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PROPOSED REMEDIAL ACTION PLAN
OPERABLE UNIT NO. 9
(SITE 65 - ENGINEER DUMP AREA
AND
SITE 73 - AMPHIBIOUS VEHICLE
MAINTENANCE FACILITY)

MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

CONTRACT TASK ORDER 0312

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LIST OF ACRONYMS AND ABBREVIATIONS

AOC	area of concern
ARARs	applicable or relevant and appropriate requirements
AST	aboveground storage tank
Baker	Baker Environmental, Inc.
CDI	chronic daily intake
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COPC	contaminant of potential concern
1,2-DCE	1,2-dichloroethene
DoN	Department of the Navy
FFA	Federal Facilities Agreement
FS	Feasibility Study
HI	hazard index
ICR	incremental cancer risk
MCB	Marine Corps Base
MCL	Maximum Contaminant Level
µg/L	microgram per liter
NC DEHNR	North Carolina Department of Environment, Health, and Natural Resources
NCWQS	North Carolina Water Quality Standards
ND	nondetect
NPW	net present worth
O&M	operation and maintenance
OU	operable unit
PAH	polynuclear aromatic hydrocarbons
PCB	polychlorinated biphenyl
POL	petroleum, oil, and lubricant
PRAP	Proposed Remedial Action Plan
RA	risk assessment
RAA	remedial action alternative
RI/FS	Remedial Investigation/Feasibility Study
RI	Remedial Investigation
ROD	Record of Decision
SSSV	surface soil screening value
SSV	sediment screening value
SVOC	semivolatile organic compound
SWSV	surface water screening value

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

TCE	trichloroethene
TRV	terrestrial reference value
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compound

INTRODUCTION

This Proposed Remedial Action Plan (PRAP) is issued to describe the Marine Corps Base (MCB), Camp Lejeune's and the Department of the Navy's (DoN's) preferred remedial action plan for Operable Unit (OU) No. 9 at MCB, Camp Lejeune. OU No. 9 consists of the following two sites:

- Site 65 - the Engineer Area Dump
- Site 73 - the Amphibious Vehicle Maintenance Facility

MCB, Camp Lejeune and the DoN are issuing this PRAP as part of the public participation responsibility under Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), and the Federal Facilities Agreement (FFA) between Camp Lejeune, the DoN, the United States Environmental Protection Agency (USEPA) Region IV, and the North Carolina Department of Environment, Health, and Natural Resources (NC DEHNR). The purpose of this PRAP is to: identify the preferred remedial action alternatives for Sites 65 and 73; explain the rationale for the preferences; solicit public review of the alternatives; and provide information on how the public can be involved in the remedial action selection process.

This document summarizes information that can be found in greater detail in the Remedial Investigation (RI) Reports prepared for Sites 65 and 73, the Feasibility Study (FS) Report prepared for Site 73 (an FS was not conducted for Site 65), and other documents referenced in the RI and FS Reports. These documents, which will be the basis for the selection of a remedial action plan for OU No. 9, are contained within an administrative record file. The administrative record file is available for public review at the MCB, Camp Lejeune Installation Restoration Division Office (Building 67, Room 238) and at the Onslow County Library in Jacksonville, North Carolina. The DoN encourages the public to review the administrative record file in order to gain a more comprehensive understanding of Sites 65 and 73.

The public is also encouraged to comment on information contained within the administrative record file and this PRAP. Public comments will be accepted by the DoN, USEPA Region IV, and NC DEHNR representatives listed at the end of this document. The public is encouraged to submit comments on this PRAP since the comments can influence the DoN's, USEPA's and State's preference. The public comment period will begin on a date to be determined. The DoN, with the assistance of the USEPA and the NC DEHNR, may modify the preferred alternative or select another remedial action based on new information or comments received from the public.

MCB, Camp Lejeune and the DoN, with the assistance of USEPA Region IV and the NC DEHNR, will select a final remedy for OU No. 9 only after the public comment period has ended and the information submitted during this time has been reviewed and considered. A Record of Decision (ROD) stating the selected remedial action plan for OU No. 9 will be prepared based upon the results of the RIs, the FS, the PRAP, and the public comment period. The Final ROD may recommend a different remedial action than is presented in this PRAP depending upon public comments and any new information that may become available.

Description of Operable Unit No. 9

Located in Onslow County, North Carolina, Camp Lejeune is a training base for the United States Marine Corps. The Base covers approximately 236 square miles and includes 14 miles of coastline. Camp Lejeune is bounded to the southeast by the Atlantic Ocean, to the northeast by State Route 24,

and to the west by U.S. Route 17. The town of Jacksonville, North Carolina is located north of the Base.

OU No. 9 is one of 18 operable units located within MCB, Camp Lejeune. Operable units were developed at the base to combine one or more individual sites that share a common element. In the case of OU No. 9, Sites 65 and 73 were grouped together because of their close geographic proximity. Figure 1 depicts the location of OU No. 9 - Sites 65 and 73, within MCB, Camp Lejeune.

Report Organization

The remainder of this PRAP document is divided into four main sections under the following headings:

- Site 65
- Site 73
- Proposed Remedial Action Plan for OU No. 9
- Community Participation

The first two sections present pertinent background information and the separate preferred alternatives for Sites 65 and 73, respectively. The third section presents the proposed remedial action plan for OU No. 9, which is a combination of the separate preferred alternatives developed for Sites 65 and 73. The fourth section presents guidelines for community participation in the selection of the OU No. 9 remedial action plan.

SITE 65

This section, which focuses on Site 65, presents the following information: a site description and history, previous investigations, a summary of the site risks, the scope and role of a remedial response action, and a description of the preferred alternative for Site 65.

Site Description and History

Site 65 is a primarily wooded area located immediately west and north of the Marine Corps Engineer School which occupies property between Site 65 and Courthouse Bay. The school is used for maintenance, storage, and operator training of amphibious vehicles and heavy construction equipment. The school also utilizes a several acre parcel located just east of Site 65 to conduct heavy equipment training activities. Figure 2 presents a site map.

Site 65 is situated in a topographically high area that is gently pitched to the south-southeast. Due to the sandy surface soils, there is relatively little storm water runoff. The limited surface water runoff tends to drain radially to the east, south, and west, away from the site, or collect in local surface depressions. Immediately east of Site 65 is the equipment training area which occupies the area between Site 65 and two small ponds located to the southeast. Portions of the area surrounding the ponds are marshy.

Site 65 reportedly operated from 1952 to 1972. Two separate disposal areas have been reported including: (1) a battery acid disposal area; and (2) a liquids disposal area where petroleum, oil, and lubricant (POL) products were reportedly disposed. However, there are no historical maps or figures which depict the location of the disposal areas, and neither area is currently discernible due to heavy overgrowth. Aerial photographs from the past depict disturbed areas east of the Engineer School which represent perhaps the best available means for approximately locating the site. In addition, Camp Lejeune base maps indicate the location of a burn area which was identified as part of Site 65. Like the disposal area, the location of the burn area is not currently discernible from the surrounding landscape. Aerial photographs show that since 1970, nearly the full extent of the current heavy equipment training area has been disturbed.

Previous Investigations

Previous investigations conducted at Site 65 include an Initial Assessment Study, a Site Inspection, and a Remedial Investigation.

The Initial Assessment Study, conducted in 1983 by Water and Air Research, Inc, identified a number of sites at MCB, Camp Lejeune as potential sources of contamination. However, Site 65 was determined to be a site that did not warrant further investigation.

Although the Initial Assessment Study recommended no further investigations, Baker conducted a Site Inspection in 1991 to investigate more recent reports that POL waste and batteries were disposed at Site 65. Field activities included surface soil, subsurface soil, groundwater, surface water, and sediment investigations. Based on the Site Inspection results, a Remedial Investigation was recommended for Site 65.

Baker conducted the RI in 1995. Field activities included surface soil, subsurface soil, groundwater, surface water, sediment, and fish-tissue investigations. Because this PRAP was primarily based on the RI, the results of the RI are described in more detail below.

Remedial Investigation Results

Table 1 summarizes the analytical results from the RI. This table presents concentration ranges for positively detected constituents, and a comparison of constituent concentrations to relevant comparison criteria (i.e., federal, state, and/or local standards, or background concentrations). The following paragraphs briefly describe the nature and extent of contamination in each environmental medium.

Surface Soil

Six volatile organic compounds (VOCs) were detected in the surface soil samples, although four of the compounds were determined to be laboratory contaminants. The two remaining VOCs detected at low levels in surface soils were ethylbenzene and total xylenes. The concentrations of these compounds did not indicate a specific source, but may have originated from vehicles and heavy equipment passing through the site.

The most widespread semivolatile organic compound (SVOC) detected was bis(2-ethylhexyl) phthalate which was encountered at nine locations. This phthalate is a common plasticizer in rubber and plastic products, such as tires. All of the sample locations with estimated concentrations of these phthalates are near roads or equipment training areas. Polynuclear aromatic hydrocarbon (PAH) constituents were detected in three samples, all near existing or previously existing debris piles. The suspected source of the PAH contamination is the debris and historic burning at the site. Di-n-butyl phthalate was detected at two locations near the waste piles, but a specific source for this contaminant cannot be identified.

Pesticides were detected in all areas of the site. The levels detected in the samples are similar to base-wide concentrations from the historical use of pesticides at Camp Lejeune. The polychlorinated biphenyl (PCB) Aroclor 1260 was detected at one location near the burn area and the southernmost debris piles. Historical records do not indicate the disposal of PCBs; however, PCBs were detected in a subsurface soil sample collected during the 1991 Site Inspection. The detection of PCBs within the vicinity of the debris piles indicates that some product containing PCBs may have been spilled or disposed at the site.

Surface soil sample analytical results for inorganics were compared to a screening level of two times average background concentrations. Seven of 13 sample locations exceeded two times the average base background for one or more inorganic. The contamination was observed in the heavy equipment training area and the southernmost debris pile. The distribution of the inorganics indicates that the contamination may be the result of rusting metal debris disposed at the site and the heavy equipment used for training.

Subsurface Soil

Five VOCs were detected in the subsurface soil samples, although four of the contaminants were determined to be laboratory-related. Xylene, a constituent of petroleum products which may have been deposited by heavy equipment, was the only non-laboratory related VOC detected.

The most widespread SVOC detected was bis(2-ethylhexyl) phthalate. The source of this contaminant is assumed to be the same as for detections in surface soil, although this compound is also commonly a laboratory and field contaminant. Di-n-butyl phthalate was detected in the subsurface soil at the same two locations where it was detected in the surface soils. The remaining 14 SVOCs, all PAH constituents, were detected at the same sampling location where they were detected in the surface soil.

Pesticide detections in subsurface soils mainly occurred in areas where the soils have been either disturbed by excavation or disposal. The occurrence of pesticide contamination may be attributed to the historical use of pesticides at MCB, Camp Lejeune. PCBs were not detected in the subsurface soil samples collected during the RI.

Nine of 13 subsurface soil sample locations exceeded two times the average base background for one or more inorganic. The majority of the inorganic contamination occurred in either the heavy equipment training area or the debris piles. The suspected source of contamination is rusting metal.

A total of six subsurface soil samples were collected from test pits near the waste piles and burn area. Three VOCs were detected in the soil samples from the test pits, although all of the compounds were determined to be laboratory contaminants. The most widespread SVOC detected was di-n-butyl phthalate which was detected at all six test pit locations. Pesticide results for subsurface test-pit soil samples included detections at four of six locations. All six test pit sample locations exceeded two times the average base background for two or more inorganics. The suspected source of the inorganics contamination is the rusting debris disposed of in these piles.

Groundwater

Carbon disulfide was the only VOC detected in the groundwater samples that was not determined to be a laboratory contaminant. It was detected in one upgradient sample location at a concentration of 5 micrograms per liter (µg/L), so it is believed to be the result of an off-site source. The SVOC naphthalene was detected in one sample collected at the site at an estimated concentration of 3 µg/L. As with the detection of carbon disulfide, naphthalene was detected in an upgradient location and is suspected to have originated from an off-site source. Groundwater samples collected from the monitoring wells contained no detectable concentrations of pesticides or PCBs.

Inorganic concentrations were, on average, one or two orders of magnitude below the base background levels for groundwater. Only two of the inorganics, iron and manganese, were detected at concentrations that exceed the state and/or federal standards. However, neither iron nor manganese concentrations exceeded the federal standard in any of the samples collected at the site, and these inorganics appear to naturally occur at high concentrations in groundwater throughout the base.

Surface Water

All of the organic compounds detected in surface water were attributable to laboratory contamination. A total of 13 inorganics were detected in the surface water samples. Aluminum, barium, copper, iron, lead, manganese, vanadium and zinc exceeded the lowest surface water screening value (SWSV). All of the detected inorganic concentrations, except iron, exceeded the average reference station concentration established at Camp Lejeune. The only sources of recharge

for the ponds are groundwater and stormwater runoff. Water evaporation and soil erosion are the suspected causes of elevated inorganics in the ponds.

Sediment

Carbon tetrachloride and tetrachloroethene were the only two VOCs detected in sediment that were not attributable to laboratory contamination. The sources of these contaminants have not been determined. The detected levels did not exceed sediment screening values. Only one SVOC, di-n-butylphthalate, was detected in the sediment samples, but it is believed to be the result of laboratory contamination. Pesticides, including beta-BHC, 4,4'-DDD, and 4,4'-DDE, were detected in all of the sediment samples collected. All of these pesticides exceeded the lowest sediment screening value (SSV) and the average reference concentration. These concentrations are similar to the concentrations detected in the surface soils across the site.

Thirteen inorganics were detected in the sediment. Copper, lead and zinc were detected at a concentration exceeding the lowest SSV only one time; however, all of these inorganics exceeded the average reference concentration at least one time. The inorganics contamination is suspected to be the result of metals precipitation contained within the surface water as evaporation occurs. In addition, the surrounding soils may contribute inorganic contaminants to the sediments via erosion, especially considering the turbidity of Courthouse Bay Pond.

Fish Tissue

Four fish-tissue samples were collected for fillet analysis, and five fish-tissue samples were collected for whole-body analysis. Only two organics were detected in the fillet samples: acetone and 4,4'-DDD. Twelve inorganics were detected in the fillet samples: aluminum, barium, calcium, copper, magnesium, manganese, mercury, potassium, selenium, sodium, thallium, and zinc. Four VOCs were detected in the whole-body samples, but they were all determined to be laboratory contaminants. There were no SVOCs detected in the whole-body samples; but there were two pesticides, 4,4'-DDD and 4,4'-DDE, detected. Seventeen inorganics were detected in the whole-body samples: aluminum, antimony, arsenic, barium, beryllium, calcium, copper, iron, lead, magnesium, manganese, mercury, potassium, selenium, sodium, thallium, and zinc. Mercury contamination does not appear to be related to Site 65 or the local environment. Other potential sources for mercury in fish could be that the fish were transported to the ponds from off-site sources, or that bioaccumulation is occurring through a food chain.

Summary of Site Risks

As part of the RI, a human health risk assessment (RA) and an ecological RA were conducted to determine the potential risks associated with the chemical constituents detected at Site 65. The following subsections briefly summarize the findings of the human health and ecological RAs.

Human Health Risk Assessment

Table 2 presents the contaminants of potential concern (COPCs) that were evaluated during the human health RA, and Table 3 summarizes the risk values (i.e., incremental cancer risk [ICR] and hazard index [HI] values) calculated with respect to each environmental medium and relevant receptor. ICR values exceeding the USEPA limit of 1E-04, and HI values exceeding the USEPA

limit of 1.0, are considered to represent unacceptable risks. ICR and HI values indicating unacceptable risks are shaded in Table 3.

The only unacceptable risk value was an HI of 1.3 for the child receptor-fisherman upon exposure to fish-tissue. However, this HI only slightly exceeds the acceptable limit of 1.0. The elevated HI was primarily due to mercury which does not appear to be a site-related contaminant for the following reasons: 1) mercury was only detected in fish-tissue, not any other medium at Site 65; 2) the ponds where mercury was detected are not located near the heavy equipment training area which prevents them from being affected by Site 65 surface water runoff; and 3) the ponds are stocked with fish from off-site sources. As a result, human health risks at Site 65 do not warrant a remedial action.

Ecological Risk Assessment

Table 4 presents the COPCs that were evaluated during the ecological RA. The following sections briefly describe the potential risks that were evaluated for the aquatic and terrestrial ecosystems.

Aquatic Ecosystem

The ecological RA indicated that a change in the structure of the benthic macroinvertebrate communities and/or a potential reduction of an aquatic receptor population or subpopulation may be attributable to contaminants detected in the surface water and/or sediment, although none of these contaminants are thought to be site-related. The low number of species and benthic macroinvertebrates in Courthouse Bay Pond most likely is due to the low dissolved oxygen concentration (2.0 parts per million) and suspended solids in the pond. Since one benthic macroinvertebrate species collected in Powerline Pond is indicative of excellent water quality, and another is indicative of good to fair water quality, the benthic macroinvertebrate population in this pond does not appear to be adversely impacted. The decreased fish population in Courthouse Bay Pond also is most likely due to the high suspended solids concentration in this pond.

Overall, there is a moderate potential risk to aquatic life in the Courthouse Bay Pond, with most of the risk associated with the non-site-related suspended solids in the surface water. There is only a slight risk to aquatic life in Powerline Pond due to pesticide contamination. Based on the ecological RA, no further investigations were deemed necessary. However, it was recommended that controls be established to prevent runoff from the heavy equipment training area to Courthouse Bay Pond.

Terrestrial Ecosystem

The ecological RA concluded that some potential impacts to soil invertebrates and plants may occur as a result of site-related contaminants in surface soil. It should be noted that there is much uncertainty in the surface soil screening values. A potential decrease in the terrestrial vertebrate population from site-related contaminants is not expected based on the terrestrial intake model.

Scope and Role of Action

The scope of the preferred remedial action plan for OU No. 9 includes the preferred alternatives selected for both Sites 65 and 73. The preferred alternative for Site 65 constitutes only one half of the proposed remedial action plan for OU No. 9.

Based on the human health and ecological RAs, current and future conditions at Site 65 appear to be protective of human health and the environment. As a result, the proposed remedial action plan for Site 65 is no further action.

Description of the Preferred Alternative for Site 65

The preferred alternative for Site 65 is no further action. The results of the human health RA indicated that, under current and future land-use scenarios, there are no significant unacceptable human health risks associated with soil and groundwater at the site. With the exception of a child fisherman exposed to fish-tissue, there were also no unacceptable human health risks associated with surface water and sediment. For the child fisherman, the calculated HI was 1.3 which slightly exceeds the acceptable limit of 1.0. However, this elevated HI was primarily due to mercury which does not appear to be a site-related contaminant. The mercury was only detected in fish-tissue, not any other medium; the ponds are not located near the heavy equipment training area which prevents them from being affected by Site 65 surface water runoff; and the ponds are stocked with fish from off-site sources. The results of the ecological RA indicated that there are no significant risks impacting the aquatic and terrestrial ecosystems at Site 65. Based on this information, the no further action plan was selected as the preferred alternative for Site 65.

SITE 73

This section, which focuses on Site 73, presents the following information: a site description and history, previous investigations, a summary of the site risks, the scope and role of a remedial response action, a summary of the remedial action alternatives, a summary of the alternative evaluation, and the preferred alternative for Site 73.

Site Description and History

Figure 4 presents a map of Site 73. The site encompasses the Amphibious Vehicle Maintenance Facility located in the Courthouse Bay Area of MCB, Camp Lejeune. The site is referred to as either the Courthouse Bay Liquids Disposal Area or the Amphibious Vehicle Maintenance Facility. Within Camp Lejeune, the site is more commonly referred to as the latter and, consequently, this report refers to Site 73 as the Amphibious Vehicle Maintenance Facility.

Site 73 is roughly bounded by State Route 172 (Sneads Ferry Road) to the north, Courthouse Bay to the south, and unnamed tributaries to Courthouse Bay to the east and west. Courthouse Bay Road, which bisects the study area, is used to enter the complex.

The study area consists of numerous buildings, aboveground storage tanks (ASTs), underground storage tanks (USTs), vehicle wash racks, and oil/water separators. Most of the USTs are or were located (some USTs have been removed) within the fenced area around Building A47. Non-petroleum wastes are routinely handled at an active Hazmat Storage Area located near UST A47/3. Other USTs are or were located near Buildings A1, A2, and A10. Figure 4 depicts the approximate locations of the USTs.

The Amphibious Vehicle Maintenance Facility began operations in 1946 and is currently active. Available information indicates that an estimated 400,000 gallons of waste oil were discharged directly onto the ground surface at this facility, primarily near Building A47. In addition to the waste oil, approximately 20,000 gallons of waste battery acid was also reportedly disposed in the area northeast of Building A47. The waste battery acid was poured into shallow hand-shoveled holes which were then backfilled. Neither area is visually apparent with respect to its history of waste disposal. Moreover, most of the area where waste disposal reportedly took place, is covered with concrete, buildings and/or roads. A previous report indicated that solvents may have also been disposed at this site although no specific disposal locations or dates were identified.

Previous Investigations

Previous environmental investigations conducted at Site 73 include an Initial Assessment Study, a Confirmation Study, five separate UST investigations, a preliminary investigation, and a Remedial Investigation.

The Initial Assessment Study was conducted in 1983 by Water and Air Research, Inc. The study identified a number of sites at MCB, Camp Lejeune, including Site 73, as potential sources of contamination. A Confirmation Study was recommended to evaluate the necessity of conducting mitigating actions or cleanup operations.

The Confirmation Study was conducted in 1990 by Environmental Science and Engineering, Inc. Upon completion of the Confirmation Study, a Site Summary Report was written to summarize the

results of the study. The report recommended that further characterization of the site be performed to complete the RI/FS process.

The five UST investigations at Site 73 were conducted by various consultants between 1991 and 1993. The first UST investigation was conducted in 1991 by ATEC Environmental Consultants and focused on UST SA-21. In 1992 and 1993, Baker performed additional investigations on the same UST. UST A47/3 was investigated by Groundwater Technology Government Services, Inc. in April 1993 and Law-Catlin in October 1993. Both USTs were reported to be leaking. UST SA-21 was a 30,000 gallon steel tank which contained both gasoline and diesel fuel. This tank was installed in 1959 and subsequently removed in 1991. UST A47/3 was a 30,000 gallon steel tank which contained diesel fuel. Available information indicates that this UST was installed in 1986. A hydrostatic test was performed on UST A47/3 in late 1992; this tank was subsequently replaced with a fiberglass tank.

The preliminary investigation was conducted by Baker in 1994 as an RI scoping initiative. Groundwater and soil gas samples were collected across the site to provide additional data prior to developing the RI project plans.

Baker conducted the RI in 1995 and 1996. Field activities included soil, groundwater, surface water, and sediment investigations, and an ecological investigation. Because the FS and PRAP for Site 73 were primarily based on the RI, the results of this investigation are described in more detail below.

Remedial Investigation Results

Table 5 summarizes the analytical results from the RI. This table presents concentration ranges for positively detected constituents, and a comparison of constituent concentrations to relevant comparison criteria (i.e., federal, state, and/or local standards, or background concentrations). The following paragraphs briefly describe the nature and extent of contamination in each environmental medium.

Soil

Eleven VOCs were detected in surface and subsurface soils collected at Site 73. However, none of the VOCs exceeded the USEPA's Soil Screening Levels for protection of groundwater.

High SVOC concentrations were detected in surface soil sample 73-AC2-MW07-00, and in subsurface soil samples collected from soil boring locations 73-MW15B, 73-MW14, 73-SB01 and 73-SB06. Soil sample 73-AC2-MW07-00 was collected from an area where evidence of waste disposal had been observed during field operations. Soil borings 73-MW15B, 73-MW14, 73-SB01 and 73-SB06 were drilled in areas located near to USTs or oil/water separators which may be the source of the elevated SVOCs. 2,4-Dinitrophenol and benzo(a)anthracene were detected in the soils at concentrations exceeding applicable soil screening levels for groundwater protection.

Pesticides were detected in the surface and subsurface soils throughout the site. The most commonly detected compound was 4,4'-DDD. An equal number of compounds were detected in both the surface and subsurface samples. Pesticides detected in the subsurface soils were observed in areas where the soils have been either disturbed by excavation, construction, or training exercises and the reworked soil may have contained pesticide contamination. The scattered detections of pesticides

and the relatively low concentrations observed in the samples provide evidence that the contamination is probably the result of surface pesticide application rather than disposal.

PCBs were detected in the surface and subsurface soils. Detections were observed in a surface soil sample collected from 73-MW20 and a subsurface soil sample collected from boring 73-SB07. The frequency, location and concentration of PCB detections suggest that the contamination is the result of POL spills and releases.

The distribution of detected inorganics among both the surface and subsurface soils followed no pattern and was observed throughout the site at varying concentrations, suggesting that the former and current site operations have not resulted in noticeable inorganic contamination.

Groundwater

Benzene contamination was detected in the shallow groundwater within the Building A47 complex. It was defined horizontally by monitoring wells A47/3-09, A47/3-11, 73-MW27 and 73-MW29. A former UST, reportedly located in the vicinity of the Building A47 complex, is the suspected source of this contamination. The contamination is, for the most part, restricted to the surficial aquifer which is consistent with the contaminant's natural tendency to reside in the upper portions of any water-bearing zone.

The highest concentration of trichloroethene (TCE) was detected in intermediate monitoring well 73-DW03 (screened from approximately -51.7 to -61.7 feet msl), located in the central portion of the Building A47 complex. The horizontal extent of contamination is defined by monitoring wells 73-DW06, -DW07, and 73-DW08 to the west, 73-DW09 and -DW10 to the north, 73-DW13 to the east and Courthouse Bay to the south. The vertical extent lies between 63 feet and 146.5 feet mean sea level based on the lack of VOCs detected in the mid to lower portions of the Castle Hayne aquifer.

Inorganic contamination in the groundwater mainly consisted of iron and manganese; however, these inorganics are commonly detected in groundwater at Camp Lejeune at levels exceeding the state standards. Therefore, these inorganics are not considered to be the result of past waste disposal practices at Site 73.

Surface Water and Sediment

VOCs were detected in Courthouse Bay, but this surface water body appears to be unaffected by them. PAHs detected in the sediments are suspected to be the result of fossil fuel combustion due to the high amount of boat and amphibious traffic occurring in the bay on a daily basis.

The concentrations and distribution of pesticides in sediments sampled in Courthouse Bay indicate that the occurrence of these compounds is probably the result of erosion and possible aerial pesticide application, and not from spills or disposal events.

Fish and Crab

VOCs detected in the fish and crab samples were restricted to common laboratory contaminants and are suspected to be the result of sample preparation. Endrin (a pesticide) was detected in a fillet

sample collected from Courthouse Bay. This compound was also detected in sediments and surface and subsurface soils and is suspected to have originated from base-wide aerial application.

A number of inorganics were detected in the fish and crab samples collected from Courthouse Bay. Three of the inorganics detected (mercury, molybdenum and selenium) were not detected in any other medium sampled at the site and are not considered to be related to past waste disposal activities at Site 73.

Summary of Site Risks

As part of the RI, a human health RA and an ecological RA were conducted to determine the potential risks associated with the chemical constituents detected at Site 73. The following subsections briefly summarize the findings of the human health and ecological RAs.

Human Health Risk Assessment

Table 6 presents the COPCs that were evaluated during the human health RA, and Table 7 summarizes the risk values (i.e., ICR and HI values) calculated with respect to each environmental medium and relevant receptor. ICR values exceeding the USEPA limit of 1E-04, and HI values exceeding the USEPA limit of 1.0, are considered to represent unacceptable risks. ICR and HI values indicating unacceptable risks are shaded in Table 7.

The unacceptable risk values include exposure to groundwater under the future child and adult residential scenario, exposure to surface water and sediment under the future residential child scenario, and exposure to fish- and crab-tissue under the current adult fisherman and child biota ingestion scenarios.

Ecological Risk Assessment

Table 8 presents the COPCs that were evaluated during the ecological RA. The following sections describe the potential risks that were evaluated for the aquatic and terrestrial ecosystems.

Aquatic Ecosystem

For the aquatic ecosystem, benthic species in Courthouse Bay and its tributaries exhibited lower indices than benthic species in the background stations. However, significant contaminant levels were not detected in the sediment of the tributaries. One sediment sample in Courthouse Bay exhibited significant pesticide levels, but these pesticides are considered to remnants of past base-wide pesticide application rather than site-related contaminants. Several contaminants detected in fish- and crab-tissues appeared to be slightly elevated above background studies. However, based on the relatively abundant and diverse fish population at Site 73, these contaminants do not appear to be significantly impacting the fish community. Tissue concentrations of arsenic, chromium, lead, and zinc were below toxicity concentrations located in the literature for aquatic and piscivorous wildlife.

Terrestrial Ecosystem

For the terrestrial ecosystem, several inorganics (aluminum, chromium, iron, and vanadium) in the surface soil exceeded soil toxicity benchmark values. Although most of the values exceeded were

plant benchmark values, the flora community did not appear to be adversely impacted during the site investigation. In addition, it should be noted that there is much uncertainty associated with the surface soil screening values (SSSVs). Using the terrestrial intake model, the chronic daily intake (CDI) value exceeded the terrestrial reference value (TRV) for several species. The greatest risk was identified for the raccoon; aluminum, antimony, arsenic, and cadmium drove the terrestrial model risks.

Scope and Role of Action

The scope of the preferred remedial action plan for OU No. 9 includes the preferred alternatives selected for both Sites 65 and 73. The preferred alternative for Site 73 constitutes only one half of the proposed remedial action plan for OU No. 9.

The response action for Site 73 was developed to address the areas of concern (AOCs) identified in Figures 5 and 6. These areas of concern correspond to VOC-contaminated plumes that were detected in the surficial and deep groundwater aquifers, respectively. Based on the RI/FS, groundwater was determined to be the only medium of concern that warrants a response action, and VOCs were determined to be the only contaminants of concern. More specifically, the VOC contaminants of concern include benzene (a fuel-related contaminant), TCE, cis-1,2-dichloroethene (cis-1,2-DCE), and vinyl chloride. Table 9 presents the remediation levels for these contaminants.

Summary of Alternatives

Based on the response action identified for Site 73, remedial action alternatives (RAAs) were developed and evaluated. The following alternatives, designated with the letter "S", were developed for the surficial aquifer:

- RAA 1S: No Action
- RAA 2S: Natural Attenuation
- RAA 3S: Groundwater Extraction and Treatment
- RAA 4S: Air Sparging and Soil Vapor Extraction
- RAA 5S: Groundwater Extraction and Treatment - Expanded System

The following alternatives, designated with the letter "D", were developed for the deep aquifer:

- RAA 1D: No Action
- RAA 2D: Natural Attenuation
- RAA 3D: Groundwater Extraction and Treatment
- RAA 4D: In-Well Aeration
- RAA 5D: In-Well Aeration - Expanded System

These surficial and deep aquifer alternatives are described below.

Surficial Aquifer Alternatives

RAA 1S: No Action

• Capital Cost:	$0
• Annual Operation and Maintenance (O&M) Cost:	$0
• Net Present Worth (NPW):	$0
• Time to Implement:	0

Under the no action alternative, contaminated groundwater in the surficial aquifer will remain untreated in its in situ state. No active remedial actions will be implemented.

RAA 2S: Natural Attenuation

• Capital Cost:	$272,000
• Annual Monitoring O&M Cost (Years 1-5):	$182,000
• Annual Monitoring O&M Cost (Years 6-30):	$42,000
• NPW:	$1,524,000
• Time to Implement:	30 years of monitoring

Under RAA 2S, natural attenuation will be relied upon to decrease contaminant levels. The main component of RAA 2S is a long-term groundwater and surface water monitoring program. All groundwater samples will be analyzed for natural attenuation parameters and VOCs to indicate the type of biodegradation that is occurring, and the kind and amount of contaminant reduction that can be expected. All surface water samples will be analyzed for VOCs to ensure that the contaminant plumes are not adversely affecting Courthouse Bay. In addition to the monitoring program, RAA 2S will include aquifer use restrictions that will prohibit future use of the surficial and deep aquifers, within a one-mile radius of Site 73, as potable water sources. RAA 2S may also include a contaminant fate and transport model and a laboratory microcosm study to provide further evidence that natural attenuation is occurring.

RAA 3S: Groundwater Extraction and Treatment

• Capital Cost:	$1,803,000
• Annual O&M Cost (Years 1-5):	$182,000
• Annual Monitoring O&M Cost (Years 6-30):	$42,000
• Annual System O&M Cost (Years 1-30):	$56,000
• NPW:	$3,916,000
• Time to Implement:	30 years of monitoring and 30 years of system operation

Under RAA 3S, two extraction wells will installed to collect contaminated groundwater from the most contaminated or "hot" portions of the surficial aquifer, and one extraction well will be installed to collect the contaminated groundwater that is trapped underneath the concrete structure near 73-MW09. Contaminated areas that do not receive active treatment will experience contaminant reduction through natural attenuation. The extracted groundwater will be conveyed to an on-site treatment facility where it will receive suspended solids/metals pretreatment, and air stripping and liquid-phase carbon adsorption for VOC removal. Once treated, the groundwater will be discharged

to Courthouse Bay. RAA 3S also includes groundwater monitoring for natural attenuation parameters and VOCs, surface water monitoring for VOCs, and aquifer use restrictions.

RAA 4S: Air Sparging and Soil Vapor Extraction

• Capital Cost:	$1,183,000
• Annual Monitoring O&M Cost (Years 1-5):	$182,000
• Annual Monitoring O&M Cost (Years 6-30):	$42,000
• Annual System O&M Cost (Years 1-10):	$35,000
• NPW:	$2,973,000
• Time to Implement:	30 years of monitoring and 10 years of system operation

Under RAA 4S, horizontal air injection and soil vapor extraction (SVE) wells will be installed to collect VOC contamination from the surficial aquifer. Four well trenches will be installed to collect the hot portions of the contaminated plumes and one well trench will be installed to collect the contamination that is trapped underneath the concrete structure near 73-MW09. Contaminated areas that do not receive active treatment will experience contaminant reduction through natural attenuation. Volatilized contaminants that are captured by the SVE wells will be conveyed to on-site treatment facilities. The treatment facilities will contain vapor-phase carbon adsorption units and the necessary air blowers and vacuum pumps. RAA 4S also includes groundwater monitoring for natural attenuation parameters and VOCs, surface water monitoring for VOCs, and aquifer use restrictions.

RAA 5S: Groundwater Extraction and Treatment - Expanded System

• Capital Cost:	$1,940,000
• Annual Monitoring O&M Cost (Years 1-5):	$139,000
• Annual Monitoring O&M Cost (Years 6-30):	$31,000
• Annual System O&M Cost (Years 1-30):	$74,000
• NPW:	$4,022,000
• Time to Implement:	30 years of monitoring and 30 years of system operation

RAA 5S expands upon the pump and treat system presented in RAA 3S by attempting to treat all of the groundwater contamination that exceeds remediation levels, as opposed to only the most highly contaminated (i.e., hot) areas. Under RAA 5S, seven extraction wells will be installed in the surficial aquifer to span the entire area of contamination. The extracted groundwater will be conveyed to an on-site treatment facility where it will receive suspended solids/metals pretreatment, and air stripping and liquid-phase carbon adsorption for VOC removal. Once treated, the groundwater will be discharged to Courthouse Bay. RAA 5S also includes groundwater monitoring for VOCs, surface water monitoring for VOCs, and aquifer use restrictions.

Deep Aquifer Alternatives

RAA 1D: No Action

• Capital Cost:	$0
• Annual O&M Cost:	$0
• NPW:	$0
• Time to Implement:	0

Under the no action alternative, contaminated groundwater in the deep aquifer will remain untreated in its in situ state. No active remedial actions will be implemented.

RAA 2D: Natural Attenuation

• Capital Cost:	$284,000
• Annual Monitoring O&M Cost (Years 1-5):	$119,000
• Annual Monitoring O&M Cost (Years 6-30):	$13,000
• NPW:	$939,000
• Time to Implement:	30 years of monitoring

Under RAA 2D, natural attenuation will be relied upon to decrease contaminant levels. The main component of RAA 2D is a long-term groundwater and surface water monitoring program. All groundwater samples will be analyzed for natural attenuation parameters and VOCs to indicate the type of biodegradation that is occurring, and the kind and amount of contaminant reduction that can be expected. All surface water samples will be analyzed for VOCs to ensure that the contaminant plumes are not adversely affecting Courthouse Bay. In addition to the monitoring program, RAA 2D will include aquifer use restrictions that will prohibit future use of the surficial and deep aquifers, within a one-mile radius of Site 73, as potable water sources. RAA 2D may also include a contaminant fate and transport model and a laboratory microcosm study to provide further evidence that natural attenuation is occurring.

RAA 3D: Groundwater Extraction and Treatment

• Capital Cost:	$1,770,000
• Annual Monitoring O&M Cost (Years 1-5):	$119,000
• Annual Monitoring O&M Cost (Years 6-30):	$13,000
• Annual System O&M Cost (Years 1-30):	$56,000
• NPW:	$3,290,000
• Time to Implement:	30 years of monitoring and 30 years of system operation

Under RAA 3D, one extraction well will be installed to collect the hot portions of the deep aquifer plumes, and one extraction well will be installed to collect the contamination that is trapped underneath the concrete structure near 73-MW09. Contaminated areas that do not receive active treatment will experience contaminant reduction through natural attenuation. The extracted groundwater will be conveyed to an on-site treatment facility where it will receive suspended solids/metals pretreatment, and air stripping and liquid-phase carbon adsorption for VOC removal. Once treated, the groundwater will be discharged to Courthouse Bay. RAA 3D also includes

groundwater monitoring for natural attenuation parameters and VOCs, surface water monitoring for VOCs, and aquifer use restrictions.

RAA 4D: In-Well Aeration

• Capital Cost:	$1,237,000
• Annual Monitoring O&M Cost (Years 1-5):	$119,000
• Annual Monitoring O&M Cost (Years 6-30):	$13,000
• Annual System O&M Cost (Years 1-10):	$38,000
• NPW:	$2,189,000
• Time to Implement:	30 years of monitoring and 10 years of system operation

Under RAA 4D, three in-well aeration wells will be installed in the upper portion of the Castle Hayne aquifer. Two aeration wells will be positioned to treat the hot portions of the contaminated plumes, and one aeration well will be positioned to treat the contamination that is trapped underneath the concrete structure at 73-MW09. Contaminated areas that do not receive active treatment will experience contaminant reduction through natural attenuation. Separate treatment units containing a vapor-liquid separation unit, a vapor-phase carbon adsorption unit, an air blower, and a vacuum pump, will be located at the opening of each aeration well. RAA 4D also includes groundwater monitoring for natural attenuation parameters and VOCs, surface water monitoring for VOCs, and aquifer use restrictions.

RAA 5D: In-Well Aeration - Expanded System

• Capital Cost:	$1,944,000
• Annual Monitoring O&M Cost (Years 1-5):	$67,000
• Annual Monitoring O&M Cost (Years 6-30):	$10,000
• Annual system O&M Cost (Years 1-10):	$93,000
• NPW:	$3,063,000
• Time to Implement:	30 years of monitoring and 10 years of system operation

RAA 5D expands upon the in-well aeration system presented in RAA 4D by attempting to treat all of the groundwater contamination that exceeds remediation levels, as opposed to only the most highly contaminated (i.e., hot) areas. Under RAA 5D, 11 aeration wells will be installed in the upper portion of the Castle Hayne aquifer. Separate treatment units containing a vapor-liquid separation unit, a vapor-phase carbon adsorption unit, an air blower, and a vacuum pump, will be located at the opening of each aeration well. RAA 5D also includes groundwater monitoring for VOCs, surface water monitoring for VOCs, and aquifer use restrictions.

Evaluation of Alternatives

This section summarizes the detailed evaluation of alternatives that was conducted for the surficial and deep aquifer RAAs. During the comparative analysis, the RAAs were comparatively analyzed using seven USEPA evaluation criteria: overall protection of human health and the environment; compliance with applicable and relevant or appropriate requirements (ARARs); long-term

effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. Table 10 presents definitions of these evaluation criteria.

Evaluation of the Surficial Aquifer Alternatives

Overall Protection of Human Health and the Environment

With the exception of RAA 1S, all of the surficial aquifer alternatives will provide overall protection of human health and the environment. By monitoring natural attenuation parameters at the site, monitoring contaminant concentrations over time, and prohibiting future potable use of the surficial aquifer, RAAs 2S, 3S, 4S, and 5S will ensure the safety of potential receptors over time. RAA 1S provides no means for ensuring their safety. In addition, RAAs 3S, 4S, and 5S include active groundwater treatment systems which will provide additional protection to human health and the environment. Thus, RAAs 2S, 3S, 4S, and 5S will achieve RAO #1 ("mitigate the potential for direct exposure via ingestion, dermal contact, and inhalation, to contaminated groundwater"), while RAA 1S will not.

Although RAAs 3S, 4S, and 5S provide additional protection by actively treating the contaminated groundwater, active treatment may not be necessary in order to provide adequate protection. Passive treatment via natural attenuation processes (i.e., RAA 2S) is expected to sufficiently protect human health and the environment. This is because the potential human health and ecological risks were insignificant, groundwater contamination is not adversely impacting Courthouse Bay, and the fuel and chlorinated solvent contamination appears to be naturally attenuating. As a result, it appears as though the groundwater may be left untreated without endangering potential receptors.

Compliance with ARARs

All five alternatives are expected to eventually achieve the chemical-specific ARARs through either passive or active treatment systems. All five alternatives are also expected to achieve RAO #2 ("remediate groundwater to the specified remediation levels") over time. RAAs 1S and 2S will attempt to achieve it passively via natural attenuation processes, whereas RAAs 3S, 4S, and 5S will attempt to achieve it through a combination of natural attenuation and active groundwater treatment systems.

No location- or action-specific ARARs apply to RAAs 1S and 2S. RAAs 3S and 4S can be designed to meet all of the location- and action- specific ARARs that apply to them.

Long-Term Effectiveness and Permanence

With the exception of RAA 1S, all of the surficial aquifer alternatives will be designed to provide long-term effectiveness and permanence. The common elements that RAAs 2S, 3S, 4S, and 5S share are a groundwater and surface water monitoring program and aquifer use restrictions. These controls will be effective provided they are enforced over time. RAAs 2S, 3S, and 4S also share natural attenuation as a common treatment component. Based on current information, it appears as though natural attenuation can be an effective and permanent solution. RAAs 3S, 4S, and 5S include active groundwater treatment systems in addition to or in lieu of natural attenuation.

All five alternatives will require 5-year reviews by the lead agency. Once contaminant concentrations reach the specified remediation levels, these reviews will no longer be required.

Reduction of Toxicity, Mobility, or Volume Through Treatment

RAAs 3S, 4S, and 5S will reduce the toxicity, mobility, and volume of contamination through active treatment. Under RAAs 1S and 2S, the contamination may experience toxicity, mobility, and volume reduction through passive treatment (i.e., natural attenuation). However, no provisions for predicting, monitoring, or evaluating the progress of any contaminant reduction is included under RAA 1S.

Unlike RAAs 1S and 2S, RAAs 3S, 4S, and 5S will create treatment residuals. The residuals associated with RAAs 3S and 5S (sludge, spent carbon, and treated groundwater) will be voluminous and must be properly treated and/or disposed. The residuals associated with RAA 4S (spent carbon, a small amount of separated liquid, and treated vapor) will be more easily treated and/or disposed. Compared to RAA 3S, RAA 5S will create a larger volume of treatment residuals.

RAAs 2S, 3S, 4S, and 5S satisfy the statutory preference for treatment; RAA 1S does not.

Short-Term Effectiveness

Implementation of RAAs 1S and 2S does not pose substantial risks to the community or to workers. Implementation of RAAs 3S, 4S, and 5S does pose risks because these alternatives require extensive construction activities. In addition, RAAs 3S and 5S involve long-term operation and maintenance of an extraction well system and on site treatment facilities. For all of the alternatives, potential risks will be reduced through the use of proper materials handling procedures, PPE, construction safety fencing, and dust minimization procedures. The treatment facilities will generate residual waste streams that must be properly treated and/or disposed. Because they may create aquifer drawdown, RAAs 3S and 5S are the only alternatives that could potentially create environmental impacts.

Under all five RAAs, the time for the action to be complete is unknown. Thirty years of groundwater and surface water monitoring was assumed for RAAs 2S, 3S, 4S, and 5S. Thirty years of treatment system O&M was assumed for RAAs 3S and 5S, and 10 years of treatment system O&M was assumed for RAA 4S.

Implementability

RAA 1S is the easiest alternative to implement, if not the most effective. RAA 2S is the next most implementable alternative followed by RAAs 3S, 4S, and 5S. RAAs 3S, 4S, and 5S have similar difficulties associated with their implementation. Pavement removal, underground utilities, and current site operations will complicate the construction of piping, extraction wells, and horizontal air injection and soil vapor extraction wells. Construction of RAA 5S will be more difficult than construction of RAAs 3S and 4S because RAA 5S involves a much larger treatment system.

RAA 1S requires no operation or maintenance. RAA 2S requires minimal operation and maintenance (groundwater and surface water samples will be collected periodically). RAA 3S requires extensive operation and maintenance. RAA 4S also requires extensive operation and maintenance, but for a shorter period of time than RAA 3S (10 years as opposed to 30 years).

RAA 5S requires the most extensive operation and maintenance because it involves a much larger treatment system. RAA 4S involves the extraction of air rather than groundwater so it will be less energy-intensive alternative compared to RAAs 3S and 5S. Under all five RAAs, additional remedial actions could easily be implemented.

RAAs 2S, 3S, 4S, and 5S involve conventional equipment and services that should be readily available. Compared to RAA 2S, RAAs 3S, 4S, and 5S will require more extensive coordination with the Base Public Works/Planning department. Unlike RAA 1S, RAAs 2S, 3S, 4S, and 5S will require semiannual submission of reports that document sampling results. Under RAAs 1S and 2S, all of the contamination will be left at concentrations exceeding remediation levels. Under RAAs 3S and 4S, only a portion of the contamination will be left at concentrations exceeding remediation levels.

Cost

In terms of NPW, the no action alternative (RAA 1S) will be the least expensive RAA to implement, followed by RAA 2S, RAA 4S, RAA 3S, and RAA 5S. The estimated NPW values in increasing order are $0 (RAA 1S), $1,524,000 (RAA 2S), $2,973,000 (RAA 4S), $3,916,000 (RAA 3S), and $4,022,000 (RAA 5S).

Evaluation of the Deep Aquifer Alternatives

Overall Protection of Human Health and the Environment

With the exception of RAA 1D, all of the deep aquifer alternatives will provide overall protection of human health and the environment. By monitoring natural attenuation parameters at the site, monitoring contaminant concentrations over time, and prohibiting future potable use of the deep aquifer, RAAs 2D, 3D, 4D, and 5D will ensure the safety of potential receptors over time. RAA 1D provides no means for ensuring their safety. In addition, RAAs 3D, 4D, and 5D include active groundwater treatment systems which will provide additional protection to human health and the environment. Thus, RAAs 2D, 3D, 4D, and 5D will achieve RAO #1 ("mitigate the potential for direct exposure via ingestion, dermal contact, and inhalation, to contaminated groundwater"), while RAA 1D will not.

Although RAAs 3D, 4D, and 5D provide additional protection by actively treating the contaminated groundwater, active groundwater treatment may not be necessary in order to provide adequate protection. Passive treatment via natural attenuation processes (i.e., RAA 2D) is expected to sufficiently protect human health and the environment. This is because the potential human health and ecological risks were insignificant, groundwater contamination is not adversely impacting Courthouse Bay, and the fuel and chlorinated solvent contamination appears to be naturally attenuating. As a result, it appears as though the groundwater may be left untreated without endangering potential receptors.

Compliance with ARARs

All five alternatives are expected to eventually achieve the chemical-specific ARARs through either passive or active treatment systems. All five alternatives are also expected to achieve RAO #2 ("remediate groundwater to the specified remediation levels") over time. RAAs 1D and 2D will attempt to achieve it passively via natural attenuation processes, whereas RAAs 3D, 4D, and 5D will

attempt to achieve it through a combination of natural attenuation and active groundwater treatment systems.

No location- or action-specific ARARs apply to RAAs 1D and 2D. RAAs 3D, 4D, and 5D can be designed to meet all of the location- and action- specific ARARs that apply to them.

Long-Term Effectiveness and Permanence

With the exception of RAA 1D, all of the deep aquifer alternatives will be designed to provide long-term effectiveness and permanence. The common elements that RAAs 2D, 3D, 4D, and 5D share are a groundwater and surface water monitoring program and aquifer use restrictions. These controls will be effective provided they are enforced over time. RAAs 2D, 3D, and 4D also share natural attenuation as a common treatment component. Based on current information, it appears as though natural attenuation can be an effective and permanent solution for the deep aquifer. RAAs 3D, 4D, and 5D include active groundwater treatment systems in addition to or in lieu of natural attenuation.

All five alternatives will require 5-year reviews by the lead agency. Once contaminant concentrations reach the specified remediation levels, these reviews will no longer be required.

Reduction of Toxicity, Mobility, or Volume Through Treatment

RAAs 2D, 3D, 4D, and 5D will reduce the toxicity, mobility, and volume of contaminated groundwater through active treatment. Under the no action alternative, RAA 1D, the contamination may experience toxicity, mobility, and volume reduction through passive treatment (i.e., natural attenuation). However, no provisions for predicting, monitoring, or evaluating the progress of any contaminant reduction is included under RAA 1D.

Unlike RAAs 1D and 2D, RAAs 3D, 4D, and 5D will create treatment residuals. The residuals associated with RAA 3D (sludge, spent carbon, and treated groundwater) will be voluminous and must be properly treated and/or disposed. The residuals associated with RAAs 4D and 5D (spent carbon, a small amount of separated liquid, and treated vapor) will be more easily treated and/or disposed. Compared to RAA 4D, RAA 5D will create a larger volume of treatment residuals.

RAAs 2D, 3D, 4D, and 5D satisfy the statutory preference for treatment; RAA 1D does not.

Short-Term Effectiveness

Implementation of RAAs 1D and 2D does not pose substantial risks to the community or to workers. Implementation of RAAs 3D, 4D, and 5D does pose risks because these alternatives require extensive construction activities. In addition, RAA 3D involves long-term operation and maintenance of an extraction well system and on-site treatment facility. For all of the alternatives, potential risks will be reduced through the use of proper materials handling procedures, PPE, construction safety fencing, and dust minimization procedures. The treatment facilities will generate residual waste streams that must be properly treated and/or disposed. Because it may create aquifer drawdown, RAA 3D is the only alternative that could potentially create environmental impacts.

Under all five RAAs, the time for the action to be complete is unknown. Thirty years of monitoring was assumed for RAAs 2D, 3D, 4D, and 5D. Thirty years of treatment system O&M was assumed for RAA 3D, and 10 years of treatment system O&M was assumed for RAAs 4D and 5D.

Implementability

RAA 1D is the easiest alternative to implement, if not the most effective. RAA 2D is the next most implementable alternative followed by RAAs 3D, 4D, and 5D. RAAs 3D, 4D, and 5D have similar difficulties associated with their implementation. Pavement removal, underground utilities, and current site operations will complicate the construction of piping, extraction wells, and in-well aeration wells. Construction of RAA 5D will be more difficult than construction of RAAs 3D and 4D because RAA 5D involves a much larger treatment system.

RAA 1D requires no operation or maintenance. RAA 2D requires minimal operation and maintenance (groundwater and surface water samples will be collected periodically). RAA 3D requires extensive operation and maintenance. RAAs 4D and 5D also requires extensive operation and maintenance, but for a shorter period of time than RAA 3D (10 years as opposed to 30 years). In addition, RAAs 4D and 5D involve the extraction of air rather than groundwater so they will be less energy-intensive alternatives compared to RAA 3D. Under all five RAAs, additional remedial actions could easily be implemented.

RAAs 2D, 3D, 4D, and 5D involve conventional equipment and services that should be readily available. Compared to RAA 2D, RAAs 3D, 4D, and 5D will require more extensive coordination with the Base Public Works/Planning department. Unlike RAA 1D, RAAs 2D, 3D, 4D, and 5D will require semiannual submission of reports that document sampling results. Under RAAs 1D and 2D, all of the contamination will be left at concentrations exceeding remediation levels. Under RAAs 3D and 4D, only a portion of the contamination will be left at concentrations exceeding remediation levels.

Cost

In terms of NPW, the no action alternative (RAA 1D) will be the least expensive RAA to implement, followed by RAA 2D, RAA 4D, RAA 5D, and RAA 3D. The estimated NPW values in increasing order are $0 (RAA 1D), $939,000 (RAA 2D), $2,189,000 (RAA 4D), $3,063,000 (RAA 5D), and $3,290,000 (RAA 3D).

The Preferred Alternative for Site 73

Based on the detailed evaluation of remedial action alternatives, RAA 2S and RAA 2D were selected as the preferred alternatives for the surficial and deep aquifers at Site 73. Both alternatives involve natural attenuation of the fuel and chlorinated solvent plumes, groundwater and surface water monitoring programs, and aquifer use restrictions. The following paragraphs explain the rationale behind the selection of the preferred alternatives.

In both the surficial and deep aquifers, the fuel and chlorinated solvent plumes appear to be naturally attenuating under the current site conditions. The following evidence supports the occurrence of natural attenuation at Site 73:

- TCE and the daughter products of TCE degradation (cis-1,2-DCE and vinyl chloride) have been detected in both the surficial and deep aquifers.

- The TCE, cis-1,2-DCE, and vinyl chloride plumes are positioned downgradient and adjacent to, or underneath, one another. The plume arrangements suggest that the cis-1,2-DCE and vinyl chloride are a direct result of TCE degradation.

- Technical literature supports the degradation of fuel and chlorinated solvent contamination through natural attenuation.

Leaving the groundwater in an untreated, in situ state will have no adverse effects on potential receptors. According to the human health and ecological RAs, the fuel and chlorinated solvent contaminants do not create significant, unacceptable risks now and in the future. Although the groundwater in both the surficial and deep aquifers discharges directly into Courthouse Bay, the VOC concentrations are diluted to safe levels by the time they reach potential receptors. A groundwater-surface water model was conducted to estimate the maximum groundwater concentrations that can discharge into Courthouse Bay before unsafe surface water conditions develop. The contaminant concentrations that are currently discharging into the bay are far below the acceptable discharge limits that were developed using the model. In addition, the maximum contaminant concentrations detected at the site are far below acceptable discharge limits.

Based on this information, natural attenuation is a justifiable solution for the surficial and deep groundwater aquifers. To ensure the protection of human health and environment, RAAs 2S and 2D also include a groundwater and surface water monitoring program and aquifer use restrictions. The monitoring program will detect unsafe increases in contaminant levels. The aquifer use restrictions will prohibit the surficial and deep aquifers, within a one-mile radius of Site 73, from being used for potable water. Thus, the monitoring program and restrictions will mitigate the potential for human and ecological exposure while natural attenuation processes are remediating the contamination.

In addition to providing overall protection of human health and the environment, RAAs 2S and 2D are the most cost-effective alternatives that provide the appropriate level of protection. RAAs 1S and 1D are less expensive than RAAs 2S and 2D, but the no action alternatives provide no means for predicting, modeling, or evaluating the impacts of natural attenuation on the contamination at the site, or restricting aquifer use. For these reasons, RAAs 1S and 1D cannot be considered protective of human health and the environment. RAAs 3S, 4S, 5S, 3D, 4D, and 5D are more expensive than RAAs 2S and 2D, but these active treatment system alternatives provide additional protection that is not necessary at Site 73.

PROPOSED REMEDIAL ACTION PLAN FOR OU NO. 9

The proposed remedial action plan for OU No. 9 is a combination of the separate preferred remedial action alternatives identified for Sites 65 and 73. For Site 65, the preferred alternative is no action. This alternative was selected based on the results of the RI which indicate that current and future conditions at Site 65 are protective of human health and the environment. For both the surficial and deep aquifers at Site 73, the preferred alternative includes natural attenuation, long-term groundwater and surface water monitoring, and aquifer use restrictions. This alternative was selected because 1) the potential human health and ecological risks appear to be insignificant both now and in the future; 2) the groundwater contamination does not appear to be adversely impacting Courthouse Bay; and 3) evidence exists that natural attenuation is an ongoing process at the site for the remediation of fuel and chlorinated solvent contamination.

COMMUNITY PARTICIPATION

A critical part of the selection of a remedial action alternative is community involvement. The following information is provided to solicit the community's input into the selection of a remedy for OU No. 9 - Sites 65 and 73.

Public Comment Period

The 30-day public comment period for the proposed remedial action plan at OU No. 9 will begin and end on dates to be determined. Written comments should be sent to the following address:

Commander
Atlantic Division
Naval Facilities Engineering Command
1510 Gilbert Street (Bldg. N-26)
Norfolk, Virginia 23511-2699
Attn: Ms. Katherine Landman, Code 18232

or Commanding General
ACIS EMD (IRD)
Marine Corps Base
PSC Box 20004
Camp Lejeune, North Carolina 28542-0004

A public meeting will be held at the Onslow County Library in Jacksonville, North Carolina on a date to be determined. Representatives of the Navy, and their consultant, will be available at the meeting to answer questions and accept public comments on the proposed plan for OU No. 9. In addition, an overview of the site characterization will be presented.

Meeting minutes will be made available to the public through the information repositories at the libraries listed within this document. A responsiveness summary will be prepared at the conclusion of the comment period to summarize significant comments, criticisms, and new relevant information submitted to MCB, Camp Lejeune and the DoN during the comment period. The summary will include the responses to each issue and question raised at the public meeting. After the ROD is signed, MCB, Camp Lejeune and the DoN will publish a notice of availability of the ROD (including the responsiveness summary) in the Jacksonville and MCB, Camp Lejeune newspapers. A copy of the ROD will also be placed in each information repository.

Information Repositories

A collection of general information pertaining to all MCB, Camp Lejeune OUs and Installation Restoration sites, including all administrative records, is available to the community for review at the following locations:

MCB, Camp Lejeune
Building 67, Room 238
Marine Corps Base
Camp Lejeune, NC 28542
(910) 451-5068

Hours:
M-F: 7:00 a.m.- 4:00 p.m.
Closed Saturday and Sunday

Onslow County Library
58 Doris Avenue East
Jacksonville, NC 28540
(910) 455-7358

Hours:
M-Thu: 9:00 a.m.- 9:00 p.m.
F-Sat: 9:00 a.m.- 6:00 p.m.
Closed Sunday

Public Inquiries

Inquiries concerning the proposed remedy for OU No. 9 or other related issues may be directed to any one of the following points of contact:

Commanding General
AC/S EMD, (IRD)
Marine Corps Base
PSC Box 20004
Camp Lejeune, North Carolina 28542-0004
Attention: Mr. Neal Paul
(910) 451-5068

Commander
Atlantic Division
Naval Facilities Engineering Command
1510 Gilbert Street (Bldg. N-26)
Norfolk, Virginia 23511-2699
Attention: Ms. Katherine Landman, Code 18232
(804) 322-4818

Remedial Project Manager
U.S. EPA, Region IV
345 Courtland Street, NE
Atlanta, Georgia 30365
Attention: Ms. Gena Townsend
(404) 347-3016

N.C. Department of Environment, Health, and Natural Resources
Division of Solid Waste Management
Superfund Section
P.O. Box 27687
Raleigh, North Carolina 27611-7687
Attention: Mr. Patrick Watters
(919) 733-2801

Community Information Line
Public Affairs Office
Marine Corps Base, PSC Box 2004
Camp Lejeune, North Carolina 28542-0004
Attention: Major Stephen Little
(910) 451-5782

Mailing List

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TABLES

TABLE 1

SUMMARY OF SITE CONTAMINATION
SITE 65 - ENGINEER AREA DUMP
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Medium	Fraction (Units)	Detected Constituents	Comparison Criteria		Site Contamination					
			Criteria I	Criteria II	Min. Conc.	Max. Conc.	Location(s) of Maximum Concentration	Detection Frequency	Number of Detections Above Comparison Criteria I	Number of Detections Above Comparison Criteria II
Surface Soil[1]	Volatiles (ug/kg)	Methylene Chloride	8.5×10^4	NA	2J	2J	65-MW07A-00 & SB12-00	2/13	0	NA
		Acetone	7.8×10^5	NA	10J	10J	65-MWO5A-00	1/13	0	NA
		Trichloroethene	5.8×10^4	NA	1J	1J	65-SB06-00	1/13	0	NA
		Toluene	1.6×10^6	NA	1J	2J	65-DW04-00 & MW07A-00	3/13	0	NA
		Ethylbenzene	7.8×10^5	NA	1J	1J	65-SB07-00	1/13	0	NA
		Xylene (total)	1.6×10^7	NA	3J	5J	65-SB07-00	2/13	0	NA
	Semivolatiles (ug/kg)	Acenaphthene (PAH)	4.7×10^5	NA	130J	130J	65-DW01-00	1/13	0	NA
		2,4-Dinitrophenol	1.6×10^4	NA	150J	150J	65-DW04-00	1/13	0	NA
		Dibenzofuran	3.1×10^4	NA	58J	58J	65-DW01-00	1/13	0	NA
		Fluorene (PAH)	3.1×10^5	NA	100J	100J	65-DW01-00	1/13	0	NA
		Phenanthrene (PAH)	2.3×10^5	NA	59J	860	65-DW01-00	3/13	0	NA
		Anthracene (PAH)	2.3×10^6	NA	190J	190J	65-DW01-00	1/13	0	NA
		Carbazole	3.2×10^4	NA	180J	180J	65-DW01-00	1/13	0	NA
		di-n-Butyl-phthalate	7.8×10^5	NA	260J	390J	65-SB06-00	2/13	0	NA
		Fluoranthene (PAH)	3.1×10^5	NA	130J	830	65-DW01-00	3/13	0	NA
		Benzo(a)anthracene (PAH)	880	NA	76J	510	65-DW01-00	3/13	0	NA
		Chrysene (PAH)	8.8×10^4	NA	70J	470	65-DW01-00	3/13	0	NA
		bis(2-Ethylhexyl)phthalate	4.6×10^4	NA	48J	87J	65-MW06A-00	9/13	0	NA
		Benzo(b)fluoranthene (PAH)	880	NA	89J	360J	65-DW01-00	3/13	0	NA
		Benzo(k)fluoranthene (PAH)	8800	NA	120J	510	65-DW01-00	2/13	0	NA

Notes:

NA - Not applicable

ND - Not detected

PAH - Polynuclear aromatic hydrocarbon

[1] Organics and Metals in both surface and subsurface soils are compared to EPA Region III risk based Contaminent of Concern (COC) Screeing Values for a residential area (Criteria I), and two times base background concentrations for MCB, Camp Lejeune (Criteria II) (Metals only). Only priority pollutant metals (i.e., aluminum, antimony, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, selenium, silver, thallium, vanadium, zinc) are presented on this table.

TABLE 1 (Continued)

SUMMARY OF SITE CONTAMINATION
SITE 65 - ENGINEER AREA DUMP
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Medium	Fraction (Units)	Detected Constituents	Comparison Criteria		Site Contamination					
			Criteria I	Criteria II	Min. Conc.	Max. Conc.	Location(s) of Maximum Concentration	Detection Frequency	Number of Detections Above Comparison Criteria I	Number of Detections Above Comparison Criteria II
Surface Soil	Semivolatiles (continued) (ug.kg)	Benzo(a)pyrene (PAH)	88	NA	100J	400	65-DW01-00	2/13	2	NA
		Indeno(1,2,3-cd)pyrene (PAH)	880	NA	88J	310J	65-DW01-00	2/13	0	NA
		Dibenzo(a,h)anthracene (PAH)	88	NA	45J	150J	65-DW01-00	2/13	1	NA
		Benzo(g,h,i)perylene (PAH)	2.3×10^5	NA	70J	250J	65-DW01-00	2/13	0	NA
	Pesticides (ug/kg)	Heptachlor epoxide	70	NA	2.3	2.3	65-MW07A-00	1/13	0	NA
		4-4'-DDE	1900	NA	4.3	83J	65-MW07A-00	6/13	0	NA
		Endosulfan II	4.7×10^4	NA	3.8NJ	3.9NJ	65-DW02-00	2/13	0	NA
		4-4'-DDD	2700	NA	3.8NJ	59J	65-SB10-00	7/13	0	NA
		4-4'-DDT	1900	NA	25	56J	65-MW07A-00 & SB07-00	3/13	0	NA
	PCBs (ug/kg)	Aroclor 1260	83	NA	52J	52J	65-DW01-00	1/13	0	NA
	Metals (ug/kg)	Aluminum	7800	5940	656	5040	65-DW01-00	13/13	0	0
		Barium	550	17.36	2.7	36.3	65-DW01-00	13/13	0	3
		Chromium	39	3.693	2.3	8.6	65-DW01-00	11/13	0	2
		Copper	290	7.2	2.5	55.6	65-DW01-00	9/13	0	6
		Iron	NA	3755	50.9	16400	65-SB12-00	13/13	NA	2
		Lead	400	23.75	2	178	65-DW01-00	13/13	0	4
		Manganese	39	18.5	2.9	163J	65-DW01-00	13/13	3	5
		Nickel	160	3.434	4.6	5.7	65-SB12-00	2/13	0	2
		Thallium	NA	0.889	2.3	2.3	65-SB10-00	1/13	NA	1
		Vanadium	55	11.63	2.8	12	65-DW01-00	9/13	0	1
		Zinc	2300	13.88	3.7	377J	65-DW01-00	11/13	0	6

Notes:
NA - Not applicable
ND - Not detected
PAH - Polynuclear aromatic hydrocarbon

TABLE 1 (Continued)

SUMMARY OF SITE CONTAMINATION
SITE 65 - ENGINEER AREA DUMP
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Medium	Fraction (Units)	Detected Constituents	Comparison Criteria		Site Contamination					
			Criteria I	Criteria II	Min. Conc.	Max. Conc.	Location(s) of Maximum Concentration	Detection Frequency	Number of Detections Above Comparison Criteria I	Number of Detections Above Comparison Criteria II
Subsurface Soil[1]	Volatiles (ug/kg)	Acetone	7.8×10^5	NA	7J	380	65-DW02-02	13/19	0	NA
		Carbon Disulfide	7.8×10^5	NA	2J	2J	65-TP04	1/19	0	NA
		2-Butanone	4.7×10^6	NA	2J	29	65-TP05	3/19	0	NA
		Trichloroethene	5.8×10^4	NA	2J	2J	65-SB07-04	1/19	0	NA
		Toluene	1.6×10^6	NA	1J	1J	65-SB11-04	1/19	0	NA
		Xylene (total)	1.6×10^7	NA	1J	3J	65-SB10-01	5/19	0	NA
	Semivolatiles (ug/kg)	Naphthalene (PAH)	3.1×10^5	NA	55J	55J	65-TP07	1/19	0	NA
		2-Methylnaphthalene	3.1×10^5	NA	60J	60J	65-TP07	1/19	0	NA
		Acenaphthene	4.7×10^5	NA	94J	97J	65-SB06-02	2/19	0	NA
		Fluorene	3.1×10^5	NA	110J	110J	65-SB06-02	1/19	0	NA
		Dibenzofuran	3.1×10^4	NA	42J	42J	65-TP07	1/19	0	NA
		Phenanthrene (PAH)	2.3×10^5	NA	150J	1200	65-SB06-02	2/19	0	NA
		Anthracene	2.3×10^6	NA	290J	290J	65-SB06-02	1/19	0	NA
		Carbazole	3.2×10^4	NA	120J	120J	65-SB06-02	1/19	0	NA
		di-n-Butylphtalate	7.8×10^5	NA	160J	340J	65-SB06-02	8/19	0	NA
		Fluoranthene (PAH)	3.1×10^5	NA	230J	1900	65-SB06-02	2/19	0	NA
		Pyrene (PAH)	2.3×10^5	NA	190J	1400	65-SB06-02	2/19	0	NA
		Benzo(a)anthracene (PAH)	880	NA	100J	900	65-SB06-02	2/19	1	NA
		Chrysene (PAH)	8.8×10^4	NA	110J	800	65-SB06-02	2/19	0	NA

Notes:
NA - Not applicable
ND - Not detected
PAH - Polynuclear aromatic hydrocarbon

[1] Organics and Metals in both surface and subsurface soils are compared to EPA Region III risk based Contaminent of Concern (COC) Screeing Values for a residential area (Criteria I), and two times base background concentrations for MCB, Camp Lejeune (Criteria II) (Metals only). Only priority pollutant metals (i.e., aluminum, antimony, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, selenium, silver, thallium, vanadium, zinc) are presented on this table. Refer to Table 4-5 and 4-6 for completed metals detection data.

TABLE 1 (Continued)

SUMMARY OF SITE CONTAMINATION
SITE 65 - ENGINEER AREA DUMP
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Medium	Fraction (Units)	Detected Constituents	Comparison Criteria		Site Contamination					
			Criteria I	Criteria II	Min. Conc.	Max. Conc.	Location(s) of Maximum Concentration	Detection Frequency	Number of Detections Above Comparison Criteria I	Number of Detections Above Comparison Criteria II
Subsurface Soil	Semivolatiles (continued) (ug/kg)	bis(2-ethylhexyl)phthalate	4.6×10^4	NA	37J	370	65-DW01-04	15/19	0	NA
		Benzo(b)fluoranthene (PAH)	880	NA	96J	710	65-SB06-02	2/19	0	NA
		Benzo(k)fluoranthene (PAH)	8800	NA	110J	620	65-SB06-02	2/19	0	NA
		Benzo(a)pyrene (PAH)	88	NA	69J	680	65-SB06-02	2/19	1	NA
		Ideno(1,2,3-cd)pyrene (PAH)	880	NA	480	480	65-SB06-02	1/19	0	NA
		Benzo(g,h,i)perylene (PAH)	2.3×10^5	NA	67J	360J	65-SB06-02	1/19	0	NA
	Pesticides (ug/kg)	Endosulfan I	3.2×10^4	NA	3.1NJ	3.1NJ	65-TP05	1/19	0	NA
		4,4'-DDE	1900	NA	4.6	45J	65-TP04	8/19	0	NA
		4,4'-DDD	2700	NA	4.4J	340J	65-TP05	8/19	0	NA
		4,4'-DDT	1900	NA	9.6	40	65-TP07	4/19	0	NA
		Endrin Aldehyde	2300	NA	9.4J	9.4J	65-DW01-04	1/19	0	NA
		alpha-Chlordane	490	NA	8.3J	8.3J	65-SB06-02	1/19	0	NA
		gamma-Chlordane	490	NA	3J	7.5J	65-SB06-02	3/19	0	NA
	PCBs (ug/kg)	ND	NA	NA	NA	NA	NA	0/19	NA	NA
	Metals (ug/kg)	Aluminum	7800	7375	1020	10600	65-SB07-04	19/19	1	1
		Antimony	3.1	6.409	11.8	11.8	65-TP07	1/19	1	1
		Arsenic	0.37	1.968	2.6	3.3	65-SB06-02	3/19	3	3
		Barium	550	14.2	2.7	38.3	65-SB06-02	19/19	0	7
		Cadmium	3.9	0.712	1.3	1.3	65-SB06-02 & TP04	2/19	0	2
		Chromium	39	12.56	2.6	17.3	65-SB07-04	16/19	0	1
		Cobalt	470	1.504	11.5	11.5	65-TP07	1/19	0	1
		Copper	290	2.416	7.7	67.2	65-TP07	8/19	2	8
		Iron	NA	7252	236J	31300	65-SB06-02	19/19	NA	5

Notes:
NA - Not applicable
ND - Not detected
PAH - Polynuclear aromatic hydrocarbon

TABLE 1 (Continued)

SUMMARY OF SITE CONTAMINATION
SITE 65 - ENGINEER AREA DUMP
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Medium	Fraction (Units)	Detected Constituents	Comparison Criteria		Site Contamination					
			Criteria I	Criteria II	Min. Conc.	Max. Conc.	Location(s) of Maximum Concentration	Detection Frequency	Number of Detections Above Comparison Criteria I	Number of Detections Above Comparison Criteria II
Subsurface Soil	Metals (continued) (ug/kg)	Lead	400	8.327	1.6	539	65-SB06-02	19/19	1	8
		Manganese	39	7.919	2	471	65-SB06-02	19/19	5	10
		Nickel	160	3.714	4.8	243	65-SB06-02	3/19	1	3
		Selenium	39	0.801	1.5	1.5	65-TP07	1/19	0	1
		Silver	39	0.866	4.2	4.2	65-TP07	1/19	0	1
		Thallium	NA	0.955	4.2	4.2	65-SB06-02	1/19	NA	NA
		Vanadium	55	13.45	3.1	27.2	65-SB07-04	15/19	0	1
		Zinc	2300	6.662	2.5J	764	65-SB06-02	16/19	0	12
Groundwater[2]	Volatiles (ug/L)	Methylene Chloride	NA	5	1J	2J	65-MW06	6/11	NA	0
		Acetone	NA	700	5J	7J	65-MW06	7/11	NA	0
		Carbon Disulfide	NA	700	5J	5J	65-MW04	1/11	NA	0
		1,2-Dichloroethane	5	0.38	2J	2J	65-MW07	8/11	0	8
		2-Butanone	NA	NA	1J	1J	65-MW03, 05, & 06	3/11	NA	NA
	Semivolatiles (ug/L)	Naphthalene	NA	21	3J	3J	65-DW04	1/11	NA	0
		di-n-Butylphthalate	NA	700	2J	6J	65-MW07	3/11	NA	0
		bis(2-ethylhexyl)phthalate	NA	3	1J	6J	65-MW07	5/11	NA	2
	Pesticides (ug/L)	ND	NA	NA	NA	NA	NA	0/11	NA	NA
	PCBs (ug/L)	ND	NA	NA	NA	NA	NA	0/11	NA	NA
	Metals (ug/L)	Aluminum	50-200[3]	NA	40.3	421	65-MW06	7/11	NA	6
		Barium	2000	2000	17.9	151	65-MW03	10/11	0	0

Notes:
NA - Not applicable
ND - Not detected
PAH - Polynuclear aromatic hydrocarbon

[2] Comparison Criteria for groundwater are Federal Maximum Contaminant Levels (MCL) (Criteria I) and North Carolina Water Quality Standards (NCWQS) (Criteria II).
[3] Secondary MCL for aluminum, iron, and zinc; if MCL is a range, the lower concetration is used for comparison.

TABLE 1 (Continued)

SUMMARY OF SITE CONTAMINATION
SITE 65 - ENGINEER AREA DUMP
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Medium	Fraction (Units)	Detected Constituents	Comparison Criteria		Site Contamination					
			Criteria I	Criteria II	Min. Conc.	Max. Conc.	Location(s) of Maximum Concentration	Detection Frequency	Number of Detections Above Comparison Criteria I	Number of Detections Above Comparison Criteria II
Groundwater	Metals (continued) (ug/L)	Chromium	100	50	10	10.2	65-MW01	2/11	0	0
		Cobalt	NA	NA	20.1	52.4	65-DW02-02	4/11	NA	NA
		Iron	300[3]	300	41.9	6580	65-MW02	10/11	5	5
		Lead	15[4]	15	3.4	3.4	65-DW04	1/11	0	0
		Manganese	NA	50	3	186	65-DW02-02	11/11	NA	5
		Nickel	100	100	53.1	59.6	65-DW02-02	2/11	0	0
		Zinc	5000[3]	2100	11	58.9	65-DW02-02	10/11	NA	0
Surface Water[5]	Volatiles (ug/L)	Acetone	NA	NA	5J	5J	65-SW04-01	1/2		
		1,2-Dichloroethane	0.38 (EPA)	NA	1J	1J	65-SW04-01 & SW05-01	2/2	2	NA
	Semivolatiles (ug/L)	ND	NA	NA	NA	NA	NA	0/2	NA	NA
	Pesticides (ug/L)	ND	NA	NA	NA	NA	NA	0/2	NA	NA
	PCBs (ug/L)	ND	NA	NA	NA	NA	NA	0/2	NA	NA
	Metals (ug/L)	Aluminum	NA	333.17	25800	25800	65-SW04-01	1/2	NA	1
		Barium	1000 (NC)	25.67	36.7	69.3	65-SW04-01	2/2	0	1
		Chromium (total)	50[6] (EPA)	NA	27.6	27.6	65-SW04-01	1/2	0	0
		Copper	1300[7] (EPA)	NA	41.1	41.1	65-SW04-01	1/2	0	NA
		Iron	300[6] (EPA)	575.67	348	7890	65-SW04-01	2/2	2	1

Notes:
NA - Not applicable
ND - Not detected
PAH - Polynuclear aromatic hydrocarbon

[3] Secondary MCL for aluminum, iron, and zinc; if MCL is a range, the lower concetration is used for comparison.
[4] Federal Action Level for lead.
[5] Positive contaminant detections in surface water are compared to freshwater screening values for human health (water and organism consumption): EPA Region IV Water Quality Standards (EPA), 1995 or NCWQS (NC) (Criteria I), and upstream background concentrations from the White Oak River Basin Study (Criteria II).
[6] EPA Water Quality Criteria, 1991, Human Health Published Criteria (water and organism consumption).
[7] EPA Water Quality Criteria, 1991, Human Health Recalculated Values using IRIS, as of 9/90 (water and organism consumption).

TABLE 1 (Continued)

SUMMARY OF SITE CONTAMINATION
SITE 65 - ENGINEER AREA DUMP
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Medium	Fraction (Units)	Detected Constituents	Comparison Criteria		Site Contamination					
			Criteria I	Criteria II	Min. Conc.	Max. Conc.	Location(s) of Maximum Concentration	Detection Frequency	Number of Detections Above Comparison Criteria I	Number of Detections Above Comparison Criteria II
Surface Water	Metals (continued) (ug/L)	Lead	50[6] (EPA)	NA	45.8	45.8	65-SW04-01	1/2	0	NA
		Manganese	200 (NC)	NA	57.3	88.4	65-SW04-01	2/2	0	0
		Vanadium	NA	NA	26.2	26.2	65-SW04-01	1/2	NA	NA
		Zinc	NA	NA	33.6	144	65-SW04-01	2/2	NA	NA
Sediment[8]	Volatiles (ug/kg)	Acetone	NA	NA	190J	450J	65-SD05-612	4/4	NA	NA
		Chloroform	NA	NA	79J	79J	65-SD04-06	1/4	NA	NA
		2-Butanone	NA	NA	72J	94J	65-SD04-06	4/4	NA	NA
		Carbon Tetrachloride	NA	NA	13J	18J	65-SD04-06	2/4	NA	NA
		Tetrachloroethene	NA	NA	6J	15J	65-SD04-06	2/4	NA	NA
		Toluene	NA	NA	3J	7J	65-SD04-06	3/4	NA	NA
	Semivolatiles (ug/kg)	Di-n-Butylphthalate	NA	NA	940J	1,600J	65-SD04-612	4/4	NA	NA
	Pesticides (ug/kg)	beta-BHC	NA	2.51	8.3NJ	8.3NJ	65-SD04-612	1/4	NA	1
		4,4'-DDE	NA	2.42	18J	19NJ	65-SD05-06	2/4	NA	2
		4,4'-DDD	NA	1.57	76J	84J	65-SD05-06	2/4	NA	2
	Metals (ug/kg)	Vanadium	NA	17.57	40.5	40.5	65-SD04-06	1/4	NA	1
		Zinc	NA	27.38	7.9	280J	65-SD04-06	4/4	NA	3

Notes:
NA - Not applicable
ND - Not detected
PAH - Polynuclear aromatic hydrocarbon

[6] EPA Water Quality Criteria, 1991, Human Health Published Criteria (water and organism consumption).
[7] EPA Water Quality Criteria, 1991, Human Health Recalculated Values using IRIS, as of 9/90 (water and organism consumption).
[8] There are no established criteria for sediment, therefore Criteria I is NA. Criteria II is the average upstream background sediment concetration from the White Oak River Basin Study.

TABLE 1 (Continued)

SUMMARY OF SITE CONTAMINATION
SITE 65 - ENGINEER AREA DUMP
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Medium	Fraction (Units)	Detected Constituents	Comparison Criteria		Site Contamination					
			Criteria I	Criteria II	Min. Conc.	Max. Conc.	Location(s) of Maximum Concentration	Detection Frequency	Number of Detections Above Comparison Criteria I	Number of Detections Above Comparison Criteria II
Fish Tissue[9]	Volatiles (ug/kg)	Acetone	14000	NA	5600J	7900J	65-FS05-LB01F	2/4	0	NA
	Pesticides (ug/kg)	4,4'-DDD	13	NA	5.7J	5.7J	65-FS04-BG01F	1/4	0	NA
	Metals (mg/kg)	Aluminum	140	NA	0.99	0.99	65-FS05-LB01F	1/4	0	NA
		Barium	9.5	NA	0.21J	0.21	65-FS04-BG01F	1/4	0	NA
		Copper	5	NA	0.46	0.49	65-FS04-BG01F	2/4	0	NA
		Manganese	0.68	NA	0.092J	0.45J	65-FS04-BG01F	4/4	0	NA
		Mercury	0.041	NA	0.051J	0.3J	65-FS05-LB01F	4/4	4	NA
		Selenium	0.68	NA	0.14	0.22	65-FS04-BG01F	4/4	0	NA
		Thallium	NA	NA	0.11	0.11	65-FS05-RS01F	3/4	NA	NA
		Zinc	41	NA	5.8J	8.4J	65-FS05-BG01F	4/4	0	NA

Notes:
NA - Not applicable

[9] Organics and Metals in fish tissue (fillet samples) are compared to EPA Region III risk based Contaminent of Concern (COC) Screeing Values for human injestion of fish (Criteria I). There is no Criteria II.

TABLE 2

CONTAMINANTS OF POTENTIAL CONCERN (COPCs) EVALUATED DURING THE HUMAN HEALTH RISK ASSESSMENT SITE 65 - ENGINEER AREA DUMP PROPOSED REMEDIAL ACTION PLAN, CTO-0312 MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant of Potential Concern	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment	Fish Tissue
Volatiles						
Acetone					X	
Carbon disulfide			X			
Chloroform					X	
2-Butanone					X	
Carbon Tetrachloride					X	
Tetrachloroethene					X	
Semivolatiles						
Di-n-butylphthalate					X	
Benzo(a)anthracene		X				
Benzo(a)pyrene	X	X				
Dibenzo(a,h)anthracene	X					
Pesticide/PCBs						
beta-BHC					X	
4,4'-DDE					X	
4,4'-DDD					X	
Inorganics						
Aluminum		X		X	X	
Antimony		X			X	
Arsenic		X				
Barium				X	X	
Chromium				X	X	
Cobalt					X	
Copper		X		X	X	
Lead		X	X	X	X	
Manganese	X	X	X	X	X	
Mercury						X
Nickel		X				
Thallium	X	X				X
Vanadium				X	X	
Zinc				X	X	

Notes:

X = Selected as a COPC for human health risk assessment.

TABLE 3

SUMMARY OF HUMAN HEALTH RISKS
SITE 65 - ENGINEER AREA DUMP
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Receptors	Soil		Groundwater		Surface Water/Sediment		Fish Tissue		Total	
	ICR	HI	ICR	HI	ICR	HI	ICR	HI	ICR	HI
Current Military Personnel - Trainee	7.3E-07 (100)	0.06 (100)	NA	NA	NA	NA	NA	NA	7.3E-07	0.06
Current Military Personnel - Recreational User	3.5E-07 (100)	<0.01 (100)	NA	NA	NA	NA	NA	NA	3.5E-07	<0.01
Future Child Resident	3.7E-06 (99.8)	0.01 (2)	--	0.1 (20)	8.2E-09 (<1)	0.36 (78)	NA	NA	3.7E-06	0.47
Future Adult Resident	2.8E-06 (99.7)	<0.01 (<1)	--	0.04 (40)	9.5E-09 (<1)	0.06 (60)	NA	NA	2.8E-06	0.1
Future Construction Worker	1.3E-07 (100)	0.08 (100)	NA	NA	NA	NA	NA	NA	1.3E-07	0.08
Fisherman - Child Receptor	NA	NA	NA	NA	8.2E-09 (100)	0.36 (22)	--	1.3 (78)	8.2E-09	1.7
Fisherman - Adult Receptor	NA	NA	NA	NA	9.5E-09 (100)	0.06 (18)	--	0.27 (82)	9.5E-09	0.33

Notes:

ICR = Incremental Lifetime Cancer Risk
HI = Hazard Index
( ) = Approximate percent contribution to the total ICR or HI values
Total = Soil + Groundwater + Surface Water/Sediment + Fish Tissue
NA = Not Applicable
-- = No carcinogenic COPCs selected
Shading indicates an ICR value that exceeds the acceptable limit of 1E-04, or an HI value that exceeds the acceptable limit of 1.0.

TABLE 4

CONTAMINANTS OF POTENTIAL CONCERN (COPCs) EVALUATED
DURING THE ECOLOGICAL RISK ASSESSMENT
SITE 65 - ENGINEER AREA DUMP
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant of Potential Concern	Surface Water		Sediment	Surface Soil	Fish	
	Aquatic Receptors	Terrestrial Receptors			Fillet	Whole Body
Volatiles						
Acetone					X	X
2-Butanone						X
Ethylbenzene				X		
Methylene chloride						X
Toluene						X
Trichloroethane				X		
Xylenes (Total)				X		
Semivolatiles						
Acenaphthene				X		
Anthracene				X		
Benzo(a)anthracene				X		
Benzo(a)pyrene				X		
Benzo(b)fluoranthene				X		
Benzo(g,h,i)perylene				X		
Benzo(k)fluoranthene				X		
Bis(2-ethylhexyl)phthalate				X		
Carbazole				X		
Chrysene				X		
Dibenz(a,h)anthracene				X		
Dibenzofuran				X		
Di-n-butylphthalate			X	X		
2,4-Dinitrophenol				X		
Fluoranthene				X		
Fluorene				X		
Indeno(1,2,3-cd)pryene				X		
Phenanthrene				X		
Pyrene				X		

TABLE 4 (Continued)

CONTAMINANTS OF POTENTIAL CONCERN (COPCs) EVALUATED
DURING THE ECOLOGICAL RISK ASSESSMENT
SITE 65 - ENGINEER AREA DUMP
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant of Potential Concern	Surface Water		Sediment	Surface Soil	Fish	
	Aquatic Receptors	Terrestrial Receptors			Fillet	Whole Body
Pesticides/PCBs						
Beta-BHC			X			
4,4'-DDE			X	X		X
4,4'-DDD			X	X	X	X
4,4'-DDT				X		
Endosulfan II				X		
Heptachlor epoxide				X		
Aroclor-1260				X		
Inorganics						
Aluminum	X	X	X		X	X
Antimony			X			X
Arsenic						X
Barium	X	X		X	X	X
Beryllium						X
Chromium		X		X		
Cobalt			X			
Copper	X	X	X		X	X
Iron	X	X		X		X
Lead	X	X	X	X		X
Manganese	X	X		X	X	X
Mercury					X	X
Nickel				X		
Selenium					X	X
Thallium				X	X	X
Vanadium	X	X	X	X		
Zinc	X	X	X	X	X	X

TABLE 5

SUMMARY OF SITE CONTAMINATION
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Medium	Fraction (units)	Constituent	Comparison Criteria		Min.	Max.	Location of Maximum Detection	Detection Frequency	Detections Above		Distribution of Positive Detections
			Soil Screening Levels	Base Background					Soil Screening Levels	Base Background	
Surface Soil	Volatile (µg/kg)	1,1,1-Trichloroethane	900	NA	2 J	2 J	73-DW09	1/35	0	NA	north, N.C. HWY 172
		1,2-Dichloroethane	10	NA	2 J	2 J	73-SB07	1/27	0	NA	adjacent to SA-42
		1,2-Dichloropropane	20	NA	1 J	1 J	73-SB07	1/35	0	NA	adjacent to SA-42
		2-Butanone	NE	NA	2 J	4.2 J	73-DW03	4/35	NA	NA	north and east
		Acetone	8,000	NA	24	29 J	73-MW20	2/35	0	NA	north
		Chlorobenzene	600	NA	1 J	1 J	73-MW14	1/35	0	NA	adjacent to 73-DW03
		Ethylbenzene	5,000	NA	8 J	8 J	73-MW20	1/35	0	NA	adjacent to 73-DW05
		Styrene	2,000	NA	2 J	2 J	73-MW18	1/35	0	NA	near Courthouse Road
		Toluene	5,000	NA	1 J	1 J	73-DW01	1/35	0	NA	north, near 73-MW01
		Trichloroethene	20	NA	2 J	2 J	73-MW05	1/35	0	NA	near Building A8
		Xylenes (total)	74,000	NA	1 J	4 J	73-MW36	10/30	0	NA	scattered
	Semivolatile (µg/kg)	2,4-Dinitrophenol	100	NA	56 J	200 J	73-MW23	4/34	2	NA	scattered
		4-Chloro-3-Methylphenol	NE	NA	36 J	36 J	73-SB09	1/35	NA	NA	near 73-MW37
		Acenaphthene	200,000	NA	40 J	40 J	73-MW07	1/35	0	NA	south, near 73-MW06
		Anthracene	4,300,000	NA	50 J	50 J	73-MW07	1/35	0	NA	south, near 73-MW06
		Benzo(a)anthracene	700	NA	220 J	220 J	73-MW07	1/35	0	NA	south, near 73-MW06
		Benzo(a)pyrene	4,000	NA	160 J	160 J	73-MW07	1/35	0	NA	south, near 73-MW06
		Benzo(b)fluoranthene	4,000	NA	260 J	330 J	73-SB07	2/35	0	NA	east and south
		Benzo (g,h,i)perylene	NE	NA	140 J	140 J	73-SB04	1/35	NA	NA	southeast, near 73-MW15
		Bis(2-ethylhexyl)phthalate	11,000	NA	42 J	84 J	73-SB12	9/35	0	NA	scattered, north and west
		Butyl Benzyl Phthalate	68,000	NA	110 J	110 J	73-SB11	1/35	0	NA	northwest, near 73-MW21
		Chrysene	1,000	NA	60 J	190 J	73-MW07	3/35	0	NA	scattered
		Di-n-butyl Phthalate	120,000	NA	110 J	510	73-MW05	11/35	0	NA	north, west and east
		Fluoranthene	980,000	NA	42 J	380 J	73-MW07	4/35	0	NA	scattered
		Phenanthrene	NE	NA	260 J	260 J	73-MW07	1/35	NA	NA	west, near 73-MW06
		Pyrene	1,400,000	NA	41 J	450	73-MW07	5/35	0	NA	southwest and east
	Pesticide (µg/kg)	4,4'-DDD	700	NA	7	82	73-MW14	7/29	0	NA	scattered
		4,4'-DDE	500	NA	3.9 NJ	11 J	73-MW20	3/29	0	NA	scattered
		4,4'-DDT	1,000	NA	2.8 NJ	15 J	73-MW20	2/29	0	NA	north and east
		Alpha-Chlordane	NE	NA	2.5 NJ	2.5 NJ	73-SB09	1/29	NA	NA	near 73-MW37
		Endrin Ketone	NE	NA	7 NJ	7 NJ	73-MW20	1/29	NA	NA	near 73-DW05
		Gamma-Chlordane	NE	NA	3.3 J	6.8 J	73-SB09	2/29	NA	NA	north and east
	PCB (µg/kg)	Aroclor-1060	NE	NA	140 NJ	140 NJ	73-MW20	1/29	NA	NA	near 73-DW05
		Aroclor-1260	NE	NA	170 J	170 J	73-MW20	1/29	NA	NA	near 73-DW05

TABLE 5

SUMMARY OF SITE CONTAMINATION
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Medium	Fraction (units)	Constituent	Comparison Criteria		Min.	Max.	Location of Maximum Detection	Detection Frequency	Detections Above		Distribution of Positive Detections
			Soil Screening Levels	Base Background					Soil Screening Levels	Base Background	
Surface Soil (continued)	TPH (mg/kg)	Diesel Range Organics	NE	NA	11	160	73-MW12	28/46	NA	NA	scattered
		Gasoline Range Organics	NE	NA	16	16	73-SB02	1/49	NA	NA	adjacent to 73-MW08
		HBPH, as motor oil	NE	NA	130	160	73-MW19	3/3	NA	NA	northeast, southwest
		Oil and Grease	NE	NA	860	13,800	73-MW28	8/26	NA	NA	west, south and southeast
	Metal (1) (mg/kg)	Aluminum	NE	5,856.1	147	10,600	73-SB03	35/35	NA	1	scattered
		Barium	32	17.3	2.3	46.3	73-MW20	35/35	4	1	scattered
		Cadmium	6	0.7	1.1	1.9	73-MW14	5/35	0	5	scattered
		Chromium	NE	6.6	2.3	13.5 J	73-SB05	27/35	NA	8	scattered
		Cobalt	NE	2	4.4	7.2	73-MW29	4/35	NA	4	central and southeast
		Copper	NE	7.1	2.4	9.2	73-MW28	15/35	NA	2	scattered
		Iron	NE	3,702	174	8,310 J	73-SB05	35/35	NA	3	scattered
		Lead	NE	23.4	1.2	38.2	73-MW07	35/35	NA	7	scattered
		Magnesium	NE	203	14	789	73-SB05	35/35	NA	10	scattered
		Manganese	NE	18.5	0.97	38.8	73-SB05	35/35	NA	1	scattered
		Vanadium	NE	11.4	2.6	14.8	73-SB03	21/35	NA	1	scattered
		Zinc	42,000	13.8	2.9 J	197	73-MW12	30/35	0	16	scattered
Subsurface Soil	Volatile (µg/kg)	1,1,1-Tricloroethane	900	NA	21	21	73-DW09	1/28	0	NA	north, N.C. HWY 172
		2-Butanone	NE	NA	2 J	9 J	73-SB07	7/27	NA	NA	scattered
		4-Methyl-2-Pentanone	NE	NA	11	11	73-SB07	1/28	NA	NA	adjacent to SA-42
		Acetone	8,000	NA	22 J	530	73-DW10	13/28	0	NA	scattered
		Carbon Disulfide	14,000	NA	2 J	2 J	73-DW09	1/28	0	NA	north, N.C. HWY 172
		Ethylbenzene	5,000	NA	1 J	1 J	73-MW37	2/28	0	NA	north and northeast
		M-Xylene & P-Xylene	240,000	NA	1.8 J	1.8 J	73-DW03	1/2	0	NA	central, near 73-MW13
		O-Xylene	150,000	NA	0.89 J	3 J	73-MW14	2/3	0	NA	central
		Tetrachloroethene	40	NA	1 J	1 J	73-SB01	1/28	0	NA	west, near 73-MW02
		Tricloroethene	20	NA	6 J	6 J	73-MW23	1/28	0	NA	west, near 73-MW30
		Xylenes (Total)	74,000	NA	1 J	11 J	73-SB13	5/25	0	NA	scattered
	Semivolatile (µg/kg)	2-Methylnaphthalene	NE	NA	250 J	9,400	73-SB01	2/27	NA	NA	west and central
		2,4-Dinitrophenol	100	NA	140 J	180 J	73-MW23	2/26	2	NA	west and northeast
		Acenaphthene	200,000	NA	51 J	830 J	73-SB01	3/27	0	NA	scattered
		Anthracene	4,300,000	NA	2000 J	2000 J	73-MW15B	1/27	0	NA	southeast, near 73-DW04
		Benzo(a)antracene	700	NA	120 J	880 J	73-MW15B	2/27	1	NA	southeast
		Benzo(a)pyrene	4,000	NA	140 J	140 J	73-SB06	1/27	0	NA	southeast, near 73-MW15
		Benzo(b)fluoranthene	4,000	NA	230 J	690 J	73-MW15B	2/27	0	NA	southeast
		Bis(2-ethylhexyl)phthalate	11,000	NA	62 J	360 J	73-MW14	11/27	0	NA	scattered
		Chrysene	1,000	NA	120 J	930 J	73-MW15B	2/27	0	NA	southeast

TABLE 5

SUMMARY OF SITE CONTAMINATION
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Medium	Fraction (units)	Constituent	Comparison Criteria		Min.	Max.	Location of Maximum Detection	Detection Frequency	Detections Above		Distribution of Positive Detections
			Soil Screening Levels	Base Background					Soil Screening Levels	Base Background	
Subsurface Soil (continued)	Semivolatile (µg/kg) (continued)	Di-n-butyl Phthalate	120,000	NA	110 J	430	73-MW02	10/27	0	NA	scattered
		Fluoranthene	980,000	NA	44 J	4000	73-MW15	3/27	0	NA	southeast and central
		Fluorene	160,000	NA	100 J	1200 J	73-SB01	2/27	0	NA	west and central
		Phenanthrene	NE	NA	140 J	1600 J	73-SB01	3/27	NA	NA	scattered
		Pyrene	1,400,000	NA	100 J	3100 J	73-MW15B	3/27	0	NA	southeast and central
	Pesticide (µg/kg)	Dieldrin	1	NA	6.6 J	6.6 J	73-SB07	1/27	1	NA	east, adjacent to SA-42
		4,4'-DDE	500	NA	4.8 J	50	73-MW15	5/27	0	NA	scattered
		4,4'-DDD	700	NA	6.5 J	9100	73-MW28	9/27	1	NA	south, west and southeast
		4,4'-DDT	1,000	NA	17 J	17 J	73-SB07	1/27	0	NA	east, adjacent to SA-42
		Alpha-Chlordane	NE	NA	2.4 J	2.4 J	73-SB07	1/27	NA	NA	east, adjacent to SA-42
		Endosulfan I	3,000	NA	4.1 J	4.1 J	73-SB07	1/27	0	NA	east, adjacent to SA-42
		Endrin Aldehyde	NE	NA	3.9	3.9	73-MW15B	1/27	NA	NA	south, near 73-DW04
	PCB (µg/kg)	Aroclor-1254	NE	NA	35 J	56 NJ	73-SB07	2/27	NA	NA	central and southeast
	TPH (mg/kg)	Diesel Range Organics	NE	NA	13	1,000	73-MW28	12/35	NA	NA	scattered
		HBPH, as motor oil	NE	NA	27	10,000	73-MW28	4/4	NA	NA	scattered
		Oil and Grease	NE	NA	730	7200	73-MW28	8/31	NA	NA	scattered
	Metal (1) (mg/kg)	Aluminum	NE	5,856.1	141	17,200	73-MW21	29/29	NA	2	scattered
		Barium	32	17.3	2	26.3	73-MW21	28/29	0	5	scattered
		Cadmium	6	0.7	1.3	1.6	73-SB07	2/29	0	2	south and southeast
		Chromium	NE	6.6	2.3	28.7	73-MW21	23/29	NA	10	scattered
		Cobalt	NE	2	4.9	5.3	73-MW28	3/29	NA	3	south and southeast
		Copper	NE	7.1	2.7	9.5	73-MW06	7/29	NA	1	south, central and east
		Iron	NE	3,702	200	9620	73-MW21	29/29	NA	3	scattered
		Lead	NE	23.4	0.91	71.8	73-MW06	29/29	NA	3	scattered
		Magnesium	NE	203	16.6	1090	73-MW21	29/29	NA	8	scattered
		Manganese	NE	18.5	0.65	20 J	73-SB06	29/29	NA	1	scattered
		Vanadium	NE	11.4	2.5	30.1	73-MW21	20/29	NA	2	scattered
		Zinc	42,000	13.8	1.4 J	87.7	73-MW12	24/29	0	9	scattered

Notes: - Concentrations are presented µg/kg for solids (parts per billion), metal concentrations for soils are presented in mg/kg (parts per million).

(1) Metals in both surface and subsurface soils were compared to twice the average base background positive concentrations for aluminum, barium, iron, manganese cadmium, chromium, cobalt, copper, lead, magnesium, vandium and zinc.

NE - Not Established

NA - Not applicable

Soil Screening Level - USEPA Region III Soil Screening Levels for Protection of Groundwater, established by the Office of Solid Waste Emergency Response: R.L. Smith (October 4, 1995).

TABLE 5

SUMMARY OF SITE CONTAMINATION
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Aquifer System	Fraction (units)	Constituent	Comparison Criteria		Min.	Max.	Location of Maximum Detection	Detection Frequency	Detections Above		Distribution of Positive Detections
			NCWQS	Federal MCLs					NCWQS	Federal MCLs	
Uppermost Portion of the Surficial Aquifer	Volatiles via EPA Method 601/602 (µg/l) (Phase I)	1,2-Dichloroethane	0.38	5	0.3	0.7 J	A47/3-08	9/38	7	0	scattered
		Benzene	1	5	2.2 J	18 J	A47/3-08	7/38	7	3	central and east
		Chloroform	0.19	100	0.7	0.7	73-MW07	1/38	1	0	south, near 73-MW06
		Cis-1,2-Dichloroethene	70	70	1.3	74	73-MW13	9/38	2	2	central, east and south
		Ethylbenzene	29	700	3.1	3.1	MW-13	1/38	0	0	north, near DW-02
		Toluene	1000	1000	3.1 J	3.1 J	A47/3-08	1/38	0	0	east, near A47/3-09
		Trans-1,2,-Dichloroethene	100	70	1.7	4.5 J	A47/3-09	4/38	0	0	central and east
		Trichloroethene	2.8	5	1.4	24	73-MW27	13/38	6	4	scattered
		Vinyl Chloride	0.015	2	1.8 J	23 J	A47/3-08	3/38	3	2	central, east and south
		Xylenes (total)	530	10,000	1.2	5.5	MW-13	4/37	0	0	central and north
	Volatiles via CLP Method (µg/l) (Phase II)	Vinyl Chloride	0.015	2	22	43 J	A47/3-08	2/20	2	2	east
		Acetone	700	NE	2 J	2 J	73-MW27	1/20	0	NA	central, near Building A-47
		1,2-Dichloroethene (total)	NE	70	2 J	44	A47/3-08	5/20	NA	0	central, east and west
		Trichloroethene	2.8	5	1 J	46	73-MW27	3/20	2	1	central and northwest
		Benzene	1	5	3 J	27	A47/3-08	3/20	3	1	central and southeast
		Toluene	1000	1000	2 J	2 J	A47/3-08	1/20	0	0	east, near SA-42
	Semivolatile (µg/l) (Phase I)	Phenol	300	NE	2 J	2 J	A47/3-22	1/42	0	NA	east, near SA-42
		Bis(2-Ethylhexyl)phthalate	3	6	1 J	50	73GW-03	3/43	1	1	scattered
		Acenaphthene	800	NE	2 J	4 J	73-MW15	2/43	0	NA	south and southeast
		Di-n-butyl Phathalate	700	NE	1 J	6 J	73-MW25	10/43	0	NA	scattered
		Fluorene	280	NE	1 J	1 J	73-MW15	1/43	0	NA	southeast, near 73-DW04
		Naphthalene	21	NE	6 J	6 J	73-MW29	1/43	0	NA	central, within parking area
	Pesticide (µg/l)	ND	--	--	--	--	--	--	--	--	--
	PCB (µg/l)	ND	--	--	--	--	--	--	--	--	--
	Metals (mg/l)	Aluminum	NE	NE	49.9	29,700 J	73-MW09	37/44	NA	NA	scattered
		Antimony	6	NE	55.8	55.8	73-MW30	1/44	1	NA	west, near 73-MW02
		Barium	2,000	2,000	10.2	116	A47/3-22	44/44	0	0	scattered
		Chromium	50	100	10.6	39.7	73-MW09	3/44	0	0	central
		Cobalt	NE	NE	26.1	53.4	A47/3-22	9/44	NA	NA	scattered
		Copper	1,000	1,300	13.8	14.3	73-MW09	2/44	0	0	south and central
		Iron	300	NE	171	38,800	A47/3-22	44/44	43	NA	scattered
		Lead	15	15	3.6	14.9	73-MW09	3/44	0	0	scattered
		Magnesium	NE	NE	629	25,900	73-MW15	44/44	NA	NA	scattered
		Manganese	50	NE	4.8	310	A47/3-13	43/44	14	NA	scattered
		Thallium	2	NE	10.8	10.8	A47/3-22	1/44	1	NA	east, near SA-42

TABLE 5

SUMMARY OF SITE CONTAMINATION
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Aquifer System	Fraction (units)	Constituent	Comparison Criteria		Min.	Max.	Location of Maximum Detection	Detection Frequency	Detections Above		Distribution of Positive Detections
			NCWQS	Federal MCLs					NCWQS	Federal MCLs	
Upper Surficial (continued)	Metals (mg/l) (continued)	Vanadium	NE	NE	10.7	10.7	73-MW09	2/44	NA	NA	east and south
		Zinc	2,100	NE	8.6	186	73-MW29	38/44	0	NA	scattered
Lower Surficial Aquifer	Volatiles via EPA Method 601/602 (µg/l) (Phase I)	1,2-Dichloroethane	0.38	5	0.4	0.4	73-MW15B	1/5	1	0	southeast, near 73-DW04
		Chloroform	0.19	100	0.6	0.7	73-MW11B	2/5	2	0	central and south
		Cis-1,2-Dichloroethene	70	70	11	11	73-MW11B	1/5	0	0	central, near 73-MW16
		Ethylbenzene	29	700	1.3 J	1.3 J	73-MW15B	1/5	0	0	southeast, near 73-DW04
		Trichloroethene	2.8	5	1.4	31	73-MW11B	3/5	2	2	scattered
		Xylenes (total)	530	10,000	1.4	31	73-MW15B	1/5	0	0	southeast, near 73-DW04
	Volatiles via CLP (µg/l) (Phase II)	1,2-Dichloroethene (total)	70	NE	3 J	35	73-MW02B	2/4	0	0	west and central
		Trichloroethene	2.8	5	9 J	9 J	73-MW01B	2/4	2	2	central and north
	Semivolatile (µg/l) (Phase I)	1,2,4-Trichlorobenzene	NE	70	1 J	1 J	73-MW01B	1/6	NA	0	north
		Naphthalene	21	NE	2 J	3 J	73-MW15B	2/6	0	NA	north and southeast
	Pesticide (µg/l)	ND	--	--	--	--	--	--	--	--	--
	PCB (µg/l)	ND	--	--	--	--	--	--	--	--	--
	Metals (mg/l) (Phase I)	Aluminum	NE	NE	67.6 J	192	73-MW02B	3/6	NA	NA	
		Barium	2,000	2,000	6.3	23.8	73-MW02B	6/6	0	0	scattered
		Cobalt	NE	NE	26.8	26.8	DW-02	1/6	NA	NA	north, near 73-MW18
		Iron	300	NE	766	2010	73-MW02B	6/6	6	NA	scattered
		Magnesium	NE	NE	687	2230	73-MW11B	5/6	NA	NA	scattered
		Manganese	50	NE	13.8	356	73-MW02B	6/6	3	NA	scattered
		Zinc	2,100	NE	11.6	46.8	73-MW15B	5/6	0	NA	scattered
Uppermost Portion of the Castle Hayne Aquifer	Volatiles via EPA Method 601/602 (µg/l) (Phase I)	1,2-Dichloroethane	0.38	5	0.6	0.7	73-DW03	2/5	2	0	
		Benzene	1	5	2.4	2.4	73-DW03	1/5	1	0	central, near 73-MW13
		Chloroform	0.19	100	1 J	5.5 J	73-DW04	3/5	3	0	
		Cis-1,2-Dichloroethene	70	70	67	67	73-DW03	1/5	0	0	central, near 73-MW13
		Trans-1,2,-Dichloroethene	100	70	1.8	1.8	73-DW03	1/5	0	0	central, near 73-MW13
		Trichloroethene	2.8	5	3.2	110	73-DW03	5/5	5	3	scattered
	Volatiles via CLP Method (µg/l) (Phase II)	Vinyl Chloride	0.015	2	4 J	4 J	73-DW03	1/14	1	1	central, near 73-MW13
		Chloroethane	NE	NE	3 J	3 J	73-DW03	1/14	NA	NA	central, near 73-MW13
		1,2-Dichloroethene (total)	NE	70	120	120	73-DW03	1/14	NA	1	central, near 73-MW13
		Chloroform	0.19	100	1 J	2 J	73-DW11	4/14	4	0	
		Trichloroethene	2.8	5	320	320	73-DW03	1/14	1	1	central, near 73-MW13
	Semivolatile (µg/l) (Phase I)	1,2,4-Trichlorobenzene	NE	70	2 J	5 J	73-DW02	2/5	NA	0	south and north
		Di-n-Butyl Phthalate	700	NE	2 J	2 J	73-DW02	1/5	0	NA	south
	Pesticide (µg/l)	ND	--	--	--	--	--	--	--	--	--

TABLE 5

SUMMARY OF SITE CONTAMINATION
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Aquifer System	Fraction (units)	Constituent	Comparison Criteria		Min.	Max.	Location of Maximum Detection	Detection Frequency	Detections Above		Distribution of Positive Detections
			NCWQS	Federal MCLs					NCWQS	Federal MCLs	
Uppermost	PCB (µg/l)	ND	--	--	--	--	--	--	--	--	--
Portion of the	Metals (mg/l)	Aluminum	NE	NE	52.1	2240	73-DW01	4/5	NA	NA	scattered
Castle Hayne	(Phase I)	Antimony	6	NE	457	457	73-DW01	1/5	1	NA	north, near 73-MW01
Aquifer		Barium	2,000	2,000	11.2	2050	73-DW01	5/5	1	1	scattered
(continued)		Beryllium	NE	4	52.3	52.3	73-DW01	1/5	NA	1	north, near 73-MW01
		Cadmium	5	5	50.7	50.7	73-DW01	1/5	1	1	north, near 73-MW01
		Chromium	50	100	210	210	73-DW01	1/5	1	1	north, near 73-MW01
		Cobalt	NE	NE	530	530	73-DW01	1/5	NA	NA	north, near 73-MW01
		Copper	1,000	1,300	269	269	73-DW01	1/5	0	0	north, near 73-MW01
		Iron	300	NE	74.4	2070	73-DW01	4/5	3	NA	scattered
		Magnesium	NE	NE	64.3	4190	73-DW01	5/5	NA	NA	scattered
		Manganese	50	NE	2.2	534	73-DW01	4/5	2	NA	scattered
		Nickel	100	100	520	520	73-DW01	1/5	1	1	north, near 73-MW01
		Silver	18	NE	54.2	54.2	73-DW01	1/5	1	NA	north, near 73-MW01
		Vanadium	NE	NE	518	518	73-DW01	1/5	NA	NA	north, near 73-MW01
		Zinc	2,100	NE	11.4 J	541	73-DW01	5/5	0	NA	scattered
Mid/Lower	Volatiles via CLP	Acetone	700	NE	2 J	2 J	73-GW05	1/6	0	NA	across Courthouse Bay
Portions of	(µg/l) (Phase II)	Chloroform	0.19	100	2 J	2 J	73-GW01	1/6	1	0	central, near 73-DW11
Castle Hayne	Semivolatile (µg/l)	Not Requested	--	--	--	--	--	--	--	--	--
Aquifer	Pesticide (µg/l)	Not Requested	--	--	--	--	--	--	--	--	--
	PCB (µg/l)	Not Requested	--	--	--	--	--	--	--	--	--
	Metals (mg/l)	Not Requested	--	--	--	--	--	--	--	--	--

Notes: - Organic concentrations are presented µg/l for liquids (parts per billion), metal concentrations for liquids are presented in mg/l (parts per million).
- Positively detected compounds were compared to North Carolina Water Quality Standards (NCWQS) and the Federal Maximum Contaminant Levels (MCLs) established by the USE
NE - Not Established
NA - Not applicable

TABLE 5

SUMMARY OF SITE CONTAMINATION
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Medium	Fraction (units)	Constituent	Comparison Criteria		Min.	Max.	Location of Maximum Detection	Detection Frequency	Detections Above		Distribution of Positive Detections
			NCWQS (2)	Average Reference Station Conc.					NCWQS	Average Reference Station Conc.	
Surface Water	Volatiles via CLP Method (µg/l)	Acetone	NE	ND	2 J	5 J	73-SW01	3/11	NA	3	scattered
		Chloroform	NE	ND	50	50	73-SW01	1/11	NA	1	east trib.
		Toluene	NE	ND	3 J	3 J	73-SW06	1/11	NA	1	Courthouse Bay
	Metal (1) (mg/l)	Aluminum	NE	ND	74.6	500	73-SW11	4/11	NA	4	scattered
		Antimony	NE	ND	116	216	73-SW06	10/11	NA	10	scattered
		Barium	NE	24.3	6.7	10.5	73-SW01	10/11	NA	0	scattered
		Iron	NE	317.8	245	4,540	73-SW01	11/11	NA	9	scattered
		Magnesium	NE	511,200	1550	1,390,000	73-SW06	11/11	NA	10	scattered
		Manganese	NE	ND	5.8	37.7	73-SW02	11/11	NA	11	scattered
		Silver	0.1	19.1	6.4	6.4	73-SW06	1/11	1	0	Courthouse Bay
		Zinc	86	ND	12	103	73-SW04	10/11	1	10	scattered

Notes: - Organic concentrations are presented in µg/l (parts per billion), metal concentrations are presented in mg/l (parts per million).

(1) Metals were compared to North Carolina Water Quality Standards and Average Reference Station Concentrations for aluminum, antimony, barium, iron, mangesium manganese, silver and zinc.

(2) NC DEHNR, 1994 (North Carolina Water Quality Standards)

NE - Not Established

ND - Not Detected

NA - Not applicable

TABLE 5

SUMMARY OF SITE CONTAMINATION
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Medium	Fraction (units)	Constituent	Comparison Criteria		Min.	Max.	Location of Maximum Detection	Depth (inches)	Detection Frequency	Detections Above		Distribution of Positive Detections
			ER-L (2)	ER-M (3)						ER-L (1)	ER-M (2)	
Sediment	Volatile (µg/kg)	Methylene Chloride	NE	NE	7 J	7 J	73-SD11	6-12	1/22	NA	NA	west trib.
		Acetone	NE	NE	5 J	280	73-SD09	0-6	7/22	NA	NA	scattered
		Carbon Disulfide	NE	NE	2 J	75	73-SD09	6-12	13/22	NA	NA	scattered
		2-Butanone	NE	NE	4 J	13 J	73-SD01	6-12	2/22	NA	NA	east trib. & Courthouse Bay
		Toluene	NE	NE	1 J	12 J	73-SD11	6-12	2/22	NA	NA	west trib. & Courthouse Bay
		Xylenes (total)	NE	NE	9 J	9 J	73-SD11	6-12	1/22	NA	NA	west trib.
	Semivolatile (µg/kg)	Bis(2-ethylhexyl)phthalate	1,300	NE	51 J	1900 J	73-SD06	6-12	8/22	1	NA	scattered
		Di-n-butyl Phthalate	1,400	NE	240 J	680 J	73-SD11	0-6	11/22	0	NA	scattered
		Fluoranthene	600	5100	1000 J	1000 J	73-SD04	0-6	1/22	1	0	Courthouse Bay
		Phenanthrene	240	1500	940 J	940 J	73-SD04	0-6	1/22	1	0	Courthouse Bay
		Phenol	NE	420	150 J	150 J	73-SD07	6-12	1/22	NA	0	Courthouse Bay
		Pyrene	665	2600	880 J	880 J	73-SD04	0-6	1/22	1	0	Courthouse Bay
	Pesticide (µg/kg)	4,4'-DDD	2	20	4.2 J	28	73-SD01	0-6	6/22	6	1	east trib. & Courthouse Bay
		4,4'-DDE	2	27	5.6 J	17 J	73-SD06	6-12	5/22	5	0	east trib. & Courthouse Bay
		Endrin	0.02	45	4.7	7.5 J	73-SD06	0-6	2/22	2	0	east trib. & Courthouse Bay
	PCB (µg/kg)	Aroclor-1260	22.7	180	120 J	120 J	73-SD06	6-12	1/22	1	0	Courthouse Bay
	Metal (1) (mg/kg)	Aluminum	NE	NE	431	28,100	73-SD09	6-12	21/22	NA	NA	scattered
		Arsenic	8.2	70	3.3	14.1	73-SD09	0-6	9/22	2	0	scattered
		Barium	500	NE	1.3	27.8	73-SD09	6-12	21/22	0	NA	scattered
		Cadmium	1.2	9.6	2.7 J	6.1 J	73-SD06	6-12	2/22	2	0	Courthouse Bay
		Chromium	81	370	3.3	55.9	73-SD09	6-12	17/22	0	0	scattered
		Cobalt	NE	NE	7.68	11.5	73-SD08	0-6	3/22	NA	NA	Courthouse Bay
		Copper	34	270	3.2	20.5	73-SD09	0-6	14/22	0	0	scattered
		Iron	27,000	NE	3.7	27,400	73-SD09	0-6	22/22	1	NA	scattered
		Lead	46.7	218	3.3	47.7 J	73-SD06	6-12	22/22	1	0	scattered
		Magnesium	NE	NE	140	9430	73-SD09	0-6	21/22	NA	NA	scattered
		Manganese	230	NE	3.4	137	73-SD09	0-6	21/22	0	NA	scattered
		Nickel	20.9	51.6	6	19.7	73-SD09	6-12	5/22	0	0	scattered
		Vanadium	NE	NE	2.6	50.8	73-SD09	6-12	16/22	NA	NA	scattered
		Zinc	150	410	8	100	73-SD09	6-12	21/22	0	0	scattered

Notes: - Organic concentrations are presented in µg/kg (parts per billion), metal concentrations for sediments are presented in mg/kg (parts per million).

(1) Metals in both surface and subsurface soils were compared to twice the average base background positive concentrations for aluminum, cobalt, barium, arsenic, cadmium, chromium, copper, lead, iron, manganese, magnesium, nickel, vanadium, zinc.

(2) NOAA ER-L - USEPA Region IV Sediment Effects-Range Low Screening Values, established by the National Oceanic and Atmospheric Administration.

(3) NOAA ER-M - USEPA Region IV Sediment Effects-Range Medium Screening Values, established by the National Oceanic and Atmospheric Administration.

NE - Not established

NA - Not applicable

ND - Not detected

TABLE 6

SUMMARY OF CONTAMINANTS OF POTENTIAL CONCERN (COPCs) EVALUATED DURING THE HUMAN HEALTH RISK ASSESSMENT SITE 73-AMPHIBIOUS VEHICLE MAINTENANCE AREA PROPOSED REMEDIAL ACTION PLAN, CTO-0312 MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant of Potential Concern	Surface Soil		Subsurface Soil		Phase I Groundwater		Phase II Groundwater		Surface Water		Sediment		Fish Tissue		Crab Tissue	
Volatiles																
Methylene Chloride														X		X
Acetone														X		X
Chloroform						X										
cis-1,2-Dichloroethene						X										
1,2-Dichloroethene (total)								X								
Vinyl Chloride						X		X								
Trichloroethene						X		X								
Benzene						X		X								
Pesticides/PCBs																
4,4'-DDD				X												
Metals																
Aluminum		X		X		X				X		X				
Antimony										X						
Arsenic												X		X		X
Barium						X										
Cadmium												X				
Chromium						X						X				
Cobalt						X										
Copper						X										X
Iron		X		X		X				X		X				
Lead														X		X
Manganese						X										
Mercury														X		X

TABLE 6 (Continued)

SUMMARY OF CONTAMINANTS OF POTENTIAL CONCERN (COPCs) EVALUATED DURING THE HUMAN HEALTH RISK ASSESSMENT SITE 73-AMPHIBIOUS VEHICLE MAINTENANCE AREA PROPOSED REMEDIAL ACTION PLAN, CTO-0312 MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant of Potential Concern	Surface Soil		Subsurface Soil		Phase I Groundwater		Phase II Groundwater		Surface Water		Sediment		Fish Tissue		Crab Tissue	
Vanadium						X										
Zinc										X						

Notes:

X = Selected as a COPC for human health risk assessment.

TABLE 7

SUMMARY OF HUMAN HEALTH RISKS
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Receptors	Surface Soil		Subsurface Soil		Phase I Groundwater		Phase II Groundwater		Surface Water/Sediment		Fish/Crab Tissue		Total (Phase I Groundwater)		Total (Phase II Groundwater)	
	ICR	HI	ICR	HI	ICR	HI	ICR	HI	ICR	HI	ICR	HI	ICR	HI	ICR	HI
Current Military Personnel	NA	0.01	NA	NA	NA	NA	NA	NA	2.7E-07	0.5	NA	NA	2.7E-07	0.5	2.7E-05	0.5
Current Adolescent Trespasser	<0.01	NA	NA	NA	NA	NA	NA	NA	5.3E-07	0.4	NA	NA	5.3E-07	0.4	5.3E-07	0.4
Current Adult Trespasser	<0.01	NA	NA	NA	NA	NA	NA	NA	1.0E-06	0.3	NA	NA	1.0E-06	0.3	1.0E-06	0.3
Current Adult Fisherman	NA	NA	NA	NA	NA	NA	NA	NA	1.0E-06	0.3	3.7E-04	2.3	3.7E-04	3.0	3.7E-04	3.0
Biota Ingestion-Child Receptor	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.5E-04	11	3.5E-04	11	3.5E-04	11
Future Child Resident	NA	0.2	NA	NA	1.6E-05	2.0	7.1E-05	2.1	2.5E-07	1.1	NA	NA	1.6E-05	3.3	7.1E-05	3.4
Future Adult Resident	NA	0.02	NA	NA	3.7E-05	0.87	2.0E-04	1.0	1.0E-06	0.3	NA	NA	3.8E-05	1.1	2.0E-04	1.3
Future Construction Worker	NA	0.02	2.5E-08	0.02	NA	NA	NA	NA	NA	NA	NA	NA	2.5E-08	0.04	2.5E-08	0.04

Notes:

ICR = Incremental Lifetime Cancer Risk
HI = Hazard Index
Total = Soil + Groundwater + Surface Water/Sediment + Fish/Crab Tissue
NA = Not Applicable
Shading indicates an ICR value that exceeds the acceptable limit of 1E-04, or an HI value that exceeds the acceptable limit of 1.0.

TABLE 8

CONTAMINANTS OF POTENTIAL CONCERN (COPCs) EVALUATED DURING THE ECOLOGICAL RISK ASSESSMENT SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY PROPOSED REMEDIAL ACTION PLAN, CTO-0312 MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant of Potential Concern	Surface Water		Sediment	Surface Soil	Fish Samples		Crab Samples
	Aquatic Receptor	Terrestrial Receptor			Fillet	Whole Body	
Volatiles: Carbon Disulfide			X				
Chloroform	X	X					
Methylene Chloride					X		X
Toluene		X	X		X		X
Xylenes (total)				X			
Semivolatiles: Benzo(b)fluoranthene				X			
Bis(2-ethylhexyl)phthalate			X				
Chrysene				X			
Di-n-Butylphthalate			X	X	X		X
2,4-Dinitrophenol				X			
Fluoranthene				X			
Pyrene				X			
Pesticides/PCBs: gamma-Chlordane				X			
4,4'-DDD			X	X			
4,4'-DDE			X	X			
4,4'-DDT				X			
Endrin			X		X		
Inorganics: Aluminum	X	X	X	X		X	
Antimony		X					
Arsenic			X		X	X	X
Barium				X	X	X	X
Cadmium			X	X			
Chromium				X		X	
Cobalt			X	X			
Copper				X	X	X	X
Iron	X	X	X	X	X	X	X
Lead			X	X	X	X	X
Manganese	X	X		X	X	X	X
Silver							X
Vanadium			X	X		X	
Zinc	X	X		X	X	X	X

TABLE 9

REMEDIATION LEVELS
SITE 73, AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
PROPOSED REMEDIATION ACTION PLAN, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant of Concern	Remediation Level	Basis of Remediation Level
1,2-Dichloroethane	0.38	NCWQS[1]
1,2-Dichloroethene (total)	70	MCL[2]
cis-1,2-Dichloroethene	70	NCWQS
Benzene	1	NCWQS
Vinyl Chloride	0.015	NCWQS
Trichloroethene	2.8	NCWQS
Aluminum	50/200	NCWQS
Barium	2,000	NCWQS
Chromium	50	NCWQS
Iron	300	NCWQS
Manganese	50	NCWQS
Vanadium	110	Risk-Ingestion and dermal contact

Notes:

Concentrations expressed in micrograms per liter (µg/L).

(1) NCWQS = North Carolina Water Quality Standards for Groundwater
(2) MCL = Maximum Contaminant Level

TABLE 10

GLOSSARY OF EVALUATION CRITERIA
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MCB, CAMP LEJEUNE, NORTH CAROLINA

- **Overall Protection of Human Health and the Environment** - addresses whether or not an alternative provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment engineering or institutional controls.
- **Compliance with ARARs/TBCs** - addresses whether or not an alternative will meet the applicable or relevant and appropriate requirements (ARARs), criteria to-be-considered (TBCs), and other federal and state environmental statutes, and/or provide grounds for invoking a waiver.
- **Long-Term Effectiveness and Permanence** - refers to the magnitude of residual risk and the ability of an alternative to maintain reliable protection of human health and the environment over time once cleanup goals have been met.
- **Reduction of Toxicity, Mobility, or Volume Through Treatment** - refers to the anticipated performance of the treatment options that may be employed within an alternative.
- **Short-Term Effectiveness** - refers to the speed with which the alternative achieves protection, as well as the remedy's potential to create adverse impacts on human health and the environment that may occur during the construction and implementation period.
- **Implementability** - refers to the technical and administrative feasibility of an alternative, including the availability of materials and services required to implement the chosen solution.
- **Cost** - includes capital and operation and maintenance costs. For comparative purposes, present worth values are provided.

FIGURES

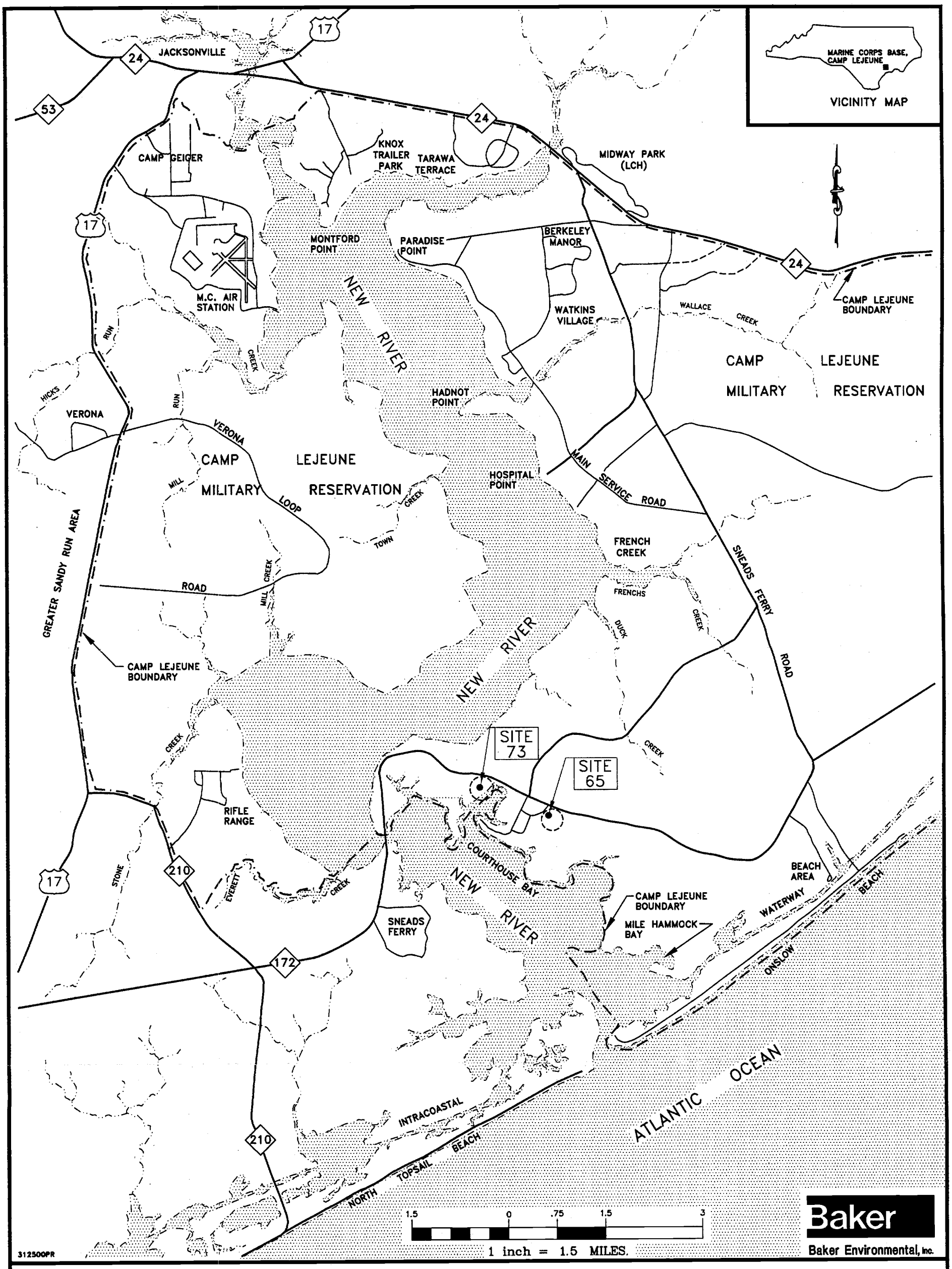
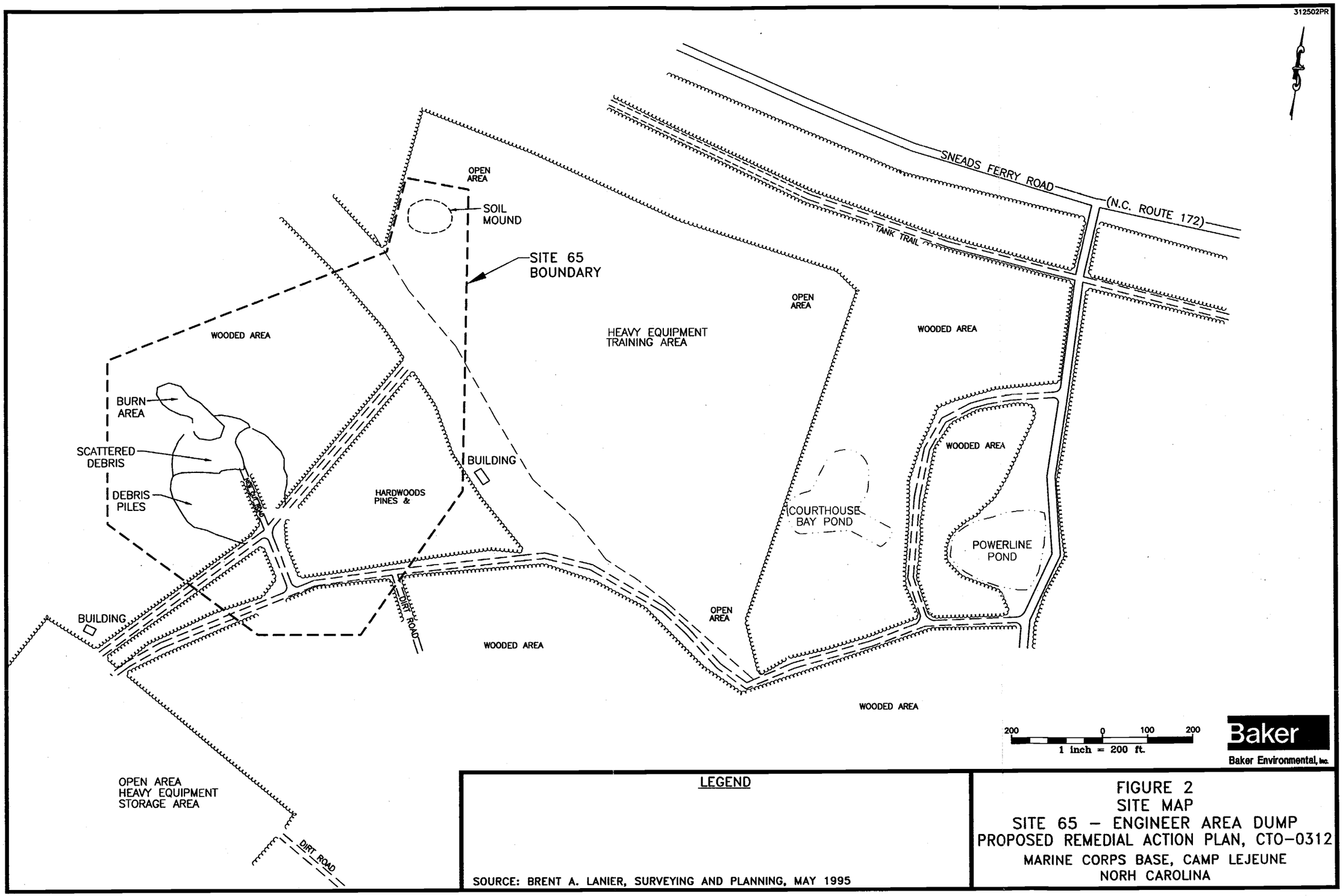


FIGURE 1
LOCATION MAP
OU No. 9
SITES 65 AND 73
PROPOSED REMEDIAL ACTION PLAN, CTO-0312

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

00325BBB12

312502PR



Baker

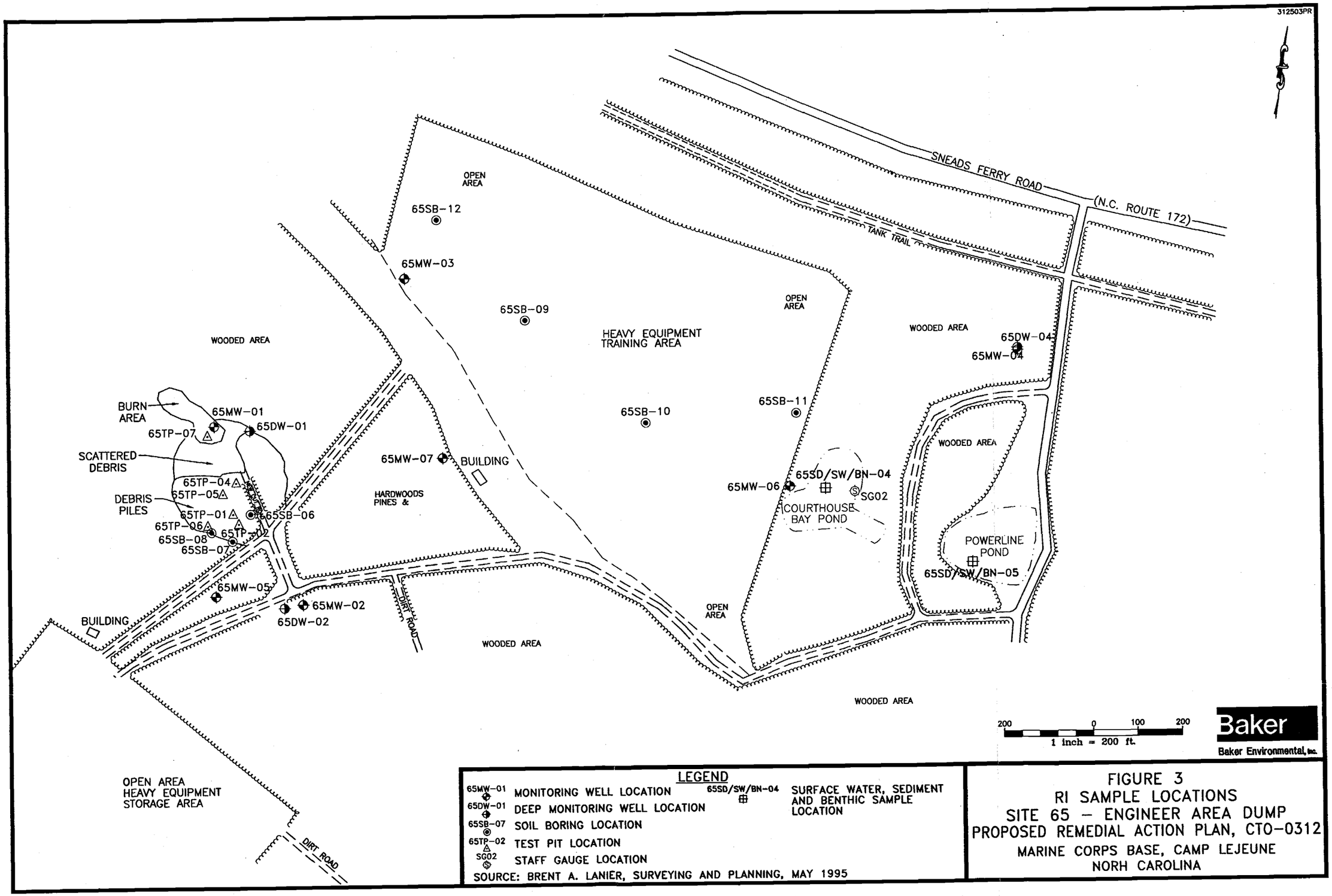
Baker Environmental, Inc.

LEGEND

SOURCE: BRENT A. LANIER, SURVEYING AND PLANNING, MAY 1995

FIGURE 2
SITE MAP
SITE 65 – ENGINEER AREA DUMP
PROPOSED REMEDIAL ACTION PLAN, CTO–0312
MARINE CORPS BASE, CAMP LEJEUNE
NORH CAROLINA

312503PR



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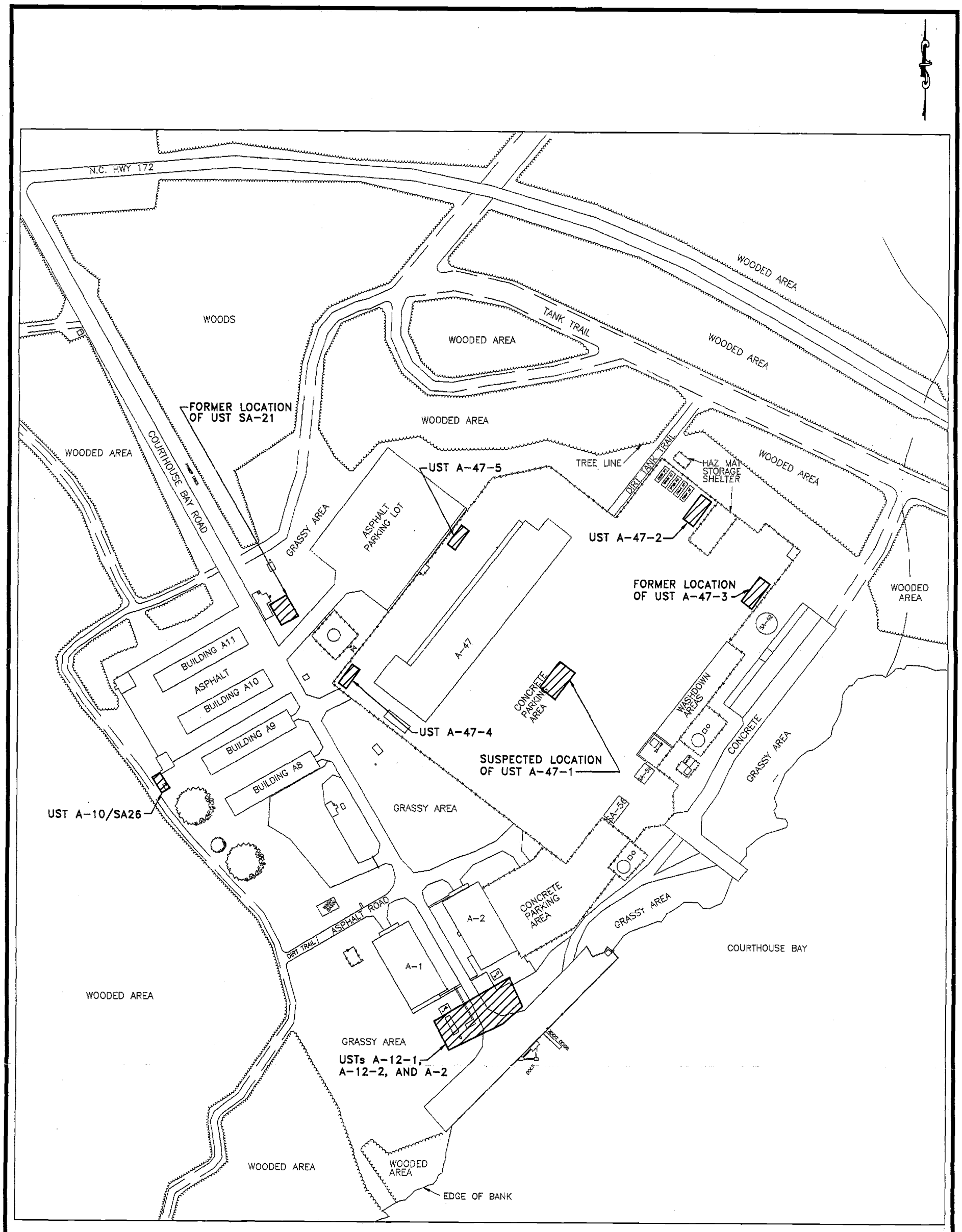
LEGEND

65MW-01	MONITORING WELL LOCATION	65SD/SW/BN-04	SURFACE WATER, SEDIMENT AND BENTHIC SAMPLE LOCATION
65DW-01	DEEP MONITORING WELL LOCATION		
65SB-07	SOIL BORING LOCATION		
65TP-02	TEST PIT LOCATION		
SG02	STAFF GAUGE LOCATION		

SOURCE: BRENT A. LANIER, SURVEYING AND PLANNING, MAY 1995

FIGURE 3
RI SAMPLE LOCATIONS
SITE 65 – ENGINEER AREA DUMP
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MARINE CORPS BASE, CAMP LEJEUNE
NORH CAROLINA



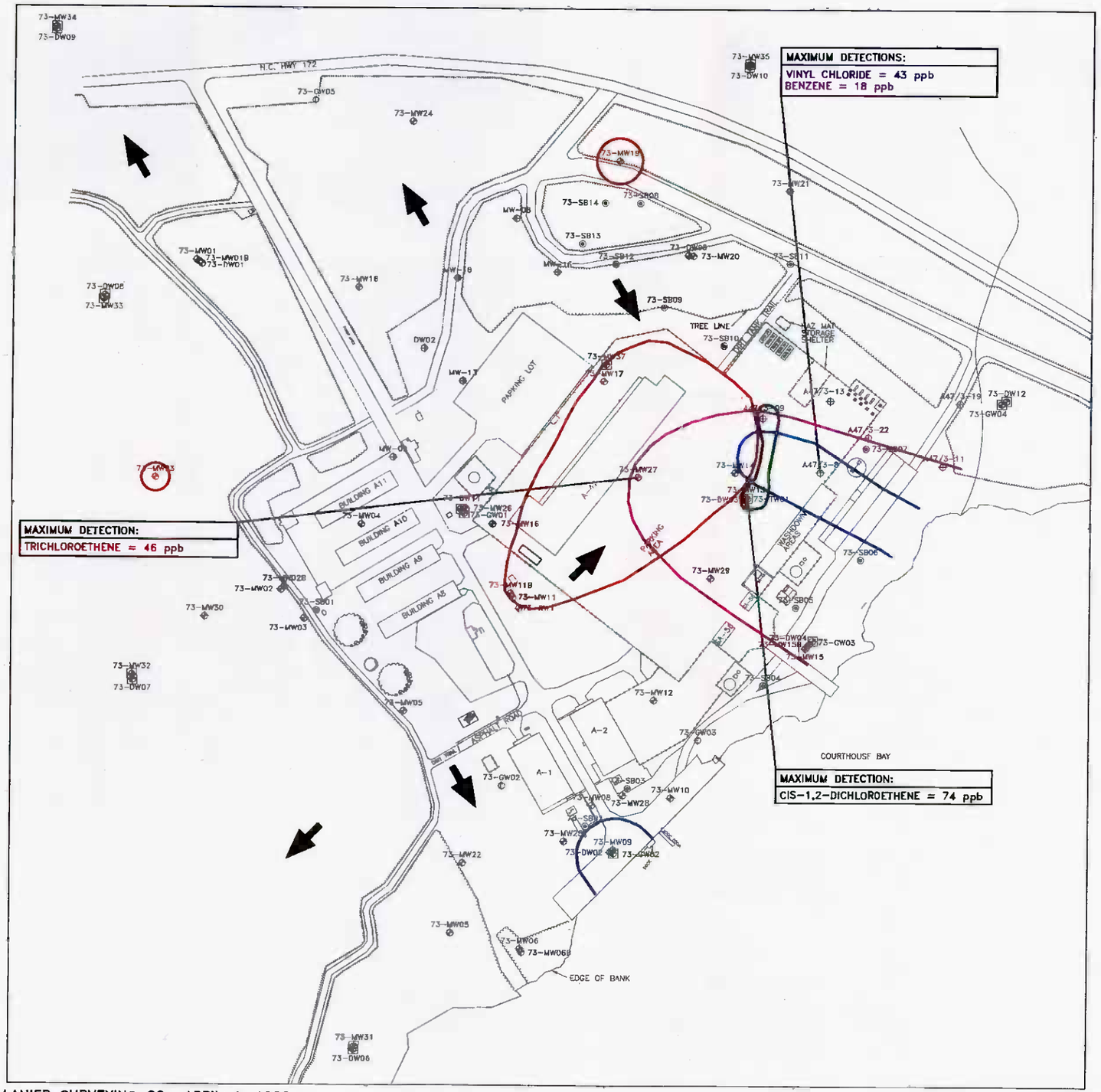
LEGEND

▨ – APPROXIMATE LOCATION OF UST

FIGURE 4
SITE MAP
SITE 73 – AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
PROPOSED REMEDIAL ACTION PLAN, CTO-0312

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

312504PR



LEGEND

73-SB01	SOIL BORINGS ADVANCED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
73-MW01	MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
73-MW31	MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE II (FEBRUARY-MARCH, 1996)
A47/3-8	MONITORING WELLS INSTALLED DURING UST INVESTIGATION BY GSI AND LAW-CATLIN AND ASSOCIATES (1993)
MW-18	MONITORING WELLS INSTALLED BY BAKER DURING UST INVESTIGATION (1992 AND 1993)
MW-08	MONITORING WELLS INSTALLED DURING A UST INVESTIGATION BY ATEC AND ASSOCIATES (1991)
73GW-02	MONITORING WELLS INSTALLED BY ESE DURING CONFIRMATORY SAMPLING (1990)
	APPROXIMATE DIRECTION OF GROUNDWATER FLOW

NOTES:

THE FOLLOWING ISOCONCENTRATION LINES DEFINE THE AREAS OF CONCERN:

- TRICHLOROETHENE = 2.8 PARTS PER BILLION (ppb)
- CIS-1,2-DICHLOROETHENE = 70 ppb
- VINYL CHLORIDE = 0.015 ppb
- BENZENE = 1 ppb

250 0 125 250
1 inch = 250 ft.

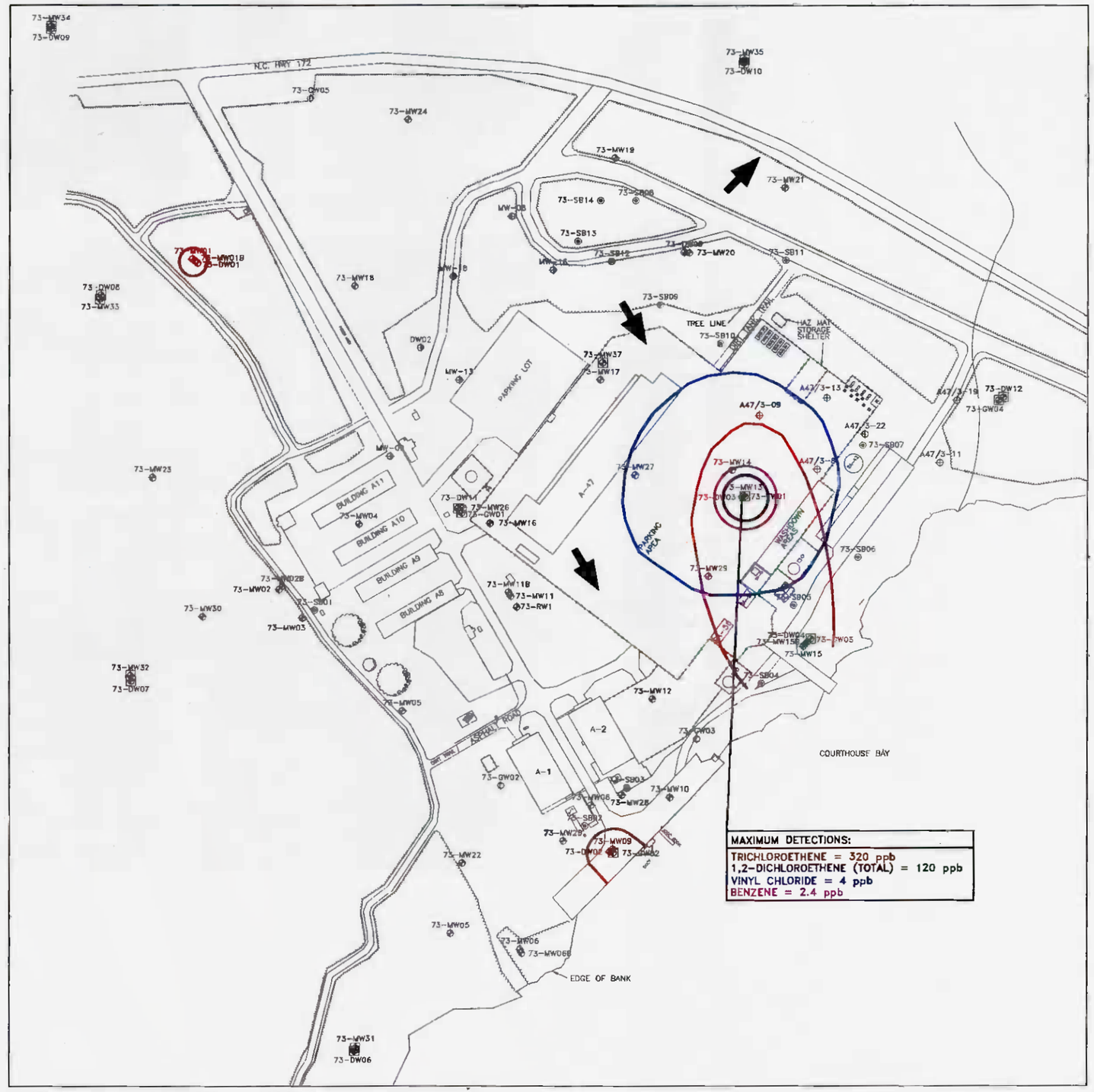
Baker
Baker Environmental, Inc.

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

FIGURE 5
AREAS OF CONCERN IN THE SURFICIAL AQUIFER
SITE 73 -
AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

00325BBB2Y

312505PR



LEGEND

- 73-SB01 — SOIL BORINGS ADVANCED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL–MAY, 1995)
- 73-MW01 — MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL–MAY, 1995)
- 73-MW31 — MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE II (FEBRUARY–MARCH, 1996)
- A47/3-8 — MONITORING WELLS INSTALLED DURING UST INVESTIGATION BY GSI AND LAW-CATLIN AND ASSOCIATES (1993)
- MW-18 — MONITORING WELLS INSTALLED BY BAKER DURING UST INVESTIGATION (1992 AND 1993)
- MW-08 — MONITORING WELLS INSTALLED DURING A UST INVESTIGATION BY ATEC AND ASSOCIATES (1991)
- 73GW-02 — MONITORING WELLS INSTALLED BY ESE DURING CONFIRMATORY SAMPLING (1990)
- APPROXIMATE DIRECTION OF GROUNDWATER FLOW

NOTES:

THE FOLLOWING ISOCONCENTRATION LINES DEFINE THE AREAS OF CONCERN:

- TRICHLOROETHENE = 2.8 PARTS PER BILLION (ppb)
- 1,2-DICHLOROETHENE (TOTAL) = 70 ppb
- VINYL CHLORIDE = 0.015 ppb
- BENZENE = 1 ppb

MAXIMUM DETECTIONS:

TRICHLOROETHENE	= 320 ppb
1,2-DICHLOROETHENE (TOTAL)	= 120 ppb
VINYL CHLORIDE	= 4 ppb
BENZENE	= 2.4 ppb

250 0 125 250
1 inch = 250 ft.

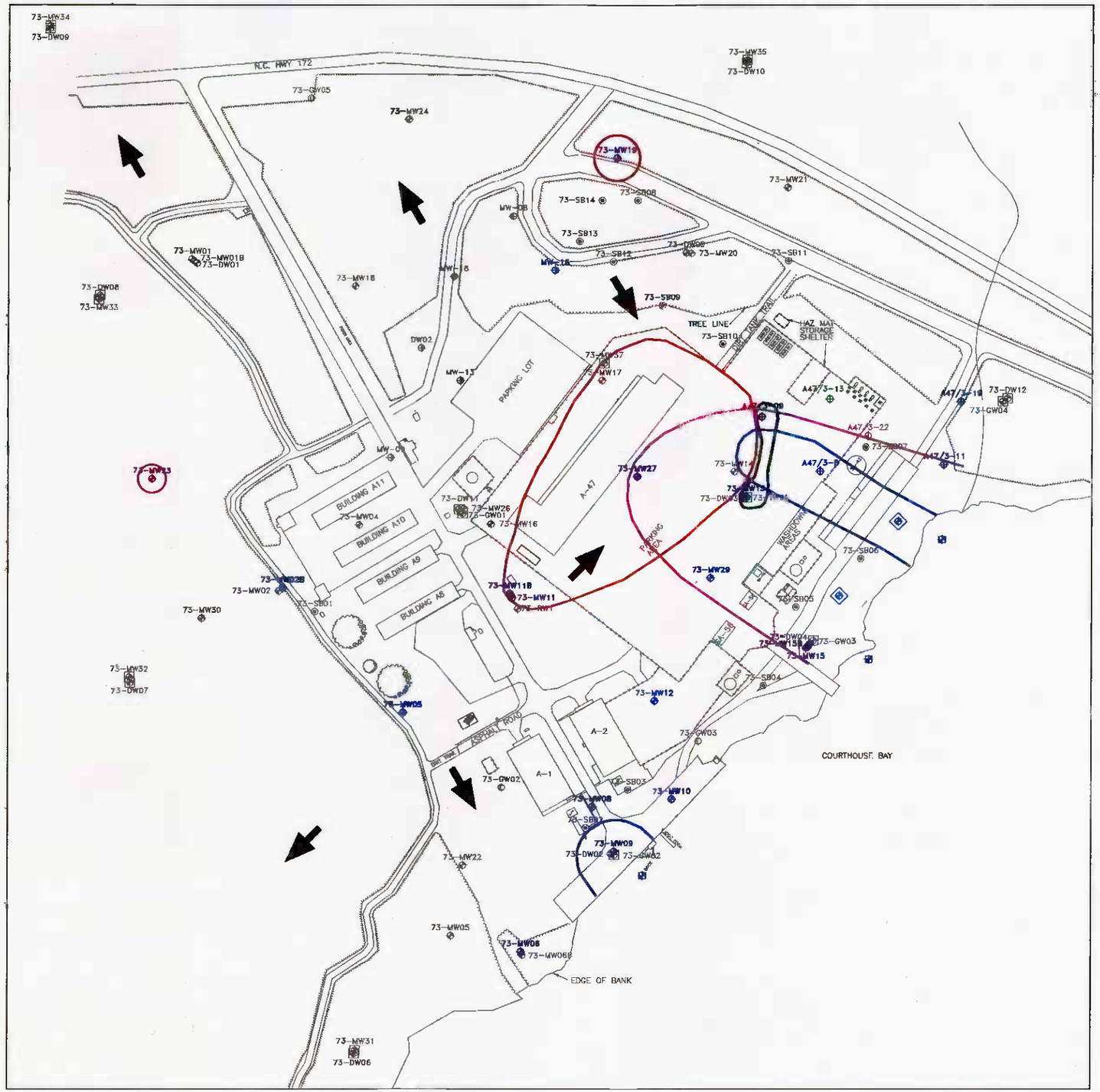
Baker
Baker Environmental, Inc.

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

FIGURE 6
AREAS OF CONCERN IN THE DEEP AQUIFER
SITE 73 –
AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
PROPOSED REMEDIAL ACTION PLAN, CTO-0312

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

312506PR



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

LEGEND

- 73-SB01 — SOIL BORINGS ADVANCED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW01 — MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW31 — MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE II (FEBRUARY-MARCH, 1996)
- A47/3-8 — MONITORING WELLS INSTALLED DURING UST INVESTIGATION BY GSI AND LAW-CATLIN AND ASSOCIATES (1993)
- MW-18 — MONITORING WELLS INSTALLED BY BAKER DURING UST INVESTIGATION (1992 AND 1993)
- MW-08 — MONITORING WELLS INSTALLED DURING A UST INVESTIGATION BY ATEC AND ASSOCIATES (1991)
- 73GW-02 — MONITORING WELLS INSTALLED BY ESE DURING CONFIRMATORY SAMPLING (1990)
- APPROXIMATE DIRECTION OF GROUNDWATER FLOW
- SURFACE WATER MONITORING LOCATION
- PROPOSED SHALLOW MONITORING WELL LOCATION

NOTES:

THE FOLLOWING ISOCONCENTRATION LINES DEFINE THE AREAS OF CONCERN:

- TRICHLOROETHENE = 2.8 PARTS PER BILLION (ppb)
- CIS-1,2-DICHLOROETHENE = 70 ppb
- VINYL CHLORIDE = 0.015 ppb
- BENZENE = 1 ppb

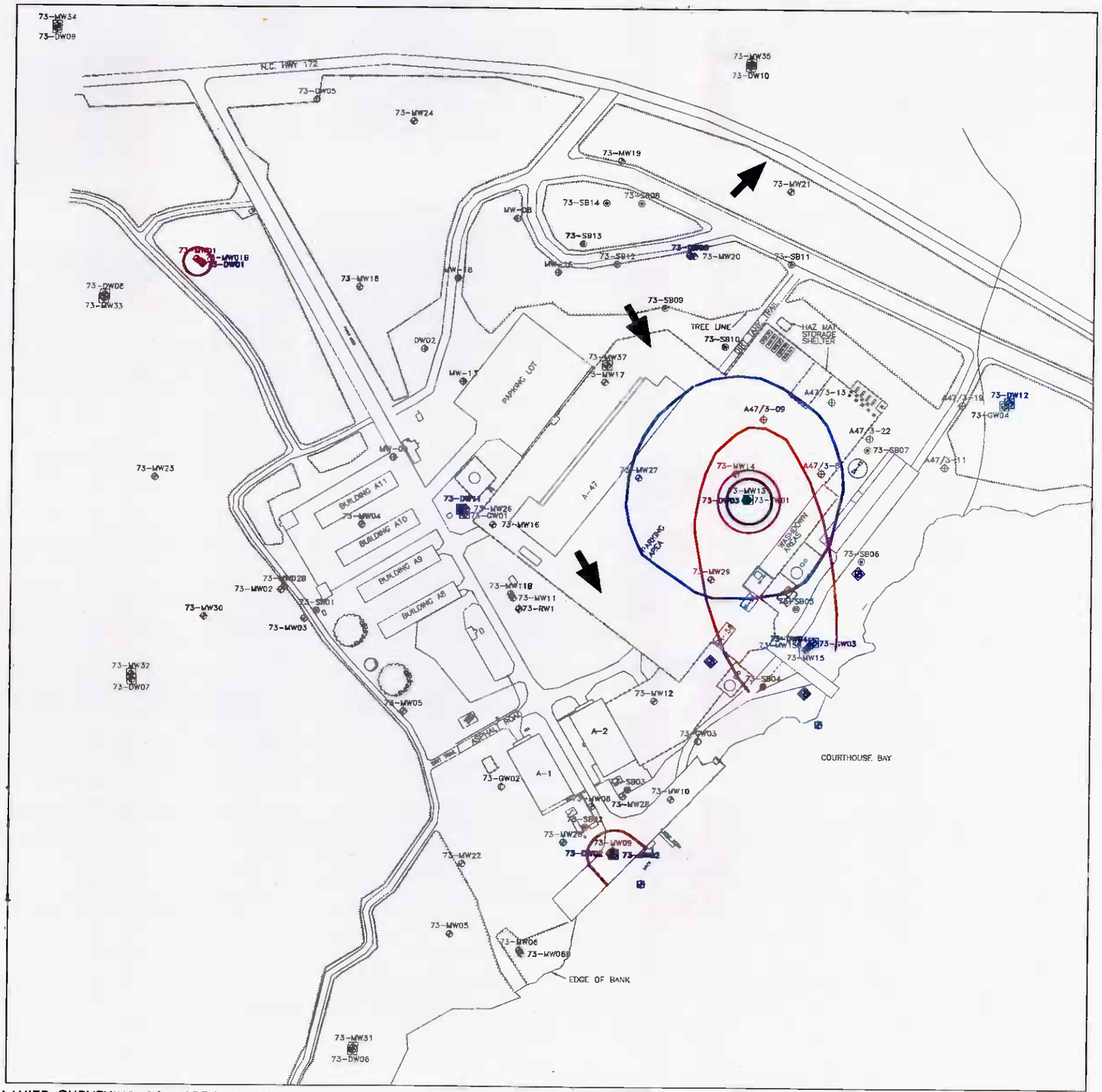
HIGHLIGHTED WELLS ARE INCLUDED IN THE MONITORING PROGRAM.

500 0 250 500
1 inch = 500 ft.

Baker
Baker Environmental, Inc.

FIGURE 7
THE PREFERRED ALTERNATIVE: MONITORING PROGRAM FOR THE SURFICIAL AQUIFER
SITE 73 -
AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

312507PR



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

LEGEND

- 73-SB01 — SOIL BORINGS ADVANCED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW01 — MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW31 — MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE II (FEBRUARY-MARCH, 1996)
- A47/3-8 — MONITORING WELLS INSTALLED DURING UST INVESTIGATION BY GSI AND LAW-CATLIN AND ASSOCIATES (1993)
- MW-18 — MONITORING WELLS INSTALLED BY BAKER DURING UST INVESTIGATION (1992 AND 1993)
- MW-08 — MONITORING WELLS INSTALLED DURING A UST INVESTIGATION BY ATEC AND ASSOCIATES (1991)
- 73GW-02 — MONITORING WELLS INSTALLED BY ESE DURING CONFIRMATORY SAMPLING (1990)
- APPROXIMATE DIRECTION OF GROUNDWATER FLOW
- SURFACE WATER MONITORING LOCATION.
- PROPOSED DEEP MONITORING WELL LOCATION.

NOTES:

THE FOLLOWING ISOCONCENTRATION LINES DEFINE THE AREAS OF CONCERN:

- TRICHLOROETHENE = 2.8 PARTS PER BILLION (ppb)
- CIS-1,2-DICHLOROETHENE = 70 ppb
- VINYL CHLORIDE = 0.015 ppb
- BENZENE = 1 ppb

HIGHLIGHTED WELLS ARE INCLUDED IN THE MONITORING PROGRAM.

250 0 125 250
1 inch = 250 ft.

Baker
Baker Environmental, Inc.

FIGURE 8
THE PREFERRED ALTERNATIVE: MONITORING PROGRAM FOR THE DEEP AQUIFER
SITE 73 -
AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
PROPOSED REMEDIAL ACTION PLAN, CTO-0312
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA