	NCWQS			
VOLATILES					
Acetone	--	700	2J - 2.04J	74-GW03A	1/8
SEMIVOLATILES					
Di-n-Butylphthalate	--	700	2J - 2J	74-GW04	1/8
PESTICIDES/PCBs					
Lindane	0.2	0.2	0.04J - 0.04J	74-GW08	1/7
Heptachlor	0.4	0.008	0.01NJ - 0.01NJ	74-GW01	1/7
Endosulfan II	--	--	0.02J - 0.02J	74-GW08	1/7
Alpha-Chlordane	2	0.027	0.02NJ - 0.02NJ	74-GW08	1/7
Metals Detected Above CRQL	Standards (µg/L)		Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
	Federal MCL	NCWQS			
TOTAL METALS					
Chromium	100	50	56.6 - 56.6	74-GW01	1/8
Iron	300	300	821 - 96,100.0	74-GW02	8/8
Lead	15	15	15.3 - 15.3	74-GW01	1/8
Manganese	50	50	115.0 - 115.0	74-GW02	1/8
DISSOLVED METALS					
Antimony	6	--	8.26 - 8.26	74-GW08	1/8
Iron	300	300	350 - 1,040	74-GW03A	4/5
Manganese	50	50	1,730 - 1,730	74-GW07	1/8

SITE 74 REMEDIAL INVESTIGATION

SURFACE WATER RESULTS

Metals Detected Above CRQL	Criteria (µg/L)		Range of Positive Detections (µg/L)	Maximum Concentration Sample Location	Frequency
	Federal AWQC	NCWQS			
Aluminum	--	--	127J - 492J	74-PDA-SW01	3/3
Calcium	--	--	10,400 - 11,700	74-PDA-SW02	3/3
Iron	300	--	138 - 274	74-PDA-SW02	3/3
Lead	50	50	1.62J - 6.04J	74-PDA-SW02	3/3
Magnesium	--	--	782 - 881	74-PDA-SW02	3/3
Potassium	--	--	448 - 719	74-PDA-SW01	2/3
Sodium	--	--	13,400 - 21,700	74-PDA-SW02	3/3

SITE 74 REMEDIAL INVESTIGATION

SEDIMENT RESULTS

Organic Compounds Detected Above CRQL	Criteria (µg/kg)		Range of Positive Detections (µg/kg)	Maximum Concentration Sample Location	Frequency
	NOAA ER-L	NOAA ER-M			
VOLATILES					
Trichloroethene	--	--	8.0J - 8.0J	74-PDA-SD01-06	1/3
SEMIVOLATILES					
3,3-Dichlorobenzidine	--	--	140.0J - 140.0J	74-PDA-SD03-06	1/3
PESTICIDES/PCBs					
4,4'-DDE	2	15	0.900J - 1.85J	74-PDA-SD01-06	2/3
4,4'-DDT	1	7	0.820NJ - 0.820NJ	74-PDA-SD02-06	1/3
Endosulfan II	--	--	0.63J - 0.80J	74-PDA-SD03-06	2/3
Methoxychlor	--	--	0.830J - 0.83J	74-PDA-SD02-06	1/3
Endrin Aldehyde	--	--	1.35NJ - 1.35NJ	74-PDA-SD03-06	1/3

Metals Detected Above CRQL	Criteria (mg/kg)		Range of Positive Detections (mg/kg)	Maximum Concentration Sample Location	Frequency
	NOAA ER-L	NOAA ER-M			
Aluminum	--	--	584 - 3,320	74-PDA-SD02-06	3/3
Barium	--	--	5,73 - 13	74-PDA-SD02-06	2/3
Calcium	--	--	178 - 725	74-PDA-SD02-06	3/3
Chromium	80	145	1.8 - 3.13	74-PDA-SD02-06	2/3
Iron	--	--	199 - 1,530	74-PDA-SD02-06	3/3
Lead	35	110	2.67J - 6.06J	74-PDA-SD02-06	3/3
Magnesium	--	--	19.3 - 102	74-PDA-SD02-06	3/3
Manganese	--	--	2.76 - 5.27	74-PDA-SD02-06	3/3
Selenium	--	--	1.02 - 1.02	74-PDA-SD03-06	1/3
Vanadium	--	--	4.4 - 4.4	74-PDA-SD03-06	1/3
Zinc	120	270	12.6 - 12.6	74-PDA-SD02-06	1/3

Appendix C
OHM Remediation Services Corporation
Contractor's Closeout Report

**OHM Remediation
Services Corp.**

A Subsidiary of OHM Corporation

September 18, 1996

Ms. Kate Landman
Atlantic Division Code 18232
Naval Facilities Engineering Command
1510 Gilbert Street
Norfolk, VA 23511-2699

Re: Contractor's Closeout Report
Site 41, MCAS New River
Contract N62470-93-D-3032; Delivery Order 0101
MCB Camp Lejeune, NC

Dear Ms. Landman:

Submitted for your review and approval is this letter Closeout Report for D.O. 0101, Site 41, MCAS New River, MCB Camp Lejeune, N.C.

Overview

OHM installed fencing and signs in support of D.O. 0101 to restrict access to Site 41 at the Marine Corps Air Station. Site access was required to be restricted because Site 41 was previously used as an open burn dump from 1946 to 1970. In addition to construction debris and several other types of waste, it is reported that in the mid-1960s, at least two waste disposal incidents occurred involving the disposal of drummed wastes from trucks. These wastes were described as being similar to the types of wastes disposed of at Site 69 (Rifle Range Chemical Dump).

Field Activities

OHM commenced field activities on August 8, 1996 and completed the field work on August 15, 1996. A photo log is attached documenting the work performed.

OHM installed 150 feet of fencing with twin 10 feet wide swing gates across a dirt road at the southeast access to the site. At the west access via the same road OHM installed 50 feet of fence with a 16 feet swing gate. Figure 1 identifies the as built locations of the fencing and gates.

Thirty four 24 inches by 24 inches metallic signs were installed around the east, west and southern boundaries of the site. These signs were posted on existing trees and adjacent to the two gates. The signs have a yellow background with red lettering. Figure 1 also indicates the locations of the signs.

Health & Safety Issues

The project was completed safely without any accidents or near misses.

Schedule Impacts/Changes

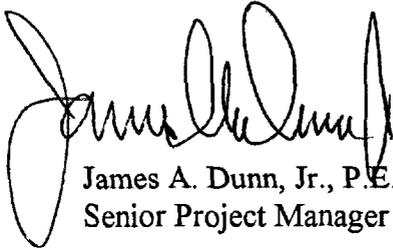
The project was delayed awaiting final approval from the New River Air Station of the sign wording and locations. The signs were changed from a green background with white lettering to a yellow background with red lettering. The final wording on the signs is as follows:

**KEEP OUT
HAZARDOUS
WASTE
SITE**

Additional signs were installed to encompass the southern boundary of the site (34 versus 15).

The final inspection and approval of the site was conducted with the ROICC on September 18, 1996.

Very truly yours,
OHM Remediation Services, Inc.



James A. Dunn, Jr., P.E.
Senior Project Manager

Attachments

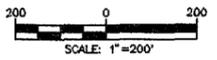
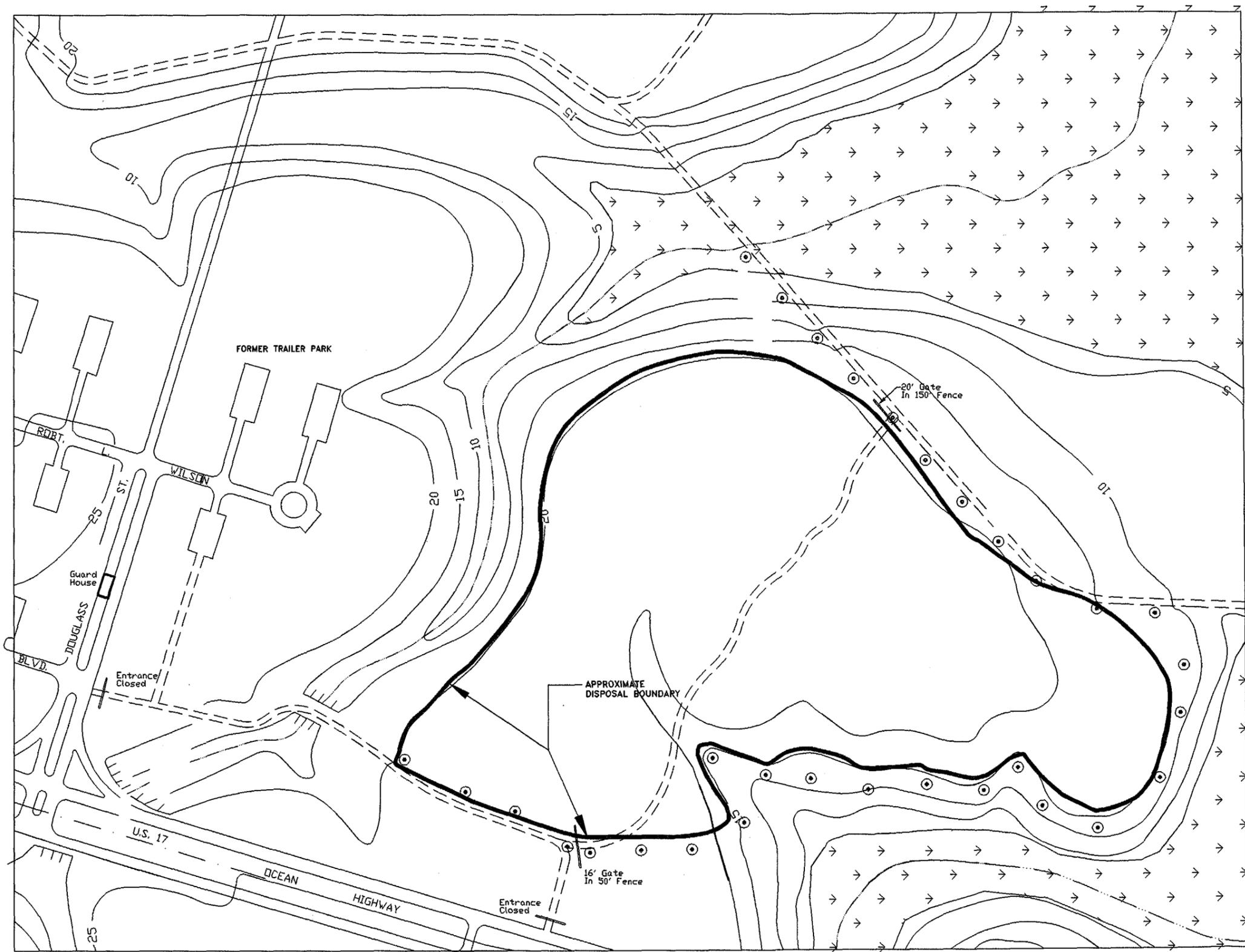
- I. Photo Log
- II. Figure 1

pc: See Page 3

Page 3

Closeout Report, Site 41

pc: Neal Paul - IRD/EMD w/enclosures (2)
Lt. Hansen - ROICC w/enclosures
Matt Bartman - Baker Environmental w/enclosures
Dave Lown - NCDEHNR w/enclosures
John Franz - OHM w/enclosures
Jerry Haste - NAVFACENGCOM w/enclosures
Gena Townsend - EPA Region IV w/enclosures
OHM Project File/18421 w/enclosures
Dwayne Currie - OHM w/enclosures
Greg Gilles - OHM w/enclosures
Chuck Lawrence - Stone & Webster w/enclosures
Project File 18421-14.3 w/enclosures



LEGEND

- MARSH
- TOPOGRAPHIC ELEVATION LINES (FEET, MEAN SEA LEVEL)
- ROAD (IMPROVED)
- ROAD (UNIMPROVED)
- INTERMITTENT STREAM
- SIGN @ 200' O.C. INSTALLED ON GATES OR EXISTING TREES

SOURCE: LANTDIV, OCT. 1991, BAKER 1996

OHM Remediation Services Corp. NORCROSS, GEORGIA A SUBSIDIARY OF OHM CORPORATION		
DRAWN BY	J. LANGE	3/15/96
CHECKED BY	J. DUNN	3/15/96
APPROVED BY	-	DATE
REV. 0	SHEET # -	PROJECT NO. 18421

FIGURE 2
AS BUILT
GENERAL ARRANGEMENT MAP
SITE 41-CAMP GEIGER DUMP
 D.O. 101
 MCB CAMP LELEUNE
 PREPARED FOR
 LANTDIV

01808 II 012

D:\OHM\LANTDIV\LELEUNE\18421\F162.DWG



Project No. 18421 **Date: 8/14/96**
Contract No. N62470-93-D-3032
Delivery Order: 101
Description: 150-foot section of fence with 20-foot gate on the east end of the spine road



Project No. 18421 **Date: 8/14/96**
Contract No. N62470-93-D-3032
Delivery Order: 101
Description: 50 foot section of fence with 20 foot gate on the west end of the spine road

01808 IIBIY



Project No. 18421 **Date: 8/14/96**
Contract No. N62470-93-D-3032
Delivery Order: 101
Description: Warning sign posted at 200 foot intervals
around the southern end



Project No. 18421 **Date: 8/14/96**
Contract No. N62470-93-D-3032
Delivery Order: 101
Description: Warning sign posted on the gate of the west
end of the spine road



Project No. 18421 **Date: 8/14/96**
Contract No. N62470-93-D-3032
Delivery Order: 101
**Description: Warning sign posted on the gate of the east
end of the spine road**

IDENTIFICATION #	DESCRIPTION
OU4.SITE41.1994.1	VIEW OF BAKER AND DRILLING SUBCONTRACTOR INSTALLING MONITORING WELL 41-GW13, LOOKING SOUTHWEST.
OU4.SITE41.1994.2	VIEW OF BAKER AND DRILLING SUBCONTRACTOR DEVELOPING MONITORING WELL 41-GW12, LOOKING WEST.
OU4.SITE41.1994.3	VIEW OF DRAINAGE AREA LOCATED IN THE NORTHWESTERN AREA OF SITE 41 WHICH FLOWS NORTHEAST INTO THE SMALL UNNAMED CREEK WHICH BISECTS SITE 41 AND FLOWS WEST TO EAST, LOOKING NORTHEAST.
OU4.SITE41.1994.4	VIEW OF DRAINAGE AREA WITH ORANGE/RUST COLORATION AND A MILKY WHITE SHEEN ON THE WATER SURFACE, LOOKING NORTHEAST.
OU4.SITE41.1994.5	CLOSEUP OF DRAINAGE AREA WITH THE ORANGE/RUST COLORATION AND MILKY WHITE SHEEN ON THE WATER SURFACE,LOOKING EAST.
OU4.SITE41.1994.6	UPSTREAM VIEW OF DRAINAGE AREA LOCATED IN THE NORTHEASTERN AREA OF SITE 41 WHICH FLOWS NORTH INTO THE SMALL UNNAMED CREEK WHICH BISECTS SITE 41 AND FLOWS WEST TO EAST, ORANGE/RUST COLORATION AND MILKY WHITE SHEEN PRESENT, LOOKING SOUTH.
OU4.SITE41.1994.7	UPSTREAM VIEW OF A UNNAMED TRIBUTARY WHICH FLOWS FROM THE NORTH TO THE SOUTH JOINING THE UNNAMED CREEK IN THE NORTHEAST CORNER OF SITE 41, ALSO SURFACE WATER AND SEDIMENT SAMPLING STATION NUMBER 5, LOOKING NORTH, DOUGLASS STREET IN BACKGROUND.
OU4.SITE41.1994.8	UPSTREAM VIEW OF SURFACE WATER AND SEDIMENT SAMPLING STATION NUMBER 8, LOCATED ON TANK CREEK WHICH BORDERS SITE 41 TO THE SOUTH, LOOKING WEST.
OU4.SITE41.1994.9	UPSTREAM VIEW OF SURFACE WATER AND SEDIMENT SAMPLING STATION NUMBER 8, LOCATED ON TANK CREEK, WITH PARTIALLY CONSTRUCTED BEAVER DAM AND BEAVER TREE MARKINGS PRESENT TO THE RIGHT, LOOKING WEST.
OU4.SITE41.1994.10	UPSTREAM VIEW OF SURFACE WATER AND SEDIMENT SAMPLING STATION NUMBER 9, LOCATED ON TANK CREEK,BAKER PERSONNEL FILLING SAMPLE CONTAINERS WITH SEDIMENT SAMPLE, LOOKING WEST.
OU4.SITE41.1994.11	VIEW OF SURFACE AND SEDIMENT SAMPLING STATION NUMBER 7, LOCATED ON TANK CREEK, LOOKING SOUTHEAST.

IDENTIFICATION #	DESCRIPTION
OU4.SITE41.1994.12	VIEW OF HAND AUGERING SAMPLING LOCATION 41-OS-SB32, SURFACE DEBRIS PRESENT IN BACKGROUND, LOOKING NORTHEAST
OU4.SITE41.1994.13	VIEW OF HAND AUGERING SAMPLING LOCATION 41-OS-SB31, TUBULAR OBJECTS PRESENT IN MIDDLE AND TO THE LEFT ARE DISCARDED ROCKET LAUNCHERS, ALSO ATV DRILLING RIG PRESENT IN UPPER LEFT CORNER INSTALLING 41-GWO7DW, LOOKING NORTH.
OU4.SITE41.1994.14	VIEW OF HAND AUGERING SAMPLING LOCATION 41-OS-SB28, PARTIALLY BURIED 55-GALLON DRUM PRESENT, LOOKING WEST.
OU4.SITE41.1994.15	VIEW OF HAND AUGERING SAMPLING LOCATION 41-OS-SB25, 5-GALLON CONTAINER OF DRY CLEANING SOLVENT PRESENT, LOOKING NORTHEAST.
OU4.SITE41.1994.16	VIEW OF HAND AUGERING SAMPLING LOCATION 41-OS-SB27, PARTIALLY BURIED 55-GALLON DRUM, LOOKING SOUTHWEST.
OU4.SITE41.1994.17	VIEW OF HAND AUGERING SAMPLING LOCATION 41-OS-SB33, SURFACE DEBRIS PRESENT IN BACKGROUND, LOOKING NORTHEAST.
OU4.SITE41.1994.18	VIEW OF HAND AUGERING SAMPLING LOCATION 41-OS-SB26, METALLIC CYLINDRICAL OBJECT PRESENT IN BACKGROUND, LOOKING SOUTHWEST.
OU4.SITE41.1994.19	VIEW OF HAND AUGERING SAMPLING LOCATION 41-OS-SB31, CRUSHED DRUM PRESENT TO THE RIGHT AND MOUNDS OF CONCRETE IN THE BACKGROUND, LOOKING WEST.
OU4.SITE41.1994.20	VIEW OF METALLIC SURFACE DEBRIS, HAND AUGERING SAMPLING LOCATION 41-OS-SB32 LOCATED BEHIND DEBRIS PILE, LOOKING WEST.
OU4.SITE41.1994.21	VIEW OF HAND AUGERING SAMPLING LOCATION 41-OS-SB32, METALLIC DEBRIS PILE PRESENT IN BACKGROUND, LOOKING EAST.
OU4.SITE41.1994.22	VIEW OF POSTS AND BARBED WIRE THAT FORMED A 10' x 10' SECTIONED OFF SQUARE LOCATED IN THE NORTHWESTERN PORTION OF SITE 41, LOOKING NORTHEAST.
OU4.SITE41.1994.23	VIEW OF COMPLETED WELLS 41-GWO7 AND 41-GWO7DW, WATER LEVEL METER PRESENT TO THE RIGHT, LOOKING SOUTH.
OU4.SITE69.1994.24	VIEW OF U.S. ARMY TECHNICAL ESCORT UNITS MONITORING EQUIPMENT (MINICAM), UTILIZED TO DETECT CHEMICAL WARFARE AGENTS, LOOKING SOUTHEAST.

IDENTIFICATION #	DESCRIPTION
OU4.SITE69.1994.25	VIEW OF U.S. ARMY TECHNICAL ESCORT UNITS MONITORING EQUIPMENT SET-UP, FROM BACKGROUND TO FOREGROUND: MINICAM, RESULTS PRINTER, CALIBRATION STANDARD PRINTER, EXTERNAL BATTERY PACK AND SURGE PROTECTOR, AND BLACK HEATED SAMPLE LINE, LOOKING NORTH.
OU4.SITE69.1994.26	VIEW OF U.S. ARMY TECHNICAL ESCORT UNITS EXTERNAL POWER SOURCE SET-UP, LOOKING SOUTHEAST.
OU4.SITE69.1994.27	VIEW OF BAKER AND DRILLING SUBCONTRACTOR IN THE PROCESS OF OBTAINING SUBSURFACE SOIL SAMPLES FROM 69-GW12DW, ACTIVITY TO THE RIGHT SHOWS THE ADDITION OF A 5' DRILLING FLIGHT, ACTIVITY TO THE LEFT SHOWS THE DECONTAMINATION OF SPLIT SPOONS, LOOKING SOUTHEAST.
OU4.SITE69.1994.28	VIEW OF BAKER PERSONNEL OBTAINING PID(HNU) POINT SOURCE READINGS, USED TO EVALUATE HEALTH AND SAFETY LEVELS OF PROTECTION, LOOKING SOUTHEAST.
OU4.SITE69.1994.29	VIEW OF BAKER AND DRILLING SUBCONTRACTOR IN LEVEL B AT WELL LOCATION 69-GW10, LOOKING NORTHWEST.
OU4.SITE69.1994.30	VIEW OF DRILLING SUBCONTRACTOR SPLITSPOONING WELL 69-GW10, BAKER PERSONNEL IN BACKGROUND, LOOKING NORTHEAST.
OU4.SITE69.1994.31	VIEW OF UNEXPLODED ORDNANCE SUBCONTRACTOR (UXO) PERFORMING A SECONDARY CLEARANCE ON BOREHOLE 69-GW10 FOR METAL DEBRIS, LOOKING EAST.
OU4.SITE69.1994.32	VIEW OF BAKER PERSONNEL SUITED UP IN LEVEL B PROTECTION, DECONTAMINATION SET-UP FOR SPLIT SPOONS IN BACKGROUND, LOOKING EAST.
OU4.SITE69.1994.33	VIEW OF U.S. ARMY TECHNICAL ESCORT UNIT PERSONNEL SUITED UP IN A MODIFIED LEVEL C PROTECTION, STRAPPED TO PERSONNEL'S LEFT SIDE IS A DETECTOR KIT UTILIZED FOR SPECIFIC CHEMICAL AGENTS, ALSO A HAND HELD VERSION OF THE MINICAM IS PRESENT IN THE RIGHT HAND, LOOKING SOUTHEAST.
OU4.SITE69.1994.34	VIEW OF COMPLETED WELLS 69-GW12 AND 69-GW12DW LOCATED IN THE SOUTHERN PORTION OF SITE 69, LOOKING SOUTHEAST.
OU4.SITE74.1994.35	VIEW OF POTENTIAL FOXHOLE LOCATED WITHIN THE PEST CONTROL AREA, LOOKING NORTH.
OU4.SITE74.1994.36	VIEW OF ANOTHER POTENTIAL FOXHOLE LOCATED WITHIN THE PEST CONTROL AREA, LOOKING NORTHWEST.

IDENTIFICATION #**DESCRIPTION****OU4.SITE74.1994.37****VIEW OF DRAINAGE AREA WHICH ACCEPTS RUN-OFF FROM THE PEST CONTROL AREA, AND WHICH RUNS TO THE SOUTH INTO HENDERSON POND, LOOKING NORTH.****OU4.SITE74.1994.38****VIEW OF HENDERSON POND WHICH IS SOUTH OF THE PEST CONTROL AREA, LOOKING SOUTH.****OU4.SITE74.1994.39****VIEW OF ACCESS ROAD WHICH LEADS INTO THE FORMER DISPOSAL AREA, THE ROAD BORDERS THE SITE TO THE EAST, LOOKING NORTH.****OU4.SITE74.1994.40****VIEW OF DRILLING SUBCONTRACTOR PERFORMING HAND AUGERING IN THE SOUTHEAST CORNER OF THE FORMER DISPOSAL AREA, LOOKING NORTHWEST.****OU4.SITE74.1994.41****VIEW OF BAKER, SUBCONTRACTORS, AND U.S. ARMY TECHNICAL ESCORT UNIT SETTING UP FOR DRILLING OPERATIONS ON 74-GW06, LOOKING NORTH.****OU4.SITE74.1994.42****VIEW OF COMPLETED WELL 74-GW06, WELL IS LOCATED ON THE EASTERN EDGE OF THE FORMER DISPOSAL AREA, LOOKING NORTH.**



OU4.SITE41.1994.1

VIEW OF BAKER AND DRILLING SUB-CONTRACTOR
INSTALLING MONITORING WELL 41-GW13, LOOKING
SOUTHWEST.



OU4.SITE41.1994.2

VIEW OF BAKER AND DRILLING SUB-CONTRACTOR
DEVELOPING MONITORING WELL 41-GW12, LOOKING
WEST.





OU4.SITE41.1994.4

**VIEW OF DRAINAGE AREA WITH ORANGE/RUST
COLORATION AND A MILKY WHITE SHEEN ON THE
WATER SURFACE, LOOKING NORTHEAST.**



OU4.SITE41.1994.5

**CLOSEUP OF DRAINAGE AREA WITH THE ORANGE/RUST
COLORATION AND MILKY WHITE SHEEN ON THE WATER
SURFACE, LOOKING EAST.**



OU4.SITE41.1994.6

**UPSTREAM VIEW OF DRAINAGE AREA LOCATED IN THE
NORTHEASTERN AREA OF SITE 41 WHICH FLOWS NORTH
INTO THE SMALL UNNAMED CREEK WHICH BISECTS SITE
41 AND FLOWS WEST TO EAST, ORANGE/RUST
COLORATION AND MILKY WHITE SHEEN PRESENT,
LOOKING SOUTH.**



OU4.SITE41.1994.7

UPSTREAM VIEW OF A UNNAMED TRIBUTARY WHICH FLOWS FROM THE NORTH TO THE SOUTH JOINING THE UNNAMED CREEK IN THE NORTHEAST CORNER OF SITE 41, ALSO SURFACE WATER AND SEDIMENT SAMPLING STATION NUMBER 5, LOOKING NORTH, DOUGLASS STREET IN BACKGROUND.



OU4.SITE41.1994.8

UPSTREAM VIEW OF SURFACE WATER AND SEDIMENT
SAMPLING STATION NUMBER 8, LOCATED ON TANK
CREEK WHICH BORDERS SITE 41 TO THE SOUTH,
LOOKING WEST.



OU4.SITE41.1994.9

**UPSTREAM VIEW OF SURFACE WATER AND SEDIMENT
SAMPLING STATION NUMBER 8, LOCATED ON TANK
CREEK, WITH PARTIALLY CONSTRUCTED BEAVER DAM
AND BEAVER TREE MARKINGS PRESENT TO THE RIGHT,
LOOKING WEST.**



OU4.SITE41.1994.10

UPSTREAM VIEW OF SURFACE WATER AND SEDIMENT
SAMPLING STATION NUMBER 9, LOCATED ON TANK
CREEK, BAKER PERSONNEL FILLING SAMPLE
CONTAINERS WITH SEDIMENT SAMPLE, LOOKING WEST.



OU4.SITE41.1994.11

**VIEW OF SURFACE AND SEDIMENT SAMPLING STATION
NUMBER 7, LOCATED ON TANK CREEK, LOOKING
SOUTHEAST.**

0
1
2
3
4
5
6
7
8
9
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B
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H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z



OU4.SITE41.1994.12
VIEW OF HAND AUGERING SAMPLING LOCATION
41-OS-SB32, SURFACE DEBRIS PRESENT IN BACKGROUND,
LOOKING NORTHEAST.



OU4.SITE41.1994.13

**VIEW OF HAND AUGERING SAMPLING LOCATION
41-OS-SB31, TUBULAR OBJECTS PRESENT IN MIDDLE AND
TO THE LEFT ARE DISCARDED ROCKET LAUNCHERS,
ALSO ATV DRILLING RIG PRESENT IN UPPER LEFT
CORNER INSTALLING 41-GWO7DW, LOOKING NORTH.**



OU4.SITE41.1994.14

VIEW OF HAND AUGERING SAMPLING LOCATION

**41-OS-SB28, PARTIALLY BURIED 55-GALLON DRUM
PRESENT, LOOKING WEST.**

41-OS-SB28-1994-14



50-1
ARMY DEPARTMENT
TYPE 1
MILITARY
U.S. ARMY
74-1



OU4.SITE41.1994.16

VIEW OF HAND AUGERING SAMPLING LOCATION
41-OS-SB27, PARTIALLY BURIED 55-GALLON DRUM,
LOOKING SOUTHWEST.



OU4.SITE41.1994.17

**VIEW OF HAND AUGERING SAMPLING LOCATION
41-OS-SB33, SURFACE DEBRIS PRESENT IN BACKGROUND,
LOOKING NORTHEAST.**



OU4.SITE41.1994.18
VIEW OF HAND AUGERING SAMPLING LOCATION
41-OS-SB26, METALLIC CYLINDRICAL OBJECT PRESENT IN
BACKGROUND, LOOKING SOUTHWEST.



OU4.SITE41.1994.19

**VIEW OF HAND AUGERING SAMPLING LOCATION
41-OS-SB31, CRUSHED DRUM PRESENT TO THE RIGHT AND
MOUNDS OF CONCRETE IN THE BACKGROUND, LOOKING
WEST.**



OU4.SITE41.1994.20

VIEW OF METALLIC SURFACE DEBRIS, HAND AUGERING
SAMPLING LOCATION 41-OS-SB32 LOCATED BEHIND
DEBRIS PILE, LOOKING WEST.



OU4.SITE41.1994.21

**VIEW OF HAND AUGERING SAMPLING LOCATION
41-OS-SB32, METALLIC DEBRIS PILE PRESENT IN
BACKGROUND, LOOKING EAST.**



OU4.SITE41.1994.22

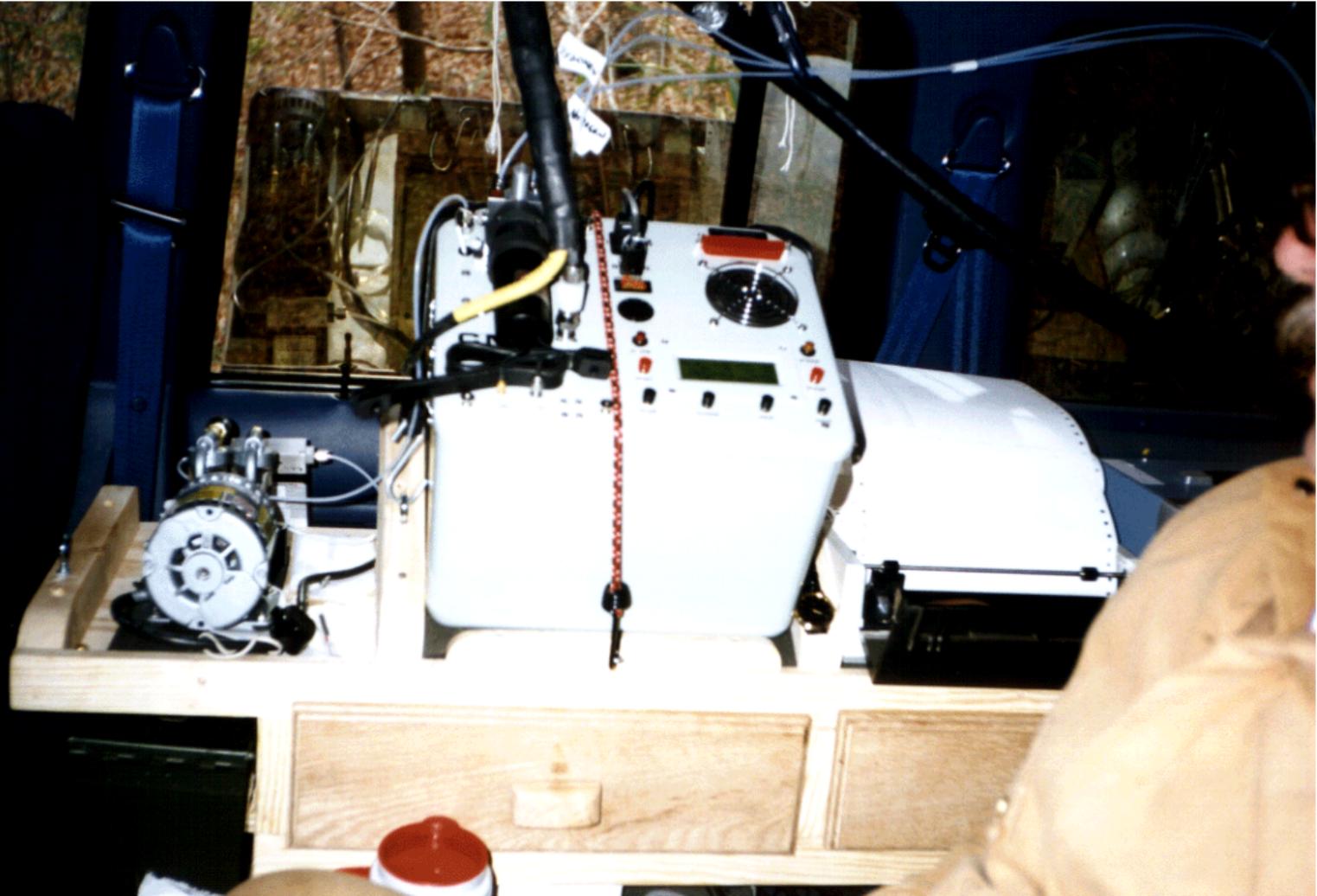
VIEW OF POSTS AND BARBED WIRE THAT FORMED A 10'
x 10' SECTIONED OFF SQUARE LOCATED IN THE
NORTHWESTERN PORTION OF SITE 41, LOOKING
NORTHEAST.

1994.22 SITE 41



OU4.SITE41.1994.23

VIEW OF COMPLETED WELLS 41-GWO7 AND
41-GWO7DW, WATER LEVEL METER PRESENT TO THE
RIGHT, LOOKING SOUTH.





OU4.SITE69.1994.25

VIEW OF U.S. ARMY TECHNICAL ESCORT UNITS
MONITORING EQUIPMENT SET-UP, FROM BACKGROUND
TO FOREGROUND: MINICAM, RESULTS PRINTER,
CALIBRATION STANDARD PRINTER, EXTERNAL BATTERY
PACK AND SURGE PROTECTOR, AND BLACK HEATED
SAMPLE LINE, LOOKING NORTH.



U-HAUL

GT 33556

GENCO

OU4.SITE69.1994.26

VIEW OF U.S. ARMY TECHNICAL ESCORT UNITS
EXTERNAL POWER SOURCE SET-UP, LOOKING
SOUTHEAST.





OU4.SITE69.1994.28

**VIEW OF BAKER PERSONNEL OBTAINING PID(HNU) POINT
SOURCE READINGS, USED TO EVALUATE HEALTH AND
SAFETY LEVELS OF PROTECTION, LOOKING SOUTHEAST.**

1994.06.28 10:00 AM



OU4.SITE69.1994.29

VIEW OF BAKER AND DRILLING SUBCONTRACTOR IN
LEVEL B AT WELL LOCATION 69-GW10, LOOKING
NORTHWEST.



OU4.SITE69.1994.30

**VIEW OF DRILLING SUBCONTRACTOR SPLITSPOONING
WELL 69-GW10, BAKER PERSONNEL IN BACKGROUND,
LOOKING NORTHEAST.**

04/11/94 09:08:44 AM





OU4.SITE69.1994.32

**VIEW OF BAKER PERSONNEL SUITED UP IN LEVEL B
PROTECTION, DECONTAMINATION SET-UP FOR SPLIT
SPOONS IN BACKGROUND, LOOKING EAST.**

9709402626 NPIH10





OU4.SITE69.1994.34

**VIEW OF COMPLETED WELLS 69-GW12 AND 69-GW12DW
LOCATED IN THE SOUTHERN PORTION OF SITE 69,
LOOKING SOUTHEAST.**



01104 5000000000

OU4.SITE74.1994.35

**VIEW OF POTENTIAL FOXHOLE LOCATED WITHIN THE
PEST CONTROL AREA, LOOKING NORTH.**



OU4.SITE74.1994.36

VIEW OF ANOTHER POTENTIAL FOXHOLE LOCATED
WITHIN THE PEST CONTROL AREA, LOOKING
NORTHWEST.





OU4.SITE74.1994.38

**VIEW OF HENDERSON POND WHICH IS SOUTH OF THE
PEST CONTROL AREA, LOOKING SOUTH.**



UPPER MERIDIAN 95202726

OU4.SITE74.1994.39

**VIEW OF ACCESS ROAD WHICH LEADS INTO THE FORMER
DISPOSAL AREA, THE ROAD BORDERS THE SITE TO THE
EAST, LOOKING NORTH.**



OU4.SITE74.1994.40

**VIEW OF DRILLING SUBCONTRACTOR PERFORMING HAND
AUGERING IN THE SOUTHEAST CORNER OF THE FORMER
DISPOSAL AREA, LOOKING NORTHWEST.**

9000
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000



OU4.SITE74.1994.41

**VIEW OF BAKER, SUBCONTRACTORS, AND U.S. ARMY
TECHNICAL ESCORT UNIT SETTING UP FOR DRILLING
OPERATIONS ON 74-GW06, LOOKING NORTH.**

5110 9781660000



01/11/95 10:00:00 AM

OU4.SITE74.1994.42

**VIEW OF COMPLETED WELL 74-GW06, WELL IS LOCATED
ON THE EASTERN EDGE OF THE FORMER DISPOSAL
AREA, LOOKING NORTH.**



Appendix D
Site 41 Long-Term Monitoring Report

**ANNUAL
MONITORING REPORT**

**OPERABLE UNIT NO. 4 – SITE 41
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA**

REPORTING PERIOD: JULY 2004 – JUNE 2005

CONTRACT TASK ORDER 0001

Prepared for:

**DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES
ENGINEERING COMMAND**
Norfolk, Virginia

Under the:

**LANTDIV Contract
N62470-03-D-1753**

Prepared by:

ENGINEERING AND ENVIRONMENT, INC.
Virginia Beach, Virginia

MICHAEL BAKER JR., INC.
Moon Township, Pennsylvania

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- B Monitoring Program Analytical Results – October 2004
- C Monitoring Program Analytical Results – January 2005

INTRODUCTION

This Annual Monitoring Report presents a summary of sampling activities, analytical results, and significant findings pertaining to the Long-Term Monitoring (LTM) program at Operable Unit (OU) No. 4 (Site 41), Marine Corps Base (MCB) Camp Lejeune, North Carolina. Conclusions and recommendations regarding the monitoring program for Site 41 are also presented in this report.

The Record of Decision (ROD) for Site 41, signed in 1995, specified that a Long-Term Monitoring program be implemented as the remedial alternative for the site. The monitoring program is tasked to assess whether contamination detected during previous investigations remains present, has migrated, or has degraded through natural processes.

MONITORING ACTIVITIES

Monitoring activities at Site 41 began in January 1997 and are scheduled to continue on a semi-annual basis (the first [January] and third [July] quarters) of each calendar year. The firm Engineering and Environment, Inc. (EEI) conducted the field sampling events during the 2004-2005. This report focuses on those activities conducted over the past 12 month monitoring period, including both the third calendar quarter of 2004 (04C) and the first calendar quarter of 2005 (05A), plus an extra sampling event in October 2004 (04D) requested by the Camp Lejeune Installation/Restoration (IR) Partnering Team. Sampling activities were completed and subsequent laboratory analyses were performed according to procedures and methods specified in the Long-Term Monitoring Work Plans for OU 4 (Baker, 2004). The project work plans identify specific tasks associated with the monitoring activities to be conducted at Site 41.

Sampling Activities

Groundwater sampling at Site 41 routinely consisted of sampling a single shallow monitoring well 41-GW11. Prior to July 2004 sampling event, the Camp Lejeune IR Partnering Team requested that six additional monitoring wells (41-GW01, 41-GW02, 41-GW03, 41-GW08, 41-GW09 and 41-GW11DW) be re-instated back into the LTM program for Site 41 and sampled for lead analysis due to the increase in lead concentrations observed in monitoring well 41-GW11 over the past several rounds. These shallow monitoring wells at Site 41 are screened in the surficial aquifer with the exception of GW11DW which is screened in the upper castle Hayne aquifer. In addition to the groundwater sampling, samples were also collected from two surface water locations and one sediment sampling location during the July 2004 and January 2005 sampling events. Figure 1 depicts all monitoring well, surface water and sediment sampling locations throughout Site 41 and identifies those sampling locations included in the monitoring program. Table 1 provides construction details of the monitoring wells included in the LTM program. [Note that all tables and figures are provided after the text portion of this report.]

Based upon previous analytical results and the ROD (Baker, 1995), Target Compound List (TCL) Volatile Organic Compounds (VOC) and Target Analytes List (TAL) metals (specifically lead, cadmium, chromium, and nickel) were selected as Contaminants of Concern (COC) at Site 41. The ROD specifies groundwater remediation levels (RLs) for TAL metals in groundwater only (Table 2) and does not establish RLs for surface water or sediment media. During the July 2004 sampling event, the Chemical Warfare Material (CWM) suite of parameters (including breakdown products) and explosives were collected from Site 41 at the request of the Partnering Team. Table 3 provides a summary of requested laboratory analyses and sample identifications for all three sampling events.

Sample information, including location number, sample identification, time and date of sample collection, sampler's initials and analytical parameters, was recorded on the sample labels and in a field logbook. In addition, all field parameters collected prior to sample collection were also recorded in the field logbooks. Groundwater field parameters were measured to ensure aquifer stabilization prior to sample collection. Surface water field parameters were also collected to depict conditions at the time of sample collection. Summaries of groundwater field parameters for the July 2004, October 2004, and January 2005 monitoring events are provided in Tables 4 through 6, respectively.

Groundwater Flow

The most recent round of static water level measurements was obtained on January 22, 2005. Table 7 provides a summary of static groundwater elevations measured at Site 41 since July 2001. Figure 2 depicts the groundwater elevations and approximate groundwater flow directions at Site 41 based on the January 2005 data. In general, shallow groundwater flows southeast across the site and semi-radially from monitoring well 41-GW11 located in the central portion of the study area. Topographically low areas in the form of adjacent marsh areas lie to the east and south of Site 41. Groundwater flow direction is influenced locally by natural surface features including intermittent streams and the marsh areas.

Field Observations

During their field activities, EEI reported no significant changes in site conditions.

DATA ANALYSIS AND VALIDATION

Katahdin Analytical Services, Inc. is the laboratory that performed the chemical analyses of the samples. Trip blanks were prepared prior to the sampling event at Site 41 and was kept with the samples during field collection, shipment and laboratory analysis. Complete trip blank analytical results for Site 41 for the July 2004, October 2004, and January 2005 sampling event are on file with EEI and are available upon request.

The firm Integrate, Inc. performed the professional data validation for the laboratory data. During the data validation of the analytical data, there were no data rejections detected in the environmental samples. The Katahdin laboratory data sheets and the Integrate validation procedures are on file at Baker and are available upon request.

ANALYTICAL RESULTS

The section that follows presents an overview of general trends in analytical results and findings from sampling performed at Site 41 during July 2004, October 2004, and January 2005. Results and findings are presented according to environmental media. Complete analytical results compiled during the July 2004, October 2004, and January 2005 sampling events are presented in Attachments A, B, and C, respectively. Corresponding laboratory data sheets and chain-of-custody forms are on file at EEI and are available upon request.

Groundwater Analytical Results

The initial implementation of the monitoring program at Site 41 included VOC and TAL metal (selected metals) analysis. Over the years of monitoring, very few VOCs and TAL metals have actually been detected. Most of the detected VOCs are known laboratory contaminants. Tables 8 and

9 and Figure 3 present summaries of analytical results for the July 2004, October 2004, and January 2005 sampling events, and are typical of the VOC and metals detections of past sampling events. The October 2004 and January 2005 data consisted of only lead analyses of monitoring well 41-GW11 and is presented in Table 9. Tables 8 and 9 also compare the detections to the North Carolina Water Quality Standard (NCWQS), the Federal Maximum Contaminant Levels (MCLs), and the ROD remediation levels. The ROD, however, does not identify VOCs as COC for Site 41 and, therefore, no remediation levels for VOCs in groundwater have been established. Only monitoring well 41-GW11 was sampled for VOCs in July 2004. Although acetone, benzene, and chlorobenzene were detected, only benzene (2 micrograms per liter [$\mu\text{g/L}$]) was detected at a concentration above the NCWQS of 1 $\mu\text{g/L}$.

Most of the groundwater VOC and metals detections of have occurred historically in the central portion of the site within the former dump area. This has allowed the monitoring wells located outside the former dump area to be removed from the monitoring program over time. Of the detections of VOCs and metals, benzene and lead have been the two contaminants that have more regularly, but not consistently been detected. Figure 4 is a time trend of the benzene detections at the remaining groundwater sampling location within the former dump, monitoring well 41-GW11.

Because of sporadic detections of lead in the groundwater at Site 41, specifically at monitoring well 41-GW11, the lead concentrations at this monitoring well were compiled and evaluated for trends. Lead concentration data from the beginning of the LTM program in February 1997 through the present were used in this evaluation (Figure 5), a total of 18 sampling events. Also evaluated was the stratigraphy (i.e., soil conditions encountered during the installation of monitoring well 41-GW11) in relation to the groundwater elevations and the lead concentrations. Seasonal variation of the lead concentrations was also evaluated. The results of these evaluations are described below.

Lead Concentrations vs. Groundwater Elevations

Figure 6 depicts the lead concentrations in the groundwater at monitoring well 41-GW11 as a function of time beginning in February 1997. Also shown on this graph on the right axis is the groundwater elevation in the monitoring well during the same sampling periods. As shown, there is an inverse relationship of lead concentrations and groundwater elevations for a two year period spanning July 2001 through July 2003. As the groundwater elevations went down, the lead concentrations at this monitoring well went up. This relationship was more pronounced in the January 2003 sampling event, when a lead detection of 499 $\mu\text{g/L}$ was detected. An exception occurred during July 2003 when the groundwater level went up and the lead concentration was its highest at 542 $\mu\text{g/L}$. The lead concentrations during the two 2004 sampling events and the January 2005 sampling event appeared to have reverted back to the lower levels seen prior to the inverse fluctuation scenario discussed above. These lower concentrations also do not appear to be influenced by the groundwater elevation changes noted during this same period.

Seasonal Variation

The lead concentration data for monitoring well 41-GW11 were separated into winter (January) and summer (July) sampling periods. The result of this separation can be seen in Figure 7. Except for 2003 when both seasonal detections were unusually high, the summer lead concentrations are consistently lower than the winter lead concentrations. All the non-detect or very low concentrations for lead occurred during the summer sampling events, while most of the detected concentrations occurred during the winter sampling events. During the winter there tends to be less recharge to the

aquifer. When recharge slows down, lead is more likely to be concentrated in the groundwater due to dissolution of any lead found in the solid matrix.

Stratigraphy and Groundwater Elevation

The stratigraphy descriptions given in the boring log for monitoring well 41-GW11 were examined to determine if a potential source of the lead in the groundwater was noted during the installation of the monitoring well. Noted in the visual description for a depth of eight feet to 12.5 feet below the ground surface was this comment: "Possible soluble paint chips or flecks or oyster shell are evident." Given this description, it seemed plausible that dissolution lead from possible paint chips could be causing the higher lead concentrations. Figure 8 depicts a modified well construction diagram with the logged interval described above highlighted in gray on the right side of the diagram. (Please note that all elevations are approximate based on the boring log and well construction diagram). Shown on the left side of the diagram are the groundwater elevations (rounded to the nearest 0.5 foot) and ranges of lead concentrations found at those elevations. It is noted that the two of the three higher concentrations of lead were detected when the groundwater elevation was located in the "paint chip or oyster shell" zone during winter sampling events.

Chemical Warfare Material and Explosive Compounds Sampling July 2004

As a precursor to the possible final closure of Site 41, the verification of the non-existence of CWMs, associated breakdown products, and explosives had to be completed. In July 2004, seven monitoring wells (Table 3) were analyzed for these constituents and all samples were non-detect.

Surface Water Analytical Results

At Site 41, two surface water samples were collected, one from Tank Creek (41-TC-SW12) and one from an unnamed tributary to Tank Creek (41-UT-SW01). Surface water samples were submitted for lead analysis only. From January 2001 to the present, lead has not been detected in either of the two surface water samples. Furthermore, the ROD does not identify remediation levels for VOCs or metals in surface water.

Sediment Analytical Results

The metals detected in sediment have occurred from samples collected in the central portion of the site (Figure 9). This has allowed the sediment sampling locations outside the former dump area to be removed from the monitoring program over time.

The ROD does not identify RLs for VOCs or metals in sediment. Table 10 summarizes cadmium, chromium, lead, and nickel detections in sediment from sampling location 41-DD-SD02 over the past three years along with applicable NOAA benchmarks for the metal detected. Only those metals that have been detected since July 2000 are shown on Table 10. Of those metals detected, only cadmium had a concentration in exceedence of NOAA benchmarks.

CONCLUSIONS

The following are conclusions for Site 41 based on historical data, and recent analytical results and field data.

Groundwater

Benzene remains the only VOC that has been consistently detected at or slightly above the NCWQS at Site 41. Shallow monitoring well 41-GW11 has exhibited the low benzene concentrations that range from non-detectable to 5J $\mu\text{g/L}$ (Figure 4) since 1997. The July 2004 sampling event continued the trend of four consecutive rounds of benzene concentrations of 2 $\mu\text{g/L}$. However, benzene dropped to a non-detected level in the most recent January 2005 sampling event.

From this data collected at monitoring well 41-GW11, three trends of lead concentrations have been established. First, the lead concentrations significantly increased when the groundwater elevation was seen to be at its lowest level since inception of the LTM program. Second, there is a seasonal trend where during the winter months, the lead concentrations are significantly higher than during summer months. Third, the stratigraphy of the study area around monitoring well 41-GW11 shows a possible source of the lead as a zone of soluble paint chips. When the groundwater elevation intercepts this zone, the lead concentrations were seen to increase dramatically. Although these three trends have been evident during the long history of monitoring at Site 41, no one trend has been 100 percent consistent. Attempts to logically explain trends and anomalies have proved insightful, but the fact remains that as long as Site 41 continues to be sampled, periods of consistent data will be interrupted by variations.

The final evaluation for Site 41 is that there are fluctuating lead concentrations at Site 41, but the overall groundwater contamination at Site 41 is not migrating. There is no evidence of downward contamination migration into the upper Castle Hayne aquifer. Analytical results from past sampling of the deeper monitoring wells were consistently non-detected, and these monitoring wells were subsequently removed from the monitoring program. There is also no evidence that contamination is moving laterally off-site. Past non-detections at monitoring wells located on the perimeter of the study area has characterized the contamination plume as very small and centered around monitoring well 41-GW11. This monitoring well is situated directly in the center of Site 41. Finally, CWM (and associated breakdown products) and explosive compounds were not detected in the groundwater at Site 41.

Surface Water

There have been no lead detections in surface water samples 41-TC-SW12 or 41-UT-SW01 over the last seven sampling events. The last time a surface water sample had a lead detection was in July 2000 that slightly exceeded the Region IV surface water criteria (no exceedences of North Carolina criteria). These findings suggest that contaminated groundwater is not impacting the streams and/or drainage ditches within Site 41 and, therefore, contaminants are not being transported off-site via surface water.

Sediment

The historical analytical data indicates there is little impact to the sediment of the several creeks and drainage ditches which flow through Site 41. The detection of metals (specifically cadmium, lead, chromium and nickel) has been very infrequent and the concentrations have been at or below the EPA Region IV or NOAA screening values. These detections are believed to be the result of natural conditions. This is a further indication that contamination migration is not being transported off-site.

RECOMMENDATIONS

The ROD for OU 4 stipulates that environmental samples from Site 41 be collected periodically to monitor the possible migration of potential site contaminants (Baker, 1997). The following sections describe recommendations in support of the selected remedy and periodic monitoring that have been implemented over the past year or that are being proposed for future consideration.

Implemented Recommendations

Information regarding recommendations that have been implemented during the January 2005 is discussed below. Recommendations implemented prior to this time are detailed in previous monitoring reports for Site 41.

Maintain Well Security and Aesthetics

During each sampling event, monitoring wells are inspected for accessibility, integrity, aesthetics and security. Maintenance may include clearing of vegetation, replacing broken watertight caps, and painting of bollards. Repairs are made to the monitoring wells on an "as needed" basis. All existing padlocks were replaced with corrosion resistant brass locks. These new padlocks are all keyed alike and are keyed identical to all IR monitoring wells at Camp Lejeune.

Modify Sampling Scheme

Monitoring wells 41-GW01, 41-GW02, 41-GW03, and 41-GW08, 41-GW09 and 41-GW11DW were temporarily re-instated back into the LTM program in July 2004. These monitoring wells were selected to provide comprehensive site wide analysis to assist in a potential Site 41 closure determination.

Modify Sampling Frequency

At the request of the Partnering Team Site 41 was sampled in October 2004, a non-scheduled LTM sampling event for Site 41, to further provide additional analytical data.

Proposed Recommendations

It is recommended that OU close out procedures for Sites 41 and 74 be implemented, and the existing monitoring wells be abandoned.

REFERENCES

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State of North Carolina Department of Environment and Natural Resources, Division of Water Quality (NCDENR). 1998. Classifications and Water Quality Standards Applicable to Surface Water and Wetlands of North Carolina. Amended Effective August 1, 1998.

Baker

Michael Baker Jr., Inc.
TABLES

TABLE 1
MONITORING WELL CONSTRUCTION DETAILS
OPERABLE UNIT NO. 4 - SITE 41
MONITORING AND O&M SUPPORT, CTO-0001
MCB, CAMP LEJEUNE, NORTH CAROLINA

Monitoring Well	Date Installed	Top of PVC Casing Elevation (feet above msl)	Ground Surface Elevation (feet above msl)	Boring Depth (feet, bgs)	Well Depth (feet, bgs)	Screen Interval (feet, bgs)	Depth to Sand Pack (feet, bgs)	Depth to Bentonite (feet, bgs)	Stick-Up (feet, ags)
41-GW01	07/16/84	22.6	20.4	NA	23.2	3.56 - 18.04	NA	NA	NA
41-GW02	1984	14.63	12.3	21	19.0	5.4 - 19.9	4.5	2.8	NA
41-GW03	07/16/84	19.23	17.1	NA	21.7	4.83 - 19.31	NA	NA	NA
41-GW08	02/07/94	19.48	17.1	16	15.0	5.0 - 15.0	3	0.5	2.4
41-GW09	02/02/94	25.98	24	21	22.8	10.5 - 20.5	NA	NA	2.0
41-GW11	1994	24.69	21.5	16	15.0	5.0 - 15.0	3	0.5	3.2
41-GW11DW	1994	23.63	21.5	52	50.0	40.0 - 50.0	37	35	2.1

Notes:

PVC = Polyvinyl Chloride
ags = above ground surface
bgs = below ground surface
msl = mean sea level
NA = information not available

TABLE 2

ROD REMEDIATION LEVELS FOR
 CONTAMINANTS OF CONCERN IN GROUNDWATER
 OPERABLE UNIT NO. 4 - SITE 41
 MONITORING AND O&M SUPPORT, CTO-0001
 MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant of Potential Concern	Remediation Goal ⁽¹⁾	
	(µg/L)	Basis of Goal
Arsenic	50	NCWQS
Beryllium	4	MCL
Cadmium	5	NCWQS
Chromium	50	NCWQS
Lead	15	NCWQS
Nickel	100	NCWQS

Notes:

(1) = Baker Environmental, Inc. (1995) Revised Final Record of Decision for Operable Unit No. 4 (Sites 41 and 74)

µg/L = microgram per liter
 NCWQS = North Carolina Water Quality Standard
 MCL = Maximum Contaminant Level

TABLE 3

SAMPLING SUMMARY
OPERABLE UNIT NO. 4 - SITE 41
MONITORING AND O&M SUPPORT, CTO-0001
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Sampled Media	TCL VOC (8260B)	Lead (ILM 04.0)	Cd, Cr, Pb, Ni (ILM 04.0)	CWM ⁽¹⁾	Explosives ⁽¹⁾	July 2004 Laboratory Sample Identification	October 2004 ⁽²⁾ Laboratory Sample Identification	January 2005 Laboratory Sample Identification
41-GW01	Groundwater		X		X	X	IR41-GW01-04C	IR41-GW01-04D	Not Sampled
41-GW02	Groundwater		X		X	X	IR41-GW02-04C	IR41-GW02-04D	Not Sampled
41-GW03	Groundwater		X		X	X	IR41-GW03-04C	IR41-GW03-04D	Not Sampled
41-GW08	Groundwater				X	X	IR41-GW08-04C	Not Sampled	Not Sampled
41-GW09	Groundwater		X		X	X	IR41-GW09-04C	IR41-GW09-04D	Not Sampled
41-GW11	Groundwater	X	X		X	X	IR41-GW11-04C	IR41-GW11-04D ⁽³⁾	IR41-GW11-05A
41-GW11DW	Groundwater				X	X	IR41-GW11DW-04C	Not Sampled	Not Sampled
41-UT-SW01	Surface Water		X				IR41-UT-SW01-04C	Not Sampled	IR41-UT-SW01-05A
41-TC-SW12	Surface Water		X				IR41-TC-SW12-04C	Not Sampled	IR41-TC-SW12-05A
41-DD-SD02	Sediment			X			IR41-DD-SD02-04C	Not Sampled	IR41-DD-SD02-05A

Notes:

- (1) = Parameters only sampled in July 2004
(2) = A non-scheduled LTM sampling event requested by the partnering team.
(3) = Sampled for Lead only

- X = Requested analysis
TCL = Target Analyte List
VOC = Volatile Organic Compounds
Cd = Cadmium
Cr = Chromium
Pb = Lead
Ni = Nickel
CWM = Chemical Warfare Materials (Arsenic, Beryllium, Cadmium, Chromium, Lead, Nickel, Chemical Surety Materials, Thiodiglycol, Mirex)

TABLE 4

GROUNDWATER AND SURFACE WATER FIELD PARAMETERS - JULY 2004
 OPERABLE UNIT NO. 4 - SITE 41
 MONITORING AND O&M SUPPORT, CTO-0001
 MCB, CAMP LEJEUNE, NORTH CAROLINA

Monitoring Well/ Surface Water	Measuring Time	Well Volumes	Field Parameters				
			Temperature (°C)	pH (S.U.)	Specific Conductance (µmhos/cm)	Dissolved Oxygen (mg/L)	Turbidity (N.T.U.)
Sample Date							
41-GW01 7/23/04	1322	1.0	17.3	6.43	209	0.3	48
	1328	2.0	18.0	6.31	222	NA	34
	1333	3.0	17.5	6.08	189	NA	17
	1340	4.0	17.4	6.08	238	NA	6
41-GW02 7/23/04	1058	1.0	18.0	6.23	879	.05	44
	1114	2.0	18.0	6.29	862	NA	12
	1119	3.0	18.0	6.26	879	NA	4
	1125	4.0	18.0	6.29	876	NA	2
41-GW03 7/23/04	1045	1.0	17.2	6.41	1415	0.3	4
	1050	2.0	17.1	6.39	1354	NA	4
	1059	3.0	17.2	6.42	1341	NA	3
41-GW08 7/23/04	1007	1.0	20.2	6.32	333	2	78
	1014	2.0	20.2	6.01	330	NA	18
	1021	3.0	19.1	6.11	380	NA	14
41-GW09 7/23/04	1326	1.0	17.1	4.77	169	NA	8
	1332	2.0	17.1	4.70	172	NA	3
	1337	3.0	17.1	4.72	174	NA	3
41-GW11 7/23/04	1012	1.0	18.5	6.59	989	0.8	4
	1017	2.0	18.4	6.63	1017	NA	5
	1022	3.0	18.2	6.71	1055	NA	3
41-GW11DW 7/23/04	1110	1.0	17.8	6.53	1204	NA	2
	1117	1.5	17.8	6.55	1169	NA	1
	1125	2.0	17.8	6.55	1142	NA	1
	1135	2.5	17.8	6.54	1189	NA	1
	1145	3.0	17.7	6.56	1221	NA	0
41-UT-SW01 7/23/04	1405	NA	23.3	6.77	333	3.00	6
41-TC-SW12 7/23/04	1215	NA	24.3	6.84	95	4.00	11

Notes:

°C	=	Degrees Centigrade
S.U.	=	Standard Units
µmhos/cm	=	micro ohms per centimeter
mg/L	=	milligrams per liter
N.T.U.	=	Nephelometric Turbidity Units
NA	=	Not Available or Applicable

TABLE 5

GROUNDWATER FIELD PARAMETERS - OCTOBER 2004
 OPERABLE UNIT NO. 4 - SITE 41
 MONITORING AND O&M SUPPORT, CTO-0001
 MCB, CAMP LEJEUNE, NORTH CAROLINA

Monitoring Well/ Surface Water	Measuring Time	Well Volumes	Field Parameters				
			Temperature (°C)	pH (S.U.)	Specific Conductance (µmhos/cm)	Dissolved Oxygen (mg/L)	Turbidity (N.T.U.)
Sample Date							
41-GW01 10/23/04	0931	1.0	18.6	6.21	192	0.8	6
	0937	2.0	18.6	60.2	189	NA	2
	0943	3.0	18.6	5.94	189	NA	3
	0945	4.0	18.6	5.94	189	NA	1
41-GW02 10/23/04	1055	1.0	18.5	6.46	871	0.2	51
	1105	2.0	18.7	6.46	838	NA	18
	1116	3.0	18.7	6.47	843	NA	5
41-GW03 10/23/04	1049	1.0	18.9	5.89	229	1.0	29
	1052	2.0	18.8	6.02	284	NA	7
	1055	3.0	18.8	6.04	292	NA	4
	1058	4.0	18.8	6.04	294	NA	2
	1101	5.0	18.8	6.06	305	NA	3
	1104	6.0	18.8	6.07	313	NA	2
41-GW09 10/23/04	0944	1.0	18.0	5.52	200	1.0	6
	0952	2.0	18.4	5.31	171	NA	1
	1002	3.0	18.4	5.18	162	NA	2
41-GW11 10/23/04	1129	1.0	19.6	6.64	923	0.7	3
	1132	2.0	19.5	6.67	910	NA	3
	1135	3.0	19.5	6.68	899	NA	2

Notes:

°C	= Degrees Centigrade
S.U.	= Standard Units
µmhos/cm	= micro ohms per centimeter
mg/L	= milligrams per liter
N.T.U.	= Nephelometric Turbidity Units
NA	= Not Available or Applicable

TABLE 6

GROUNDWATER AND SURFACE WATER FIELD PARAMETERS - JANUARY 2005
 OPERABLE UNIT NO. 4 - SITE 41
 MONITORING AND O&M SUPPORT, CTO-0001
 MCB, CAMP LEJEUNE, NORTH CAROLINA

Monitoring Well/ Surface Water Sample Date	Measuring Time	Well Volumes	Field Parameters				
			Temperature (°C)	pH (S.U.)	Specific Conductance (µmhos/cm)	Dissolved Oxygen (mg/L)	Turbidity (N.T.U.)
41-GW11 1/22/05	0900	1.0	15.6	6.86	886	1.0	1
	0910	2.0	15.5	6.86	887	NA	0
	0920	3.0	15.4	6.90	905	NA	0
	0925	3.5	15.4	6.90	907	NA	0
41-UT-SW01 1/22/05	1010	NA	9.1	7.09	367	6.0	13
41-TC-SW12 1/22/05	0915	NA	4.5	7.09	217	8.0	8
41-DD-SD02 1/22/05	0945	NA	NA	NA	NA	NA	NA

Notes:

- °C = Degrees Centigrade
- S.U. = Standard Units
- µmhos/cm = micro ohms per centimeter
- mg/L = milligrams per liter
- N.T.U. = Nephelometric Turbidity Units
- NA = Not Available or Applicable

TABLE 7

SUMMARY OF WATER LEVEL MEASUREMENTS
 OPERABLE UNIT NO. 4 - SITE 41
 MONITORING AND O&M SUPPORT, CTO-0001
 MCB, CAMP LEJEUNE, NORTH CAROLINA

Monitoring Well	Reference Elevation ⁽¹⁾	SWE 7/15/01	SWE 1/12/02	SWE 7/29/02	SWE 1/29/03	SWE 7/26/03	SWE 1/24/04	SWE 4/25/04	SWE 7/04	SWE 10/23/04	SWL 1/22/05	SWE 1/22/05
41-GW01	22.6	NA	NA	NA	13.59	15.02	14.79	14.68	NA	NA	8.92	13.68
41-GW02	14.63	NA	7.44	6.40	8.91	10.64	10.22	9.21	NA	NA	5.40	9.23
41-GW03	19.23	8.21	NA	NA	Dry	9.18	8.78	8.75	NA	NA	11.72	7.51
41-GW04	11.99	NA	NA	NA	5.36	6.25	NA	5.74	NA	5.33	6.32	5.67
41-GW04DW	12.89	NA	NA	NA	5.22	5.99	NA	5.66	NA	5.29	7.56	5.33
41-GW05	26.59	15.03	14.5	14.29	15.28	15.86	15.40	15.28	NA	14.58	12.02	14.57
41-GW06DW	25.31	NA	NA	NA	12.46	14.20	14.07	13.86	NA	13.59	12.36	12.95
41-GW07	22.73	12.07	10.72	10.16	11.64	13.50	13.27	13.17	NA	NA	10.68	12.05
41-GW07DW	22.88	NA	NA	NA	11.47	13.20	12.98	12.87	NA	NA	11.04	11.84
41-GW08	19.48	11.26	5.80	5.85	11.03	12.15	NA	11.68	NA	11.50	8.54	10.94
41-GW09	25.98	14.71	12.9	12.53	13.17	16.43	16.33	16.12	NA	NA	11.55	14.43
41-GW09DW	26.95	NA	NA	NA	15.05	16.30	16.07	15.86	NA	NA	12.60	14.35
41-GW10	13.93	7.10	7.37	6.09	8.11	8.57	8.52	8.20	NA	7.43	NA	NA
41-GW11	24.69	14.69	12.87	12.83	13.29	15.53	15.37	15.03	NA	11.48	10.93	13.76
41-GW11DW	23.63	10.01	8.18	NA	10.45	11.31	11.17	11.03	NA	NA	13.86	9.77
41-GW12	8.41	2.99	3.83	2.38	3.86	4.59	NA	3.65	NA	NA	4.51	3.90
41-GW12DW	9.08	NA	NA	NA	3.86	4.57	NA	3.68	NA	NA	5.15	3.93
41-GW13	16.19	NA	NA	NA	5.86	7.19	NA	6.83	NA	NA	10.49	5.70

Notes:

⁽¹⁾ = Top of well casing expressed in feet above mean sea level

SWL = Static water level taken from top of well casing

SWE = Static water elevation expressed in feet above mean sea level

NA = Data not available

TABLE 8

SUMMARY OF GROUNDWATER ANALYTICAL RESULTS - JULY 2004
 OPERABLE UNIT NO. 4 - SITE 41
 MONITORING AND O&M SUPPORT, CTO-0001
 MCB, CAMP LEJEUNE, NORTH CAROLINA

Fraction	Detected Compounds	Comparison Criteria			Concentration Range of Positive Detections		Location of Maximum Detection	Detection Frequency	Detections Above Comparison Criteria		
		NCWQS	MCL	ROD	Min.	Max.			NCWQS	MCL	ROD
Volatile Organic Compounds	Acetone	700	NE	NE	8J	8J	GW11	1/1	0	NA	NE
	Benzene	1	5	NE	2J	2J	GW11	1/1	1	0	NA
	Chlorobenzene	50	100	NE	0.6J	0.6J	GW11	1/1	0	0	NA
Inorganic Compounds	Arsenic	10	10	50	4.3J	8.6J	GW11	2/6	0	0	0
	Beryllium	NE	4	4	1.4J	1.4J	GW02	1/6	NA	0	0
	Cadmium	5	5	5	0.39J	0.55J	GW03	3/6	0	0	0
	Chromium	50	100	50	1.4J	2J	GW03	6/6	0	0	0
	Lead	15	15	15	22.7	22.7	GW11	1/6	1	1	1
	Nickel	100	NE	100	7.1J	50.8	GW11	2/6	0	NA	0

Notes:

Concentrations presented in micrograms per liter (ug/L).

NCWQS = North Carolina Water Quality Standards (North Carolina Administrative Code, Title 15A, Subchapter 2L).

MCL = Federal Maximum Contaminant Level. Maximum permissible level of a contaminant in water which is delivered to users of public water systems (U.S. Environmental protection Agency - Drinking Water Regulations and Health Advisories.).

ROD = Record of Decision for OU No. 4 Remediation Levels for Contaminants of Concern (Baker, December 1995).

J = Estimated Value

NE = Not Established

NA = Not Applicable

TABLE 9

SUMMARY OF GROUNDWATER ANALYTICAL RESULTS - OCTOBER 2004 AND JANUARY 2005
 OPERABLE UNIT NO. 4 - SITE 41
 MONITORING AND O&M SUPPORT, CTO-0001
 MCB, CAMP LEJEUNE, NORTH CAROLINA

Fraction	Detected Compounds	Comparison Criteria			Concentration Range of Positive Detections		Location of Maximum Detection	Detection Frequency	Detections Above Comparison Criteria		
		NCWQS	MCL	ROD	Min.	Max.			NCWQS	MCL	ROD
Metals	Lead	15	15	15	3.4	6.4	GW11	1/1	0	0	0

Notes:

Concentrations presented in micrograms per liter (ug/L).

NCWQS = North Carolina Water Quality Standards (North Carolina Administrative Code, Title 15A, Subchapter 2L).

MCL = Federal Maximum Contaminant Level. Maximum permissible level of a contaminant in water which is delivered to users of public water systems (U.S. Environmental protection Agency - Drinking Water Regulations and Health Advisories.).

ROD = Record of Decision for OU No. 4 Remediation Levels for Contaminants of Concern (Baker, December 1995).

TABLE 10

TIME TREND OF METALS ANALYSIS IN SEDIMENT SAMPLE 41-DD-SD02
 OPERABLE UNIT NO. 4 - SITE 41
 MONITORING AND O&M SUPPORT, CTO-0001
 MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Metals	NOAA ER-L	July 2000	January 2001	July 2001	January 2002	July 2002	January 2003	July 2003	January 2004	July 2004	January 2005
41-DD-SD02	Cadmium	1.2	ND	NA	0.44J	1.2J	ND	0.17J	2.6J	ND	1.3J	NA
	Chromium	81	ND	NA	6	9.1	7.6	ND	12.9 J	5.6	ND	NA
	Lead	46.7	18.4	NA	14.2	25.5	16.5	2.6J	36.5 J	7.5	10.2	40.8J
	Nickel	20.9	ND	NA	ND	4.9J	5.9J	ND	7 J	1.6	2.5J	NA

Notes:

Metal concentrations presented in milligrams per kilogram (mg/kg).

 = Shading indicates that the detected concentration exceeded the NOAA ER-L greater than instrument detection limits.

NOAA = National Oceanic and Atmospheric Administration sediment quality benchmarks for marine and estuarine sediments, Effects Range - Low (ER-L), recommended for use by U.S. Environmental Protection Agency, Region IV. (Jones et al, 1997)

J = Estimated Value

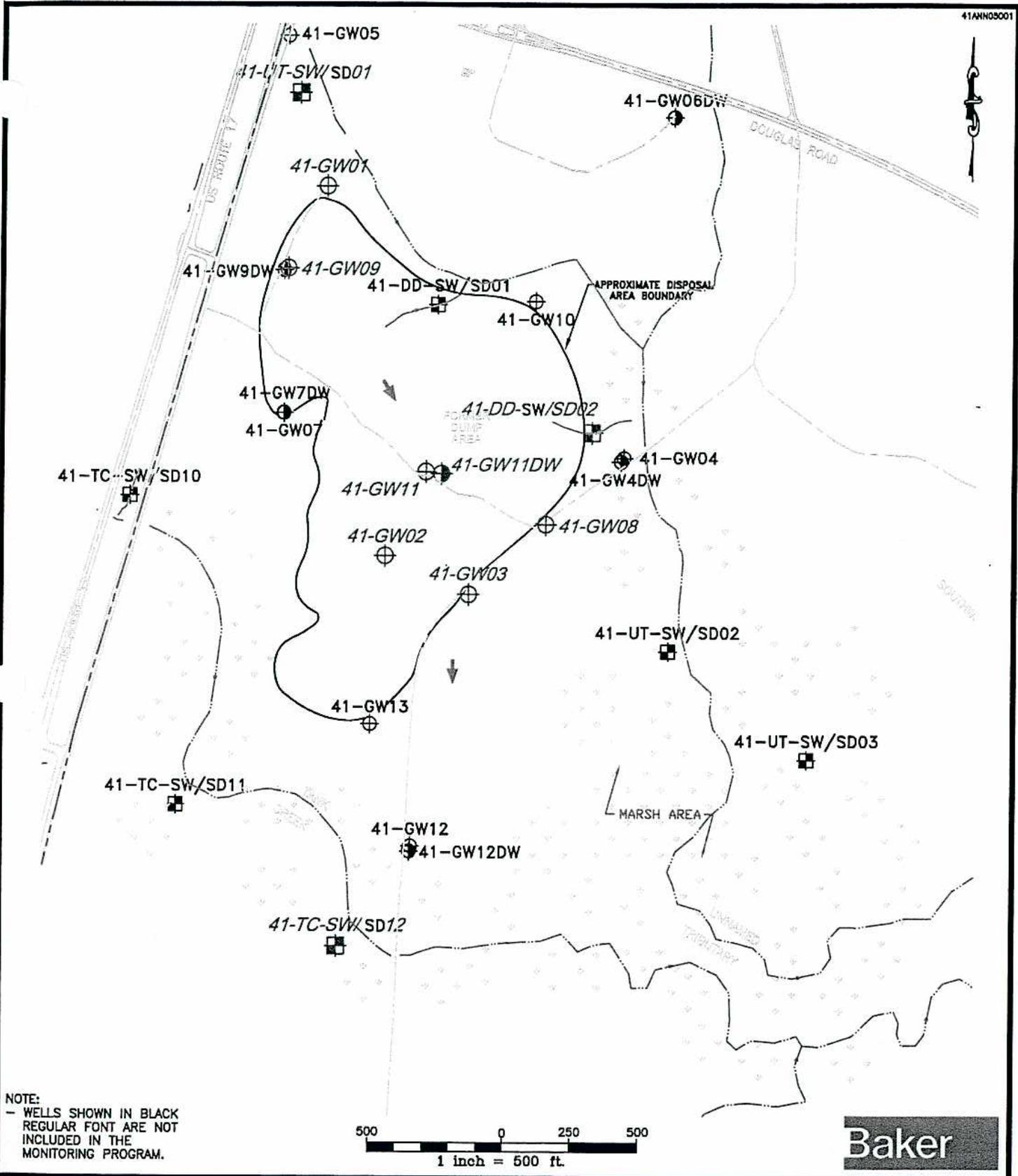
ND = Not Detected

NA = Not Applicable; Not sampled

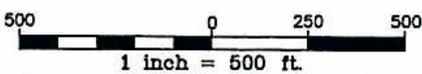
Baker

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FIGURES



NOTE:
 - WELLS SHOWN IN BLACK
 REGULAR FONT ARE NOT
 INCLUDED IN THE
 MONITORING PROGRAM.

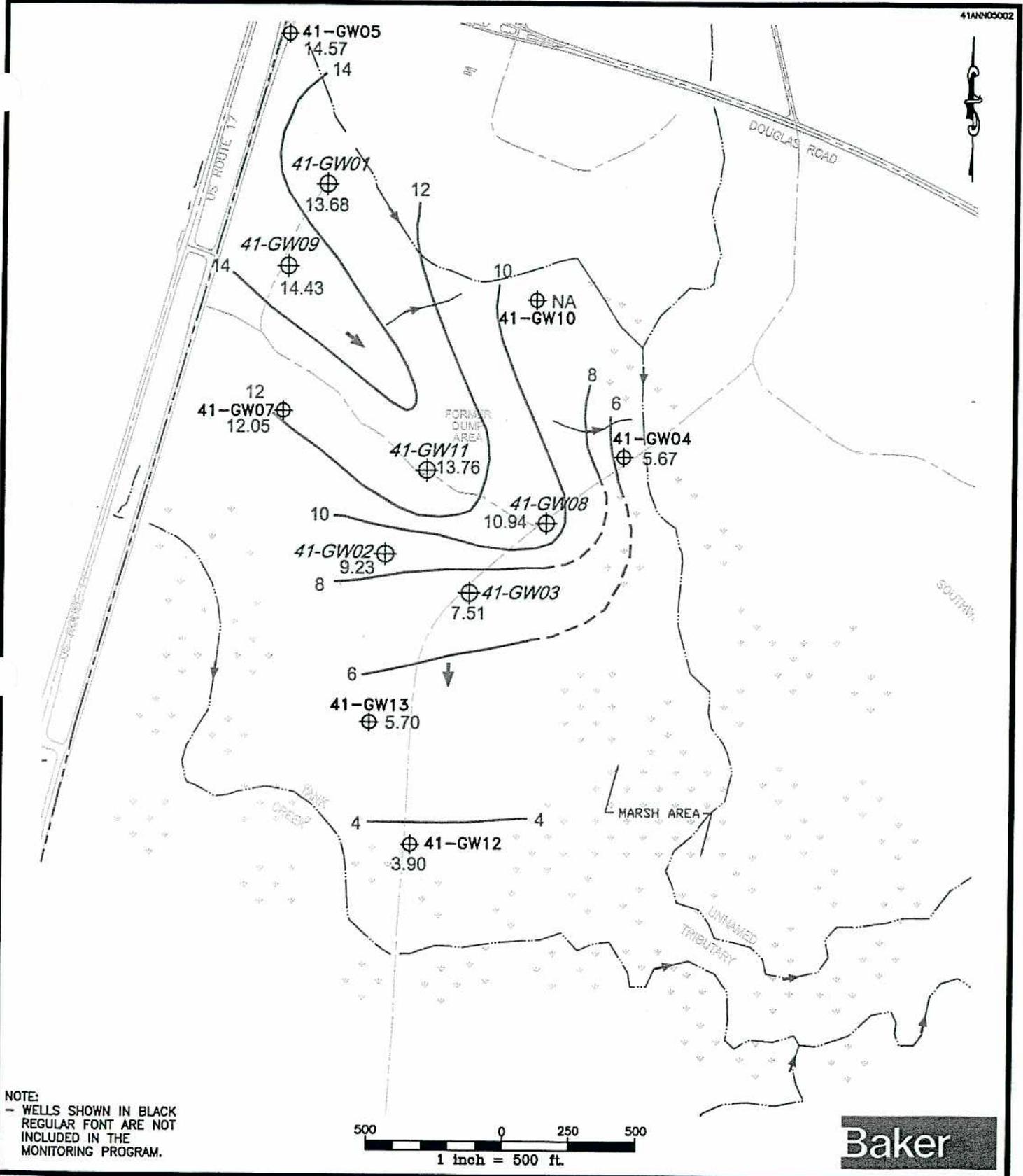


LEGEND

- 41-GW11DW - DEEP MONITORING WELL
- 41-GW01 - SHALLOW MONITORING WELL
- TC-SW/SD11 - SURFACE WATER AND SEDIMENT SAMPLING LOCATION
- - - - ROAD (UNIMPROVED)
- > - DIRECTION OF GROUNDWATER FLOW

FIGURE 1
SAMPLING LOCATION MAP
OPERABLE UNIT NO. 4 - SITE 41
MONITORING AND O&M SUPPORT
CTO - 0001
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

SOURCE: MCB, CAMP LEJEUNE MARCH 2000



NOTE:
 - WELLS SHOWN IN BLACK REGULAR FONT ARE NOT INCLUDED IN THE MONITORING PROGRAM.

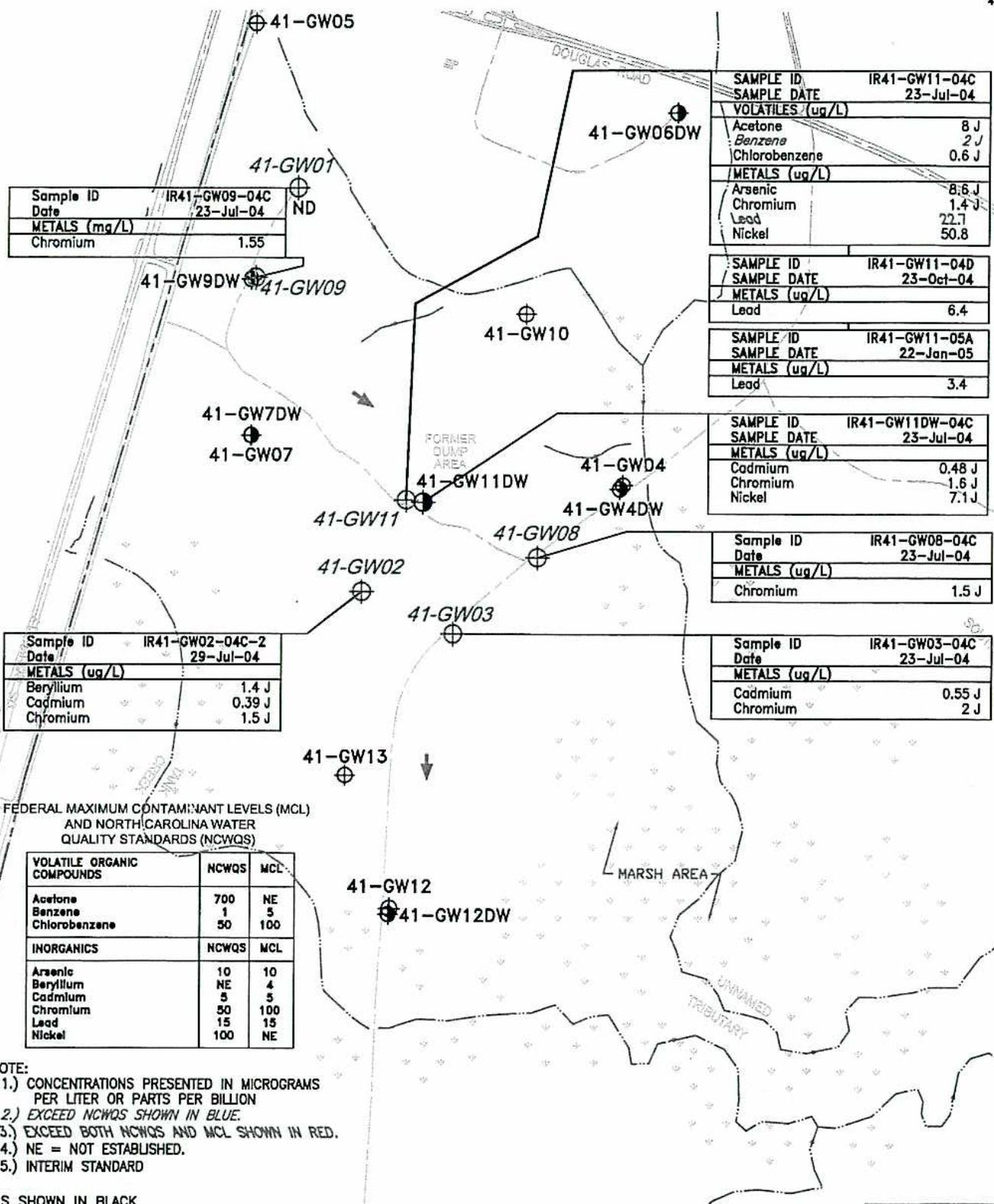


LEGEND

- 41-GW01 ⊕ - SHALLOW MONITORING WELL
- 13.68 - GROUNDWATER ELEVATION (MSL) MEASURED ON JANUARY 22, 2005
- - GROUNDWATER FLOW DIRECTION
- - DIRECTION OF SURFACE WATER FLOW
- - - GROUNDWATER CONTOUR

FIGURE 2
 GROUNDWATER CONTOUR MAP
 SURFICIAL AQUIFER, JANUARY 22, 2005
 OPERABLE UNIT NO. 4 - SITE 41
 MONITORING AND O&M SUPPORT
 CTO - 0001
 MARINE CORPS BASE, CAMP LEJEUNE
 NORTH CAROLINA

SOURCE: MCB, CAMP LEJEUNE MARCH 2000



Sample ID	IR41-GW09-04C
Date	23-Jul-04
METALS (mg/L)	
Chromium	1.55

SAMPLE ID	IR41-GW11-04C
SAMPLE DATE	23-Jul-04
VOLATILES (ug/L)	
Acetone	8 J
Benzene	2 J
Chlorobenzene	0.6 J
METALS (ug/L)	
Arsenic	8.6 J
Chromium	1.4 J
Lead	22.7
Nickel	50.8

SAMPLE ID	IR41-GW11-04D
SAMPLE DATE	23-Oct-04
METALS (ug/L)	
Lead	6.4

SAMPLE ID	IR41-GW11-05A
SAMPLE DATE	22-Jan-05
METALS (ug/L)	
Lead	3.4

SAMPLE ID	IR41-GW11DW-04C
SAMPLE DATE	23-Jul-04
METALS (ug/L)	
Cadmium	0.48 J
Chromium	1.6 J
Nickel	7.1 J

Sample ID	IR41-GW08-04C
Date	23-Jul-04
METALS (ug/L)	
Chromium	1.5 J

Sample ID	IR41-GW02-04C-2
Date	29-Jul-04
METALS (ug/L)	
Beryllium	1.4 J
Cadmium	0.39 J
Chromium	1.5 J

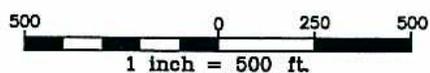
Sample ID	IR41-GW03-04C
Date	23-Jul-04
METALS (ug/L)	
Cadmium	0.55 J
Chromium	2 J

FEDERAL MAXIMUM CONTAMINANT LEVELS (MCL) AND NORTH CAROLINA WATER QUALITY STANDARDS (NCWQS)

VOLATILE ORGANIC COMPOUNDS	NCWQS	MCL
Acetone	700	NE
Benzene	1	5
Chlorobenzene	50	100
INORGANICS	NCWQS	MCL
Arsenic	10	10
Beryllium	NE	4
Cadmium	5	5
Chromium	50	100
Lead	15	15
Nickel	100	NE

- NOTE:
- 1.) CONCENTRATIONS PRESENTED IN MICROGRAMS PER LITER OR PARTS PER BILLION
 - 2.) EXCEED NCWQS SHOWN IN BLUE.
 - 3.) EXCEED BOTH NCWQS AND MCL SHOWN IN RED.
 - 4.) NE = NOT ESTABLISHED.
 - 5.) INTERIM STANDARD

NOTE:
- WELLS SHOWN IN BLACK REGULAR FONT ARE NOT INCLUDED IN THE MONITORING PROGRAM.



LEGEND	
41-GW11DW	- DEEP MONITORING WELL
41-GW01	- SHALLOW MONITORING WELL
- - -	- ROAD (UNIMPROVED)
→	- GROUNDWATER FLOW DIRECTION
ND	- NOT DETECTED

FIGURE 3
CONTAMINANTS IN GROUNDWATER OPERABLE UNIT NO. 4 - SITE 41
MONITORING AND O&M SUPPORT
CTO - 0001
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

FIGURE 4

TIME TREND OF BENZENE IN GROUNDWATER AT 41-GW11
 OPERABLE UNIT NO. 4 - SITE 41
 MONITORING AND O&M SUPPORT, CTO-0001
 MCB, CAMP LEJEUNE, NORTH CAROLINA

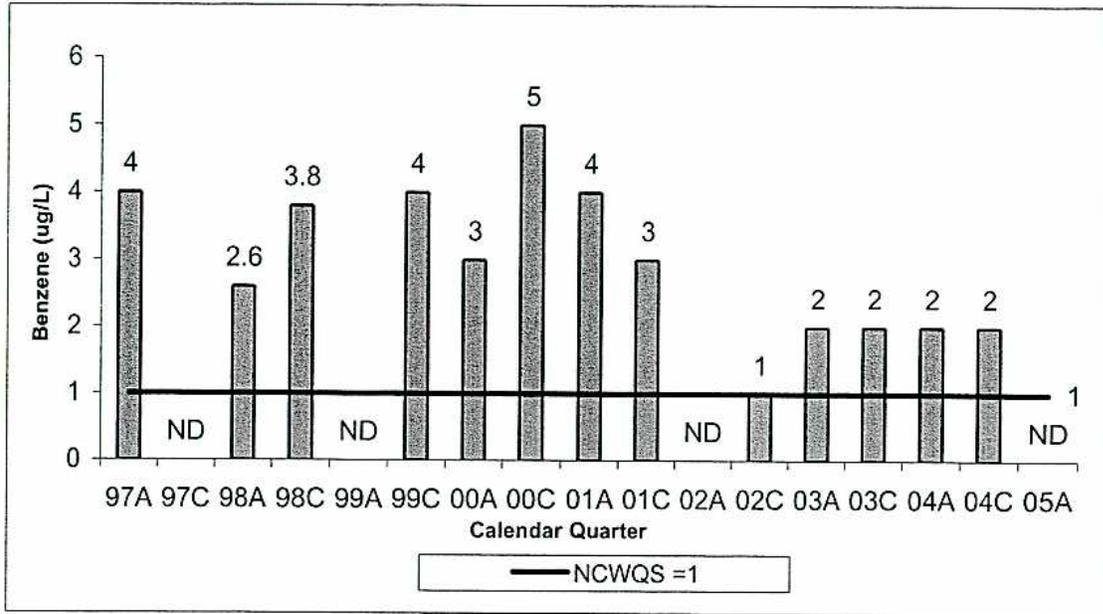
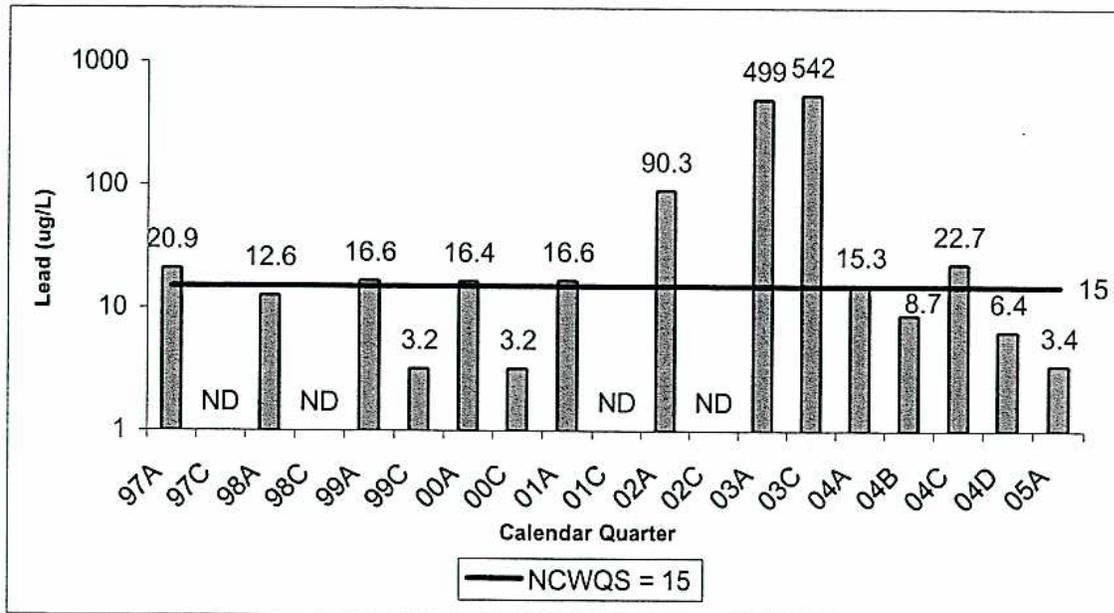


FIGURE 5

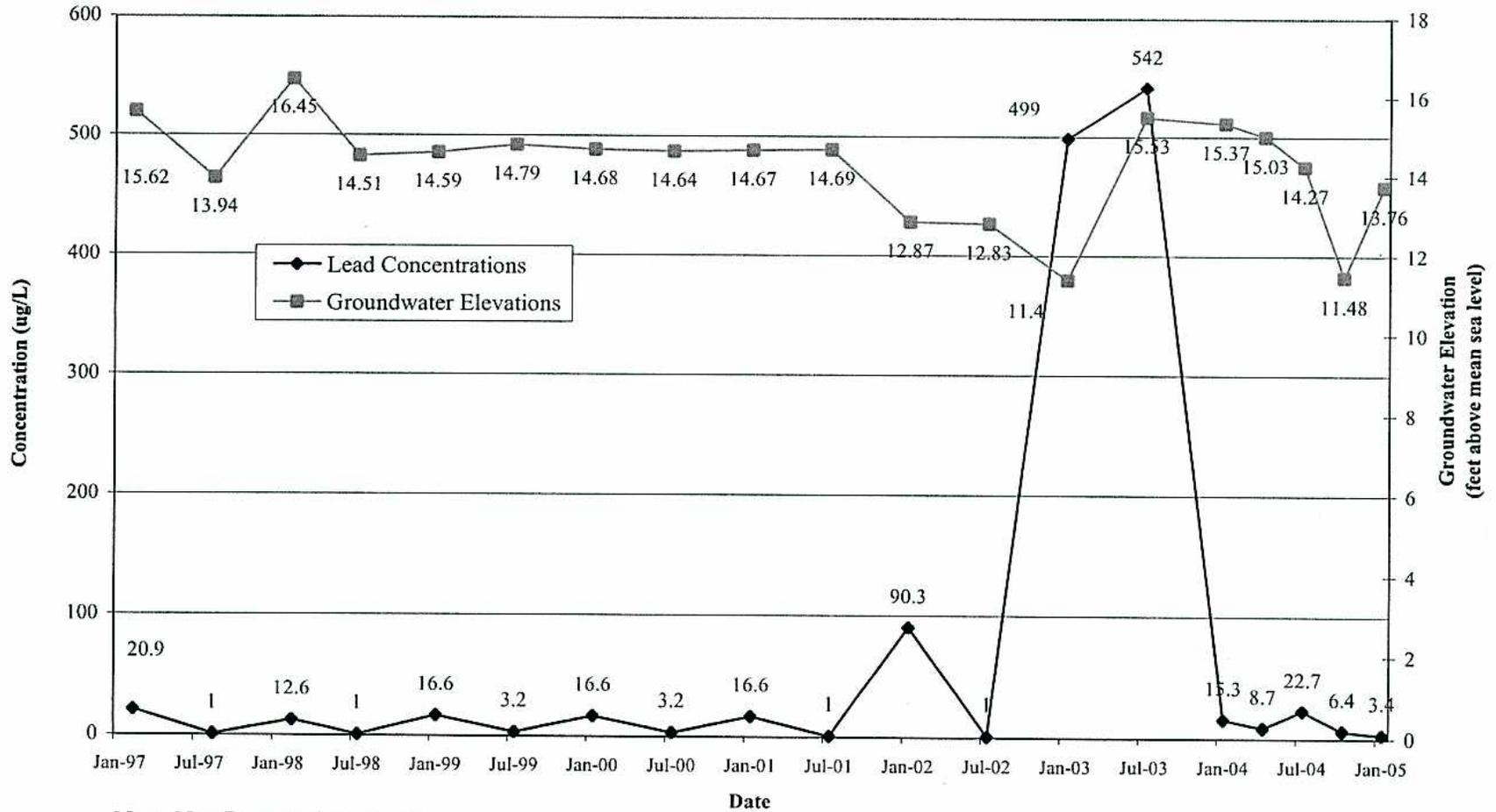
TIME TREND OF TOTAL LEAD IN GROUNDWATER AT 41-GW11
 OPERABLE UNIT NO. 4 - SITE 41
 MONITORING AND O&M SUPPORT, CTO-0001
 MCB, CAMP LEJEUNE, NORTH CAROLINA



ND = Not Detected
 NA=Not Analyzed

FIGURE 6

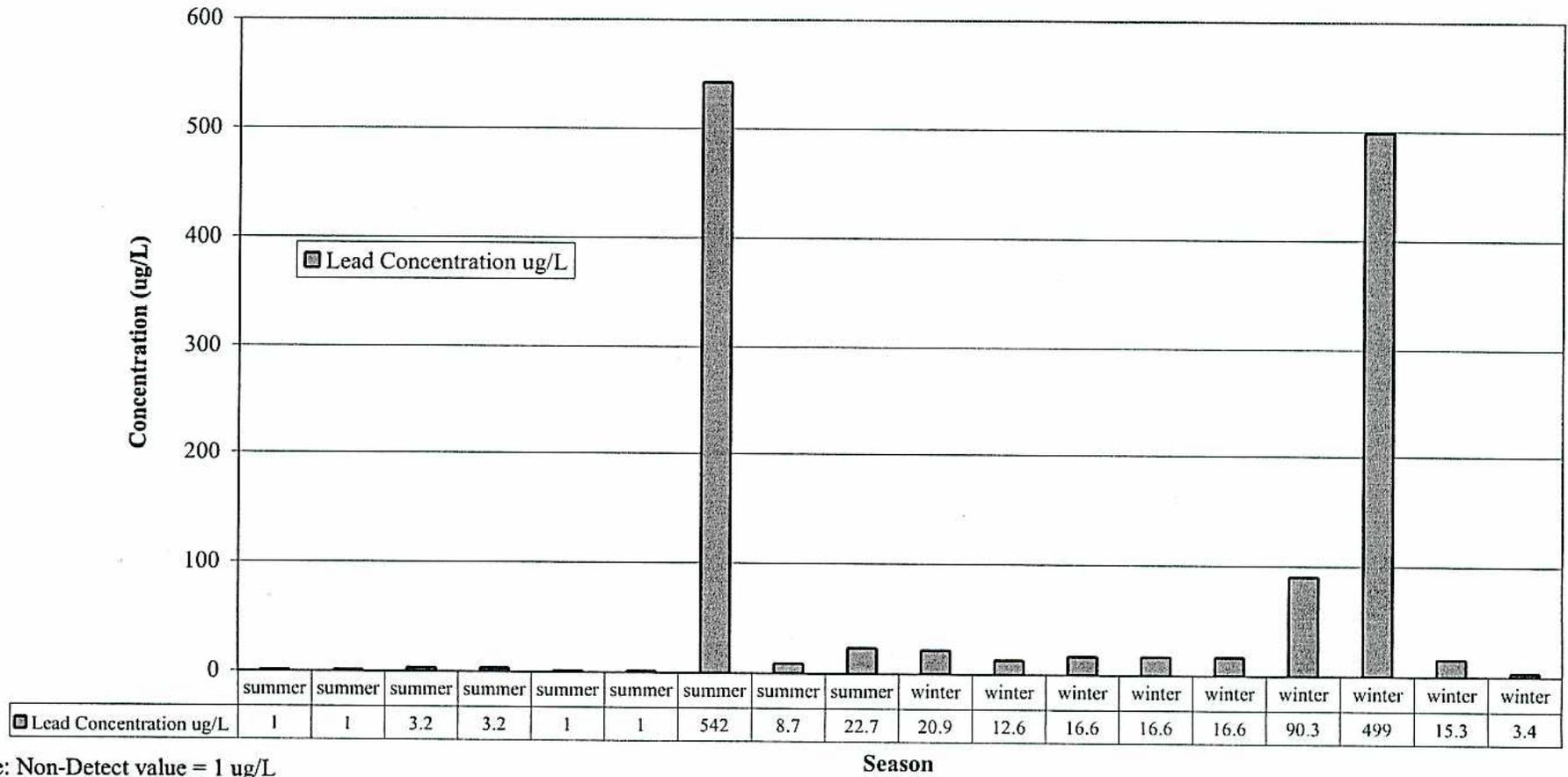
LEAD CONCENTRATIONS VS. GROUNDWATER ELEVATIONS AT 41-GW11
 OPERABLE UNIT NO. 4 - SITE 41
 MONITORING AND O&M SUPPORT, CTO -0001
 MCB, CAMP LEJEUNE, NORTH CAROLINA



Note: Non-Detect value = 1 ug/L

FIGURE 7

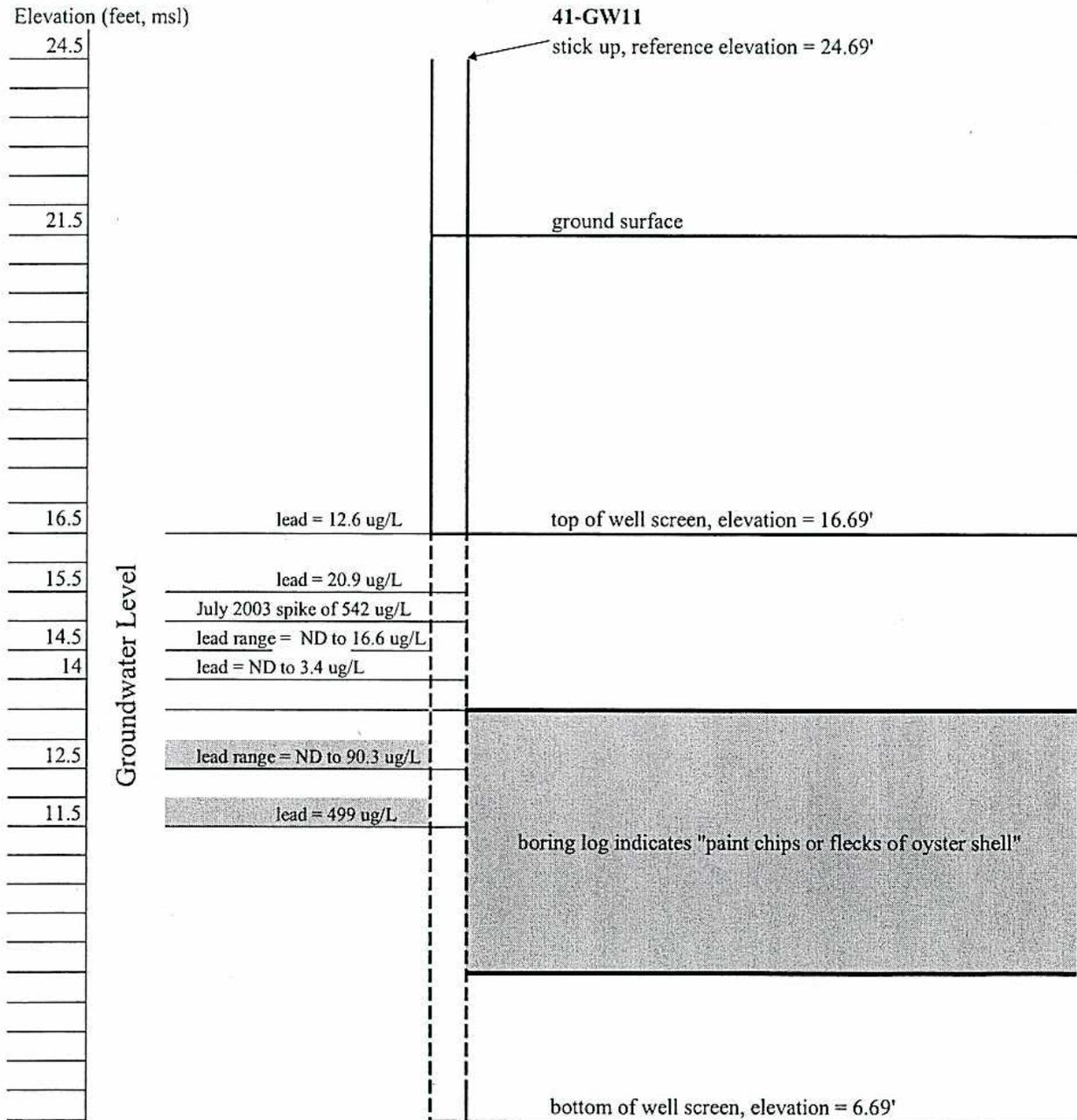
SEASONAL VARIATIONS OF LEAD CONCENTRATIONS AT 41-GW11
 OPERABLE UNIT NO. 4 - SITE 41
 MONITORING AND O&M SUPPORT, CTO -0001
 MCB, CAMP LEJEUNE, NORTH CAROLINA



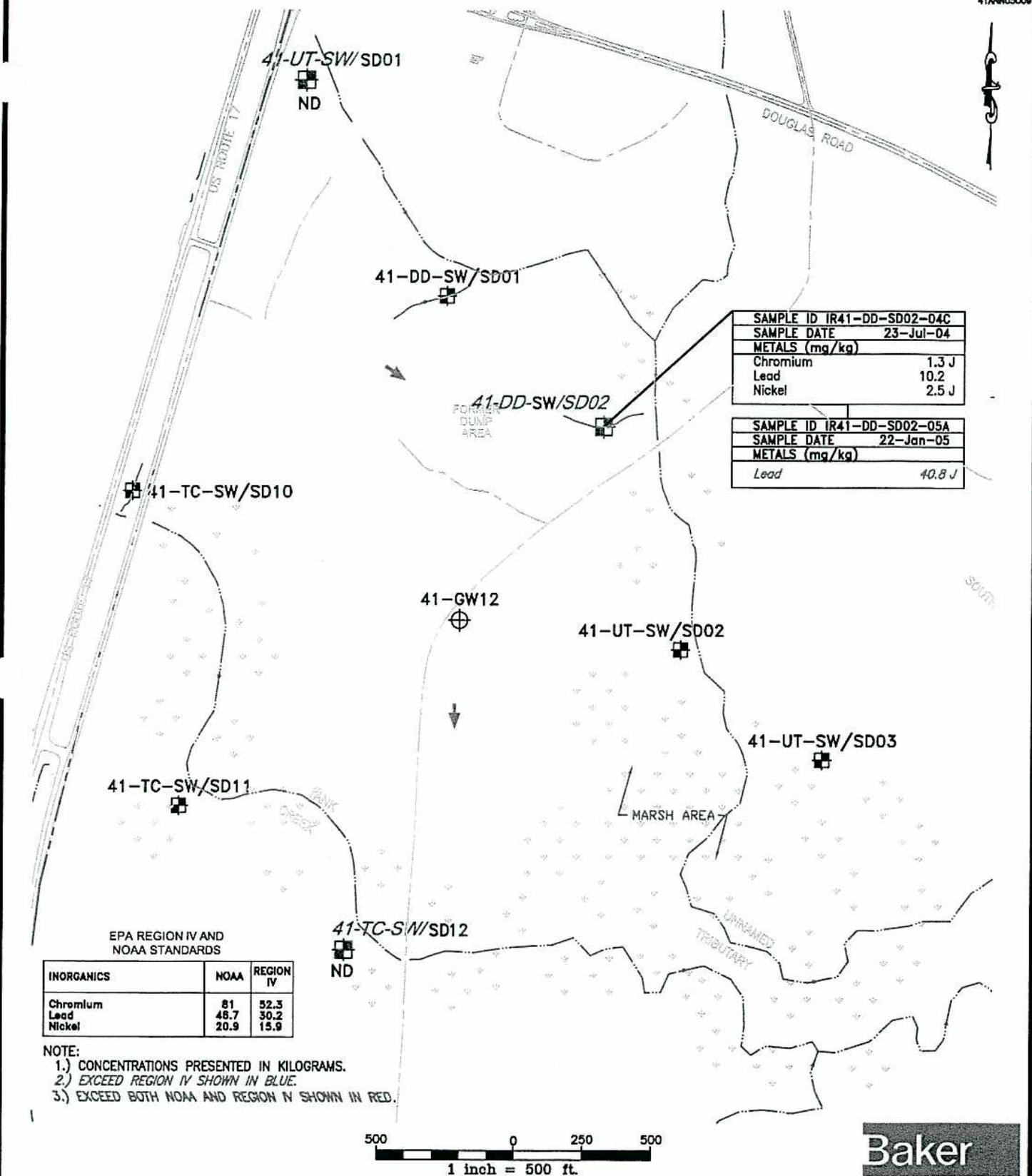
Note: Non-Detect value = 1 ug/L

FIGURE 8

SUMMARY OF LEAD DETECTIONS AND GROUNDWATER LEVELS AT 41-GW11
OPERABLE UNIT NO. 4 - SITE 41
MONITORING AND O&M SUPPORT, CTO-0001
MCB, CAMP LEJEUNE, NORTH CAROLINA



Note: Approximately to scale
Groundwater levels are approximate
msl= mean sea level



SAMPLE ID	IR41-DD-SD02-04C
SAMPLE DATE	23-Jul-04
METALS (mg/kg)	
Chromium	1.3 J
Lead	10.2
Nickel	2.5 J

SAMPLE ID	IR41-DD-SD02-05A
SAMPLE DATE	22-Jan-05
METALS (mg/kg)	
Lead	40.8 J

EPA REGION IV AND NOAA STANDARDS

INORGANICS	NOAA	REGION IV
Chromium	81	52.3
Lead	48.7	30.2
Nickel	20.9	15.9

- NOTE:
 1.) CONCENTRATIONS PRESENTED IN KILOGRAMS.
 2.) EXCEED REGION IV SHOWN IN BLUE.
 3.) EXCEED BOTH NOAA AND REGION IV SHOWN IN RED.



LEGEND	
41-TC-SW/SD11	- SURFACE WATER AND SEDIMENT SAMPLING LOCATION
—	- ROAD (UNIMPROVED)
→	- DIRECTION OF GROUNDWATER FLOW
ND	- NOT DETECTED

FIGURE 9
 CONTAMINANTS IN SEDIMENT
 OPERABLE UNIT NO. 4 - SITE 41
 MONITORING AND O&M SUPPORT
 CTO - 0001
 MARINE CORPS BASE, CAMP LEJEUNE
 NORTH CAROLINA

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Michael Baker Jr., Inc.

ATTACHMENT A

Monitoring Program Analytical Results - July 2004

GROUNDWATER ANALYTICAL RESULTS - JULY 2004
 OPERABLE UNIT NO. 4 - SITE 41
 MONITORING AND O&M SUPPORT, CTO-0001
 MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	IR41-GW02-04C	IR41-GW02-04C-2	IR41-GW03-04C	IR41-GW08-04C	IR41-GW09-04C	IR41-GW11-04C	IR41-GW11D-04C
SAMPLE DATE	23-Jul-04	29-Jul-04	23-Jul-04	23-Jul-04	23-Jul-04	23-Jul-04	23-Jul-04
VOLATILES (ug/L)							
1,1,1-trichloroethane	NA	NA	NA	NA	NA	5 U	NA
1,1,2,2-tetrachloroethane	NA	NA	NA	NA	NA	5 U	NA
1,1,2-trichloroethane	NA	NA	NA	NA	NA	5 U	NA
1,1-dichloroethane	NA	NA	NA	NA	NA	5 U	NA
1,1-dichloroethene	NA	NA	NA	NA	NA	5 U	NA
1,2-dichloroethane	NA	NA	NA	NA	NA	5 U	NA
1,2-dichloroethene	NA	NA	NA	NA	NA	10 U	NA
1,2-dichloropropane	NA	NA	NA	NA	NA	5 U	NA
2-butanone	NA	NA	NA	NA	NA	10 U	NA
2-hexanone	NA	NA	NA	NA	NA	10 U	NA
4-methyl-2-pentanone	NA	NA	NA	NA	NA	10 U	NA
Acetone	NA	NA	NA	NA	NA	8 J	NA
Benzene	NA	NA	NA	NA	NA	2 J	NA
Bromodichloromethane	NA	NA	NA	NA	NA	5 U	NA
Bromoform	NA	NA	NA	NA	NA	5 U	NA
Bromomethane	NA	NA	NA	NA	NA	5 U	NA
Carbon Disulfide	NA	NA	NA	NA	NA	5 U	NA
Carbon Tetrachloride	NA	NA	NA	NA	NA	5 U	NA
Chlorobenzene	NA	NA	NA	NA	NA	0.6 J	NA
Chloroethane	NA	NA	NA	NA	NA	5 U	NA
Chloroform	NA	NA	NA	NA	NA	5 U	NA
Chloromethane	NA	NA	NA	NA	NA	5 U	NA
Cis-1,2-dichloroethene	NA	NA	NA	NA	NA	5 U	NA
Cis-1,3-dichloropropene	NA	NA	NA	NA	NA	5 U	NA
Dibromochloromethane	NA	NA	NA	NA	NA	5 U	NA
Ethylbenzene	NA	NA	NA	NA	NA	5 U	NA
M,p-xylenes	NA	NA	NA	NA	NA	10 U	NA
Methylene Chloride	NA	NA	NA	NA	NA	5 U	NA
Ortho-xylene	NA	NA	NA	NA	NA	5 U	NA
Styrene	NA	NA	NA	NA	NA	5 U	NA
Tetrachloroethene	NA	NA	NA	NA	NA	5 U	NA
Toluene	NA	NA	NA	NA	NA	5 U	NA
Trans-1,2-dichloroethene	NA	NA	NA	NA	NA	5 U	NA
Trans-1,3-dichloropropene	NA	NA	NA	NA	NA	5 UJ	NA
Trichloroethene	NA	NA	NA	NA	NA	5 U	NA
Vinyl Chloride	NA	NA	NA	NA	NA	5 U	NA
Xylene (total)	NA	NA	NA	NA	NA	2 U	NA
						15 U	NA

ATTACHMENT A

GROUNDWATER ANALYTICAL RESULTS - JULY 2004
OPERABLE UNIT NO. 4 - SITE 41
MONITORING AND O&M SUPPORT, CTO-0001
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	IR41-GW02-04C	IR41-GW02-04C-2	IR41-GW03-04C	IR41-GW08-04C	IR41-GW09-04C	IR41-GW11-04C	IR41-GW11D-04C
SAMPLE DATE	23-Jul-04	29-Jul-04	23-Jul-04	23-Jul-04	23-Jul-04	23-Jul-04	23-Jul-04
CHEMICAL WARFARE (ug/L)							
1,3,5-Trinitrobenzene	0.26 U	0.26 UJ	0.26 U				
1,3-Dinitrobenzene	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ
1,4-Dithiane	0.63 UJ	0.63 UJ	0.63 UJ	0.63 UJ	0.63 UJ	0.63 UJ	0.63 UJ
2,4,6-Trinitrotoluene	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ
2,4-Dinitrotoluene	0.26 U	0.26 UJ	0.26 U				
2,6-Dinitrotoluene	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ
2-Amino-4,6-Dinitrotoluene	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ
2-chloroacetonephenone	11 U	10 U	11 U	12 U	11 U	10 U	11 U
2-nitrotoluene	0.52 UJ	0.52 UJ	0.52 UJ	0.52 UJ	0.52 UJ	0.52 UJ	0.52 UJ
3-nitrotoluene	0.52 UJ	0.52 UJ	0.52 UJ	0.52 UJ	0.52 UJ	0.52 UJ	0.52 UJ
4-Amino-2,6-Dinitrotoluene	0.26 U	0.26 UJ	0.26 U				
4-nitrotoluene	0.52 UJ	0.52 UJ	0.52 UJ	0.52 UJ	0.52 UJ	0.52 UJ	0.52 UJ
Acetophenone	11 U	10 U	11 U	12 U	11 U	10 U	11 U
Hexachloroethane	11 U	10 U	11 U	12 U	11 U	10 U	11 U
HMX	0.52 UJ	0.52 UJ	0.52 UJ	0.52 UJ	0.52 UJ	0.52 UJ	0.52 UJ
Hydroxyacetophenone, 2-	11 U	10 U	11 U	12 U	11 U	10 U	11 U
Nitrobenzene	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ	0.26 UJ
Nitroglycerine	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U
Nitroguanidine	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Pentaerythritol Tetranitrate	1.3 U	1.3 UJ	1.3 U				
Phosphorous	0.12 U	0.1 U	0.11 U	0.12 U	0.11 U	0.12 U	0.11 U
RDX	0.52 U	0.52 UJ	0.52 U				
Tetryl	0.52 UJ	0.52 UJ	0.52 UJ	0.52 UJ	0.52 UJ	0.52 UJ	0.52 UJ
Thiodiglycol	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Isopropylmethyl							
Phosphonic Acid (mg/L)	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
Methyl Phosphonic Acid (mg/L)	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
METALS (ug/L)							
Arsenic	4.3 J	20 U	20 U	20 U	20 U	8.6 J	20 U
Beryllium	1 J	1.4 J	2 U	2 U	2 U	2 U	2 U
Cadmium	0.62 J	0.39 J	0.55 J	6 U	6 U	6 U	0.48 J
Chromium	5 U	1.5 J	2 J	1.5 J	1.5 J	1.4 J	1.6 J
Lead	10 U	10 U	10 U	10 U	10 U	22.7	10 U
Nickel	8.4 J	10 U	10 U	10 U	10 U	50.8	7.1 J

SURFACE WATER / SEDIMENT ANALYTICAL RESULTS - JULY 2004
OPERABLE UNIT NO. 4 - SITE 41
MONITORING AND O&M SUPPORT, CTO - 0001
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	IR41-UT-SW01-04C	IR41-TC-SW12-04C	IR41-DD-SD02-04C
Date	23-Jul-04	23-Jul-04	23-Jul-04
METALS (ug/L)			
Cadmium	NA	NA	1.3 J
Chromium	NA	NA	0.74 U
Lead	1.7 U	1.7 U	10.2
Nickel	NA	NA	2.5 J

Baker

Michael Baker Jr., Inc.

ATTACHMENT B

Monitoring Program Analytical Results – October 2004

GROUNDWATER ANALYTICAL RESULTS - OCTOBER 2004
OPERABLE UNIT NO. 4 - SITE 41
MONITORING AND O&M SUPPORT, CTO - 0001
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	IR41-GW01-04D	IR41-GW02-04D	IR41-GW03-04D	IR41-GW09-04D	IR41-GW11-04D
Date	23-Oct-04	23-Oct-04	23-Oct-04	23-Oct-04	23-Oct-04
METALS (ug/L)					
LEAD	1.7 U	1.7 U	1.7 U	1.7 U	6.4

Baker

Michael Baker Jr., Inc.

ATTACHMENT C

Monitoring Program Analytical Results – January 2005

ATTAC NT C

GROUNDWATER ANALYTICAL RESULTS - JANUARY 2005
OPERABLE UNIT NO. 4 - SITE 41
MONITORING AND O&M SUPPORT, CTO - 0001
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID IR41-GW11-05A
Date 22-Jan-05

METALS (ug/L)
Lead 3.4

ATTACHMENT C

SURFACE WATER ANALYTICAL RESULTS, JANUARY 2005
OPERABLE UNIT NO. 4 - SITE 41
MONITORING AND O&M SUPPORT, CTO - 0001
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	IR41-UT-SW01-05A	IR41-TC-SW12-05A
Date	22-Jan-05	22-Jan-05
METALS (ug/L)		
Lead	1.7 U	1.7 U

SEDIMENT ANALYTICAL RESULTS - JANUARY 2005
OPERABLE UNIT NO. 4 - SITE 41
MONITORING AND O&M SUPPORT, CTO - 0001
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID IR41-DD-SD02-05A
Date 22-Jan-05

METALS (mg/kg)
Lead 40.8 J

Appendix E
US Army Chemical Materials Agency Chemical
Warfare Materiel Sites Memorandum and Policy



REPLY TO
ATTENTION OF:

DEPARTMENT OF THE ARMY
US ARMY CHEMICAL MATERIALS AGENCY
5183 BLACKHAWK ROAD
ABERDEEN PROVING GROUND, MD 21010-5424

S: 14 Feb 05

AMSCM-ECN-SO

MEMORANDUM FOR Commanding General, Camp Lejeune Marine Corps Base, PSC Box
2004, Camp Lejeune, NC 28542

SUBJECT: Review of Updated Information on Chemical Warfare Materiel Sites

1. Reference memo, Program Manager for Chemical Demilitarization Office, subject: Request for Information on Chemical Warfare Materiel, dated 7 Nov 02.
2. The Project Manager for Non-Stockpile Chemical Materiel (NSCM), which is an element of the Office of the Program Manager for the Elimination of Chemical Weapons, is tasked with providing centralized management and direction to the Department of Defense for the disposal of non-stockpile chemical materiel in a safe, environmentally sound, and cost-effective manner. To effectively accomplish this mission, a responsibility of my office is to identify actual and potential locations of NSCM.
3. Previous efforts related to this responsibility resulted in the congressionally mandated NSCM Program Survey and Analysis Report dated Nov 93, and the establishment of a database that contains pertinent information about sites and installations that are known or suspected to contain chemical warfare materiel. The 1993 Survey and Analysis Report was previously provided to your installation. This updated information is required to maintain consistency between our database, installation records, and records from the US Army Corps of Engineers. In addition, as my office continues to field mobile treatment and disposal systems, data from your installation will provide us essential information to plan for any required future remediation activities.
4. The non-stockpile chemical warfare materiel sites update has been completed. The document, entitled "Potential Buried Chemical Warfare Materiel Sites Update," contains information on individual installations, as well as summarized information by the various services and formerly used defense sites. We request you review the updated information at enclosure 1 pertaining to your installation/site. Please provide any comments or concurrence electronically to the point of contact (POC) listed below in paragraph 5, by COB 4 March 05 or sooner. After resolution of any comments, the entire document will be considered available for public release. The overall updated document has undergone operational security review locally, and was determined to be suitable for public release.

AMSCM-ECN-SO

SUBJECT: Review of Updated Information on Chemical Warfare Materiel Sites

5. The POC for this action is Mr. Russell Fendick, (410) 436-8094 or e-mail russell.fendick@pmcd.apgea.army.mil.

Encl



LAURENCE G. GOTTSCHALK
Project Manager for
Non-Stockpile Chemical Materiel

EXECUTIVE SUMMARY

BACKGROUND

United States Congressional Interest. In November 1985, the U.S. Congress passed Public Law 99-145 (Title 50 U.S. Code, § 1521) requiring the destruction of the United States stockpile of lethal chemical agents and munitions. Subsequently, House Appropriations Report 101-822, accompanying the FY91 Defense Appropriations Act, stated that,

The Program Manager for Chemical Demilitarization (PMCD) currently has responsibility for demilitarizing only those items which were originally identified in 1986 as part of the Chemical Stockpile Disposal Program (CSDP). Not included are a host of lethal wastes from past disposal efforts, unserviceable munitions, chemically contaminated containers, chemical production facilities, subsequently located chemical munitions, sites known to contain significant concentrations of buried chemical weapons and waste, and binary weapons and components. The Committee therefore directs the Secretary of Defense to organize an overall program so that operational responsibility for all Defense Department chemical warfare activities rests within a single office which shall be fully accountable for total program execution.

Congress directed the Department of Defense (DoD) to organize an overall program so that operational responsibility for all DoD chemical warfare activities rested within a single office that would be fully accountable for total program execution. On 13 March 1991, the Deputy Secretary of Defense directed that the Department of the

Army be fully accountable for all DoD chemical warfare-related materiel destruction and designated the Secretary of the Army as the Defense Executive Agent for this purpose. As a result, the 1993 Survey and Analysis Report was developed and provided to Congress on 23 November 1993.

Remediation of buried chemical warfare materiel (CWM) sites poses a great challenge for the DoD. There are numerous sites with potential buried CWM within the United States, some on military installations and others at Formerly Used Defense Sites (FUDS). The DoD will develop site characterization, excavation, removal, and treatment procedures for each burial type. Alternative courses of action include onsite treatment, leaving the CWM in the ground while controlling access to the site and containing potential contamination, and transporting the recovered chemical warfare materiel (RCWM) to a facility capable of storage and destruction.

Disposal and transportation options will be fully assessed in accordance with federal and state environmental regulations. Along with these environmental requirements, the RCWM will be subject to the provisions of the Chemical Weapons Convention (CWC). As long as CWM remains buried, it is not subject to the provisions of the CWC.

RCWM includes items recovered during range-clearing operations and from buried CWM sites. These items are stored at controlled locations and accounted for by careful documentation. State-of-the-art systems are in use by the U.S. Army for recovering, handling, moving, storing, treatment, and disposal of RCWM. System enhancements

and potentially new systems are being researched to meet the diverse disposal challenges (i.e., large burial sites such as Deseret Chemical Depot and Redstone Arsenal). New technologies are assessed and evaluated routinely as the U.S. Army strives to meet mission mandates with strict adherence to worker and public safety, and environmental preservation.

The Non-Stockpile Chemical Materiel Project (NSCMP) is challenging and dynamic. Although progress has been made in defining the scope of the program and removing the potential hazards at some sites, much more needs to be done. The DoD recognizes the significance of the program and is prepared to take full responsibility for the safe recovery and destruction of all non-stockpile chemical materiel (NSCM), if so directed. The DoD will continue the effort begun in 1993 to gather information on possible sites and associated NSCM, study the different destruction alternatives, develop destruction plans, and comply with all federal, state, and local regulations in selecting and executing the recovery and destruction processes. The DoD will also work closely with other federal agencies, local communities, and Congress to develop the destruction plans and identify resources for safe destruction operations.

APPROACH FOR 2003 BURIAL SITES UPDATE

The approach used to compile and update the list of potential sites is based on historical research of locations that may contain buried chemical weapons, or those sites where chemical weapons were developed, manufactured, tested, or stored. These sites are listed based on the likelihood that chemical weapons may have been disposed

of by burial or, as in the case of test ranges, penetrated below the ground surface by impact. The data reflected in this report constitute research efforts conducted November 2002 through December 2003. Information was solicited from multiple sources in writing, via telephone, and electronic mail. The baseline for this latest research effort was the 1996 Draft Survey and Analysis Report. It is also the source document for the current NSCM Data Management System (DMS) for Burial Sites. The 1996 draft report was created from the original research effort published in 1993. The current report was developed from Archive Search Reports, input and discussions with the U.S. Army Corps of Engineers Office of FUDS CWM; (USACE) Site Assessments, assorted records, and input from all contacted DoD installations.

This research effort, however, did not include any site visits in support of the data collection effort. Further, there was significant interaction with the USACE yielding more potential FUDS CWM activity than revealed in previous research reports.

During the research, the USACE Huntsville was simultaneously updating their FUDS database to include potential FUDS CWM sites. As a result, 88 potential FUDS CWM sites were captured for the database from the USACE FUDS database. Because of multiple sites and the likelihood that chemical agent identification sets (CAIS) sites may also contain other CWM, it is not possible to generate an "apples-to-apples" comparison of the current data with the data reported in the 1993 version and later in the 1996 version of the Survey and Analysis Report.

POTENTIAL BURIED CWM SITE CLASSIFICATION

Since 1993, the Project Manager for Non-Stockpile Chemical Materiel (PMNSCM) has used a five-tiered classification system designed to assess the likelihood for potential CWM at each site. This classification system included the following categories: Known; Likely; Suspect; Possible; and No Further Action to describe the results of that specific research effort for identifying potential burial sites. To the extent possible, attempts were made to discover the exact nature of the site, its size, and contents. However, records during the time frame researched were often imprecise. In many cases, the source states only that materiel was buried without any definitive information on the type of materiel or the exact location of the site. Within military installations, historical information is also open to question since many areas are no longer used for their original purposes.

A new classification is being implemented to eliminate as much interpretive ambiguity as possible and to better assess sites for planned or potential remediation activities. The new system includes three possible classifications: 1) "Likely/Known/Confirmed"; 2) "Possible"; and 3) "Unlikely" compared against five classifications from the previous method. The new classification system, respective criteria, and total number of sites within each classification are shown in Figure 1.

	LIKELY, KNOWN, CONFIRMED	POSSIBLE	UNLIKELY
	<ul style="list-style-type: none"> • Actual recovery occurred • CWM confirmed by site assessment • Dumping/burial clearly supported by historical documentation • Firing of CWM under range conditions 	<ul style="list-style-type: none"> • Documentation states burial occurred and all destroyed • Documentation states CWM transfer without proper receipt confirmation • CWM disposal documented; however, site reported cleared by historical documentation • Documents indicate the potential for CWM • Extensive use of CAIS or large shipment of CAIS to a location without proper accountability • Non-remediated sites with adequate investigation; site assessment performed with good justification, no anomalies encountered, and no CWM detection • Vestiges of CWM breakdown products in soil/groundwater 	<ul style="list-style-type: none"> • Analysis of available data does not warrant "Likely" or "Possible" • Remediation performed at site to locate buried CWM or characterize contamination from buried CWM without detection
Sites by Category	88	142	181

Figure 1. Potential Buried CWM Site Assessment Classification

CAIS SITES

Many military installations encompass a broad range of missions, some of which are not associated primarily with the development, production, or testing of chemical weapons. For example, some of these sites often contain CAIS. CAIS represent an unknown factor in chemical warfare burials given that they were considered expendable training items and few records exist. However, some of those sites may also be found in one of the main categories if actual CAIS has been recovered or if the site had a known larger CWM mission at one time.

Chemical agent identification sets were developed to aid in the training of soldiers, airmen, and sailors. Training consisted of teaching the proper procedures for identifying chemical agents and taking proper actions in the event of a chemical attack. The CAIS contain small amounts of chemical agents and of industrial chemicals that simulate chemical agents. Three major varieties including seventeen different types of CAIS were produced over the years.

Approximately 110,000 CAIS were produced between 1928 and 1969. They were widely distributed to military organizations conducting chemical warfare training. In the early 1980s, the U.S. Army recalled the remaining CAIS for destruction. Approximately 21,458 CAIS were recovered and destroyed as a result of this effort. In addition, many of the CAIS would have been destroyed during the training for which they were originally intended. However, not all CAIS have been accounted for. To date, they continue to be found unexpectedly. It has been reported that some CAIS items have been kept as war souvenirs.

CAIS material not used during training was sometimes buried in remote areas as a means of disposal, but because of increasing privatization and development of FUDS, once remote areas are now accessible to the public. This explains why CAIS are sometimes found during excavation operations.

CAIS were extensively used by all military services. Because they were disposable training aids, detailed records about their disposition were not kept. A list of locations that have been associated with CAIS is included to illustrate the widespread use.

Exposure to these chemical agents can cause coughing, nausea, vomiting, irritation, burning sensation, swelling of the eyes, itching, redness and blisters on the skin, and acute pain and tightness in the chest.

If items encountered are suspected to be CAIS components, the recommended response procedure is to secure and mark the site, back away, seek medical attention, and notify Army and state officials.

CONCLUSION

Limited data and a legacy of poor recordkeeping inhibit a true scientific approach for collecting information and identifying all potential non-stockpile burial sites.

The data provided by the USACE, Huntsville, and assistance provided by

historical offices, environmental offices, public affairs offices, Base Realignment and Closure offices, and higher headquarters are all instrumental in painting a clearer picture about the large number of potential non-stockpile sites and the magnitude of the remediation mission. Their support was crucial in helping to assemble the most comprehensive collection of potential sites to date. Where errors have been made or new information becomes available, every effort will be made to correct the record.

Continuous communication and information sharing will avail program managers and decision-makers with the most current data for potential CWM sites.

Partnering with all DoD branches, other government agencies, federal, state, and local lawmakers, special interest groups, and affected citizens is a formula for safely eliminating hazards associated with buried CWM and carrying out this national mission.

Potential Buried Chemical Warfare Materiel for Marine Corp Base, North Carolina:

State	Location	Site	CWM Recovery Classification	CAIS Recovery Classification	Installation Type	EPA Region	COE Division	COE District
North Carolina	Marine Corp Base, Camp Lejeune	Camp Geiger Dump	Unlikely	Φ	Marine Corps	IV	South Atlantic	Wilmington
		MCAS Basketball Site	Unlikely	Φ	Marine Corps	IV	South Atlantic	Wilmington
		MCAS Curtis Road Site	Unlikely	Φ	Marine Corps	IV	South Atlantic	Wilmington
		Mess Hall Grease Disposal Area	Unlikely	Φ	Marine Corps	IV	South Atlantic	Wilmington
		Rifle Range Chemical Dump	Unlikely	Known	Marine Corps	IV	South Atlantic	Wilmington

Key:

Previously listed in 1996 S&A Report
Not previously listed in 1996 S&A Report
Φ Data insufficient to classify

Appendix F
Site 74 Final Long-Term Monitoring Report

**DRAFT-FINAL
MONITORING REPORT**

**OPERABLE UNIT NO. 4 – SITE 74
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA**

AUGUST 31, 2001

CONTRACT TASK ORDER 0120

Prepared for:

**DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES
ENGINEERING COMMAND
*Norfolk, Virginia***

Under the:

**LANTDIV CLEAN II Program
Contract N62470-95-D-6007**

Prepared by:

**CH2M HILL FEDERAL GROUP, LTD.
*Herndon, Virginia***

**BAKER ENVIRONMENTAL, INC.
*Coraopolis, Pennsylvania***

QC Review Page

Final Long-Term Monitoring Report

OU No. 4, Site 74

MCB Camp Lejeune

Jacksonville, North Carolina

Contract Task Order Number - 0120

Contract Number N62470-95-D-6007

Navy CLEAN II Program

Prepared by

CH2M HILL

Baker Environmental

August 2001

Approved by: David G. Collins

David G. Collins
Project Manager, CH2M HILL

Date: 8/27/01

Approved by: Rich Bonelli

Rich Bonelli, P.G.
Activity Coordinator, Baker Environmental

Date: 8/29/01

INTRODUCTION

This document provides the Final Long Term Monitoring (LTM) Report for Site 74, the Mess Hall Grease Disposal Area. Site 74 has completed the necessary requirements for no further LTM actions as stipulated in the Final Record of Decision (ROD). This Final LTM Report is being prepared as an interim document prior to the future submittal of a Final Closeout Report for Operable Unit (OU) No. 4.

SUMMARY OF SITE CONDITIONS

Site 74, along with Site 41, comprise OU 4 at Marine Corps Base (MCB) Camp Lejeune, North Carolina. These two sites were grouped into OU 4 since both have a reported history of chemical warfare material (CWM) disposal. Site 74 is located in the northeastern portion of the Base, approximately one-half mile east of Holcomb Boulevard (Figure 1).

Site 74 consists of two areas of concern: the former grease pit disposal area and a former pest control area. Spent grease was reportedly disposed of by dumping it into excavated trenches. It was reported that a volatile substance was sometimes used to ignite the grease. Storage drums containing polychlorinated biphenyls (PCBs) and “pesticide soaked bags” were also reportedly disposed of in these trenches. One internal memorandum reported that drums, which were supposed to have been taken to Site 69 (OU 14) for disposal, were actually disposed of at Site 74. During the Remedial Investigation (RI) (Baker, 1995) there were no apparent signs of disposal activity, with the exception of one area within the grease pit disposal area where a small depression in the ground surface was observed. The former pest control area is believed to have been used for the storage and handling of pesticides. There are no known disposal activities associated with the former pesticide control area at Site 74.

PROCEDURES

The LTM program for Site 74 consisted of field activities and data reporting. The field activities included sample collection and field observations, while the data reporting was comprised of data management and evaluation. Sampling activities were conducted and subsequent laboratory analyses were performed according to procedures and methods specified in the Work Plans for Long Term Monitoring for OU 4 (Baker, 1996). The project work plans identify specific tasks associated with the monitoring activities to be conducted at Site 74.

INVESTIGATIVE ACTIVITIES AND REMEDIAL GOALS

The conditions at Site 74 have been evaluated through several separate investigative activities, including a monitoring program. A chronological account of these investigative activities for Site 74 is presented on the Site Activities Timeline in Figure 2. This timeline provides milestones reached during the six years of activity conducted at Site 74. Relevant information associated with specific events are cross-referenced as data tables or graphs and are presented within this report. The following subsections provide a summary of the previous studies completed at the site along with the results of the LTM program.

Investigative activities for OU 4 began in 1983 with an Initial Assessment Study (IAS) along with other sites on the Base. Site 74 was identified as one of the 22 sites that was recommended for further investigative studies. A two-part Confirmation Study was conducted by Environmental Science and Engineering, Inc. (ESE) from 1984 through 1987. The purpose of the Confirmation

Study was to investigate potential contaminant source areas identified in the IAS Report. Site 74 was evaluated and consequently further investigations were recommended.

In addition to the IAS, an aerial photographic study was conducted which evaluated site operations between 1938 and 1990. An interim report was completed in August 1992 (Figure 2, box 3). A recent aerial photograph of Site 74 with superimposed site boundaries is provided on Figure 3.

In July 1992, groundwater samples were collected from monitoring wells 74-GW1 and 74-GW2 as part of a Pre-Remedial Investigation sampling effort (Figure 2, box 4). This Pre-RI sampling was conducted to aid in scoping of the RI field program.

Remedial Investigation

The RI field program was concluded in March 1994 and the report was issued in May 1995 (Figure 2, box 5). As part of the RI, both soil and groundwater investigations were conducted. In August 1994, selected monitoring wells were re-sampled for the purposes of obtaining representative groundwater samples for subsequent total and dissolved metals analysis. The data gathered during these investigations was used to assess human health and ecological risks. Remedial alternatives for soil and groundwater were evaluated during preparation of the Feasibility Study (FS) (Figure 2, box 6).

Record of Decision

The Final ROD was completed on June 22, 1995 (Figure 2, box 7). As stipulated in the signed revised final ROD for OU 4 in October 1995 (Figure 2, box 8), the primary objective of the remedial action at Site 74 was to address contamination in the shallow groundwater aquifer. The selected remedy for the groundwater identifies the implementation of institutional controls and monitoring for shallow groundwater.

Long Term Monitoring Program

The LTM program began in February 1997 (Figure 2, box 9) and initially included the sampling of four shallow monitoring wells on a semi-annual basis. The timeline on Figure 2 provides the evolution of the monitoring program over time. The following provides clarifications of the LTM sequence shown on Figure 2:

- In Figure 2, boxes 10 and 11 indicate that sampling continued at Site 74 with recommendations for removal from the LTM program due to concentrations below the North Carolina Water Quality Standards 2L (NCWQS) and/or Federal Maximum Contaminant Levels (MCLs).
- In Figure 2, box 12 indicates that Site 74 was removed from LTM entirely and sampling was discontinued. LTM analytical data suggested that Site 74 had achieved the ROD specified objectives and, therefore, the site was recommended for removal from the overall monitoring program at Camp Lejeune.

Table 1 provides analytical results from the data that was collected during the LTM program. Aluminum and iron concentrations detected during the LTM sampling event are presented on a time trend graph in Figures 4 and 5. As stated in previous monitoring reports and letters, only

aluminum and iron have consistently been detected at excess concentrations. Aluminum does not currently have an established NCWQS or MCL.

Metal concentrations at Site 74 are indicative of naturally occurring metals in the presence of acidic soils. The coastal plain environment of North Carolina is naturally rich in metals. As a result, iron has consistently been detected at concentrations in excess of the established NCWQS of 300 µg/L during the LTM program.

PROTECTIVENESS

Past investigations at Site 74 focused on the evaluation of the extent as well as the cleanup of contamination at Site 74. In addition to these efforts, several support documents were prepared to address the protectiveness of human health and the environment at Site 74.

ROD

The ROD is a decision document that establishes an agreed upon and legally binding set of conditions that Site 74 must achieve to acquire a “no further action” status. The ROD specifies restrictions on use of the soil and shallow groundwater within OU 4, and requires the periodic monitoring of the groundwater to meet the 2L standards. Based on the data collected at Site 74, groundwater remediation levels have met in compliance with the ROD. As noted above, the high iron concentrations at Site 74 are indicative of naturally occurring levels.

LUCIP/LUCAP

Site-specific land use controls have been implemented at Site 74 as documented in the Land Use Control Assurance Plan (LUCAP) and Land Use Control Implementation Plan (LUCIP) (Baker, June 2001). The LUCAP (Figure 2, box 13) is intended to ensure that all of the Navy’s site-specific selected remedies with land use controls remain protective of human health and the environment. The LUCIP and its requirements are part of the selected remedy as specified within the Final ROD. The LUCIP identifies the boundary for land use controls and aquifer use controls that prohibits intrusive activities for groundwater. The LUCIP restricts all groundwater use (except for monitoring purposes) within a 1000-foot buffer zone surrounding known areas of groundwater contamination. These land use and aquifer use control boundaries are identified in the Final LUCIP completed in June 2001.

Five Year Review

In 1999, the initial five-year review was conducted for all sites at Camp Lejeune. The five year review is conducted in line with procedures detailed in the National Contingency Plan (NCP) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980. A five year review is required for a CERCLA site if: 1) a remedial action results in hazardous substances, pollutants, or contaminants remaining at a site; or 2) the ROD was signed on or after October 17, 1986. This document was submitted to, reviewed, and approved by the United States Environmental Protection Agency (USEPA) and NC DENR. The Final Five-Year Review can be referenced as part of the Administrative Record for Camp Lejeune.

REGULATORY AGENCY

The USEPA and NC DENR have been actively involved with the investigation process of Site 74. These agencies are members of the Camp Lejeune Partnering Team, which review the monitoring reports, discuss the proposed recommended items, and provide direction for future activities.

CONCLUSION

Serving as the final LTM report for Site 74, there will be no future activities associated with this site. Once all the sites that comprise OU 4 (i.e. Site 41) reach this degree of completion, a Final Close Out Report will be submitted for the OU.

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TABLE 1
INORGANIC DETECTIONS IN GROUNDWATER
FINAL LTM REPORT
OPERABLE UNIT NO. 4 - SITE 74
MONITORING AND O&M SUPPORT, CTO - 0120
MCB, CAMP LEJEUNE, NORTH CAROLINA

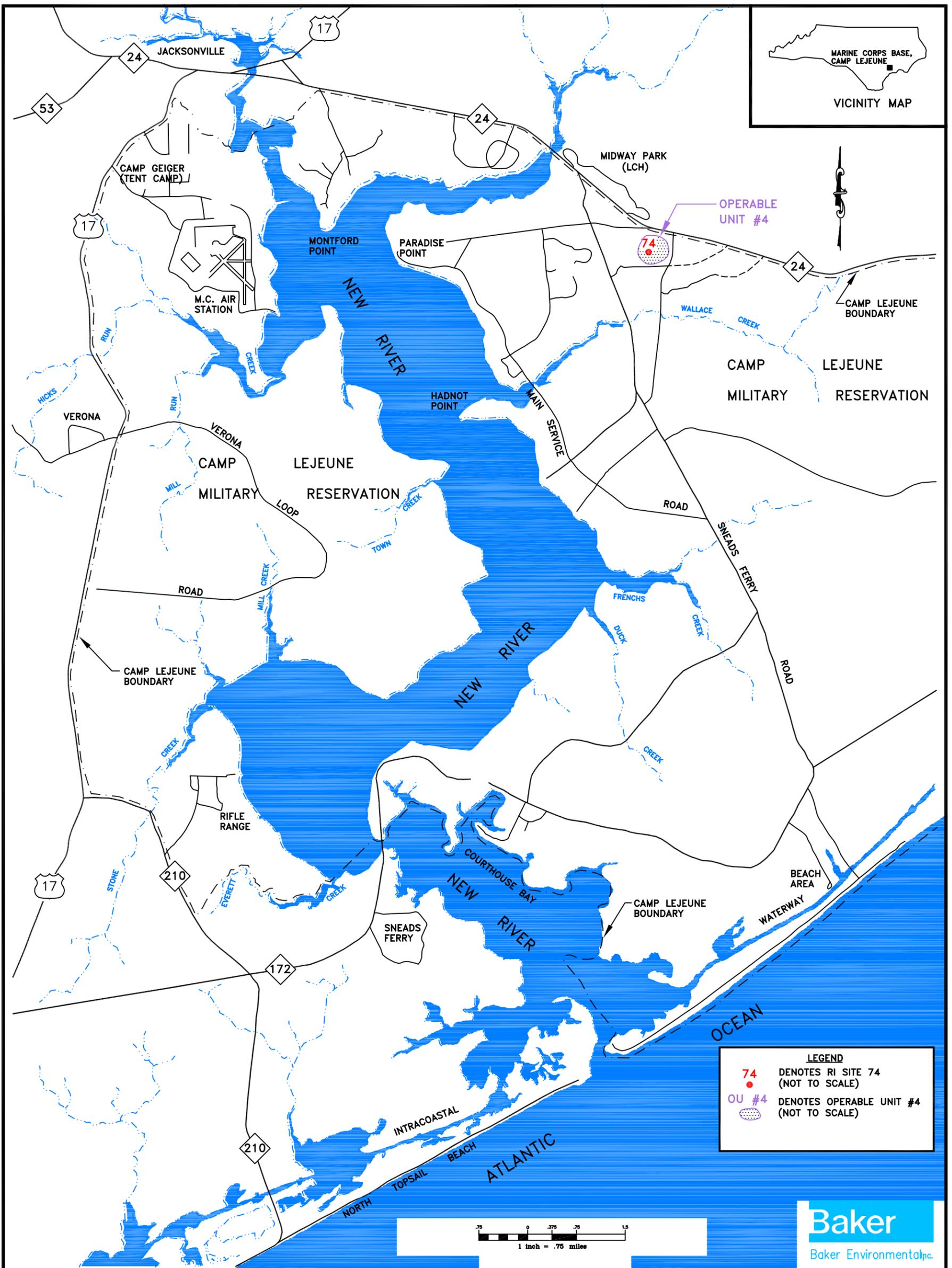
Analyte	74-GW01			74-GW02			74-GW03A			74-GW07		
	Feb-97	Aug-97	Jan-98	Feb-97	Aug-97	Jan-98	Feb-97	Aug-97	Jan-98	Feb-97	Aug-97	Jan-98
Aluminum	228	411	838	239	585	796	2,340	2,900	3,710	260	279	345
Barium	21.6	40.8	48.7 J	33.8	42.5	54.2 J	37.5	54.1	58.9 J	89.7	90.6	96.5 J
Calcium	1,190	553	984 J	5,640	12,000	19,200	202	192	290 J	385	358	515 J
Chromium	ND	ND	ND	ND	ND	ND	ND	1.2	ND	ND	ND	ND
Cobalt	ND	ND	ND	ND	ND	ND	2.3	ND	ND	ND	ND	ND
Copper	ND	1.1	3.9 J	ND	1.3	ND	ND	1.1	3.3 J	ND	1.2	7.4 J
Iron	ND	180.0	423	49.3	61.8	724.0	504	443	803	1,770	1,900	1,840
Lead	2.8	ND	ND	1.2	ND	2.5 J	1.5	ND	2.5 J	ND	ND	ND
Magnesium	1,320	1,170	1950 J	1,860	1,330	1570 J	610	561	565 J	1,990	1,920	2310 J
Manganese	2.1	2.3	5.3 J	11.7	2.2	8.8 J	2.3	1.0	6.1 J	3.2	4.1	6.2 J
Mercury	ND	ND	0.054 J	ND	ND	0.05 J	ND	ND	0.051 J	ND	ND	0.048 J
Potassium	ND	563	1070 J	ND	250	ND	ND	352	782 J	ND	843	1020 J
Sodium	6,250	5,420	11,400	5,060	2,410	3100 J	5,240	6,970	8,700	7,310	7,980	8,410
Thallium	ND	ND	ND	ND	ND	ND	3.4	ND	3.4 J	ND	ND	ND
Vanadium	ND	ND	10.6 J	ND	ND	10.7 J	ND	3.0	13.6 J	ND	3.5	9.5 J
Zinc	ND	1.2	2.5 J	ND	1.5	6 J	ND	2.6	8.7 J	ND	1.7	6 J

Notes:

Concentrations are presented in micrograms per liter ($\mu\text{g/L}$)

ND = Not Detected

J = Estimated Value



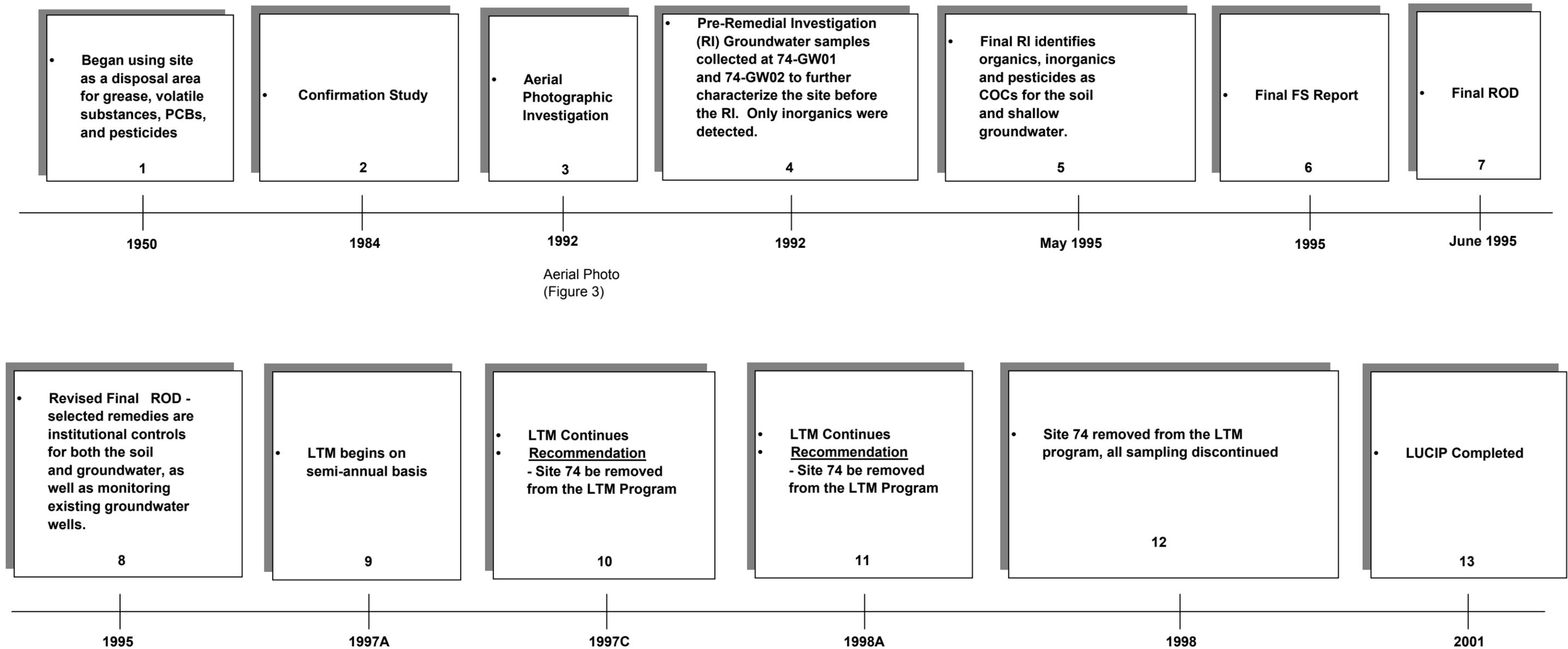
k:\26007\120phase\lrm\site1&28\final lrm report\2120910W

FIGURE 1
 OPERABLE UNIT AND SITE LOCATION MAP
 FINAL LTM REPORT
 OPERABLE UNIT NO.4 – SITE 74
 MONITORING AND O&M SUPPORT, CTO-0120
 MARINE CORPS BASE, CAMP LEJEUNE
 NORTH CAROLINA



FIGURE 2

**SITE ACTIVITIES TIMELINE
FINAL LTM REPORT
OPERABLE UNIT NO. 4 - SITE 74
MONITORING AND O&M SUPPORT, CTO-120
MCB, CAMP LEJEUNE, NORTH CAROLINA**



[Inorganic Detections in Groundwater \(Table 1\)](#)
Time Trend for Aluminum (Figure 4)
Time Trend for Iron (Figure 5)

Notes:

A = First Quarter of Calendar Year
C = Third Quarter of Calendar Year



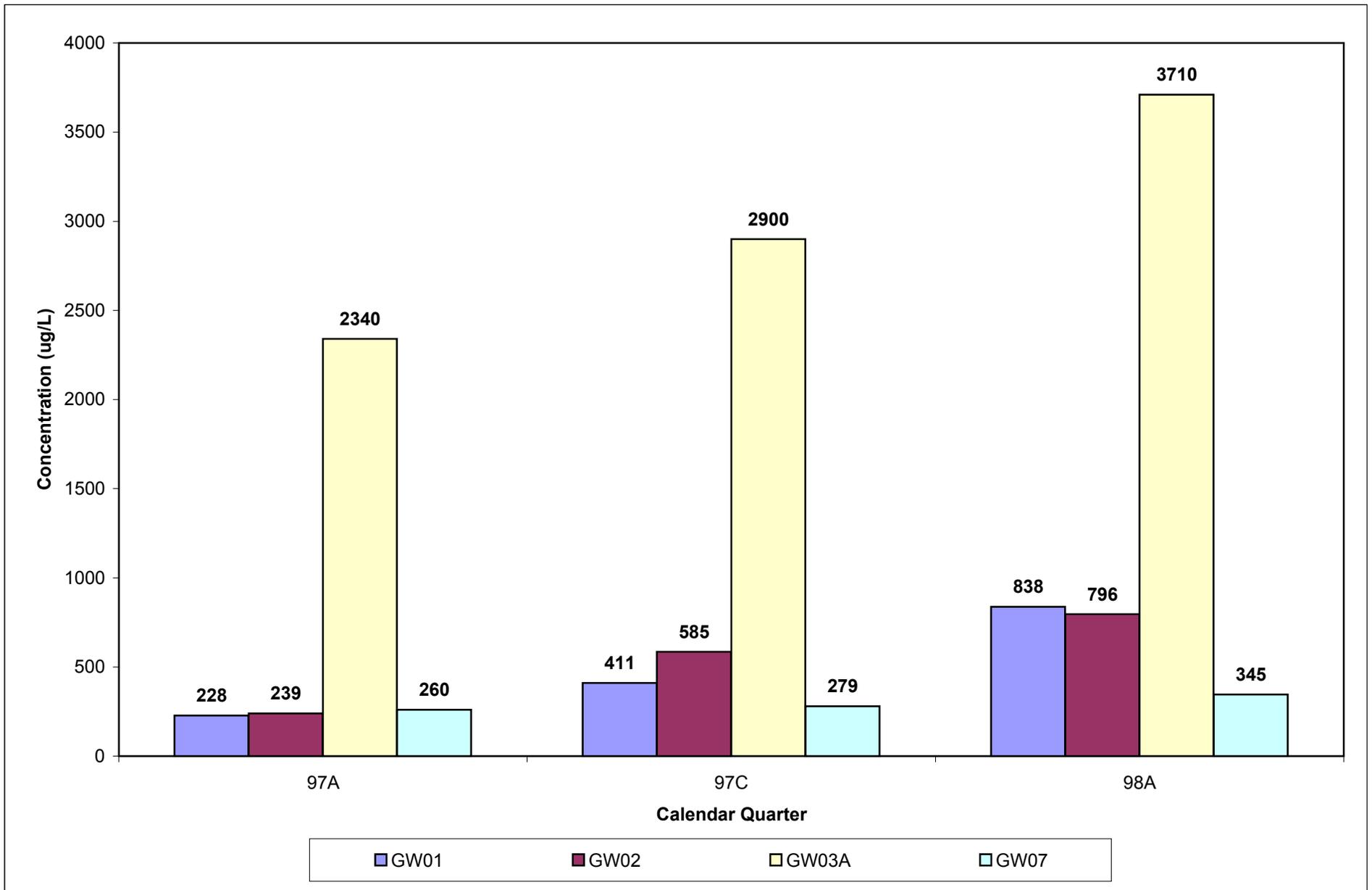
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SCALE: 1=150 DATE: MARCH 1996
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DSN/DWN: CHK:
SOURCE: IGIR - DATA CATALOG



BAKER ENVIRONMENTAL, INC.
CORAOPOLIS, PENNSYLVANIA

FIGURE 3
OPERABLE UNIT NO.4 - SITE 74
FINAL LTM REPORT
MONITORING AND O&M SUPPORT, CTO-0120

FIGURE 4
TIME TREND OF ALUMINUM IN GROUNDWATER
FINAL LTM REPORT
OPERABLE UNIT NO. 4 - SITE 74
MONITORING AND O&M SUPPORT, CTO - 0120
MCB, CAMP LEJEUNE, NORTH CAROLINA



There are no NCWQS established for aluminum.

**FIGURE 5
TIME TREND OF IRON IN GROUNDWATER
FINAL LTM REPORT
OPERABLE UNIT NO. 4 - SITE 74
MONITORING AND O&M SUPPORT, CTO - 0120
MCB, CAMP LEJEUNE, NORTH CAROLINA**

