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RCRA FACILITY INVESTIGATION REPORT

MCB CAMP LEJEUNE, NORTH CAROLINA

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QC Review Page

Final

SWMU 311

RCRA Facility Investigation Report

MCB Camp Lejeune

Jacksonville, North Carolina

Contract Task Order Number – 041
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ACRONYMS AND ABBREVIATIONS

AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirement
AT	Averaging Time
ATSDR	Agency for Toxic Substance and Disease Registry
Baker	Baker Environmental, Inc.
bgs	below the ground surface
Base	MCB Camp Lejeune, North Carolina
BERA	Baseline ERA
C	Celsius
$CaCO_3/L$	Calcium Carbonate per Liter
CDI	Chronic Daily Intake
cis-DCE	cis-1,2-Dichloroethene
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
CNO	Chief of Naval Operations
COC	Chain-of-Custody
COPC	Constituents of Potential Concern
CRAVE	Carcinogen Risk Assessment Verification Endeavor
CRDL	Contract Required Detection Limit
CRQL	Contract Required Quantitation Limit
CSF	Cancer Slope Factor
CSI	Confirmatory Sampling Investigation
CT	Central Tendency
CTO	Contract Task Order
DAD	Dermally-Absorbed Dose
DoN	Department of the Navy
DOT	United States Department of Transportation
EF	Exposure Frequency
EQB	Environmental Quality Branch
ERA	Ecological Risk Assessment
ET	Exposure Time
gpm	Gallons Per Minute
gpd	Gallons Per Day
GPS	Global Positioning System
HA	Health Advisories
HEAST	Health Effects Assessment Summary Table
HHRA	Human Health Risk Assessment
HI	Hazard Index
HPIA	Hadnot Point Industrial Area
HQ	Hazard Quotient
HSWA	Hazardous and Solid Waste Amendments

ACRONYMS AND ABBREVIATIONS
(Continued)

ICR	Incremental Cancer Risk
ILCR	Incremental Lifetime Cancer Risk
IDW	Investigation Derived Waste
IEUBK	Integrated Exposure Uptake Biokinetic
IMAC	Interim Maximum Allowable Concentrations
IR	Installation Restoration
IRIS	Integrated Risk Information System
LTM	Long-Term Monitoring
MATC	Maximum Acceptable Toxicant Concentration
MCAS	Marine Corps Air Station
MCB	Marine Corps Base
MCLG	Maximum Contaminant Levels Goals
MDL	Maximum Detection Limit
Mg/kg	Milligram per Kilogram
MHSPE	Ministry of Housing, Spatial Planning and Environment
MS	Matrix Spike
MSD	Matrix Spike Duplicate
msl	Mean Sea Level
NEESA	Naval Energy and Environmental Support Activity
NC DENR	North Carolina Department of Environment and Natural Resources
NCEA	National Center for Environmental Assessment
NCWQS	North Carolina Water Quality Standards for Groundwater
OD	Outside Diameter
OEPA	Ohio Environmental Protection Agency
OSWER	Office of Solid Waste and Emergency Response
PAH	Poly-Aromatic Hydrocarbon
PCE	Tetrachloroethene
PE	Polyethylene
PEF	Particulate Emission Factor
PID	Photo Ionization Detector
PRGs	Preliminary Remediation Goals
PVC	Polyvinyl Chloride
QA	Quality Assurance
QC	Quality Control
RAC	Remedial Action Contractor
RAGS	Risk Assessment Guidance for Superfund
RBC	Risk-Based Concentration
RCRA	Resource Conservation and Recover Act
RfC	Reference Concentration
RfD	Reference Dose
RFA	RCRA Facility Assessment

ACRONYMS AND ABBREVIATIONS
(Continued)

RFI	RCRA Facility Investigation
RME	Reasonable Maximum Exposure
RPD	Relative Percent Difference
SAF	Skin Adherence Factor
SLERA	Screening Level Ecological Risk Assessment
SOP	Standard Operating Procedure
SQL	Sample Quantitation Level
SSSV	Surface Soil Screening Value
STGC	Soil-to-Groundwater concentrations
SVOC	Semi-Volatile Organic Compound
SWL	Static Water Level
SWMU	Solid Waste Management Unit
SWSV	Surface Water Screening Value
TCE	Trichloroethene
TCL	Target Compound List
TDS	Treatment, Storage, and Disposal (Facility)
TIC	Tentatively Identified Compound
trans-DCE	Trans-1,2-dichloroethene
UCL	Upper Confidence Limit
USGS	United States Geological Survey
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
VKT	Vehicle Kilometers Traveled
µg/L	Micrograms per Liter

EXECUTIVE SUMMARY

This document presents the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report for Solid Waste Management Unit (SWMU) 311 at Marine Corps Base (MCB) Camp Lejeune, North Carolina (the Base). The primary goal of this RFI is to determine the potential for future corrective action at SWMU 311 (if any) based on risk to human health and the environment. Specifically, the objectives of this RFI are as follows:

- Collect information to supplement and/or verify the environmental setting at the SWMU.
- Characterize the sources via the collection of analytical data, and evaluate the migration and dispersal characteristics of the waste.
- Characterize the hazardous constituents (if any) via the collection of groundwater and soil samples in the vicinity of the SWMU.
- Evaluate potential receptors by collecting data describing human populations and environmental systems susceptible to contaminant exposure.

The field program was conducted in conjunction with two other SWMUs (SWMU 43 and SWMU 360) and initiated June 2003 and completed in July 2003. The RFI objectives were met through a field program that consisted of soil borings, collection of surface and subsurface soil samples, groundwater sample collection via Geoprobe® Screen Point Sampler, and installation of temporary piezometers. The field program was dynamic in nature, in that the direction and termination of the investigation were driven by field decisions based on quick-turn mobile laboratory analysis of VOCs. Samples were also submitted to a fixed-base laboratory for analysis of the constituents of concern, including VOCs and metals. Other physical parameters of soils, including grain size distribution and vertical permeability, were tested to support characterization of fate and transport properties.

Constituent concentrations in surface and subsurface soil are compared to four main criteria; USEPA Region IX preliminary remediation goals (PRGs), North Carolina Soil-to-Groundwater values (STGCs), AOC 5 background, and Base background concentrations. Constituent concentrations in groundwater are compared to three main criteria; North Carolina Groundwater

Quality Standards (2L Standards), USEPA Region III Tap Water Risk-Based Concentrations (RBCs), and base-wide background concentrations.

Previous investigations gave an indication of organic and inorganic contamination in subsurface soil, including PCE, TCE, methylene chloride, benzene, chlorobenzene, chloroform, bromoform, cadmium, chromium, and lead. In light of the new RFI data, several of these constituents appear to be related to SWMU 311, but the impact is limited to surrounding soil. Additionally, no evidence of an impact to groundwater was observed during the RFI.

In summary, earlier indications of potentially significant subsurface soil contamination at SWMU 311 were not manifest in the RFI findings:

- While lead was detected in all 28 RFI samples, the highest detection was 51.2J mg/kg. All concentrations were below PRGs and STGCs. The maximum observed detection of lead during the RFI was in a sample from boring SWMU311-SB05, which was located near the oil/water separator. The highest lead detection in any phase of investigation was in a sample from boring SWMU311-IS04 at 1,100 mg/kg (Phase I CSI). These "highest" detections appear in a pattern in shallow subsurface soils around SWMU 311, which suggests site-related contamination. However, the distribution of STGC/PRG exceedences is very localized and not indicative of large-scale contamination.

- The Phase I CSI detections of cadmium and chromium in one sample (SWMU311-IS02-00) exceeded background criteria as well as the STGC. Cadmium and chromium were detected in the RFI above background criteria, but below STGCs and PRGs. This evidence suggests that STGC exceedences are very localized and not indicative of larger scale contamination.

- During the Phase II CSI, PCE was detected in subsurface soils just above the water (15 to 17 feet bgs) in boring SWMU311-TW03 at 400 μg/kg. During the RFI, borings SWMU311-SB25 and SWMU311-SB26 were located within 10-feet of SWMU311-TW03 to confirm or refute the presence of PCE at these levels. PCE was not detected in these samples. Thus, the Phase II CSI detection of PCE was not confirmed. There were two extenuating circumstances, however; 1) The detection limit for these samples was 200 μg/kg and were not re-run at lower levels, and 2) the groundwater table was more shallow during the RFI, so the samples were collected at a different depth.

Despite these circumstances, it can be concluded that detections of PCE above the STGC/PRG are isolated to the vicinity of boring SWMU311-TW03 and not indicative of larger scale contamination. The fact that neither PCE nor daughter products were detected in shallow groundwater samples (the detection of 1,2-cis-dichloroethene at 2 μg/L at SWMU311-GW05 notwithstanding) supports this conclusion.

- Chlorobenzene and benzene were detected above the STGC in one soil sample each in the Phase I CSI and Phase II CSI, respectively. These compounds were not detected in the RFI. The lack of any additional detections indicates that the presence of chlorobenzene and benzene is limited in extent.

- The presence of methylene chloride, chloroform, and bromoform in environmental samples in all investigation phases are likely linked to non-site related sources, due the detection of methylene chloride in blank samples and occurrence of chloroform and bromoform in potable water sources in the past.

- The presence of arsenic and silver in soil was not determined to be significant in the Phase I and II CSIs. The lines of evidence suggest that neither arsenic nor silver is related to SWMU 311.

No constituents detected in groundwater during the Phase II CSI and the RFI were detected above PRGs or STGCs. Thus, groundwater does not appear to be negatively impacted by SWMU 311 activity and warrants no further evaluation. It is important to note that the human health and ecological risk assessments independently evaluate all analytical data apart from this nature and extent discussion. Therefore, the following conclusions are the result of the human health and ecological risk assessments:

- The presence of lead in surface soil in the immediate vicinity of the oil/water separator exceeds the soil to groundwater concentration (STGC) criterion and contributes a possible adverse health effects from exposure in surface soil for a future child resident.

- Detections of cadmium and chromium in one surface soil sample (SWMU311-IS02-00) in the vicinity of the oil/water separator exceeded the STGC criterion. Additionally, cadmium and chromium did not pose an unacceptable human health or ecological risk.

- Arsenic and silver exceed STGC criteria in subsurface soil, with some evidence suggesting that they are not related to SWMU 311. Additionally, these constituents did not present a human health or ecological risk.

- The detections of PCE and TCE exceeded the STGC in one subsurface soil sample, but did not provide a human health or ecological risk.

- Chlorobenzene and benzene were detected above the STGC criterion in one soil sample each, but did not present a human health or ecological risk.

- Methylene chloride, chloroform, and bromoform detections were limited, with some evidence suggesting that they are not related to SWMU 311. Additionally, these constituents did not present a human health or ecological risk.

Based on the preceding conclusions, it is recommended that an Interim Measures removal action be conducted for surface soil in the immediate vicinity of the oil/water separator to mitigate the human health risk associated with the presence of lead.

1.0 INTRODUCTION

This document presents the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report for Solid Waste Management Unit (SWMU) 311 at Marine Corps Base (MCB) Camp Lejeune, North Carolina (the Base) (Figure 1-1). This document has been prepared by Baker Environmental, Inc. (Baker) under Contract Task Order (CTO) 0143 of the Department of the Navy's (DoN's) Comprehensive Long-Term Environmental Action Navy (CLEAN) Program. Baker is subcontracted to CH2M Hill for implementation of this project.

The Base was issued a RCRA Part B Permit to operate a hazardous waste container storage facility in September 1984. This permit was issued before the enactment of the Hazardous and Solid Waste Amendments of 1984 (HSWA), which under Section 3004(u) empowers the United States Environmental Protection Agency (USEPA) to order corrective action at treatment, storage, and disposal (TSD) facilities. This section of the HSWA requires corrective action to be taken for all releases of hazardous waste or hazardous constituents from any SWMU. As a result, a revised Hazardous Waste Management Permit was issued on January 10, 1997 and included corrective actions for SWMUs.

The USEPA Region IV and the North Carolina Department of Environment and Natural Resources (NC DENR) conducted an initial RCRA Facility Assessment (RFA) at the Base in January 1989. The RFA included 76 SWMUs. Seven of the SWMUs required confirmatory sampling; 23 of the SWMUs required an RFI; 46 of the SWMUs required no further action. The initial RFA was later expanded to include units such as landfills, surface impoundments, waste piles, tanks, container storage areas, septic tanks, drain fields, waste treatment units, and storm water conveyances. More than 3,500 SWMUs were identified during a preliminary review of Base records. Visual site inspections were conducted on nearly 500 of these SWMUs. The findings from the RFA are presented in the RCRA Facility Assessment Report for Marine Corps Base, Camp Lejeune, North Carolina (EnSafe, 1996).

The 1996 RFA Report identified 41 Installation Restoration (IR) sites, 112 underground storage tank (UST) sites, and 56 SWMUs that required confirmatory sampling or corrective measures. Based on further negotiations between NC DENR and the Base, 62 SWMUs required confirmatory sampling. The Confirmatory Sampling Investigation (CSI) was completed in two phases. Phase I was conducted by Baker in 1997 and included a soil investigation in the vicinity of these 62 SWMUs. Phase II was conducted by Baker in 2002 and included additional soil

sampling and a groundwater investigation at 41 of the SWMUs that warranted additional investigation at the conclusion of Phase I. In addition, six new SWMUs were included in the Phase II CSI thus increasing the number of SWMUs to 47. Of the 47 SWMUs, it was recommended that 29 SWMUs required no further action, five required additional confirmatory sampling, three required Interim Measures, two required additional confirmatory sampling/Interim Measures, and eight required RFIs. The findings from the Phase I and II CSIs are presented in the reports titled Phase I Confirmatory Sampling Report (Baker, 2001) and Draft Phase II Confirmatory Sampling Report (Baker, 2002).

1.1 Purpose/Objectives

The primary goal of this RFI is to determine the potential for future corrective action at SWMU 311 (if any) based on risk to human health and the environment. Specifically, the objectives of this RFI are as follows:

- Collect information to supplement and/or verify the environmental setting at the SWMU, including hydrogeology, geology, hydrology, topography, aquifer characteristics, and any other anthropogenic influences that may affect the hydrology or contaminant pathways at the site.

- Characterize the sources via the collection of analytical data, and evaluate the migration and dispersal characteristics of the waste.

- Characterize the hazardous constituents (if any) via the collection of groundwater and soil samples in the vicinity of the SWMU. Characterization includes a definition of the extent, origin, direction and rate of movement of any contamination.

- Evaluate potential receptors by collecting data describing human populations and environmental systems susceptible to contaminant exposure.

- Evaluate the risk of any contaminants associated with the SWMU to human health and the environment.

- Provide recommendations for site management.

1.2 Site Descriptions and History

SWMU 311 is located in the Hadnot Point Industrial Area (HPIA) just north of Michael Road between Gum and Fir Streets (Figure 1-1). SWMU 311 consists of an oil/water separator that is associated with a vehicle wash rack (Figure 1-2). The vehicle wash rack is situated between Buildings 1604 and 1605 in a fenced-in and paved area. The oil/water separator is situated in a grassy area adjacent to the paved area and outside of the fence line. The separator was installed in 1984 and is currently used. The structure is a concrete, in-ground unit that discharges to a wastewater treatment plant via sanitary sewer. A drainage swale runs parallel to Michael Road and flows into a culvert that leads to Cogdels Creek. The interception of the drainage swale and culvert is approximately 2,250 feet northwest of Cogdels Creek. The drain from the wash rack to the oil/water separator showed evidence of overflow (i.e., eroded soils) during the October 1996 site visit conducted by Baker.

The term "study area" is used in this report. The study area generally includes the area bounded by Michael and Hammond Roads and Gum and Fir Streets, which includes SWMU 311 itself.

1.3 Previous Investigations

A Phase I CSI was conducted in September 1997. The purpose of the investigation was to determine if operation of the oil/water separator and wash rack has impacted surface and subsurface soils in the vicinity of the SWMU. Surface and subsurface soil samples were collected at three soil borings advanced around the perimeter of the SWMU. The samples were submitted to the laboratory and analyzed for select volatile organic compounds (VOCs), Target Compound List (TCL) semi-volatile organic compounds SVOCs, and RCRA metals. Based on evaluation of the results, one VOC (chlorobenzene) and metals exceeded the regulatory driven criteria and established background/secondary criteria (for metals only). Therefore, additional investigation at SWMU 311 was recommended in the form of a Phase II CSI.

The Phase II CSI was conducted in March/April 2002. The purpose of the investigation was to further evaluate potential impacts to soil at the SWMU and determine if groundwater has been impacted as a result of a release(s) from the SWMU. The field investigation included: 1) surface and subsurface soil sampling at three soil borings and three temporary well borings, 2) installation of three temporary wells, and 3) groundwater sampling at the three temporary wells. Analytes included TCL VOCs and RCRA metals. It should be noted that perched water was

encountered in the borings/wells at approximately 7 to 8 feet below the ground surface (bgs). The actual water table was encountered at approximately 14 to 15 feet bgs.

The soil and groundwater samples were submitted to the laboratory and analyzed for VOCs and RCRA metals. Based on evaluation of the results, VOCs and metals were detected in soil at concentrations exceeding the regulatory driven criteria and established background/secondary criteria (for metals only). The highest concentrations were detected at the 15 to 17-foot bgs interval, which was immediately above the vadose/groundwater interface. Low concentrations of VOCs and metals were detected in groundwater. However, none of the compounds detected in groundwater exceeded the regulatory driven criteria.

Since VOCs and metals exceeded the established screening criteria in soil samples collected during the Phase I and II CSI, an RFI was recommended at SWMU 311. The specific constituents identified as constituents of potential concern (COPCs) in the Phase II CSI Report were the primary focus of the RFI. These constituents include benzene, bromoform, chlorobenzene, chloroform, methylene chloride, tetrachloroethene (PCE), trichloroethene (TCE), cadmium, chromium, and lead.

It is important to note that over the lifetime of the investigation of SWMU 311, the number of sampling constituents decreased. The Phase I CSI included select VOCs and TCL SVOCs, and RCRA metals. During the Phase I CSI, no SVOCs were detected. Therefore, as specified in the Phase II CSI Project Plans and consistent with North Carolina RCRA Section protocol, SVOCs were eliminated from further consideration during the Phase II CSI at SWMU 311. No additional constituents were removed for the RFI however.

FIGURES

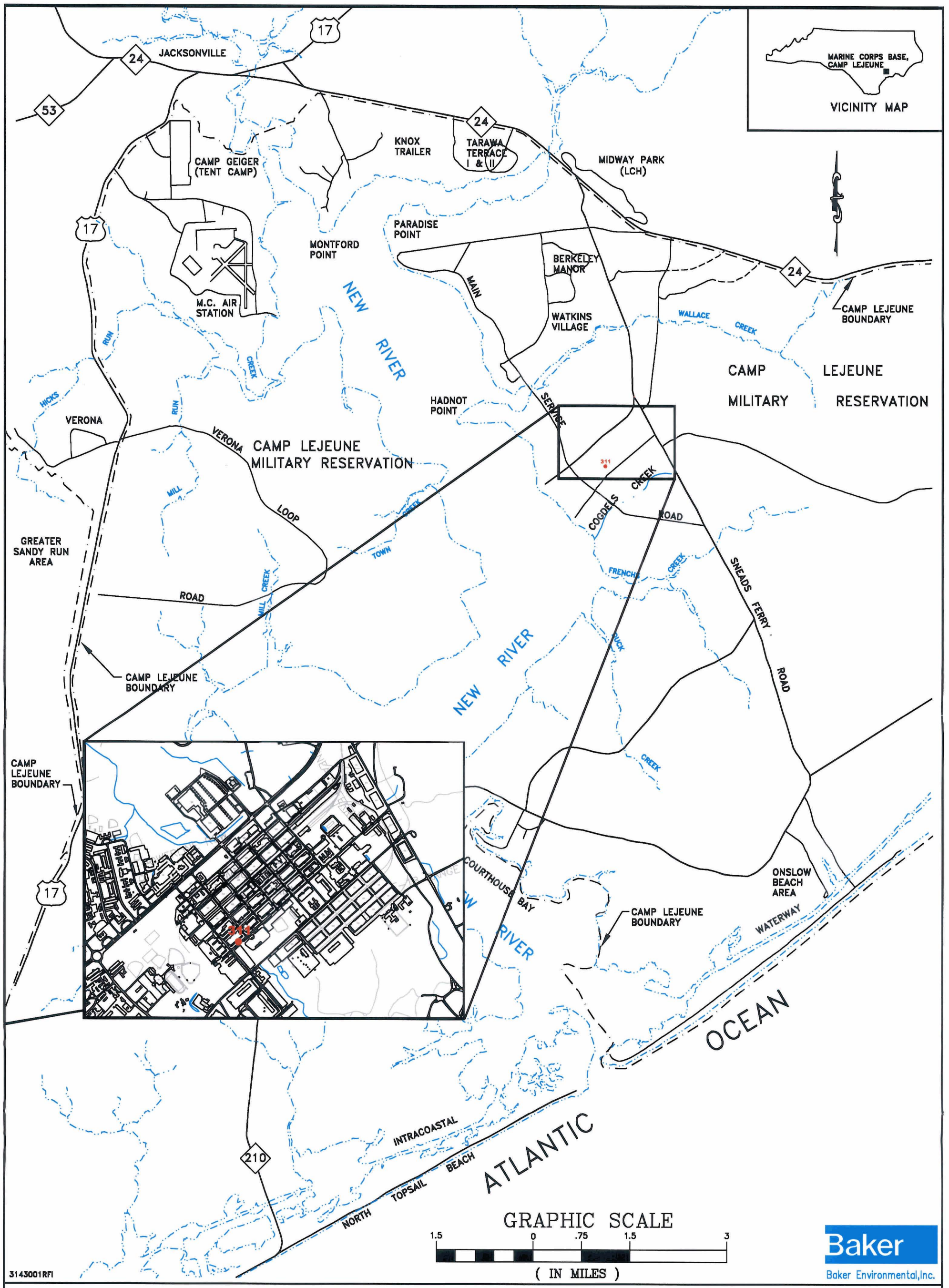

FIGURE 1-1
SWMU LOCATION AT MCB CAMP LEJEUNE
RCRA FACILITY INVESTIGATION
SWMU 311, CTO - 0143

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

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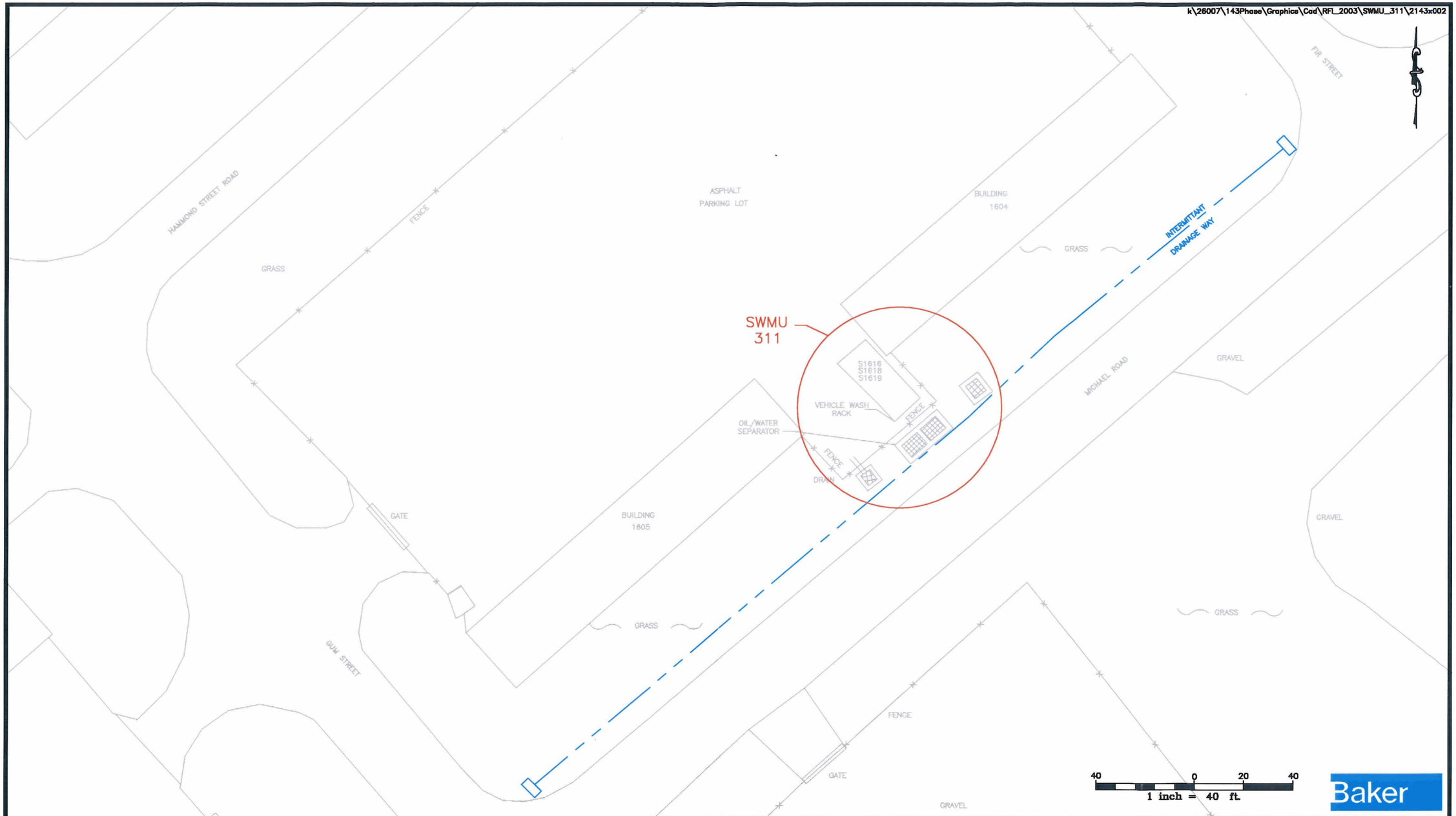


LEGEND

- FENCE
- DRAINAGE DITCH

SOURCE: MCB CAMP LEJEUNE MARCH 2000

FIGURE 1-2
CURRENT CONDITIONS
RCRA FACILITY INVESTIGATION
SWMU 311, CTO - 0143
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

2.0 FIELD INVESTIGATION

This section describes the investigation procedures and analytical program conducted as part of the RFI field program for SUMU 311. The field program was conducted in conjunction with two other SWMUs (SWMU 43 and SWMU 360) and initiated in June 2003. The objectives outlined in Section 1.1 were met through a field program that consisted of soil borings, collection of surface and subsurface soil samples, groundwater sample collection via Geoprobe® Screen Point Sampler, and installation of temporary piezometers. The field program was dynamic in nature, therefore, the direction and termination of the investigation were governed by decisions based on quick-turn mobile laboratory analysis of VOCs. Samples were also submitted to a fixed-base laboratory for analysis of the constituents of concern, including VOCs and metals. Other physical parameters of soils were analyzed, including grain size distribution and vertical permeability to support characterization of fate and transport properties. The sections that follow describe the methods used to collect and analyze the samples.

2.1 Soil Investigation

Surface and subsurface soil samples were collected around SWMU 311 to determine if soil in the vicinity of SWMU 311 has been impacted during SWMU-related operations. Samples were collected from borings advanced by a direct-push soil sampler (i.e., Geoprobe®) attached to a drill rig operated by Parrott Wolff, Inc. of Hillsboro, North Carolina. Prior to sampling, utility clearance was completed at all locations by Locating Contractors, Inc. of Jacksonville, North Carolina. No utilities were disrupted during this investigation.

An approximately 50-foot by 50-foot sampling grid was established across the site as proposed in the Site Specific Work Plans (Baker, 2003). Borings located closest to the oil/water separator were initially advanced, namely SWMU311-SB04 through SWMU311-SB06, SWMU311-SB10, SWMU311-SB11, SWMU311-SB15, and SWMU311-SB16 (Figure 2-1). As discussed in Section 4.0, the data from samples collected from these boring did not indicate the presence of any soil or groundwater contamination above screening criteria. Nonetheless, six additional soil borings (SWMU311-SB07, SWMU311-SB18 through SWMU311-SB20, SWMU311-SB25, and SWMU311-SB26) were subsequently installed to verify/complement the findings of the initial set of borings. Test Boring Records were prepared for each soil boring. Appendix A contains these records.

2.1.1 Surface and Subsurface Soils

Surface soil samples were proposed at all soil boring locations; however, some borings were located in paved areas where surface soils were not present. Consequently, surface soil samples were not collected at these locations. Where present, surface soil samples were obtained using a new stainless steel spoon prior to advancement of the soil boring. Grass and/or approximately 2-inches of surface material were removed and discarded. A small hole was dug to approximately 1-foot bgs using the same spoon. Samples were collected for off-site analysis of VOC and RCRA metal, using the following procedures:

First, three Encore Samplers were pushed directly into the sidewall of the hole.

Next, soil was shaved off the sidewall and homogenized in-situ.

Finally, the homogenized soil sample was then placed in one 4-ounce, laboratory-supplied sample container.

All samples for chemical analysis were stored on ice in a cooler at a minimum temperature of 4° Celsius (C) until shipped to the laboratory. Table 2-1 presents a summary of surface soil samples collected.

The subsurface soil samples were collected at each boring using a direct push sampler. Samples were collected continuously from the ground surface to the regional groundwater table. It should be noted that evidence of very localized perched water-bearing zones was observed in previous investigations. Since evidence of soil contamination below these perched zones was apparent in previous investigations, one objective of the field program was to characterize subsurface soils to the regional groundwater table. One sample was collected from each 4-foot Geoprobe® sleeve for on-site or off-site analysis (see Section 2.1.2). A 4-foot long Geoprobe® Macro Core sampler was driven by a hydraulic drive assembly. Once the desired depth was obtained, the sampler was pulled from the hole. The sampler was dissembled and handed to the geologist for logging and photo ionization detector (PID) measurements. The sampler was decontaminated following procedures outlined in Section 2.5 and reassembled prior to use. Soils were logged and sampled in accordance with the Work Plans, with additional details provided in the paragraphs that follow.

A small ¼-inch diameter hole was drilled ½-foot below the top of sample and a PID reading was taken and recorded. This was repeated at 1-foot intervals over the length of the sample. Upon completion, the sleeve was cut open length-wise to reveal the sample. Samples for on-site and/or off-site analysis were collected next based on the location of the highest PID reading or in areas of observable contamination. Finally, samples were logged noting relative grain size, color, moisture, evidence of contamination, and any other relevant property (e.g., plasticity or relative density). Discarded soil was placed in 5-gallon buckets and later transferred to 55-gallon drum(s) or roll-off box.

Soils collected for on-site and off-site analysis of VOCs were sampled differently. For on-site analysis, an open-ended virgin plastic syringe was pushed in the selected area to obtain 7mL of soil. The sample was then extruded into one 20-mL glass vial filled with 3-mL of distilled/de-ionized water. The vial was capped with a Teflon® lined lid, which was crimped in place. The vial was stored on ice until picked up by the mobile laboratory chemist or dropped off at the mobile laboratory (typically within 4- hours of collection). For off-site analysis, samples were collected in 3 5-mL Encore Samplers following SW846 Method 5035. Samples were also collected for off-site analysis of RCRA metals. Soil for this analysis was taken from the same general location that VOC samples were collected. Samples were collected using a stainless steel spoon or spatula and placed into one 4-ounce, laboratory-supplied sample container. Samples for off-site analysis were stored on ice in a cooler at a minimum temperature of 4°C until shipped to the laboratory. To minimize the potential for cross-contamination, new stainless steel spoons and/or spatulas were used to handle each soil sample as it was removed from the acetate liner and placed into the sample container(s). Table 2-1 presents a summary of subsurface soil samples collected.

Subsequent to sampling, borings not converted to temporary piezometers were backfilled with sodium bentonite. After hydration, the surface was plugged with asphalt or material similar to the existing surface.

2.1.2 Analytical Program for Soils

One sample per Geoprobe® sleeve was collected for mobile laboratory analysis of VOCs and fixed-based laboratory analysis of RCRA metals (approximately three subsurface soil samples per boring). Additionally, one sample for laboratory VOC analysis was split for analysis by the

fixed-based laboratory. The samples were selected based on field observations (e.g., elevated PID readings, discoloration, odors, etc.). Mobile laboratory analysis including benzene, PCE, TCE, cis-1,2-dichloroethene (cis-DCE), trans-1,2-dichloroethene (trans-DCE), methylene chloride, and 1,1-dichloroethene (1,1-DCE) using a gas chromatograph head space method.

All soil samples retained for analysis were prepared and handled according to USEPA Region IV Standard Operating Procedures (SOPs) as outlined in the Master Project Plans (Baker, 2003a). Chain-of-Custody documentation, which included information such as sample numbers, date, time of sampling, and sampling party accompanied the samples to the laboratory and is provided in Appendix B. Samples were shipped via overnight delivery to Chemtech laboratory in Mountainside, New Jersey for analysis.

2.2 Groundwater Investigation

The groundwater investigation at SWMU 311 consisted of installation of 6 piezometers and collection of static water level (SWL) measurements, and groundwater grab sampling using Geoprobe® tools. The sections that follow describe the methods used to collect and analyze the samples.

2.2.1 Piezometer Installation and Groundwater Level Measurements

Six piezometers were installed at SWMU 311 on July 7, 2003 to determine groundwater flow direction in the surficial aquifer (Figure 2-1). These piezometers were installed adjacent to soil borings SWMU311-SB05, SWMU311-SB07, SWMU311-SB08, SWMU311-SB15, SWMU311-SB18, and SWMU311-SB20. All piezometers were installed to a depth of 20-feet bgs, which was determined to be below the perched groundwater zone. Each piezometer consisted of 5 feet of 1-inch outside diameter (OD), Schedule 40 Polyvinyl Chloride (PVC) screen (0.01-inch manufactured slots) and 15 feet of 1-inch OD Schedule 40 PVC casing. Each piezometer was installed by driving 2-inch OD steel casing with disposable steel drive tip to the desired depth. The piezometer screen and casing were assembled and installed in the open drive casing. As the drive casing was retracted from the ground, the formation was allowed to collapse around the screen annulus (or filter sand was placed around the screen annulus as required). Bentonite pellets were placed in the casing annulus to ground surface. Each piezometer was surveyed according to Section 2.3. SWL measurements were collected on July 9, 2003. Table 2-2 presents piezometer construction details, and SWL measurement and corresponding elevations. Appendix A also presents a graphic representation of the piezometer installation.

2.2.2 Groundwater Sampling

Groundwater grab samples were collected from each Geoprobe® boring used in subsurface soil sampling (Figure 2-1). The groundwater grab samples were collected using a Geoprobe® SP15 discrete sampler. The sampler consists of a 1-1/2-inch OD stainless steel outer casing with a sliding 1-inch OD, 4-foot long inner screen (stainless steel with 0.01-inch slots). A drive point is attached to the outer casing and driven to the desired depth using a Geoprobe® hammer. As the casing is retracted the drive point and screen stay in place, exposing the screen to the aquifer. At SWMU 311, the Geoprobe® SP15 discrete sampler was pushed to approximately 4 to 6 feet below the water table. Groundwater samples were retrieved using a peristaltic pump and new silicone and polyethylene (PE) tubing for each sample. Groundwater was purged from the sampler for approximately five to ten minutes to reduce the sediment content of the groundwater sample.

Groundwater samples were collected for on-site and/or off-site analysis of VOCs. For on-site headspace analysis, 10-mL of groundwater was collected in one 20-mL vial. The vial was capped with a Teflon® lined lid, which was crimped in place. The vial was stored on ice until picked by the mobile laboratory chemist or dropped off at the mobile laboratory (typically within 4- hours of collection). For off-site analysis, samples were collected in three 40-mL vials. Samples for off-site analysis were stored on ice in a cooler at a minimum temperature of 4°C until shipped to the laboratory. Table 2-1 presents a summary of groundwater samples collected.

2.2.3 Analytical Program for Groundwater Samples

One groundwater sample per boring was collected for mobile laboratory analysis of VOCs, including benzene, PCE, TCE, cis-DCE, trans-DCE, methylene chloride, and 1,1-DCE using a gas chromatograph head space method. Select samples (Table 2-1) were split for off-site laboratory analysis via SW846 Method 8260B for VOCs.

All groundwater samples retained for analysis were prepared and handled according to USEPA Region IV SOPs as outlined in the Master Project Plans (Baker, 2003a). Chain-of-Custody documentation, which included information such as sample numbers, date, time of sampling, and sampling party accompanied the samples to the laboratory and is provided in Appendix B.

Samples were shipped via overnight delivery to Chemtech laboratory in Mountainside, New Jersey for analysis.

2.3 Survey

The soil boring locations were surveyed using mapping-grade global positioning system (GPS) equipment (Trimble Pro XRS with a TSCE Data Collector) operated by trained Baker personnel. The horizontal position of each soil boring was determined within the North Carolina State Plane Coordinate System. The horizontal accuracy was within approximately three feet. Ground surface elevations of borings were not measured by the GPS due to low accuracy. Instead, elevations were estimated by the following:

1) Survey of adjacent piezometers, or;
2) Interpolated from ground surface contouring between known elevations (e.g., piezometers or CSI temporary wells).

The temporary piezometers were surveyed for topographic elevation relative to mean sea level (msl) and horizontal position within the North Carolina State Plane Coordinate System. This survey was performed by Lanier Surveying Company, PLLC, a North Carolina licensed surveyor. The vertical accuracy of the survey was within 0.01 feet and the horizontal accuracy was within 0.1 feet. It should be noted that the surveyor obtained an elevation from the top of PVC cap, rather than the top of PVC casing (reference point). Baker personnel had to determine the difference between the top of PVC cap and PVC casing to determine a reference point elevation.

2.4 Quality Assurance/Quality Control Samples

Specific Quality Assurance/Quality Control (QA/QC) requirements are presented in the Master QAPP, which is contained in the Master Project Plans (Baker 2003a). The Master QAPP describes the different levels of sample analysis and the associated QC procedures required with each. Adherence to established USEPA chain-of-custody (COC) procedures during the collection, transport, and analyses of the samples was maintained throughout the project. Laboratory analyses of the samples conformed to accepted QA requirements.

The following QA/QC samples were collected/prepared during the field activities to ensure precision, accuracy, representativeness, completeness, and comparability:

- Equipment rinsate blanks
- Field blanks
- Trip blanks
- Field duplicates
- Matrix Spike/Matrix Spike Duplicates (MS/MSDs)

Table 2-1 provides a summary of QA/QC samples collected, as well as sources of equipment rinsate and field blanks.

2.5 Decontamination Procedures

Specific decontamination procedures for this investigation followed methods presented in the Master Work Plans, which is contained in the Master Project Plans (Baker 2003a). These procedures were for reusable equipment. Sampling equipment for the RFI at SWMU 311 was generally disposable and not reused and included stainless steel spoons, Geoprobe® Macro Core acetate liners, PE tubing, and silicone tubing. Reusable equipment included the Geoprobe® Macro Core drive shoe and casing and the SP15 Groundwater Sampler. Between samples, this equipment was decontaminated by Alquinox® and potable water wash and potable water rinse. Between borings, this equipment was decontaminated by high-pressure steam cleaning.

2.6 Investigation Derived Waste

Investigation derived waste (IDW) included those materials used in the normal course of field activities, including health and safety disposables and disposable sampling equipment. IDW also included materials generated from drilling and sampling activities (i.e., excess soil samples, purge water, and decontamination fluids).

Health and safety disposables generally included sampling gloves, paper towels, and plastic sheeting. Contact with contaminated soil and water was negligible. Health and safety disposables were placed in plastic bags and disposed in Baker's regular trash dumpster located by at Lot 203.

Soil cuttings were not generated during direct push drilling activities. Excess soil samples were minimal and temporarily containerized in one United States Department of Transportation DOT-approved, 55-drum. The drum was clearly marked to indicate contents, the borehole from which the cuttings were removed, the date, CTO number, and the site. Because the mobile laboratory analytical data indicated only trace levels of VOCs, this soil was combined with the soil IDW from the SWMU 360 RFI.

Liquid IDW generated during decontamination and Geoprobe® SP15 Groundwater Sampler purging was minimal and combined with the liquid IDW from the SWMU 360 RFI.

It should be noted that the Base Environmental Quality Branch (EQB) has developed an SOP for IDW management. Baker is responsible for collection, labeling and storing IDW, as well as communications with the EQB and the Remedial Action Contractor (RAC) (Shaw Environmental & Infrastructure, Inc). Shaw is responsible for IDW sampling and disposal.

2.7 Data Management and Tracking

Data management activities consisted of data tracking, database entry, and data manipulation. Data tracking followed samples from collection (based on COC forms) through entry of the sample analytical data into the database. The data manager checked that the off-site laboratory received and processed all samples within the required holding times. The data manager also checked that the resultant analytical data (in electronic and hard copy formats) were sent to and received by the independent data validator. Finally, the data manager received the analytical data from the independent data validator and checked the data set for completeness and correctness. Data entry consisted of importing the data into the database. Once in the database, the data were manipulated for presentation herein. This activity included creating tables showing positive detections, comparison to screening criteria, data statistics, and tabulation of all data into appendix tables.

An independent data validator was contracted for data validation. The laboratory analytical results were evaluated to assess the technical adequacy and usability of the data based on specifications set forth in the Naval Energy and Environmental Support Activity (NEESA) and USEPA guidance documents.

TABLES

TABLE 2-1

SWMU 311
SUMMARY OF SAMPLES COLLECTED DURING THE RFI
RCRA FACILITY INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	Date Sampled	Sample Interval (Feet)	Media		Analysis					Comments
			Soil	Groundwater	Mobile Laboratory VOCs	TCL VOCs (OLMO 4.2)	TCL SVOCs (OLMO 4.2)	TCL Pesticides (OLMO 4.2)	RCRA Metals (ILMO 4.1)	
Environmental										
SWMU311-SB04-00	6/19/03	0 - 1	X		X					
SWMU311-SB04-01	6/19/03	1 - 3	X		X	X			X	
SWMU311-SB04-02	6/19/03	3 - 5	X		X					
SWMU311-SB04-04	6/19/03	7 - 9	X						X	
SWMU311-SB04-06	6/19/03	11 - 13	X		X				X	
SWMU311-SB04-08	6/19/03	15 - 17	X		X					
SWMU311-SB05-02	6/18/03	3 - 5	X		X				X	
SWMU311-SB05-04	6/18/03	7 - 9	X		X	X			X	
SWMU311-SB06-00	6/19/03	0 - 1	X		X					
SWMU311-SB06-01	6/19/03	1 - 3	X		X	X			X	
SWMU311-SB06-04	6/19/03	7 - 9	X		X				X	
SWMU311-SB06-06	6/19/03	11 - 13	X		X					
SWMU311-SB07-00	6/24/03	0 - 1	X		X					
SWMU311-SB07-01	6/24/03	1 - 3	X		X				X	
SWMU311-SB07-03	6/24/03	5 - 7	X		X					
SWMU311-SB07-04	6/24/03	7 - 9	X						X	
SWMU311-SB07-06	6/24/03	11 - 13	X		X					
SWMU311-SB07-08	6/24/03	15 - 17	X		X	X			X	
SWMU311-SB10-02	6/18/03	3 - 5	X		X	X			X	
SWMU311-SB10-04	6/18/03	7 - 9	X		X				X	
SWMU311-SB10-06	6/18/03	11 - 13	X		X					
SWMU311-SB10-08	6/18/03	15 - 17	X						X	
SWMU311-SB11-02	6/18/03	3 - 5	X		X				X	
SWMU311-SB11-03	6/18/03	5 - 7	X		X	X			X	
SWMU311-SB11-06	6/18/03	11 - 13	X		X				X	
SWMU311-SB11-08	6/18/03	15 - 17	X		X					
SWMU311-SB15-00	6/19/03	0 - 1	X		X					
SWMU311-SB15-01	6/19/03	1 - 3	X		X				X	
SWMU311-SB15-02	6/19/03	3 - 5	X		X				X	
SWMU311-SB15-05	6/19/03	9 - 11	X		X					
SWMU311-SB15-08	6/19/03	15 - 17	X			X			X	
SWMU311-SB16-00	6/19/03	0 - 1	X		X					
SWMU311-SB16-01	6/19/03	1 - 3	X		X				X	
SWMU311-SB16-03	6/19/03	5 - 7	X		X					
SWMU311-SB16-05	6/19/03	9 - 11	X		X				X	
SWMU311-SB16-08	6/19/03	15 - 17	X			X			X	
SWMU311-SB16-08D	6/19/03	15 - 17	X			X			X	
SWMU311-SB18-02	6/23/03	3 - 5	X		X	X			X	
SWMU311-SB18-02MS/MSD	6/23/03	3 - 5	X			X			X	
SWMU311-SB18-04	6/23/03	7 - 9	X		X				X	
SWMU311-SB18-06	6/23/03	11 - 13	X		X				X	
SWMU311-SB20-00	6/23/03	0 - 1	X		X					
SWMU311-SB20-01	6/23/03	1 - 3	X		X				X	
SWMU311-SB20-03	6/23/03	5 - 7	X		X	X			X	
SWMU311-SB20-03D	6/23/03	5 - 7	X			X			X	
SWMU311-SB20-06	6/23/03	11 - 13	X		X				X	

TABLE 2-1

SWMU 311
SUMMARY OF SAMPLES COLLECTED DURING THE RFI
RCRA FACILITY INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	Date Sampled	Sample Interval (Feet)	Media		Analysis					Comments
			Soil	Groundwater	Mobile Laboratory VOCs	TCL VOCs (OLMO 4.2)	TCL SVOCs (OLMO 4.2)	TCL Pesticides (OLMO 4.2)	RCRA Metals (ILMO 4.1)	
Environmental										
SWMU311-GW04	6/19/03	16 - 20		X	X					
SWMU311-GW05	6/18/03	18 - 22		X	X					
SWMU311-GW06	6/19/03	20 - 24		X	X					
SWMU311-GW07	6/23/03	20 - 24		X	X					
SWMU311-GW10	6/18/03	18 - 22		X	X					
SWMU311-GW11	6/18/03	19 - 23		X	X					
SWMU311-GW15	6/19/03	21 - 25		X	X					
SWMU311-GW16	6/19/03	21 - 25		X	X					
SWMU311-GW18	6/23/03	16 - 20		X	X					
SWMU311-GW20	6/23/03	20 - 24		X	X					
QA/QC Samples										
ER02	06/18/03	--	--	--		X	X	X	X	spoon
ER03	06/19/03	--	--	--		X	X	X	X	geoprobe sleeve and shoe
ER07	06/23/03	--	--	--		X	X	X	X	geoprobe sleeve and shoe
ER08	06/24/03	--	--	--		X	X	X	X	split spoon
FB01	6/25/2003	--	--	--		X	X	X	X	Drill rig decon water
FB02	6/26/2003	--	--	--		X	X	X	X	Lab grade water
FB03	6/26/2003	--	--	--		X	X	X	X	Distilled bottled water - Wal-Mart
TB01	06/18/03	--	--	--		X				
TB02	06/19/03	--	--	--		X				
TB04	06/23/03	--	--	--		X				

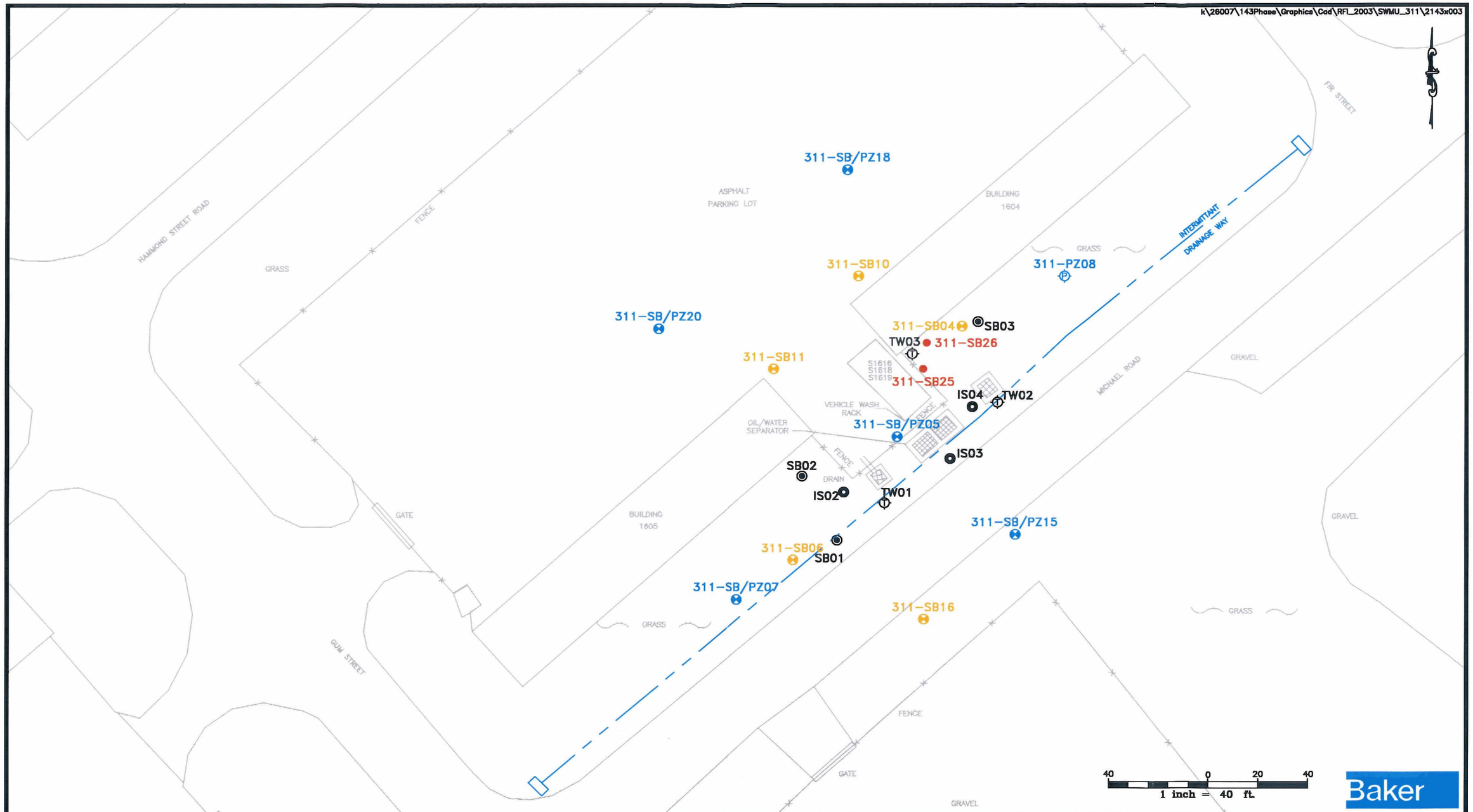
TABLE 2-2

SWMU 311
TEMPORARY PIEZOMETER CONSTRUCTION DETAILS
RCRA FACILITY INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Well Identification	Date Installed	Reference Elevation[1] (feet above msl)	Well Depth (feet bgs)	Screen Interval (feet bgs)	Depth to Sand/Slough (feet bgs)	Depth to Bentonite (feet bgs)	Static Water Level (feet below Ref[1])	Static Water Elevation (feet above msl)
311-PZ05	7/7/03	29.15	20.0	15.0 - 20.0	14.0	0.0	12.48	16.67
311-PZ07	7/7/03	26.29	20.0	15.0 - 20.0	4.0	0.0	12.21	14.08
311-PZ08	7/7/03	27.27	20.0	15.0 - 20.0	2.0	0.0	9.78	17.49
311-PZ15	7/7/03	26.69	20.0	15.0 - 20.0	5.0	0.0	9.63	17.06
311-PZ18	7/7/03	27.08	20.0	15.0 - 20.0	14.0	0.0	10.46	16.62
311-PZ20	7/7/03	27.30	20.0	15.0 - 20.0	10.0	0.0	11.93	15.37

Notes:
msl - mean sea level
bgs - below ground surface
[1] Reference Elevation - Top of PVC casing

FIGURES



LEGEND

- PHASE II CSI TEMPORARY WELL
- PHASE II CSI SOIL BORING
- PHASE II CSI SURFACE SOIL SAMPLE
- PHASE I CSI SOIL BORING
- RFI SOIL BORING LOCATION
- RFI SOIL BORING AND GROUNDWATER GRAB LOCATION
- RFI SOIL BORING, GROUNDWATER GRAB AND PIEZOMETER LOCATION
- RFI PIEZOMETER LOCATION

SOURCE: MCB CAMP LEJEUNE MARCH 2000

FIGURE 2-1
BORING AND GROUNDWATER GRAB LOCATION MAP
RCRA FACILITY INVESTIGATION
SWMU 311, CTO - 0143
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

3.0 PHYSICAL CHARACTERISTICS

This section summarizes the data collected during the field program related to topography and surface features, water supply, surface water hydrology, and geology and hydrogeology from a regional and site-specific perspective. A sufficient understanding of the nature and extent of contamination as well as fate and transport of those constituents requires an understanding of the physical environment context in which the contamination occurs. Even if contamination is not evident, a sufficient understanding of the physical environment is required to demonstrate that the samples collected were appropriately located and are representative of the entire site. The subsections that follow present information to support an interpretation of the physical environment.

3.1 Topography and Surface Features

The overall topography of SWMU 311 area is flat and is developed as storage and maintenance of military equipment. On a local scale, drainage ways on the shoulders of roads provide some topographic relief. The Building 1604/1605 compound to the north of SWMU 311 is a flat, paved parking and storage area, with an elevation of approximately 27-feet above mean sea level (msl). Building 1604/1605 and its compound occupy the entire block between Michael and Hammond Roads and Gum and Fir Streets. A curbed, concrete wash pad is situated between Buildings 1604 and 1605 at an elevation of approximately 29-feet above msl (Figure 1-2). A wooden wash rack is located on the northeast end of the wash pad. The oil/water separator is located immediately southeast of the wash pad, between the pad and a drainage way. The oil/water separator is manifest on the ground surface as three concrete structures with steel grating covering openings. These concrete structures are estimated to be approximately 30-feet above msl. The bottom of the drainage way located on the shoulder of Michael Road is unlined and estimated to be approximately 24-feet above msl. The sidewalls are relatively steep in the vicinity of the oil/water separator. The relief between the bottom of the ditch and surroundings is less pronounced toward the intersection of Fir Street and Michael Road. Michael Road is a two-lane asphalt road nearest to the oil/water separator; with hard pack gravel shoulder on either side. The elevation of Michael Road in the vicinity of the oil/water separator is estimated to be approximately 27-feet above msl. Another unlined drainage way is located on the southern side of Michael Road. The bottom of this drainage way is estimated to be approximately 25-feet above msl.

3.2 Water Supply

Potable water for the base is derived entirely by groundwater. The Base does not have established groundwater preservation areas. However, because the Base controls more than 236 square miles of land, and because much of this land has remained undeveloped, the undeveloped areas serve the function of groundwater preserves. Groundwater usage is roughly eight million gpd (Cardinell, et al., 1993). Groundwater is pumped from approximately 84 water supply wells located within the boundaries of the Base. According to Base personnel, groundwater is treated at five plants located at Hadnot Point, Holcomb Boulevard, Marine Corps Air Station (MCAS) New River, Courthouse Bay, and Onslow Beach having a maximum total capacity of 15.8 million gallons per day (gpd). However, the base population only requires 6.5 million gpd.

The water supply wells at the base withdraw water from the Castle Hayne aquifer. The Castle Hayne aquifer is a highly permeable, semi-confined aquifer that can yield several hundred to 1,000 gpm. The wells (8-inch diameter) at the Base average 162 feet in depth and yield 174 gpm (Harned, et al., 1989). The water is typically a hard, calcium bicarbonate type. Information concerning the supply wells was derived from the Wellhead Protection Plan – 2002 Update (AH, 2002), and interviews with Base personnel.

There are no active or inactive water supply wells within 1,500 feet of SWMU 311. Figure 3-1 shows SWMU 311 in relation to nearby water supply wells. The nearest water supply well (PSWHP-642) is located approximately 4,400-feet hydraulically upgradient of SWMU 311. Additionally, the Wellhead Protection Plan states that the 10-year maximum pumping capture zone of PSWHP-642 is approximately 1,400-feet. In other words, well PSWHP-642 will capture contaminants released within that radius on the surface or near surface within 10-years. This does not account for attenuation. Finally, groundwater contour maps from Long-Term Monitoring reports for Site 78 North (located relatively near the well) indicate that PSWHP-642 does not influence groundwater flow in the Hadnot Point industrial Area, where Site 78 and SWMU 311 are located. Thus, it is improbable that any release from SWMU 311 will impact well PSWHP-642.

3.3 Surface Water Hydrology

Surface water flow across the study area is controlled. Due to the built up nature of the study area, rainwater runoff is collected in roof gutters, storm water sewer inlets in parking areas, and in drainage ways along roads. Direct infiltration occurs in grassy and gravel areas surrounding the Building 1604/1605 compound. The wash pad associated with SWMU 311 is designed to capture water from vehicle wash downs, and to an extent, captures some rainwater. Water in the wash pad drains to the oil/water separator, which in turn drains to a wastewater treatment plant via sanitary sewer. As noted in Section 1.3, the drain from the wash rack to the oil/water separator showed evidence of overflow (i.e., eroded soils) during the October 1996 site visit. This overflow would lead to the drainage way that runs parallel to Michael Road. This drainage way is generally dry. During rain events, surface water runoff from Michael Road would flow into the drainage way. Water has not been observed in the drainage way, so it is suspected that what water does not infiltrate into the ground would flow to the northeast, into a culvert that leads to Cogdels Creek. The interception of the drainage way and culvert is approximately 2,250 feet northwest of Cogdels Creek.

3.4 Geologic and Hydrogeologic Framework

Site-specific geologic and hydrogeologic information was obtaining through logging of soil samples from 12 shallow soil borings advanced at SWMU 311. This site-specific geology and hydrogeology is placed in context of a regional framework in the sections that follow.

3.4.1 Regional Framework

The Base is located within the Tidewater region of the Atlantic Coastal Plain physiographic province. The sediments of the Atlantic Coastal Plain consist mostly of interbedded sands, silts, clays, calcareous clays, shell beds, sandstone, and limestone. These sediments are layered in interfingering beds and lenses that gently dip and thicken to the southeast to a combined thickness of approximately 1,500 feet. The sediments were deposited in marine or near-shore environments and range in age from early Cretaceous to Quaternary time. Regionally, the sediments comprise 10 aquifers and nine confining units, which overlie igneous and metamorphic basement rocks of the pre-Cretaceous age. Seven of these aquifers and their associated confining units are present at the Base (Cardinell, et al., 1993). Table 3-1 presents a generalized stratigraphic column for Jones

and Onslow Counties, North Carolina. A hydrogeologic section location plan and hydrogeologic cross-sections of the Base are presented in the Hydrogeologic Framework of U.S. Marine Corps Base at Camp Lejeune, North Carolina (Cardinell, et al, 1993).

United States Geological Survey (USGS) studies performed by Harned, et al., 1989 and Cardinell, et al., 1993 indicate that the base is underlain by sand and limestone aquifers separated by confining units of silt and clay. These aquifers include the surficial (water table), Castle Hayne, Beaufort, Peedee, Black Creek, and upper and lower Cape Fear. Less permeable clay and silt beds function as confining units or semi-confining units that separate the aquifers and impede the flow of groundwater between aquifers.

Historically, only the upper two aquifers have been impacted by Base activity, namely the surficial aquifer and the Castle Hayne aquifer. The surficial unit consists of interfingering beds of sand, clay, sandy clay, and silt that contain some peat and shells in the undifferentiated formation. According to information presented by the USGS, the undifferentiated formation/surficial aquifer is approximately 15 to 25 feet thick in the vicinity of the Hadnot Point industrial area. Although this aquifer is classified as GA (i.e., existing or a potential source of drinking water supply for humans), it is not used as a potable water source at the Base because of its low yielding production rates (typically less than three gallons per minute [gpm]). The Belgrade formation consists of clay, sandy clay, and silt beds and is part of the Castle Hayne Confining unit. Practically though, the Belgrade formation tends to be semi-confining in nature because it is laterally discontinuous. The thickness of this unit ranges from approximately 0 to 26 feet, typically averages 9 feet where present, with no discernible thickness trend. The Castle Hayne aquifer primarily resides within the River Bend Formation, which consists of sand, cemented shells, and limestone. The upper portion of the aquifer primarily consists of calcareous sands with some thin clay and silt beds. The sand becomes increasingly more limy with depth. The lower portion of the aquifer consists of partially unconsolidated limestone and sandy limestone interbedded with clay and sand. In addition, buried paleostream channels containing various deposits exist within the aquifer. According to information presented by the USGS, the Castle Hayne aquifer is approximately 350 feet thick in the vicinity of the Hadnot Point industrial area.

Recharge to the surficial aquifer is by rainfall. The aquifer receives more recharge in the winter than in the summer when much of the water evaporates or is transpired by plants before it can reach the water table. Most of the surficial groundwater is discharged to local streams, but some

water passes through the underlying semi-confining unit. Recharge is estimated to average 30 percent of an average rainfall of 52 inches per year. The remaining 70 percent of rainfall is lost as surface runoff or evapotranspiration. Water levels in wells tapping the surficial aquifer vary seasonally. The water table is generally highest in the winter and spring, and lowest in the summer and early fall. Recharge of the Castle Hayne aquifer at the Base is primarily received from the surficial aquifer. Natural discharge is to the New River and its major tributaries. Although the Castle Hayne aquifer provides approximately seven million gallons of water to the Base, groundwater pumping has not significantly affected natural head gradients in the aquifer.

Hydraulic conductivities of the surficial and Castle Hayne aquifers have been estimated through various studies and have been found to vary significantly from study to study as well as spatially. The estimated lateral hydraulic conductivity for the surficial aquifer is 50 feet per day (ft/d) and is based on a general composition of fine sand mixed with some silt and clay (Cardinal, et al., 1993). Baker compiled and studied data from aquifer pumping tests at the Base in 1994 to evaluate aquifer characteristics and production capacities. The technical memorandum is provided as Appendix C. The information contained in this memorandum pertains primarily to the surficial aquifer. Average pumping rates were established between 0.5 to 3 gpm, with a hydraulic conductivity estimate range from 0.5 to 1.4 feet per day.

3.4.2 Site-Specific Framework

The subsections that follow provide a discussion of geology, hydrogeology, and provide a summary of findings.

3.4.2.1 Geology

Two cross sections were prepared for the SWMU 311 RFI report to represent subsurface geology (Figure 3-2). Cross Section A-A' begins at boring SWMU311-SB07 and traverses to the northeast, to boring SWMU311-SB04 (Figure 3-3). Cross Section B-B' begins at boring SWMU311-SB20 and traverses to the southeast, to boring SWMU311-SB15. The paragraphs that follow discuss the cross section geology (Figure 3-4).

The subsurface geology in the vicinity of SWMU 311 exhibits some heterogeneity. Fine sand and silt of the undifferentiated formation predominate. A relatively thin clay layer is also present within the sand unit over much of the study area.

Figure 3-3 shows that silt is generally present as the uppermost unit in the grassy area between Buildings 1604/1605 and Michael Road. The minor constituents of this silt appear to vary from little clay to trace fine sand. The silt unit appears to pinch out on the southwest end of Cross Section A-A', where it is overlain by fine sand. The silt unit appears thickest at boring SWMU311-SB06 (from the ground surface to a depth of 7-feet bgs), and gradually thins toward boring SWMU311-SB04 (from the ground surface to a depth of 4-feet bgs). The vicinity of the wash pad/rack area may have been backfilled. At boring SWMU311-SB05, very fine sand, with some silt, cinders, and clay was observed. Fine sand underlies a surficial silt in the grassy area along Cross Section A-A'. Elsewhere, fine sand is the uppermost unit, including under the paved compound area (Figure 3-4, borings SWMU311-SB11 and SWMU311-SB20), and under Michael Road (Figure 3-4, boring SWMU311-SB15). The minor constituents of this fine sand appear to vary from some silt and little clay to trace silt. Fine to medium sand was encountered at the bottom of boring SWMU311-SB25. The occurrence of the coarser-grained sand appears to be limited in that it was not observed in any other boring in the study area.

A thin clay layer is present across much of the study area. This clay layer appears to be thickest (at least 6 feet thick) in the vicinity of boring SWMU311-SB04 (Figure 3-3). This clay layer thins and dips to the west and southwest (Figure 3-3 between borings SWMU311-SB04 and SWMU311-SB25). The layer is only 1 foot thick at boring SWMU311-SB20, and was not encountered in borings SWMU311-SB06 and SWMU311-SB07. The minor constituents of this clay vary and include fine sand and silt.

3.4.2.2 Hydrogeology

Groundwater was generally encountered in the fine sand within 10 feet of the ground surface, and appears to be perched in some areas. The clay layer exhibits some confining capability as evidenced by the perched conditions, although the degree is uncertain. At borings SWMU311-SB20 and SWMU311-SB11, groundwater was encountered above the clay layer (at about 5-feet bgs). The relative description of water saturation changes from "wet" to "moist" within the clay layer, indicating a decrease in saturation. Saturated conditions appear again,

below the clay layer. As a contrast, water was observed at boring SWMU311-SB25 in the clay layer where the sand content is high (Figure 3-3).

Groundwater flow direction and gradient were determined through the use of six piezometers (Section 2.2.1). These piezometers were installed deeper than the clay layer and do not intercept the perched water-bearing zone. Thus, the SWL measurements are representative of surficial aquifer and not a perched water table. SWL measurements were taken on July 8, 2003 and converted to elevations (Table 2-2). Figure 3-5 shows the groundwater potentiometric surface as interpreted by a minimum curvature algorithm using Surfer 7.0 software. Groundwater flows to the west and southwest across the study area. This flow direction is consistent with groundwater flow in the HPIA (as determined by the IR Site 78 Long-Term Monitoring [LTM] well network). It should be noted that this groundwater flow direction is different than the direction observed in the Phase II CSI, which was to the north. The Phase II CSI groundwater flow direction was based on three closely spaced temporary wells. Based on one RFI monitoring event, the hydraulic gradient varies slightly across the study area. The hydraulic gradient across Line "A" as shown of Figure 3-5 is 0.03 feet/foot. The hydraulic gradient across Line "B" as shown of Figure 3-5 is 0.02 feet/foot.

TABLES

TABLE 3-1

SWMU 311
GEOLOGIC AND HYDROGEOLOGIC UNITS IN THE COASTAL PLAIN OF NORTH CAROLINA
RCRA FACILITY INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

GEOLOGIC UNITS			HYDROGEOLOGIC UNITS
System	**Series**	**Formation**	**Aquifer and Confining Unit**
Quaternary	Holocene/Pleistocene	Undifferentiated	Surficial Aquifer
Tertiary	Pliocene	Yorktown Formation [1]	Yorktown Confining Unit
			Yorktown Aquifer
	Miocene	Eastover Formation [1]	
		Pungo River Formation [1]	Pungo River Confining Unit
			Pungo River Aquifier
		Belgrade Formation [2]	Castle Hayne Confining Unit
	Oligocene	River Bend Formation	Castle Hayne Aquifier
	Eocene	Castle Hayne Formation	Beaufort Confining Unit[3]
	Palocene	Beaufort Formation	Beaufort Aquifer
Cretaceous	Upper Cretaceous	Peedee Formation	Peedee Confining Unit
			Peedee Aquifer
		Black Creek and Middendorf Formations	Black Creek Confining Unit
			Black Creek Aquifer
			Upper Cape Fear Confining Unit
		Cape Fear Formation	Upper Cape Fear Aquifer
			Lower Cape Fear Confining Unit
			Lower Cape Fear Aquifer
	Lower Cretaceous [1]	Unnamed Deposits [1]	Lower Cretaceous Confining Unit
			Lower Cretaceous Aquifier [1]
Pre-Cretaceous Basement Rocks		---	---

Notes:

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

[2] Constitutes part of the surficial aquifer and Castle Hayne confining unit in the study area.

[3] Estimated to be confined to deposits of Paleocene age in the study area.

Source: Cardinell, et al., 1993

FIGURES

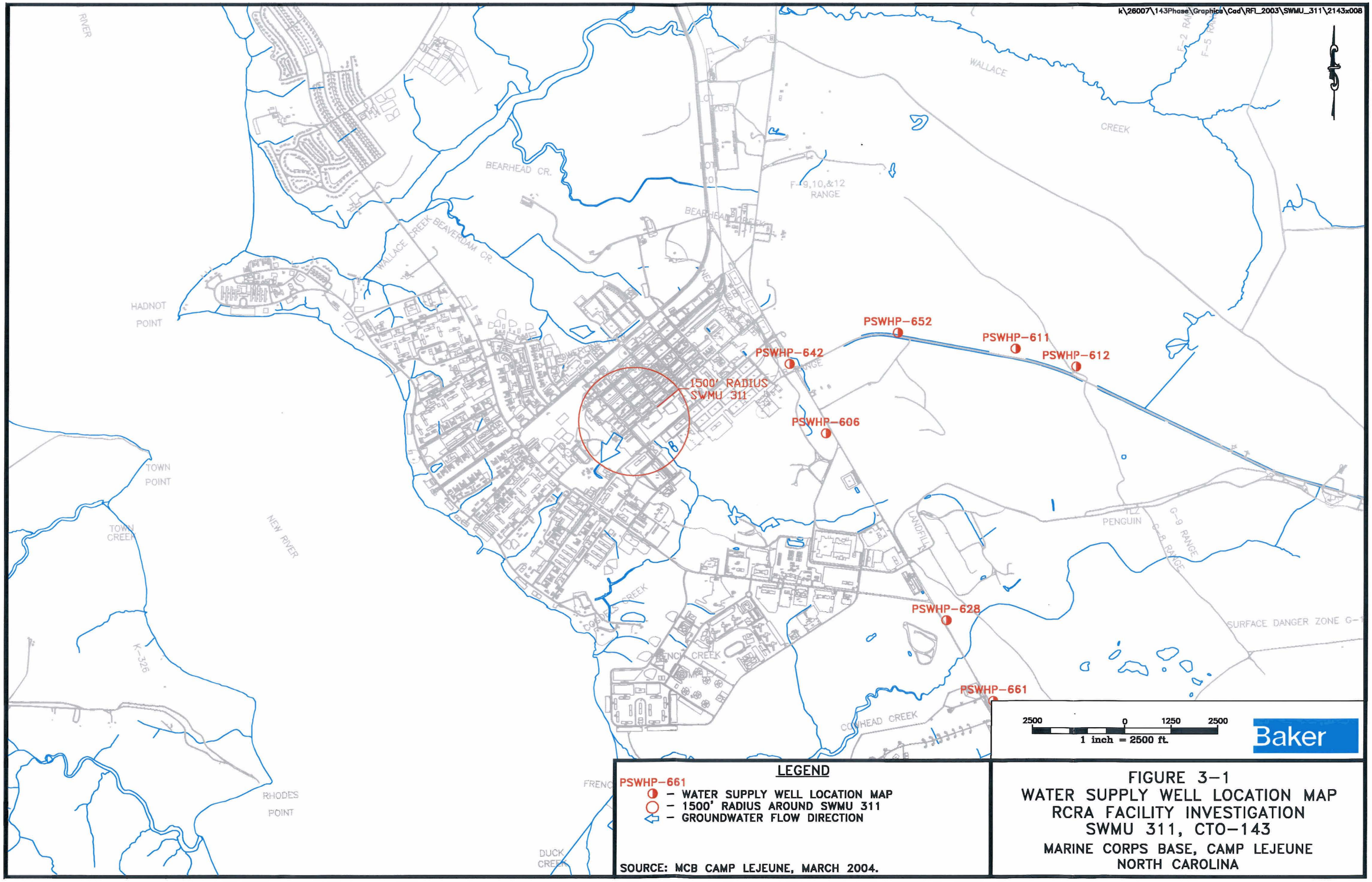
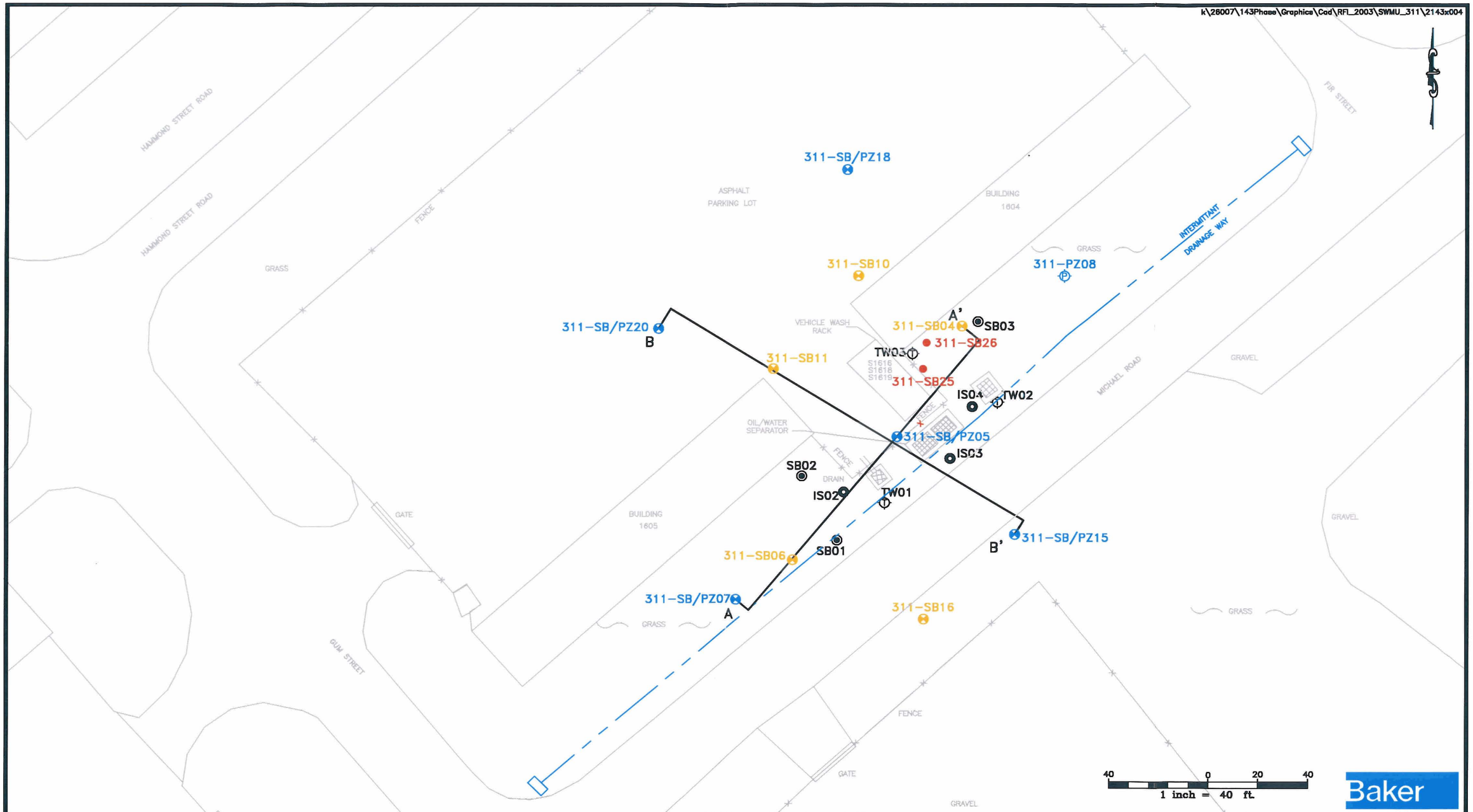


FIGURE 3-1
WATER SUPPLY WELL LOCATION MAP
RCRA FACILITY INVESTIGATION
SWMU 311, CTO-143
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



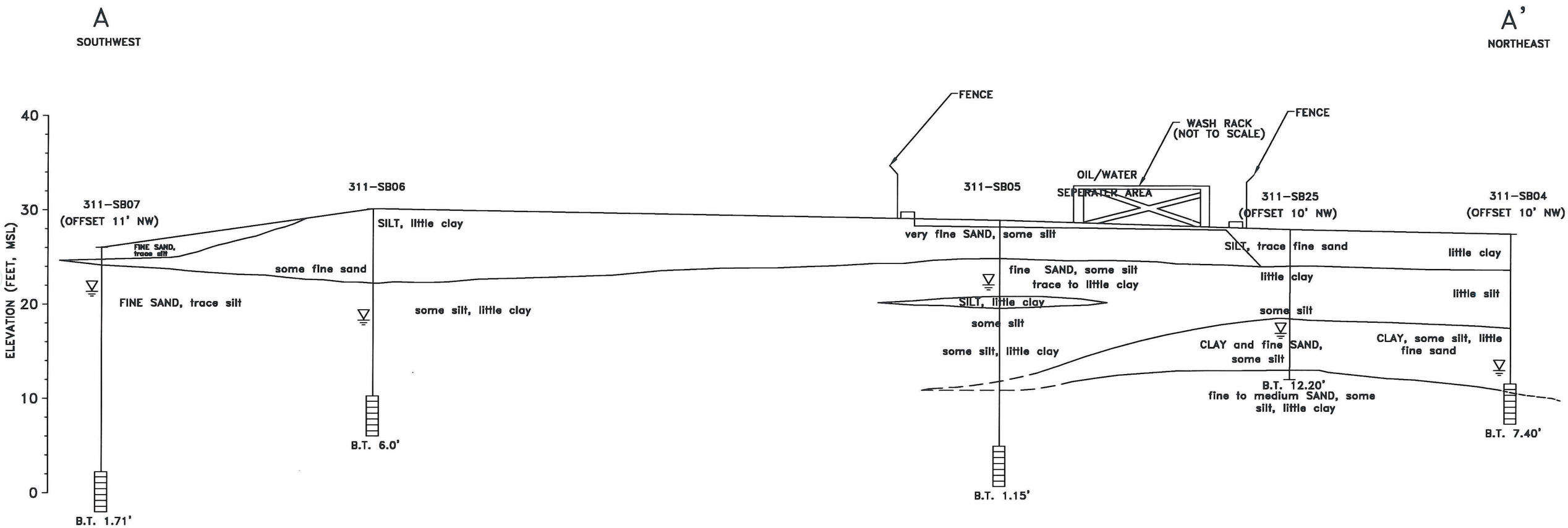
LEGEND

- PHASE II CSI TEMPORARY WELL
- PHASE II CSI SOIL BORING
- PHASE II CSI SURFACE SOIL SAMPLE
- PHASE I CSI SOIL BORING
- RFI SOIL BORING LOCATION
- RFI SOIL BORING AND GROUNDWATER GRAB LOCATION
- RFI SOIL BORING AND GROUNDWATER GRAB AND PIEZOMETER LOCATION
- RFI PIEZOMETER LOCATION

SOURCE: MCB CAMP LEJEUNE MARCH 2000

FIGURE 3-2
CROSS SECTION LOCATIONS
RCRA FACILITY INVESTIGATION
SWMU 311, CTO - 0143
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

k:\26007\143Phase\Graphics\Cad\RFI_2003\SWMU_311\2143x005



Baker

10 0 5 10
1 inch = 10 ft.
Horizontal Scale:

10 0 5 10
1 inch = 10 ft.
Vertical Scale:

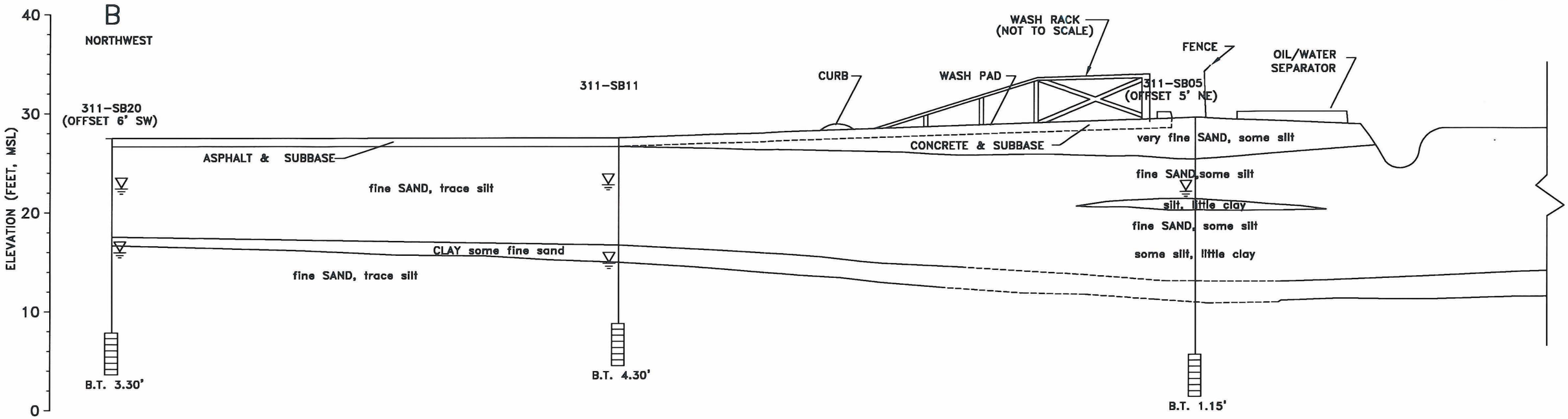
THE SOIL BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS. SUBSURFACE CONDITIONS INTERPOLATED BETWEEN BORINGS ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.

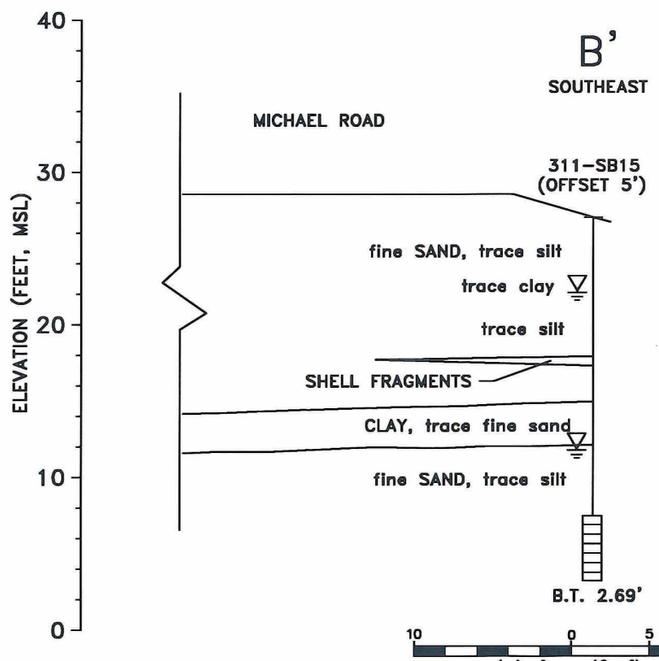
LEGEND

- ESTIMATED CONTACT
- PROJECT CONTACT
- GROUNDWATER ENCOUNTERED DURING DRILLING
- B.T. 1.15' BORING TERMINATION
- GROUNDWATER GRAB SAMPLE INTERVAL

FIGURE 3-3
CROSS SECTION A-A'
RCRA FACILITY INVESTIGATION
SWMU 311, CTO - 0143
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

k\26007\143Phase\Graphics\Cad\RFI_2003\SWMU_311\2143x005





10 0 5 10
1 inch = 10 ft.
Horizontal Scale:

10 0 5 10
1 inch = 10 ft.
Vertical Scale:

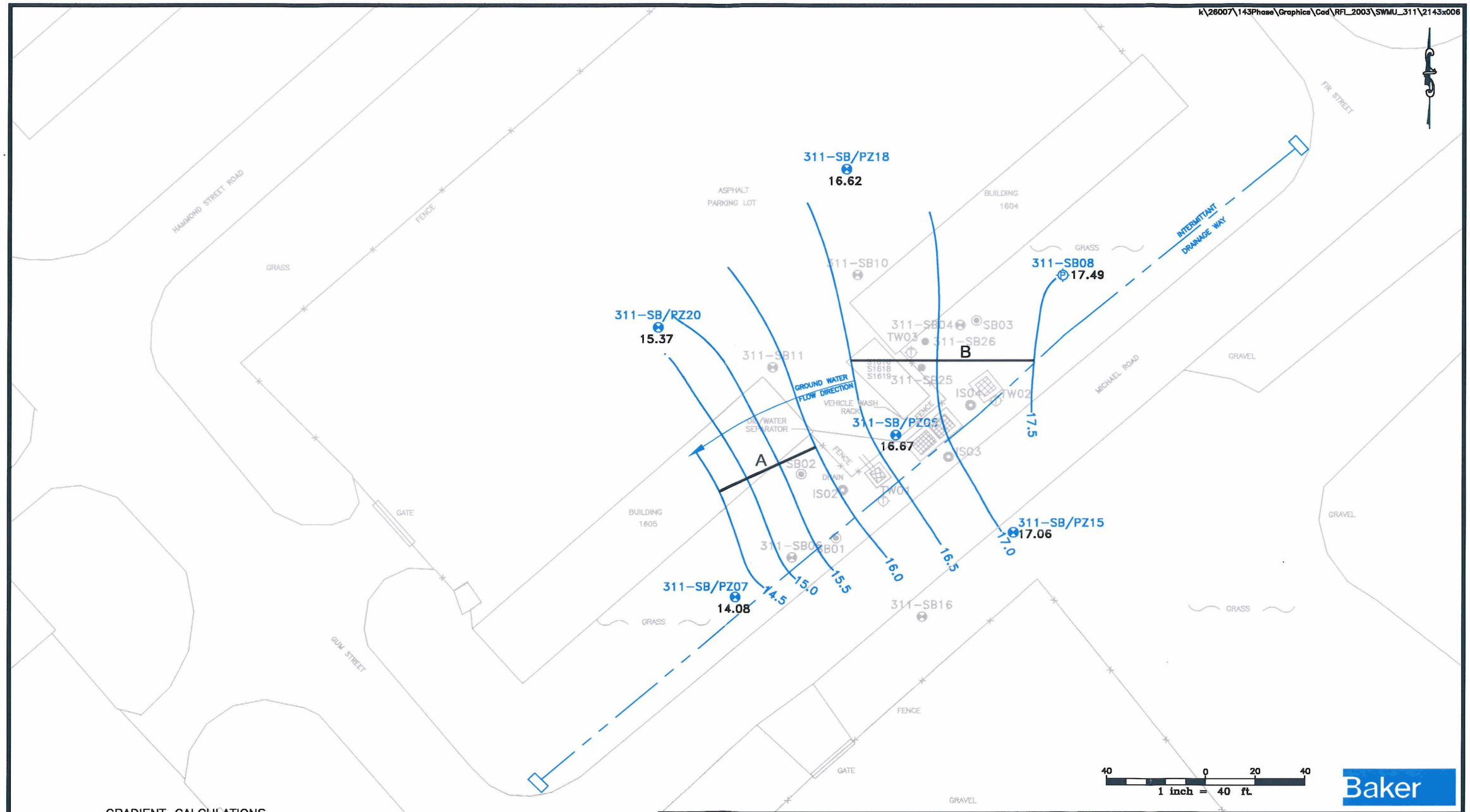
THE SOIL BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS. SUBSURFACE CONDITIONS INTERPOLATED BETWEEN BORINGS ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.

LEGEND

- ESTIMATED CONTACT
- PROJECT CONTACT
- GROUNDWATER ENCOUNTERED DURING DRILLING
- B.T. 1.15' BORING TERMINATION
- GROUNDWATER GRAB SAMPLE INTERVAL

Baker

FIGURE 3-4
CROSS SECTION B-B'
RCRA FACILITY INVESTIGATION
SWMU 11, CTO - 0143
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



Baker

GRADIENT CALCULATIONS

A: DISTANCE (D) = 43 FEET
ELEVATION CHANGE (ΔZ) = 1.5 FEET
GRADIENT = $\Delta Z/D$ OR 1.5/43 = 0.03 FEET/FOOT

B: DISTANCE (D) = 73 FEET
ELEVATION CHANGE (ΔZ) = 1.0 FOOT
GRADIENT = $\Delta Z/D$ OR 1.0/73 = 0.02 FEET/FOOT

LEGEND

- PHASE II CSI TEMPORARY WELL
- PHASE II CSI SOIL BORING
- PHASE II CSI SURFACE SOIL SAMPLE
- PHASE I CSI SOIL BORING
- RFI SOIL BORING LOCATION
- RFI SOIL BORING AND GROUNDWATER GRAB LOCATION
- RFI SOIL BORING AND GROUNDWATER GRAB AND PIEZOMETER LOCATION
- RFI PIEZOMETER LOCATION

SOURCE: MCB CAMP LEJEUNE MARCH 2000

FIGURE 3-5
SURFICIAL AQUIFER POTENTIOMETRIC SURFACE
RCRA FACILITY INVESTIGATION
SWMU 311, CTO - 0143
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

4.0 ANALYTICAL RESULTS AND EXTENT OF CONTAMINATION

This section presents information regarding the nature and extent of contamination related to SMWU 311. This contaminant characterization was accomplished by mobile and fixed-base laboratory analysis of soil and groundwater samples. Sections 4.1 through 4.4 discuss data quality, screen out constituents not related to the SMWU, and provide information regarding data usability. Section 4.5 discusses the nature and extent of the constituents of concern.

4.1 Data Quality

This RFI consisted of field-based analysis of VOCs in soil and groundwater and fixed-base analysis for RCRA metals analysis. Fixed-base laboratory data were validated using procedures established by the National Functional Guidelines for Organic and Inorganic Analyses (USEPA, 2002). Validation of the analytical data, through established procedures, served to reduce the inherent uncertainties associated with its usability. Data qualified as "J" were retained as estimated values. Estimated analytical results within a data set are common and considered usable by the EPA. Data may be qualified as estimated for several reasons, including an exceedence of holding times, high or low surrogate recovery, or intra-sample variability. In addition, values may be assigned an estimated "J" qualifier if the reported value is below the Contract Required Detection Limit (CRDL) or the Contract Required Quantitation Limit (CRQL).

Additional data qualifiers were employed during the validation of data. Compounds that were not detected were assigned the "U" qualifier and those non-detected compounds that had inaccurate or imprecise quantitation limits were assigned the "UJ" qualifier.

Split samples were collected to assess the reliability of the mobile laboratory. Samples were split for analysis via SW-846 Method 8260B at a fixed-base laboratory. Approximately 20% of samples collected for the mobile laboratory were split with the fixed-base laboratory. Table 4-1 compares sample split data. An examination of Table 4-1 shows that the split data generally indicates good correlation. That is an indication that the mobile laboratory provided adequately reliable information to make field decisions in terms of investigation direction and termination, and can be used to evaluate any extent of contamination. With the exception of methylene chloride, all analyzed compounds were not detected by either laboratory. Methylene chloride was detected by the fixed-base laboratory in 4 of eight samples at estimated concentrations between

1.9 micrograms per liter (μg/L) and 2.6 μg/L. Given the fact that the fixed-base laboratory also detected methylene chloride in blank samples, these detections in the split samples are may not be representative of site conditions.

4.1.1 Laboratory and Non-Site Related Contaminants

Some organic and inorganic constituents detected in soil and groundwater at SWMU 311 can be attributed to non-site related conditions or activities. Two primary sources of non-site related results include laboratory contaminants and naturally occurring inorganic elements. In addition, non-site related operational activities and conditions might contribute to "on-site" contamination. A discussion of non-site related analytical results is provided in the sections that follow, and includes laboratory contaminants, non-site related contaminants, and naturally occurring inorganic elements.

Blank samples provide a measure of contamination that has been introduced into a sample set during the collection, transportation, preparation, and/or analysis of samples. To remove non-site related contaminants from further consideration, the concentrations of chemicals detected in blanks were compared with concentrations of the same chemicals detected in environmental samples. These blank samples include, trip blanks, rinsate blanks, and field blanks. Rinsate blanks were collected from the sampling equipment to ensure that decontamination procedures were effective in cleaning the field equipment. One field blank was collected from the potable water source used during drilling and decontamination. Table 4-2 provides a summary of all compounds detected in blank samples.

Common laboratory contaminants (i.e., acetone, 2-butanone, methylene chloride, toluene, and phthalate esters) were considered as positive results only when observed concentrations exceeded ten times the maximum concentration detected in any blank. If the concentration of a common laboratory contaminant was less than ten times the maximum blank concentration, then it was concluded that the chemical was not detected in that particular sample (USEPA, 1989). The maximum concentrations of detected common laboratory contaminants in blanks for SWMU 311 were as follows:

Acetone	23 μg/L
Methylene Chloride	4.0 μg/L

Other constituents contained in blanks that are not considered common laboratory contaminants were considered as positive results only when observed concentrations exceeded five times the maximum concentration detected in any blank (USEPA, 1989). All TCL and RCRA metal constituents of less than five times the maximum level of contamination noted in any blank were not considered detected in that sample. The detection of certain VOCs (bromodichloromethane, chloroform, and dibromochloromethane) are typically associated with disinfection byproducts and are likely related to use of Base potable water in decontamination. The maximum concentrations of all other detected blank contaminants were as follows:

Bromodichloromethane	10 μg/L
Chloroform	21 μg/L
Dibromochloromethane	4.9 μg/L
Barium (total)	1.2J μg/L
Cadmium (total)	0.46J μg/L
Chromium (total)	4.8J μg/L
Selenium (total)	3.5J μg/L
Silver (total)	2.5J μg/L

4.1.2 Naturally-Occurring Inorganic Elements

A base background soil study was conducted at the Base in June and July 2000. A Base background groundwater study was conducted later, in March and April 2002. Naturally occurring inorganic constituents occur ubiquitously in soil and groundwater; therefore, distinguishing between background levels and site-related concentrations is difficult. Because many naturally occurring inorganic constituents also may be of anthropogenic origin, an appropriate number of background samples were obtained to distinguish naturally occurring concentrations.

A total of 50 surface soil samples and 50 subsurface soil samples were collected from 50 soil borings in areas that had no known history of any activity that may bias inorganic concentrations in surface and subsurface soils (Baker, 2001a). All soil samples were analyzed for Target

Analyte List (TAL) inorganics (Method 601 OB/7471A) and pH (ASTM Standard D 4972-95A, US EPA Method 9045). The inorganic analysis results were subsequently validated.

In general, inorganic constituents were detected at similar levels of concentration in the surface and subsurface samples collected as part of this investigation. There were observed differences between the datasets but these differences are primarily based upon the soil type in each soil horizon. As the soils were separated into datasets based on their soil type, it became apparent that the majority of the constituents were more prevalent in the fine-grained soils (clay and silts) than in coarse-grained soils (sands). This was an expected finding since metals are known to adsorb onto clays through the formation of ionic bonds.

Temporary groundwater monitoring wells were installed to provide spatial coverage across the Base (Baker, 2002a). Two clustered monitoring wells were installed at each of the 25 locations. Each cluster contained one shallow well (upper surficial aquifer) and one deep well (lower surficial aquifer) for a total of 50 temporary wells. Samples were collected from each monitoring well for TAL inorganics analysis by Method 601 OB/7471A. The inorganic analysis results were subsequently validated.

In general, similar inorganic constituents were detected in both the shallow and deeper portions of the surficial aquifer during this investigation. However, the deeper portion of the surficial aquifer appeared to have a higher concentration of inorganics than the shallow portion.

Statistical analysis was performed on the background soil and groundwater sample set. This was done to determine distribution of the data, to identify outliers, to determine means and standard deviations, and to compare data sets of different lithology and depth. The surface soil and subsurface soil data sets were then segregated according to soil type. Groundwater data sets were segregated according to depth.

An Area of Concern (AOC) background study was also conducted at the Base in June and July 2000 (Baker, 2001b). AOCs were established based on geographical location, geology, and type of SWMU(s). The purpose of this investigation was to establish a background concentration for the group of SWMUs within the AOCs that would be representative of conditions immediately surrounding to the SWMU (resultant of Base activities in that area). An inorganic constituent could be eliminated as a COPC if its concentration is less than AOC background; arguing that the

concentration is a result of Base activities in that AOC and is not directly associated with the SWMU.

Surface and subsurface soil samples were collected from 165 borings. All soil samples were analyzed for TAL inorganics (EPA Method 6010B/7471A), ph (ASTM Standard D 4972-95A, USEPA Method 9045), and TOC (SSTM Standard D 2178) for select samples.

4.2 Comparison Criteria and Standards

Constituent concentrations in surface and subsurface soil are compared to three main criteria; USEPA Region IX preliminary remediation goals (PRGs), North Carolina Soil-to-Groundwater values (STGCs), AOC 5 background, and Base background concentrations. Constituent concentrations in groundwater are compared to three main criteria; North Carolina Groundwater Quality Standards (2L Standards), USEPA Region III Tap Water Risk-Based Concentrations (RBCs) and base-wide background concentrations. The paragraphs that follow discuss details regarding each screening criteria.

Region IX Preliminary Remediation Goals (PRGs) - (USEPA, 2003a). Region IX PRGs are risk-based tools for evaluating and cleaning up contaminated sites. They are being used to streamline and standardize all stages of the risk decision-making process. The Region IX PRGs combine current EPA toxicity values with "standard" exposure factors to estimate constituent concentration in environmental media (soil, water, and air) that are considered protective of humans, including sensitive groups, over a lifetime. Chemical concentrations above these levels would not automatically trigger a response action; however, exceeding a PRG suggests that further evaluation of the potential risks that may be posed by site contamination is appropriate.

The PRG concentrations can be used to screen pollutants in environmental media, trigger further investigation, and provide an initial cleanup goal if applicable. Given the land use of SWMU 311 and surrounding area, use of the industrial PRGs is appropriate.

North Carolina Soil-to-Groundwater Concentrations - (NC, 1996). Soil-to-Groundwater concentrations (STGC) are determined by North Carolina and are based on the current Groundwater Protection Standard (2L) or Interim Maximum Allowable Concentrations (IMAC). If there are no 2L or IMAC, a Soil-to-Groundwater concentration can be calculated based on the

recommended 2L, or if a recommended 2L is not available, the Maximum Contaminant Levels Goals (MCLG), which are based on a 10^{-6} carcinogenic risk.

North Carolina Water Quality Standards for Groundwater - (NC, 2002) - North Carolina Water Quality Standards for Groundwater NCWQS are the maximum allowable concentrations resulting from any discharge of contaminants to the land or waters of the state, which may be tolerated without creating a threat to human health or which otherwise render the groundwater unsuitable for its intended purpose. The NCWQS is also known as the 2L Standard.

Region III Tap Water Risk-Based Concentrations (RBCs) - October 2003 - RBC values are derived using conservative USEPA promulgated default values and the most recent toxicological criteria available. The RBCs for potentially carcinogenic chemicals are based on a target Incremental Cancer Risk (ICR) of $1x10^{-6}$. The RBCs for non-carcinogens are based on a target hazard quotient of 1.0. In order to account for cumulative risk from multiple chemicals in a medium, it is necessary to derive the RBCs based on a target hazard quotient of 0.1. Re-derivation of the non-carcinogenic RBCs based on a target hazard quotient of 0.1, while using the most recent toxicological criteria available, results in a set of values that can be used as screening values. In order to provide the accurate screening values, the non-carcinogenic RBCs were divided by a factor of ten. For potential carcinogens, the toxicity criteria applicable to the derivation of RBC values are oral and inhalation cancer slope factors (CSFs); for non-carcinogens, they are chronic oral and inhalation reference doses (RfDs). These toxicity criteria are subject to change as more updated information and results from the most recent toxicological/epidemiological studies become available. Therefore, the use of toxicity criteria in the derivation of RBC values requires that the screening concentrations be updated periodically to reflect changes in the toxicity criteria. The RBC table is issued on a semi-annual basis.

Base Background (Soil and Groundwater)/AOC-Specific Background (Soil) – It was apparent from statistical analysis that inorganic constituent were normally or log-normally distributed. Constituents with frequent non-detections were neither normally nor log-normally distributed. Base background screening criteria for normally distributed constituents or neither distribution pattern was based on the arithmetic mean, plus two standard deviations. Base background screening criteria for log-normally distributed constituents was based on the log arithmetic mean, plus two standard deviations. The sand subsurface soil and shallow groundwater Base background data sets were used for comparisons. Also, the subsurface soil

AOC 5 background data sets were used for comparisons. The relevant background data tables are presented in Appendix D.

The following decision process has been adopted for this report to screen each constituent to determine if an evaluation of the nature and extent of that constituent is warranted:

- If a constituent exceeds PRGs, and/or STGCs, and background (inorganics only), that constituent might be related to SWMU activity, and an evaluation of the nature and extent will be performed (Section 4.5).

- If a constituent exceeds PRGs and/or STGCs, but not background that constituent likely represents background conditions and is not related to SWMU activity. An evaluation of the nature and extent will not be performed.

- If a constituent does not exceed PRGs, STGCs, or background an evaluation of the nature and extent that constituent will not be performed.

- If a constituent exceeds background but not PRGs and/or STGCs that constituent might be related to SWMU activity, but poses no risk to human health or groundwater. An evaluation of the nature and extent will not be performed.

Human health and ecological risk assessments generally follow guidelines that are independent of any discussion regarding the nature and extent of contamination. Thus, the list of COPCs may differ between the nature and extent and the risk assessments. Resolution of any differences will be performed in Section 8.0, Conclusions and Recommendations.

4.3 Data Usability

For soil samples, both the mobile and fixed-base laboratories were able to achieve detection limits below the PRGs and STGCs for all constituents of interest. For groundwater samples, the mobile laboratory was able to achieve detection limits below the North Carolina 2L Standard for all constituents of interest.

The Phase I and II CSI data were used to screen out SWMUs from further investigation, or to screen (reduce) the list of constituents for subsequent investigations. Thus, the CSI data are not intended to be re-evaluated in this nature and extent section, but rather to supplement the RFI data in establishing the nature and extent of contamination. Section 1.3 identifies COPCs from previous investigations, which are discussed Section 4.4.3 in context of the RFI data. Sections 6.2 and 7.2 discuss which data sets were used in the risk assessments, and how the data were applied.

4.4 Nature and Extent of Contamination

This section presents the results of the soil and groundwater investigations performed at SWMU 311. The data from the mobile laboratory (VOCs in soil and groundwater) are presented in Tables 4-3a, 4-3b, and 4-3c for surface soil, subsurface soil, and groundwater, respectively. The positive detections of VOCs and RCRA metals from the fixed-base laboratory samples are presented in Table 4-4. This table also compares the positive detections to screening criteria. A complete summary of fixed-base laboratory analytical data is presented in Appendix E. A summary of statistics of the fixed-base laboratory data is presented in Table 4-5.

4.4.1 Soil Investigation

No organic compounds were detected by the mobile laboratory (Tables 4-3a and 4-3b). Four organic compounds were detected by the fixed-base laboratory in surface and subsurface soil samples, including acetone, carbon disulfide, methylene chloride, and PCE (Table 4-4). Detections of acetone and methylene chloride (common laboratory contaminants) were within ten times the maximum concentration in blank samples and therefore can be attributed to non-site related sources (Section 4.1.1). Carbon disulfide and PCE were each detected in one sample (Table 4-5), but concentrations were below PRGs and STGCs. Consequently, carbon disulfide and PCE detected at these levels pose no risk to human health or the environment, and will not be considered further.

Seven inorganic compounds were detected in surface and subsurface soil samples, including arsenic, barium, cadmium, chromium, lead, selenium, and silver (Table 4-4). Several metals constituents including cadmium, chromium, selenium, and silver were detected in blank samples, but at concentrations well below what was detected in the environmental samples.

Barium and lead were detected in all 28 samples, with concentrations ranging from 1.6 J mg/kg to 30.7J milligram per kilogram (mg/kg) (barium) and 1 mg/kg to 51.2 mg/kg (lead). Both barium and lead were detected above Base background in only 3 of 28 samples (Table 4-5). Additionally, barium was detected above AOC background in 1 of 28 samples, while lead was detected above AOC background in 3 of 28 samples. Neither barium nor lead detections exceeded PRGs or STGCs.

Chromium was detected in 19 of 28 samples, ranging from 0.88J mg/kg to 7.4 mg/kg. No detections exceeded the PRG, STGC, or background criteria.

Silver was detected in 16 of 28 samples, ranging from 0.33J mg/kg to 0.65J mg/kg. All 16 silver detections exceeded STGC and AOC5/Base background criteria. No detections exceeded the PRG criterion.

Selenium was detected in 8 of 28 samples, ranging from 0.67J mg/kg to 1.7 mg/kg. All eight selenium detections exceeded AOC 5 background criterion. Six of the eight selenium detections also exceeded Base background. No detections exceeded PRG or STGC criteria.

Arsenic was detected in 7 of 28 samples, ranging from 0.66J mg/kg to 4.5 mg/kg. Only 3 of 7 detections exceeded Base and AOC 5 background as well as PRG criteria (Table 4-5). No detections of arsenic exceeded the STGC.

Cadmium was detected in 3 of 28 samples, ranging from 0.09J mg/kg to 1.1J mg/kg. All three cadmium detections exceeded AOC 5 and Base background. No detections of cadmium exceeded the PRG or STGC.

Chromium was not detected at concentrations in excess of background, PRG, or STGC criteria and will not be further evaluated. Some or all of the barium, cadmium, lead, and selenium detections exceeded background criteria, but did not exceed either the PRG or STGC criteria. As such these compounds in general, pose no risk to human health or the environment, and will not be further evaluated. It should be noted that previous detections of lead appear to be SWMU related. The previous detections of lead will be further discussed in context of the RFI data in Section 4.4.3.

Arsenic and silver exceed background, PRG and/or STGC criteria, and will be evaluated further. Figure 4-1 shows positive detections of arsenic and silver in soils at SWMU 311. Arsenic and silver detections appear to be scattered and not located near the SWMU. Based on this figure and Phase I and II CSI data, the presence of arsenic and silver does not appear to be related to the SWMU:

- The presence of arsenic or silver is not consistent with activity at SWMU 311. SMWU 311 is associated with vehicle wash-down activity. Fuel, oil, and coolant-type compounds might be expected along with some metals (related to batteries, fuel additives, and particles from engine wear. However, arsenic is typically associated with anthropogenic activities such as coal-fired power plants, pesticide production or heavy application, and landfills. Silver is typically associated with anthropogenic activities such as photograph development and plating.

- Arsenic and silver were not detected in the RFI boring closest to SWMU 311 (SWMU311-SB05). A surface spill at the SWMU or oil/water separator leak related to arsenic or silver would be manifest in soils closest to the SWMU.

- Neither arsenic nor silver was a concern in soil or groundwater in the Phase I and II CSIs.

- Arsenic and silver detections appear to be scattered and of varying depths. Two of the three screening criteria exceedences for arsenic are relatively far from the SWMU. Additionally, the distribution of both arsenic and silver appear to be in a random pattern, not indicative of a point source origination.

- Elevated arsenic detections are not coincident with detections of solvent or fuel constituents, which is more likely associated with SWMU 311 activity. This suggests that the presence of arsenic in soils is not related to any release from SWMU 311.

4.4.2 Groundwater Investigation

There were no COPCs in groundwater from the Phase I and II CSIs. The RFI data further support in conclusion that groundwater has not been impacted by SWMU 311 (relative to VOCs). One

organic compound was detected in one groundwater sample (Table 4-3c). The compound cis-1,2-dichloroethene was detected in sample SWMU311-GW05 at 2 μg/L. The detection is well below the North Carolina 2L Standard of 70 μg/L.

4.4.3 Summary

Previous investigations gave indication of organic and inorganic contamination in subsurface soil, including PCE, TCE, methylene chloride, benzene, chlorobenzene, chloroform, bromoform, cadmium, chromium, and lead. In light of the new RFI data, several of these constituents appear to be related to SWMU 311,but the impact is limited to surrounding soil. Additionally, no evidence of an impact to groundwater was observed during the RFI.

In summary, earlier indications of potentially significant subsurface soil contamination at SWMU 311 were not manifest in the RFI findings:

- While lead was detected in all 28 RFI samples, the highest detection was 51.2J mg/kg. All concentrations were below PRGs and SSLs. The maximum observed detection of lead during the RFI was in a sample from boring SWMU311-SB05, which was located near the oil/water separator. The highest lead detection in any phase was in a sample from boring SWMU311-IS04 at 1,100 mg/kg (Phase I CSI). These "highest" detections appear in a pattern in shallow subsurface soils around SWMU 311, which suggests site-related contamination. However, the distribution of STGC/PRG exceedences is very localized and not indicative of large-scale contamination. Lead could be related to the SWMU in that it was a fuel additive and associated with batteries.

- The Phase I CSI detections of cadmium and chromium in one sample (SWMU311-IS02-00) exceeded background criteria as well as the STGC. Cadmium and chromium were detected in the RFI above background criteria, but below STGCs and PRGs. This evidence suggests that STGC exceedences are very localized and not indicative of larger scale contamination. Cadmium and chromium could be related to the SWMU in that cadmium is associated with batteries and both are metal alloys.

- During the Phase II CSI, PCE was detected in subsurface soils just above the water (15 to 17 feet bgs) in boring SWMU311-TW03 at 400 μg/kg. While solvents such as PCE as

generally associated with dry cleaning, it is possible to have been used in engine parts degreasing and could be related to the SWMU. During the RFI, borings SWMU311-SB25 and SWMU311-SB26 were located within 10-feet of SWMU311-TW03 to confirm or refute the presence of PCE at these levels. PCE was not detected in these samples. Thus, the Phase II CSI detection of PCE was not confirmed. There were two extenuating circumstances, however; 1) The detection limit for these samples was 200 µg/kg and were not re-run at lower levels, and 2) the groundwater table was more shallow during the RFI, so the samples were collected at a different depth. Despite these circumstances, it can be concluded that detections of PCE above the STGC/PRG are isolated to the vicinity of boring SWMU311-TW03 and not indicative of larger scale contamination. The fact that neither PCE nor daughter products were detected in shallow groundwater samples (the detection of 1,2-cis-dichloroethene at 2 µg/L at SWMU311-GW05 notwithstanding) supports this conclusion.

- TCE, chlorobenzene, and benzene were detected above the STGC in one soil sample each in the Phase I CSI and Phase II CSI, respectively. TCE and chlorobenzene were degreasing agents, while benzene is associated with fuels. All three constituents could be related to the SWMU. These compounds were not detected in the RFI. The lack of any additional detections indicates that the presence of chlorobenzene and benzene is limited in extent.

- The presence of acetone, methylene chloride, chloroform, and bromoform in environmental samples in all investigation phases may be linked to non-site related sources:

  - Acetone and methylene chloride was again detected during the RFI, and at similar levels as the Phase I and II CSIs. It is important to note that methylene chloride (a common laboratory contaminant) was also detected in several of the blank samples during the RFI and the Phase II CSI. Because detections of methylene chloride in soil samples are similar to blank sample detections and was frequently detected in blank samples, it is reasonable to conclude that methylene chloride is not SWMU related.

- Chloroform was not detected in environmental samples collected during the RFI, but was detected in blank samples. Additionally, chloroform was detected in blank samples and environmental samples from the Phase II CSI. This is an indication that the chloroform detections are not SWMU related. Professional experience indicates that chloroform is a by-product of water chlorination and has frequently been detected in potable water sources on the Base. As with chloroform, bromoform has frequently been detected in potable water sources on Base.

- Bromoform was not detected during the RFI in any environmental or blank samples. Because bromoform was not detected in any blank samples, it is difficult to dismiss its presence in the environmental samples as non-site related. However, professional experience indicates that bromoform is also a by-product of water chlorination.

- The presence of arsenic and silver in soil was not determined to be significant in the Phase I and II CSIs. The lines of evidence presented in Section 4.4.1 suggest that neither arsenic nor silver is related to SWMU 311.

- No constituents detected in groundwater during Phase II CSI and the RFI were detected above PRGs or STGCs. Thus, groundwater does not appear to be negatively impacted by SWMU 311 activity and warrants no further evaluation.

The RFI did not identify any new COPCs at SWMU 311. Furthermore, evidence from the RFI indicate that the CSI COPCs (lead, cadmium, chromium, PCE, TCE, chlorobenzene, and benzene) could be associated with the SWMU, but appear to have a limited impact to soil and groundwater. Fate and transport issues related to these COPCs will be addressed in Section 5.0.

It is important to note that the human health and ecological risk assessments independently evaluate all analytical data apart from this nature and extent discussion. So, constituents identified in this section as being not SWMU-related or not considered COPCs may still be evaluated in Sections 6.0 and 7.0 in accordance with regulatory guidance.

TABLES

TABLE 4-1

MOBILE AND FIXED-BASE LABORATORIES SPLIT SAMPLE COMPARISON
SWMU 311
RCRA FACILITY INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Constituent	SWMU311-SB04-01 06-19-2003		SWMU311-SB05-04 06-18-2003		SWMU311-SB06-01 06-19-2003		SWMU311-SB07-08 06-24-2003	
	Sample	Split	Sample	Split	Sample	Split	Sample	Split
1,1-Dichloroethene	2 U	11 U	2 U	12 U	2 U	12 U	2 U	12 U
Benzene	2 U	11 U	2 U	12 U	2 U	12 U	2 U	12 U
cis-1,2-Dichloroethene	2 U	11 U	2 U	12 U	2 U	12 U	2 U	12 U
Methylene Chloride	2 U	1.9 J	2 U	12 U	2 U	2.5 J	2 U	12 U
Tetrachloroethene	2 U	11 U	2 U	12 U	2 U	12 U	2 U	12 U
trans-1,2-Dichloroethene	2 U	11 U	2 U	12 U	2 U	12 U	2 U	12 U
Trichloroethene	2 U	11 U	2 U	12 U	2 U	12 U	2 U	12 U

Constituent	SWMU311-SB10-02 06-18-2003		SWMU311-SB11-03 06-18-2003		SWMU311-SB18-02 06-23-2003		SWMU311-SB20-03 06-23-2003	
	Sample	Split	Sample	Split	Sample	Split	Sample	Split
1,1-Dichloroethene	2 U	12 U	2 U	13 U	2 U	11 U	2 U	12 U
Benzene	2 U	12 U	2 U	13 U	2 U	11 U	2 U	12 U
cis-1,2-Dichloroethene	2 U	12 U	2 U	13 U	2 U	11 U	2 U	12 U
Methylene Chloride	2 U	2.6 J	2 U	2.3 J	2 U	11 U	2 U	12 U
Tetrachloroethene	2 U	12 U	2 U	13 U	2 U	11 U	2 U	12 U
trans-1,2-Dichloroethene	2 U	12 U	2 U	13 U	2 U	11 U	2 U	12 U
Trichloroethene	2 U	12 U	2 U	13 U	2 U	11 U	2 U	12 U

Notes:
U - not detected above the method detection limit
J - value estimated; detected below the method detection limit

TABLE 4-2

POSITIVE DETECTION IN BLANK SAMPLES
SWMU 311
RCRA FACILITY INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Consitiuent	Sample ID									
	ER02	ER03	ER07	ER08	FB01	FB02	FB03	TB01	TB02	TB04
Volatiles (ug/L)										
Acetone	10 U	10 U	10 U	10 U	10 U	10 U	10 U	**15**	**23**	10 U
Bromodichloromethane	10 U	10 U	10 U	10 U	**10**	10 U	10 U	10 U	10 U	10 U
Chloroform	10 U	10 U	10 U	10 U	**21**	10 U	10 U	10 U	10 U	10 U
Dibromochloromethane	10 U	10 U	10 U	10 U	**4.9 J**	10 U	10 U	10 U	10 U	10 U
Methylene Chloride	**4 J**	**3.8 J**	10 U	10 U	10 U	10 U	10 U	10 U	**2.3 J**	10 U
Metals (ug/L)										
Barium	10 U	10 U	0.8 U	**1.2 J**	10 U	0.8 U	0.8 U	NA	NA	NA
Cadmium	**0.41 J**	10 U	0.4 U	**0.46 J**	10 U	0.4 U	0.4 U	NA	NA	NA
Chromium	**4.4 J**	**4.8 J**	0.6 U	10 U	10 U	0.6 U	0.6 U	NA	NA	NA
Selenium	10 U	10 U	3 UJ	**3.5 J**	10 U	3 UJ	3 UJ	NA	NA	NA
Silver	**1.6 J**	**2.5 J**	1 UJ	10 U	10 U	1 UJ	1 UJ	NA	NA	NA

Notes:
U - Not detected above the method detection limit
J - Value estimated; detected below the method detection limit
NA - Not analyzed
See Table 2-1 for rinsate and blank sources

TABLE 4-3a

POSITIVE DETECTIONS IN SURFACE SOIL - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D.	SWMU311-SB04-00	SWMU311-SB06-00	SWMU311-SB07-00	SWMU311-SB15-00	SWMU311-SB16-00	SWMU311-SB20-00
Lab Sample I.D.	Missing	Missing	Missing	Missing	Missing	Missing
Sample Date	06-19-2003	06-19-2003	06-24-2003	06-19-2003	06-19-2003	06-23-2003
Depth Range	0-1	0-1	0-1	0-1	0-1	0-1
Volatiles (ug/kg)						
	No Hits Detected					

TABLE 4-3b

POSITIVE DETECTIONS IN SUBSURFACE SOILS - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D.	SWMU311-SB04-01	SWMU311-SB04-02	SWMU311-SB04-06	SWMU311-SB04-08	SWMU311-SB05-02	SWMU311-SB05-04	SWMU311-SB06-01
Lab Sample I.D.	Missing	Missing	Missing	Missing	Missing	Missing	Missing
Sample Date	06-19-2003	06-19-2003	06-19-2003	06-19-2003	06-18-2003	06-18-2003	06-19-2003
Depth Range	1-3	3-5	11-13	15-17	3-5	7-9	1-3

Volatiles ug/kg

No Hits Detected

TABLE 4-3b

POSITIVE DETECTIONS IN SUBSURFACE SOILS - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D.	SWMU311-SB06-04	SWMU311-SB06-06	SWMU311-SB07-01	SWMU311-SB07-03	SWMU311-SB07-06	SWMU311-SB07-08	SWMU311-SB10-02
Lab Sample I.D.	Missing	Missing	Missing	Missing	Missing	Missing	Missing
Sample Date	06-19-2003	06-19-2003	06-24-2003	06-24-2003	06-24-2003	06-24-2003	06-18-2003
Depth Range	7-9	11-13	1-3	5-7	11-13	15-17	3-5

Volatiles ug/kg

No Hits Detected

TABLE 4-3b

POSITIVE DETECTIONS IN SUBSURFACE SOILS - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D.	SWMU311-SB10-04	SWMU311-SB10-06	SWMU311-SB11-02	SWMU311-SB11-03	SWMU311-SB11-06	SWMU311-SB11-08	SWMU311-SB15-00
Lab Sample I.D.	Missing	Missing	Missing	Missing	Missing	Missing	Missing
Sample Date	06-18-2003	06-18-2003	06-18-2003	06-18-2003	06-18-2003	06-18-2003	06-19-2003
Depth Range	7-9	11-13	3-5	5-7	11-13	15-17	0-1

Volatiles ug/kg

No Hits Detected

TABLE 4-3b

POSITIVE DETECTIONS IN SUBSURFACE SOILS - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D.	SWMU311-SB15-01	SWMU311-SB15-02	SWMU311-SB15-05	SWMU311-SB16-01	SWMU311-SB16-03	SWMU311-SB16-05	SWMU311-SB18-02
Lab Sample I.D.	Missing	Missing	Missing	Missing	Missing	Missing	Missing
Sample Date	06-19-2003	06-19-2003	06-19-2003	06-19-2003	06-19-2003	06-19-2003	06-23-2003
Depth Range	1-3	3-5	9-11	1-3	5-7	9-11	3-5

Volatiles ug/kg

No Hits Detected

TABLE 4-3b

POSITIVE DETECTIONS IN SUBSURFACE SOILS - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D.	SWMU311-SB18-04	SWMU311-SB18-06	SWMU311-SB20-01	SWMU311-SB20-03	SWMU311-SB20-06	SWMU311-sb25-05	SWMU311-sb26-07
Lab Sample I.D.	Missing	Missing	Missing	Missing	Missing	03-0309	03-0310
Sample Date	06-23-2003	06-23-2003	06-23-2003	06-23-2003	06-23-2003	Missing	Missing
Depth Range	7-9	11-13	1-3	5-7	11-13	9-11	13-15

Volatiles ug/kg

No Hits Detected

TABLE 4-3c

POSITIVE DETECTIONS IN GROUNDWATER - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D. Sample Date	USEPA Region IX PRGs Tap Water	NC 2L Groundwater Protection Stds (ug/l)[1]	SWMU311-GW04 06-19-2003	SWMU311-GW05 06-18-2003	SWMU311-GW06 06-19-2003	SWMU311-GW07 06-23-2003	SWMU311-GW10 06-18-2003
Volatiles (ug/L)							
cis-1,2-Dichloroethene	61	70	1 U	2	1 U	1 U	1 U

Shaded - Exceeds USEPA Region IX Tap Water PRGs
Bold - Exceeds NC DENR 2L Groundwater Protection Standard
J - Analyte detected. Report value is estimated.
NA - Not analyzed
ND - Analyte not detected
NE - Not established
[1] - If NC 2L Standard was not available, Interim standards were used.

TABLE 4-3c

POSITIVE DETECTIONS IN GROUNDWATER - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D. Sample Date	USEPA Region IX PRGs Tap Water	NC 2L Groundwater Protection Stds (ug/l)[1]	SWMU311-GW11 06-18-2003	SWMU311-GW15 06-19-2003	SWMU311-GW16 06-19-2003	SWMU311-GW18 06-23-2003	SWMU311-GW20 06-23-2003
Volatiles (ug/L)							
cis-1,2-Dichloroethene	61	70	1 U	1 U	1 U	1 U	1 U

Shaded - Exceeds USEPA Region IX Tap Water PRGs
Bold - Exceeds NC DENR 2L Groundwater Protection Standard
J - Analyte detected. Report value is estimated.
NA - Not analyzed
ND - Analyte not detected
NE - Not established
[1] - If NC 2L Standard was not available, Interim standards wer

SWMU 311
POSITIVE DETECTIONS OF VOCS AND RCRA METALS BY THE FIXED-BASE LABORATORY ANALYTICAL DATA
RCRA FACILITY INVESTIGATION - CTO-0143
MCB CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID SAMPLE DATE DEPTH RANGE	EPA Region IX PRGs Industrial	**North Carolina Soil to Groundwater Stds**	Background Criteria AOC 5 Subsurface	Base Background Criteria Subsurface-Sand	SWMU311-SB04-01 06-19-2003 1-3	SWMU311-SB04-04 06-19-2003 7-9	SWMU311-SB04-06 06-19-2003 11-13	SWMU311-SB05-02 06-18-2003 3-5
VOLATILES (ug/kg)								
Acetone	6000000	2810	NE	NE	11 U	NA	NA	NA
Carbon Disulfide	720000	4940	NE	NE	11 U	NA	NA	NA
Methylene Chloride	21000	22	NE	NE	1.9 J	NA	NA	NA
Tetrachloroethene	3400	7.42	NE	NE	11 U	NA	NA	NA
METALS (mg/kg)								
Arsenic	1.6	5.24	1.90	1.62	0.62 U	0.62 U	4.5	0.62 U
Barium	67000	848	26.05	22.0	11.5 J	2.9 J	14.9 J	12 J
Cadmium	450	2.72	ND	ND	0.09 U	0.09 U	0.1 U	1.1 J
Chromium	450	27.2	12.29	16.3	4.4	0.88 J	5	5.7
Lead	750	270	8.58	8.16	4.2	1	4.1	51.2 J
Selenium	5100	12.2	ND	0.687	0.66 UJ	0.68 J	0.71 UJ	0.67 UJ
Silver	5100	0.223	ND	ND	0.36 J	0.22 UJ	0.43 J	0.22 UJ

Shaded - Exceeds USEPA Region IX PRGs
Bold - Exceeds NC DENR default soil to groundwater comparison criteria
Underline - Exceeds AOC background concentrations (AOC 5 Subsurface Soil)
Boxed - Exceeds base background concentrations (Sand Data Set for Subsurface Soil)

J - Analyte detected. Report value is estimated.
NA - Not analyzed
ND - Analyte not detected
NE - Not established
Value for total chromium was used for chromium comparison.

SWMU 311
POSITIVE DETECTIONS OF VOCS AND RCRA METALS BY THE FIXED-BASE LABORATORY ANALYTICAL DATA
RCRA FACILITY INVESTIGATION - CTO-0143
MCB CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID SAMPLE DATE DEPTH RANGE	EPA Region IX PRGs Industrial	North Carolina Soil to Groundwater Stds	Background Criteria AOC 5 Subsurface	Base Background Criteria Subsurface-Sand	SWMU311-SB05-04 06-18-2003 7-9	SWMU311-SB06-01 06-19-2003 1-3	SWMU311-SB06-04 06-19-2003 7-9	SWMU311-SB07-01 06-24-2003 13-15
VOLATILES (ug/kg)								
Acetone	6000000	2810	NE	NE	12 U	12 U	NA	NA
Carbon Disulfide	720000	4940	NE	NE	12 U	12 U	NA	NA
Methylene Chloride	21000	22	NE	NE	12 U	2.5 J	NA	NA
Tetrachloroethene	3400	7.42	NE	NE	12 U	12 U	NA	NA
METALS (mg/kg)								
Arsenic	1.6	5.24	1.90	1.62	0.65 U	0.67 U	0.68 U	0.9 J
Barium	67000	848	26.05	22.0	7.1 J	20.7 J	7.4 J	18.3 J
Cadmium	450	2.72	ND	ND	0.09 U	0.1 U	0.1 U	0.1 U
Chromium	450	27.2	12.29	16.3	2.8	4.4	3.7	0.15 U
Lead	750	270	8.58	8.16	2.1 J	3.7	2.8	5 J
Selenium	5100	12.2	ND	0.687	0.7 UJ	1.1 J	0.73 UJ	1.7
Silver	5100	0.223	ND	ND	0.23 UJ	0.44 J	0.38 J	0.25 UJ

Shaded - Exceeds USEPA Region IX PRGs
Bold - Exceeds NC DENR default soil to groundwater comparison criteria
Underline - Exceeds AOC background concentrations (AOC 5 Subsurface Soil)
Boxed - Exceeds base background concentrations (Sand Data Set for Subsurface Soil)

J - Analyte detected. Report value is estimated.
NA - Not analyzed
ND - Analyte not detected
NE - Not established
Value for total chromium was used for chromium comparison.

SWMU 311
POSITIVE DETECTIONS OF VOCS AND RCRA METALS BY THE FIXED-BASE LABORATORY ANALYTICAL DATA
RCRA FACILITY INVESTIGATION - CTO-0143
MCB CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID SAMPLE DATE DEPTH RANGE	EPA Region IX PRGs Industrial	**North Carolina Soil to Groundwater Stds**	Background Criteria AOC 5 Subsurface	Base Background Criteria Subsurface-Sand	SWMU311-SB07-04 06-24-2003 7-9	SWMU311-SB07-08 06-24-2003 15-17	SWMU311-SB10-02 06-18-2003 3-5	SWMU311-SB10-04 06-18-2003 7-9
VOLATILES (ug/kg)								
Acetone	6000000	2810	NE	NE	NA	41	12 U	NA
Carbon Disulfide	720000	4940	NE	NE	NA	28	12 U	NA
Methylene Chloride	21000	22	NE	NE	NA	12 U	2.6 J	NA
Tetrachloroethene	3400	7.42	NE	NE	NA	12 U	12 U	NA
METALS (mg/kg)								
Arsenic	1.6	5.24	1.90	1.62	0.69 U	2.5	0.67 U	0.74 J
Barium	67000	848	26.05	22.0	5.8 J	3.6 J	6.9 J	8.1 J
Cadmium	450	2.72	ND	ND	0.1 U	0.1 U	0.1 U	0.09 U
Chromium	450	27.2	12.29	16.3	0.15 U	0.15 U	1.4 J	4.8
Lead	750	270	8.58	8.16	2.3 J	2 J	2.2	3
Selenium	5100	12.2	ND	0.687	0.74 U	0.73 U	0.72 UJ	0.69 UJ
Silver	5100	0.223	ND	ND	0.25 UJ	0.24 UJ	0.35 J	0.33 J

Shaded - Exceeds USEPA Region IX PRGs
Bold - Exceeds NC DENR default soil to groundwater comparison criteria
Underline - Exceeds AOC background concentrations (AOC 5 Subsurface Soil)
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RCRA FACILITY INVESTIGATION - CTO-0143
MCB CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID SAMPLE DATE DEPTH RANGE	EPA Region IX PRGs Industrial	North Carolina Soil to Groundwater Stds	Background Criteria AOC 5 Subsurface	Base Background Criteria Subsurface-Sand	SWMU311-SB10-08 06-18-2003 15-17	SWMU311-SB11-02 06-18-2003 3-5	SWMU311-SB11-03 06-18-2003 5-7	SWMU311-SB11-06 06-18-2003 11-13
VOLATILES (ug/kg)								
Acetone	6000000	2810	NE	NE	NA	NA	13 U	NA
Carbon Disulfide	720000	4940	NE	NE	NA	NA	13 U	NA
Methylene Chloride	21000	22	NE	NE	NA	NA	2.3 J	NA
Tetrachloroethene	3400	7.42	NE	NE	NA	NA	13 U	NA
METALS (mg/kg)								
Arsenic	1.6	5.24	1.90	1.62	1.1 J	0.61 U	0.74 U	0.72 U
Barium	67000	848	26.05	22.0	5.4 J	6.5 J	2.5 J	24.4 J
Cadmium	450	2.72	ND	ND	0.1 U	0.09 U	0.11 U	0.1 U
Chromium	450	27.2	12.29	16.3	7.4	2.9	4.3	5.5
Lead	750	270	8.58	8.16	4.8	2.8	3.1	8.6
Selenium	5100	12.2	ND	0.687	0.74 UJ	0.67 J	1.1 J	0.77 UJ
Silver	5100	0.223	ND	ND	0.36 J	0.51 J	0.39 J	0.41 J

Shaded - Exceeds USEPA Region IX PRGs
Bold - Exceeds NC DENR default soil to groundwater comparison criteria
Underline - Exceeds AOC background concentrations (AOC 5 Subsurface Soil)
Boxed - Exceeds base background concentrations (Sand Data Set for Subsurface Soil)

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SWMU 311
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RCRA FACILITY INVESTIGATION - CTO-0143
MCB CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID SAMPLE DATE DEPTH RANGE	EPA Region IX PRGs Industrial	**North Carolina Soil to Groundwater Stds**	Background Criteria AOC 5 Subsurface	Base Background Criteria Subsurface-Sand	SWMU311-SB15-01 06-19-2003 1-3	SWMU311-SB15-02 06-19-2003 3-5	SWMU311-SB15-08 06-19-2003 15-17	SWMU311-SB16-01 06-19-2003 1-3
VOLATILES (ug/kg)								
Acetone	6000000	2810	NE	NE	NA	NA	13 U	NA
Carbon Disulfide	720000	4940	NE	NE	NA	NA	13 U	NA
Methylene Chloride	21000	22	NE	NE	NA	NA	13 U	NA
Tetrachloroethene	3400	7.42	NE	NE	NA	NA	13 U	NA
METALS (mg/kg)								
Arsenic	1.6	5.24	1.90	1.62	0.66 J	0.73 U	0.75 U	0.64
Barium	67000	848	26.05	22.0	2.2 J	8.8 J	30.7 J	9.8
Cadmium	450	2.72	ND	ND	0.09 U	0.1 U	0.11 J	0.09
Chromium	450	27.2	12.29	16.3	2.4	5.2	6.7	5.1
Lead	750	270	8.58	8.16	1.8	10.5	6.5	7.6
Selenium	5100	12.2	ND	0.687	1.3 J	0.78 UJ	0.8 UJ	0.68
Silver	5100	0.223	ND	ND	0.37 J	0.35 J	0.65 J	0.54

Shaded - Exceeds USEPA Region IX PRGs
Bold - Exceeds NC DENR default soil to groundwater comparison criteria
Underline - Exceeds AOC background concentrations (AOC 5 Subsurface Soil)
Boxed - Exceeds base background concentrations (Sand Data Set for Subsurface Soil)

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SWMU 311
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RCRA FACILITY INVESTIGATION - CTO-0143
MCB CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID SAMPLE DATE DEPTH RANGE	EPA Region IX PRGs Industrial	North Carolina Soil to Groundwater Stds	Background Criteria AOC 5 Subsurface	Base Background Criteria Subsurface-Sand		SWMU311-SB16-05 06-19-2003 9-11	SWMU311-SB16-08 06-19-2003 15-17	SWMU311-SB18-02 06-23-2003 3-5	SWMU311-SB18-04 06-23-2003 7-9
VOLATILES (ug/kg)									
Acetone	6000000	2810	NE	NE		NA	22	11 UJ	NA
Carbon Disulfide	720000	4940	NE	NE		NA	12 U	11 U	NA
Methylene Chloride	21000	22	NE	NE		NA	3 J	11 U	NA
Tetrachloroethene	3400	7.42	NE	NE		NA	1.3 J	11 U	NA
METALS (mg/kg)									
Arsenic	1.6	5.24	1.90	1.62	U	2.1 J	0.69 U	0.61 U	0.58 U
Barium	67000	848	26.05	22.0	J	18 J	2.8 J	7.2 J	1.6 J
Cadmium	450	2.72	ND	ND	J	0.1 U	0.1 U	0.09 U	0.08 U
Chromium	450	27.2	12.29	16.3		7.4	2.5	0.13 U	0.12 U
Lead	750	270	8.58	8.16		6.3	1.6	1.8	1
Selenium	5100	12.2	ND	0.687	UJ	0.74 UJ	0.74 UJ	0.65 UJ	0.62 U
Silver	5100	0.223	ND	ND	J	0.43 J	0.49 J	0.22 UJ	0.21 UJ

Shaded - Exceeds USEPA Region IX PRGs
Bold - Exceeds NC DENR default soil to groundwater comparison criteria
Underline - Exceeds AOC background concentrations (AOC 5 Subsurface Soil)
Boxed - Exceeds base background concentrations (Sand Data Set for Subsurface Soil)

J - Analyte detected. Report value is estimated.
NA - Not analyzed
ND - Analyte not detected
NE - Not established
Value for total chromium was used for chromium comparison.

SWMU 311
POSITIVE DETECTIONS OF VOCS AND RCRA METALS BY THE FIXED-BASE LABORATORY ANALYTICAL DATA
RCRA FACILITY INVESTIGATION - CTO-0143
MCB CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID SAMPLE DATE DEPTH RANGE	EPA Region IX PRGs Industrial	North Carolina Soil to Groundwater Stds	Background Criteria AOC 5 Subsurface	Base Background Criteria Subsurface-Sand	SWMU311-SB18-06 06-23-2003 11-13	SWMU311-SB20-01 06-23-2003 1-3	SWMU311-SB20-03 06-23-2003 5-7	SWMU311-SB20-06 06-23-2003 11-13
VOLATILES (ug/kg)								
Acetone	6000000	2810	NE	NE	NA	NA	12 J	NA
Carbon Disulfide	720000	4940	NE	NE	NA	NA	12 U	NA
Methylene Chloride	21000	22	NE	NE	NA	NA	12 U	NA
Tetrachloroethene	3400	7.42	NE	NE	NA	NA	12 U	NA
METALS (mg/kg)								
Arsenic	1.6	5.24	1.90	1.62	0.65 U	0.7 U	0.64 U	0.72 U
Barium	67000	848	26.05	22.0	2 J	4.8 J	8.9 J	25.4 J
Cadmium	450	2.72	ND	ND	0.09 U	0.1 U	0.09 U	0.1 U
Chromium	450	27.2	12.29	16.3	0.14 U	0.15 U	0.14 U	0.15 U
Lead	750	270	8.58	8.16	1.2	4.7	3.9	5.8
Selenium	5100	12.2	ND	0.687	0.7 U	0.96 J	0.69 U	0.87 J
Silver	5100	0.223	ND	ND	0.23 UJ	0.25 UJ	0.23 UJ	0.26 UJ

Shaded - Exceeds USEPA Region IX PRGs
Bold - Exceeds NC DENR default soil to groundwater comparison criteria
Underline - Exceeds AOC background concentrations (AOC 5 Subsurface Soil)
Boxed - Exceeds base background concentrations (Sand Data Set for Subsurface Soil)

J - Analyte detected. Report value is estimated.
NA - Not analyzed
ND - Analyte not detected
NE - Not established
Value for total chromium was used for chromium comparison.

TABLE 4-5

ANALYTICAL DATA STATISTICAL SUMMARY - SOIL
RCRA FACILITY INVESTIGATION - SWMU 311
MCB CAMP LEJEUNE, NORTH CAROLINA

	Minimum Non-Detect	Maximum Non-Detect	Minimum Detected	Maximum Detected	Frequency of Detection	EPA Region IX PRGs Industrial	North Carolina Soil to Groundwater Stds	Background Criteria AOC 5 Subsurface	Base Background Criteria Subsurface-Sand	Location of Maximum Detect
Volatiles (ug/kg)										
Acetone	11 UJ	13 U	12 J	41	3/10	0	0	0	0	SWMU311-SB07-08
Carbon Disulfide	11 U	13 U	28	28	1/10	0	0	0	0	SWMU311-SB07-08
Methylene Chloride	11 U	13 U	1.9 J	3 J	5/10	0	0	0	0	SWMU311-SB16-08
Tetrachloroethene	11 U	13 U	1.3 J	1.3 J	1/10	0	0	0	0	SWMU311-SB16-08
Metals (mg/kg)										
Arsenic	0.58 U	0.75 U	0.66 J	4.5	7/28	3	0	3	3	SWMU311-SB04-06
Barium	0	0	1.6 J	30.7 J	28/28	0	0	1	3	SWMU311-SB15-08
Cadmium	0.08 U	0.11 U	0.09 J	1.1 J	3/28	0	0	3	3	SWMU311-SB05-02
Chromium	0.12 U	0.15 U	0.88 J	7.4	19/28	0	0	0	0	SWMU311-SB10-08, SWMU311-SB16-05
Lead	0	0	1	51.2 J	28/28	0	0	3	3	SWMU311-SB05-02
Selenium	0.62 U	0.8 UJ	0.67 J	1.7	8/28	0	0	8	6	SWMU311-SB07-01
Silver	0.21 UJ	0.26 UJ	0.33 J	0.65 J	16/28	0	16	16	16	SWMU311-SB15-08

TABLE 4-5

ANALYTICAL DATA STATISTICAL SUMMARY - GROUNDWATER
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

	Minimum Non-Detect		Maximum Non-Detect		Minimum Detected	Maximum Detected	Frequency of Detection	EPA Region 9 PRGs TAP Water	NC 2L Groundwater Protection Stds (ug/l)	Location of Maximum Detect
Volatiles (ug/L)										
Cis-1,2-DCE	1	U	1	U	2	2	1/10	0	0	SWMU311-GW05

FIGURES

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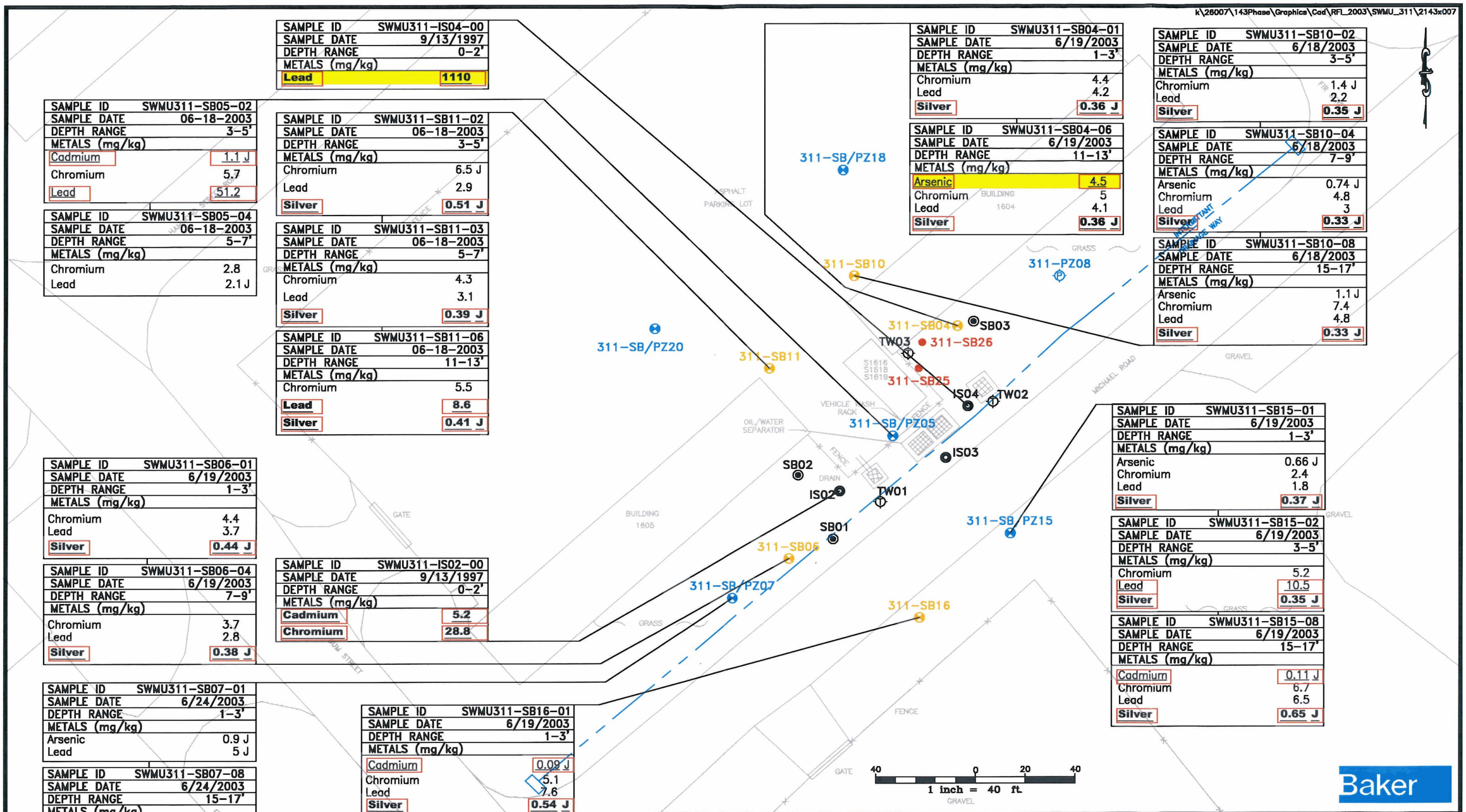


SAMPLE ID	SWMU311-IS04-00
SAMPLE DATE	9/13/1997
DEPTH RANGE	0-2'
METALS (mg/kg)	
Lead	**1110**

SAMPLE ID	SWMU311-SB05-02
SAMPLE DATE	06-18-2003
DEPTH RANGE	3-5'
METALS (mg/kg)	
Cadmium	1.1 J
Chromium	5.7
Lead	51.2

SAMPLE ID	SWMU311-SB05-04
SAMPLE DATE	06-18-2003
DEPTH RANGE	5-7'
METALS (mg/kg)	
Chromium	2.8
Lead	2.1 J

SAMPLE ID	SWMU311-SB11-02
SAMPLE DATE	06-18-2003
DEPTH RANGE	3-5'
METALS (mg/kg)	
Chromium	6.5 J
Lead	2.9
Silver	**0.51 J**

SAMPLE ID	SWMU311-SB11-03
SAMPLE DATE	06-18-2003
DEPTH RANGE	5-7'
METALS (mg/kg)	
Chromium	4.3
Lead	3.1
Silver	**0.39 J**

SAMPLE ID	SWMU311-SB11-06
SAMPLE DATE	06-18-2003
DEPTH RANGE	11-13'
METALS (mg/kg)	
Chromium	5.5
Lead	**8.6**
Silver	**0.41 J**

SAMPLE ID	SWMU311-SB04-01
SAMPLE DATE	6/19/2003
DEPTH RANGE	1-3'
METALS (mg/kg)	
Chromium	4.4
Lead	4.2
Silver	**0.36 J**

SAMPLE ID	SWMU311-SB04-06
SAMPLE DATE	6/19/2003
DEPTH RANGE	11-13'
METALS (mg/kg)	
Arsenic	4.5
Chromium	5
Lead	4.1
Silver	**0.36 J**

SAMPLE ID	SWMU311-SB10-02
SAMPLE DATE	6/18/2003
DEPTH RANGE	3-5'
METALS (mg/kg)	
Chromium	1.4 J
Lead	2.2
Silver	**0.35 J**

SAMPLE ID	SWMU311-SB10-04
SAMPLE DATE	6/18/2003
DEPTH RANGE	7-9'
METALS (mg/kg)	
Arsenic	0.74 J
Chromium	4.8
Lead	3
Silver	**0.33 J**

SAMPLE ID	SWMU311-SB10-08
SAMPLE DATE	6/18/2003
DEPTH RANGE	15-17'
METALS (mg/kg)	
Arsenic	1.1 J
Chromium	7.4
Lead	4.8
Silver	**0.33 J**

SAMPLE ID	SWMU311-SB06-01
SAMPLE DATE	6/19/2003
DEPTH RANGE	1-3'
METALS (mg/kg)	
Chromium	4.4
Lead	3.7
Silver	**0.44 J**

SAMPLE ID	SWMU311-SB06-04
SAMPLE DATE	6/19/2003
DEPTH RANGE	7-9'
METALS (mg/kg)	
Chromium	3.7
Lead	2.8
Silver	**0.38 J**

SAMPLE ID	SWMU311-IS02-00
SAMPLE DATE	9/13/1997
DEPTH RANGE	0-2'
METALS (mg/kg)	
Cadmium	**5.2**
Chromium	**28.8**

SAMPLE ID	SWMU311-SB07-01
SAMPLE DATE	6/24/2003
DEPTH RANGE	1-3'
METALS (mg/kg)	
Arsenic	0.9 J
Lead	5 J

SAMPLE ID	SWMU311-SB07-08
SAMPLE DATE	6/24/2003
DEPTH RANGE	15-17'
METALS (mg/kg)	
Arsenic	2.5
Lead	2 J

SAMPLE ID	SWMU311-SB16-01
SAMPLE DATE	6/19/2003
DEPTH RANGE	1-3'
METALS (mg/kg)	
Cadmium	0.09 J
Chromium	5.1
Lead	7.6
Silver	**0.54 J**

SAMPLE ID	SWMU311-SB16-05
SAMPLE DATE	6/19/2003
DEPTH RANGE	9-11'
METALS (mg/kg)	
Arsenic	2.1 J
Chromium	7.4
Lead	6.3
Silver	**0.54 J**

SAMPLE ID	SWMU311-SB15-01
SAMPLE DATE	6/19/2003
DEPTH RANGE	1-3'
METALS (mg/kg)	
Arsenic	0.66 J
Chromium	2.4
Lead	1.8
Silver	**0.37 J**

SAMPLE ID	SWMU311-SB15-02
SAMPLE DATE	6/19/2003
DEPTH RANGE	3-5'
METALS (mg/kg)	
Chromium	5.2
Lead	10.5
Silver	**0.35 J**

SAMPLE ID	SWMU311-SB15-08
SAMPLE DATE	6/19/2003
DEPTH RANGE	15-17'
METALS (mg/kg)	
Cadmium	0.11 J
Chromium	6.7
Lead	6.5
Silver	**0.65 J**

SHADED – EPA REGION IX INDUSTRIAL PRG
BOLD – NORTH CAROLINA SOIL-TO-GROUNDWATER TARGET CONCENTRATIONS
UNDERLINED – AOC 5 SURFACE SOIL BACKGROUND
BOXED – BASE SURFACE SOIL BACKGROUND

LEGEND
- PHASE II CSI TEMPORARY WELL
- PHASE II CSI SOIL BORING
- PHASE II CSI SURFACE SOIL SAMPLE
- PHASE I CSI SOIL BORING
- RFI SOIL BORING LOCATION
- RFI SOIL BORING AND GROUNDWATER GRAB LOCATION
- RFI SOIL BORING AND GROUNDWATER GRAB AND PIEZOMETER LOCATION
- RFI PIEZOMETER LOCATION

SOURCE: MCB CAMP LEJEUNE MARCH 2000

Baker

FIGURE 4-1
SCREENING CRITERIA EXCEEDANCES OF RCRA METALS IN SOIL
RCRA FACILITY INVESTIGATION
SWMU 311, CTO – 0143
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

5.0 FATE AND TRANSPORT

The potential for a constituent to migrate and persist in an environmental medium is critical when evaluating the potential for a chemical to elicit an adverse human health or ecological effect. The environmental mobility of a chemical is influenced by its physical and chemical properties, the physical characteristics of the site, and the site chemistry. This section presents a discussion of the various physical and chemical properties of significant constituents in SWMU 311 media discussed in Section 4.0, and their fate and transport in the environment.

5.1 Chemical and Physical Properties Impacting Fate and Transport

Table 5-1 presents the physical and chemical properties associated with the organic COPCs. These properties determine the inherent environmental mobility and fate of a constituent. The properties of interest include:

- Vapor pressure
- Water solubility
- Octanol/water partition coefficient
- Organic carbon adsorption coefficient (sediment partition)
- Specific gravity
- Henry's Law constant

A discussion of the environmental significance of each of these properties follows.

Vapor pressure provides an indication of the rate at which a chemical may volatilize. It is of primary significance at environmental interfaces such as surface soil/air and surface water/air. Volatilization can be important when evaluating groundwater and subsurface soils, particularly when selecting remedial technologies. Vapor pressure for monocyclic aromatics is generally higher than vapor pressures for poly-aromatic hydrocarbons (PAHs). Constituents with higher vapor pressures (e.g., VOCs) will enter the atmosphere at a quicker rate than the constituents with low vapor pressures (e.g., pesticides).

The rate at which a contaminant is leached from soil by infiltrating precipitation is proportional to its water solubility. More soluble constituents are usually more readily leached than less soluble

constituents. The water solubilities indicate that VOCs, including monocyclic aromatics, are usually several orders-of-magnitude more soluble than pesticides. Consequently, highly soluble compounds such as chlorinated VOCs will go into solution faster and possibly in greater concentrations than less soluble compounds. The solubility of a specific compound is dependent on the chemistry of the groundwater and aquifer material. Factors such as groundwater pH, Eh (redox potential), temperature, and the presence of other compounds can greatly affect the solubility.

The octanol/water partition coefficient (K_{ow}) is the ratio of the chemical concentration in octanol divided by the concentration in water. The octanol/water partition coefficient has been shown to correlate well with bioconcentration factors in aquatic organisms and adsorption to soil or sediment. Specifically, a linear relationship between octanol/water partition coefficients and the uptake of chemicals by fatty tissues of animal and human receptors (the bioconcentration factor - BCF) has been established (Lyman et al., 1982). The coefficient is also useful in characterizing the sorption of compounds by organic soils where experimental values are not available.

The organic carbon adsorption coefficient (K_{oc}) indicates the tendency of a chemical to adhere to the organic carbon in soil particles. The solubility of a chemical in water is inversely proportional to the K_{oc}. Contaminants with high soil/sediment adsorption coefficients generally have low water solubilities. For example, contaminants such as pesticides are relatively immobile in the environment, are preferentially bound to the soil, and have a higher K_{oc} value. These compounds are not subject to aqueous transport to the extent of compounds with higher water solubilities. Mechanical activities (e.g., erosion) and the physical characteristics of surface soils may, however, increase the mobility of these bound soil contaminants.

Specific gravity is the ratio of a given volume of pure chemical at a specified temperature to the weight of the same volume of water at a specified temperature. Its primary use is to determine whether a contaminant will have a tendency to "float" or "sink" (as an immiscible liquid) in water if it exceeds its corresponding water solubility.

Vapor pressure and water solubility are of use in determining volatilization rates from surface water bodies and from groundwater. These two parameters can be used to estimate an equilibrium concentration of a contaminant in the water phase and in the air directly above the water. This relationship is expressed as Henry's Law Constant.

A quantitative assessment of mobility has been developed that uses water solubility (S), vapor pressure (VP), and organic carbon partition coefficient (K_{oc}) (Laskowski, 1983). This value is referred to as the Mobility Index (MI). It is defined as:

$$MI = \log ([S*VP]/ K_{oc})$$

A scale to evaluate MI as presented by Ford and Gurba (1984) is:

Relative MI	Mobility Description
> 5	extremely mobile
0 to 5	very mobile
-5 to 0	slightly mobile
-10 to –5	immobile
< -10	very immobile

As shown on Table 5-1, the VOC COPCs are extremely mobile.

5.2 Contaminant Transport Pathways

Based on the evaluation of existing conditions at SWMU 311, the following potential contaminant transport pathways have been identified:

- Wind-blown dust and erosion
- Leaching of soil contaminants to groundwater

In general, constituent concentrations may be affected by one or more mechanisms during transport. Constituents may be physically transformed by volatilization or precipitation. Constituents may be chemically transformed through photolysis, hydrolysis, and oxidation/reduction. Constituents may be biologically transformed by biodegradation. Additionally, constituents may accumulate in one or more media. The paragraphs that follow describe the potential transport pathways listed above with respect to significant constituent concentrations.

5.2.1 Wind-blown Dust and Erosion

Cadmium, chromium, and lead were observed in surface soil samples. Wind and surface water serves as a constituent transport pathway agent by eroding exposed soil and sediment and moving it off site. These processes are influenced by rain, infiltration rate, wind velocity, grain

size/density of the soil/sediment particles, moisture conditions, and the amount of vegetative cover over the soil or sediment. Organic compounds with high K_{oc} values adsorb to organic matter in the soil. Inorganic compounds tend to absorb to the clay minerals in the soil.

Most of the area in the vicinity of the oil/water separator is vegetated. This vegetation minimizes the likelihood of fugitive dust generation. Occasional and very small patches of bare ground were observed in the vicinity of the oil/water separator (on the order of a few square inches). Thus, the likelihood of transport by surface water or wind is minimal. This is verified by the fact that cadmium, chromium, and lead were generally not detected above screening criteria in soils samples away from the SWMU.

5.2.2 Leaching of Soil Constituents to Groundwater

Cadmium, chromium, and lead were detected primarily in surface soil, while PCE, TCE, chlorobenzene, and benzene were detected in subsurface soil. Constituents that adhere to soil particles or accumulate in soil pore spaces can leach and migrate vertically to the groundwater as a result of infiltration of precipitation. The rate and extent of this leaching is influenced by several factors, including:

- The depth to the water table
- The amount of precipitation
- The rate of infiltration
- The physical and chemical properties of the soil
- The physical and chemical properties of the contaminant

There are four lines of evidence that suggest that leaching of soil constituents to groundwater is insignificant or not a complete pathway:

- Detections of PCE, TCE, benzene, and chlorobenzene above STGCs were shown to be limited in extent in the Phase II CSI Report and in Section 4.0 herein. The volume of contaminated soil through which percolating rainwater or groundwater passes is small. Thus, the mass of contamination available for leaching is small. Additionally, with a maximum COPCs concentration at 400 μg/kg, the concentration gradient is small. All this suggests that leaching of these VOCs is insignificant.

- Detections of cadmium, chromium, and lead above PRGs/STGCs in samples near the SWMU are limited to surface soil. Detections of cadmium and lead above STGCs in subsurface soil are limited and scattered, and not in a pattern suggesting leaching from a surface soil source.

- As shown on Table 5.2, cadmium exhibits a medium relative mobility in most environmental conditions, while chromium and lead exhibit a low to very low relative mobility in most environmental conditions.

- PCE, TCE, benzene, chlorobenzene, and cadmium were not detected in any groundwater samples. Chromium, and lead were detected in one groundwater sample (SWMU311-GW01) during the Phase II CSI, but at concentrations below North Carolina 2L Standards. No evidence of impacts to groundwater have been observed.

TABLES

TABLE 5-1

ORGANIC CONSTITUENT PHYSICAL AND CHEMICAL PROPERTIES
SWMU-311
RCRA FACILITY INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Constituents of Potential Concern	log K_{ow} (unitless)	Specific Gravity (unitless)	Henry's Law Constant (atm-m^3/mol)	Imbility Index Input Parameters			Mobility Index	Comments
				Vapor Pressure (mm Hg)	Water Solubility (mg/L)	Koc (mL/g)		
Tetrachloroethene	2.60	1.62	2.59E-02	1.78E+01	150	364	0.87	Extremely mobile
Trichloroethene	2.38	1.46	9.10E-03	5.79E+01	1100	126	2.70	Extremely mobile
Benzene	2.12	0.88	5.59E-03	9.52E+01	1750	83	3.30	Extremely mobile
Chlorobenzene	2.84	1.11	3.72E-03	1.17E+01	466	330	1.22	Extremely mobile

Notes:
Sources - Superfund Public Health Evaluation Manual (EPA 540/1-86/060)
- Specific gravity data from Chemfinder.com
NA - Not available

TABLE 5-2

RELATIVE MOBILITIES OF METALS AS A FUNCTION OF ENVIRONMENTAL CONDITIONS (Eh, pH)
SWMU-311
RCRA FACILITY INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Relative Mobility	Environmental Conditions			
	Oxidizing	Acidic	Neutral/Alkaline	Reducing
Very high			Se	
High	Se, Zn	Se, Zn, Cu, Ni, Hg, Ag		
Medium	Cu, Ni, Hg, Ag, As, **Cd**	As, **Cd**	As, **Cd**	
Low	**Pb**, Ba, Se	**Pb**, Ba, Be	**Pb**, Ba, Be	
Very Low	Fe, **Cr**	**Cr**	**Cr**, Zn, Cu, Ni, Hg, Ag	**Cr**, Se, Zn, Cu, Ni, Hg, **Pb**, Ba, Be, Ag

Notes:

Se = Selenium	Cd = Cadmium
Zn = Zinc	Ba = Barium
Cu = Copper	Pb = Lead
Ni = Nickel	Fe = Iron
Hg = Mercury	Cr = Chromium
Ag = Silver	Be = Beryllium
As = Arsenic	Zn = Zinc

Metals in bold are Section 5.0 COPCs

Source: Swartzbaugh, et al. "Remediating Sites Contaminated with Heavy Metals." Hazardous Materials Control, November/December 1992.

6.0 HUMAN HEALTH RISK ASSESSMENT

A baseline human health risk assessment (HHRA) was completed as part of the RFI for SWMU 311 to evaluate if unacceptable risks may be associated with potential exposure to existing conditions at the site. The baseline HHRA considers the most likely routes of potential human exposure for both current and future risk scenarios. The baseline HHRA was conducted in accordance with the Risk Assessment Guidance for Superfund (RAGS), Part A, Human Health Evaluation Manual (USEPA, 1989) and the most recent updates, including the reporting format as set forth in RAGS Part D (USEPA, 1998). USEPA Region IV Supplemental Risk Guidance (USEPA, 1996) was also utilized throughout the baseline HHRA process. Soil and groundwater data from the Phase I (1997) and Phase II (2002) CSIs and RFI (2003) field investigation activities were evaluated in this baseline HHRA.

The baseline HHRA is comprised of seven sections; Section 6.1 presents the site location and characterization. Section 6.2 presents the hazard identification, which presents criteria for selecting COPCs. Sections 6.3 and 6.4 present the exposure assessment and toxicity assessment, respectively. The risk characterization, including a discussion of potential human health effects, is presented in Section 6.5. Section 6.6 outlines the potential sources of uncertainty encountered in the process of performing a risk assessment, and their potential effects on the estimation of human health risks. A summary of the baseline HHRA is provided in Section 6.7.

6.1 Site Location and Characterization

The following information on SWMU 311 is provided in order to characterize the exposure setting. This background section will provide an overview of the characteristics of SWMU 311 and will provide a site location, a general site description, and the site-specific chemicals as discussed in past reports. The physical characteristics of the site and the geographical areas of concern will also be briefly discussed. For more detailed information on the previous investigations and the site characteristics of SWMU 311, a complete discussion is included in Sections 1.0 and 3.0 of this RFI report.

The SWMU 311 is located in the HPIA just north of Michael Road between Gum and Fir Streets (Figure 1-1). SWMU 311 consists of an oil/water separator that is associated with a vehicle wash rack (Figure 1-2). The vehicle wash rack is situated between Buildings 1604 and 1605 in a

fenced-in and paved area. The oil/water separator is situated in a grassy area adjacent to the paved area and outside of the fence line. The separator was installed in 1984 and is currently used. The structure is a concrete, in-ground unit that discharges to a wastewater treatment plant via sanitary sewer. A drainage swale runs parallel to Michael Road and flows into a culvert that leads to Cogdels Creek. The interception of the drainage swale and culvert is approximately 2,250 feet northwest of Cogdels Creek. The drain from the wash rack to the oil/water separator showed evidence of overflow (i.e., eroded soils) during the October 1996 site visit conducted by Baker.

The term "study area" is used in this report. The study area generally includes the area bounded by Michael and Hammond Roads and Gum and Fir Streets, including SWMU 311 itself.

Refer to Section 1.3 for details on previous investigations conducted at SWMU 311. Refer to Section 2.0, "Field Investigation," for details on the collection of the samples for the RFI field investigation activities conducted in June and July 2003.

The laboratory results from the Phase I (1997) and Phase II (2002) CSIs and RFI (2003) sampling activities that will be utilized in the human health risk assessment are discussed in Section 6.2 "Hazard Identification."

6.2 Hazard Identification

Data generated during the Phase I CSI (1997), Phase II (2002) CSI, and RFI (2003) field investigations at SWMU 311 were used to draw conclusions and to identify data gaps in the baseline HHRA. The data were evaluated to assess which data were of sufficient quality to include in the risk assessment. The objective when selecting data to include in the risk assessment was to provide accurate and precise data to characterize contamination and evaluate exposure pathways.

6.2.1 Data Evaluation

The initial hazard identification step entailed the validation and evaluation of the site data to determine its usability in the risk assessment. This process identified a data set of useable data for human health risk assessment for the site. During this validation and evaluation, data that

would result in inaccurate conclusions (e.g., data that were rejected or attributed to blank contamination, as qualified by the validator) were reduced within the data set. Data reduction entailed the removal of unreliable data from the original data set based on the guidelines established by USEPA. A summary of the data quality was presented in Section 4.0.

Duplicate sample data were averaged with corresponding environmental sample data and re-included into the data set for these risk evaluations. In instances where the original and duplicate sample result were either both detected or both non-detected, the values were averaged for the risk assessment. In instances when the original and duplicate sample result contained one positive detection and one non-detection, the detected value was averaged with one-half of the detection limit of the non-detected value and the averaged sample result was considered a positive detection.

6.2.2 Identification of Data Suitable for Use in a Quantitative Risk Assessment

To provide for accurate conclusions to be drawn from sampling results, analytical data were reviewed and evaluated. This section summarizes the available analytical data for SWMU 311 and the subsequent reduction of these data to the data sets that were used in the HHRA.

Data available for the HHRA at SWMU 311 includes surface soil, subsurface soil, and groundwater data collected for the Phase I SWMU CSI (Baker, 2001), Phase II SWMU CSI (Baker, 2002), and the current RFI field investigation. These investigations were conducted in series with specific goals for each investigation. The Phase I investigation was conducted to determine if activities associated with the SWMU had possibly impacted the environment surrounding the SWMU. Therefore, the samples collected as part of this investigation were located as close to the SWMU as physically possible or in areas were evidence of possible environmental impact had been observed. If a specific group of constituents were not detected in the samples (e.g., volatiles), then they were eliminated as constituents of concern for that particular SWMU. As such, subsequent investigations did not include any group of constituents that had been eliminated as potential constituents of concern. Likewise, if a particular group of constituents were delineated during any investigation or combination of investigations, the extent of the contamination is assumed to be delineated and further investigation of these compounds would not be considered necessary.

As part of the Phase I CSI, surface (0-2 feet bgs) and subsurface (>2 feet bgs) soil samples were collected from each of three soil borings advanced around the perimeter of the SWMU and were analyzed for aromatic VOCs (1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, benzene, chlorobenzene, ethylbenzene, toluene, and xylenes), SVOCs, and RCRA metals. As part of the Phase II CSI, surface (0-1 foot bgs) and subsurface (>1 foot bgs) soil samples were collected from three soil borings and three temporary well borings, and groundwater was sampled from three temporary wells. Soil and groundwater samples were analyzed for VOCs and RCRA metals. SVOC analysis was not included in the Phase II study because none of the ten SVOCs detected during Phase I were detected at concentrations greater than NC DENR soil to groundwater screening criteria or USEPA Region IX residential PRGs (Baker, 2001). Because these compounds did not exceed any of the comparison criteria in the samples collected closest to the SWMU during the Phase I investigation, the COPC list was reduced to include only VOCs and RCRA metals. The RFI field investigation included the collection of six surface soil samples (0-1 foot bgs), 37 subsurface soil samples (>1 foot bgs) from 10 soil borings, and 10 groundwater grab samples from soil borings (not including QC samples). Surface soil and groundwater samples collected for the RFI were analyzed for VOCs by a mobile laboratory (benzene, PCE, TCE, cis-DCE, trans-DCE, methylene chloride, and 1,1-DCE). Subsurface soil samples were analyzed for VOCs by a mobile laboratory and/or a fixed base laboratory and for RCRA metals by a fixed base laboratory (Table 2-1).

Of the data collected during the RFI field investigation, only analytical results from the fixed-base laboratory were included in the HHRA. Soil and groundwater samples collected for the RFI were analyzed for VOCs by a mobile laboratory using a gas chromatograph headspace method. Field decisions based on quick-turn mobile laboratory analysis of VOCs determined the direction and termination of the RFI field investigation. However, the mobile laboratory data were not validated and as such, were not included in the HHRA. It should be noted that soil and groundwater samples that were analyzed by the fixed base laboratory and validated were collected from locations distributed throughout the source area. Also, exclusion of the mobile laboratory data is not expected to affect the results of the HHRA. The uncertainty associated with the mobile laboratory data is discussed further in Section 6.6.1.

A subset of the available data was used for the SWMU 311 HHRA. All surface soil data collected from 0-1 feet bgs (Phase II and RFI investigations) was used in the HHRA. Surface soil samples collected from 0-2 feet bgs (Phase I investigation) are generally not included in a HHRA

because they are not representative of the depth range recommended by USEPA Region IV risk guidance (USEPA, 1996). However, the three surface soil samples collected from 0-2 feet bgs during the Phase I investigation were included in the HHRA data set to maximize the number of available data points and to gain representative coverage within the exposure area. Additionally, the soil data collected during Phase I is only data that includes SVOC analytical results. It is noted that the use of the 0-2 foot bgs surface soil samples adds uncertainty to the risk assessment. The inclusion of soils from 1-2 feet bgs in these samples may dilute the concentration of any constituents that may be present in the top foot of soil. This uncertainty is addressed in Section 6.6.1. Subsurface soil data from 1 to 9 feet bgs was used in the HHRA. Analytical results from subsurface soil samples collected from locations 311-SB15 and 311-SB16 were not included in the HHRA because these locations are side gradient (south) to SWMU 311. These locations were not impacted by site operations and inclusion of these data would likely dilute the concentration of any constituents present in subsurface soil present in the "study area" of SWMU 311. These data are presented in full in Appendix F.

As discussed above, soil data collected during the Phase I CSI was incorporated in this risk assessment. It should be noted that this data was analyzed by a fixed-base laboratory following Contract Laboratory Program (CLP) protocol but was not validated by an independent third-party data validator. These data were included in the risk assessment because removing these data would result in data gaps for surface soil and shallow subsurface soil. It is recognized that the use of this data adds uncertainty to the risk assessment. This uncertainty is addressed in Section 6.6.1.

It is also important to note that there are two different surface soil data sets used for evaluation of human receptors in this HHRA. In addition to the data set including all surface soil data points previously discussed, a second surface soil data set was created to more accurately evaluate trespasser exposure. These two different data sets were created because there is restricted access to Buildings 1604 and 1605 located on either side of SWMU 311. Buildings 1604 and 1605 are located in a fenced-in and paved area. Only authorized personnel have access to the buildings inside the fence. As shown on Figure 1-2, SWMU 311 is located outside the fence, but in order to characterize the site, environmental samples were collected around SWMU 311 from points both inside and outside the fence. Therefore, a separate data set containing surface soil data points located outside the fence line was used to evaluate potential exposure to surface soil for

those individuals who cannot access the area inside the fence. This data set consists of surface soil samples from the following locations: IS03, SB01, TW01, and TW02.

Shallow groundwater is currently not utilized as a potable source at the site. Although the shallow aquifer is classified as GA (i.e., existing or potential source of drinking water for humans), it is not used as a potable water source at MCB Camp Lejeune because of its low yielding production rates. However, there remains the possibility that upon closure of this facility, residential housing or industrial/commercial buildings could be constructed, and groundwater at SWMU 311 could be used for potable purposes in the future. Therefore, in accordance with USEPA guidance, groundwater exposure was conservatively evaluated for future residential receptors.

For current receptors (military Base personnel and trespassers), potable water is supplied by the Base treatment facilities using water supply wells that are set in the lower reaches of the Castle Hayne aquifer (typically 200 to 300 feet bgs). Current operating wells are periodically sampled for control purposes. Hence, assessing current risks to constituents detected in the groundwater for current receptors is unnecessary and, if estimated, may present an unlikely risk. Based on this, groundwater exposure to current receptors was not estimated for this investigation.

Information relating to the nature and extent of contamination at the site is provided in Section 4.0 of this report. The reduced data sets for all site media of concern used in this HHRA are provided in Appendix F of this report.

6.2.3 Criteria for Selecting Chemicals of Potential Concern

As recommended in the USEPA RAGS (USEPA, 1989) and Region IV Bulletin (USEPA, 1996), the following criteria were used to select the COPCs:

- Comparison to USEPA Region IX PRGs;
- Comparison to field and laboratory blank data;
- Comparison to background or naturally occurring levels; and
- Essential Nutrients

Additional criteria used to assist in the evaluation of COPCs include:

- Historical information;
- Persistence;
- Mobility;
- Comparison to anthropogenic levels;
- Toxicity; and
- State and federal standards and criteria

A brief description of the selection criteria used in choosing final COPCs is presented below.

Tables 6-1 through 6-6 present the data and COPC selection summary for each media, grouped according to organic compounds and inorganics within each table.

USEPA Region IX PRGs - The screening values used in this baseline HHRA are PRGs for Region IX. PRGs are tools for evaluating and cleaning up contaminated sites. They are risk-based concentrations derived from standardized equations (representing ingestion, dermal contact, and inhalation exposure pathways), combining exposure information assumptions and EPA toxicity data. The PRGs contained in the Region IX PRG Table are generic; they are calculated without site-specific information. Region IX PRGs should be viewed as Agency guidelines, not legally enforceable standards. The PRGs for potentially carcinogenic chemicals are based on a target Incremental Lifetime Cancer Risk (ILCR) of $1x10^{-6}$. The PRGs for noncarcinogens are based on a target hazard quotient of 1.0. In order to account for cumulative risk from multiple chemicals in a medium, it is necessary to derive the PRGs based on a target hazard quotient of 0.1. Noncarcinogenic PRGs based on a target hazard quotient of 0.1 and the most recent toxicological criteria available, results in a set of values that can be used as screening criteria. In order to yield a hazard index of 0.1, the noncarcinogenic PRGs were divided by a factor of ten. For potential carcinogens, the toxicity criteria applicable to the derivation of PRG values are oral and inhalation CSFs; for noncarcinogens, they are chronic oral and inhalation RfDs. These toxicity criteria are subject to change as more updated information and results from the most recent toxicological/epidemiological studies become available. The PRG table is updated annually to reflect such changes. It should be noted that the most recent update was in the year 2002.

Tap water PRGs were used as screening values for groundwater based on the assumption that groundwater will be used as a potable supply in the future. Because of the potential for residential use of this site, residential soil PRGs were used as screening criteria for soil (USEPA, 1996). As recommended in USEPA Region IV guidance, industrial PRGs were used as screening criteria for the subsurface soil when considering an industrial scenario.

Contaminant Concentrations in Blanks - If a chemical is detected in both the environmental sample and a blank sample, it may not be retained as a COPC in accordance with RAGS depending on the concentration of the chemical in the media (USEPA, 1989). Therefore, blank data were compared with results from environmental samples. If the blanks contained detectable results for common laboratory contaminants (i.e., acetone, 2-butanone, methylene, chloride, toluene, and phthalate esters), environmental sample results were considered as positive results only if they exceeded 10 times the maximum amount detected in the associated blank. If the chemical detected in the blank(s) is not a common laboratory contaminant, environmental sample results were considered as positive results only if they exceeded five times the maximum amount detected in the associated blank(s) (USEPA, 1991). Furthermore, the elimination of an environmental sample result would directly correlate to a reduction in the prevalence of the contaminant in that media.

The aforementioned methodologies for evaluating blanks were implemented during third party analytical data validation prior to the selection of COPCs in the risk assessments. QA/QC data summaries are presented in Table 4-2 of this RFI Report.

Background or Naturally-Occurring Levels - Generally, a comparison to naturally-occurring levels applies only to inorganic analytes, because the majority of organic chemicals are not naturally occurring. Background samples are collected from areas that are not influenced by site contamination. Sample concentrations for surface soil, subsurface soil, and groundwater were compared to base-specific (i.e., two times the average concentration) background levels. If the maximum detected concentration of an inorganic was less than two times the average background concentration, it was not retained as a COPC.

Surface and subsurface soil background data were obtained from the Area of Concern Background Study (Baker, 2001b). SWMU-specific background concentrations were established using protocol outlined in Ohio Environmental Protection Agency's (OEPA's) Closure Plan

Review Guidance for RCRA Facilities (OEPA, 1999). NC DENR agreed that SWMUs could be grouped together into AOCs based on geographical location, geology and type of SWMU, and that background concentrations for metals could be established for each of these AOCs. These background data are to be evaluated in comparison to the levels of inorganic constituents detected at individual SWMUs to assess whether the presence of such constituents is naturally occurring or may be attributed to activities (past and/or present) within the AOCs. Surface and subsurface soil samples were collected from eleven AOCs. Surface soil samples were collected from 0 to 1 foot bgs, and subsurface soil samples were collected from just above the water table. All soil samples were analyzed for TAL metals, TOC, and pH. SWMU 311 is one of 14 SWMUs included within AOC 5, which is located on the eastern side of MCB Camp Lejeune. Therefore, surface and subsurface soil data from SWMU 311 are compared to the AOC 5 background data set. The complete set of background data collected for each AOC is presented in the AOC Background Study (Baker, 2001b). Background soil data are presented in Tables 6-1 through 6-4.

Groundwater background data were obtained from the Draft Base Background Groundwater Investigation (Baker 2002a). Background groundwater data were collected from locations throughout the Base away from identified sites in relatively undisturbed areas not near any known sources of contamination. In the Base Background Groundwater Investigation, groundwater data were divided into two categories, including upper (shallow) and lower (deep) portions of the surficial aquifer. Groundwater samples at SWMU 311 were collected from the shallow portions of the surficial aquifer (less than 25 feet bgs); therefore, they were compared to the background data set for the upper surficial aquifer. Background groundwater data are presented in Tables 6-5 and 6-6.

Essential Nutrients - Despite their inherent toxicity, certain inorganic constituents are essential nutrients. Essential nutrients need not be considered further in the baseline HHRA if they are present in relatively low concentrations (i.e., slightly elevated above naturally occurring levels), or if the constituent is toxic at doses much higher than those which could be assimilated through exposures at the site (USEPA, 1989). Elements evaluated as essential nutrients include calcium, magnesium, potassium, and sodium.

Re-inclusion of Chemicals as COPCs – Chemicals can be re-included as COPCs for quantitative evaluation in the baseline HHRA, despite having been eliminated as such from a comparison to PRGs (or other aforementioned criteria). Criteria for reinclusion of chemicals as COPCs are as

follows: toxicity, mobility, persistence and bioaccumulation, chemicals by class (i.e., carcinogenic poly-aromatic hydrocarbons [PAHs]), historical use, special exposure routes (i.e., daycares, nursing homes, hospitals), and ARARs (chemicals with Applicable or Relevant and Appropriate Requirements). Each criterion is discussed in the paragraphs that follow.

Toxicity, Mobility, Persistence and Bioaccumulation - Certain aspects of toxicity of the chemicals must be considered before eliminating them. For example, before eliminating potentially carcinogenic chemicals, the weight-of-evidence classification, which indicates the quality and quantity of data underlying a chemical's designation as a potential human carcinogen, should be considered in conjunction with the concentrations detected at the site. It may be practical and conservative to retain a chemical that was detected at low concentrations if that chemical is a Group A carcinogen. Three additional factors that must be considered for a chemical's retention as a COPC are mobility, persistence, and bioaccumulation. For example, a highly volatile or mobile chemical such as benzene or a long-lived or persistent chemical such as dioxin, probably should remain in the risk assessment.

Chemicals by Class - Chemicals grouped by class, such as PAHs, may be included as a COPC despite the fact that some were detected at levels below the PRG screening criterion, or if toxicity information is not available. Carcinogenic PAHs are known to occur in groups and so their reinclusion can provide a more conservative evaluation for human health and the environment.

Historical Information - Chemicals reliably associated with site activities based on historical information generally should not be eliminated from the quantitative risk assessment, even if they do not exceed relevant criteria.

Special Exposure Routes - For some chemicals, certain exposure routes need to be considered carefully to determine if they should be reincluded. For example, some chemicals are highly volatile and may pose significant inhalation risk due to the home use of contaminated water, particularly for showering. In addition, sensitive populations can create special exposure routes, such as the location of a daycare center, a nursing home, or a hospital near an area containing potentially harmful chemicals.

ARARs - Chemicals with Applicable or Relevant and Appropriate Requirements or ARARs (including those relevant to land ban compliance) usually are not appropriate for exclusion from

the quantitative risk assessment. This may, however, depend in part on how the chemicals' site concentrations in specific media compare with their ARAR concentrations for these media. (USEPA, 1989).

Constituent concentrations in aqueous media can be compared to constituent-specific state and federal criteria. This risk assessment utilizes NC WQS for groundwater and Federal MCLs.

Regulatory guidelines are used, when necessary, to infer potential health risks and environmental impacts. Health Advisories (HA) are relevant regulatory guidelines. An explanation of the federal and state criteria and standards used for qualitative evaluation of chemical compounds and inorganics is presented below. It should be emphasized that COPCs were not chosen based on comparison to state and federal criteria. However, these standards and criteria were used for a qualitative analysis of the COPCs.

North Carolina Water Quality Standards (NC WQSs) - Groundwater - NC WQSs (15A NCAC 2L. 0202) are the maximum allowable concentrations resulting from any discharge of contaminants to the land or waters of the state, which may be tolerated without creating a threat to human health or which otherwise render the groundwater unsuitable for its intended purpose (NC, 2002).

Maximum Contaminant Levels (MCLs) - Federal Groundwater Standards - MCLs are enforceable standards for public water supplies promulgated under the Safe Drinking Water Act and are designed for the protection of human health. MCLs are based on laboratory or epidemiological studies and apply to drinking water supplies consumed by a minimum of 25 persons. They are designed for prevention of human health effects associated with a lifetime exposure (70-year lifetime) of an average adult (70 kg) consuming 2 liters of water per day. MCLs also consider the technical feasibility of removing the contaminant from the public water supply (USEPA, 1996a).

6.2.4 Selection of COPCs

As discussed previously, three environmental media (i.e., surface soil, subsurface soil, and groundwater) were sampled at SWMU 311 during one or more of three different field investigations. Data were combined for each medium for the human health risk assessment. The

data sets used in the HHRA are presented in Appendix F. Tables 6-1 through 6-6 present the selection of COPCs for each environmental medium based on comparisons of maximum detected concentrations of constituents with corresponding USEPA Region IX PRGs, and other applicable criteria (see Section 6.2.1). Constituents retained as COPCs are indicated by shaded cells in the tables. Information is presented in these tables only for those constituents detected at least once in the medium of interest.

The following subsections present the rationale for selection of COPCs for SWMU 311. Sample locations, analytical results, and corresponding figures are presented in Sections 2.0 and 4.0 and in the appendices of this RFI report.

Surface Soil

Surface soil samples (0 – 2 feet bgs) collected during Phase I were analyzed for aromatic VOCs, SVOCs, and RCRA metals. As part of the Phase II CSI, surface soil samples (0-1 foot bgs) were collected and analyzed for VOCs and RCRA metals. For the RFI field investigation, surface soil samples (0-1 foot bgs) were collected and analyzed for VOCs and RCRA metals. VOCs, SVOCs, and metals were detected in the surface soil. SWMU 311 surface soil data summary and COPC selection results are presented in Table 6-1.

Surface soil samples were analyzed for VOCs, and three surface soil samples were analyzed for VOCs. There were no positively detected VOCs that exceeded residential soil PRGs. Therefore, VOCs were not retained as SWMU 311 surface soil COPCs.

Surface soil samples were analyzed for SVOCs. There were no positively detected SVOCs that exceeded residential soil PRGs. Therefore, SVOCs were not retained as SWMU 311 surface soil COPCs.

Surface soil samples were analyzed for RCRA metals. The following inorganics were detected at maximum concentrations greater than their respective residential soil PRGs: cadmium and lead. Therefore, these metals were retained as surface soil COPCs.

Surface Soil (Trespasser Receptor Evaluation)

COPCs were selected from a reduced surface soil data set consisting of only those surface soil samples collected outside the fence line enclosing Buildings 1604 and 1605. These COPCs were used for evaluation of the trespasser receptor only as trespassers would be unable to access the area inside the fence. VOCs, SVOCs, and metals were detected in this surface soil data set. The surface soil data summary and COPC selection results for trespasser evaluation are presented in Table 6-2.

Surface soil samples were analyzed for VOCs. There were no positively detected VOCs that exceeded residential soil PRGs. Therefore, VOCs were not retained as SWMU 311 surface soil COPCs for evaluation of trespassers.

Surface soil samples were analyzed for SVOCs. There were no positively detected SVOCs that exceeded residential soil PRGs. Therefore, SVOCs were not retained as SWMU 311 surface soil COPCs for evaluation of trespassers.

Surface soil samples were analyzed for RCRA metals. There were no positively detected metals that exceeded residential soil PRGs. Therefore, metals were not retained as SWMU 311 surface soil COPCs for evaluation of trespassers.

Subsurface Soil

Subsurface soil samples (>1 foot bgs) collected during Phase I were analyzed for aromatic VOCs, SVOCs, and RCRA metals. As part of the Phase II CSI, subsurface soil samples (>1 foot bgs) were collected and analyzed for VOCs and RCRA metals. For the RFI field investigation, subsurface soil samples (>1 foot bgs) were collected and analyzed for VOCs and RCRA metals. COPCs were selected from a subsurface soil data set consisting of only those samples collected from 1-9 feet bgs. VOCs, SVOCs, and metals were detected in the subsurface soil. SWMU 311 subsurface soil data summary and COPC selection results are presented in Tables 6-3 and 6-4. Table 6-3 presents the comparison of subsurface soil data to residential PRGs, and Table 6-4 presents the comparison of subsurface soil data to industrial soil PRGs.

Subsurface soil samples were analyzed for VOCs. VOCs detected in the subsurface soil samples were present at concentrations below the residential and industrial PRGs. Therefore, none of these chemicals were retained as subsurface soil COPCs.

Subsurface soil samples were analyzed for SVOCs. SVOCs detected in the subsurface soil samples were present at concentrations below the residential and industrial PRGs. Therefore, none of these chemicals were retained as subsurface soil COPCs.

Subsurface soil samples were analyzed for RCRA metals. Arsenic was detected at a maximum concentration greater than its residential and industrial soil PRGs. Therefore, arsenic was retained as a subsurface soil COPC for the residential and industrial scenarios.

Groundwater

As part of the Phase II CSI, groundwater was sampled from three temporary wells and analyzed for VOCs and RCRA metals. The RFI field investigation included the collection of three groundwater samples from groundwater monitoring wells. The data and COPC selection summary for groundwater samples collected at SWMU 311 is presented in Tables 6-5 and 6-6. Table 6-5 presents the comparison of groundwater data to tap water PRGs. Table 6-6 presents the comparison of groundwater data to NC 2L Standards. Note that COPCs were not selected base on the comparison with NC 2L Standards. Table 6-6 is for presentation purposes only.

Three groundwater samples were analyzed for VOCs. There were no VOCs detected in the groundwater samples at concentrations exceeding tap water PRGs. Therefore, no VOCs were retained as groundwater COPCs. Also, none of the VOCs with corresponding NC 2L Standards exceeded those values.

Three groundwater samples were analyzed for RCRA metals. Arsenic and chromium were detected in the groundwater samples at concentrations that exceeded their respective tap water PRGs. Therefore, arsenic and chromium were retained as subsurface soil COPCs. Also, neither arsenic nor chromium exceeded their respective NC 2L Standards.

6.2.5 Summary of COPCs

The following chemicals exceeded the residential PRG values in the environmental media obtained from SWMU 311 during the Phase I CSI, Phase II CSI, and RFI field investigations, and were therefore retained as COPCs for further analysis.

Surface Soil: cadmium and lead.

Surface Soil (Trespasser Receptor Evaluation): none.

Subsurface Soil (residential and industrial): arsenic.

Groundwater: arsenic and chromium.

6.3 Exposure Assessment

The exposure assessment estimates the magnitude of actual and/or potential human exposure, the frequency and duration of those exposures, and the pathways (i.e., inhalation, ingestion, and dermal contact) by which people are potentially exposed. To determine whether human exposure could occur at SWMU 311 in the absence of remedial action, an exposure assessment, which identifies potential exposure pathways and receptors, was conducted. The following four elements were considered to determine whether a complete exposure pathway was present (USEPA, 1989):

- A source and potential mechanism of chemical release
- An environmental retention or transport medium
- A point of potential human contact with the contaminated medium; and
- A human exposure route (e.g., ingestion) at the contact point

The exposure scenarios discussed in this report represent USEPA's Reasonable Maximum Exposure (RME). Relevant equations for assessing intakes and exposure factors were obtained from RAGS (USEPA, 1989), Region IV Bulletin (USEPA, 1996), Exposure Factors Handbook (USEPA, 1997), Dermal Exposure Assessment: Principles and Applications, Interim Report (USEPA, 1992), RAGS Part E, Supplemental Guidance for Dermal Risk Assessment Interim

(USEPA, 2001), Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure (USEPA, 1993), and Standard Default Exposure Factors, Interim Final (USEPA, 1991a). The Central Tendency (CT) risk descriptor was also used for exposure scenarios when the RME scenarios indicated a potential risk to human health, to more completely present the range of possible risks. The CT exposure calculations use less conservative exposure factors (as appropriate) to calculate chemical intakes for the CT-case scenarios. In this baseline HHRA, the CT exposure scenario was calculated only for those RME exposure scenarios that resulted in unacceptable risk or hazard levels. The inclusion of the CT exposure scenario provides a range of potential carcinogenic risks and noncarcinogenic health hazards with which to make informed risk management decisions when determining remedial action.

6.3.1 Potential Human Receptors

MCB Camp Lejeune operates as a Marine Corps base. It is assumed that long-term plans for the facility are the same as the present plan, with land use also generally the same as at present. Based on information available regarding the physical features, site setting, site historical activities, and current and expected land uses, four potential human receptors have been selected for evaluation. These include:

- Current Military Base Personnel
- Current Adult and Adolescent (7-16 years) Trespassers
- Future Resident Adults and Children (1-6 years)
- Future Construction Workers

SWMU 311 is currently an active oil-water separator that is associated with a vehicle wash rack. The vehicle wash rack is situated between Buildings 1604 and 1605 in a fenced-in and paved area. Access to Buildings 1604 and 1605 on either side of the separator is limited to authorized personnel only and is restricted by a locked 7-foot high chain link fence. Consequently, the only potential trespassing possible is outside the fenced area. Current receptors include military Base personnel who work at the pesticide shop and trespassers (i.e., adult and adolescent receptors). However, trespasser exposure to surface soil is limited to outside the fence line, and there were no COPCs retained for surface soil outside the fence line. Therefore, the surface soil exposure

pathway is incomplete for the trespasser receptors, and trespasser exposure to surface soil was not assessed in the HHRA for SWMU 311.

Current adult military Base personnel who work at Buildings 1604 and 1605 may be exposed to COPCs and media of concern at SWMU 311. These include military personnel stationed at the Base. These individuals who work at Buildings 1604 and 1605 have access to inside and outside the fenced area. A standard tour of duty of four years was assumed. Workers were evaluated for incidental ingestion of and dermal contact with surface soil inside and outside the fenced area and inhalation of fugitive dusts from the surface soil.

At present, groundwater is not utilized for potable purposes. For the current receptors (military Base personnel), potable water is municipally supplied. As a result, current groundwater exposure was not assessed. Exposure to subsurface soil in the current scenario is unlikely for the receptor population. Consequently, subsurface soil exposure was not considered to be viable.

Although residential development by the military or general public is unlikely in the industrialized area of SWMU 311, future hypothetical residential exposure to children and adults was evaluated. The future adult and child residential receptors could potentially be exposed to COPCs in surface soil by ingestion and dermal contact, and inhalation of dusts from surface soil. Residential receptors could also potentially be exposed to COPCs in subsurface soil (ingestion and dermal contact, and inhalation of dusts) should that soil be excavated. The depths of soil samples used in the risk evaluation for future residents were 0 to 9 feet bgs. Groundwater at SWMU 311 is currently not utilized as a potable source. However, it is possible that the groundwater could be used for potable purposes in the future. Therefore, in accordance with USEPA guidance, groundwater exposure via ingestion and dermal contact was conservatively evaluated for future residential receptors. Total inorganic results in groundwater were evaluated according to USEPA Region IV guidance. Inhalation of volatiles in groundwater was not evaluated in this HHRA since there were no VOCs retained as COPCs in the groundwater at SWMU 311.

Future construction workers that may perform excavation and construction at the site were also evaluated for incidental ingestion and dermal contact exposures to excavated soils, as well as the inhalation of fugitive dusts emanating from soil during excavation/construction activities. The depths of soil samples used in the risk evaluation for construction workers were 0 to 9 feet bgs.

For the future construction worker, surface soil and subsurface soil were evaluated as separate data sets segregated by depth. Surface soil depths were 0 to 12 inches and 0 to 2 feet, and subsurface soil depth was 1 to 9 feet.

In summary, the following potential human receptors and exposure pathways were retained for quantitative evaluation in this baseline HHRA.

Current Military Base Personnel

- Incidental Ingestion of Surface Soil
- Dermal Contact with Surface Soil
- Inhalation of Fugitive Dusts Emanating from Surface Soil

Future Adult and Child (Ages 1-6 Years) Residents

- Incidental Ingestion of Surface Soil and Subsurface Soil
- Dermal Contact with Surface Soil and Subsurface Soil
- Inhalation of Fugitive Dusts Emanating from Surface Soil and Subsurface Soil
- Ingestion of Groundwater
- Dermal Contact with Groundwater

Future Construction Workers

- Incidental Ingestion of Surface Soil and Subsurface Soil
- Dermal Contact with Surface Soil and Subsurface Soil
- Inhalation of Fugitive Dusts from Surface Soil and Subsurface Soil

6.3.2 Conceptual Site Model

Development of a conceptual site model of potential exposure is critical in evaluating exposures for the human receptors. The conceptual site model considers all reasonable current and future potential exposures and media of concern under a no-action scenario. Current and potential future exposure scenarios for SWMU 311 are summarized in the conceptual site model in Figure 6-1 of this HHRA. Current exposures evaluated at SWMU 311 are military Base personnel. Future exposures evaluated at this site are construction workers and residents.

Potential contaminant release mechanisms from affected media include stormwater runoff, leaching to underlying groundwater, and advective transport in the direction of groundwater flow. Potentially affected media at SWMU 311 may include surface and subsurface soil and groundwater.

The current/potential future land use scenarios considered adult exposures. In addition, a residential child, 1-6 years old, and an adolescent trespasser, 7-16 years old, were also considered. Exposure routes (i.e., ingestion, dermal contact, and inhalation) for each exposure scenario are summarized in Figure 6-1.

6.3.3 Quantification of Exposure

Exposure to contaminants is quantified using 1) data from the site (i.e., concentrations of contaminants) and 2) determining human exposure to the environmental media. The chemical concentrations used in the estimation of chronic daily intakes (CDIs) and dermally-absorbed doses (DADs) for each medium are considered to be representative of the types of potential exposures encountered by each receptor throughout the time of exposure. The equations used to calculate the CDIs and DADs for each receptor and exposure pathway are presented in Section 6.3.5 and on Tables 6-7 through 6-15. Groundwater is in motion, thus chemical concentrations detected in these media change frequently over time. Soil generally moves more slowly through erosion and deposition. Therefore, groundwater contaminant concentrations may be best represented by the most recently collected data, while soil concentrations can include some older data, as appropriate. The manner in which environmental data are represented also depends on the number of samples and sampling locations available for a given area and a given medium. For example, exposure can occur to a portion of the site (i.e., a "hotspot") or the entire site, depending on the type of scenario considered for a given receptor.

6.3.4 Data Analysis

An individual moving randomly across the study area of SWMU 311 is assumed to have an equal probability of potential exposure to environmental media such as soil. Therefore, for soil, the exposure point concentration for a constituent in the intake equation can be reasonably estimated as the arithmetic average concentration of site sampling data. USEPA supplemental risk assessment guidance (USEPA, 1992a) states that the average concentration is an appropriate estimator of the exposure concentration for two reasons: 1) carcinogenic and chronic

noncarcinogenic toxicity criteria are based on lifetime average exposures; and 2) the average concentration is most representative of the concentration that would be contacted over time. However, uncertainty is inherent in the estimation of the true average constituent concentration at the site.

USEPA Region IV risk assessment guidance makes an exception to the use of the average concentration of site sampling data as the exposure point concentration for groundwater. Region IV guidance states that groundwater exposure point concentrations should be the arithmetic average of the wells in the highly concentrated area of the plume. However, there was no plume defined at SWMU 311. Therefore, the maximum detected concentrations of the COPCs retained in groundwater were used as the exposure concentrations.

A conservative estimate of the arithmetic average concentration recommended by the USEPA (1992a) is the 95% upper confidence limit of the arithmetic mean concentration (95% Upper Confidence Limit [UCL]). A statistical test to determine the distribution of the data set was used. The Shapiro-Wilkes distribution test was used for data sets of less than 50 samples. If the data were determined to be normally distributed (this includes those results that indicate "yes" to both normal and lognormal distributions), the 95% UCL of the arithmetic mean of the data was used (USEPA, 1992). If the data were lognormally distributed, the 95% UCL of the arithmetic mean of the log-transformed data was used (USEPA, 1992a). In those instances where the distribution tests were unable to definitively determine the type of distribution (i.e., the results indicated "no" to both normal and lognormal distributions), the data set was assumed to be lognormally distributed, as per USEPA Region IV risk assessment guidance (USEPA, 1996). If the 95% UCL of the arithmetic mean exceeds the maximum detected concentration in a given data set, the maximum detected concentration will be used to represent the concentration term for that COPC.

The 95% UCL for a normal distribution was calculated using the following equation (USEPA, 1992a):

$$95\%UCL = \bar{x} + t\left(s / \sqrt{n}\right)$$

Where:

$\bar{x}$	=	mean
s	=	standard deviation
t	=	Student t statistic (Gilbert, 1987)
n	=	number of samples

The 95 percent UCL of the lognormal distribution was calculated using the following equation (USEPA, 1992a):

$$Lognormal\ 95\%\ UCL = e^{(\bar{x}+0.5s^2+sH/\sqrt{n-1})}$$

where:

UCL	=	upper confidence limit
e	=	constant (base of the natural log, equal to 2.718)
$\bar{x}$	=	mean of the transformed data
s	=	standard deviation of the transformed data
H	=	H-statistic (Gilbert, 1987)
n	=	number of samples

Frequencies of detection, as well as maximum detected values, are presented in Tables 6-1 through 6-6. 95% UCL values, mean values, and results of the W-test derived for COPCs in all media at SWMU 311 are presented on Tables 6-16 through 6-18 and in Appendix G. The equations for estimating intakes due to direct exposures to site-related chemicals for the various identified pathways are presented in Section 6.3.5 and on the risk calculation spreadsheets found in Appendix H.

For results reported as "nondetect" (i.e., results flagged with the following validation qualifiers: U and UJ), a value of one half of the sample-specific detection limit was used to calculate the 95% UCL; the actual value could be between zero and a value just below the detection limit. 95% UCLs were calculated only for the constituents detected in at least one sample collected from the environmental medium of interest.

Estimated concentrations also were used to calculate the 95% UCL, such as "J" qualified (estimated) data. Reported concentrations qualified with an "R" (rejected) were not used in the statistical evaluation.

As previously mentioned, duplicate sample data were averaged with corresponding environmental sample data and re-included into the data set for these risk evaluations. In instances where the original and duplicate sample result were either both detected or both non-detected, the values were averaged for the risk assessment. In instances when the original and duplicate sample result contained one detection and one non-detection, the detected value was

averaged with one-half of the detection limit of the non-detected value and the averaged sample result was considered a detection.

Statistical data summary tables for COPCs in each medium sampled (i.e. surface soil, subsurface soil, and groundwater) are found in the Statistical Summaries presented in Appendix G. These tables provide the arithmetic mean, the standard deviation, and the upper 95 percent confidence limit value for both normally and lognormally distributed data (as determined by Shapiro-Wilkes distribution test).

6.3.5 Calculation of Chronic Daily Intakes

In order to numerically estimate the risks for current and future human receptors at SWMU 311, a CDI must be estimated for each COPC in every retained exposure pathway. These equations were obtained from USEPA guidance (USEPA, 1989).

The following paragraphs present the general equations used in the calculation of CDIs for each potential exposure pathway. The exposure input parameters used in the calculation of CDIs are presented in Section 6.3.6. Input parameters were taken from USEPA's default exposure factors guidelines where available and applicable. All inputs not defined by USEPA were derived from USEPA documents concerning exposure or from best professional judgment. All exposure assessments incorporate the representative contaminant concentrations in the estimation of intakes. Therefore, only one exposure scenario was developed for each exposure route/receptor combination.

CDIs for carcinogenic effects incorporate terms to represent the exposure duration (years) over the course of a lifetime (70 years or 25,550 days) (USEPA, 1989). Noncarcinogenic CDIs, on the other hand, were estimated using the concept of an average annual exposure. The intake incorporates terms describing the exposure time and/or frequency representing the number of hours per day and the number of days per year that exposure occurs. In general, noncarcinogenic CDIs for many exposure routes (e.g., soil ingestion) are greater for children than adults because of the differences in body weights, similar exposure frequencies, and higher ingestion rates.

6.3.5.1 Surface/Shallow Subsurface Soil

Incidental Ingestion of Surface/Shallow Subsurface Soil

The following equation is used in the calculation of a CDI (mg/kg/day) for a human receptor who accidentally ingests soils at the site:

$$CDI = \frac{Cs \ x \ IR \ x \ FI \ x \ CF \ x \ EF \ x \ ED}{BW \ x \ AT_c \ or \ AT_{nc}}$$

Where:

Cs	=	chemical concentration in soil (mg/kg)
IR	=	ingestion rate (mg/day)
FI	=	fraction of soil ingested from the source (unitless)
CF	=	conversion factor (10^{-06} kg/mg)
EF	=	exposure frequency (days/yr)
ED	=	exposure duration (yrs)
BW	=	adult body weight (kg)
AT_c	=	averaging time carcinogens (days)
AT_{nc}	=	averaging time, noncarcinogens (days)

Relevant equations and factors required for estimating the daily intake were calculated and are presented in Appendix H.

Dermal Contact with Surface/Shallow Subsurface Soil

The absorbed dose associated with the potential dermal contact of COPCs in soil was calculated using the following equation (USEPA, 1989):

$$DAD = \frac{Cs \ x \ SA \ x \ AF \ x \ ABS \ x \ EF \ x \ ED \ x \ CF}{BW \ x \ AT}$$

Where:

DAD	=	Dermally Absorbed Dose, mg/kg-day
Cs	=	Chemical concentration in the soil, mg/kg
AF	=	Adherence Factor, milligram per square centimeter day (mg/cm^2-d)
ABS	=	Absorbed fraction, unitless
CF	=	Conversion Factor, 10^{-06} mg/kg
SA	=	Surface Area of exposed skin, cm^2
EF	=	Exposure Frequency, days/year
ED	=	Exposure Duration, years
BW	=	average Body Weight, kg
AT	=	Averaging Time, days

Relevant equations and factors required for estimating the absorbed dose were calculated and are presented in Appendix H.

Inhalation of Fugitive Dust from Surface/Shallow Subsurface Soil

The daily intake resulting from the inhalation of COPCs adsorbed onto fugitive dust particulate was estimated using the following equation (USEPA, 1989):

$$CDI = \frac{Ca \ x \ RR \ x \ ET \ x \ EF \ x \ ED}{BW \ x \ AT}$$

Where:

CDI	=	Chronic Daily Intake, mg/kg-day
Ca	=	Chemical concentration in air as fugitive dust, milligrams per cubic meter (mg/m^3)
RR	=	Respiration Rate, m^3/hour
ET	=	Exposure Time, hours/day
EF	=	Exposure Frequency, days/year
ED	=	Exposure Duration, years
BW	=	average Body Weight, kg
AT	=	Averaging Time, days

The air concentration (Ca) of a chemical in fugitive dust emissions was estimated from the following equation, as determined by Cowherd (1985).

$$Ca = Cs \times 1/PEF$$

Where:

Ca	=	Chemical concentration in air as fugitive dust, mg/m^3
Cs	=	Concentration of chemical in the soil, mg/kg
PEF	=	Particulate Emission Factor, m^3/kg

Relevant equations and factors required for estimating the absorbed dose were calculated and are presented in Appendix H.

6.3.5.2 Groundwater

Ingestion of Groundwater

The daily intake associated with the direct potential ingestion of the COPCs in groundwater under a drinking water scenario were calculated using the following equation (USEPA, 1989):

$$CDI = \frac{Cw \times IR \times EF \times ED}{BW \times AT}$$

Where:

CDI	=	Chronic Daily Intake, mg/kg-day
Cw	=	Chemical concentration in water, mg/L
IR	=	Ingestion Rate, L/day
EF	=	Exposure Frequency, days/year
ED	=	Exposure Duration, years
BW	=	average Body Weight, kg
AT	=	Averaging Time, days

Relevant equations and factors required for estimating the absorbed dose were calculated and are presented in Appendix H.

Dermal Contact with Groundwater

The absorbed dose associated with potential dermal contact with COPCs in groundwater was calculated using the following equation (USEPA, 1989):

$$CDI = \frac{Cw \ x \ SA \ x \ PC \ x \ ET \ x \ EF \ x \ ED \ x \ CF}{BW \ x \ AT}$$

Where:

CDI	=	Chronic Daily Intake, mg/kg-day
Cw	=	Chemical concentration in water, mg/L
SA	=	Surface Area of exposed skin, cm^2
PC	=	chemical-specific Permeability Constant, cm/hr
ET	=	Exposure Time, hours/day
EF	=	Exposure Frequency, days/year
ED	=	Exposure Duration, years
CF	=	Conversion Factor, 1 L/1000 cm^3
BW	=	average Body Weight, kg
AT	=	Averaging Time, days

Relevant equations and factors required for estimating the absorbed dose were calculated and are presented in Appendix H.

6.3.6 Exposure Input Parameters

Tables 6-7 through 6-15 present the exposure factors used in the estimation of potential CDIs for COPCs retained for each receptor identified below. USEPA promulgated exposure factors are used in conjunction with USEPA standard default exposure factors. When USEPA exposure factors are not available, best professional judgment and site-specific information are used to derive a conservative and defensible value. The following paragraphs present the rationale for the selection of exposure factors for each receptor group evaluated in the baseline HHRA.

6.3.6.1 Current Military Personnel

This scenario assumes that current adult Base military personnel working on-site could come into contact with surface soil at SWMU 311. Therefore, this receptor was evaluated for potential exposure to surface soil via incidental ingestion, dermal contact, and inhalation of fugitive dust. A summary of the exposure parameters is discussed in the following paragraphs and presented on Table 6-7.

The ingestion rate for military personnel exposed to surficial soils was assumed to be 100 mg/day (USEPA, 1993), and the fraction ingested was assumed to be 100 percent. An exposure frequency (EF) of 250 days per year (USEPA, 2001) was used in conjunction with an exposure duration of 4 years (standard military tour of duty). A respiration rate of 0.55 m^3/hr (representing an average of 11.3 m^3/day for women and 15.2 m^3/day for men) for an adult (USEPA, 1997) was also used. An exposure time (ET) of 8 hours (professional judgment) was used to represent an average work day. An averaging time (AT) of 70 years or 25,550 days was used for exposure to potentially carcinogenic compounds while an averaging time of 1,460 days was used for noncarcinogenic exposures.

There is a potential for base personnel to absorb COPCs by dermal contact. A skin surface area of 3,300 cm^2 for an adult (USEPA, 2001) assumed to wear a short-sleeved shirt, long pants, and shoes, was used to evaluate dermal contact with soil. The soil to skin adherence factor (SAF) of 0.2 mg/cm^2 was used and is based on the 50th percentile weighted SAF for utility workers, which is the activity determined by USEPA to represent a reasonable, high-end contact activity (USEPA, 2001). Dermal absorption fractions provided in USEPA RAGS Part E (USEPA, 2001) or Region IV default dermal absorption fractions of 0.01 for organics, and 0.001 for inorganics (USEPA, 1996) were also used to estimate soil exposures.

6.3.6.2 Future Adult and Young Child Residents

This scenario assumes that future adult and young child (1-6 years) residents could come into contact with surface soil and subsurface soil at SWMU 311. It is also conservatively assumed that the groundwater will be potable. Therefore, these receptors could come into contact with contaminants detected in the groundwater under a drinking water scenario in the future, in

addition to coming into contact with surface and subsurface soil. These receptors were evaluated for potential exposure to surface and subsurface soil via accidental ingestion, dermal contact, and inhalation of fugitive dust and groundwater via ingestion and dermal contact. There were no VOCs retained as groundwater COPCs. Therefore, inhalation of VOCs in groundwater was not evaluated. A summary of the exposure parameters is discussed in the following paragraphs and presented on Tables 6-8 through 6-13. Unless otherwise noted, the CT exposure parameters are the same as for RME.

Future adult and young child residents could contact surface/subsurface soil during outdoor recreational activities such as playing, walking, or running, in the area immediately surrounding their homes or while performing gardening activities. A 70 kg adult and a 15 kg child were assumed for exposure durations of 24 years and 6 years, respectively (USEPA, 1993). Exposure durations of 7 years for the adult and 2 years for the child were used for CT exposure (USEPA, 1993). Exposure times were estimated to be 1.5 hours per day for adults and 5.57 hours per day for the child (USEPA, 1997). The ingestion rate was assumed to be 200 mg/day for the young child and 100 mg/day for the adult (USEPA, 1993), with a 100% fraction ingested from source, over 350 days/year (USEPA, 1993). Ingestion rates of 100 mg/day for the young child and 50 mg/day for the adult over 234 days per year were used for CT exposure (USEPA, 1993). Respiration rates of 0.308 m^3/hr for the child and 0.55 m^3/hr for the adult (USEPA, 1997) were also used. The respiration rate used for the young child represents the average for an individual aged 0 to 8 years old. Averaging times of 8,760 days for adults and 2,190 days for children for noncarcinogens, and 25,550 days for carcinogens were also used (USEPA, 1989). The USEPA recommended weighted SAF of 0.07 mg/cm^2 was used for the residential adult (USEPA, 2001). This is based on the 50th percentile weighted SAF for gardeners, which is the activity determined to represent a reasonable, high-end contact activity. The USEPA recommended weighted 0.2 mg/cm^2 SAF for the young child was used and is based on the 95th percentile weighted SAF for children playing at a day care center or in wet soil (USEPA, 2001). Dermal absorption values provided in USEPA RAGS Part E (USEPA, 2001) or Region IV default dermal absorption values of 0.01 for organics, and 0.001 for inorganics (USEPA, 1996) were also used to estimate soil exposures. Skin surface areas of 2,800 cm^2 for the young child and 5,700 cm^2 for the adult (USEPA, 2001) were assumed for the surface soil scenario. These are the SA values currently recommended by the USEPA for exposure to contaminated soil and are the averages of the 50th percentiles for males and females greater than 18 years of age (adults) and from <1 to <6 years

old (young children). As recommended in RAGS Part E, the SA values used for the RME scenario were also assumed for the CT exposure scenario.

Potential exposures to groundwater COPCs may occur under a drinking water scenario. Exposure to total concentrations of groundwater inorganic COPCs were evaluated as per USEPA Region IV guidance. Exposure pathways evaluated for future residents include accidental ingestion and dermal contact. Inhalation of VOCs while showering was not evaluated for SWMU 311 because VOCs were not retained as groundwater COPCs. Groundwater ingestion rates of 2 L/day and 1 L/day, respectively, were also assumed for the adult and young child residents (USEPA, 1993). Exposure frequency of 350 days per year was also assumed for groundwater. Groundwater ingestion rates of 1.4 L/day and 1 L/day (adult and child, respectively) over 234 days per year were used for CT exposure (USEPA, 1993). Total body surface areas of 6,600 cm^2 and 18,000 cm^2 (50th percentile values for male and female young children or adults) (USEPA, 2001a) were assumed for the groundwater scenario for the young child and adult, respectively. All other exposure parameters were the same as the soil exposure parameters.

6.3.6.3 Future Adult Construction Workers

Potential exposures to soil COPCs may occur to construction workers while performing soil excavation and construction activities at SWMU 311. Exposure pathways evaluated include accidental ingestion, dermal contact, and inhalation of fugitive dust of surface and shallow subsurface soil. A summary of the exposure parameters is discussed in the following paragraphs and presented on Tables 6-14 through 6-15. Exposure was assumed to occur for 8 hours per day (USEPA, 1991a), 250 days per year (USEPA, 2001), for a construction period of 1 year (professional judgment). A USEPA default value for the soil ingestion rate of 480 mg/day (USEPA, 1993), a 100% fraction ingested from source and a respiration rate of 3.3 m^3/hour (USEPA, 1997) were also assumed for a 70 kg construction worker (USEPA, 1997). A skin surface area of 3,300 cm^2 for an adult (USEPA, 2001) assumed to wear a short-sleeved shirt, long pants, and shoes, was used to evaluate dermal contact with soil. The soil to skin adherence factor of 0.2 mg/cm^2 (USEPA, 2001) was used. Dermal absorption values provided in USEPA RAGS Part E (USEPA, 2001) or Region IV default dermal absorption values of 0.01 for organics, and 0.001 for inorganics (USEPA, 1996) were also used to estimate soil exposures. The averaging time of 365 for noncarcinogens and 25,550 days for carcinogens, respectively, were also used (USEPA, 1989).

USEPA believes construction workers are likely to experience substantial exposures to soils during excavation and other work activities. The equation to calculate particulate emission factor (PEF) for a construction scenario has been revised to focus exclusively on emissions from truck traffic on unpaved roads, which typically contribute the majority of dust emissions during construction. A site-specific PEF has been derived for the construction worker scenario for this risk assessment. As shown on Figure 1-2, the "study area" surrounding SWMU 311 is approximately 2.5 acres in size. The methodologies used to calculate the new PEF are taken from USEPA's Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites (Peer Review Draft) (USEPA, 2001a). The following equation was used to calculate the construction scenario PEF:

$$PEF_{sc} = Q/C_{sr} * 1/F_D * \left[\frac{(T * A_R)}{(556 * (W/3)^{0.4} * (365-p)/365 * VKT)} \right]$$

Where:

PEF_{sc}	=	subchronic road particulate emission factor (m^3/kg)
Q/C_{sr}	=	Inverse of 1-h average air concentration along a straight road segment bisecting a 2.5 acre square site (g/m^2-s per kg/m^3)
F_D	=	dispersion correction factor (unitless) (0.185)
T	=	total time over which construction occurs (s) (250 days or 7.2×10^6 seconds)
A_R	=	surface area of contaminated road segment (m^2) (1,524 m^2)
W	=	mean vehicle weight (11 tons)
p	=	number of days with at least 0.01 inches of precipitation (days/year) (120 days for the area of Jacksonville, NC)
VKT	=	sum of fleet vehicle kilometers traveled during the exposure duration (km) (196.95 km assuming a site area of 2.5 acres)

The following assumptions were incorporated into the above-referenced parameters used to calculate the site-specific construction worker scenario. SWMU 311 is in an industrialized area of MCB Camp Lejeune. The site is surrounded on three sides by paved roads, and the necessity to construct a dirt road across the site is considered unlikely. Therefore, it was assumed that daily

unpaved road traffic would consist of at most eight cars (2 tons) and seven trucks (20 tons). A_R is based on a road length of 100 m and assumes a road width of 15.24 m. VKT is based on 15 vehicles traveling a road length of 100 m (or 0.1 km) for five days per week for 36 weeks (considering an EF of 250 days per year). Thus, a construction worker scenario PEF of 8.83 x 10^6 m^3/kg was calculated. This calculation is also presented in Appendix H.

6.4 Toxicity Assessment

Section 6.4 presents potential exposure pathways and receptors for this baseline HHRA. This section will review the available toxicological information for COPCs retained for quantitative evaluation.

An important component of the HHRA process is the relationship between the dose of a compound (amount to which an individual or population is potentially exposed) and the potential for adverse health effects resulting from exposure to that dose. Dose-response relationships provide a means by which potential public health impacts may be evaluated. Standard RfDs and/or CSFs have been developed for many of the COPCs. This section provides a brief description of these parameters.

6.4.1 Reference Doses

The RfDs and Reference Concentrations (RfCs for inhalation) are developed for chronic and/or subchronic human exposure to chemicals, and are based solely on the noncarcinogenic effects of chemical substances. These values are defined as an estimate of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of adverse effects during a lifetime. The RfD is expressed as dose (mg) per unit body weight (kg) per unit time (day). The RfC is expressed as dose (mg) per cubic meter of air (m^3).

6.4.2 Carcinogenic Slope Factors

CSFs are used to estimate an upper bound lifetime probability of an individual developing cancer as a result of exposure to a particular level of a potential carcinogen (USEPA, 1989). This factor is reported in units of proportion (of a population) affected per mg/kg/day and is derived through an assumed low-dosage, linear multistage model and an extrapolation from high to low dose-responses determined from animal studies. The slope factor represents the upper 95th percent

confidence limit on the increased cancer risk from a lifetime exposure to an agent. CSFs can also be derived from USEPA promulgated unit risk values for air and/or water. CSFs derived from unit risks cannot, however, be applied to environmental media other than the medium considered in the unit risk estimate.

Slope factors are also accompanied by weight-of-evidence classifications, which designate the strength of the evidence that the COPC is a potential human carcinogen.

Quantitative indices of toxicity and USEPA weight-of-evidence classifications are presented in Tables 6-19 through 6-22 for the identified COPCs. The hierarchy (USEPA, 1989) for choosing these values was:

- Integrated Risk Information System (IRIS, 2001)
- Health Effects Assessment Summary Table (HEAST, 1997)
- National Center for Environmental Assessment (NCEA, 2000)

The IRIS database is updated a few times each year and contains verified RfDs, RfCs and CSFs. The USEPA has formed an RfD work group to review existing data used to derive RfDs and RfCs. Once this task has been completed, the verified RfD appears in IRIS. Like the RfD Work Group, the USEPA has also formed the Carcinogen Risk Assessment Verification Endeavor (CRAVE) Work Group to review and validate toxicity values used in developing CSFs. Once the slope factors have been verified via extensive peer review, they also appear in the IRIS database. HEAST and NCEA, on the other hand, provide provisional (unverified) RfDs, RfCs and CSFs.

6.4.3 Dermal Absorption Efficiency

Many of the RfDs and CSFs are derived from oral toxicological studies based on administered dose, and do not account for the amount of a substance that can penetrate exchange boundaries after contact (e.g., absorbed dose). As a result, there is very little information available regarding dermal toxicity criteria. Therefore, in order to account for a difference in toxicity between an administered dose and an absorbed dose, the RfDs and CSFs (that were based on an administered dose) were adjusted, as described by Appendix A of RAGS A (USEPA, 1989), using experimentally-derived oral absorption efficiencies obtained from information compiled by Oak Ridge National Laboratory (as recommended by North Carolina Department of Environment and

Natural Resources). The adjustment for the oral RfD that would correspond to a dermally absorbed dose is represented by multiplying the RfD by an oral-to-dermal extrapolation value. The adjustment for the oral CSF that would correspond to the dermally-absorbed dose is represented by dividing the CSF by an oral-to-dermal extrapolation value. The oral-to-dermal extrapolation values were obtained from sources such as the NCEA, IRIS, Agency for Toxic Substance and Disease Registry (ATSDR) toxicological profiles, toxicology publications, toxicology references, and USEPA Regional Offices. Only oral-to-dermal extrapolation values that had reference documents available were used in this risk assessment. For other chemicals, the default values of 80% for VOCs, 50% for SVOCs, and 20% for inorganics recommended in Region IV supplemental guidance were used. The oral-to-dermal extrapolation values used in this baseline HHRA for SWMU 311 are presented in Tables 6-19 and 6-21. The table of oral absorption efficiencies compiled by Oak Ridge National Laboratory, which includes detailed references, is provided as a subsection of Appendix H.

6.4.4 Lead

Lead was identified as a COPC in samples collected from surface soil at SWMU 311. Currently, health-based criteria are not available for evaluating either the noncarcinogenic or carcinogenic effects of lead exposure. The USEPA has not developed health-based criteria because a threshold level for many noncancer health effects has not been identified in infants and younger children (i.e., the most sensitive populations). Consequently, risk from lead exposure was not calculated for the SWMU.

To evaluate lead at sites, the USEPA developed an Integrated Exposure Uptake Biokinetic (IEUBK) Model for Lead in Children, Windows™ version (USEPA, 2001b). This model utilizes site-specific exposure parameters to estimate blood lead levels in infants and young children. The USEPA considers remediation necessary if a five percent probability or greater exists that the predicted child blood level will exceed 10 micrograms per deciliter (μg/dl) as a result of contact with lead-containing media at the site.

There are several criteria available for lead level comparisons in the form of standards and/or criteria. These standards/criteria include federal and state MCLs. In addition, there is an Office of Solid Waste and Emergency Response (OSWER) action level for lead of 400 mg/kg in residential soil. At SWMU 311, the maximum concentration of lead found in surface soil (1,110

mg/kg) exceeded the OSWER action level for residential soil. Consequently, the lead IEUBK model was utilized to evaluate the risk associated with exposure to lead in the surface soil. The maximum concentration for lead in surface soil was used as the exposure point concentration for the IEUBK model because the 95 percent UCL was greater than the maximum. All other exposure parameters used in the model were default values recommended by the IEUBK model guidance document (USEPA, 2001b).

6.5 Risk Characterization

The risk characterization combines the selected COPCs, the exposure assessment, and the toxicity assessment to produce a quantitative estimate of current and future potential human health risks associated with SWMU 311. Sections 6.5.1 and 6.5.2 discuss the USEPA methodologies used for quantifying and characterizing carcinogenic and noncarcinogenic human health risks. ILCRs and Hazard Indices (HIs) are calculated to characterize potential human health effects. These terms are defined in the sections that follow. ILCRs and HIs are estimated for current and future receptors exposure scenarios that were identified for SWMU 311 in Section 6.3, and are discussed in Section 6.5.3.

6.5.1 Quantification and Characterization of Carcinogenic Risks

Quantitative risk calculations for potentially carcinogenic compounds estimate inferentially (versus probablistically) the potential ILCR for an individual in a specified population. This unit of risk refers to a potential cancer risk that is above the background cancer risk in unexposed individuals. For example, an ILCR of 1 x 10^{-6} indicates that an exposed individual has an increased probability of one in one million of developing cancer subsequent to exposure, over the course of their lifetime.

The potential lifetime ILCR for an individual was estimated from the following relationship:

$$ILCR = \sum_{i=1}^{n}(CDI_i or DAD_i) \times CSF_i$$

where the CSFi is expressed as $(mg/kg/day)^{-1}$ for compound i, and the chronic daily intake (CDI_i) and dermally absorbed dose (DAD_i) is expressed as mg/kg/day for compound i. Since the units of CSF are $(mg\ chemical/kg\ body\ weight\text{-}day)^{-1}$ and the units of intake or dose are mg

chemical/kg body weight-day, the ILCR value is dimensionless. The aforementioned equation was derived assuming that cancer is a nonthreshold process and that the potential excess risk level is proportional to the cumulative intake over a lifetime.

For quantitative estimation of risk, it is assumed that cancer risks from various exposure routes are additive. Estimated ILCR values will be compared to 1×10^{-6} to 1×10^{-4}, which represents the target risk range of ILCR values considered by the USEPA to represent an acceptable (i.e., de minimis) risk (USEPA, 1990).

6.5.2 Quantification and Characterization of Noncarcinogenic Risks

Noncarcinogenic compounds assume that a threshold toxicological effect exists. Therefore, the potential for noncarcinogenic effects are calculated by comparing (i.e., dividing) CDI_i and DAD_i levels with RfDs for each COPC.

Noncarcinogenic effects are estimated by calculating the Hazard Quotient (HQ) for individual chemicals and the HI for overall chemicals and pathways by the following equation:

$$HI = \sum_{i=1}^{n} HQ_i$$

$$where: HQ_i = \frac{(CDI_i or DAD_i)}{RfD_i or RfC_i}$$

An HQ is the ratio of the daily intake or absorbed dose to the reference dose (or reference concentration for inhalation exposure). CDI_i is the chronic daily intake (mg/kg/day) of contaminant i; DAD_i is the dermally absorbed dose (mg/kg/day) of contaminant i, and RfD_i is the reference dose (mg/kg/day) of the contaminant i over a prolonged period of exposure. RfC_i is the reference concentration used when determining exposure due to inhalation. Since the units of RfD are mg/kg-day and the units of CDI/DAD are mg/kg-day, the HQ and HI are dimensionless. To account for the additivity of noncarcinogenic risk following exposure to numerous chemicals, the HI, which is the sum of all the HQs, will be calculated. A ratio of 1.0 is used for comparison to the HQ and HI (USEPA, 1990). Ratios less than 1.0 indicate that adverse noncarcinogenic health effects are unlikely. Ratios greater than 1.0 indicate that adverse noncarcinogenic health

effects may occur at that exposure level. However, this does not mean that adverse effects will definitely occur, since the RfD incorporates safety and modifying factors to ensure that it is well below that dose for which adverse effects have been observed. This procedure assumes that the risks from exposure to multiple chemicals are additive, an assumption that is probably valid for compounds that have the same target organ or cause the same toxic effect.

6.5.3 Potential Human Health Effects

Both pathway-specific risks and total site risks have been estimated for current military Base personnel, future residents, and future construction workers at SWMU 311. All scenarios evaluated in this baseline HHRA were previously discussed in detail in Section 6.3. All calculation spreadsheets used for estimating potential carcinogenic and noncarcinogenic risks for receptors at SWMU 311 are presented in Appendix H. Please note that the full set of RAGS Part D tables is presented in Appendix I.

The total site carcinogenic and noncarcinogenic risks estimated for all current and future receptors evaluated in this baseline HHRA are presented in Tables 6-23 through 6-28. The pathway risks contributing to the potentially unacceptable total site risks are also presented in these tables.

6.5.3.1 Current Military Base Personnel

Table 6-23 presents all potential pathway-specific and total site risks estimated for current military Base personnel evaluated for ingestion and dermal exposures to site COPCs in surface soil and inhalation of fugitive dusts from surface soil.

There were no carcinogenic risks or adverse noncarcinogenic health hazards calculated that exceeded USEPA's acceptable criteria for the current military Base personnel.

6.5.3.2 Current Adult and Adolescent Trespassers

There were no COPCs selected for surface soil outside the fence line in the vicinity of SWMU 311. Therefore, a complete surface soil exposure pathway does not exist for the current trespassers. Consequently, there are no carcinogenic risks or adverse health effects resulting from exposure to surface soil outside the fence line.

It is acknowledged that there is the potential for the fence to be breached or removed in the future, and future trespasser exposure to surface soil inside the fence would be possible. However, quantitative evaluation of this receptor/pathway combination was not included in this HHRA. A future residential scenario was evaluated for SWMU 311, which is considered to represent the upper bound for potential risk from site-related media. Surface soil exposure for adult and child residents was part of this evaluation and represents a more conservative evaluation of human exposure than the trespasser scenario. Therefore, the evaluation of residential exposure to surface soil adequately assesses potential future human risk. In the event that unacceptable risks or health hazards are calculated for future residential exposure to surface soil, a qualitative evaluation of future trespasser exposure to surface soil will be included as an uncertainty in Section 6.6.

6.5.3.3 Future Adult and Child Residents

Tables 6-24 and 6-26 (RME) and 6-25 and 6-27 (CT) present all potential pathway-specific and total site risks estimated for future adult and child residents evaluated for ingestion and dermal exposures to site COPCs in surface and subsurface soil, groundwater, and inhalation of fugitive dusts from surface and subsurface soil. There were no carcinogenic risks or adverse noncarcinogenic health hazards calculated that exceeded USEPA's acceptable criteria for the future adult resident. There were no carcinogenic risks calculated that exceeded USEPA's acceptable risk range for the future young child resident. However, a total site HI value slightly exceeding USEPA's acceptable hazard level of 1.0 was calculated for the future young child resident. Potential exposure to groundwater comprised the elevated hazard value. As shown in Table 6-27, the total site HI value for the future young child resident was less than USEPA's acceptable hazard level of 1.0 under the CT exposure scenario.

Ingestion of arsenic in groundwater was the main contributor (percent contribution of approximately 74 to the groundwater ingestion pathway) to the elevated groundwater HI of 1.06 for the child resident. It should be noted that the total HQ for arsenic summed over all media was less than 1.0. Furthermore, there were no individual HQ values for COPCs or target organs that exceeded 1.0. As previously mentioned, the total site HI value calculated for the child resident was acceptable under the CT exposure scenario.

Therefore, based on the results of the baseline HHRA, it is unlikely that adverse health effects will occur for future child residents upon exposure to environmental media investigated at SWMU 311.

6.5.3.4 Future Construction Workers

Table 6-28 presents all potential pathway-specific and total site risks estimated for future construction workers evaluated for ingestion and dermal exposures to site COPCs in surface soil and subsurface soil, and inhalation of fugitive dusts from surface and subsurface soil.

There were no carcinogenic risks or adverse noncarcinogenic health hazards calculated that exceeded USEPA's acceptable criteria for the future construction worker.

6.5.3.5 Lead IEUBK Model Results

The USEPA lead IEUBK model (Windows™ version) was used to determine if exposure to site media would result in unacceptable blood lead levels in younger children upon exposure to surface soil at SWMU 311. Blood lead levels are considered unacceptable if there is a greater than five percent probability that the blood lead levels will exceed 10 μg/dl.

The maximum concentration for lead in surface soil (1,110 mg/kg) was used in the model. The remaining model parameters used were the default factors supplied in the model (USEPA, 2001b). The concentration in surface soil inside the landfill resulted in a 55 percent probability that blood lead levels would exceed 10 μg/dl, which is above the acceptable level. These results are presented graphically in Figures 6-2. This indicates that the potential for adverse health effects from exposure to lead may occur in the future child resident. However, it should be noted that the maximum concentration of lead was two orders of magnitude greater than all other lead concentrations and was the only concentration that exceeded the USEPA's action level for lead of 400 mg/kg in residential soil.

6.6 Sources of Uncertainty

Uncertainties are encountered throughout the risk assessment process. This section discusses the sources of uncertainty inherent in the following elements of the human health evaluation performed for SWMU 311:

- Sampling and analysis
- Selection of COPCs
- Exposure assessment
- Toxicological assessment
- Human risk characterization

Uncertainties associated with this risk assessment are discussed in the following paragraphs. Table 6-29 summarizes the potential effects of certain uncertainties on the estimation of human health risks.

6.6.1 Sampling and Analysis

The development of a risk assessment depends on the reliability of, and uncertainties associated with, the analytical data available to the risk assessor. These, in turn, are dependent on the operating procedures and techniques applied to the collection of environmental samples in the field and their subsequent analyses in the laboratory. To minimize the uncertainties associated with sampling and analysis at SWMU 311, USEPA-approved sampling and analytical methods were employed. Data was generated following USEPA's Statement of Work for Contract Laboratory Program (CLP). Samples were analyzed for TCL organics and RCRA metals. Samples were taken from locations specified in the approved Work Plan along with the necessary QA/QC samples.

Analytical data are limited by the precision and accuracy of the methods of analysis, which are reflected by the Relative Percent Difference (RPD) of duplicate analyses and the percent recovery of spikes, respectively. In addition, the statistical methods used to compile and analyze the data (mean concentrations, detection frequencies) are subject to the overall uncertainty in data measurement. Furthermore, chemical concentrations in environmental media fluctuate over time

and with respect to sampling location. Analytical data must be sufficient to consider the temporal and spatial characteristics of contamination at the site with respect to exposure.

Uncertainty exists also in the fact that contamination may or may not be fully delineated. And so, having a complete data set impacts the representativeness of exposure concentrations derived from the data.

There is some uncertainty associated with the exclusion of the mobile laboratory data from this HHRA. Upon evaluation of the mobile laboratory data, there were no organic compounds detected in surface or subsurface soil (refer to Table 4-3), and only cis-1,2-dichloroethene was detected in one groundwater sample (refer to Table 4-3). Therefore, it can be concluded that the exclusion of the mobile laboratory data does not change the results of the HHRA. Also, the inclusion of the mobile laboratory data introduces uncertainty in that those data were not validated. However, fixed-base laboratory data were validated using procedures established by the National Functional Guidelines for Organic and Inorganic Analyses (USEPA, 2002).

Surface soil samples collected from 0-2 feet bgs (Phase I investigation) were included in this HHRA. This depth interval is generally not included in a HHRA as surface soil because it is not representative of the depth range recommended by USEPA Region IV risk guidance (USEPA, 1996). However, the three surface soil samples collected from 0-2 feet bgs during the Phase I investigation were included in the HHRA data set to maximize the number of available data points and to gain representative coverage within the exposure area. Additionally, the soil data collected during Phase I is only data that includes SVOC analytical results.

It is noted that the use of the 0-2 foot bgs surface soil samples adds uncertainty to the risk assessment. These data were not validated but were analyzed by a fixed-base laboratory following USEPA's CLP. Also, the inclusion of soil from 1-2 feet bgs in these samples may dilute the concentration of any contaminants that may be present in the top foot of soil. Upon review of the surface soil data, barium was not detected in the Phase I samples but was detected in all 0-1 foot bgs surface soil samples, and mercury was detected only once in the Phase I samples but was detected in all 0-1 foot bgs surface soil samples. However, it should be noted that the maximum detected concentrations of barium and mercury were below USEPA Region IX residential PRGs. Concentrations of the remaining RCRA metals do not appear to have been

diluted by soil from 1-2 feet bgs. Based on examination of the data sets, it is anticipated that the contribution to the uncertainty of this risk assessment is low.

6.6.2 Selection of COPCs

Soil and groundwater water COPCs were selected based on comparisons of the maximum detected concentration with USEPA Region IX PRGs for residential soil (soil) and tap water (groundwater).

PRGs were derived using conservative, USEPA-promulgated default values, and the most recent toxicological criteria available. All non-carcinogenic PRGs were divided by 10 to account for potential additive effects. This adjustment corresponds to assuming an HQ of 0.1, rather than 1.0. This adds additional conservatism to the COPC selection process.

RfDs and CSFs have been combined with "standard" exposure scenarios to calculate the PRGs. Actual exposure scenarios and parameters may differ from those used to calculate the PRG.

Guidance contained within RAGS Volume I, Part A discusses the evaluation of quantitation limits in relationship to whether or not chemicals should be eliminated from a baseline HHRA because they were not detected. In other words, just because a chemical was not detected does not mean it should be deleted from consideration. In the baseline HHRA performed for SWMU 311, only those chemicals that were positively detected were retained for quantitative evaluation in the risk assessment. There is some uncertainty associated with chemicals that may not have been detected, but the sample quantitation limits were greater than corresponding standards and/or criteria. This situation could result in undetected risk. However, given the other conservative aspects of this baseline HHRA, it is anticipated that the contribution to the uncertainty of this risk assessment is low. Furthermore, for chemicals detected just once in a given medium, one half of all detection limits of that chemical (considered as non-detects) are used as proxy calculations in calculating the concentration term. Only those chemicals in a medium that are not positively detected in each sample collected and analyzed are eliminated from further consideration.

Currently, no Base closures are planned for MCB Camp Lejeune; therefore future residential development is unlikely. The application of the residential PRG values to soil and groundwater

COPC selections would, therefore, tend to result in a list of COPCs that could be considered conservative for a military base. Conservative COPC selections in the baseline HHRA protects public health because the results of the baseline HHRA determine remedial alternatives and remedial action objectives.

6.6.3 Exposure Assessment

In performing exposure assessments, uncertainties arise from two main sources. First, uncertainties arise in estimating the fate of a compound in the environment, including estimating release and transport in a particular environmental medium. Second, uncertainties arise in the estimation of chemical intakes resulting from contact by a receptor with a particular medium.

To estimate an intake, certain assumptions must be made about exposure events, exposure durations, and the corresponding assimilation of constituents by the receptor. Exposure factors have been generated by the scientific community and have been reviewed by the USEPA. The USEPA has published an Exposure Factors Handbook (USEPA, 1997), which contains the best and latest values. These exposure factors have been derived from a range of values generated by studies of limited numbers of individuals. It is assumed that all potential receptors remain on or near the site throughout the exposure periods and that their exposures to chemicals from the site are all uniform. In all instances, values used in this risk assessment, scientific judgments, and conservative assumptions agree with those of the USEPA.

The use of a RME approach, designed to avoid underestimating daily intakes, was employed throughout this risk assessment. The use of 95% UCL estimates of the arithmetic mean versus maximum values as the concentration terms in estimating the CDI or DAD for the soil exposure scenarios and the maximum values as the concentration terms for groundwater exposure scenarios reduces the potential for underestimating exposure at SWMU 311.

6.6.4 Toxicological Assessment

In making quantitative estimates of the toxicity of varying dosages of compounds to human receptors, uncertainties arise from two sources. First, data on human exposure and the subsequent effects are usually insufficient, if they are at all available. Human exposure data usually lack adequate concentration estimations and suffer from inherent temporal variability.

Therefore, animal studies are often used and new uncertainties arise from the process of extrapolating animal results to humans. Second, to obtain observable effects with a manageable number of experimental subjects, high doses of a compound are often used. In this situation, a high dose means that high exposures are used in the experiment with respect to most environmental exposures. Therefore, when applying the results of the animal experiment to human exposures, the effects at the high doses must be extrapolated to approximate effects at lower doses.

In extrapolating effects from high doses in animals to low doses in humans, scientific judgment and conservative assumptions are employed. In selecting animal studies for use in dose-response calculations, the following factors are considered:

- Studies are preferred where the animal closely mimics human pharmacokinetics.

- Studies are preferred where dose intake most closely mimics the intake route and duration for humans.

- Studies are preferred which demonstrate the most sensitive response to the compound in question.

For compounds believed to cause threshold effects (i.e., noncarcinogens), safety factors are employed in the extrapolation of effects from animals to humans and from high doses to low doses. In deriving carcinogenic potency factors, the 95% UCL value is promulgated by the USEPA to prevent underestimation of potential risk.

All potential toxic endpoints for human receptors have been addressed to the extent allowed by the data evaluated from the most recent toxicological/epidemiological studies used to derive the cancer slope factors and reference doses. Therefore, any uncertainties associated with toxic endpoints are directly correlated to the information obtained from, and reliability of those studies.

Further conservatism in the baseline HHRA is also introduced through the use of experimentally-derived oral absorption efficiencies to account for a difference in the degree of toxicity between an administered dose and an absorbed dose. Equating the absorption efficiency

of the dermal bi-phasic barrier to the absorption efficiency of the gastrointestinal lining is a very conservative approach that tends to overestimate the potential risk to human health.

6.6.5 Human Risk Characterization

The risk characterization bridges the gap between potential exposure and the possibility of systemic or carcinogenic human health effects, ultimately providing impetus for the remediation of the site or providing a basis for no remedial action.

Uncertainties associated with risk characterization include the assumption of chemical additivity and the inability to predict synergistic or antagonistic interactions between COPCs. These uncertainties are inherent in any inferential risk assessment. USEPA promulgated inputs to the quantitative risk assessment and toxicological indices are calculated to be protective of the human receptor and to err conservatively, so as to not underestimate the potential human health risks.

6.7 Summary of the Baseline HHRA

Current land use scenarios that were evaluated in this baseline HHRA for SWMU 311 include the adolescent and adult trespasser and military Base personnel. Future land use scenarios that were evaluated include the adult and child residents and construction worker.

There were no surface soil COPCs selected for the trespasser exposure evaluation. Therefore, a quantitative risk evaluation for the trespasser receptors was not necessary. Consequently, there are no unacceptable risks or hazard levels for the adult and adolescent trespassers. There were no unacceptable risks or hazard levels calculated for the current military Base personnel.

There were no carcinogenic risks or adverse noncarcinogenic health hazards calculated that exceeded USEPA's acceptable criteria for the future adult resident or future construction worker. There were no carcinogenic risks calculated that exceeded USEPA's acceptable risk range for the future young child resident.

The total site HI value slightly exceeding USEPA's acceptable hazard level of 1.0 was calculated for the future young child resident. Ingestion of arsenic in groundwater was the main contributor to the elevated groundwater HI for the child resident. However, the total site HI value for the

future young child resident was less than USEPA's acceptable hazard level of 1.0 under the CT exposure scenario. Also, the total HQ for arsenic summed over all media was less than 1.0, and there were no individual HQ values for COPCs or target organs that exceeded 1.0. Therefore, based on the results of the baseline HHRA, it is unlikely that adverse health effects will occur for future child residents upon exposure to arsenic in groundwater at SWMU 311.

The results of the Lead IEUBK model indicated that the potential for adverse health effects from exposure to lead in surface soil may occur in the future child resident. However, it should be noted that the maximum concentration of lead was two orders of magnitude greater than all other lead concentrations and was the only concentration that exceeded the USEPA's action level for lead of 400 mg/kg in residential soil.

TABLES

TABLE 6-1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current, Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil

CAS Number	Chemical	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (1)	Screening (2) Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (3) Contaminant Deletion or Selection
	VOLATILES (ug/kg)															
78-93-3	2-Butanone (MEK)	6	J	11	J	µg/kg	SWMU311-TW02-00	2/6	12U - 15U	11	NA	7.33E+05 N	N/A	N/A	NO	BSL
108-10-1	4-Methyl-2-pentanone (MIBK)	2	J	2	J	µg/kg	SWMU311-SB03-00	1/6	12U - 16U	2	NA	7.87E+04 N	N/A	N/A	NO	BSL
67-64-1	Acetone	4	J	34	J	µg/kg	SWMU311-TW02-00	6/6	(4)	34	NA	1.57E+05 N	N/A	N/A	NO	BSL
71-43-2	Benzene	2	J	2	J	µg/kg	SWMU311-TW02-00	1/9	1U - 6U	2	NA	6.01E+02 C	N/A	N/A	NO	BSL
75-25-2	Bromoform	6.75	J	19		µg/kg	SWMU311-TW02-00	4/6	5U - 6U	19	NA	6.16E+04 C	N/A	N/A	NO	BSL
75-15-0	Carbon Disulfide	2	J	2	J	µg/kg	SWMU311-TW02-00	1/6	5U - 6U	2	NA	3.55E+04 N	N/A	N/A	NO	BSL
67-66-3	Chloroform	1.5	J	2	J	µg/kg	SWMU311-TW01-00	2/6	5U - 6U	2	NA	3.56E+03 C	N/A	N/A	NO	BSL
110-82-7	Cyclohexane	1	J	1	J	µg/kg	SWMU311-TW02-00	1/6	5U - 6U	1	NA	1.40E+05 S	N/A	N/A	NO	BSL
100-41-4	Ethylbenzene	2	J	2	J	µg/kg	SWMU311-TW02-00	1/9	1U - 6U	2	NA	8.92E+03 C	N/A	N/A	NO	BSL
108-87-2	Methyl Cyclohexane	1	J	1	J	µg/kg	SWMU311-TW02-00	1/6	5U - 6U	1	NA	2.59E+05 N	N/A	N/A	NO	BSL
75-09-2	Methylene Chloride	13		30		µg/kg	SWMU311-TW01-00	6/6	(4)	30	NA	9.11E+03 C	N/A	N/A	NO	BSL
	SEMIVOLATILES (ug/kg)															
56-55-3	Benzo(a)anthracene	33	J	33	J	µg/kg	SWMU311-IS03-00	1/3	340U - 400U	33	NA	6.21E+02 C	N/A	N/A	NO	BSL
50-32-8	Benzo(a)pyrene	48	J	48	J	µg/kg	SWMU311-IS03-00	1/3	340U - 400U	48	NA	6.21E+01 C	N/A	N/A	NO	BSL
205-99-2	Benzo(b)fluoranthene	48	J	48	J	µg/kg	SWMU311-IS03-00	1/3	340U - 400U	48	NA	6.21E+02 C	N/A	N/A	NO	BSL
191-24-2	Benzo(g,h,i)perylene	50	J	50	J	µg/kg	SWMU311-IS03-00	1/3	340U - 400U	50	NA	2.32E+05 N (5)	N/A	N/A	NO	BSL
207-08-9	Benzo(k)fluoranthene	60	J	60	J	µg/kg	SWMU311-IS03-00	1/3	340U - 400U	60	NA	6.21E+03 C	N/A	N/A	NO	BSL
117-81-7	Bis(2-ethylhexyl) Phthalate (DEHP)	170	J	230	J	µg/kg	SWMU311-IS02-00	3/3	(4)	230	NA	3.47E+04 C	N/A	N/A	NO	BSL
218-01-9	Chrysene	49	J	49	J	µg/kg	SWMU311-IS03-00	1/3	340U - 400U	49	NA	6.21E+04 C	N/A	N/A	NO	BSL
206-44-0	Fluoranthene	65	J	65	J	µg/kg	SWMU311-IS03-00	1/3	340U - 400U	65	NA	2.29E+05 N	N/A	N/A	NO	BSL
193-39-5	Indeno(1,2,3-cd)pyrene	41	J	41	J	µg/kg	SWMU311-IS03-00	1/3	340U - 400U	41	NA	6.21E+02 C	N/A	N/A	NO	BSL
129-00-0	Pyrene	62	J	62	J	µg/kg	SWMU311-IS03-00	1/3	340U - 400U	62	NA	2.32E+05 N	N/A	N/A	NO	BSL
	METALS (mg/kg)															
7440-38-2	Arsenic	0.25	J	0.31	J	mg/kg	SWMU311-TW01-00	2/9	0.24U - 1.2U	0.31	0.742	3.90E-01 C	N/A	N/A	NO	BSL
7440-39-3	Barium	8.5		13.65	J	mg/kg	SWMU311-TW03-00	6/9	20.8U - 24U	13.65	23.4	5.37E+02 N	N/A	N/A	NO	BSL
7440-43-9	Cadmium	0.041	J	5.2		mg/kg	SWMU311-IS02-00	6/9	0.033U - 0.52U	5.2	0.0340	3.70E+00 N	N/A	N/A	YES	ASL
7440-47-3	Chromium	3.3		28.8		mg/kg	SWMU311-IS02-00	9/9	(4)	28.8	11.4	3.01E+01 C (6)	N/A	N/A	NO	BSL
7439-92-1	Lead	4.4	J	1,110		mg/kg	SWMU311-IS04-00	9/9	(4)	1,110	13.4	4.00E+02 N	N/A	N/A	YES	ASL
7439-97-6	Mercury	0.0185	J	0.09		mg/kg	SWMU311-IS02-00	7/9	0.034U - 0.038U	0.09	0.0694	2.35E+00 N (7)	N/A	N/A	NO	BSL
7782-49-2	Selenium	0.56		0.91		mg/kg	SWMU311-TW01-00	2/9	0.47U - 0.6U	0.91	0.651	3.91E+01 N	N/A	N/A	NO	BSL

(1) MCB Camp Lejeune Base Background Study, Final (Baker, 2001): 2 * Mean (1/2 nondetects) - Soil Associatio
(2) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals
USEPA Region IX COC Screening Value (derived from USEPA Region IX PRG Table)
(3) Rationale Codes Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)

(4) No detection limits given; analyte detected in every sample.
(5) Screening value for pyrene used as a surrogate.
(6) Screening value for chromium VI used.
(7) Screening values for mercuric chloride used as a surrogate.

Definitions: NA = Not Analyzed
COPC = Chemical of Potential Concern
ARAR/TBC = arplicable or Relevant and arpropriate Requirement/To Be Considered

J - Analyte present - Reported value is estimated
U - Not detected

C = Carcinogenic
N = Non-Carcinogenic
S = Soil Saturation

mg/kg = milligrams per kilogram
ug/kg = microgram per kilogram

TABLE 6-2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN (TRESPASSER ONLY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil

CAS Number	Chemical	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (1)	Screening (2) Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (3) Contaminant Deletion or Selection
	VOLATILES (ug/kg)															
78-93-3	2-Butanone (MEK)	6	J	11	J	µg/kg	SWMU311-TW02-00	2/3	15U - 15U	11	NA	7.33E+05 N	N/A	N/A	NO	BSL
67-64-1	Acetone	14	J	34	J	µg/kg	SWMU311-TW02-00	3/3	(4)	34	NA	1.57E+05 N	N/A	N/A	NO	BSL
71-43-2	Benzene	2	J	2	J	µg/kg	SWMU311-TW02-00	1/4	1.2U - 6U	2	NA	6.01E+02 C	N/A	N/A	NO	BSL
75-25-2	Bromoform	12		19		µg/kg	SWMU311-TW02-00	3/3	(4)	19	NA	6.16E+04 C	N/A	N/A	NO	BSL
75-15-0	Carbon Disulfide	2	J	2	J	µg/kg	SWMU311-TW02-00	1/3	6U - 6U	2	NA	3.55E+04 N	N/A	N/A	NO	BSL
67-66-3	Chloroform	2	J	2	J	µg/kg	SWMU311-TW01-00	1/3	5U - 6U	2	NA	3.56E+03 C	N/A	N/A	NO	BSL
110-82-7	Cyclohexane	1	J	1	J	µg/kg	SWMU311-TW02-00	1/3	6U - 6U	1	NA	1.40E+05 S	N/A	N/A	NO	BSL
100-41-4	Ethylbenzene	2	J	2	J	µg/kg	SWMU311-TW02-00	1/4	1.2U - 6U	2	NA	8.92E+03 C	N/A	N/A	NO	BSL
108-87-2	Methyl Cyclohexane	1	J	1	J	µg/kg	SWMU311-TW02-00	1/3	6U - 6U	1	NA	2.59E+05 N	N/A	N/A	NO	BSL
75-09-2	Methylene Chloride	18		30		µg/kg	SWMU311-TW01-00	3/3	(4)	30	NA	9.11E+03 C	N/A	N/A	NO	BSL
	SEMIVOLATILES (ug/kg)															
56-55-3	Benzo(a)anthracene	33	J	33	J	µg/kg	SWMU311-IS03-00	1/1	(4)	33	NA	6.21E+02 C	N/A	N/A	NO	BSL
50-32-8	Benzo(a)pyrene	48	J	48	J	µg/kg	SWMU311-IS03-00	1/1	(4)	48	NA	6.21E+01 C	N/A	N/A	NO	BSL
205-99-2	Benzo(b)fluoranthene	48	J	48	J	µg/kg	SWMU311-IS03-00	1/1	(4)	48	NA	6.21E+02 C	N/A	N/A	NO	BSL
191-24-2	Benzo(g,h,i)perylene	50	J	50	J	µg/kg	SWMU311-IS03-00	1/1	(4)	50	NA	2.32E+05 N (5)	N/A	N/A	NO	BSL
207-08-9	Benzo(k)fluoranthene	60	J	60	J	µg/kg	SWMU311-IS03-00	1/1	(4)	60	NA	6.21E+03 C	N/A	N/A	NO	BSL
117-81-7	Bis(2-ethylhexyl) Phthalate (DEHP)	170	J	170	J	µg/kg	SWMU311-IS03-00	1/1	(4)	170	NA	3.47E+04 C	N/A	N/A	NO	BSL
218-01-9	Chrysene	49	J	49	J	µg/kg	SWMU311-IS03-00	1/1	(4)	49	NA	6.21E+04 C	N/A	N/A	NO	BSL
206-44-0	Fluoranthene	65	J	65	J	µg/kg	SWMU311-IS03-00	1/1	(4)	65	NA	2.29E+05 N	N/A	N/A	NO	BSL
193-39-5	Indeno(1,2,3-cd)pyrene	41	J	41	J	µg/kg	SWMU311-IS03-00	1/1	(4)	41	NA	6.21E+02 C	N/A	N/A	NO	BSL
129-00-0	Pyrene	62	J	62	J	µg/kg	SWMU311-IS03-00	1/1	(4)	62	NA	2.32E+05 N	N/A	N/A	NO	BSL
	METALS (mg/kg)															
7440-38-2	Arsenic	0.31	J	0.31	J	mg/kg	SWMU311-TW01-00	1/4	0.27U - 1.2U	0.31	0.742	3.90E-01 C	N/A	N/A	NO	BSL
7440-39-3	Barium	8.5		11.6		mg/kg	SWMU311-TW01-00	3/4	23.2U - 23.2U	11.6	23.4	5.37E+02 N	N/A	N/A	NO	BSL
7440-43-9	Cadmium	0.056	J	0.74		mg/kg	SWMU311-IS03-00	3/4	0.033U - 0.033U	0.74	0.0340	3.70E+00 N	N/A	N/A	NO	BSL
7440-47-3	Chromium	4.8		10.4		mg/kg	SWMU311-TW01-00	4/4	(4)	10.4	11.4	3.01E+01 C (6)	N/A	N/A	NO	BSL
7439-92-1	Lead	5.2	J	16		mg/kg	SWMU311-IS03-00	4/4	(4)	16	13.4	4.00E+02 N	N/A	N/A	NO	BSL
7439-97-6	Mercury	0.034	J	0.053		mg/kg	SWMU311-TW01-00	3/4	0.038U - 0.038U	0.053	0.0694	2.35E+00 N (7)	N/A	N/A	NO	BSL
7782-49-2	Selenium	0.91		0.91		mg/kg	SWMU311-TW01-00	1/4	0.51U - 0.58U	0.91	0.651	3.91E+01 N	N/A	N/A	NO	BSL

(1) MCB Camp Lejeune Base Background Study, Final (Baker, 2001): 2 * Mean (1/2 nondetects) - Soil Associatio
(2) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals
USEPA Region IX COC Screening Value (derived from USEPA Region IX PRG Table)
(3) Rationale Codes Deletion Reason: Below Screening Level (BSL)

(4) No detection limits given; analyte detected in every sample.
(5) Screening value for pyrene used as a surrogate.
(6) Screening value for chromium VI used.
(7) Screening values for mercuric chloride used as a surrogate.

Definitions: NA = Not Analyzed
COPC = Chemical of Potential Concern
ARAR/TBC = arplicable or Relevant and arpropriate Requirement/To Be Considered

J - Analyte present - Reported value is estimated
U - Not detected

C = Carcinogenic
N = Non-Carcinogenic
S = Soil Saturation

mg/kg = milligrams per kilogram
ug/kg = microgram per kilogram

TABLE 6-3
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Subsurface Soil

CAS Number	Chemical	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (1)	Screening (2) Toxicity Value RESIDENTIAL	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (3) Contaminant Deletion or Selection
	VOLATILES (ug/kg)															
95-50-1	1,2-Dichlorobenzene (o-)	530		530		µg/kg	SWMU311-IS02-03	1/15	1.1U - 13U	530	NA	3.70E+05 S	N/A	N/A	NO	BSL
541-73-1	1,3-Dichlorobenzene (m-)	140		140		µg/kg	SWMU311-IS02-03	1/15	1.1U - 13U	140	NA	1.59E+03 N	N/A	N/A	NO	BSL
106-46-7	1,4-Dichlorobenzene (p-)	220		220		µg/kg	SWMU311-IS02-03	1/15	1.1U - 13U	220	NA	3.45E+03 C	N/A	N/A	NO	BSL
67-64-1	Acetone	2	J	18	J	µg/kg	SWMU311-SB20-03	6/13	11UJ - 14UJ	18	NA	1.57E+05 N	N/A	N/A	NO	BSL
75-25-2	Bromoform	22		28		µg/kg	SWMU311-TW02-03	3/13	5U - 13U	28	NA	6.16E+04 C	N/A	N/A	NO	BSL
108-90-7	Chlorobenzene	530		530		µg/kg	SWMU311-IS02-03	1/15	1.1U - 13U	530	NA	1.51E+04 N	N/A	N/A	NO	BSL
67-66-3	Chloroform	1	J	2	J	µg/kg	SWMU311-TW02-03	2/13	5U - 13U	2	NA	3.56E+03 C	N/A	N/A	NO	BSL
75-09-2	Methylene Chloride	1.9	J	34		µg/kg	SWMU311-TW03-03	10/13	11U - 12U	34	NA	9.11E+03 C	N/A	N/A	NO	BSL
108-88-3	Toluene	200		200		µg/kg	SWMU311-IS02-03	1/15	1.1U - 13U	200	NA	5.20E+05 S	N/A	N/A	NO	BSL
1330-20-7	Xylenes, total	2,000		2,000		µg/kg	SWMU311-IS02-03	1/8	1.1U - 18UJ	2,000	NA	2.75E+04 N	N/A	N/A	NO	BSL
	SEMIVOLATILES (ug/kg)															
91-57-6	2-Methylnaphthalene	1,300	J	1,300	J	µg/kg	SWMU311-IS02-03	1/2	370U - 370U	1,300	NA	5.59E+03 N (5)	N/A	N/A	NO	BSL
117-81-7	Bis(2-ethylhexyl) Phthalate (DEHP)	800	J	800	J	µg/kg	SWMU311-IS03-03	1/2	4000U - 4000U	800	NA	3.47E+04 C	N/A	N/A	NO	BSL
	METALS (mg/kg)															
7440-38-2	Arsenic	0.55	J	1.9		mg/kg	SWMU311-IS02-03	5/23	0.27U - 1.1U	1.9	0.553	3.90E-01 C	N/A	N/A	YES	ASL
7440-39-3	Barium	1.6	J	45		mg/kg	SWMU311-TW01-03	21/23	22.7U - 24.2U	45	13.5	5.37E+02 N	N/A	N/A	NO	BSL
7440-43-9	Cadmium	0.03075	J	1.1	J	mg/kg	SWMU311-SB05-02	6/23	0.033U - 0.57U	1.1	ND	3.70E+00 N	N/A	N/A	NO	BSL
7440-47-3	Chromium	0.88	J	21		mg/kg	SWMU311-IS02-03	18/23	0.12U - 0.15U	21	12.5	3.01E+01 C (6)	N/A	N/A	NO	BSL
7439-92-1	Lead	1		51.2	J	mg/kg	SWMU311-SB05-02	23/23	(4)	51.2	7.55	4.00E+02 N	N/A	N/A	NO	BSL
7439-97-6	Mercury	0.01875	J	0.057		mg/kg	SWMU311-IS02-03	4/23	0.018U - 0.12U	0.057	0.0394	2.35E+00 N (7)	N/A	N/A	NO	BSL
7782-49-2	Selenium	0.4625		1.1	J	mg/kg	11-SB06-01,SWMU311-	7/23	0.51U - 0.74U	1.1	0.286	3.91E+01 N	N/A	N/A	NO	BSL
7440-22-4	Silver	0.33	J	0.51	J	mg/kg	SWMU311-SB11-02	7/23	0.0995U - 1.2U	0.51	ND	3.91E+01 N	N/A	N/A	NO	BSL

(1) MCB Camp Lejeune Base Background Study, Final (Baker, 2001): 2 * Mean (1/2 nondetects) - Soil Associatior
(2) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals
USEPA Region IX COC Screening Value (derived from USEPA Region IX PRG Table)
(3) Rationale Codes Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)

(4) No detection limits given; analyte detected in every sample.
(5) Screening values for naphthalene used as a surrogate
(6) Screening value for chromium VI used.
(7) Screening values for mercuric chloride used as a surrogate.

Definitions: NA = Not Analyzed
ND = Not Detected
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered

J - Analyte present - Reported value is estimated
U - Not detected
UJ - Reported quantitation limit is qualified as estimated

C = Carcinogenic
N = Non-Carcinogenic
S = Soil Saturation

mg/kg = milligrams per kilogram
ug/kg = microgram per kilogram

TABLE 6-4
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Subsurface Soil

CAS Number	Chemical	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (1)	Screening (2) Toxicity Value INDUSTRIAL	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (3) Contaminant Deletion or Selection
	VOLATILES (ug/kg)															
95-50-1	1,2-Dichlorobenzene (o-)	530		530		µg/kg	SWMU311-IS02-03	1/15	1.1U - 13U	530	NA	3.70E+05 S	N/A	N/A	NO	BSL
541-73-1	1,3-Dichlorobenzene (m-)	140		140		µg/kg	SWMU311-IS02-03	1/15	1.1U - 13U	140	NA	6.27E+03 N	N/A	N/A	NO	BSL
106-46-7	1,4-Dichlorobenzene (p-)	220		220		µg/kg	SWMU311-IS02-03	1/15	1.1U - 13U	220	NA	7.87E+03 C	N/A	N/A	NO	BSL
67-64-1	Acetone	2	J	18	J	µg/kg	SWMU311-SB20-03	6/13	11UJ - 14UJ	18	NA	6.04E+05 N	N/A	N/A	NO	BSL
75-25-2	Bromoform	22		28		µg/kg	SWMU311-TW02-03	3/13	5U - 13U	28	NA	2.18E+05 C	N/A	N/A	NO	BSL
108-90-7	Chlorobenzene	530		530		µg/kg	SWMU311-IS02-03	1/15	1.1U - 13U	530	NA	5.30E+04 N	N/A	N/A	NO	BSL
67-66-3	Chloroform	1	J	2	J	µg/kg	SWMU311-TW02-03	2/13	5U - 13U	2	NA	1.17E+04 C	N/A	N/A	NO	BSL
75-09-2	Methylene Chloride	1.9	J	34		µg/kg	SWMU311-TW03-03	10/13	11U - 12U	34	NA	2.05E+04 C	N/A	N/A	NO	BSL
108-88-3	Toluene	200		200		µg/kg	SWMU311-IS02-03	1/15	1.1U - 13U	200	NA	5.20E+05 S	N/A	N/A	NO	BSL
1330-20-7	Xylenes, total	2,000		2,000		µg/kg	SWMU311-IS02-03	1/8	1.1U - 18UJ	2,000	NA	4.20E+05 S	N/A	N/A	NO	BSL
	SEMIVOLATILES (ug/kg)															
91-57-6	2-Methylnaphthalene	1,300	J	1,300	J	µg/kg	SWMU311-IS02-03	1/2	370U - 370U	1,300	NA	1.88E+04 N (5)	N/A	N/A	NO	BSL
117-81-7	Bis(2-ethylhexyl) Phthalate (DEHP)	800	J	800	J	µg/kg	SWMU311-IS03-03	1/2	4000U - 4000U	800	NA	1.23E+05 C	N/A	N/A	NO	BSL
	METALS (mg/kg)															
7440-38-2	Arsenic	0.55	J	1.9		mg/kg	SWMU311-IS02-03	5/23	0.27U - 1.1U	1.9	0.553	1.59E+00 C	N/A	N/A	YES	ASL
7440-39-3	Barium	1.6	J	45		mg/kg	SWMU311-TW01-03	21/23	22.7U - 24.2U	45	13.5	6.66E+03 N	N/A	N/A	NO	BSL
7440-43-9	Cadmium	0.03075	J	1.1	J	mg/kg	SWMU311-SB05-02	6/23	0.033U - 0.57U	1.1	ND	4.51E+01 N	N/A	N/A	NO	BSL
7440-47-3	Chromium	0.88	J	21		mg/kg	SWMU311-IS02-03	18/23	0.12U - 0.15U	21	12.5	6.40E+01 C (6)	N/A	N/A	NO	BSL
7439-92-1	Lead	1		51.2	J	mg/kg	SWMU311-SB05-02	23/23	(4)	51.2	7.55	7.50E+01 N	N/A	N/A	NO	BSL
7439-97-6	Mercury	0.01875	J	0.057		mg/kg	SWMU311-IS02-03	4/23	0.018U - 0.12U	0.057	0.0394	3.07E+01 N (7)	N/A	N/A	NO	BSL
7782-49-2	Selenium	0.4625		1.1	J	mg/kg	11-SB06-01,SWMU311-	7/23	0.51U - 0.74U	1.1	0.286	5.11E+02 N	N/A	N/A	NO	BSL
7440-22-4	Silver	0.33	J	0.51	J	mg/kg	SWMU311-SB11-02	7/23	0.0995U - 1.2U	0.51	ND	5.11E+02 N	N/A	N/A	NO	BSL

(1) MCB Camp Lejeune Base Background Study, Final (Baker, 2001): 2 * Mean (1/2 nondetects) - Soil Associatior
(2) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals
USEPA Region IX COC Screening Value (derived from USEPA Region IX PRG Table)
(3) Rationale Codes Deletion Reason: Below Screening Level (BSL)

(4) No detection limits given; analyte detected in every sample.
(5) Screening values for naphthalene used as a surrogate
(6) Screening value for chromium VI used.
(7) Screening values for mercuric chloride used as a surrogate.

Definitions: NA = Not Analyzed
ND = Not Detected
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered

J - Analyte present - Reported value is estimated
U - Not detected
UJ - Reported quantitation limit is qualified as estimated

C = Carcinogenic
N = Non-Carcinogenic
S = Soil Saturation

mg/kg = milligrams per kilogram
ug/kg = microgram per kilogram

TABLE 6-5
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Groundwater

CAS Number	Chemical	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value	Screening (1) Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (2) Contaminant Deletion or Selection
	VOLATILES (ug/L)															
110-82-7	Cyclohexane	3	J	3	J	µg/L	SWMU311-GW01	1/3	5U - 5U	3	NA	3.47E+03 N	N/A	N/A	NO	BSL
100-41-4	Ethylbenzene	2	J	2	J	µg/L	SWMU311-GW01	1/3	5U - 5U	2	NA	2.91E+00 C	700	MCL	NO	BSL
98-82-8	Isopropylbenzene (Cumene)	3	J	3	J	µg/L	SWMU311-GW01	1/3	5U - 5U	3	NA	6.58E+01 N	70	NC WQC	NO	BSL
108-87-2	Methyl Cyclohexane	3	J	3	J	µg/L	SWMU311-GW01	1/3	5U - 5U	3	NA	5.22E+02 N	N/A	N/A	NO	BSL
1330-20-7	Xylenes, total	3	J	3	J	µg/L	SWMU311-GW01	1/3	5U - 5U	3	NA	2.10E+01 N	10,000	MCL	NO	BSL
	METALS (ug/L)															
7440-38-2	Arsenic	3.4	J	3.4	J	µg/L	SWMU311-GW03	1/3	2.4UJ - 2.4UJ	3.4	NA	4.48E-02 C	10	MCL	YES	ASL
7440-39-3	Barium	24.7		53.75		µg/L	SWMU311-GW01	2/3	33U - 33U	53.75	NA	2.55E+02 N	2,000	MCL	NO	BSL
7440-47-3	Chromium	12		12		µg/L	SWMU311-GW01	1/3	0.5UJ - 0.6U	12	NA	1.09E+01 N (3)	100	MCL	YES	ASL
7439-92-1	Lead	10.6		10.6		µg/L	SWMU311-GW01	1/3	1.1U - 1.8U	10.6	NA	1.50E+01 N (4)	15	MCL (4)	NO	BSL

(1) All non-carcinogenic RBCs were divided by 10 to account for potential additive effects of chemicals
USEPA Region IX COC Screening Value (derived from USEPA Region IX PRG Table)

(2) Rationale Codes Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)

(3) Screening value for chromium VI used.
(4) Action level for lead.

Definitions: NA = Not Analyzed
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
MCL = Maximum Contaminant Level
NC WQC = North Carolina Water Quality Criteria (EHNR)

J - Analyte present - Reported value is estimated
U - Not detected
UJ - Reported quantitation limit is qualified as estimated

C = Carcinogenic
N = Non-Carcinogenic
ug/L = microgram per liter

TABLE 6-6
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Groundwater

CAS Number	Chemical	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value	Screening (1) Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (2) Contaminant Deletion or Selection
	VOLATILES (ug/L)															
110-82-7	Cyclohexane	3	J	3	J	µg/L	SWMU311-GW01	1/3	5U - 5U	3	NA	N/A	N/A	N/A	YES	NSC
100-41-4	Ethylbenzene	2	J	2	J	µg/L	SWMU311-GW01	1/3	5U - 5U	2	NA	2.90E+01	700	MCL	NO	BSL
98-82-8	Isopropylbenzene (Cumene)	3	J	3	J	µg/L	SWMU311-GW01	1/3	5U - 5U	3	NA	7.00E+01	70	NC WQC	NO	BSL
108-87-2	Methyl Cyclohexane	3	J	3	J	µg/L	SWMU311-GW01	1/3	5U - 5U	3	NA	N/A	N/A	N/A	YES	NSC
1330-20-7	Xylenes, total	3	J	3	J	µg/L	SWMU311-GW01	1/3	5U - 5U	3	NA	5.30E+02	10,000	MCL	NO	BSL
	METALS (ug/L)															
7440-38-2	Arsenic	3.4	J	3.4	J	µg/L	SWMU311-GW03	1/3	2.4UJ - 2.4UJ	3.4	NA	1.00E+01	10	MCL	NO	BSL
7440-39-3	Barium	24.7		53.75		µg/L	SWMU311-GW01	2/3	33U - 33U	53.75	NA	2.00E+03	2,000	MCL	NO	BSL
7440-47-3	Chromium	12		12		µg/L	SWMU311-GW01	1/3	0.5UJ - 0.6U	12	NA	5.00E+01	100	MCL	NO	BSL
7439-92-1	Lead	10.6		10.6		µg/L	SWMU311-GW01	1/3	1.1U - 1.8U	10.6	NA	1.50E+01	15	MCL (4)	NO	BSL

(1) North Carolina Environmental Health and Natural Resources (NC DENR) Target Groundwater Concentration (2L Standards)

(2) Rationale Codes
Selection Reason: No Screening Criteria (NSC)
Deletion Reason: Below Screening Level (BSL)

(3) Screening value for chromium VI used.
(4) Action level for lead.

Definitions:
N/A = Not Applicable
NA = Not Analyzed
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
MCL = Maximum Contaminant Level
NC WQC = North Carolina Water Quality Criteria (EHNR)

J - Analyte present - Reported value is estimated
U - Not detected
UJ - Reported quantitation limit is qualified as estimated

ug/L = microgram per liter

TABLE 6-7
VALUES USED FOR DAILY INTAKE CALCULATION
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Military Base Personnel
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	--	--	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	100	USEPA, 1993	--	--	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	--	--	
	FI	Fraction Ingested from Source	NA	1	Prof Judge	--	--	
	EF	Exposure Frequency	days/year	250	USEPA, 2001	--	--	
	ED	Exposure Duration	years	4	Std Tour of Duty	--	--	
	BW	Body Weight	kg	70	USEPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	1,460	USEPA, 1989	--	--	
Dermal	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	--	--	CDI (mg/kg-day) =
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	--	--	C x CF x SA x AF x ABS x EF x ED x
	SA	Surface Area Available for Contact	cm2/day	3,300	USEPA, 2001	--	--	1/BW x1/AT
	AF	Soil to Skin Adherence Factor	mg/cm2	0.2	USEPA, 2001	--	--	
	ABS	Absorption Factor	NA	(1)	USEPA, 2001	--	--	
	EF	Exposure Frequency	days/year	250	USEPA, 2001	--	--	
	ED	Exposure Duration	years	4	Std Tour of Duty	--	--	
	BW	Body Weight	kg	70	USEPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	1,460	USEPA, 1989	--	--	

Notes

(1) If available, ABS values from ORNL or RAGS Part E were used. Otherwise, USEPA Region IV default values of 0.01% organics and 0.001% for inorganics were used for ABS values

Prof Judge - Professional Judgment
Std Tour of Duty - Standard Tour of Duty

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 6-7 (continued)
VALUES USED FOR DAILY INTAKE CALCULATION:
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Military Base Personnel
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	--	--	CDI (mg/kg-day) =
	RR	Respiration Rate	m3/hour	0.55	USEPA, 1997	--	--	C x IR x ET x EF x ED x 1/PEF x
	ET	Exposure Time	hours/day	8	Prof Judge	--	--	1/BW x1/AT
	EF	Exposure Frequency	days/year	250	USEPA, 2001	--	--	
	ED	Exposure Duration	years	4	Std Tour of Duty	--	--	
	PEF	Particulate Emission Factor	m3/kg	1.32E+09	Cowherd, et al., 1995	--	--	
	BW	Body Weight	kg	70	USEPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	1,460	USEPA, 1989	--	--	

Notes

Std Tour of Duty - Standard Tour of Duty

Sources:

Cowherd, et al., 1995: Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination. OHEA. EPA/600/8-85/002.
USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 6-8
VALUES USED FOR DAILY INTAKE CALCULATION
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	100	USEPA, 1993	50	USEPA, 1993	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	1.00E-06	USEPA, 1989	
	FI	Fraction Ingested from Source	NA	1	Prof Judge	1	Prof Judge	
	EF	Exposure Frequency	days/year	350	USEPA, 2001	234	USEPA, 1993	
	ED	Exposure Duration	years	24	USEPA, 1993	7	USEPA, 1993	
	BW	Body Weight	kg	70	USEPA, 1997	70	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, 1989	2,555	USEPA, 1989	
Dermal	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	CDI (mg/kg-day) =
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	1.00E-06	USEPA, 1989	C x CF x SA x AF x ABS x EF x ED x
	SA	Surface Area Available for Contact	cm2/day	5,700	USEPA, 2001	5,700	USEPA, 2001	1/BW x1/AT
	AF	Soil to Skin Adherence Factor	mg/cm2	0.07	USEPA, 2001	0.01	USEPA, 2001	
	ABS	Absorption Factor	NA	(1)	USEPA, 2001	(1)	USEPA, 2001	
	EF	Exposure Frequency	days/year	350	USEPA, 2001	234	USEPA, 1993	
	ED	Exposure Duration	years	24	USEPA, 1993	7	USEPA, 1993	
	BW	Body Weight	kg	70	USEPA, 1997	70	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, 1989	2,555	USEPA, 1989	

Notes

(1) If available, ABS values from ORNL or RAGS Part E were used. Otherwise, USEPA Region IV default values of 0.01% organics and 0.001% for inorganics were used for ABS values

Prof Judge - Professional Judgment

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 6-8 (continued)
VALUES USED FOR DAILY INTAKE CALCULATION
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	CDI (mg/kg-day) =
	RR	Respiration Rate	m3/hour	0.55	USEPA, 1997	0.55	USEPA, 1997	C x IR x ET x EF x ED x 1/PEF x
	ET	Exposure Time	hours/day	1.5	USEPA, 1997	1.5	USEPA, 1997	1/BW x1/AT
	EF	Exposure Frequency	days/year	350	USEPA, 2001	234	USEPA, 1993	
	ED	Exposure Duration	years	24	USEPA, 1993	7	USEPA, 1993	
	PEF	Particulate Emission Factor	m3/kg	1.32E+09	Cowherd, et al., 1995	1.32E+09	Cowherd, et al., 1995	
	BW	Body Weight	kg	70	USEPA, 1997	70	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, 1989	2,555	USEPA, 1989	

Notes

Sources:

Cowherd, et al., 1995: Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination. OHEA. EPA/600/8-85/002.
USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 6-9
VALUES USED FOR DAILY INTAKE CALCULATION
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Subsurface Soil
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	100	USEPA, 1993	50	USEPA, 1993	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	1.00E-06	USEPA, 1989	
	FI	Fraction Ingested from Source	NA	1	Prof Judge	1	Prof Judge	
	EF	Exposure Frequency	days/year	350	USEPA, 2001	234	USEPA, 1993	
	ED	Exposure Duration	years	24	USEPA, 1993	7	USEPA, 1993	
	BW	Body Weight	kg	70	USEPA, 1997	70	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, 1989	2,555	USEPA, 1989	
Dermal	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	CDI (mg/kg-day) =
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	1.00E-06	USEPA, 1989	C x CF x SA x AF x ABS x EF x ED x
	SA	Surface Area Available for Contact	cm2/day	5,700	USEPA, 2001	5,700	USEPA, 2001	1/BW x1/AT
	AF	Soil to Skin Adherence Factor	mg/cm2	0.07	USEPA, 2001	0.01	USEPA, 2001	
	ABS	Absorption Factor	NA	(1)	USEPA, 2001	(1)	USEPA, 2001	
	EF	Exposure Frequency	days/year	350	USEPA, 2001	234	USEPA, 1993	
	ED	Exposure Duration	years	24	USEPA, 1993	7	USEPA, 1993	
	BW	Body Weight	kg	70	USEPA, 1997	70	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, 1989	2,555	USEPA, 1989	

Notes

(1) If available, ABS values from ORNL or RAGS Part E were used. Otherwise, USEPA Region IV default values of 0.01% organics and 0.001% for inorganics were used for ABS values

Prof Judge - Professional Judgment

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 6-9 (continued)
VALUES USED FOR DAILY INTAKE CALCULATION
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	CDI (mg/kg-day) =
	RR	Respiration Rate	m3/hour	0.55	USEPA, 1997	0.55	USEPA, 1997	C x IR x ET x EF x ED x 1/PEF x
	ET	Exposure Time	hours/day	1.5	USEPA, 1997	1.5	USEPA, 1997	1/BW x1/AT
	EF	Exposure Frequency	days/year	350	USEPA, 2001	234	USEPA, 1993	
	ED	Exposure Duration	years	24	USEPA, 1993	7	USEPA, 1993	
	PEF	Particulate Emission Factor	m3/kg	1.32E+09	Cowherd, et al., 1995	1.32E+09	Cowherd, et al., 1995	
	BW	Body Weight	kg	70	USEPA, 1997	70	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, 1989	2,555	USEPA, 1989	

Notes

Sources:

Cowherd, et al., 1995: Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination. OHEA. EPA/600/8-85/002.
USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 6-10
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tap Water - Drinking Water Scenario
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	C	Contaminant Concentration in Groundwater	mg/L	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-W	Ingestion Rate of Groundwater	L/day	2	USEPA, 1993	1.4	USEPA, 1993	C x IR-W x EF x ED x 1/BW x 1/AT
	EF	Exposure Frequency	days/year	350	USEPA, 1993	234	USEPA, 1993	
	ED	Exposure Duration	years	24	USEPA, 2001	7	USEPA, 2001	
	BW	Body Weight	kg	70	USEPA, 1997	70	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, 1989	2,555	USEPA, 1989	
Dermal	C	Contaminant Concentration in Groundwater	mg/L	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	CDI (mg/kg-day) =
	CF	Conversion Factor	L/cm3	1.00E-03	USEPA, 1989	1.00E-03	USEPA, 1989	C x CF x SA x PC x ET x EF x ED x
	SA	Surface Area Available for Contact	cm2	18,000	USEPA, 2001	18,000	USEPA, 2001	1/BW x1/AT
	PC	Permeability Constant	cm/hour	Chemical Specific	USEPA, 1992	Chemical Specific	USEPA, 1992	
	ET	Exposure Time	hours/day	0.58	USEPA, 2001	0.25	USEPA, 2001	
	EF	Exposure Frequency	days/year	350	USEPA, 1993	234	USEPA, 1993	
	ED	Exposure Duration	years	24	USEPA, 2001	7	USEPA, 2001	
	BW	Body Weight	kg	70	USEPA, 1997	70	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, 1989	2,555	USEPA, 1989	

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002
USEPA, 1992: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual Supplemental Guidance: Dermal Risk Assessment.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa

TABLE 6-10 (continued)
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air
Exposure Point: Tap
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	C	Contaminant Concentration in Groundwater	mg/L	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-W	Ingestion Rate of Groundwater	L/day	2	USEPA, 1993	1.4	USEPA, 1993	C x IR-W x EF x ED x 1/BW x 1/AT
	EF	Exposure Frequency	days/year	350	USEPA, 1993	234	USEPA, 1993	
	ED	Exposure Duration	years	24	USEPA, 2001	7	USEPA, 2001	
	BW	Body Weight	kg	70	USEPA, 1997	70	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, 1989	2,555	USEPA, 1989	

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa

TABLE 6-11
VALUES USED FOR DAILY INTAKE CALCULATION:
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	200	USEPA, 1993	100	USEPA, 1993	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	1.00E-06	USEPA, 1989	
	FI	Fraction Ingested from Source	NA	1	Prof Judge	1	Prof Judge	
	EF	Exposure Frequency	days/year	350	USEPA, 2001	234	USEPA, 2001	
	ED	Exposure Duration	years	6	USEPA, 1993	2	USEPA, 1993	
	BW	Body Weight	kg	15	USEPA, 1997	15	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	USEPA, 1989	730	USEPA, 1989	
Dermal	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	CDI (mg/kg-day) =
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	1.00E-06	USEPA, 1989	C x CF x SA x AF x ABS x EF x ED x
	SA	Surface Area Available for Contact	cm2/day	2,800	USEPA, 2001	2,800	USEPA, 2001	1/BW x1/AT
	AF	Soil to Skin Adherence Factor	mg/cm2	0.2	USEPA, 2001	0.04	USEPA, 2001	
	ABS	Absorption Factor	NA	(1)	USEPA, 2001	(1)	USEPA, 2001	
	EF	Exposure Frequency	days/year	350	USEPA, 2001	234	USEPA, 2001	
	ED	Exposure Duration	years	6	USEPA, 1993	2	USEPA, 1993	
	BW	Body Weight	kg	15	USEPA, 1997	15	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	USEPA, 1989	730	USEPA, 1989	

Notes

(1) If available, ABS values from ORNL or RAGS Part E were used. Otherwise, USEPA Region IV default values of 0.01% organics and 0.001% for inorganics were used for ABS values

Prof Judge - Professional Judgment

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 6-11 (continued)
VALUES USED FOR DAILY INTAKE CALCULATION:
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	CDI (mg/kg-day) =
	RR	Respiration Rate	m3/hour	0.308	USEPA, 1997	0.308	USEPA, 1997	C x IR x ET x EF x ED x 1/PEF x
	ET	Exposure Time	hours/day	5.57	USEPA, 1997	5.57	USEPA, 1997	1/BW x1/AT
	EF	Exposure Frequency	days/year	350	USEPA, 2001	234	USEPA, 2001	
	ED	Exposure Duration	years	6	USEPA, 1993	2	USEPA, 1993	
	PEF	Particulate Emission Factor	m3/kg	1.32E+09	Cowherd, et al., 1995	1.32E+09	Cowherd, et al., 1995	
	BW	Body Weight	kg	15	USEPA, 1997	15	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	USEPA, 1989	730	USEPA, 1989	

Notes

Sources:

Cowherd, et al., 1995: Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination. OHEA. EPA/600/8-85/002.
USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 6-12
VALUES USED FOR DAILY INTAKE CALCULATION:
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Subsurface Soil
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	200	USEPA, 1993	100	USEPA, 1993	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	1.00E-06	USEPA, 1989	
	FI	Fraction Ingested from Source	NA	1	Prof Judge	1	Prof Judge	
	EF	Exposure Frequency	days/year	350	USEPA, 2001	234	USEPA, 2001	
	ED	Exposure Duration	years	6	USEPA, 1993	2	USEPA, 1993	
	BW	Body Weight	kg	15	USEPA, 1997	15	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	USEPA, 1989	730	USEPA, 1989	
Dermal	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	CDI (mg/kg-day) =
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	1.00E-06	USEPA, 1989	C x CF x SA x AF x ABS x EF x ED x
	SA	Surface Area Available for Contact	cm2/day	2,800	USEPA, 2001	2,800	USEPA, 2001	1/BW x1/AT
	AF	Soil to Skin Adherence Factor	mg/cm2	0.2	USEPA, 2001	0.04	USEPA, 2001	
	ABS	Absorption Factor	NA	(1)	USEPA, 2001	(1)	USEPA, 2001	
	EF	Exposure Frequency	days/year	350	USEPA, 2001	234	USEPA, 2001	
	ED	Exposure Duration	years	6	USEPA, 1993	2	USEPA, 1993	
	BW	Body Weight	kg	15	USEPA, 1997	15	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	USEPA, 1989	730	USEPA, 1989	

Notes

(1) If available, ABS values from ORNL or RAGS Part E were used. Otherwise, USEPA Region IV default values of 0.01% organics and 0.001% for inorganics were used for ABS values

Prof Judge - Professional Judgment

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 6-12 (continued)
VALUES USED FOR DAILY INTAKE CALCULATION
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	CDI (mg/kg-day) =
	RR	Respiration Rate	m3/hour	0.308	USEPA, 1997	0.308	USEPA, 1997	C x IR x ET x EF x ED x 1/PEF x
	ET	Exposure Time	hours/day	5.57	USEPA, 1997	5.57	USEPA, 1997	1/BW x1/AT
	EF	Exposure Frequency	days/year	350	USEPA, 2001	234	USEPA, 2001	
	ED	Exposure Duration	years	6	USEPA, 1993	2	USEPA, 1993	
	PEF	Particulate Emission Factor	m3/kg	1.32E+09	Cowherd, et al., 1995	1.32E+09	Cowherd, et al., 1995	
	BW	Body Weight	kg	15	USEPA, 1997	15	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	USEPA, 1989	730	USEPA, 1989	

Notes

Sources:

Cowherd, et al., 1995: Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination. OHEA. EPA/600/8-85/002.
USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 6-13
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tap Water - Drinking Water Scenario
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	C	Contaminant Concentration in Groundwater	mg/L	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-W	Ingestion Rate of Groundwater	L/day	1	USEPA, 1989	1	USEPA, 1989	C x IR-W x EF x ED x 1/BW x 1/AT
	EF	Exposure Frequency	days/year	350	USEPA, 1993	234	USEPA, 1993	
	ED	Exposure Duration	years	6	USEPA, 2001	2	USEPA, 1993	
	BW	Body Weight	kg	15	USEPA, 1997	15	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	USEPA, 1989	730	USEPA, 1989	
Dermal	C	Contaminant Concentration in Groundwater	mg/L	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	CDI (mg/kg-day) =
	CF	Conversion Factor	L/cm3	1.00E-03	USEPA, 1989	1.00E-03	USEPA, 1989	C x CF x SA x PC x ET x EF x ED x
	SA	Surface Area Available for Contact	cm2	6,600	USEPA, 2001	6,600	USEPA, 2001	1/BW x1/AT
	PC	Permeability Constant	cm/hour	Chemical Specific	USEPA, 1992	Chemical Specific	USEPA, 1992	
	ET	Exposure Time	hours/day	1	USEPA, 2001	0.33	USEPA, 2001	
	EF	Exposure Frequency	days/year	350	USEPA, 1993	234	USEPA, 1993	
	ED	Exposure Duration	years	6	USEPA, 2001	2	USEPA, 1993	
	BW	Body Weight	kg	15	USEPA, 1997	15	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	USEPA, 1989	730	USEPA, 1989	

Notes

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002
USEPA, 1992: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual Supplemental Guidance: Dermal Risk Assessment.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa

TABLE 6-14
VALUES USED FOR DAILY INTAKE CALCULATION
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Construction Workers
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	--	--	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	480	USEPA, 1993	--	--	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	--	--	
	FI	Fraction Ingested from Source	NA	1	Prof Judge	--	--	
	EF	Exposure Frequency	days/year	250	USEPA, 2001	--	--	
	ED	Exposure Duration	years	1	Prof Judge	--	--	
	BW	Body Weight	kg	70	USEPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	365	USEPA, 1989	--	--	
Dermal	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	--	--	CDI (mg/kg-day) =
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	--	--	C x CF x SA x AF x ABS x EF x ED x
	SA	Surface Area Available for Contact	cm2/day	3,300	USEPA, 2001	--	--	1/BW x1/AT
	AF	Soil to Skin Adherence Factor	mg/cm2	0.2	USEPA, 2001	--	--	
	ABS	Absorption Factor	NA	(1)	USEPA, 2001	--	--	
	EF	Exposure Frequency	days/year	250	USEPA, 2001	--	--	
	ED	Exposure Duration	years	1	Prof Judge	--	--	
	BW	Body Weight	kg	70	USEPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	365	USEPA, 1989	--	--	

Notes

(1) If available, ABS values from ORNL or RAGS Part E were used. Otherwise, USEPA Region IV default values of 0.01% organics and 0.001% for inorganics were used for ABS values

Prof Judge - Professional Judgment

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 6-14 (continued)
VALUES USED FOR DAILY INTAKE CALCULATION:
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Construction Workers
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	--	--	CDI (mg/kg-day) =
	RR	Respiration Rate	m3/hour	3.3	USEPA, 1997	--	--	C x IR x ET x EF x ED x 1/PEF x
	ET	Exposure Time	hours/day	8	USEPA, 1991	--	--	1/BW x1/AT
	EF	Exposure Frequency	days/year	250	USEPA, 2001	--	--	
	ED	Exposure Duration	years	1	Prof Judge	--	--	
	PEF	Particulate Emission Factor	m3/kg	9.35E+08	Site-specific	--	--	
	BW	Body Weight	kg	70	USEPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	365	USEPA, 1989	--	--	

Notes

Prof Judge - Professional Judgment

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1991: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual Supplemental Guidance: Standard Default Exposure Factors.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 6-15
VALUES USED FOR DAILY INTAKE CALCULATION:
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Subsurface Soil
Receptor Population: Construction Workers
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	--	--	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	480	USEPA, 1993	--	--	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	--	--	
	FI	Fraction Ingested from Source	NA	1	Prof Judge	--	--	
	EF	Exposure Frequency	days/year	250	USEPA, 2001	--	--	
	ED	Exposure Duration	years	1	Prof Judge	--	--	
	BW	Body Weight	kg	70	USEPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	365	USEPA, 1989	--	--	
Dermal	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	--	--	CDI (mg/kg-day) =
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	--	--	C x CF x SA x AF x ABS x EF x ED x
	SA	Surface Area Available for Contact	cm2/day	3,300	USEPA, 2001	--	--	1/BW x1/AT
	AF	Soil to Skin Adherence Factor	mg/cm2	0.2	USEPA, 2001	--	--	
	ABS	Absorption Factor	NA	(1)	USEPA, 2001	--	--	
	EF	Exposure Frequency	days/year	250	USEPA, 2001	--	--	
	ED	Exposure Duration	years	1	Prof Judge	--	--	
	BW	Body Weight	kg	70	USEPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	365	USEPA, 1989	--	--	

Notes

(1) If available, ABS values from ORNL or RAGS Part E were used. Otherwise, USEPA Region IV default values of 0.01% organics and 0.001% for inorganics were used for ABS values

Prof Judge - Professional Judgment

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 6-15 (continued)
VALUES USED FOR DAILY INTAKE CALCULATION:
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Construction Workers
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	--	--	CDI (mg/kg-day) =
	RR	Respiration Rate	m3/hour	3.3	USEPA, 1997	--	--	C x IR x ET x EF x ED x 1/PEF x
	ET	Exposure Time	hours/day	8	USEPA, 1991	--	--	1/BW x1/AT
	EF	Exposure Frequency	days/year	250	USEPA, 2001	--	--	
	ED	Exposure Duration	years	1	Prof Judge	--	--	
	PEF	Particulate Emission Factor	m3/kg	9.35E+08	Site-specific	--	--	
	BW	Body Weight	kg	70	USEPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	365	USEPA, 1989	--	--	

Notes

Prof Judge - Professional Judgment

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1991: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual Supplemental Guidance: Standard Default Exposure Factors.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 6-16
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current, Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil

Chemical of Potential Concern	Units	Arithmetic Mean	95% Upper Confidence Level (95% UCL)	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure			Central Tendency		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale	Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Cadmium	mg/kg	0.73	29.6	5.2		mg/kg	5.2	Max	(1)	5.2	Max	(1)
Lead	mg/kg	154	6,007	1,110		mg/kg	1,110	Max	(1)	1,110	Max	(1)

EPC = Exposure Point Concentration
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.

(1) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.

TABLE 6-17
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Subsurface Soil

Chemical of Potential Concern	Units	Arithmetic Mean	95% Upper Confidence Level (95% UCL)	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure			Central Tendency		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale	Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Arsenic	mg/kg	0.44	0.6	1.9		mg/kg	0.6	W-Lognormal	(1)	0.6	W-Lognormal	(1)

EPC = Exposure Point Concentration
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.

(1) Conservative estimate of the arithmetic average concentration (95% UCL), based on the Shapiro-Wilks (W-) or D-Agostino (D-) distribution tests

TABLE 6-18
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Groundwater, total inorganics

Chemical of Potential Concern	Units	Arithmetic Mean	95% Upper Confidence Level (95% UCL)	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure			Central Tendency		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale	Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Arsenic	mg/L	0.0019	0.0983	0.0034	J	mg/L	0.0034	Max	(1)	0.0034	Max	(1)
Chromium	mg/L	0.0042	8.89E+19	0.012		mg/L	0.012	Max	(1)	0.012	Max	(1)

EPC = Exposure Point Concentration
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.

(1) Region 4 Human Health Risk Assessment Bulletin, 1996

TABLE 6-19
NON-CANCER TOXICITY DATA -- ORAL/DERMAL
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal RfD (2)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ (3) (MM/DD/YY)
Arsenic	Chronic	3.00E-04	mg/kg/day	41.0%	1.23E-04	mg/kg/day	Skin / CVS	3/1	IRIS	9/20/2002
Cadmium	Chronic	5.00E-04	mg/kg/day	5.0%	2.50E-05	mg/kg/day	Kidney	10/1	IRIS	12/30/2002
Chromium	Chronic	3.00E-03	mg/kg/day	2.0%	6.00E-05	mg/kg/day	NOEL	300/3	IRIS	9/20/2002
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

(1) Refer to table presented as subsection of Appendix H.
(2) Adjusted dermal RfD = Oral RfD * Adj Factor
(3) For IRIS values, provide the date IRIS was searched.
For HEAST values, provide the date of HEAST.
For NCEA values, provide the date of the article provided by NCEA.

Target Organ Abbreviations:
CVS = Cardiovascular System
NOEL = No Observed Effect Level

Sources:
IRIS = Integrated Risk Information System

NA = Not Applicable

TABLE 6-20
NON-CANCER TOXICITY DATA -- INHALATION
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Chemical of Potential Concern	Chronic/ Subchronic	Value Inhalation RfC	Units	Adjusted Inhalation RfD (1)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfC:RfD: Target Organ	Dates (2) (MM/DD/YY)
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	Chronic	NA	NA	NA	NA	Kidney	1/1	NA	3/4/1999
Chromium	Subchronic	8.0E-06	mg/m3	2.20E-06	mg/kg/day	RsS	90/1 (aerosols), 300/1 (particulates)	IRIS	9/20/2002
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

(1) Provide equation used for derivation in text.
(2) For IRIS values, provide the date IRIS was searched.
For HEAST values, provide the date of HEAST.
For NCEA values, provide the date of the article provided by NCEA.

NA = Not Applicable

Target Organ Abbreviations:
RsS = Respiratory System

Sources:
IRIS = Integrated Risk Information System

TABLE 6-21
CANCER TOXICITY DATA -- ORAL/DERMAL
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Chemical of Potential Concern	Oral Cancer Slope Factor	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal Cancer Slope Factor (2)	Units	Weight of Evidence/ Cancer Guideline Description	Source	Date (3) (MM/DD/YY)
Arsenic	1.50E+00	41%	3.66E+00	$(mg/kg/day)^{-1}$	A	IRIS	9/20/2002
Cadmium	NA	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA

Notes:

(1) Refer to table presented as subsection of Appendix H.
(2) Adjusted dermal CSF = Oral CSF / Adj Factor
(3) For IRIS values, provide the date IRIS was searched.
For HEAST values, provide the date of HEAST.
For NCEA values, provide article date provided by NCEA.

NA = Not Applicable

Sources:
IRIS = Integrated Risk Information System

EPA Group:
A - Human carcinogen
B1 - Probable human carcinogen - indicates that limited human data are available
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as a human carcinogen
E - Evidence of noncarcinogenicity

Weight of Evidence:
Known/Likely (EPA classes A, B1, B2, C)
Cannot be Determined (EPA class D)
Not Likely (EPA class E)

TABLE 6-22
CANCER TOXICITY DATA -- INHALATION
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Chemical of Potential Concern	Unit Risk	Units	Adjustment (1)	Inhalation Cancer Slope Factor	Units	Weight of Evidence/ Cancer Guideline Description	Source	Date (2) (MM/DD/YY)
Arsenic	4.3E+00	mg/m3	3,500	1.51E+01	mg/kg/day	A	IRIS	9/20/2002
Cadmium	1.8E-03	ug/m3	3,500	6.30E+00	mg/kg/day	B1	IRIS	12/30/2002
Chromium	1.2E-02	ug/m3	3,500	2.94E+02	mg/kg/day	A	IRIS	7/1/1997
Lead	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

(1) Adjustment Factor applied to Unit Risk to calculate Inhalation Slope Factor = 70kg x 1/20m3/day x 1000ug/mg
(2) For IRIS values, provide the date IRIS was searched.
For HEAST values, provide the date of HEAST.
For NCEA values, provide the date of the article provided by NCEA.

EPA Group:
A - Human carcinogen
B1 - Probable human carcinogen - indicates that limited human data are available
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as a human carcinogen
E - Evidence of noncarcinogenicity

Sources:

IRIS = Integrated Risk Information System

NA = Not Applicable

Weight of Evidence:
Known/Likely (EPA classes A, B1, B2, C)
Cannot be Determined (EPA class D)
Not Likely (EPA class E)

TABLE 6-23
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Receptor Population: Military Base Personnel
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Cadmium	--	6.1E-11	--	6.1E-11	Cadmium	Kidney	1.0E-02	--	1.3E-03	1.2E-02
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	--	6.1E-11	--	6.1E-11	(Total)		1.0E-02	--	1.3E-03	1.2E-02

Total Risk Across Surface Soil: 6.1E-11
Total Risk Across All Media and All Exposure Routes: 6.1E-11

Total Hazard Index Across Surface Soil: 0.01
ızard Index Across All Media and All Exposure Routes: 0.01

All Exposure Routes:
Total Kidney HI = 0.01

TABLE 6-24
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Cadmium	--	9.6E-11	--	9.6E-11	Cadmium	Kidney	1.4E-02	--	1.1E-03	1.5E-02
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	--	9.6E-11	--	9.6E-11	(Total)		1.4E-02	--	1.1E-03	1.5E-02
Subsurface Soil	Subsurface Soil	Subsurface Soil	Arsenic	4.0E-07	2.5E-11	1.2E-07	5.1E-07	Arsenic	(o) Skin / CVS	2.6E-03	--	7.5E-04	3.3E-03
			(Total)	4.0E-07	2.5E-11	1.2E-07	5.1E-07	(Total)		2.6E-03	--	7.5E-04	3.3E-03
Groundwater	Groundwater	Tap	Arsenic	4.8E-05	--	3.7E-07	4.8E-05	Arsenic	(o) Skin / CVS	3.1E-01	--	2.4E-03	3.1E-01
			Chromium	--	--	--	--	Chromium	(o) NOEL, (i) RsS	1.1E-01	--	2.3E-02	1.3E-01
			(Total)	4.8E-05	--	3.7E-07	4.8E-05	(Total)		4.2E-01	--	2.6E-02	4.5E-01

Notes:
Target Organ Abbreviations:
CVS = Cardiovascular System
RsS = Respiratory System
NOEL = No Observed Effect Level

(o) Oral exposure
(i) Inhalation exposure

Total Risk Across Surface Soil	9.6E-11
Total Risk Across Subsurface Soil	5.1E-07
Total Risk Across Groundwater	4.8E-05
Total Risk Across All Media and All Exposure Routes	4.9E-05

Total Hazard Index Across Surface Soil	0.02
Total Hazard Index Across Subsurface Soil	0.00
Total Hazard Index Across Groundwater	0.45
ıl Hazard Index Across All Media and All Exposure Routes	0.46

All Exposure Routes:
Total Kidney HI = 0.02

Oral and Dermal Exposure Routes:
Oral / Dermal Cardiovascular System HI = 0.32
Oral / Dermal Skin HI = 0.32

Inhalation Exposure Routes:
Inhalation Respiratory System HI = 0.00E+00

TABLE 6-25
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Cadmium	--	1.9E-11	--	1.9E-11	Cadmium	Kidney	4.8E-03	--	1.1E-04	4.9E-03
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	--	1.9E-11	--	1.9E-11	(Total)		4.8E-03	--	1.1E-04	4.9E-03
Subsurface Soil	Subsurface Soil	Subsurface Soil	Arsenic	3.9E-08	4.8E-12	3.2E-09	4.2E-08	Arsenic	(o) Skin / CVS	8.6E-04	--	7.1E-05	9.3E-04
			(Total)	3.9E-08	4.8E-12	3.2E-09	4.2E-08	(Total)		8.6E-04	--	7.1E-05	9.3E-04
Groundwater	Groundwater	Tap	Arsenic	6.5E-06	--	3.1E-08	6.6E-06	Arsenic	(o) Skin / CVS	1.5E-01	--	6.9E-04	1.5E-01
			Chromium	--	--	--	--	Chromium	(o) NOEL, (i) RsS	5.1E-02	--	6.7E-03	5.8E-02
			(Total)	6.5E-06	--	3.1E-08	6.6E-06	(Total)		2.0E-01	--	7.4E-03	2.0E-01

Notes:
Target Organ Abbreviations:
CVS = Cardiovascular System
RsS = Respiratory System
NOEL = No Observed Effect Level

(o) Oral exposure
(i) Inhalation exposure

Total Risk Across Surface Soil	1.9E-11
Total Risk Across Subsurface Soil	4.2E-08
Total Risk Across Groundwater	6.6E-06
Total Risk Across All Media and All Exposure Routes	6.6E-06

Total Hazard Index Across Surface Soil	0.00
Total Hazard Index Across Subsurface Soil	0.00
Total Hazard Index Across Groundwater	0.20
l Hazard Index Across All Media and All Exposure Routes	0.21

All Exposure Routes:
Total Kidney HI = 0.00

Inhalation Exposure Routes:
Inhalation Respiratory System HI = 0.00E+00

Oral and Dermal Exposure Routes:
Oral / Dermal Cardiovascular System HI = 0.15
Oral / Dermal Skin HI = 0.15

TABLE 6-26
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Young Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Cadmium	--	2.3E-10	--	2.3E-10	Cadmium	Kidney	1.3E-01	--	7.4E-03	1.4E-01
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	--	2.3E-10	--	2.3E-10	(Total)		1.3E-01	--	7.4E-03	1.4E-01
Subsurface Soil	Subsurface Soil	Subsurface Soil	Arsenic	9.2E-07	6.0E-11	1.9E-07	1.1E-06	Arsenic	(o) Skin / CVS	2.4E-02	--	4.9E-03	2.9E-02
			(Total)	9.2E-07	6.0E-11	1.9E-07	1.1E-06	(Total)		2.4E-02	--	4.9E-03	2.9E-02
Groundwater	Groundwater	Tap	Arsenic	2.8E-05	--	2.7E-07	2.8E-05	Arsenic	(o) Skin / CVS	7.2E-01	--	7.0E-03	7.3E-01
			Chromium	--	--	--	--	Chromium	(o) NOEL, (i) RsS	2.6E-01	--	6.8E-02	3.2E-01
			(Total)	2.8E-05	--	2.7E-07	2.8E-05	(Total)		9.8E-01	--	7.5E-02	**1.1E+00**

Notes:
Target Organ Abbreviations:
CVS = Cardiovascular System
RsS = Respiratory System
NOEL = No Observed Effect Level

(o) Oral exposure
(i) Inhalation exposure

Total Risk Across Surface Soil	2.3E-10
Total Risk Across Subsurface Soil	1.1E-06
Total Risk Across Groundwater	2.8E-05
Total Risk Across All Media and All Exposure Routes	2.9E-05

Total Hazard Index Across Surface Soil	0.14
Total Hazard Index Across Subsurface Soil	0.03
Total Hazard Index Across Groundwater	1.06
al Hazard Index Across All Media and All Exposure Routes	1.22

All Exposure Routes:
Total Kidney HI = 0.14

Inhalation Exposure Routes:
Inhalation Respiratory System HI = 0.00E+00

Oral and Dermal Exposure Routes:
Oral / Dermal Cardiovascular System HI = 0.76
Oral / Dermal Skin HI = 0.76

TABLE 6-27
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Young Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Cadmium	--	5.2E-11	--	5.2E-11	Cadmium	Kidney	4.4E-02	--	1.0E-03	4.5E-02
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	--	5.2E-11	--	5.2E-11	(Total)		4.4E-02	--	1.0E-03	4.5E-02
Subsurface Soil	Subsurface Soil	Subsurface Soil	Arsenic	1.0E-07	1.3E-11	8.4E-09	1.1E-07	Arsenic	(o) Skin / CVS	8.0E-03	--	6.6E-04	8.7E-03
			(Total)	1.0E-07	1.3E-11	8.4E-09	1.1E-07	(Total)		8.0E-03	--	6.6E-04	8.7E-03
Groundwater	Groundwater	Tap	Arsenic	6.2E-06	--	2.0E-08	6.2E-06	Arsenic	(o) Skin / CVS	4.8E-01	--	1.6E-03	4.9E-01
			Chromium	--	--	--	--	Chromium	(o) NOEL, (i) RsS	1.7E-01	--	1.5E-02	1.9E-01
			(Total)	6.2E-06	--	2.0E-08	6.2E-06	(Total)		6.6E-01	--	1.7E-02	6.7E-01

Notes:
Target Organ Abbreviations:
CVS = Cardiovascular System
RsS = Respiratory System
NOEL = No Observed Effect Level

(o) Oral exposure
(i) Inhalation exposure

Total Risk Across Surface Soil	5.2E-11
Total Risk Across Subsurface Soil	1.1E-07
Total Risk Across Groundwater	6.2E-06
Total Risk Across All Media and All Exposure Routes	6.4E-06

Total Hazard Index Across Surface Soil	0.05
Total Hazard Index Across Subsurface Soil	0.01
Total Hazard Index Across Groundwater	0.67
al Hazard Index Across All Media and All Exposure Routes	0.73

All Exposure Routes:
Total Kidney HI = 0.05

Oral and Dermal Exposure Routes:
Oral / Dermal Cardiovascular System HI = 0.49
Oral / Dermal Skin HI = 0.49

Inhalation Exposure Routes:
Inhalation Respiratory System HI = 0.00E+00

TABLE 6-28
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Cadmium	--	1.3E-10	--	1.3E-10	Cadmium	Kidney	4.9E-02	--	1.3E-03	5.0E-02
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	--	1.3E-10	--	1.3E-10	(Total)		4.9E-02	--	1.3E-03	5.0E-02
Subsurface Soil	Subsurface Soil	Subsurface Soil	Arsenic	5.6E-08	3.3E-11	5.7E-09	6.2E-08	Arsenic	(o) Skin / CVS	8.8E-03	--	8.8E-04	9.7E-03
			(Total)	5.6E-08	3.3E-11	5.7E-09	6.2E-08	(Total)		8.8E-03	--	8.8E-04	9.7E-03

Notes:
Target Organ Abbreviations:
CVS = Cardiovascular System

(o) Oral exposure
(i) Inhalation exposure

Total Risk Across Surface Soil	1.3E-10
Total Risk Across Subsurface Soil	6.2E-08
Total Risk Across All Media and All Exposure Routes	6.2E-08

All Exposure Routes:
Total Kidney HI = 0.05

Total Hazard Index Across Surface Soil	0.05
Total Hazard Index Across Subsurface Soil	0.01
Total Hazard Index Across All Media and All Exposure Routes	0.06

Oral and Dermal Exposure Routes:
Oral / Dermal Cardiovascular System HI = 0.01
Oral / Dermal Skin HI = 0.01

TABLE 6-29

SUMMARY OF UNCERTAINTIES IN THE RESULTS OF THE
HUMAN HEALTH RISK ASSESSMENT
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

	Potential Magnitude for Over-Estimation of Risks	Potential Magnitude for Under-Estimation of Risks	Potential Magnitude for Over or Under-Estimation of Risks
Environmental Sampling and Analysis			
Sufficient samples may not have been taken to characterize the media being evaluated.			Moderate
Inclusion of surface soil data collected from the 0-2 foot bgs interval			Low
Inclusion/exclusion of mobile laboratory data			Low
Systematic or random errors in the chemical analysis may yield erroneous data.			Low
Selection of COPCs			
The use of site-specific background and USEPA Region III COPC screening concentrations in selecting COPCs in all media of concern.		Low	
Exposure Assessment			
The standard assumptions regarding body weight, exposure period, life expectancy, population characteristics, and lifestyle may not be representative of the actual exposure situations.			Moderate
The use of the 95th percentile upper confidence level data for the normal or lognormal distribution in the estimation of the RME.			Low
The amount of media intake is assumed to be constant and representative of any actual exposure.			Low
Toxicological Assessment			
Toxicological indices derived from high dose animal studies, extrapolated to low dose human exposure.	Moderate		
Risk Characterization			
Assumption of additivity in the quantitation of cancer risks without consideration of synergism, antagonism, promotion and initiation.			Moderate
Assumption of additivity in the estimation of systemic health effects without consideration of synergism, antagonism, etc.			Moderate
Additivity of risks by individual exposure pathways (dermal and ingestion and inhalation).			Low

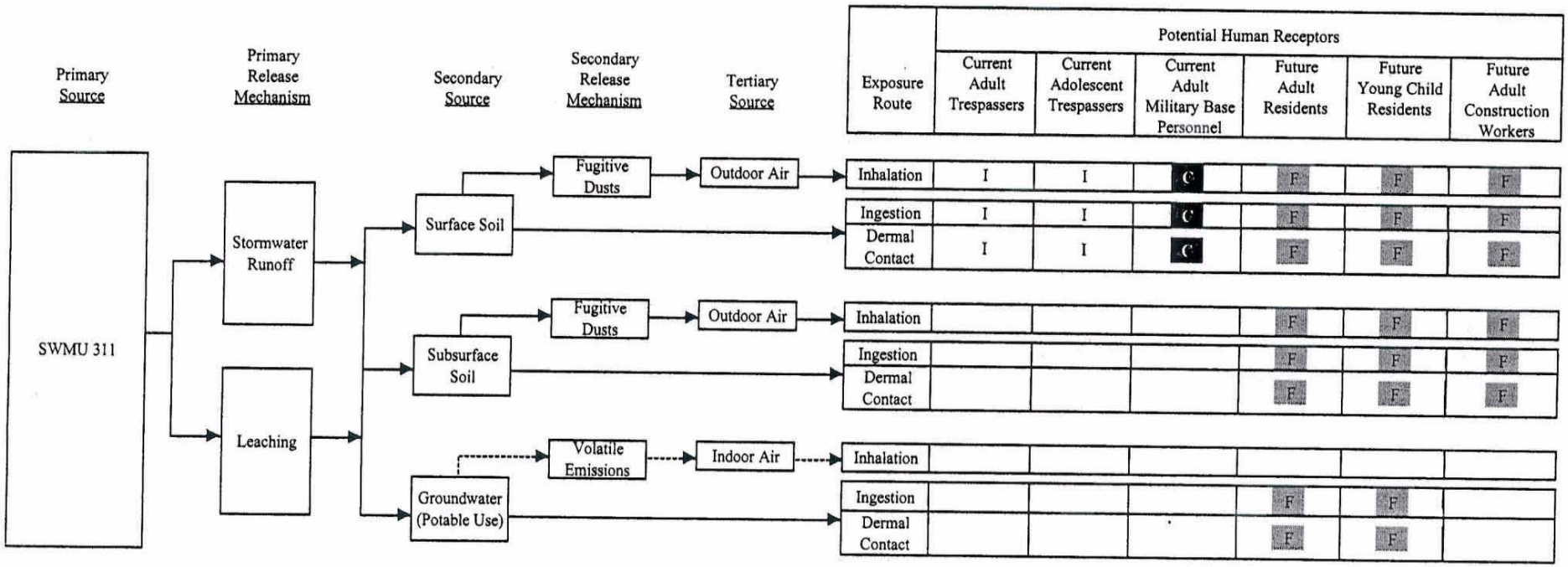
Notes:

Low - Assumptions categorized as "low" may effect risk estimates by less than one order of magnitude.
Moderate - Assumptions categorized as "moderate" may effect estimates of risk by between one and two orders of magnitude.
High - Assumptions categorized as "high" may effect estimates of risk by more than two orders of magnitude.

Source: Risk Assessment Guidance for Superfund, Volume 1, Part A: Human Health Evaluation Manual. USEPA, 1989.

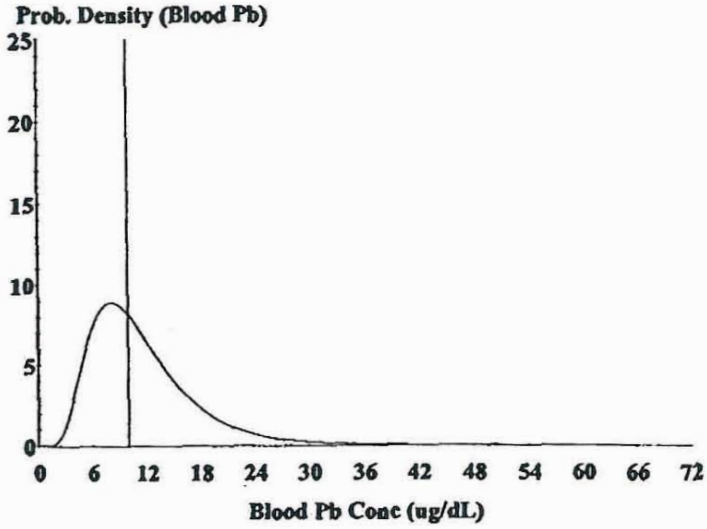
FIGURES

FIGURE 6-1
FLOWCHART OF POTENTIAL EXPOSURE PATHWAYS AND RECEPTORS
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA



Legend

C	Current Exposure Pathway	→	Complete Exposure Pathway
F	Future Exposure Pathway	⇢	Incomplete Exposure Pathway
I	Incomplete pathway for this receptor		



Cutoff = 10.000 ug/dl
Geo Mean = 10.569
GSD = 1.600
% Above = 54.688
% Below = 45.312

Age Range = 0 to 72 months
Time Step = Every 4 Hours
Run Mode = Research

FIGURE 6-2
PROBABILITY DENSITY FUNCTION –
BLOOD LEAD CONCENTRATIONS, SURFACE SOIL
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

7.0 ECOLOGICAL RISK ASSESSMENT

The overall purpose of an ecological risk assessment (ERA) is to evaluate the likelihood that adverse ecological effects would occur or are occurring as a result of exposure to one or more physical or chemical stressors. The assessment evaluates the potential effects of chemicals on terrestrial and aquatic receptors (e.g., flora and fauna) and their habitats, including the consideration of protected species and sensitive or critical habitats, and identifies particular chemical stressors that may cause adverse effects (ecological COPCs).

Because no risk assessment guidance has been developed specifically for the RCRA program, guidance designed for CERCLA sites was followed. The following guidance documents were consulted during the risk assessment process:

- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. USEPA 1997a.

- Supplemental Guidance to RAGS: Region IV Bulletins, Ecological Risk Assessment. USEPA 2001. Originally published November 1995. Website version last updated November 30, 2001 <http://www.epa.gov/region4/waste/ots/ecolbul.htm>

- Amended Guidance on Ecological Risk Assessment at Military Bases: Process Considerations, Timing of Activities, and Inclusion of Stakeholders. USEPA, 2000.

- Navy Policy for Conducting Ecological Risk Assessments. Chief of Naval Operations (CNO) 1999.

- Guidelines for Performing Screening Level Ecological Risk Assessments Within the North Carolina Division of Waste Management, NCDENR 2003.

This section presents a Screening Level Ecological Risk Assessment (SLERA) and Step 3A of the Baseline ERA (BERA) for SWMU 311, MCB Camp Lejeune, North Carolina. The SLERA includes Steps 1 and 2 of the USEPA's eight step process as outlined in the Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk

Assessments, Interim Final (USEPA, 1997a). The risk evaluation is organized into the following components (NC DENR 2003):

Step 1: Helps to answer the question "Is there an ecology here to protect?"

- Ecological Setting
- Fate and Transport Mechanisms
- Potentially Complete Exposure Pathways

Step 2: Answers the question "Are ecological effects possible?"

- Data Collection and Evaluation
- Abiotic Screen

Step 3A: Refining the List of Chemicals of Potential Concern

Summary and Conclusions

- Risk Characterization
- Uncertainty

It is noted that Step 3A is only conducted if it is determined that potential ecological effects are possible based on the results of Steps 1 and 2. The conclusion of the SLERA and Step 3A (if applicable) will be one of the following (NC DENR 2003):

- The risks are not significant to cause adverse impacts.

- The risks posed by the contamination require immediate response (focused removal study).

- The risks cannot be said to pose no potential for adverse impacts, and must be further defined in the subsequent steps of the ERA process (i.e., site must proceed to BERA).

- Site has inadequate data to complete the risk characterization. Large data gaps need to be filled prior to completion of the screening process.

The following sections describe the general technical approach and results of the risk evaluation at SWMU 311.

7.1 Step 1 – Screening-Level Problem Formulation and Ecological Effects Evaluation

Screening-level problem formulation concerns the development of a preliminary conceptual model for the site that includes a description of the ecological setting including discussion of contaminants known or suspected to exist at the site and potential contaminant fate and transport mechanisms, and the identification of potentially complete exposure pathways (USEPA, 1997a). Information gathered as part of Step 1 of the SLERA is used to answer the question: "Is there an ecology here to protect?"

7.1.1 Ecological Setting

An understanding of the ecological setting of the site is an important component of the SLERA. A discussion of the ecological setting generally includes a description of facility operations, the regional ecological setting, and the site-specific ecological setting. A detailed description of MCB, Camp Lejeune, including the history and mission of the base and a summary of hazardous wastes generated is provided in Section 1.3. Section 1.3 also provides detailed information regarding the regional ecological setting, including topography and surface features, surface water hydrology, geology, hydrogeology, land use and demographics, climatology, water supply, ecological characteristics, wetlands, and threatened and endangered species information. Information on the site-specific ecological setting follows.

The ecological setting of SWMU 311 was evaluated via examination of historical information and a site visit conducted 11 July 2003. During the site visit, which lasted approximately one-half hour, the Checklist for Ecological Assessments/Sampling (Appendix A, NCDENR 2003; also located in Appendix B, USEPA 1997a) was completed. This checklist, including photographs of the site taken during the site visit, is presented as Appendix J.

The SWMU 311 is located in the HPIA just north of Michael Road between Gum and Fir Streets (Figure 1-1). SWMU 311 consists of an oil/water separator (approximately 10 by 22 feet) that is associated with a vehicle wash rack (Figure 1-2). The vehicle wash rack is situated between Buildings 1604 and 1605 in a fenced-in and paved area. The oil/water separator is situated in a manicured lawn adjacent to the paved area and outside of the fence line (Photo 1 in Appendix J). The separator was installed in 1984 and is currently used. The structure is a concrete, in-ground unit that discharges to a wastewater treatment plant.

Due to the industrial nature of the site, terrestrial habitat is limited. The manicured lawn consists primarily of grass but also contains a variety of herbaceous species and may be used for foraging by small birds and mammals. With the exception of insects, no animals were observed at the site during the July 2003 site visit. An aerial view of SWMU 311 is presented as Figure 7-1. As indicated on the figure, the closest terrestrial habitat is located southeast of the SWMU across Michael road approximately 60 feet from the oil/water separator. This habitat is a narrow wooded corridor flanked by industrial areas.

The topography of the study area is generally flat. As noted in Section 3.3, surface water flow across the study area is controlled. Due to the built up nature of the study area, rainwater runoff is collected in roof gutters, storm water sewer inlets in parking areas, and in drainage ways along roads. Direct infiltration occurs in grassy and gravel areas surrounding the Building 1604/1605 compound. The wash pad associated with SWMU 311 is designed to capture water from vehicle wash downs, and to an extent, captures rainwater. Water in the wash pad drains to the oil/water separator, which in turn drains to a wastewater treatment plant via sanitary sewer. The drain from the wash rack to the oil/water separator showed evidence of overflow (i.e., eroded soils) during the October 1996 site visit. This overflow would lead to the drainage way that runs parallel to Michael Road. This drainage way is generally dry, but would convey surface water runoff from Michael Road during rain events. What water does not infiltrate into the ground flows into a culvert that leads into the wooded corridor (Photo 6 in Appendix J) and eventually intercepts Cogdels Creek. The interception of the drainage way and culvert is approximately 2,250 feet northwest of Cogdels Creek.

Groundwater at the site flows in a west/southwest direction (Figure 3-5). There is no indication that groundwater from the SWMU is discharged to any surface water habitat. However, there is the potential for groundwater discharge to the New River, a tidally influenced water body located approximately 5,400 feet southwest of the SWMU (Figure 1-1). Freshwater tributaries exist along the northeast boundary of the New River; therefore, the potential for groundwater discharge to a freshwater habitat also exists.

No protected species have been reported or observed at SWMU 311. The site is not located within any areas identified as ecologically protected or of significant natural value. No endangered species were noted during the site visit nor were endangered species referenced at the site during the endangered species survey (LeBlond et al. 1994).

7.1.2 Fate and Transport Mechanisms

A transport pathway describes the mechanisms whereby chemicals may be transported from a source of contamination to ecologically relevant media. Transport pathways for SWMU 311 are illustrated in the preliminary ecological conceptual model (Figure 7-2). As depicted in the preliminary ecological conceptual model, the primary mechanisms for chemical transport from potential source areas are believed to include the following:

- Overland transport of chemicals with surface soil via surface runoff to down gradient surface soil.

- Leaching/desorption of chemicals from surface soil or subsurface soil to groundwater and subsequent discharge to surface water bodies.

- Uptake by biota from soil and trophic transfer to upper trophic level receptors.

- Volatile emissions from surface soils and erosion releasing fugitive dusts to the atmosphere.

Although a potentially complete and significant pathway, as per USEPA Region IV Guidance (USEPA Region IV, 2000) the transfer of chemicals to upper trophic level ecological receptors via food chain uptake is beyond the scope of the SLERA and therefore is not evaluated.

7.1.3 Potentially Complete Exposure Pathways

An exposure pathway links a source of contamination with one or more receptors through exposure via one or more media. Exposure, and thus potential risk, can only occur if each of the following components exists:

- A source and mechanism of chemical release into the environment
- An environmental transport medium
- A point of potential contact between an ecological receptor and the medium
- A feasible exposure route at the contact point

An exposure route describes the specific mechanism(s) by which a receptor is exposed to a chemical present in an environmental medium. The most common exposure routes are direct uptake, dermal contact, ingestion, and inhalation. Although SWMU 311 is not in the immediate vicinity of an aquatic habitat, potential exposure to aquatic as well as terrestrial receptors is discussed in the following paragraphs because of the potential of the SWMU to impact a down gradient aquatic habitat via groundwater discharge.

Terrestrial plants may be exposed to chemicals present in surface soils through their root surfaces during water and nutrient uptake. Unrooted, floating aquatic plants, rooted submerged aquatic plants, and algae may be exposed to chemicals directly from the water or (for rooted plants) from sediments. Terrestrial and aquatic invertebrates may be exposed to chemicals in soil, sediment, or surface water through dermal adsorption and ingestion. Much of the toxicological data available for terrestrial and aquatic invertebrates are based upon in situ studies that represent both pathways; therefore, both pathways are considered together in the risk evaluation.

Upper trophic level receptors may be exposed to chemicals through: (1) the inhalation of gaseous chemicals or chemicals adhered to particulate matter; (2) the incidental ingestion of contaminated abiotic media (e.g., soil or sediment) during feeding or cleaning activities; (3) the ingestion of contaminated water; (4) the ingestion of contaminated plant and/or animal tissues for chemicals that have entered food webs; and/or (5) dermal contact with contaminated abiotic media. These exposure routes, where applicable, are depicted on Figure 7-2. Their relative importance depends in part on the chemical being evaluated. For chemicals having the potential to bioaccumulate (e.g., PCBs), the greatest exposure to wildlife is likely to be from the ingestion of prey. For chemicals having a limited potential to bioaccumulate (e.g., aluminum), the exposure of wildlife to chemicals is likely to be greatest through the direct ingestion of abiotic media, such as soil or sediment. As noted above, the evaluation of potential risks to upper trophic level receptors is beyond the scope of the SLERA; however, should the site proceed to Step 3A of the ERA process, the bioaccumulative potential of chemicals will be considered when determining the need for additional evaluation.

A discussion of potential complete exposure pathways for ecological receptors at SWMU 311 is presented below. Specific pathways addressed by the SLERA are also identified.

Groundwater Exposure Pathway. The potential release sources for the groundwater exposure pathway are surface and subsurface soils that may have been contaminated as a result of prior leaks or spills. Release mechanisms are leaching/desorption of chemicals to subsurface soil and vertical migration with infiltrating precipitation to groundwater (or leaching/desorption directly to groundwater).

Although groundwater is not inhabited by ecological receptors, receptors may potentially be exposed to chemicals in groundwater if the chemicals migrate to surface water and/ or sediment. Based on groundwater contours (see Section 3.4.2.2), groundwater flow direction in the surficial aquifer is to the west/southwest. Discharge may be to the New River located 5,400 feet southwest of the SWMU, or to a freshwater tributary of the New River.

The evaluation of potential exposures resulting from the migration of chemicals with groundwater to off-site aquatic habitats is addressed in the evaluation of the surface water and sediment exposure pathway below.

Surface Water and Sediment Exposure Pathway. The potential release source for the surface water and sediment exposure pathway is contaminated groundwater migrating from the site.

Aquatic life (e.g., fish and invertebrates) may be exposed to chemicals that have potentially migrated to off-site aquatic habitats through incidental ingestion, direct contact, and ingestion of plant and/or animal tissues for chemicals that have entered the food web (i.e., food chain transfer). Aquatic vegetation within these areas may be exposed to chemicals directly from the water (direct contact) or through root uptake from the substrate. Mammals and birds using the aquatic habitat as a potential food and/or drinking water source may be exposed to chemicals in surface water and sediment through ingestion, direct contact, and food chain transfer.

Other receptors that may forage within aquatic areas include reptiles and amphibians. The potential exposure routes for reptiles and amphibians are ingestion of surface water and sediment, direct contact with surface water and sediment, and food chain transfer. For all potential receptors, exposures from food chain transfer will be limited to those chemicals that bioaccumulate in lower trophic level organisms or biomagnify through successive trophic levels. It should be noted that there is no direct evidence that groundwater from the SWMU is migrating to a surface water body. However, because groundwater flow is in the direction of the New River (a tidal water body 5,400 feet southwest of the SWMU) and its freshwater tributaries, as a

conservative measure, the surface water and sediment exposure pathway for aquatic receptors was evaluated by comparing groundwater analytical data to NCDENR recommended surface water screening values for brackish water.

Subsurface and Surface Soil Exposure Pathway. The release source for the subsurface and surface soil exposure pathway is the material that may have leaked or spilled from the former wash area and oil/water separator at the site. Chemicals may remain in study area soils or migrate via surface runoff and fugitive dust emissions. Due to the pavement, buildings, and lawn covering the majority of the study area, fugitive dusts would be minimized.

Soil invertebrates, such as earthworms, may be exposed to chemicals in surface soil through direct contact and ingestion. Terrestrial plants may be exposed to chemicals in surface soil through root uptake. Terrestrial birds may be exposed to chemicals in surface soil through incidental ingestion and food chain transfer. Dermal absorption in birds is mostly excluded through feather coverings; however, preening will contribute to incidental ingestion. Mammals and reptiles may be exposed to chemicals in surface soil through incidental ingestion and food chain transfer. For mammals and some reptiles (e.g. lizards) dermal absorption is mostly excluded through fur and scale coverings, respectively. Similar to preening by birds, grooming by mammals will contribute to incidental ingestion. Based upon the limited size of the SWMU and the active use of the surrounding area, exposure to mammals and reptiles is likely to be limited. Again, exposure from food chain transfer will be limited to those chemicals that bioaccumulate in lower trophic level organisms or biomagnify through successive trophic levels.

Subsurface soil is not considered a complete exposure pathway for terrestrial receptors for the following reasons:

- The mass of most root systems is within the surface soil
- Most soil heterotrophic activity is within the surface organic layer
- Soil invertebrates occur on the surface or within the oxidized root zone

Surface soil is considered a complete exposure pathway for terrestrial receptors. The surface soil exposure pathway was evaluated by comparing contaminant concentrations in the surface soil to the NCDENR recommended Soil Screening Values.

Air Exposure Pathway. Contaminated surface soil may serve as a release source for the air exposure pathway (fugitive dust emissions from wind erosion). In addition to this release mechanism, volatilization of chemicals from surface soil may also occur. Terrestrial mammals, birds, and reptiles may be exposed to chemicals in fugitive dust emissions and volatilization through inhalation. As discussed above, the study area is covered with buildings, concrete, or a manicured lawn providing a dense vegetative cover. These features minimizes fugitive dust emissions to ambient air and would also limit the area over which volatilization of chemicals could potentially occur. The fence surrounding the site limits access by larger mammalian receptors. Burrowing mammals may be exposed to volatile emissions in subterranean passageways; however, due to the industrial nature of the site, burrowing mammals are unlikely to be present in the study area. No evidence of burrowing mammals was found during the July 2002 site visit. For these reasons, the inhalation exposure pathway is considered insignificant for terrestrial receptors. It is noted that this pathway is not indicated in the ecological conceptual model.

7.1.4 Conclusions of Step 1

Step 1 of the SLERA posed the question "Is there an ecology here to protect?" Based on information regarding the ecological setting of the site, fate and transport mechanisms, and potentially complete exposure pathways, which are discussed in the preceding sections, there is an ecology at the site to protect. Terrestrial habitat on site consists a manicured lawn that leads into an off-site wooded habitat. Potential migration of contaminated groundwater to off-site aquatic habitats is also a concern, although there is a substantial distance between the site and the nearest downgradient surface water body. An evaluation of the potential for ecological effects to occur in each of these habitats is presented in the following section.

7.2 Step 2 - Screening-Level Preliminary Exposure Estimate and Risk Calculation

Step 2 of the ERA process consists of the preliminary exposure estimate and risk calculation. The following sections describe the data available for the preliminary exposure estimate, and the methods and results of the abiotic screen.

7.2.1 Data Used in the SLERA

Data available for the SLERA at SWMU 311 include surface soil, subsurface soil, and groundwater data collected for the Phase I SWMU CSI (Baker 2001), Phase II SWMU CSI (Baker 2002), and the current RFI field investigation. These investigations were conducted in series with specific goals for each investigation. The Phase I investigation was conducted to determine if activities associated with the SWMU had possibly impacted the environment surrounding the SWMU. Therefore, the samples collected as part of this investigation were located as near the SWMU as physically possible or in areas where evidence of possible environmental impact had been observed. If a specific group of contaminants were not detected in the samples (e.g. volatiles), then they were eliminated as contaminants of concern for that particular SWMU. As such, subsequent investigations did not include any group of contaminants that had been eliminated as a potential contaminant of concern. Likewise, if a particular group of contaminants have been delineated during any investigation or combination of investigations, the extent of the contamination is assumed to be delineated and further investigation of these compounds would not be considered necessary.

As part of the Phase I CSI, surface (0-2 feet bgs) and subsurface (>2 feet bgs) soil samples were collected from each of three soil borings advanced around the perimeter of the SWMU and were analyzed for aromatic VOCs (1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, benzene, chlorobenzene, ethylbenzene, toluene, and xylenes), SVOCs, and RCRA metals.

As part of the Phase II CSI, surface (0-1 foot bgs) and subsurface (>1 foot bgs) soil samples were collected from three soil borings and three temporary well borings, and groundwater was sampled from three temporary wells. Soil and groundwater samples were analyzed for VOCs and RCRA metals. SVOCs analysis was not included in the Phase II study because the none of the ten SVOCs detected during Phase I were detected at concentrations greater than NC DENR soil to groundwater screening criteria or USEPA Region IX residential PRGs (Baker 2001). Because these compounds did not exceed any of the comparison criteria in the samples collected closest to the SWMU, the COPC list was reduced to include only VOCs and RCRA metals based on the Phase I results.

The RFI field investigation included the collection of six surface soil samples (0-1 foot bgs), 37 subsurface soil samples (>1 foot bgs) from 10 soil borings, and 10 groundwater grab samples

from soil borings (not including QC samples). Surface soil and groundwater samples collected for the RFI were analyzed for VOCs (benzene, PCE, TCE, cis-DCE, trans-DCE, methylene chloride, and 1,1-DCE) by a mobile laboratory. Subsurface soil samples were analyzed for VOCs by a mobile laboratory and/or a fixed based laboratory and for RCRA metals by a fixed base laboratory (Table 2-1).

A subset of the available data was used for the SWMU 311 SLERA. The six surface soil samples collected from 0-1 feet bgs during the Phase II investigation were used in the SLERA. Soils from depths greater than 1-foot bgs are generally not included in a SLERA because they are not representative of the most biologically active soil zone. However, the three surface soil samples collected from 0-2 feet bgs during the Phase I investigation were included in the ecological data set because they were collected from the area immediately surrounding the oil/water separator, at locations not represented by the 0-1 foot surface soil data. It is noted that the use of the 0-2 foot bgs surface soil samples adds uncertainty to the risk evaluation. In addition to not being representative of the most biologically active soil zone, the inclusion of soils from 1-2 feet bgs in these samples may dilute the concentration of any contaminants that may be present in the top foot of soil. This uncertainty is addressed in Section 7.2.3. Mobile laboratory surface soil data collected during the RFI was not included in the SLERA. Field decisions based on quick-turn mobile laboratory analysis of VOCs determined the direction and termination of the RFI field investigation. It should be noted that soil and groundwater samples that were analyzed by the fixed base laboratory and validated were collected from locations distributed throughout the source area. Also, the exclusion of the mobile laboratory data would not affect the conclusions of the SLERA (discussed in Sections 7.2.3 and 7.5). No subsurface soil data were included in the SLERA.

Groundwater data collected from temporary wells during the Phase II investigation were included in the SLERA. Groundwater grab sample mobile laboratory data collected during the RFI were not included in the SLERA because, as for the soil samples, these data were not validated. Surface soil and groundwater data evaluated in the SLERA are the same as those used for the human health risk assessment (Section 6.0). These data are summarized on Table 7-1 and are presented in full in Appendix F.

Duplicate samples were included in the data set by the following means. In instances where the original and duplicate sample were both detected or both non-detected the values were averaged

for the risk assessment. In instances when the original and duplicate samples contained one detection and one non-detection, the detected value was averaged with one-half of the detection limit of the non-detected value and the sample was considered a detection.

7.2.2 Abiotic Screen

The screening-level exposure estimate and risk calculation provides a highly conservative evaluation of potential ecological risks at a site. Although upper trophic level receptors (e.g., terrestrial mammals, piscivorous birds) may be identified as potential receptors at the site, the SLERA is limited to a comparison of analytical data to media-specific screening values. Screening values used in the SLERA were recommended by NCDENR (2003) and are consistent with ecological screening values established by USEPA Region IV (USEPA Region IV 1995, updated April 2001). The sections that follow describe the various criteria and toxicological benchmarks used as screening values (toxicological thresholds) for chemicals analyzed in groundwater and surface soil. NCDENR's recommended chemical-specific surface water and surface soil screening values are summarized on Table 7-2. The screening values represent conservative exposure thresholds above which adverse ecological effects may occur.

7.2.2.1 Media-Specific Screening Values

Surface Water Screening Values – USEPA Region IV

Surface water screening values (SWSVs) used in this evaluation were obtained from the NCDENR Guidelines for Performing SLERAs (NCDENR 2003). Surface water was not present at SWMU 311; however, brackish surface water screening values were used to screen groundwater contaminant concentrations. Brackish screening values were used for the groundwater screen because there is the potential for groundwater discharge to freshwater and/or marine habitats. Brackish surface water screening values represent the lowest of available freshwater and marine screening values.

The NCDENR recommended chronic freshwater SWSVs for the RCRA metals cadmium and lead and the chronic value for trivalent chromium are expressed as a function of water hardness. As a conservative measure, chromium in site groundwater was assumed to be hexavalent chromium, the more toxic form of the element. Therefore the screening value for hexavalent chromium,

which is not hardness based, was used in the risk assessment. Screening values for cadmium and lead are ideally calculated based on site-specific hardness values. Hardness is usually calculated for each groundwater sample using the following equation (Franson, 1992):

$$\text{Hardness} = 2.497*[\text{Calcium}](\text{mg/L}) + 4.118*[\text{Magnesium}](\text{mg/L})$$

However, because calcium and magnesium are not included in the RCRA metals analysis, these inorganic constituents were not analyzed in the groundwater samples used in the SLERA and site-specific hardness could not be calculated. A default hardness of 50 mg calcium carbonate per liter ($CaCO_3$/L) was used in place of a mean of site-specific hardness value to calculate SWSVs for total recoverable metals as follows (USEPA 2002a):

- Cadmium: $\text{SWSV} = e^{(0.7409*\ln(\text{hardness value})-4.719)}$
- Lead: $\text{SWSV} = e^{(1.273*\ln(\text{hardness value})-4.705)}$

In the SLERA, only total recoverable metals data for groundwater were considered. This is done as a conservative measure. For some metals (including arsenic, cadmium, chromium, lead, mercury, and selenium), the dissolved fraction more closely indicates the bioavailable fraction of the metal; therefore, the use of total recoverable metals data for these chemicals is likely to overestimate potential risks. The uncertainty the use of total recoverable metals data adds to the risk assessment is addressed in Section 7.2.3.

The SWSV selected for pentachlorophenol is expressed as a function of pH. A default pH value of 7.8 S.U. was used to adjust the chronic criterion for this organic chemical (USEPA 2001c).

Surface Water Screening Values – North Carolina Water Quality Standards

North Carolina Surface Water Quality Standards (NCWQS) for Aquatic Life were obtained from the North Carolina guidelines for performing SLERAs (NCDENR 2003). These standards were originally published as North Carolina Administrative Code (NCAC) Section 15A NCAC 2B (NC 2002).

Surface Soil Screening Values

Surface soil screening values (SSSV) used in this evaluation were obtained from the NCDENR Guidelines for Performing SLERAs (NCDENR 2003). The recommended soil screening values presented by NCDENR are consistent with values recommended by USEPA Region 4 in the Ecological Risk Assessment Bulletins. The original sources for these values include the following: Beyer (1990), Efroymson et al. (1997), Efroymson et al. (1997a), Canadian Council of Ministers of the Environment (1997), the Dutch Ministry of Housing, Spatial Planning and Environment (CCME, 1994), and Crommentuijn et al. (1997).

7.2.2.2 Hazard Quotient Calculation

A HQ was calculated for each chemical by dividing the maximum exposure concentration of the chemical by the ecological screening value for that chemical:

$$Hazard\ Quotient = \frac{Maximum\ Exposure\ Concentration}{Screening\ Value}$$

The maximum exposure concentration is estimated as the maximum detected concentration of the chemical or, in cases where the chemical was not detected in a given media, the maximum sample detection limit (MDL)(NCDENR 2003). HQs equal to or exceeding 1.0 indicate the potential for risk since the estimated exposure exceeds the estimated effects concentration. However, screening values and exposure estimates are derived using intentionally conservative assumptions such that HQs greater than or equal to one do not necessarily indicate that risks are present or impacts are occurring. Rather, they identify chemical-pathway-receptor combinations requiring further evaluation. Following the same reasoning, HQs that are less than one indicate that risks are very unlikely, enabling a conclusion of no unacceptable risk to be reached with high confidence.

Chemicals were identified as COPCs if they fell in to one or more of the following categories (NCDENR 2003):

- Category 1 – Chemicals whose maximum detection exceeds the NCDENR media specific ecological screening value (HQ> 1.0; chemical detected).

- Category 2 – Chemicals that were not detected in any samples for a given media, but for which the MDL exceeded the NCDENR media specific ecological screening value (HQ>1.0; chemical not detected).

- Category 3 – Chemicals that have no NCDENR ecological screening value but were detected above the laboratory sample quantitation level (SQL) (No screening value; chemical detected).

- Category 4 – Chemicals that were not detected above the laboratory SQL and have no NCDENR ecological screening value (No screening value; chemical not detected).

- Category 5 – Chemicals for which the maximum detection or the MDL exceeds the North Carolina Surface Water Quality Standards (for aqueous samples only).

Any tentatively identified compounds (TICs) or unknown chemicals present at the site would have been identified as preliminary COPCs and included as Category 3 contaminants; however, no such chemicals were present at SWMU 311. Chemicals that do not fall in to one or more of the contaminant categories were not identified as COPCs. It should be noted that chemicals could be classified into more than one category only if one of those categories was Category 5. Furthermore, because of the differential toxicity of many contaminants to ecological verses human receptors, the COPCs for ecological receptors may differ from those selected for the human health risk assessment.

7.2.2.3 Results of the Abiotic Screen

The results of the abiotic screen for surface soil are presented in the following section. Chemicals identified as ecological COPCs based on the abiotic screen proceed to Step 3A of the ERA (Section 7.3).

7.2.2.3.1 Surface Soil

Three surface soil samples collected from 0-2 feet bgs and six surface soil samples collected from 0-1 feet bgs were evaluated in the SLERA. As discussed in Section 7.2.1, the 0-2 foot

samples were analyzed for VOCs, SVOCs, and RCRA metals while the 0-1 foot samples were analyzed for VOCs and RCRA metals. Table 7-3 presents HQ calculations for surface soil. Sixty-nine chemicals were identified as ecological COPCs in surface soils. One VOC (chloroform), and four metals (cadmium, chromium, lead, and selenium) were identified as Category 1 COPCs because maximum detected concentrations exceeded surface soil screening values. The HQ for chloroform was 2.0 while HQs for Category 1 metals ranged from 1.12 (selenium) to 72.0 (chromium).

Figure 7-3 presents all detected concentrations of Category 1 COPCs that exceeded NCDENR soil screening values. As indicated on the figure, detections of chloroform exceeded the soil screening value at two locations. Detections of chromium, lead, cadmium, and selenium exceeded soil screening values at 9, 2, 1, and 1 locations, respectively.

One VOC and 11 SVOCs were not detected but were identified as Category 2 COPCs because their MDL exceeded surface soil screening values. HQs for Category 2 COPCs ranged from 4.0 (for 5 SVOCs) to 950.0 (for pentachlorophenol).

Five VOCs (2-butanone, 4-methyl-2-pentanone, acetone, bromoform, and carbon disulfide), and ten SVOCs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, bis(2-ethylhexyl)phthalate, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene), and pyrene were identified as Category 3 COPCs because they were detected at the site but lacked soil screening values with which to evaluate potential risks.

Finally, nine VOCs and 28 SVOCs were identified as Category 4 COPCs because they were not detected and are lacking soil screening values.

7.2.2.3.2 Groundwater

Three groundwater samples collected from temporary wells and analyzed for VOCs and RCRA metals were evaluated in the SLERA. Table 7-4 presents HQ calculations for groundwater. Thirty-three chemicals were identified as ecological COPCs in groundwater. Two metals (chromium and lead) were identified as Category 1 COPCs because maximum detected concentrations exceeded brackish surface water screening values. The HQ for chromium was 1.29 and the HQ for lead was 8.05. Figure 7-4 presents all detected concentrations of chromium

and lead that exceeded NCDENR screening values or NCWQS for brackish water aquatic life. As indicated on the figure, contaminant levels that exceeded screening values were limited to sample SWMU311-GW01, collected from temporary monitoring well TW01.

One VOC (1,2,4-thrichlorobenzene) and three metals (cadmium, mercury, and silver) were not detected but were identified as Category 2 COPCs because their MDL exceeded brackish surface water screening values. HQs for Category 2 COPCs ranged from 1.11 (for 1,2,4-trichlorobenzene) to 75.0 (for silver).

Four VOCs (cyclohexane, isopropylbenzene, methylcyclohexane, and total xylenes) and one metal (barium) were identified as Category 3 COPCs because they were detected in site groundwater but lacked surface water screening values with which to evaluate potential risks.

Twenty VOCs were identified as Category 4 COPCs because they were not detected and are lacking surface water screening values.

Finally, two VOCs and two metals were identified as Category 5 COPCs because they were detected in groundwater at concentrations exceeding NCWQS. Carbon tetrachloride and tetrachloroethene were identified soley as Category 5 COPCs, while mercury and silver were identified both as Category 2 and Category 5 COPCs.

7.2.3 Uncertainties Associated with the SLERA

The procedures used in this evaluation to assess risks to ecological receptors, as in all such assessments, are subject to uncertainties because of the limitations of the available data and the need to make certain assumptions and extrapolations based on incomplete information. Uncertainties associated with the SLERA for SWMU 311 and their effects on risk conclusions are presented and discussed below.

<u>Limitations of Available Data Set</u>

- Surface soil samples collected in 1997 during the Phase I investigation were obtained from 0-2 feet bgs. This is a deeper sampling depth than is typically included in the SLERA; however, these samples were included in the ecological data set because they

were collected from the area immediately surrounding the former oil/water separator, an area that is not represented by the 0-1 foot surface soil data. Surface samples from 0-1 feet bgs are preferred for use in an ERA because this depth represents the most biologically active soil zone. In addition to not being representative of the most biologically active soil zone, the inclusion of soils from 1-2 feet bgs in the 1997 samples may dilute the concentration of any contaminants that may be present in the top foot of soil (e.g., those deposited directly on to soils or transported to down gradient soils via surface runoff), or alternatively may elevate apparent surface concentrations of those chemicals that may be more prevalent at depths greater than 1 foot (e.g., those that have leaked into soils from underground piping).

A second source of uncertainty related to the use of the Phase I surface soil data is attributed to the fact that these samples were not validated by an independent third-party data validator; therefore, there is some uncertainty regarding the quality of these data. However, these data were analyzed by a fixed-base laboratory following CLP procedures. As described above, due to the location of these samples and their representation of important source and migration pathways at the site, the inclusion of these samples in the data set was considered a more conservative approach that would be most protective of the environment.

A third source of uncertainty regarding the Phase I soil data is introduced because these data were analyzed for aromatic VOCs (1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, benzene, chlorobenzene, ethylbenzene, toluene, and xylenes) and not the full TCL VOC list. Soil samples collected during the Phase II investigation were analyzed for the full TCL VOC list. VOCs detected in Phase II soil samples that were not analyzed for in Phase I samples include 2-butanone, 4-methyl-2-pentanone, acetone, bromoform, carbon disulfide, chloroform, cyclohexane, methyl cyclohexane, and methylene chloride. These chemicals and potentially additional VOCs may be present in the soils closest to the oil/water separator. The lack of analytical data on the full TCL VOC list for Phase I may lead to an underestimation of ecological risk at the SWMU. Phase I samples were also not analyzed for pesticides or herbicides. Because the SWMU is not in an area associated with the storage or manufacture of pesticides or herbicides these chemicals were not suspected contaminants of concern at the SWMU.

- Surface soil samples collected as part of the Phase II investigation (2002) and RFI investigation (2003) were not analyzed for SVOCs, pesticides, or herbicides. As indicated above, because the SWMU is not in an area associated with the storage or manufacture of pesticides or herbicides these chemicals were not suspected contaminants of concern at the SWMU. SVOCs were excluded from the Phase II and RFI investigation analyses because the none of the ten SVOCs detected during Phase I were detected at concentrations greater than NC DENR soil to groundwater screening criteria or USEPA Region IX residential PRGs (Baker 2001). The exclusion of SVOCs in subsequent phases of investigation at this SWMU is in agreement with the phased nature of the investigation (see Section 7.2.1). It should be noted that of the 10 SVOCs detected in the Phase I samples, seven were identified as Category 3 COPCs on Table 7-3 due to the lack of established surface soil screening values. The remaining three SVOCs were detected at concentrations below established ecological screening criteria.

- Groundwater data were used to evaluate potential risks to off-site aquatic habitat that may be impacted by groundwater discharge from the SWMU. There is no evidence that groundwater from the site reaches a surface water body, nor is there any indication that groundwater contamination is migrating outside the study area. However, evaluation of the groundwater migration pathway is included as a conservative approach aimed at preventing the elimination of chemicals from the list of COPCs that may in fact be contributing unacceptable risks to the environment.

- Mobile laboratory data from the RFI field investigation were not included in the SLERA because these data were analyzed for VOCs by a mobile laboratory using a gas chromatograph headspace method (as opposed to standard CLP methods) and were not validated. The exclusion of mobile laboratory data limits the information that can be used to evaluate potential ecological risks. However, the data evaluated were collected from locations distributed throughout the source area. Furthermore, the inclusion of RFI data would not change the risk evaluation for surface soils. In the groundwater evaluation, using the Phase I and Phase II data set, cis-1,2-DCE is classified as a Category 4 COPC because it was not detected in any of the three groundwater samples and no screening value has been established. If the RFI data set (i.e. mobile laboratory data) were included in the SLERA, this chemical would be classified as a Category 3

contaminant because it was detected in one of the 10 groundwater samples from the RFI investigation.

Identification of Ecological COPCs

- There is uncertainty regarding potential risk that may be contributed by chemicals that were identified as COPCs but were not detected in site media (Category 2 and Category 4 COPCs). It is as likely that the concentrations of these chemicals at the SWMU are at or near zero and that they are not present in ecologically harmful concentrations. The identification of such chemicals as COPCs is a conservative measure designed to be highly protective, but is likely to overestimate the potential for adverse effects.

- There is also uncertainty regarding the potential risk that may be contributed by chemicals that lack soil or surface water screening values (Category 3 and Category 4 COPCs). Because toxicological data regarding the potential effects of such chemicals on ecological receptors is lacking, it is not possible to quantitatively evaluate risks to ecological receptors. The identification of such chemicals as COPCs is a highly conservative approach aimed at preventing the elimination of compounds that could have harmful impacts on the environment from the list of COPCs. Although this approach is conservative, the absence of toxicological data on these chemicals adds uncertainty to the conclusions of the risk assessment and may lead to an underestimation or overestimation of potential ecological impacts contributed by the SWMU.

Exposure Point Concentrations

- As is typical in a SLERA, a finite number of samples of environmental media are used to develop the exposure estimates. The maximum measured concentration provides a conservative estimate for immobile biota or those with a limited home range. The most realistic exposure estimates for mobile species with relatively large home ranges and for species populations (even those that are immobile or have limited home ranges) are those based on the mean chemical concentrations in each medium to which these receptors are exposed. This is reflected in the wildlife dietary exposure models contained in the Wildlife Exposure Factors Handbook (USEPA 1993a), which specify the use of average media concentrations. The use of mean concentrations to estimate exposure in a

refinement (Step 3a of the BERA) is more likely to provide a more accurate picture of potential risks at the site.

- A second source of uncertainty related to exposure point concentrations applies to the evaluation of groundwater data. Current USEPA guidance (USEPA 1995 and 1999) indicates that the dissolved fraction of some metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc) more closely estimates the bioavailable fraction of these metals in the water column. In the SLERA, maximum total recoverable metal concentrations in groundwater were used as exposure point concentrations in the screening level risk calculation assuming discharge to surface waters. The use of total recoverable metals data for these chemicals is likely to overestimate potential risks; however, because the fraction of dissolved metals may change upon discharge to surface water, the use of total metals concentrations in groundwater is more appropriate than the use of dissolved concentrations.

Media-specific Screening Values

- Potential adverse impacts to terrestrial flora and fauna were evaluated by comparing the detected compound concentrations to surface soil screening values. Screening values may not take into account soil type, which may have a great influence on the toxicity of the chemicals. For example, soil with high organic carbon content will tend to absorb many of the organic compounds, thus making them less bioavailable to terrestrial receptors. Some screening values can be developed based on both field and growth chamber studies; therefore, the reported toxic concentrations are not always equivalent to actual field conditions. In addition, some screening values may be calculated based on a low number of studies or may have only examined toxicities to a limited diversity of invertebrate species.

- Screening values for some chemicals, including many polynuclear aromatic hydrocarbons (PAHs) and pesticides, are based on background soil concentrations and not on toxicological studies. The use of these values may overestimate risks at the site.

- In the case of chromium, to be conservative, screening levels were estimated from the chromium VI form of the element. Chromium III, which is orders of magnitude less toxic than chromium VI, is most likely to be the predominant form in the environment.

- In the case of mercury, screening values were estimated assuming the methylated form of the element, which is the more toxic form. It is unlikely that mercury detected at the site is 100 percent methylated; therefore, risk estimates for this compound are likely to err on the side of being overly-conservative.

- Surface water screening levels are established to be protective of *most* of the potential ecological receptors. However, some species will not be protected by the values because of their increased sensitivity to the chemicals. For example, the Ambient Water Quality Criteria developed by the USEPA, in theory, only protect 95 percent of the exposed species. Therefore, there may be some sensitive species present that may not be protected with these criteria. In addition, most of the values are established using laboratory tests, where the concentrations of certain water quality parameters (pH, total organic carbon) that may influence toxicity are most likely at different concentrations than in surface waters that may be influenced by the study area.

- The species used to develop the screening values may not be present at the site, or have the potential to exist at the site. Depending on the sensitivity of the tested species relative to that of the species at the site, use of the toxicity values may overestimate or underestimate risk.

- Groundwater data were used to evaluate potential risks to aquatic receptors in off-site aquatic habitats via a comparison of data to brackish surface water screening values. Because there is no clear indication that groundwater is in fact discharging to an aquatic habitat off-site, the inclusion of this evaluation in the risk assessment is a conservative feature. Evaluation of surface water and sediment data would provide a more realistic evaluation of potential risks to an aquatic habitat; however, no such data were collected because no connection between the source of contamination at the site and any specific aquatic habitat was established.

Chemical Mixtures

- Information on the ecotoxicological effects of chemical interactions is generally lacking, which required (as is standard for ecological risk assessments) that the chemicals be evaluated on a compound-by-compound basis during the comparison to screening values. This could result in an underestimation of risk (if there are additive or synergistic effects among chemicals) or an overestimation of risks (if there are antagonistic effects among chemicals).

Bioaccumulative Chemicals

- Many of the chemicals identified as ecological COPCS at SWMU 311 have been identified as important bioaccumulative chemicals by the USEPA (2000a). There is some potential that bioaccumulative chemicals may pose unacceptable risks to upper trophic level receptors even if no unacceptable risk is posed to primary receptors. Because ecological screening values are typically based on toxicological studies of primary receptors (e.g., terrestrial plants and invertebrates), the abiotic screen alone may underestimate the number of COPCs at the SWMU. An evaluation of risks to upper trophic level receptors is beyond the scope of the SLERA. The bioaccumulative potential of individual chemicals is considered in Step 3A of the BERA when determining the need for further evaluation.

7.3 Step 3A – Refinement of the List of Chemicals of Potential Concern

The SLERA for SWMU 311 indicated that, based on a set of conservative exposure assumptions, there are multiple chemicals that may present a risk to ecological receptors at the site. Therefore, SWMU 311 was carried in to Step 3A of the ERA process. In Step 3A, the ecological COPCs identified in Step 2 are further evaluated to determine which chemicals, if any, can be removed from further ecological consideration. The Step 3A evaluation examines multiple factors that improve the realism of the risk evaluation while remaining protective of the environment. These factors include consideration of population-level effects, use of alternative screening values, an evaluation of background data, consideration of the frequency and distribution of detections, consideration of bioavailability, dilution, and natural attenuation, and any chemical or site-specific considerations that may be relevant. These factors were used to weigh the evidence of

potential risk for each COPC identified for each media to assess whether the COPC should be carried in to Step 3B of the BERA. The specific assumptions and methods that were modified for Step 3A are identified below, along with justification for each modification. If re-evaluation of the conservative exposure assumptions supports an acceptable risk determination then the site may exit the ecological risk assessment process (USEPA 1997a, CNO 1999).

7.3.1 Refinement of Exposure and Effects Level Estimates

During Steps 1 and 2, maximum chemical concentrations of detected chemicals were used as conservative estimates of receptor exposure to calculate HQs. Because many of the receptors evaluated are relatively immobile or have a limited home range, individuals are more likely to be impacted by locations of maximum concentration; however, average contaminant concentrations are more appropriate for evaluating impacts to populations of soil invertebrates, sediment invertebrates, and aquatic receptors. Arithmetic means were calculated for all compounds identified as COPCs in the SLERA. For COPCs detected in less than 100 percent of the samples collected, arithmetic means were calculated using one half the detection limit of non-detected samples. These means were used to estimate the exposure of ecological receptors to site contaminants. If the arithmetic mean for a given chemical was greater than the maximum detected concentration, the maximum detected concentration was used as the exposure estimate.

Effects levels used in Steps 1 and 2 were NCDENR media screening values. In Step 3A, screening values were introduced, when available, for chemicals that did not have screening values recommended by NCDENR. All screening values used in Step 3A are provided on Table 7-5. Screening values that were introduced for Step 3A are shaded on the table. Introduced screening values for soils included those established by NCDENR for chemical classes (e.g., the screening value for total chlorobenzenes is applied to individual chlorobenzenes), and the USEPA Region III Biological Technical Assistance Group (USEPA 1995). If the USEPA Region III value was obtained from a source that has since been updated, the updated value was used and the updated source referenced. USEPA Region V soil ecological screening values for RCRA hazardous constituents (USEPA, 2003b) were also introduced in Step 3a when available. Introduced screening values for fresh surface water included (in order of preference), those established by NCDENR for chemical classes, USEPA Region V fresh surface water screening values for RCRA hazardous constituents (USEPA, 2003b), and USEPA Region III BTAG screening values for fresh surface waters (USEPA, 2004). Freshwater values that were less than

corresponding marine values were selected as the brackish surface water screening value used in the evaluation of groundwater.

A mean HQ was calculated for each COPC using the refined estimates of exposure and effects. Because chemicals with mean HQs less than one are unlikely to pose unacceptable risks to populations of ecological receptors, such chemicals were not considered to be risk-driving COPCs and were not recommended for further ecological evaluation.

Results of the refinement of exposure assumptions are summarized on Table 7-6 for surface soil and Table 7-7 for groundwater. Those COPCs that were removed from further consideration because mean HQs were less than one are indicated on the table by the comment "Mean HQ < 1.0."

7.3.2 Comparison to Background Data

Inorganic constituents in surface soils and groundwater that were selected as COPCs based on the SLERA were compared to background data. Surface soil background data were obtained from the Final Area of Concern Background Study (Baker 2001b). SWMU-specific background concentrations were established using protocol outlined in OEPA's Closure Plan Review Guidance for RCRA Facilities (OEPA 1999). NC DENR agreed that SWMUs could be grouped together into AOCs based on geographical location, geology and type of SWMU, and that background concentrations for metals could be established for each of these AOCs. These background data are to be evaluated in comparison to the levels inorganic constituents detected at individual SWMUs to assess whether the presence of such constituents is naturally occurring or may be attributed to activities (past and/or present) within the AOCs. Surface and subsurface soil samples were collected from eleven AOCs. Surface soil samples were collected from 0 to 1 foot bgs, and subsurface soil samples were collected from just above the water table. All soil samples were analyzed for TAL metals, TOC, and pH. SWMU 311 is one of 14 SWMUs included within AOC 5, which is located on the eastern side of MCB Camp Lejeune. Therefore, surface soil data from SWMU 311 are compared to the AOC 5 background data set. The complete set of background data collected for each AOC is presented in the AOC Background Study.

Groundwater background data were obtained from the Draft Base Background Groundwater Investigation (Baker 2002a). Background groundwater data were collected from locations

throughout the Base away from identified sites in relatively undisturbed areas not near any known sources of contamination. In the Base Background Groundwater Investigation, groundwater data were divided into two categories, including upper (shallow) and lower (deep) portions of the surficial aquifer. Groundwater samples at SWMU 311 were collected from the shallow portions of the surficial aquifer (less than 25 feet bgs); therefore, they were compared to the background data set for the upper surficial aquifer.

In accordance with USEPA Region 4 Human Health Risk Assessment Bulletins, Supplement to RAGS, maximum site concentrations were compared to two times the base background mean (USEPA Region IV, 2001c). The comparison is useful for determining whether or not the presence of chemicals at the site should be considered site related or may be considered naturally occurring. Inorganic constituents with background concentrations (two times the mean) that exceed maximum site concentrations are not considered risk-driving COPCs and are not recommended for further evaluation. Organic compounds, unlike inorganic analytes, are not ubiquitous in nature and were not analyzed as part of the AOC Background Study or Groundwater Base Background Groundwater Investigation.

Tables 7-6 and 7-7 present background data and results of comparisons to maximum soil and groundwater concentrations, respectively, at SWMU 311. Those COPCs that were removed from further consideration because maximum site concentrations were less than twice the mean background concentration are indicated on the tables by the comment "< Background."

7.3.3 Frequency and Distribution of Detections

Chemicals not detected in any environmental samples are unlikely to be present in sufficient volume to contribute significant risks to receptors at a site, especially at the population level. Those COPCs that were not detected in surface soil or groundwater were removed from further consideration and are indicated on Tables 7-6 (for surface soil) and 7-7 (for groundwater) by the comment "Not Detected."

It should be noted that COPCs detected infrequently may also be removed from further consideration after evaluation of a variety of factors including the the distribution of detections, the magnitude of potential risks, and site history and presence or absence of chemical precursors in any site media. When appropriate, a discussion of such COPCs will be included in the text.

7.3.4 Considerations of Bioavailability

The USEPA has identified certain chemicals as "important bioaccumulative chemicals" (USEPA 2000a). Bioaccumulative chemicals may pose unacceptable risks to upper trophic level receptors even if no unacceptable risk is posed to primary receptors. Although an evaluation of risks to upper trophic level receptors is not included in the SLERA, consideration of the bioaccumulative potential of each COPC will be made before determining the need for additional evaluation of a particular chemical. Those chemicals identified as important bioaccumulative chemicals by the USEPA are indicated in the third column from the right on Tables 7-6 and 7-7.

7.3.5 Dilution and Natural Attenuation

The risk evaluation for groundwater assumes discharge to a surface water body with no natural attenuation or dilution. Buchman (1999) recommends the use of a dilution factor of 10 to account for the dilution expected during migration and upon discharge of groundwater to surface water in the absence of site-specific dilution factors. Under this scenario, mean HQs for chloroform, TCE, 2,4-dimethylphenol, 2,4-dinitrotoluene, 2,6-dinitrotoluene, 2-methylphenol, 2-nitroaniline, 2-nitrophenol, 3,3'-dichlorobenzidine, 3-nitroaniline, 4,6-dinitro-2-methylphenol, 4-chlorophenyl-phenylether, 4-methylphenol, 4-nitroaniline, acenaphthylene, anthracene, dibenz(a,h)anthracene, naphthalene, phenanthrene, phenol, and lead (Table 7-7) would be less than one and they would not be recommended for further evaluation. Refined HQs for all remaining ecological COPCs with the exception of pentachlorophenol would be less than eight if dilution were accounted for. Considerations of dilution were not used as a sole criteria for removing a COPC from further consideration.

7.3.6 Additional Considerations

Additional factors that were considered when determining the need for further evaluation of an ecological COPC include but are not limited to the following:

- Identification of chemicals as common laboratory contaminants.

- For chemicals lacking screening values, comparison to range of available screening values for chemicals in the same chemical class.

- For chemicals with screening values not based on toxicological studies, consideration of toxicological-based screening values from the scientific literature.

Chemical specific considerations for surface soil and groundwater COPCs are addressed in the following sections.

7.3.6.1 Surface Soil COPCs

The VOCs 2-butanone and acetone and the SVOC bis(2-ethylhexyl)phthalate were identified as Category 3 COPCs in Step 2 of the SLERA because they were detected in surface soils and lacked soil screening values. The maximum detected concentrations of 2-butanone (11 J μg/kg) and acetone (34 J μg/kg) were within the range of available screening values for VOCs (1 [for TCE] to 1,000,000 [for carbon tetrachloride; Table 7-2]). The maximum detected concentration of bis(2-ethylhexyl)phthalate (230 μg/kg) was within the range of available screening values for SVOCs (2 [for pentachlorophenol] to 200,000 [for dimethylphthalate and di-n-butylphthalate]). USEPA (1989) identifies 2-butanone, acetone, and bis(2-ethylhexyl)phthalate as common laboratory contaminants, indicating that the presence of these chemicals may be attributable to analytical procedures and not to site-related factors. Based upon these considerations, 2-butanone, acetone, and bis(2-ethylhexyl)phthalate are not recommended for further evaluation at SWMU 311. The fact that these chemicals are common laboratory contaminants is indicated by the comment "Lab. Contaminant" on Table 7-6.

4-Methyl-2-pentanone, bromoform, and carbon disulfide were identified as Category 3 COPCs because they were detected in surface soils but lacked surface soil screening values. The maximum detected concentrations of each of these chemicals (2 J μg/kg, 19 μg/kg, and 2 J μg/kg, respectively), are at the low end of the range of available screening values for VOCs (1 μg/kg to 1,000,000 μg/kg, see preceding paragraph), and in the case of 4-methyl-2-pentanone and carbon disulfide are less than the range of detection limits for these chemicals (Table 7-3). Based on these considerations, the potential for adverse ecological impacts from 4-methyl-2-pentanone, bromoform, and carbon disulfide is considered low and no further evaluation is recommended.

Chloroform, a Category 1 COPC, was detected in two of six soil samples with a maximum concentration of 2.0 J μg/kg. This is twice the NCDENR soil screening value (1.0 μg/kg; maximum HQ = 2.0). Because detection limits for chloroform (5U – 6U μg/kg) exceeded the maximum detected concentration, the SWMU mean concentration exceeded the maximum detected concentration; therefore, the Step 3A HQ value was calculated using the maximum detected concentration (HQ = 2.0). Positive detections of chloroform were found in samples SWMU311-TW01 and SWMU311-TW03, collected as part of the Phase II Investigation (Baker 2002a). During this investigation, chloroform was also detected in blank samples including equipment rinsates, field blanks, and trip blanks (maximum detection in blank = 85 μg/L; Appendix E of Baker 2002). Because detections in blank samples exceeded five times detections in site samples, chloroform detections may be the result of sample contamination and not representative of conditions at the study area (USEPA 1989). Furthermore, the NCDENR screening value for chloroform (1 μg/kg) is a very conservative value that is a Dutch soil quality standard (Ministry of Housing, Spatial Planning and Environment [MHSPE] 1994) representing a "target value." Target values indicate soil quality required for "the full restoration of the soil's functionality for human, animal, and plant life" (Friday 1998). MHSPE also established an "intervention value" for chloroform of 10,000 μg/kg, a concentration level above which "the functionality of the soil for human, plant, and animal life is seriously impaired or threatened" (Friday 1998). The level at which chloroform effects on ecological receptors begin to be expressed is intermediate to these two values. Based on the low HQ value calculated with a highly conservative screening value and uncertainty regarding the presence of chloroform at SWMU 311, it is unlikely that chloroform is present at SWMU 311 at concentrations sufficient to pose adverse ecological effects and no further evaluation is recommended.

Chromium was detected in each of the nine surface soil samples (concentrations ranged from 3.3 to 28.8 mg/kg); each of these detections was in excess of the soil screening value of 0.4 mg/kg (Figure 7-3). Concentrations of chromium in the study area were elevated relative to AOC 5 background concentrations (Table 7-6). The maximum HQ for chromium was 72.0, and the mean HQ was 20.89. It should be noted that the USEPA Region IV ecological screening value for chromium was derived from earthworm toxicity studies on the chromium VI form of the element (Efroymson et al. 1997b). Chromium III, which is orders of magnitude less toxic than chromium VI, is most likely to be the predominant form in the environment. In addition to the USEPA Region IV screening value, the Federal USEPA has established Eco-SSLs for chromium (USEPA 2005b). An Eco-SSL of 26 mg/kg (Cr III) was established for avian receptors, while

Eco-SSLs of 34 mg/kg (Cr III) and 81 mg/kg (Cr VI) were established for mammalian receptors. With the exception of the maximum detected concentration (28.8 mg/kg in sample SWMU311-IS02-00), chromium concentrations at SWMU 311 were less than each of these values. Insufficient data were available for the USEPA to establish Eco-SSLs for terrestrial plants or invertebrates; however, USEPA 2005b does provide data from two invertebrate toxicity studies that they consider eligible for Eco-SSL derivation (a minimum of three studies are required to establish an Eco-SSL). In the first study, Van Gestel et al, (1992) identified a Maximum Acceptable Toxicant Concentration (MATC) of 57 mg/kg for effects on reproduction of the earthworm *Eisenia andrei* in soils with a pH of 6.7. In 1993, the same researchers studied reproductive effects of chromium on *E. andrei* in a soil with a pH of 6.0 and again identified a MATC of 57 mg/kg (Van Gestel et al., 1993). Each of the detected concentrations of chromium was less than these toxicity-based values. Based on comparisons to federal Eco-SSLs, chromium at SWMU 311 is unlikely to pose adverse ecological impacts to populations of ecological receptors. No additional evaluation of chromium in soils is recommended.

Lead was detected in all nine surface soil samples. Lead concentrations in excess of the soil screening value (50 mg/kg) were limited to two hot spots at sample locations SWMU311-IS02-00 (211 mg/kg) and SWMU311-IS04-00 (1,110 mg/kg). The horizontal extent of these hot spots is very limited, as lead concentrations in surrounding samples did not exceed screening values. It should be noted that both of these samples were collected from 0-2 feet bgs, and therefore, there is uncertainty regarding the concentration of lead in the most biologically active surface soils (0-1 foot bgs) at these locations (Section 7.2.3). The maximum HQ for lead was 22.2 and the mean HQ was 3.08, indicating some potential for adverse ecological impacts. Lead is associated with many fuels; therefore, the presence of lead in the study area may be SWMU-related. There is no evidence of migration of lead from the site at ecologically significant concentrations. Lead has been identified as an important bioaccumulative chemical by the USEPA (2000a). Although the SLERA and Step 3A indicate some potential for adverse ecological effects from lead at SWMU 311, based on the relatively low mean HQ, limited spatial extent of detections above screening values, industrial nature of the site, and uncertainty regarding the presence of this constituent in the biologically active zone of soils, it is unlikely that lead contamination in the study area is sufficient to cause adverse ecological impacts to populations of ecological receptors. No further action or evaluation of lead in soils is recommended.

7.3.6.2 Groundwater COPCs

The VOCs cyclohexane, isopropylbenzene, and methyl cyclohexane were identified as Category 3 COPCs in Step 2 of the SLERA because they were detected in groundwater and lacked surface water screening values. Each of these VOCs was detected in one of three groundwater samples at a concentration of 3.00 J μg/L, which is less than the minimum available screening value for VOCs (24.4 μg/L for cis- and trans-1,3-dichloropropene, Table 7-1). Based on the sole detected concentrations being less than screening values for similar chemicals, it is unlikely that cyclohexane, isopropylbenzene, and methyl cyclohexane are present in groundwater at concentrations that would pose unacceptable ecological risks and no further evaluation is recommended.

Lead was identified as an ecological COPC in groundwater in the SLERA because detected concentrations exceeded NCDENR brackish surface water screening values and/or NCWQS. Lead was detected in one of three groundwater samples (SWMU311-GW01) at a concentration of 10.6 μg/L, exceeding the NCDENR brackish surface water screening value of 1.32 μg/L. The maximum HQ for lead was 8.05 (Table 7-4) and the mean HQ was 3.05 (Table 7-7). As stated in Section 7.3.5, if reasonable estimates of dilution with migration and discharge to surface water were accounted for, both the mean and maximum HQs of lead would be less than 1.0. Based upon acceptable levels of risk when dilution is accounted for, no further evaluation of lead in groundwater is recommended.

7.4 Risk Characterization

The risk characterization integrates the results of the SLERA and Step 3A. The likelihood of adverse effects occurring as a result of exposure to a stressor is evaluated. The ecological significance of the risks characterized at the site is discussed considering the types and magnitudes of the effects and their spatial and temporal patterns. Ecologically significant risks are defined as those potential adverse risks or impacts to ecological integrity that affect populations, communities, and ecosystems, rather than individuals (i.e. measured impacts to individuals does not necessarily indicate impacts to the ecosystem).

7.4.1 Surface Soil

Of the 69 chemicals identified as ecological COPCs in surface soil based on Steps 1 and 2 of the SLERA, none are recommended for further action or evaluation based on the results of Step 3A.

7.4.2 Groundwater

Of the 33 chemicals identified as ecological COPCs in groundwater based on the SLERA, none are recommended for further action or evaluation based on the results of Step 3a.

7.5 Uncertainties Associated with Step 3A of the BERA

Many of the uncertainties identified in Section 7.2.3 also apply to the refined screening level risk calculation. Additionally, many uncertainties present in the screening level risk calculation are reduced or eliminated with the Step 3a evaluation. In addition to the uncertainties identified in Section 7.2.3, the following uncertainty has been identified for Step 3A of the BERA at SWMU 311.

Limitations of Available Data Set

Mobile laboratory data from the RFI field investigation were not included in the SLERA. As discussed in Section 7.2.3, the inclusion of RFI data in the SLERA would have led to the classification of cis-1,2-DCE as a Category 3 COPC in groundwater because it was detected in one of 10 groundwater samples from the RFI investigation (detected in 1 of 13 groundwater samples total) but lacked a NCDENR surface water screening value. Under the Step 3A evaluation, an alternative screening value of 22,400 μg/L was introduced for cis-1,2-DCE (Table 7-5). Because this value was much greater than the detected concentration of 2.0 μg/L, cis-1,2-DCE would not be recommended for further ecological evaluation.

7.6 Summary

Based upon the results of the SLERA and Step 3A of the BERA, terrestrial receptors that may forage or live in the manicured lawn surrounding the SWMU 311 study area are not estimated to be at unacceptable levels of risk from surface soil contamination. No further evaluation of surface soil is recommended.

Based upon the results of the SLERA and Step 3A of the BERA, potential aquatic receptors in off-site habitats are not estimated to be at unacceptable levels of risk from groundwater contamination associated with SWMU 311. No further ecological evaluation of groundwater is recommended.

TABLES

TABLE 7-1
SUMMARY OF ANALYTICAL DATA USED IN THE SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJEUNE, NORTH CAROLINA

Media	Sample ID	Date Sampled	Sample Interval or Well Depth (Feet below ground surface)	Analyses				Comments
				Aromatic VOCs (EPA 8020)	TCL VOCs (OLMO 4.2)	TCL SVOCs (OLMO 4.2)	RCRA Metals (ILMO 4.1)	
Surface Soil	SWMU311-IS02-00	9/13/1997	0 - 2	X		X	X	
	SWMU311-IS03-00	9/13/1997	0 - 2	X		X	X	
	SWMU311-IS04-00	9/13/1997	0 - 2	X		X	X	
	SWMU311-SB01-00	3/24/2002	0 - 1		X		X	
	SWMU311-SB02-00	3/25/2002	0 - 1		X		X	
	SWMU311-SB03-00	3/25/2002	0 - 1		X		X	
	SWMU311-TW01-00	3/24/2002	0 - 1		X		X	
	SWMU311-TW02-00	3/24/2002	0 - 1		X		X	
	SWMU311-TW03-00	3/25/2002	0 - 1		X		X	
Groundwater	SWMU311-GW01	4/4/2002	12		X		X	Temporary Well
	SWMU311-GW02	4/4/2002	13		X		X	Temporary Well
	SWMU311-GW03	4/9/2002	20		X		X	Temporary Well

TABLE 7-2
NCDENR ECOLOGICAL SCREENING VALUES
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJUENE, NORTH CAROLINA

Analyte	NCDENR Recommended Surface Soil Screening Values	
	(ug/kg) or (mg/kg) [1]	Comment
Volatile Organics:		
1,1,1-Trichloroethane	100	value for aliphatic chlorinated hydrocarbons
1,1,2,2-Tetrachloroethane	100	value for aliphatic chlorinated hydrocarbons
1,1,2-Trichloro-1,2,2-trifluoroethane	100	value for aliphatic chlorinated hydrocarbons
1,1,2-Trichloroethane	100	value for aliphatic chlorinated hydrocarbons
1,1-Dichloroethane	100	value for aliphatic chlorinated hydrocarbons
1,1-Dichloroethene	100	value for aliphatic chlorinated hydrocarbons
1,2-Dibromoethane	NA	
1,2-Dibromo-3-chloropropane (DBCP)	100	value for aliphatic chlorinated hydrocarbons
1,2-Dichloroethane	400	
1,2-Dichloroethene (cis)	100	value for aliphatic chlorinated hydrocarbons
1,2-Dichloroethene (trans)	100	value for aliphatic chlorinated hydrocarbons
1,2-Dichloropropane	700000	
2-Butanone	NA	
2-Hexanone	NA	
4-Methyl-2-Pentanone	NA	
Acetone	NA	
Benzene	50	
Bromodichloromethane	100	value for aliphatic chlorinated hydrocarbons
Bromoform	NA	
Bromomethane	NA	
Carbon Disulfide	NA	
Carbon Tetrachloride	1000000	
Chlorobenzene	50	
Chloroethane	100	value for aliphatic chlorinated hydrocarbons
Chloroform	1	
Chloromethane	100	value for aliphatic chlorinated hydrocarbons
cis-1,3-Dichloropropene	100	value for aliphatic chlorinated hydrocarbons
Cyclohexane	100	
Dibromochloromethane	100	value for aliphatic chlorinated hydrocarbons
Dichlorodifluoromethane	100	value for aliphatic chlorinated hydrocarbons
Ethylbenzene	50	
Methyl tert-butyl ether	NA	
Isopropylbenzene (Cumene)	100	value for monocyclic aromatic hydrocarbons
Methyl Acetate	NA	
Methyl Cyclohexane	100	value for monocyclic aromatic hydrocarbons
Methylene Chloride	2000	
Styrene	100	
Tetrachloroethene	10	
Toluene	50	
trans-1,3-Dichloropropene	100	value for aliphatic chlorinated hydrocarbons
Trichloroethene (TCE)	1	
Trichlorofluoromethane	100	value for aliphatic chlorinated hydrocarbons
Vinyl Chloride	10	
Xylene (Total)	50	
Semivolatile Organics:		
1,1'-Biphenyl	60000	
1,2,4-Trichlorobenzene	NA	
1,2-Dichlorobenzene	NA	
1,3-Dichlorobenzene	NA	
1,4-Dichlorobenzene	NA	
2,2'-Oxybis (1-Chloropropane)	100	value for aliphatic chlorinated hydrocarbons
2,4,5-Trichlorophenol	4000	
2,4,6-Trichlorophenol	10000	
2,4-Dichlorophenol	3	value for total dichlorophenols
2,4-Dimethylphenol	500	value for cresols
2,4-Dinitrophenol	20000	
2,4-Dinitrotoluene	NA	
2,6-Dinitrotoluene	NA	
2-Chloronaphthalene	1000	value for chloronapthalene
2-Chlorophenol	NA	

TABLE 7-2
NCDENR ECOLOGICAL SCREENING VALUES
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJUENE, NORTH CAROLINA

Analyte	NCDENR Recommended Surface Soil Screening Values	
	(ug/kg) or (mg/kg) [1]	Comment
Semivolatile Organics (Cont):		
2-Methylnaphthalene	NA	
2-Methylphenol	500	value for cresols
2-Nitroaniline	NA	
2-Nitrophenol	7000	value for 4-nitrophenol
3,3'-Dichlorobenzidine	100	value for total polycyclic chlorinated hydrocarbons
3-Nitroaniline	NA	
4,6-Dinitro-2-Methylphenol	NA	
4-Bromophenyl-Phenylether	NA	
4-Chloro-3-Methylphenol	NA	
4-Chloroaniline	NA	
4-Chlorophenyl-Phenylether	10	value for chlorophenols
4-Methylphenol	500	value for cresols
4-Nitroaniline	NA	
4-Nitrophenol	7000	
Acenaphthene	NA	
Acenaphthylene	NA	
Anthracene	NA	
Benzo(a)anthracene	NA	
Benzo(a)pyrene	NA	
Benzo(b)fluoranthene	NA	
Benzo(g,h,i)perylene	NA	
Benzo(k)fluoranthene	NA	
bis(2-Chloroethyl)ether	100	value for aliphatic chlorinated hydrocarbons
bis(2-Chloroethoxy)methane	100	value for aliphatic chlorinated hydrocarbons
bis(2-Ethylhexyl)phthalate	NA	see value for total phthalates
Butylbenzylphthalate	NA	see value for total phthalates
Carbazole	NA	
Chrysene	NA	
Dibenzo(a,h)anthracene	NA	
Dibenzofuran	NA	
Diethylphthalate	100000	
Dimethylphthalate	200000	
Di-n-butylphthalate	200000	
Di-n-octylphthalate	NA	
Fluoranthene	NA	
Fluorene	NA	
Hexachlorobenzene	2.5	
Hexachlorobutadiene	100	value for aliphatic chlorinated hydrocarbons
Hexachlorocyclopentadiene	10000	
Hexachloroethane	100	value for aliphatic chlorinated hydrocarbons
Indeno(1,2,3-cd)pyrene	NA	
Isophorone	NA	
Naphthalene	NA	
Nitrobenzene	40000	
n-Nitroso-di-n-propylamine	NA	
n-Nitrosodiphenylamine	20000	
Pentachlorophenol	2	
Phenanthrene	NA	
Phenol	50	
Pyrene	NA	
PAHs (total)	1000	

TABLE 7-2
NCDENR ECOLOGICAL SCREENING VALUES
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJUENE, NORTH CAROLINA

Analyte	NCDENR Recommended Surface Soil Screening Values	
	(ug/kg) or (mg/kg) [1]	Comment
Total Inorganics:		
Arsenic	10	
Barium	165	
Cadmium	1.6	
Chromium (Total)	0.4	
Lead	50	
Mercury	0.1	
Selenium	0.81	
Silver	2	

Notes:
NA = Not Applicable/ Not Established
NCDENR = North Carolina Department of Environment and Natural Resources
[1] Soil screening values are in microgram per kilogram (ug/kg) for organic compounds and in milligram per kilogram (mg/kg) for inorganic constituents.

TABLE 7-2
NCDENR ECOLOGICAL SCREENING VALUES
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJUENE, NORTH CAROLINA

Analyte	NCDENR Recommended Surface Water Screening Values - Brackish Water [2]	
	(ug/L)	Comment
Volatile Organics:		
1,1,1-Trichloroethane	312	
1,1,2,2-Tetrachloroethane	90.2	
1,1,2-Trichloro-1,2,2-trifluoroethane	NA	
1,1,2-Trichloroethane	940	
1,1-Dichloroethane	NA	
1,1-Dichloroethene	303	
1,2-Dibromoethane	NA	
1,2-Dibromo-3-chloropropane (DBCP)	NA	
1,2-Dichloroethane	1130	
1,2-Dichloroethene (cis)	NA	
1,2-Dichloroethene (trans)	1350	
1,2-Dichloropropane	525	
2-Butanone	NA	
2-Hexanone	NA	
4-Methyl-2-Pentanone	NA	
Acetone	NA	
Benzene	53	
Bromodichloromethane	NA	
Bromoform	293	
Bromomethane	110	
Carbon Disulfide	NA	
Carbon Tetrachloride	352	
Chlorobenzene	105	
Chloroethane	NA	
Chloroform	289	
Chloromethane	2700	
cis-1,3-Dichloropropene	7.9	Cis and Trans isomers
Cyclohexane	NA	
Dibromochloromethane	NA	
Dichlorodifluoromethane	NA	
Ethylbenzene	4.3	
Methyl tert-butyl ether	NA	
Isopropylbenzene (Cumene)	NA	
Methyl Acetate	NA	
Methyl Cyclohexane	NA	
Methylene Chloride	1930	
Styrene	NA	
Tetrachloroethene	45	
Toluene	37	
trans-1,3-Dichloropropene	7.9	Cis and Trans isomers
Trichloroethene (TCE)	NA	
Trichlorofluoromethane	NA	
Vinyl Chloride	NA	
Xylene (Total)	NA	
Semivolatile Organics:		
1,1'-Biphenyl	NA	
1,2,4-Trichlorobenzene	4.5	
1,2-Dichlorobenzene	15.8	
1,3-Dichlorobenzene	28.5	
1,4-Dichlorobenzene	11.2	
2,2'-Oxybis (1-Chloropropane)	NA	
2,4,5-Trichlorophenol	NA	
2,4,6-Trichlorophenol	3.2	
2,4-Dichlorophenol	36.5	
2,4-Dimethylphenol	21.2	
2,4-Dinitrophenol	6.2	
2,4-Dinitrotoluene	310	
2,6-Dinitrotoluene	NA	
2-Chloronaphthalene	NA	
2-Chlorophenol	43.8	

TABLE 7-2
NCDENR ECOLOGICAL SCREENING VALUES
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJUENE, NORTH CAROLINA

Analyte	NCDENR Recommended Surface Water Screening Values - Brackish Water [2]	
	(ug/L)	Comment
Semivolatile Organics (Cont):		
2-Methylnaphthalene	NA	
2-Methylphenol	NA	
2-Nitroaniline	NA	
2-Nitrophenol	3500	
3,3'-Dichlorobenzidine	NA	
3-Nitroaniline	NA	
4,6-Dinitro-2-Methylphenol	2.3	
4-Bromophenyl-Phenylether	12.2	
4-Chloro-3-Methylphenol	0.3	
4-Chloroaniline	NA	
4-Chlorophenyl-Phenylether	NA	
4-Methylphenol	NA	
4-Nitroaniline	NA	
4-Nitrophenol	71.7	
Acenaphthene	9.7	
Acenaphthylene	NA	
Anthracene	NA	
Benzo(a)anthracene	NA	
Benzo(a)pyrene	NA	
Benzo(b)fluoranthene	NA	
Benzo(g,h,i)perylene	NA	
Benzo(k)fluoranthene	NA	
bis(2-Chloroethyl)ether	2380	
bis(2-Chloroethoxy)methane	NA	
bis(2-Ethylhexyl)phthalate	0.299	
Butylbenzylphthalate	22	
Carbazole	NA	
Chrysene	NA	
Dibenzo(a,h)anthracene	NA	
Dibenzofuran	NA	
Diethylphthalate	75.9	
Dimethylphthalate	330	
Di-n-butylphthalate	3.4	
Di-n-octylphthalate	0.3	value for bis(2-ethylhexyl)phthalate
Fluoranthene	1.6	
Fluorene	NA	
Hexachlorobenzene	NA	
Hexachlorobutadiene	0.32	
Hexachlorocyclopentadiene	0.07	
Hexachloroethane	9.4	
Indeno(1,2,3-cd)pyrene	NA	
Isophorone	129	
Naphthalene	23.5	
Nitrobenzene	66.8	
n-Nitroso-di-n-propylamine	NA	
n-Nitrosodiphenylamine	58.5	
Pentachlorophenol	12.79430308	pH = 7.8 S.U.
Phenanthrene	NA	
Phenol	58	
Pyrene	NA	
PAHs (total)	0	

TABLE 7-2
NCDENR ECOLOGICAL SCREENING VALUES
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJUENE, NORTH CAROLINA

Analyte	NCDENR Recommended Surface Water Screening Values - Brackish Water [2]	
	(ug/L)	Comment
Total Inorganics:		
Arsenic	36	Trivalent (+3) form
Barium	NA	
Cadmium	0.1619	Hardness = 50 mg CaCO3/L (default)(2)
Chromium (Total)	9.3	value is for hexavalent (+6) form
Lead	1.3165	Hardness = 50 mg CaCO3/L (default)
Mercury	0.012	
Selenium	5	
Silver	0.012	

Notes:
NA = Not Applicable/ Not Established
NCDENR = North Carolina Department of Environment and Natural Resources
[2] Brackish screening value is the minimum of freshwater and salt water screening va

TABLE 7-2
NCDENR ECOLOGICAL SCREENING VALUES
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJUENE, NORTH CAROLINA

Analyte	North Carolina Surface Water Quality Standard for Aquatic Life - Brackish Water[2,3] (ug/L)	Comment
Volatile Organics:		
1,1,1-Trichloroethane	NA	
1,1,2,2-Tetrachloroethane	NA	
1,1,2-Trichloro-1,2,2-trifluoroethane	NA	
1,1,2-Trichloroethane	NA	
1,1-Dichloroethane	NA	
1,1-Dichloroethene	NA	
1,2-Dibromoethane	NA	
1,2-Dibromo-3-chloropropane (DBCP)	NA	
1,2-Dichloroethane	NA	
1,2-Dichloroethene (cis)	NA	
1,2-Dichloroethene (trans)	NA	
1,2-Dichloropropane	NA	
2-Butanone	NA	
2-Hexanone	NA	
4-Methyl-2-Pentanone	NA	
Acetone	NA	
Benzene	NA	
Bromodichloromethane	NA	
Bromoform	NA	
Bromomethane	NA	
Carbon Disulfide	NA	
Carbon Tetrachloride	0.4	
Chlorobenzene	NA	
Chloroethane	NA	
Chloroform	NA	
Chloromethane	NA	
cis-1,3-Dichloropropene	NA	
Cyclohexane	NA	
Dibromochloromethane	NA	
Dichlorodifluoromethane	NA	
Ethylbenzene	NA	
Methyl tert-butyl ether	NA	
Isopropylbenzene (Cumene)	NA	
Methyl Acetate	NA	
Methyl Cyclohexane	NA	
Methylene Chloride	NA	
Styrene	NA	
Tetrachloroethene	NA	
Toluene	0.36	
trans-1,3-Dichloropropene	NA	
Trichloroethene (TCE)	NA	
Trichlorofluoromethane	NA	
Vinyl Chloride	NA	
Xylene (Total)	NA	
Semivolatile Organics:		
1,1'-Biphenyl	NA	
1,2,4-Trichlorobenzene	NA	
1,2-Dichlorobenzene	NA	
1,3-Dichlorobenzene	NA	
1,4-Dichlorobenzene	NA	
2,2'-Oxybis (1-Chloropropane)	NA	
2,4,5-Trichlorophenol	NA	
2,4,6-Trichlorophenol	NA	
2,4-Dichlorophenol	NA	
2,4-Dimethylphenol	NA	
2,4-Dinitrophenol	NA	
2,4-Dinitrotoluene	NA	
2,6-Dinitrotoluene	NA	
2-Chloronaphthalene	NA	
2-Chlorophenol	NA	

TABLE 7-2
NCDENR ECOLOGICAL SCREENING VALUES
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJUENE, NORTH CAROLINA

Analyte	North Carolina Surface Water Quality Standard for Aquatic Life - Brackish Water[2,3] (ug/L)	Comment
Semivolatile Organics (Cont):		
2-Methylnaphthalene	NA	
2-Methylphenol	NA	
2-Nitroaniline	NA	
2-Nitrophenol	NA	
3,3'-Dichlorobenzidine	NA	
3-Nitroaniline	NA	
4,6-Dinitro-2-Methylphenol	NA	
4-Bromophenyl-Phenylether	NA	
4-Chloro-3-Methylphenol	NA	
4-Chloroaniline	NA	
4-Chlorophenyl-Phenylether	NA	
4-Methylphenol	NA	
4-Nitroaniline	NA	
4-Nitrophenol	NA	
Acenaphthene	NA	
Acenaphthylene	NA	
Anthracene	NA	
Benzo(a)anthracene	NA	
Benzo(a)pyrene	NA	
Benzo(b)fluoranthene	NA	
Benzo(g,h,i)perylene	NA	
Benzo(k)fluoranthene	NA	
bis(2-Chloroethyl)ether	NA	
bis(2-Chloroethoxy)methane	NA	
bis(2-Ethylhexyl)phthalate	NA	
Butylbenzylphthalate	NA	
Carbazole	NA	
Chrysene	NA	
Dibenzo(a,h)anthracene	NA	
Dibenzofuran	NA	
Diethylphthalate	NA	
Dimethylphthalate	NA	
Di-n-butylphthalate	NA	
Di-n-octylphthalate	NA	
Fluoranthene	NA	
Fluorene	NA	
Hexachlorobenzene	NA	
Hexachlorobutadiene	NA	
Hexachlorocyclopentadiene	NA	
Hexachloroethane	NA	
Indeno(1,2,3-cd)pyrene	NA	
Isophorone	NA	
Naphthalene	NA	
Nitrobenzene	NA	
n-Nitroso-di-n-propylamine	NA	
n-Nitrosodiphenylamine	NA	
Pentachlorophenol	NA	
Phenanthrene	NA	
Phenol	NA	
Pyrene	NA	
PAHs (total)	NA	

TABLE 7-2
NCDENR ECOLOGICAL SCREENING VALUES
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJUENE, NORTH CAROLINA

Analyte	North Carolina Surface Water Quality Standard for Aquatic Life - Brackish Water[2,3]	
	(ug/L)	Comment
Total Inorganics:		
Arsenic	50	
Barium	NA	
Cadmium	0.4	
Chromium (Total)	20	value is for hexavalent (+6) form
Lead	25	
Mercury	0.012	
Selenium	5	
Silver	0.06	

Notes:

NA = Not Applicable/ Not Established

[2] Brackish screening value is the minimum of freshwater and salt water screening values.

[3] North Carolina Water Quality Standards (North Carolina Administrative Code.Title 15A,

TABLE 7-3
SELECTION OF ECOLOGICAL COPCs IN SURFACE SOIL
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	Contaminant Frequency/Range					NCDENR ESV	Note	Maximum Hazard Quotient	Soil COPC?	Contaminant Category
	Frequency of Detection	Range of Positive Detections	Location of Maximum Concentration	Range of Detection Limits	Concentration Used For Screening (1)					
VOLATILES (ug/kg)										
1,1,1-Trichloroethane (TCA)	0/6	NA	NA	5U - 6U	6.00	100	value for aliphatic chlorinated hydrocarbons	0.06	No	
1,1,2,2-Tetrachloroethane	0/6	NA	NA	5U - 6U	6.00	100	value for aliphatic chlorinated hydrocarbons	0.06	No	
1,1,2-Trichloro-1,2,2-trifluoroethane	0/6	NA	NA	5U - 6U	6.00	100	hydrocarbons	0.06	No	
1,1,2-Trichloroethane	0/6	NA	NA	5U - 6U	6.00	100	value for aliphatic chlorinated hydrocarbons	0.06	No	
1,1-Dichloroethane	0/6	NA	NA	5U - 6U	6.00	100	value for aliphatic chlorinated hydrocarbons	0.06	No	
1,1-Dichloroethene	0/6	NA	NA	5U - 6U	6.00	100	value for aliphatic chlorinated hydrocarbons	0.06	No	
1,2,4-Trichlorobenzene	0/6	NA	NA	5U - 6U	6.00	NA		NA	Yes	4
1,2-Dibromo-3-chloropropane (DBCP)	0/6	NA	NA	5U - 6U	6.00	100	value for aliphatic chlorinated hydrocarbons	0.06	No	
1,2-Dibromoethane (EDB)	0/6	NA	NA	5U - 6U	6.00	NA		NA	Yes	4
1,2-Dichlorobenzene (o-)	0/9	NA	NA	1U - 6U	6.00	NA		NA	Yes	4
1,2-Dichloroethane	0/6	NA	NA	5U - 6U	6.00	400		0.02	No	
1,2-Dichloroethene (cis)	0/6	NA	NA	5U - 6U	6.00	100	hydrocarbons	0.06	No	
1,2-Dichloroethene (trans)	0/6	NA	NA	5U - 6U	6.00	100	hydrocarbons	0.06	No	
1,2-Dichloropropane	0/6	NA	NA	5U - 6U	6.00	700000		<0.01	No	
1,3-Dichlorobenzene (m-)	0/9	NA	NA	1U - 6U	6.00	NA		NA	Yes	4
1,3-Dichloropropene (cis)	0/6	NA	NA	5U - 6U	6.00	100	value for aliphatic chlorinated hydrocarbons	0.06	No	
1,3-Dichloropropene (trans)	0/6	NA	NA	5U - 6U	6.00	100	value for aliphatic chlorinated hydrocarbons	0.06	No	
1,4-Dichlorobenzene (p-)	0/9	NA	NA	1U - 6U	6.00	NA		NA	Yes	4
2-Butanone (MEK)	2/6	6J - 11J	SWMU311-TW02-00	12U - 15U	11.00	NA		NA	Yes	3
2-Hexanone (MBK)	0/6	NA	NA	12U - 16U	16.00	NA		NA	Yes	4
4-Methyl-2-pentanone (MIBK)	1/6	2J - 2J	SWMU311-SB03-00	12U - 16U	2.00	NA		NA	Yes	3
Acetone	6/6	4J - 34J	SWMU311-TW02-00	NA	34.00	NA		NA	Yes	3
Benzene	1/9	2J - 2J	SWMU311-TW02-00	1U - 6U	2.00	50		0.04	No	
Bromodichloromethane	0/6	NA	NA	5U - 6U	6.00	100	value for aliphatic chlorinated hydrocarbons	0.06	No	
Bromoform	4/6	6.75J - 19	SWMU311-TW02-00	5U - 6U	19.00	NA		NA	Yes	3
Bromomethane	0/6	NA	NA	5UJ - 6UJ	6.00	NA		NA	Yes	4
Carbon Disulfide	1/6	2J - 2J	SWMU311-TW02-00	5U - 6U	2.00	NA		NA	Yes	3
Carbon Tetrachloride	0/6	NA	NA	5U - 6U	6.00	1000000		<0.01	No	
Chlorobenzene	0/9	NA	NA	1U - 6U	6.00	50		0.12	No	
Chloroethane	0/6	NA	NA	5U - 6U	6.00	100	value for aliphatic chlorinated hydrocarbons	0.06	No	
Chloroform	2/6	1.5J - 2J	SWMU311-TW01-00	5U - 6U	2.00	1		2.00	Yes	1
Chloromethane	0/6	NA	NA	5U - 6U	6.00	100	value for aliphatic chlorinated hydrocarbons	0.06	No	

TABLE 7-3
SELECTION OF ECOLOGICAL COPCs IN SURFACE SOIL
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	Contaminant Frequency/Range					NCDENR ESV	Note	Maximum Hazard Quotient	Soil COPC?	Contaminant Category
	Frequency of Detection	Range of Positive Detections	Location of Maximum Concentration	Range of Detection Limits	Concentration Used For Screening (1)					
VOLATILES (ug/kg)(Cont.)										
Cyclohexane	1/6	1J - 1J	SWMU311-TW02-00	5U - 6U	1.00	100		0.01	No	
Dibromochloromethane	0/6	NA	NA	5U - 6U	6.00	100	value for aliphatic chlorinated hydrocarbons	0.06	No	
Dichlorodifluoromethane	0/6	NA	NA	5U - 6U	6.00	100	value for aliphatic chlorinated hydrocarbons	0.06	No	
Ethylbenzene	1/9	2J - 2J	SWMU311-TW02-00	1U - 6U	2.00	50		0.04	No	
Isopropylbenzene (Cumene)	0/6	NA	NA	5U - 6U	6.00	100	value for monocyclic aromatic hydrocarbons	0.06	No	
Methyl Acetate	0/6	NA	NA	5U - 6U	6.00	NA		NA	Yes	4
Methyl Cyclohexane	1/6	1J - 1J	SWMU311-TW02-00	5U - 6U	1.00	100	value for monocyclic aromatic hydrocarbons	0.01	No	
Methyl Tert-Butyl Ether (MTBE)	0/6	NA	NA	5U - 6U	6.00	NA		NA	Yes	4
Methylene Chloride	6/6	13 - 30	SWMU311-TW01-00	NA	30.00	2000		0.02	No	
Styrene	0/6	NA	NA	5U - 6U	6.00	100		0.06	No	
Tetrachloroethene (PCE)	0/6	NA	NA	5U - 6U	6.00	10		0.60	No	
Toluene	0/9	NA	NA	1U - 6U	6.00	50		0.12	No	
Trichloroethene (TCE)	0/6	NA	NA	5U - 6U	6.00	1		6.00	Yes	2
Trichlorofluoromethane	0/6	NA	NA	5U - 6U	6.00	100	value for aliphatic chlorinated hydrocarbons	0.06	No	
Vinyl Chloride	0/6	NA	NA	5U - 6U	6.00	10		0.60	No	
Xylenes, total	0/9	NA	NA	1U - 19UJ	19.00	50		0.38	No	
SEMIVOLATILES (ug/kg)										
1,2,4-Trichlorobenzene	0/6	NA	NA	5U - 6U	6.00	NA		NA	Yes	4
1,2-Dichlorobenzene (o-)	0/9	NA	NA	1U - 6U	6.00	NA		NA	Yes	4
1,3-Dichlorobenzene (m-)	0/9	NA	NA	1U - 6U	6.00	NA		NA	Yes	4
1,4-Dichlorobenzene (p-)	0/9	NA	NA	1U - 6U	6.00	NA		NA	Yes	4
2,2'-Oxybis[1-chloropropane]	0/3	NA	NA	340U - 400U	400.00	100	hydrocarbons	4.00	Yes	2
2,4,5-Trichlorophenol	0/3	NA	NA	340U - 400U	400.00	4000		0.10	No	
2,4,6-Trichlorophenol	0/3	NA	NA	340U - 400U	400.00	10000		0.04	No	
2,4-Dichlorophenol	0/3	NA	NA	340U - 400U	400.00	3	value for total dichlorophenols	133.33	Yes	2
2,4-Dimethylphenol	0/3	NA	NA	340U - 400U	400.00	500	value for cresols	0.80	No	
2,4-Dinitrophenol	0/3	NA	NA	1700U - 1900U	1900.00	20000		0.10	No	
2,4-Dinitrotoluene	0/3	NA	NA	340U - 400U	400.00	NA		NA	Yes	4
2,6-Dinitrotoluene	0/3	NA	NA	340U - 400U	400.00	NA		NA	Yes	4
2-Chloronaphthalene	0/3	NA	NA	340U - 400U	400.00	1000	value for chloronapthalene	0.40	No	
2-Chlorophenol	0/3	NA	NA	340U - 400U	400.00	NA		NA	Yes	4
2-Methylnaphthalene	0/3	NA	NA	340U - 400U	400.00	NA		NA	Yes	4

TABLE 7-3
SELECTION OF ECOLOGICAL COPCs IN SURFACE SOIL
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	Contaminant Frequency/Range					NCDENR ESV	Note	Maximum Hazard Quotient	Soil COPC?	Contaminant Category
	Frequency of Detection	Range of Positive Detections	Location of Maximum Concentration	Range of Detection Limits	Concentration Used For Screening (1)					
SEMIVOLATILES (ug/kg)(Cont.)										
2-Methylphenol (o-Cresol)	0/3	NA	NA	340U - 400U	400.00	500	value for cresols	0.80	No	
2-Nitroaniline	0/3	NA	NA	1700U - 1900U	1900.00	NA		NA	Yes	4
2-Nitrophenol	0/3	NA	NA	340U - 400U	400.00	7000	value for 4-nitrophenol	0.06	No	
3,3'-Dichlorobenzidine	0/3	NA	NA	1700U - 1900U	1900.00	100	value for total polycyclic chlorinated hydrocarbons	19.00	Yes	2
3-Nitroaniline	0/3	NA	NA	1700U - 1900U	1900.00	NA		NA	Yes	4
4,6-Dinitro-2-methylphenol	0/3	NA	NA	1700U - 1900U	1900.00	NA		NA	Yes	4
4-Bromophenyl-phenylether	0/3	NA	NA	340U - 400U	400.00	NA		NA	Yes	4
4-Chloro-3-methylphenol	0/3	NA	NA	340U - 400U	400.00	NA		NA	Yes	4
4-Chloroaniline	0/3	NA	NA	340U - 400U	400.00	NA		NA	Yes	4
4-Chlorophenyl-phenylether	0/3	NA	NA	340U - 400U	400.00	10	value for chlorophenols	40.00	Yes	2
4-Methylphenol (p-Cresol)	0/3	NA	NA	340U - 400U	400.00	500	value for cresols	0.80	No	
4-Nitroaniline	0/3	NA	NA	1700U - 1900U	1900.00	NA		NA	Yes	4
4-Nitrophenol	0/3	NA	NA	1700U - 1900U	1900.00	7000		0.27	No	
Acenaphthene	0/3	NA	NA	340U - 400U	400.00	NA		NA	Yes	4
Acenaphthylene	0/3	NA	NA	340U - 400U	400.00	NA		NA	Yes	4
Anthracene	0/3	NA	NA	340U - 400U	400.00	NA		NA	Yes	4
Benzo(a)anthracene	1/3	33J - 33J	SWMU311-IS03-00	340U - 400U	33.00	NA		NA	Yes	3
Benzo(a)pyrene	1/3	48J - 48J	SWMU311-IS03-00	340U - 400U	48.00	NA		NA	Yes	3
Benzo(b)fluoranthene	1/3	48J - 48J	SWMU311-IS03-00	340U - 400U	48.00	NA		NA	Yes	3
Benzo(g,h,i)perylene	1/3	50J - 50J	SWMU311-IS03-00	340U - 400U	50.00	NA		NA	Yes	3
Benzo(k)fluoranthene	1/3	60J - 60J	SWMU311-IS03-00	340U - 400U	60.00	NA		NA	Yes	3
Bis(2-chloroethoxy)methane	0/3	NA	NA	340U - 400U	400.00	100	hydrocarbons	4.00	Yes	2
Bis(2-chloroethyl)ether	0/3	NA	NA	340U - 400U	400.00	100	hydrocarbons	4.00	Yes	2
Bis(2-ethylhexyl) Phthalate (DEHP)	3/3	170J - 230J	SWMU311-IS02-00	NA	230.00	NA	see value for total phthalates	NA	Yes	3
Butyl Benzyl Phthalate	0/3	NA	NA	340U - 400U	400.00	NA	see value for total phthalates	NA	Yes	4
Carbazole	0/3	NA	NA	340U - 400U	400.00	NA		NA	Yes	4
Chrysene	1/3	49J - 49J	SWMU311-IS03-00	340U - 400U	49.00	NA		NA	Yes	3
Dibenz(a,h)anthracene	0/3	NA	NA	340U - 400U	400.00	NA		NA	Yes	4
Dibenzofuran	0/3	NA	NA	340U - 400U	400.00	NA		NA	Yes	4
Diethyl Phthalate (DEP)	0/3	NA	NA	340U - 400U	400.00	100000		<0.01	No	
Dimethyl Phthalate	0/3	NA	NA	340U - 400U	400.00	200000		<0.01	No	
Di-n-butyl Phthalate (DBP)	0/3	NA	NA	340U - 400U	400.00	200000		<0.01	No	
Di-n-octyl Phthalate	0/3	NA	NA	340U - 400U	400.00	NA		NA	Yes	4

TABLE 7-3
SELECTION OF ECOLOGICAL COPCs IN SURFACE SOIL
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	Contaminant Frequency/Range					NCDENR ESV	Note	Maximum Hazard Quotient	Soil COPC?	Contaminant Category
	Frequency of Detection	Range of Positive Detections	Location of Maximum Concentration	Range of Detection Limits	Concentration Used For Screening [1]					
SEMIVOLATILES (ug/kg)(Cont.)										
Fluoranthene	1/3	65J - 65J	SWMU311-IS03-00	340U - 400U	65.00	NA		NA	Yes	3
Fluorene	0/3	NA	NA	340U - 400U	400.00	NA		NA	Yes	4
Hexachlorobenzene	0/3	NA	NA	340U - 400U	400.00	2.5		160.00	Yes	2
Hexachlorobutadiene	0/3	NA	NA	340U - 400U	400.00	100	hydrocarbons	4.00	Yes	2
Hexachlorocyclopentadiene	0/3	NA	NA	1700U - 1900U	1900.00	10000		0.19	No	
Hexachloroethane	0/3	NA	NA	340U - 400U	400.00	100	hydrocarbons	4.00	Yes	2
Indeno(1,2,3-cd)pyrene	1/3	41J - 41J	SWMU311-IS03-00	340U - 400U	41.00	NA		NA	Yes	3
Isophorone	0/3	NA	NA	340U - 400U	400.00	NA		NA	Yes	4
Naphthalene	0/3	NA	NA	340U - 400U	400.00	NA		NA	Yes	4
Nitrobenzene	0/3	NA	NA	340U - 400U	400.00	40000		0.01	No	
n-Nitrosodi-n-propylamine	0/3	NA	NA	340U - 400U	400.00	NA		NA	Yes	4
n-Nitrosodiphenylamine	0/3	NA	NA	340U - 400U	400.00	20000		0.02	No	
Pentachlorophenol	0/3	NA	NA	1700U - 1900U	1900.00	2		950.00	Yes	2
Phenanthrene	0/3	NA	NA	340U - 400U	400.00	NA		NA	Yes	4
Phenol	0/3	NA	NA	340U - 400U	400.00	50		8.00	Yes	2
Pyrene	1/3	62J - 62J	SWMU311-IS03-00	340U - 400U	62.00	NA		NA	Yes	3
METALS (mg/kg)										
Arsenic	2/9	0.25J - 0.31J	SWMU311-TW01-00	0.24U - 1.2U	0.31	10		0.03	No	
Barium	6/9	8.5 - 13.65J	SWMU311-TW03-00	20.8U - 24U	13.65	165		0.08	No	
Cadmium	6/9	0.041J - 5.2	SWMU311-IS02-00	0.033U - 0.52U	5.20	1.6		3.25	Yes	1
Chromium	9/9	3.3 - 28.8	SWMU311-IS02-00	NA	28.80	0.4		72.00	Yes	1
Lead	9/9	4.4J - 1110	SWMU311-IS04-00	NA	1110.00	50		22.20	Yes	1
Mercury	7/9	0.0185J - 0.09	SWMU311-IS02-00	0.034U - 0.038U	0.09	0.1		0.90	No	
Selenium	2/9	0.56 - 0.91	SWMU311-TW01-00	0.47U - 0.6U	0.91	0.81		1.12	Yes	1
Silver	0/9	NA	NA	0.091U - 1.2U	1.20	2		0.60	No	

Notes:

[1] Maximum concentration. If contaminant was not detected, equals the maximum detection limit.

COPC = Contaminant of Potential Concern

ESV = Ecological Screening Value

Hazard Quotient = Contaminant Concentration/ ESV

J = Estimated Value

MDL = Maximum detection limit

mg/kg = miligram per kilogram

NA = Not Available

NCDENR = North Carolina Department of Environment and Natural Resources

SQL = Sample quantitation limit

U = Chemical was not detected above the method detection limit

ug/kg = microgram per kilogram

TABLE 7-3
SELECTION OF ECOLOGICAL COPCs IN SURFACE SOIL
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	Contaminant Frequency/Range					NCDENR ESV	Note	Maximum Hazard Quotient	Soil COPC?	Contaminant Category
	Frequency of Detection	Range of Positive Detections	Location of Maximum Concentration	Range of Detection Limits	Concentration Used For Screening [1]					

Notes (Cont.):

Contaminant Categories

1 Contaminant was found in concentrations exceeding its screening value.
2 Contaminant was not found in concentrations exceeding the SQL; however, the MDL exceed its screening value.
3 Contaminant was found in concentrations exceeding its SQL; however, there is no current screening value for the contaminant.
4 Contaminant was not found in concentrations exceeding the SQL and there is no current screening value for the contaminant.

TABLE 7-4
SELECTION OF ECOLOGICAL COPCs IN GROUNDWATER
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	Contaminant Frequency/Range					NCDENR Brackish Water CSV	Maximum Hazard Quotient	North Carolina Brackish Surface Water Quality Standard	Exceeds NCWQS?	Groundwater COPC?	Contaminant Category
	Frequency of Detection	Range of Positive Detections	Location of Maximum Concentration	Range of Detection Limits	Concentration Used For Screening (1)						
VOLATILES (ug/L)											
1,1,1-Trichloroethane (TCA)	0/3	NA	NA	5U	5.00	312	0.02	NA	NA	No	
1,1,2,2-Tetrachloroethane	0/3	NA	NA	5U	5.00	90.2	0.06	NA	NA	No	
1,1,2-Trichloro-1,2,2-trifluoroethane	0/3	NA	NA	5U	5.00	NA	NA	NA	NA	Yes	4
1,1,2-Trichloroethane	0/3	NA	NA	5U	5.00	940	<0.01	NA	NA	No	
1,1-Dichloroethane	0/3	NA	NA	5U	5.00	NA	NA	NA	NA	Yes	4
1,1-Dichloroethene	0/3	NA	NA	5U	5.00	303	0.02	NA	NA	No	
1,2,4-Trichlorobenzene	0/3	NA	NA	5U	5.00	4.5	1.11	NA	NA	Yes	2
1,2-Dibromo-3-chloropropane (DBCP)	0/3	NA	NA	5U	5.00	NA	NA	NA	NA	Yes	4
1,2-Dibromoethane (EDB)	0/3	NA	NA	5U	5.00	NA	NA	NA	NA	Yes	4
1,2-Dichlorobenzene (o-)	0/3	NA	NA	5U	5.00	15.8	0.32	NA	NA	No	
1,2-Dichloroethane	0/3	NA	NA	5U	5.00	1130	<0.01	NA	NA	No	
1,2-Dichloroethene (cis)	0/3	NA	NA	5U	5.00	NA	NA	NA	NA	Yes	4
1,2-Dichloroethene (trans)	0/3	NA	NA	5U	5.00	1350	<0.01	NA	NA	No	
1,2-Dichloropropane	0/3	NA	NA	5U	5.00	525	<0.01	NA	NA	No	
1,3-Dichlorobenzene (m-)	0/3	NA	NA	5U	5.00	28.5	0.18	NA	NA	No	
1,3-Dichloropropene (cis)	0/3	NA	NA	5U	5.00	7.9	0.63	NA	NA	No	
1,3-Dichloropropene (trans)	0/3	NA	NA	5U	5.00	7.9	0.63	NA	NA	No	
1,4-Dichlorobenzene (p-)	0/3	NA	NA	5U	5.00	11.2	0.45	NA	NA	No	
2-Butanone (MEK)	0/3	NA	NA	13U	13.00	NA	NA	NA	NA	Yes	4
2-Hexanone (MBK)	0/3	NA	NA	13U	13.00	NA	NA	NA	NA	Yes	4
4-Methyl-2-pentanone (MIBK)	0/3	NA	NA	13U	13.00	NA	NA	NA	NA	Yes	4
Acetone	0/3	NA	NA	5U - 13U	13.00	NA	NA	NA	NA	Yes	4
Benzene	0/3	NA	NA	5U	5.00	53	0.09	NA	NA	No	
Bromodichloromethane	0/3	NA	NA	5U	5.00	NA	NA	NA	NA	Yes	4
Bromoform	0/3	NA	NA	5U	5.00	293	0.02	NA	NA	No	
Bromomethane	0/3	NA	NA	5U	5.00	110	0.05	NA	NA	No	
Carbon Disulfide	0/3	NA	NA	5U	5.00	NA	NA	NA	NA	Yes	4
Carbon Tetrachloride	0/3	NA	NA	5U	5.00	352	0.01	0.4	Yes	Yes	5
Chlorobenzene	0/3	NA	NA	5U	5.00	105	0.05	NA	NA	No	
Chloroethane	0/3	NA	NA	5U	5.00	NA	NA	NA	NA	Yes	4
Chloroform	0/3	NA	NA	5U	5.00	289	0.02	NA	NA	No	
Chloromethane	0/3	NA	NA	5U	5.00	2700	<0.01	NA	NA	No	
Cyclohexane	1/3	3J - 3J	SWMU311-GW01	5U	3.00	NA	NA	NA	NA	Yes	3
Dibromochloromethane	0/3	NA	NA	5U	5.00	NA	NA	NA	NA	Yes	4
Dichlorodifluoromethane	0/3	NA	NA	5U	5.00	NA	NA	NA	NA	Yes	4
Ethylbenzene	1/3	2J - 2J	SWMU311-GW01	5U	2.00	4.3	0.47	NA	NA	No	
Isopropylbenzene (Cumene)	1/3	3J - 3J	SWMU311-GW01	5U	3.00	NA	NA	NA	NA	Yes	3
Methyl Acetate	0/3	NA	NA	5U	5.00	NA	NA	NA	NA	Yes	4

TABLE 7-4
SELECTION OF ECOLOGICAL COPCs IN GROUNDWATER
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	Contaminant Frequency/Range					NCDENR Brackish Water CSV	Maximum Hazard Quotient	North Carolina Brackish Surface Water Quality Standard	Exceeds NCWQS?	Groundwater COPC?	Contaminant Category
	Frequency of Detection	Range of Positive Detections	Location of Maximum Concentration	Range of Detection Limits	Concentration Used For Screening [1]						
VOLATILES (ug/L)(Cont.):											
Methyl Cyclohexane	1/3	3J - 3J	SWMU311-GW01	5U	3.00	NA	NA	NA	NA	Yes	3
Methyl Tert-Butyl Ether (MTBE)	0/3	NA	NA	5U	5.00	NA	NA	NA	NA	Yes	4
Methylene Chloride	0/3	NA	NA	5U	5.00	1930	<0.01	NA	NA	No	
Styrene	0/3	NA	NA	5U	5.00	NA	NA	NA	NA	Yes	4
Tetrachloroethene (PCE)	0/3	NA	NA	5U	5.00	45	0.11	NA	NA	No	
Toluene	0/3	NA	NA	5U	5.00	37	0.14	0.36	Yes	Yes	5
Trichloroethene (TCE)	0/3	NA	NA	5U	5.00	NA	NA	NA	NA	Yes	4
Trichlorofluoromethane	0/3	NA	NA	5U	5.00	NA	NA	NA	NA	Yes	4
Vinyl Chloride	0/3	NA	NA	5U	5.00	NA	NA	NA	NA	Yes	4
Xylenes, total	1/3	3J - 3J	SWMU311-GW01	5U	3.00	NA	NA	NA	NA	Yes	3
METALS (ug/L)											
Arsenic	1/3	3.4J - 3.4J	SWMU311-GW03	2.4UJ	3.40	36	0.09	50	No	No	
Barium	2/3	24.7 - 53.75	SWMU311-GW01	33U	53.75	NA	NA	NA	NA	Yes	3
Cadmium	0/3	NA	NA	0.3U - 0.4U	0.40	0.1619	2.47	0.4	No	Yes	2
Chromium	1/3	12 - 12	SWMU311-GW01	0.5UJ - 0.6U	12.00	9.3	1.29	20	No	Yes	1
Lead	1/3	10.6 - 10.6	SWMU311-GW01	1.1U - 1.8U	10.60	1.3165	8.05	25	No	Yes	1
Mercury	0/3	NA	NA	0.1UJ	0.10	0.012	8.33	0.012	Yes	Yes	2 , 5
Selenium	0/3	NA	NA	2.1UJ - 4.6UJ	4.60	5	0.92	5	No	No	
Silver	0/3	NA	NA	0.5U - 0.9U	0.90	0.012	75.00	0.06	Yes	Yes	2 , 5

Notes:

[1] Maximum concentration. If contaminant was not detected, equals the maximum detection limit.

COPC = Contaminant of Potential Concern
CSV = Chronic Screening Value
Hazard Quotient = Contaminant Concentration/ CSV
J = Estimated Value
MDL = Maximum detection limit
mg/L = miligram per liter
NA = Not Available
NCDENR = North Carolina Department of Environment and Natural Resources
NCWQS = North Carolinal Water Quality Standard
SQL = Sample quantitation limit
U = Chemical was not detected above the method detection limit
ug/L = microgram per liter
UJ = Chemical was not detected above the method detection limit; method detection limit is an estimated value.

TABLE 7-4
SELECTION OF ECOLOGICAL COPCs IN GROUNDWATER
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	Contaminant Frequency/Range					NCDENR Brackish Water CSV	Maximum Hazard Quotient	North Carolina Brackish Surface Water Quality Standard	Exceeds NCWQS?	Groundwater COPC?	Contaminant Category
	Frequency of Detection	Range of Positive Detections	Location of Maximum Concentration	Range of Detection Limits	Concentration Used For Screening [1]						

Notes (Continued):

Contaminant Categories

1 Contaminant was found in concentrations exceeding its screening value.
2 Contaminant was not found in concentrations exceeding the SQL; however, the MDL exceed its screening value.
3 Contaminant was found in concentrations exceeding its SQL; however, there is no current screening value for the contaminant.
4 Contaminant was not found in concentrations exceeding the SQL and there is no current screening value for the contaminant.
5 Contaminant's SQL (if not detected) or maximum concentration exceeds the NCWQS.

TABLE 7-5
MEDIA-SPECIFIC SCREENING VALUES FOR STEP 3A
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJUENE, NORTH CAROLINA

Analyte	Step 3A Soil Screening Values		
	(ug/kg) or (mg/kg) [1]	Reference [2]	Comment
Volatile Organics:			
1,1,1-Trichloroethane	100		value for aliphatic chlorinated hydrocarbons
1,1,2,2-Tetrachloroethane	100		value for aliphatic chlorinated hydrocarbons
1,1,2-Trichloro-1,2,2-trifluoroethane	100		value for aliphatic chlorinated hydrocarbons
1,1,2-Trichloroethane	100		value for aliphatic chlorinated hydrocarbons
1,1-Dichloroethane	100		value for aliphatic chlorinated hydrocarbons
1,1-Dichloroethene	100		value for aliphatic chlorinated hydrocarbons
1,2-Dibromoethane	1,230	USEPA, 2003	
1,2-Dibromo-3-chloropropane (DBCP)	100		value for aliphatic chlorinated hydrocarbons
1,2-Dichloroethane	400		
1,2-Dichloroethene (cis)	100		value for aliphatic chlorinated hydrocarbons
1,2-Dichloroethene (trans)	100		value for aliphatic chlorinated hydrocarbons
1,2-Dichloropropane	700,000		
2-Butanone	89,600	USEPA, 2003	
2-Hexanone	12,600	USEPA, 2003	
4-Methyl-2-Pentanone	443,000	USEPA, 2003	
Acetone	2,500	USEPA, 2003	
Benzene	50		
Bromodichloromethane	100		value for aliphatic chlorinated hydrocarbons
Bromoform	15,900	USEPA, 2003	
Bromomethane	NA		
Carbon Disulfide	94.1	USEPA, 2003	
Carbon Tetrachloride	1,000,000		
Chlorobenzene	50		
Chloroethane	100		value for aliphatic chlorinated hydrocarbons
Chloroform	1		
Chloromethane	100		value for aliphatic chlorinated hydrocarbons
cis-1,3-Dichloropropene	100		value for aliphatic chlorinated hydrocarbons
Cyclohexane	100		
Dibromochloromethane	2,050	USEPA, 2003	
Dichlorodifluoromethane	100		value for aliphatic chlorinated hydrocarbons
Ethylbenzene	50		
Methyl tert-butyl ether	NA		
Isopropylbenzene (Cumene)	100		value for monocyclic aromatic hydrocarbons
Methyl Acetate	NA		
Methyl Cyclohexane	100		value for aliphatic chlorinated hydrocarbons
Methylene Chloride	2000		
Styrene	100		
Tetrachloroethene	10		
Toluene	50		
trans-1,3-Dichloropropene	100		value for aliphatic chlorinated hydrocarbons
Trichloroethene (TCE)	1		
Trichlorofluoromethane	100		value for aliphatic chlorinated hydrocarbons
Vinyl Chloride	10		
Xylene (Total)	50		
Semivolatile Organics:			
1,2,4-Trichlorobenzene	50	NCDENR 2003	value for total chlorobenzenes
1,2-Dichlorobenzene	50	NCDENR 2003	value for total chlorobenzenes
1,3-Dichlorobenzene	50	NCDENR 2003	value for total chlorobenzenes
1,4-Dichlorobenzene	50	NCDENR 2003	value for total chlorobenzenes
2,2'-Oxybis (1-Chloropropane)	100		value for aliphatic chlorinated hydrocarbons
2,4,5-Trichlorophenol	4,000		
2,4,6-Trichlorophenol	10,000		
2,4-Dichlorophenol	3		value for total dichlorophenols
2,4-Dimethylphenol	500		value for cresols
2,4-Dinitrophenol	20,000		
2,4-Dinitrotoluene	1,280	USEPA, 2003	
2,6-Dinitrotoluene	32.8	USEPA, 2003	

TABLE 7-5
MEDIA-SPECIFIC SCREENING VALUES FOR STEP 3A
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJUENE, NORTH CAROLINA

Analyte	Step 3A Soil Screening Values		
	(ug/kg) or (mg/kg) (1)	Reference (2)	Comment
Semivolatile Organics (Cont.):			
2-Chloronaphthalene	1000		value for chloronapthalene
2-Chlorophenol	2.5	NCDENR 2003	value for total monochlorophenols
2-Methylnaphthalene	3,240	USEPA, 2003	
2-Methylphenol	500		value for cresols
2-Nitroaniline	74,100	USEPA, 2003	
2-Nitrophenol	7,000		value for 4-nitrophenol
3,3'-Dichlorobenzidine	100		value for total polycyclic chlorinated hydrocarbons
3-Nitroaniline	NA		
4,6-Dinitro-2-Methylphenol	NA		
4-Bromophenyl-Phenylether	NA		
4-Chloro-3-Methylphenol	2.5	NCDENR 2003	value for total monochlorophenols
4-Chloroaniline	1,100	USEPA, 2003	
4-Chlorophenyl-Phenylether	10		value for chlorophenols
4-Methylphenol	500		value for cresols
4-Nitroaniline	NA		
4-Nitrophenol	7,000		
Acenaphthene	1,000	NCDENR 2003	value for total PAHs
Acenaphthylene	1,000	NCDENR 2003	value for total PAHs
Anthracene	1,000	NCDENR 2003	value for total PAHs
Benzo(a)anthracene	1,000	NCDENR 2003	value for total PAHs
Benzo(a)pyrene	1,000	NCDENR 2003	value for total PAHs
Benzo(b)fluoranthene	1,000	NCDENR 2003	value for total PAHs
Benzo(g,h,i)perylene	1,000	NCDENR 2003	value for total PAHs
Benzo(k)fluoranthene	1,000	NCDENR 2003	value for total PAHs
bis(2-Chloroethyl)ether	100		value for aliphatic chlorinated hydrocarbons
bis(2-Chloroethoxy)methane	100		value for aliphatic chlorinated hydrocarbons
bis(2-Ethylhexyl)phthalate	100	NCDENR 2003	value for total phthalates
Butylbenzylphthalate	100	NCDENR 2003	value for total phthalates
Carbazole	NA		
Chrysene	1,000	NCDENR 2003	value for total PAHs
Dibenzo(a,h)anthracene	1,000	NCDENR 2003	value for total PAHs
Dibenzofuran	NA		
Diethylphthalate	100,000		
Dimethylphthalate	200,000		
Di-n-butylphthalate	200,000		
Di-n-octylphthalate	100	NCDENR 2003	value for total phthalates
Fluoranthene	1,000	NCDENR 2003	value for total PAHs
Fluorene	1,000	NCDENR 2003	value for total PAHs
Hexachlorobenzene	2.5		
Hexachlorobutadiene	100		value for aliphatic chlorinated hydrocarbons
Hexachlorocyclopentadiene	10,000		
Hexachloroethane	100		value for aliphatic chlorinated hydrocarbons
Indeno(1,2,3-cd)pyrene	1,000	NCDENR 2003	value for total PAHs
Isophorone	139,000	USEPA, 2003	
Naphthalene	1,000	NCDENR 2003	value for total PAHs
Nitrobenzene	40,000		
n-Nitroso-di-n-propylamine	544	USEPA, 2003	
n-Nitrosodiphenylamine	20,000		
Pentachlorophenol	2		
Phenanthrene	1,000	NCDENR 2003	value for total PAHs
Phenol	50		
Pyrene	1,000	NCDENR 2003	value for total PAHs
PAHs (total)	1000		
Phthalates (total)	100		

TABLE 7-5
MEDIA-SPECIFIC SCREENING VALUES FOR STEP 3A
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJUENE, NORTH CAROLINA

Analyte	Step 3A Soil Screening Values		
	(ug/kg) or (mg/kg) [1]	Reference [2]	Comment
Total Inorganics:			
Arsenic	10		18 Eco-SSL terrestrial plants (USEPA 2003)
Barium	165		330 Eco-SSL soil invertebrates (USEPA 2003)
Cadmium	1.6		0.36 Eco-SSL mammalian wildlife (USEPA 2003)
Chromium (Total)	0.4		26 Eco-SSL avian wildlife (USEPA 2003)
Lead	50		16 Eco-SSL avian wildlife (USEPA 2003)
Mercury	0.1		
Selenium	0.81		
Silver	2		

Notes:
NA = Not Applicable/ Not Established
NCDENR = North Carolina Department of Environment and Natural Resources
USEPA = United States Environmental Protection Agency
(1) Soil screening values are in microgram per kilogram (ug/kg) for organic compounds and in milligram per kilogram (mg/kg) for inorganic constituents.
(2) Non-shaded values are USEPA Region IV screening values obtained from *Guidelines for Performing Screening Level Ecological Risk Assessments within the North Carolina Division of Waste Management* (NCDENR 2003)
Shading indicates a screening value not included in Step 2 evaluation.

TABLE 7-5
MEDIA-SPECIFIC SCREENING VALUES FOR STEP 3A
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJUENE, NORTH CAROLINA

Analyte	Step 3A Surface Water Screening Values - Brackish Water [1]		
	(ug/L)	Reference [2]	Comment
Volatile Organics:			
1,1,1-Trichloroethane	312		
1,1,2,2-Tetrachloroethane	90.2		
1,1,2-Trichloro-1,2,2-trifluoroethane	NA		
1,1,2-Trichloroethane	940		
1,1-Dichloroethane	47	USEPA, 2003	
1,1-Dichloroethene	303		
1,2-Dibromoethane	NA		
1,2-Dibromo-3-chloropropane (DBCP)	NA		
1,2-Dichloroethane	1130		
1,2-Dichloroethene (cis)	22400	USEPA Region III, 1995	acute endpoint, safety factor of 10 applied
1,2-Dichloroethene (trans)	1350		
1,2-Dichloropropane	525		
2-Butanone	2200	USEPA, 2003	
2-Hexanone	99	USEPA, 2003	
4-Methyl-2-Pentanone	170	USEPA, 2003	
Acetone	1700	USEPA, 2003	
Benzene	53		
Bromodichloromethane	4320	USEPA, 2003	
Bromoform	293		
Bromomethane	110		
Carbon Disulfide	2	USEPA Region III, 1995	
Carbon Tetrachloride	352		
Chlorobenzene	105		
Chloroethane	NA		
Chloroform	289		
Chloromethane	2700		
cis-1,3-Dichloropropene	7.9		Cis and Trans isomers
Cyclohexane	NA		
Dibromochloromethane	9.7	USEPA, 2003	
Dichlorodifluoromethane	6400	USEPA Region III, 1995	
Ethylbenzene	4.3		
Methyl tert-butyl ether	11070	USEPA Region III, 2004	
Isopropylbenzene (Cumene)	2.6	USEPA Region III, 2004	
Methyl Acetate	NA		
Methyl Cyclohexane	NA		
Methylene Chloride	1930		
Styrene	32000	USEPA, 2003	
Tetrachloroethene	45		
Toluene	37		
trans-1,3-Dichloropropene	7.9		Cis and Trans isomers
Trichloroethene (TCE)	47	USEPA, 2003	
Trichlorofluoromethane	6400	USEPA Region III, 1995	
Vinyl Chloride	930	USEPA, 2003	
Xylene (Total)	27	USEPA, 2003	
Semivolatile Organics:			
1,2,4-Trichlorobenzene	4.5		
1,2-Dichlorobenzene	15.8		
1,3-Dichlorobenzene	28.5		
1,4-Dichlorobenzene	11.2		
2,2'-Oxybis (1-Chloropropane)	NA		
2,4,5-Trichlorophenol	11	USEPA Region III, 1995	proposed value
2,4,6-Trichlorophenol	3.2		
2,4-Dichlorophenol	36.5		
2,4-Dimethylphenol	21.2		
2,4-Dinitrophenol	6.2		
2,4-Dinitrotoluene	310		
2,6-Dinitrotoluene	81	USEPA, 2003	

TABLE 7-5
MEDIA-SPECIFIC SCREENING VALUES FOR STEP 3A
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJUENE, NORTH CAROLINA

Analyte	Step 3A Surface Water Screening Values - Brackish Water [1]		
	(ug/L)	Reference [2]	Comment
Semivolatile Organics (Cont.):			
2-Chloronaphthalene	0.396	USEPA, 2003	
2-Chlorophenol	43.8		
2-Methylnaphthalene	30	USEPA Region III, 1995	acute endpoint, safety factor of 10 applied
2-Methylphenol	67	USEPA, 2003	
2-Nitroaniline	NA		
2-Nitrophenol	3500		
3,3'-Dichlorobenzidine	4.5	USEPA, 2003	
3-Nitroaniline	NA		
4,6-Dinitro-2-Methylphenol	2.3		
4-Bromophenyl-Phenylether	12.2		
4-Chloro-3-Methylphenol	0.3		
4-Chloroaniline	129	Buchman 1999	Update of reference cited in USEPA Region III, 1995
4-Chlorophenyl-Phenylether	NA		
4-Methylphenol	25	USEPA, 2003	
4-Nitroaniline	NA		
4-Nitrophenol	71.7		
Acenaphthene	9.7		
Acenaphthylene	30	USEPA Region III, 1995	acute endpoint, safety factor of 10 applied
Anthracene	0.035	USEPA, 2003	
Benzo(a)anthracene	0.025	USEPA, 2003	
Benzo(a)pyrene	0.014	USEPA, 2003	
Benzo(b)fluoranthene	9.07	USEPA, 2003	
Benzo(g,h,i)perylene	7.64	USEPA, 2003	
Benzo(k)fluoranthene	30	USEPA Region III, 1995	acute endpoint, safety factor of 10 applied
bis(2-Chloroethyl)ether	2380		
bis(2-Chloroethoxy)methane	6400	USEPA Region III, 1995	
bis(2-Ethylhexyl)phthalate	0.30		
Butylbenzylphthalate	22		
Carbazole	NA		
Chrysene	30	USEPA Region III, 1995	acute endpoint, safety factor of 10 applied
Dibenzo(a,h)anthracene	4	USEPA, 2003	
Dibenzofuran	3.7	USEPA Region III, 2004	
Diethylphthalate	75.9		
Dimethylphthalate	330		
Di-n-butylphthalate	3.4		
Di-n-octylphthalate	0.3		value for bis(2-ethylhexyl)phthalate
Fluoranthene	1.6		
Fluorene	19	USEPA, 2003	
Hexachlorobenzene	0.0003	USEPA, 2003	
Hexachlorobutadiene	0.32		
Hexachlorocyclopentadiene	0.07		
Hexachloroethane	9.4		
Indeno(1,2,3-cd)pyrene	4.31	USEPA, 2003	
Isophorone	129		
Naphthalene	23.5		
Nitrobenzene	66.8		
n-Nitroso-di-n-propylamine	NA		
n-Nitrosodiphenylamine	58.5		
Pentachlorophenol	12.79		pH = 7.8 S.U.
Phenanthrene	3.6	USEPA, 2003	
Phenol	58		
Pyrene	0.3	USEPA, 2003	
PAHs (total)	17		Value for acenaphthene
Phthalates (total)	NA		

TABLE 7-5
MEDIA-SPECIFIC SCREENING VALUES FOR STEP 3A
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJUENE, NORTH CAROLINA

Analyte	Step 3A Surface Water Screening Values - Brackish Water [1]		
	(ug/L)	Reference [2]	Comment
Total Inorganics:			
Arsenic	36		Trivalent (+3) form
Barium	220	USEPA, 2003	
Cadmium	0.16	NCDENR 2003, USEPA 2002	Hardness = 50 mg CaCO3/L (default)(2)
Chromium (Total)	9.3		value is for hexavalent (+6) form
Lead	1.3165		Hardness = 50 mg CaCO3/L (default)
Mercury	0.012		
Selenium	5		
Silver	0.012		

Notes:
NA = Not Applicable/ Not Established
NCDENR = North Carolina Department of Environment and Natural Resources
USEPA = United States Environmental Protection Agency
[1] Brackish screening value is the minimum of freshwater and salt water screening values.
[2] Non-shaded values are USEPA Region IV screening values obtained from *Guidelines for Performing Screening Level Ecological Risk Assessments within the North Carolina Division of Waste Management* (NCDENR 2003)
Shading indicates a screening value not included in Step 2 evaluation.

TABLE 7-6
REFINED ASSESSMENT OF ECOLOGICAL CONTAMINANTS OF POTENTIAL CONCERN IN SURFACE SOIL
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJEUNE, NORTH CAROLINA

Ecological Contaminant of Potential Concern based on Steps 1 and 2	Contaminant Category [1]	Refined Risk Screening				Background Comparison			Frequency of Detection		Important Bioaccumulative Chemical? [5]	Further Evaluation Recommended based on Step 3A?	Comments
		Arithmetic Mean (Half Non-Detects)	Refined Surface Soil Screening Value (SSSV)[2]	Mean HQ [3]	Mean HQ ≤1.0?	Maximum Site Concentration	2 X Mean Background [4] Concentration	Maximum Site Concentration Less than 2X Background?	Frequency of Detection	Contaminant Detected?			
VOLATILES (ug/kg)													
1,2,4-Trichlorobenzene	4	2.75	50	0.06	Yes	ND	NA	NA	0/6	No	Yes	No	Mean HQ < 1.0
1,2-Dibromoethane (EDB)	4	2.75	1230	<0.01	Yes	ND	NA	NA	0/6	No	No	No	Mean HQ < 1.0
1,2-Dichlorobenzene (o-)	4	2.02	50	0.04	Yes	ND	NA	NA	0/9	No	Yes	No	Mean HQ < 1.0
1,3-Dichlorobenzene (m-)	4	2.02	50	0.04	Yes	ND	NA	NA	0/9	No	Yes	No	Mean HQ < 1.0
1,4-Dichlorobenzene (p-)	4	2.02	50	0.04	Yes	ND	NA	NA	0/9	No	Yes	No	Mean HQ < 1.0
2-Butanone (MEK)	3	7.33	89600	<0.01	Yes	11 J	NA	NA	2/6	Yes	No	No	Lab. Contaminant
2-Hexanone (MBK)	4	7.00	12600	<0.01	Yes	ND	NA	NA	0/6	No	No	No	Mean HQ < 1.0
4-Methyl-2-pentanone (MIBK)	3	6.17	443000	<0.01	Yes	2 J	NA	NA	1/6	Yes	No	No	See text
Acetone	3	14.08	2500	<0.01	Yes	34 J	NA	NA	6/6	Yes	No	No	Lab. Contaminant
Bromoform	3	9.54	15900	<0.01	Yes	19	NA	NA	4/6	Yes	No	No	See text
Bromomethane	4	2.75	NA	NA	NA	ND	NA	NA	0/6	No	No	No	Not Detected
Carbon Disulfide	3	2.67	94.1	0.02	Yes	2 J	NA	NA	1/6	Yes	No	No	See text
Chloroform	1	2.42	1	2.00	No	2 J	NA	NA	2/6	Yes	No	No	See text
Methyl Acetate	4	2.75	NA	NA	NA	ND	NA	NA	0/6	No	No	No	Not Detected
Methyl Tert-Butyl Ether (MTBE)	4	2.75	NA	NA	NA	ND	NA	NA	0/6	No	No	No	Not Detected
Trichloroethene (TCE)	2	2.75	1	2.75	No	ND	NA	NA	0/6	No	No	No	Not Detected
SEMIVOLATILES (ug/kg)													
1,2,4-Trichlorobenzene	4	2.75	50	0.06	Yes	ND	NA	NA	0/6	No	Yes	No	Mean HQ < 1.0
1,2-Dichlorobenzene (o-)	4	2.02	50	0.04	Yes	ND	NA	NA	0/9	No	Yes	No	Mean HQ < 1.0
1,3-Dichlorobenzene (m-)	4	2.02	50	0.04	Yes	ND	NA	NA	0/9	No	Yes	No	Mean HQ < 1.0
1,4-Dichlorobenzene (p-)	4	2.02	50	0.04	Yes	ND	NA	NA	0/9	No	Yes	No	Mean HQ < 1.0
2,2'-Oxybis[1-chloropropane]	2	186.67	100	1.87	No	ND	NA	NA	0/3	No	No	No	Not Detected
2,4-Dichlorophenol	2	186.67	3	62.22	No	ND	NA	NA	0/3	No	No	No	Not Detected
2,4-Dinitrotoluene	4	186.67	1280	0.15	Yes	ND	NA	NA	0/3	No	No	No	Mean HQ < 1.0
2,6-Dinitrotoluene	4	186.67	32.8	5.69	No	ND	NA	NA	0/3	No	No	No	Not Detected
2-Chlorophenol	4	186.67	2.5	74.67	No	ND	NA	NA	0/3	No	No	No	Not Detected
2-Methylnaphthalene	4	186.67	3240	0.06	Yes	ND	NA	NA	0/3	No	No	No	Mean HQ < 1.0
2-Nitroaniline	4	916.67	74100	0.01	Yes	ND	NA	NA	0/3	No	No	No	Mean HQ < 1.0
3,3'-Dichlorobenzidine	2	916.67	100	9.17	No	ND	NA	NA	0/3	No	No	No	Not Detected
3-Nitroaniline	4	916.67	NA	NA	NA	ND	NA	NA	0/3	No	No	No	Not Detected
4,6-Dinitro-2-methylphenol	4	916.67	NA	NA	NA	ND	NA	NA	0/3	No	No	No	Not Detected
4-Bromophenyl-phenylether	4	186.67	NA	NA	NA	ND	NA	NA	0/3	No	Yes	No	Not Detected
4-Chloro-3-methylphenol	4	186.67	2.5	74.67	No	ND	NA	NA	0/3	No	No	No	Not Detected
4-Chloroaniline	4	186.67	1100	0.17	Yes	ND	NA	NA	0/3	No	No	No	Mean HQ < 1.0
4-Chlorophenyl-phenylether	2	186.67	10	18.67	No	ND	NA	NA	0/3	No	Yes	No	Not Detected
4-Nitroaniline	4	916.67	NA	NA	NA	ND	NA	NA	0/3	No	No	No	Not Detected
Acenaphthene	4	186.67	1000	0.19	Yes	ND	NA	NA	0/3	No	Yes	No	Mean HQ < 1.0
Acenaphthylene	4	186.67	1000	0.19	Yes	ND	NA	NA	0/3	No	Yes	No	Mean HQ < 1.0
Anthracene	4	186.67	1000	0.19	Yes	ND	NA	NA	0/3	No	Yes	No	Mean HQ < 1.0

TABLE 7-6
REFINED ASSESSMENT OF ECOLOGICAL CONTAMINANTS OF POTENTIAL CONCERN IN SURFACE SOIL
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJEUNE, NORTH CAROLINA

Ecological Contaminant of Potential Concern based on Steps 1 and 2	Contaminant Category [1]	Refined Risk Screening				Background Comparison			Frequency of Detection		Important Bioaccumulative Chemical? [5]	Further Evaluation Recommended based on Step 3A?	Comments
		Arithmetic Mean (Half Non-Detects)	Refined Surface Soil Screening Value (SSSV)[2]	Mean HQ [3]	Mean HQ ≤1.0?	Maximum Site Concentration	2 X Mean Background [4] Concentration	Maximum Site Concentration Less than 2X Background?	Frequency of Detection	Contaminant Detected?			
SEMIVOLATILES (ug/kg)(Cont.)													
Benzo(a)anthracene	3	134.33	1000	0.03	Yes	33 J	NA	NA	1/3	Yes	Yes	No	Mean HQ < 1.0
Benzo(a)pyrene	3	139.33	1000	0.05	Yes	48 J	NA	NA	1/3	Yes	Yes	No	Mean HQ < 1.0
Benzo(b)fluoranthene	3	139.33	1000	0.05	Yes	48 J	NA	NA	1/3	Yes	Yes	No	Mean HQ < 1.0
Benzo(g,h,i)perylene	3	140.00	1000	0.05	Yes	50 J	NA	NA	1/3	Yes	Yes	No	Mean HQ < 1.0
Benzo(k)fluoranthene	3	143.33	1000	0.06	Yes	60 J	NA	NA	1/3	Yes	Yes	No	Mean HQ < 1.0
Bis(2-chloroethoxy)methane	2	186.67	100	1.87	No	ND	NA	NA	0/3	No	No	No	Not Detected
Bis(2-chloroethyl)ether	2	186.67	100	1.87	No	ND	NA	NA	0/3	No	No	No	Not Detected
Bis(2-ethylhexyl) Phthalate (DEHP)	3	196.67	100	1.97	No	230 J	NA	NA	3/3	Yes	No	No	Lab. Contaminant
Butyl Benzyl Phthalate	4	186.67	100	1.87	No	ND	NA	NA	0/3	No	No	No	Not Detected
Carbazole	4	186.67	NA	NA	NA	ND	NA	NA	0/3	No	No	No	Not Detected
Chrysene	3	139.67	1000	0.05	Yes	49 J	NA	NA	1/3	Yes	Yes	No	Mean HQ < 1.0
Dibenz(a,h)anthracene	4	186.67	1000	0.19	Yes	ND	NA	NA	0/3	No	Yes	No	Mean HQ < 1.0
Dibenzofuran	4	186.67	NA	NA	NA	ND	NA	NA	0/3	No	No	No	Not Detected
Di-n-octyl Phthalate	4	186.67	100	1.87	No	ND	NA	NA	0/3	No	No	No	Not Detected
Fluoranthene	3	145.00	1000	0.07	Yes	65 J	NA	NA	1/3	Yes	Yes	No	Mean HQ < 1.0
Fluorene	4	186.67	1000	0.19	Yes	ND	NA	NA	0/3	No	Yes	No	Mean HQ < 1.0
Hexachlorobenzene	2	186.67	2.5	74.67	No	ND	NA	NA	0/3	No	Yes	No	Not Detected
Hexachlorobutadiene	2	186.67	100	1.87	No	ND	NA	NA	0/3	No	Yes	No	Not Detected
Hexachloroethane	2	186.67	100	1.87	No	ND	NA	NA	0/3	No	Yes	No	Not Detected
Indeno(1,2,3-cd)pyrene	3	137.00	1000	0.04	Yes	41 J	NA	NA	1/3	Yes	Yes	No	Mean HQ < 1.0
Isophorone	4	186.67	139000	<0.01	Yes	ND	NA	NA	0/3	No	No	No	Mean HQ < 1.0
Naphthalene	4	186.67	1000	0.19	Yes	ND	NA	NA	0/3	No	No	No	Mean HQ < 1.0
n-Nitrosodi-n-propylamine	4	186.67	544	0.34	Yes	ND	NA	NA	0/3	No	No	No	Mean HQ < 1.0
Pentachlorophenol	2	916.67	2	458.33	No	ND	NA	NA	0/3	No	Yes	No	Not Detected
Phenanthrene	4	186.67	1000	0.19	Yes	ND	NA	NA	0/3	No	Yes	No	Mean HQ < 1.0
Phenol	2	186.67	50	3.73	No	ND	NA	NA	0/3	No	No	No	Not Detected
Pyrene	3	144.00	1000	0.06	Yes	62 J	NA	NA	1/3	Yes	Yes	No	Mean HQ < 1.0
METALS (mg/kg)													
Cadmium	1	0.73	1.6	0.45	Yes	5	0.05	No	6/9	Yes	Yes	No	Mean HQ < 1.0
Chromium	1	8.36	0.4	20.89	No	29	11.36	No	9/9	Yes	Yes	No	See text
Lead	1	153.89	50	3.08	No	1110	26.73	No	9/9	Yes	Yes	No	See text
Selenium	1	0.37	0.81	0.46	Yes	1	0.65	No	2/9	Yes	Yes	No	Mean HQ < 1.0

Notes:

COPC = Ecological Contaminant of Potential Concern
HQ = Hazard Quotient
mg/kg = miligram per kilogram
ug/kg = microgram per kilogram

N = sample size
NA = Not Applicable
ND = Not Detected
NE = Not Established

TABLE 7-6
REFINED ASSESSMENT OF ECOLOGICAL CONTAMINANTS OF POTENTIAL CONCERN IN SURFACE SOIL
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJEUNE, NORTH CAROLINA

Ecological Contaminant of Potential Concern based on Steps 1 and 2	Contaminant Category [1]	Refined Risk Screening				Background Comparison			Frequency of Detection		Important Bioaccumulative Chemical? [5]	Further Evaluation Recommended based on Step 3A?	Comments
		Arithmetic Mean (Half Non-Detects)	Refined Surface Soil Screening Value (SSSV)[2]	Mean HQ [3]	Mean HQ ≤1.0?	Maximum Site Concentration	2 X Mean Background [4] Concentration	Maximum Site Concentration Less than 2X Background?	Frequency of Detection	Contaminant Detected?			

Notes (Continued):

[1] See Table 7-3 and text for definitions of contaminant categories.

[2] References for alternative screening values are provided on Table 7-5.

[3] The mean HQ represents the mean (half non-detect) concentration divided by the screening value. In cases where the mean exceeds the maximum the maximum value is used.

[4] The background concentration presented is for AOC 5 surface soils (Final Area of Concern Background Study [Baker 2001]).

[5] Compound is identified as an "important bioaccumulative chemical" in the USEPA document *Bioaccumulation Testing and Interpretation for the Purpose of Sediment Quality Assessment, Status and Needs* (EPA-823-R-00-001, February 2000).

TABLE 7-7
REFINED ASSESSMENT OF ECOLOGICAL CONTAMINANTS OF POTENTIAL CONCERN IN GROUNDWATER
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJEUNE, NORTH CAROLINA

Ecological Contaminant of Potential Concern based on Steps 1 and 2	Contaminant Category [1]	Refined Risk Screening					Background Comparison			Frequency of Detection		Important Bioaccumulative Chemical? [5]	Further Evaluation Recommended based on Step 3A?	Comments
		Arithmetic Mean (Half Non-Detects)	Refined Surface Water Screening Value (SWSV)[2]	North Carolina Brackish Surface Water Quality Standard	Refined SWSV Mean HQ [3]	NCWQS Mean HQ [3]	Maximum Site Concentration	2 X Mean Background [4] Concentration	Maximum Site Concentration < 2 X Mean Background?	Frequency of Detection	Contaminant Detected?			
VOLATILES (ug/L)														
1,1,2-Trichloro-1,2,2-trifluoroethane	4	2.5	NA	NA	NA	NA	ND	NA	NA	0/3	No	No	No	Not Detected
1,1-Dichloroethane	4	2.5	47	NA	0.05	NA	ND	NA	NA	0/3	No	No	No	Mean HQ < 1.0
1,2,4-Trichlorobenzene	2	2.5	4.5	NA	0.56	NA	ND	NA	NA	0/3	No	Yes	No	Mean HQ < 1.0
1,2-Dibromo-3-chloropropane (DBCP)	4	2.5	NA	NA	NA	NA	ND	NA	NA	0/3	No	No	No	Not Detected
1,2-Dibromoethane (EDB)	4	2.5	NA	NA	NA	NA	ND	NA	NA	0/3	No	No	No	Not Detected
1,2-Dichloroethene (cis)	4	2.5	22400	NA	<0.01	NA	ND	NA	NA	0/3	No	No	No	Mean HQ < 1.0
2-Butanone (MEK)	4	6.5	2200	NA	<0.01	NA	ND	NA	NA	0/3	No	No	No	Mean HQ < 1.0
2-Hexanone (MBK)	4	6.5	99	NA	0.07	NA	ND	NA	NA	0/3	No	No	No	Mean HQ < 1.0
4-Methyl-2-pentanone (MIBK)	4	6.5	170	NA	0.04	NA	ND	NA	NA	0/3	No	No	No	Mean HQ < 1.0
Acetone	4	4.5	1700	NA	<0.01	NA	ND	NA	NA	0/3	No	No	No	Mean HQ < 1.0
Bromodichloromethane	4	2.5	4320	NA	<0.01	NA	ND	NA	NA	0/3	No	No	No	Mean HQ < 1.0
Carbon Disulfide	4	2.5	2	NA	1.25	NA	ND	NA	NA	0/3	No	No	No	Not Detected
Carbon Tetrachloride	5	2.5	352	0.4	<0.01	6.25	ND	NA	NA	0/3	No	No	No	Mean HQ < 1.0
Chloroethane	4	2.5	NA	NA	NA	NA	ND	NA	NA	0/3	No	No	No	Not Detected
Cyclohexane	3	2.6667	NA	NA	NA	NA	3.00 J	NA	NA	1/3	Yes	No	No	See text
Dibromochloromethane	4	2.5	9.7	NA	0.26	NA	ND	NA	NA	0/3	No	No	No	Mean HQ < 1.0
Dichlorodifluoromethane	4	2.5	6400	NA	<0.01	NA	ND	NA	NA	0/3	No	No	No	Mean HQ < 1.0
Isopropylbenzene (Cumene)	3	2.6667	2.6	NA	1.03	NA	3.00 J	NA	NA	1/3	Yes	No	No	See text
Methyl Acetate	4	2.5	NA	NA	NA	NA	ND	NA	NA	0/3	No	No	No	Not Detected
Methyl Cyclohexane	3	2.6667	NA	NA	NA	NA	3.00 J	NA	NA	1/3	Yes	No	No	See text
Methyl Tert-Butyl Ether (MTBE)	4	2.5	11070	NA	<0.01	NA	ND	NA	NA	0/3	No	No	No	Mean HQ < 1.0
Styrene	4	2.5	32000	NA	<0.01	NA	ND	NA	NA	0/3	No	No	No	Mean HQ < 1.0
Toluene	5	2.5	37	0.36	0.07	6.94	ND	NA	NA	0/3	No	No	No	Mean HQ < 1.0
Trichloroethene (TCE)	4	2.5	47	NA	0.05	NA	ND	NA	NA	0/3	No	No	No	Mean HQ < 1.0
Trichlorofluoromethane	4	2.5	6400	NA	<0.01	NA	ND	NA	NA	0/3	No	No	No	Mean HQ < 1.0
Vinyl Chloride	4	2.5	930	NA	<0.01	NA	ND	NA	NA	0/3	No	No	No	Mean HQ < 1.0
Xylenes, total	3	2.6667	27	NA	0.10	NA	3.00 J	NA	NA	1/3	Yes	No	No	Mean HQ < 1.0
METALS (ug/L)											Yes			
Barium	3	31.65	220	NA	0.14	NA	53.75	86.24	Yes	2/3	Yes	No	No	Mean HQ < 1.0
Cadmium	2	0.1667	0.161931454	0.4	1.03	0.42	ND	0.36	No	0/3	No	Yes	No	Not Detected
Chromium	1	4.1833	9.3	20	0.45	0.21	12.00	3.13	No	1/3	Yes	Yes	No	Mean HQ < 1.0
Lead	1	4.0167	1.32	25	3.05	0.16	10.60	2.80	No	1/3	Yes	Yes	No	See text
Mercury	2, 5	0.05	0.012	0.012	4.17	4.17	ND	0.10	No	0/3	No	Yes	No	Not Detected
Silver	2, 5	0.3833	0.012	0.06	31.94	6.39	ND	0.77	No	0/3	No	Yes	No	Not Detected

Notes:
HQ = Hazard Quotient
COPC = Ecological Contaminant of Potential Concern
ug/L = microgram per liter
NA = Not Applicable
NE = Note Established

TABLE 7-7
REFINED ASSESSMENT OF ECOLOGICAL CONTAMINANTS OF POTENTIAL CONCERN IN GROUNDWATER
SWMU 311
RCRA FACILITY INVESTIGATION (CTO-0143)
MCB CAMP LEJEUNE, NORTH CAROLINA

Ecological Contaminant of Potential Concern based on Steps 1 and 2	Contaminant Category [1]	Refined Risk Screening					Background Comparison			Frequency of Detection		Important Bioaccumulative Chemical? [5]	Further Evaluation Recommended based on Step 3A?	Comments
		Arithmetic Mean (Half Non-Detects)	Refined Surface Water Screening Value (SWSV)[2]	North Carolina Brackish Surface Water Quality Standard	Refined SWSV Mean HQ [3]	NCWQS Mean HQ [3]	Maximum Site Concentration	2 X Mean Background [4] Concentration	Maximum Site Concentration < 2 X Mean Background?	Frequency of Detection	Contaminant Detected?			

Notes (Cont.):

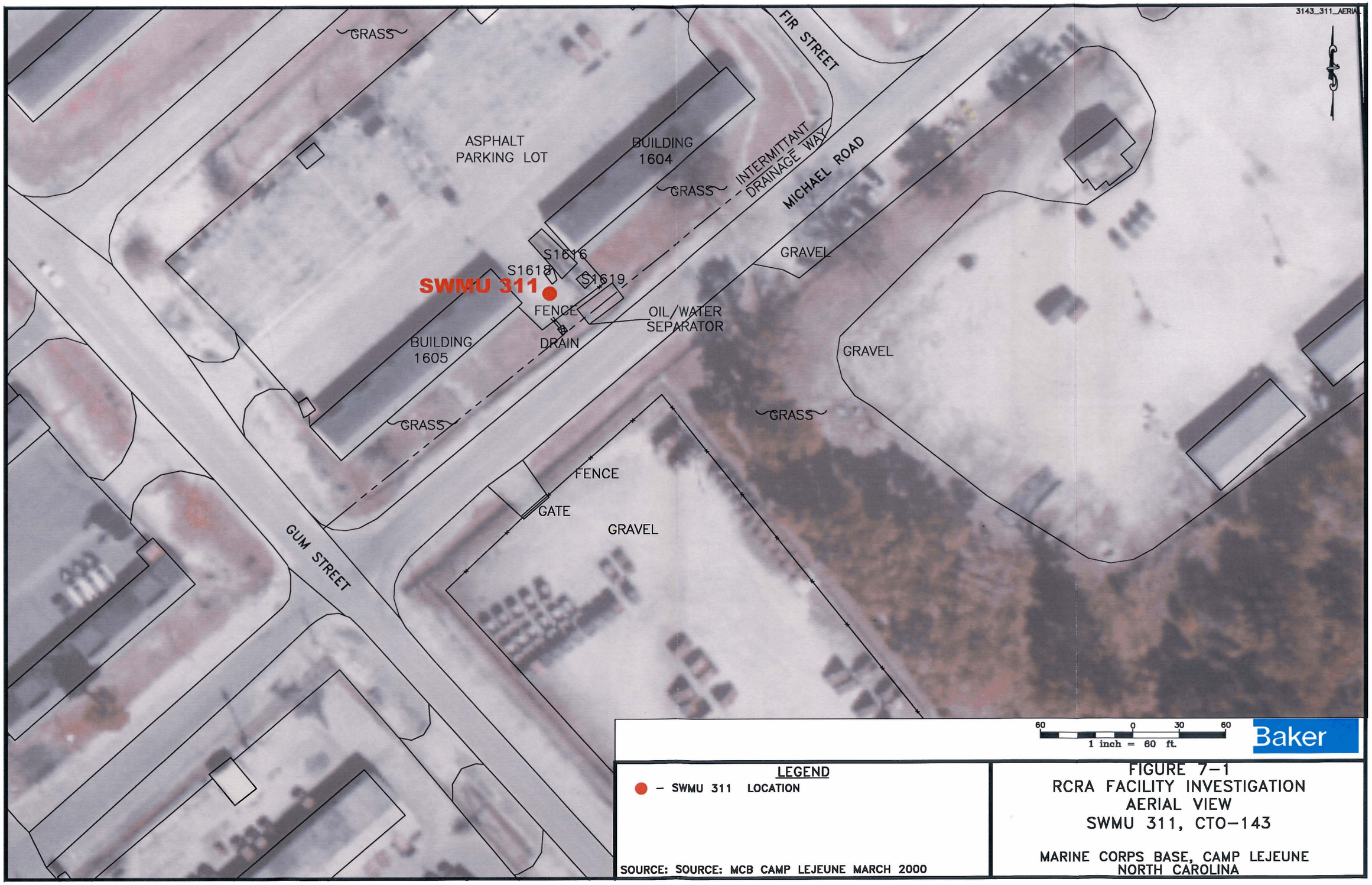
[1] See Table 7-3 and text for definitions of contaminant categories.

[2] References for alternative screening values are provided on Table 7-5.

[3] The mean HQ represents the mean (half non-detect) concentration divided by the screening value. In cases where the mean exceeds the maximum the maximum value is used.

[4] The background concentration presented is for shallow portions of the surficial aquifer (Base Background Groundwater Investigation [Baker 2002]).

[5] Compound is identified as an "important bioaccumulative chemical" in the USEPA documen*Bioaccumulation Testing and Interpretation for the Purpose of Sediment Quality Assessment, Status and Needs* (EPA-823-R-00-001, February 2000).



LEGEND

● – SWMU 311 LOCATION

SOURCE: SOURCE: MCB CAMP LEJEUNE MARCH 2000

FIGURE 7–1
RCRA FACILITY INVESTIGATION
AERIAL VIEW
SWMU 311, CTO–143

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

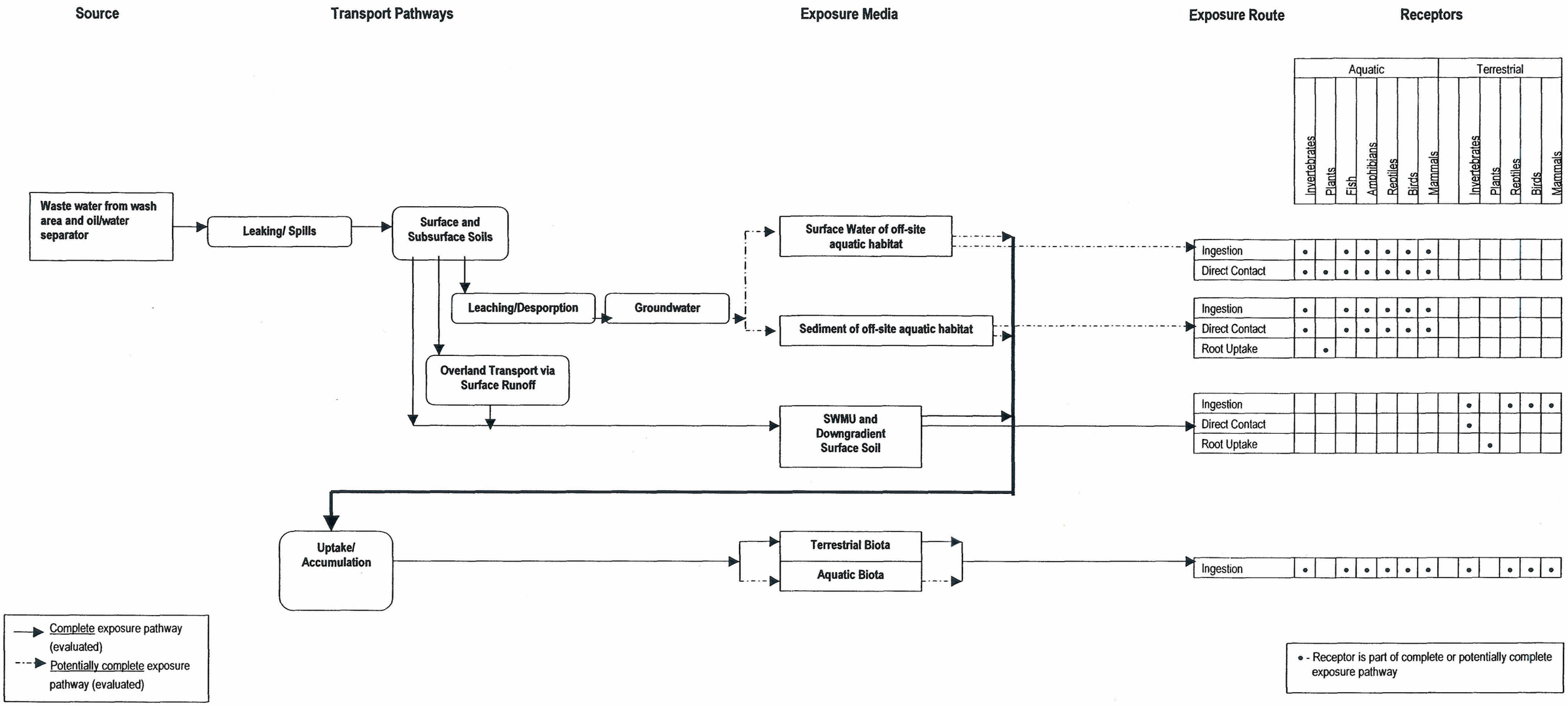
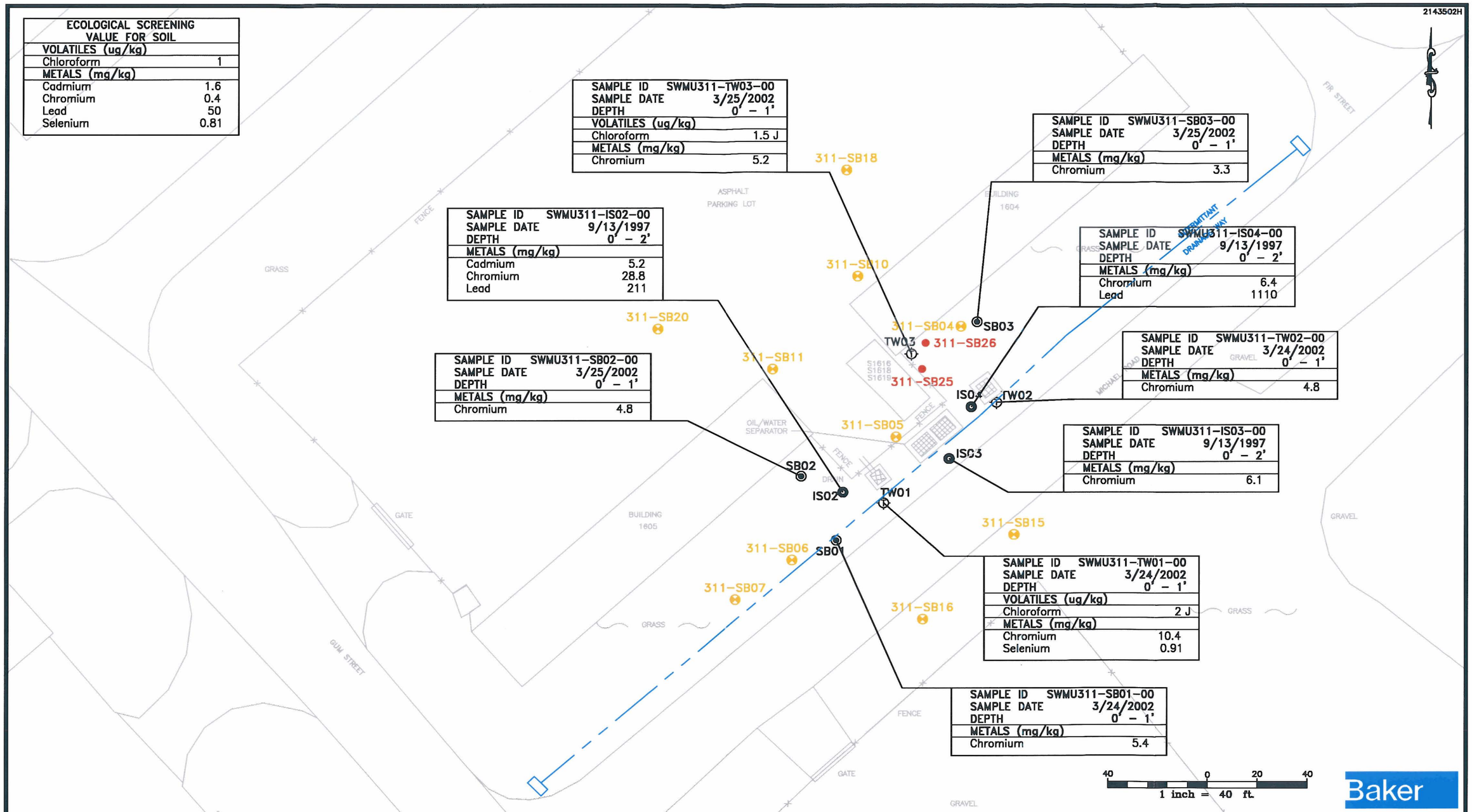


FIGURE 7-2. ECOLOGICAL CONCEPTUAL MODEL
SWMU 311, MCB CAMP LEJEUNE

2143502H

ECOLOGICAL SCREENING VALUE FOR SOIL	
VOLATILES (ug/kg)	
Chloroform	1
METALS (mg/kg)	
Cadmium	1.6
Chromium	0.4
Lead	50
Selenium	0.81



SAMPLE ID	SWMU311-TW03-00
SAMPLE DATE	3/25/2002
DEPTH	0' – 1'
VOLATILES (ug/kg)	
Chloroform	1.5 J
METALS (mg/kg)	
Chromium	5.2

SAMPLE ID	SWMU311-SB03-00
SAMPLE DATE	3/25/2002
DEPTH	0' – 1'
METALS (mg/kg)	
Chromium	3.3

SAMPLE ID	SWMU311-IS02-00
SAMPLE DATE	9/13/1997
DEPTH	0' – 2'
METALS (mg/kg)	
Cadmium	5.2
Chromium	28.8
Lead	211

SAMPLE ID	SWMU311-IS04-00
SAMPLE DATE	9/13/1997
DEPTH	0' – 2'
METALS (mg/kg)	
Chromium	6.4
Lead	1110

SAMPLE ID	SWMU311-SB02-00
SAMPLE DATE	3/25/2002
DEPTH	0' – 1'
METALS (mg/kg)	
Chromium	4.8

SAMPLE ID	SWMU311-TW02-00
SAMPLE DATE	3/24/2002
DEPTH	0' – 1'
METALS (mg/kg)	
Chromium	4.8

SAMPLE ID	SWMU311-IS03-00
SAMPLE DATE	9/13/1997
DEPTH	0' – 2'
METALS (mg/kg)	
Chromium	6.1

SAMPLE ID	SWMU311-TW01-00
SAMPLE DATE	3/24/2002
DEPTH	0' – 1'
VOLATILES (ug/kg)	
Chloroform	2 J
METALS (mg/kg)	
Chromium	10.4
Selenium	0.91

SAMPLE ID	SWMU311-SB01-00
SAMPLE DATE	3/24/2002
DEPTH	0' – 1'
METALS (mg/kg)	
Chromium	5.4

Baker

Notes:
J = Value is estimated.

Hits boxes list all detections of Category 1 Ecological Contaminants of Potential Concern that exceed Region IV Ecological Screening Values for Soil.
Surface soil samples collected in 1997 were sampled from 0-2 feet bgs. All other samples were collected from 0-1 feet bgs.

LEGEND

- PHASE II TEMPORARY WELL
- PHASE II SOIL BORING
- PHASE II SURFACE SOIL SAMPLE
- PHASE I SOIL BORING
- SOIL BORING LOCATION
- SOIL BORING AND GROUNDWATER GRAB LOCATION

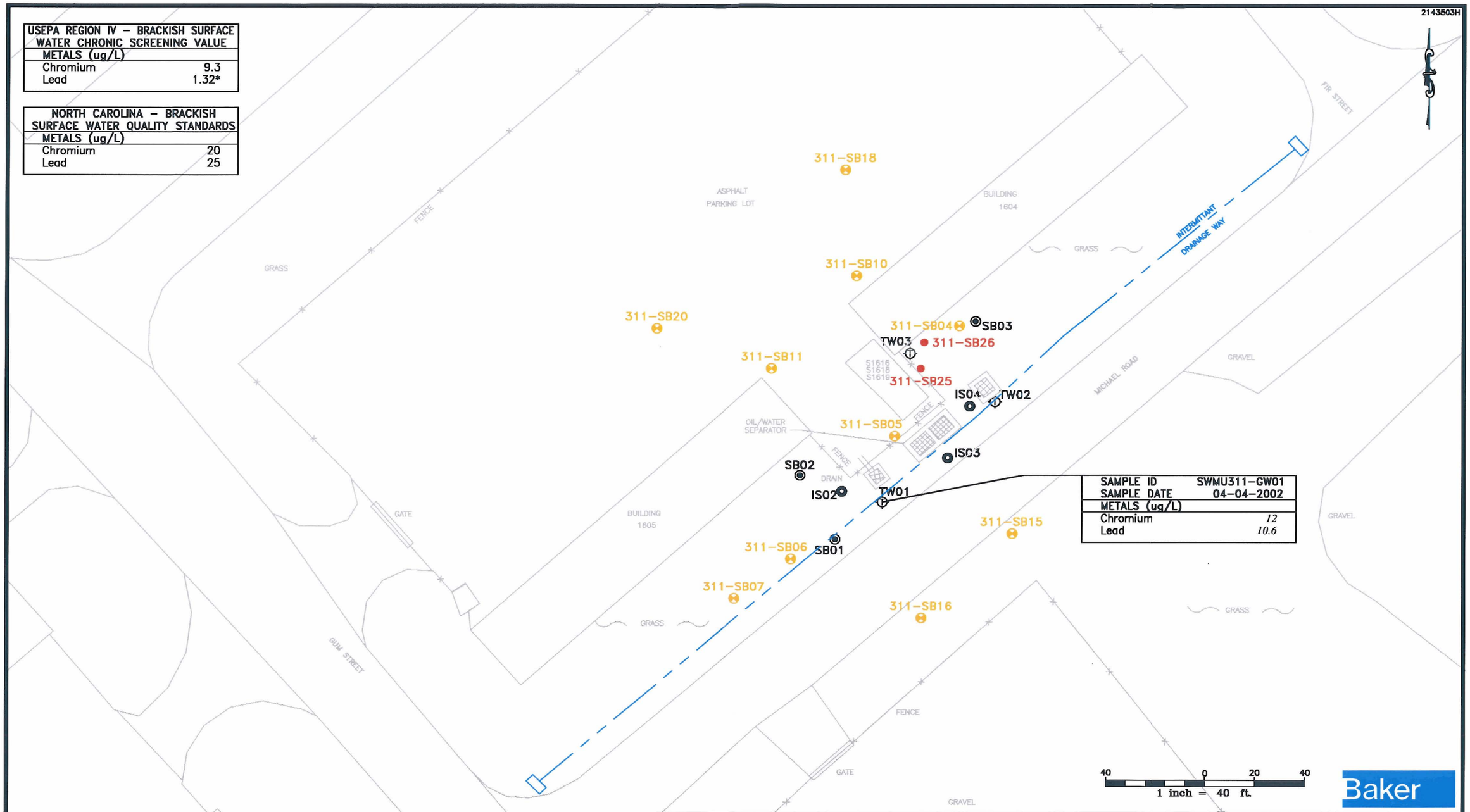
SOURCE: MCB CAMP LEJEUNE MARCH 2000

FIGURE 7-3
DETECTIONS OF CATEGORY 1 ECOLOGICAL COPCs IN SURFACE SOIL EXCEEDING SCREENING VALUES
SWMU 311, CTO – 0143
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

2143503H

USEPA REGION IV – BRACKISH SURFACE WATER CHRONIC SCREENING VALUE	
METALS (ug/L)	
Chromium	9.3
Lead	1.32*

NORTH CAROLINA – BRACKISH SURFACE WATER QUALITY STANDARDS	
METALS (ug/L)	
Chromium	20
Lead	25



SAMPLE ID	SWMU311-GW01
SAMPLE DATE	04-04-2002
METALS (ug/L)	
Chromium	*12*
Lead	*10.6*

* Assumes water hardness of 50 mg/L

Notes:
Italic font exceeds USEPA Region IV Screening Value.
Bold font exceeds NCWQS for freshwater.

LEGEND

- – PHASE II TEMPORARY WELL
- – PHASE II SOIL BORING
- – PHASE II SURFACE SOIL SAMPLE
- – PHASE I SOIL BORING
- – SOIL BORING LOCATION
- – SOIL BORING AND GROUNDWATER GRAB LOCATION

SOURCE: MCB CAMP LEJEUNE MARCH 2000

FIGURE 7-4
DETECTIONS OF CATEGORY 1 ECOLOGICAL COPCs IN GROUNDWATER EXCEEDING SCREENING VALUES
SWMU 311, CTO – 0143
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

8.0 CONCLUSIONS AND RECOMMENDATIONS

This section provides a discussion of conclusions based on the data collected from the CSIs (Phase I and II) and the RFI. Recommendations for future actions are presented after the conclusions.

8.1 Conclusions

Based on the nature and extent of contamination and human health and ecological risk assessments, the following conclusions can be made:

- The presence of lead in surface soil in the immediate vicinity of the oil/water separator exceeds the PRG and STGC criteria. Additionally, lead contributes to possible adverse health effects from exposure in surface soil for a future child resident. However, lead was not detected soil over a large area at concentrations exceeding the screening criteria. In fact, lead contamination was localized. Therefore, the likelihood of a child to be at risk from exposure to lead in the surface soil is fairly minimal.

Detections of cadmium and chromium above STGCs were limited in extent. Both metals were detected in one surface soil sample (SWMU311-IS02-00) in the vicinity of the oil/water separator. As with the lead detection, the detections of these constituents were localized. Additionally, cadmium and chromium did not pose an unacceptable human health or ecological risk.

- Arsenic and silver exceed STGC criteria in subsurface soil. Based on the distribution of the detections and the likely sources for these constituents, evidence suggests that they are not related to SWMU 311. Additionally, these constituents did not present a human health or ecological risk.

- The detections of PCE and TCE exceeded the STGC in only one subsurface soil sample, but did not provide a human health or ecological risk. The limited extent of this contamination was evident by the constituents not being detected in soil samples collected from soil borings SWMU311-SB25 and SWMU311-SB26. Additionally, PCE and TCE were not detected in groundwater.

- Chlorobenzene and benzene were detected above the STGC criterion in one soil sample each, but did not present a human health or ecological risk. Evidence of chlorobenzene and benzene at levels above screening criteria in a broader distribution pattern in soil and groundwater was not observed.

- Methylene chloride, chloroform, and bromoform detections were limited, with evidence suggesting that they are not related to SWMU 311. Additionally, these constituents did not present a human health or ecological risk.

8.2 Recommendations

Based on the preceding conclusions, the following recommendations are provided:

- Conduct an Interim Measures removal action of surface soil in the immediate vicinity of the oil/water separator to mitigate the human health risk associated with the presence of lead.

- PCE, TCE, benzene, chlorobenzene, cadmium, and chromium should not be considered in any future site management plans.

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APPENDIX A

Test Boring and Well Construction Records

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TEST BORING RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

PROJ. NO.: CTO-0143 BORING NO.: SB04

COORDINATES: EAST: 2500000.789 NORTH: 337448.74

ELEVATION: SURFACE: 27.40

Rig: Ingersoll Rand A200	Macro Core	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	2-in	--	--	--	6/19/03	0.0 - 16.0	Decr clouds,calm 80s	14.0
Length	4-ft	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: Sample ID is as follows: "SWMU311-SB04-__", with the suffix shown below

SAMPLE TYPE

S = Sample A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description		Elevation (Ft. MSL)
1		S-1	3.0 75%	--	00	3.1 / 0.0	SILT, little clay, trace fine gravel & sand; dark brown; damp		
2					01	0.7 / 0.0			
3						0.4 / 0.0			
4	4.0							3.8	23.60
5		S-2	2.5 63%	--		0.0 / 0.0	F SAND, little silt, trace clay; dark gray, becoming brown w/ depth; damp		
6						0.0 / 0.0			
7									
8	8.0				04				
9		S-3	2.8 70%	--		0.0 / 0.0			
10						0		10.0	17.40

Match to Sheet 2

DRILLING COMPANY Parratt-Wolff BAKER REP.: Mark DeJohn

DRILLER: Lewis LaFever BORING NO.: SB04 SHEET 1 OF 2

Baker
Baker Environmental

TEST BORING RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311
CTO NO.: CTO-0143 BORING NO.: SB04

SAMPLE TYPE
S = Sample A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston N = No Sample

DEFINITIONS
SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description		Elevation (Ft. MSL)
11						12	Continued from Sheet 1		
						49	CLAY, some silt, little fine sand; tan w/ rusty		
12	12.0				06	14	staining; moist		
						0			
13						0			
						0			
14		S-4	4.0	--		0	some silt, no sand; gray; wet at 14.0-ft		
			100%			0			
15						0			
					08	0			
16	16.0					0		16.0	11.40
							Termination Depth at 16.0-ft		
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									

DRILLING COMPANY: Parratt-Wolff
DRILLER: Lewis LaFever

BAKER REP.: Mark DeJohn
BORING NO.: SB04 SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

PROJ. NO.: CTO-0143 BORING NO.: SB05

COORDINATES: EAST: 2499974.753 NORTH: 337403.101

ELEVATION: SURFACE: 29.15

Rig: Ingersoll Rand A200								
	Macro Core	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	2-in	--	--	--	6/18/03	0.0 - 16.0	Cloudy, occ rain, 80	7.0
Length	4-ft	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: Sample ID is as follows: "SWMU311-SB05-__", with the suffix shown below

SAMPLE TYPE

S = Sample A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description		Elevation (Ft. MSL)
1						20.4 / 0.5			
2		S-1	3.0 75%	--		19.5 / 0.5	VF SAND, some silt; brown; damp		
3					02	24.5 / 2.6			
4	4.0						2-in of cinders & clay		
5							F SAND, some silt, trace to little clay; brown; moist		
6		S-2	3.2 80%	--		14.0 / 2.5	gray; moist; sl petro odor		
7					04	7.8 / 2.2			
8	8.0					18.4 / 0.5	wet at 7.0-ft	8.0	21.15
9						11.9 / 2.2	SILT, little clay, trace fine sand; brown, then gray; moist to wet	9.2	19.95
10		S-3	4.0 100%	--	--	22.2 / 0.5	F SAND, some silt, trace clay; brown and gray; wet Match to Sheet 2		

DRILLING COMPANY Parratt-Wolff BAKER REP.: Mark DeJohn

DRILLER: Lewis LaFever BORING NO.: SB05 SHEET 1 OF 2

Baker
Baker Environmental

TEST BORING RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311
CTO NO.: CTO-0143 BORING NO.: SB05

SAMPLE TYPE
S = Sample A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston N = No Sample

DEFINITIONS
SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Elevation (Ft. MSL)
11							Continued from Sheet 1	
12	12.0						F SAND, some silt, little clay; brown; wet	
13								
14		S-4	4.0 100%	--	08	--	gray	
15								
16	16.0						16.0	13.15
17							Termination Depth at 16.0-ft	
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								

DRILLING COMPANY: Parratt-Wolff BAKER REP.: Mark DeJohn
DRILLER: Lewis LaFever BORING NO.: SB05 SHEET 2 OF 2

Baker
Baker Environmental

TEST BORING RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311
PROJ. NO.: CTO-0143 BORING NO.: SB06
COORDINATES: EAST: 2499932.981 NORTH: 337352.171
ELEVATION: SURFACE: 30.20

Rig: Ingersoll Rand A200								
	Macro Core	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	2-in	--	--	--	6/19/03	0.0 - 16.0	Decr clouds,calm 80s	4.0
Length	4-ft	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: Sample ID is as follows: "SWMU311-SB06-__", with the suffix shown below

SAMPLE TYPE
S = Sample A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

DEFINITIONS
SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description		Elevation (Ft. MSL)
1					00	55 / 0.0	SILT, little clay; black; moist		
2		S-1	2.7 68%	--	01	0.6 / 70.0			
3						48 / 0.0			
4	4.0						some sand; dark gray; moist		
5							wet at 4.0-ft		
6		S-2	3.5 88%	--		0.0 / 0.0			
7									
8	8.0				04		large wood fragment little clay; light greeninsh-gray; moist	8.0	22.20
9									
10		S-3	1.0 25%	--		0.0 / 0.0 / 0	F SAND, some silt, little clay; gray; moist to wet		
							Match to Sheet 2		

DRILLING COMPANY Parratt-Wolff BAKER REP.: Mark DeJohn
DRILLER: Lewis LaFever BORING NO.: SB06 SHEET 1 OF 2

Baker

Baker Environmental

TEST BORING RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

CTO NO.: CTO-0143 BORING NO.: SB06

SAMPLE TYPE

S = Sample A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Elevation (Ft. MSL)
11						Continued from Sheet 1	
12 12.0				06		F SAND, some silt, little clay; gray; moist wet at 12.0-ft	
13							
14	S-4	0.7 18%	--		0 / 0		
15							
16 16.0						16.0	14.20
17						Termination Depth at 16.0-ft	
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							

DRILLING COMPANY: Parratt-Wolff BAKER REP.: Mark DeJohn

DRILLER: Lewis LaFever BORING NO.: SB06 SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

PROJ. NO.: CTO-0143 BORING NO.: SB07

COORDINATES: EAST: 2499910.156 NORTH: 337335.8

ELEVATION: SURFACE: 26.29

Rig: Ingersoll Rand A300	Macro Core	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	2-in	--	--	--	6/24/03	0.0 - 16.0		4.9
Length	4-ft	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: Sample ID is as follows: "SWMU311-SB07-__", with the suffix shown below

SAMPLE TYPE

S = Sample A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description		Elevation (Ft. MSL)
					00	0	F.SAND, trace silt, dark brown, loose, damp		
1						0		1.2	25.09
						0	SILT, little f.sand, dk brown, loose, mc	1.7	24.59
2		S-1	3.3	--	01	0	F.SAND, trace silt, orangish brown, loose, damp		
			83%			0			
3						0			
								3.3	22.99
4	4.0							4.0	22.29
						0.1		4.7	21.59
5						0	CLAY, little sand, orangish brown, firm	4.9	21.39
						0	plastic, moist		
6		S-2	3.9	--	03	0	F.SAND, trace silt, brownish gray,	6.1	20.19
			98%			0	loose, wet		
7						0	F.SAND, trace clay, olive drab, loose, wet		
						0			
8	8.0				04	0		7.9	18.39
						0	F.SAND, trace silt, olive drab, loose, wet		
9						0			
						0			
10		S-3	4.0	--		0			
			100%			0			

DRILLING COMPANY Parratt-Wolff BAKER REP.: David D. Schilling

DRILLER: Lewis LeFever BORING NO.: SB07 SHEET 1 OF 2

Baker

Baker Environmental

TEST BORING RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

CTO NO.: CTO-0143 BORING NO.: SB07

SAMPLE TYPE

S = Sample A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description		Elevation (Ft. MSL)
11						0			
						0			
12	12.0				06	0		12.0	14.29
						0	F.SAND, trace silt, olive drab, loose, wet		
13						0			
						0			
14		S-4	4.0 100%	--		0			
						0			
15						0			
						0		15.5	10.79
16	16.0				08	0	F.SAND, trace silt, gray, loose, moist	16.0	10.29
							Termination Depth at 16.0'		
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									

DRILLING COMPANY: Parratt-Wolff BAKER REP.: David D. Schilling

DRILLER: Lewis LeFever BORING NO.: SB07 SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

PROJ. NO.: CTO-0143 BORING NO.: SB10

COORDINATES: EAST: 2499959.290 NORTH: 337469.49

ELEVATION: SURFACE: 27.53

Rig: Ingersoll Rand A200	Macro Core	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	2-in	--	--	--	6/18/03	0.0 - 16.0	Cloudy, occ rain, 80	6.0
Length	4-ft	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: Sample ID is as follows: "SWMU311-SB10-__", with the suffix shown below

SAMPLE TYPE

S = Sample A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description		Elevation (Ft. MSL)
1									
2		S-1	Not Recorded	--		18.5 / 1.0	Lithology not recorded		
3						14.8 / 0.0			
4	4.0				02				
5							F SAND, some silt; tan; damp		
6		S-2	3.0 75%	--		52.0 / 10.0			
7						52.0 / 10.0	some silt, little clay; orangish-brown; wet at 6.0-ft		
8	8.0				04				
9		S-3	4.0 100%	--		40.0 / 1.0	some silt, trace clay; orangish-brown; wet		
10						50.0 / 10.0		10.0	17.53
						50	Match to Sheet 2		

DRILLING COMPANY Parratt-Wolff BAKER REP.: Mark DeJohn

DRILLER: Lewis LaFever BORING NO.: SB10 SHEET 1 OF 2

Baker

Baker Environmental

TEST BORING RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

CTO NO.: CTO-0143 BORING NO.: SB10

SAMPLE TYPE

S = Sample A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Elevation (Ft. MSL)
11					12	Continued from Sheet 1	
12 12.0				06	49 / 14	SILT, some clay, trace fine sand; brown; moist 11.8	15.73
13						F SAND, some silt, trace clay; gray & brown; wet	
14	S-4	4.0 100%	--	--	--		
15						little clay; gray w/ rusty staining; wet	
16 16.0						16.0	11.53
17						Termination Depth at 16.0-ft	
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							

DRILLING COMPANY: Parratt-Wolff

DRILLER: Lewis LaFever

BAKER REP.: Mark DeJohn

BORING NO.: SB10 SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

PROJ. NO.: CTO-0143 BORING NO.: SB11

COORDINATES: EAST: 2499925.115 NORTH: 337431.115

ELEVATION: SURFACE: 27.30

Rig: Ingersoll Rand A300								
	Macro Core	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	2-in	--	--	--	6/18/03	0.0 - 16.0	Cloudy, occ rain, 80	4.8
Length	4-ft	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: Sample ID is as follows: "SWMU311-SB11-__", with the suffix shown below

SAMPLE TYPE

S = Sample A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description		Elevation (Ft. MSL)
						0.0	ASPHALT	0.4	26.90
1						0.0	SAND & GRAVEL	0.9	26.40
						0.0	F. SAND, trace silt, dark gray, loose, damp		
2		S-1	3.0	--		0.0			
			75%			0.0			
3						0.0			
						0.0			
4	4.0				02	0.0			
						0.0			
5						0.0		4.8	22.50
						0.0	F. SAND, trace silt, brownish gray, loose, wet		
6		S-2	4.0	--	03	0.0			
			100%			0.0			
7						0.0		7.2	20.10
						0.0	F. SAND, trace silt, orangish brown, loose, wet		
8	8.0					0.0		8.0	19.30
						0.0	F. SAND, trace silt, brownish gray, loose,		
9						0.0	saturated		
						0.0			
10		S-3	4.0	--		0.0		9.9	17.40
			100%			0.0	F. SAND, trace silt, orangish brown, very loose		

DRILLING COMPANY Parratt-Wolff BAKER REP.: David D. Schilling

DRILLER: Phillip Nichols BORING NO.: SB11 SHEET 1 OF 2

Baker

Baker Environmental

TEST BORING RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

CTO NO.: CTO-0143 BORING NO.: SB11

SAMPLE TYPE

S = Sample A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description		Elevation (Ft. MSL)
11						0.0	saturated	10.9	16.40
						0.0	CLAY, some sand, light gray, firm, plastic, moist		
12	12.0				06	0.0			
						0.0			
13						0.0		12.8	14.50
						0.0	F. SAND, trace silt, light brown, very loose,		
14		S-4	4.0	--		0.0	saturated		
			100%			0.0			
15						0.0			
						0.0		15.6	11.70
16	16.0				08	0.0	F.SAND, little silt, dark brown, loose, moist	16.0	
							Termination Depth at 16.0-ft		
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									

DRILLING COMPANY: Parratt-Wolff BAKER REP.: David D. Schilling

DRILLER: Phillip Nichols BORING NO.: SB11 SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

PROJ. NO.: CTO-0143 BORING NO.: SB15

COORDINATES: EAST: 2500021.929 NORTH: 337362.667

ELEVATION: SURFACE: 26.69

Rig: Ingersoll Rand A300								
	Macro Core	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	2-in	--	--	--	6/19/03	0.0 - 20.0		14.9
Length	4-ft	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: Sample ID is as follows: "SWMU311-SB15-__", with the suffix shown below

SAMPLE TYPE

S = Sample A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description		Elevation (Ft. MSL)
					00	0.0	F.SAND, trace silt, brown, loose, damp		
1						0.0			
						0.0			
2		S-1	2.3 58%	--	01	0.0			
								2.3	24.39
3									
4	4.0							4.0	22.69
					02	0.4	F.SAND, trace silt, brown, orange staining,		
5						0.0	loose, moist	5.0	21.69
						0.0	F.SAND, trace clay, dark brown and orange		
6		S-2	2.8 70%	--		0.0	mottled, loose, wet		
						0.0			
7						0.0		6.8	19.89
8	8.0							8.0	18.69
						0.0	F.SAND, trace silt, brown, very loose, wet		
9						0.0		9.1	17.59
							SHELL FRAGMENTS	9.3	17.39
10		S-3	1.3 33%	--	05				

DRILLING COMPANY Parratt-Wolff BAKER REP.: David D. Schilling

DRILLER: Phillip Nichols BORING NO.: SB15 SHEET 1 OF 2

Baker

Baker Environmental

TEST BORING RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

CTO NO.: CTO-0143 BORING NO.: SB15

SAMPLE TYPE

S = Sample A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Elevation (Ft. MSL)
11							
12 12.0						12.0	14.69
13					0.0	CLAY, trace sand, gray, light orange staining, firm, plastic, moist	
					0.0		
14	S-4	4.0 100%	--		0.0		
					0.0		
15					0.0		
					0.0	14.9	11.79
16 16.0				08	0.0	F.SAND, little silt, brownish gray, loose, wet	
17					0.0	F.SAND, trace silt, light gray, loose, wet	
					0.0		
18	S-5	2.4 60%	--		0.0	F.SAND, trace silt, orange, loose, wet	17.5 9.19
19							18.4 8.29
20 20.0				10			20.0 6.69
21						Termination Depth at 20.0-ft	
22							
23							
24							
25							
26							
27							
28							
29							

DRILLING COMPANY: Parratt-Wolff

DRILLER: Phillip Nichols

BAKER REP.: David D. Schilling

BORING NO.: SB15 SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

PROJ. NO.: CTO-0143 BORING NO.: SB16

COORDINATES: EAST: 2499985.570 NORTH: 337327.72

ELEVATION: SURFACE: 26.7

Rig: Ingersoll Rand A300	Macro Core	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	2-in	--	--	--	6/19/03	0.0 - 28.0		5.1
Length	4-ft	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: Sample ID is as follows: "SWMU311-SB16-__", with the suffix shown below

SAMPLE TYPE

S = Sample A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description		Elevation (Ft. MSL)
1					00	0.0	F.SAND, trace silt, light brown, loose, damp		
						0.0		1.2	25.50
2		S-1	2.6	--	01	0.0	CLAY, trace sand, brownish gray, firm, plastic, moist		
			65%			0.0		2.6	24.10
3						0.0			
4	4.0								
5						0.0	F.SAND, trace clay, brown, loose, moist		
						0.0		5.1	21.60
6		S-2	2.7	--	03	0.0	F.SAND, some silt, brown, orange staining, loose, wet		
			68%			0.0		6.7	20.00
7						0.0			
8	8.0								
9						0.0	F.SAND, trace silt, brown, orange staining, loose, wet		
10		S-3	4.0	--	05	0.0		9.7	17.00
			100%			0.0	F.SAND, trace silt, brown, loose, wet		

DRILLING COMPANY Parratt-Wolff BAKER REP.: David D. Schilling

DRILLER: Phillip Nichols BORING NO.: SB16 SHEET 1 OF 2

Baker

Baker Environmental

TEST BORING RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

CTO NO.: CTO-0143 BORING NO.: SB16

SAMPLE TYPE

S = Sample A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description		Elevation (Ft. MSL)
11						0.0		10.7	16.00
						0.0	CLAY & SILT, gray, plastic, wet	11.2	15.50
12	12.0					0.0	F.SAND, little silt, gray, loose, wet	12.0	14.70
						0.0	F.SAND, trace silt, gray, moist		
13						0.0			
						0.0		13.3	13.40
14		S-4	4.0	--	07	0.0	CLAY, trace silt, blueish gray, firm, plastic, moist		
			100%			0.0			
15						0.0			
						0.0			
16	16.0					0.0		16.0	10.70
					08	0.0	F.SAND, trace silt, light orangish brown, loose, moist	16.4	10.30
17						0.0			
						0.0	F.SAND, trace silt, light orangish brown, loose, wet		
18		S-5	3.0	--		0.0			
			75%			0.0			
19						0.0			
20	20.0							20.0	6.70
						0.0			
21						0.0			
						0.0		21.7	5.00
22		S-6	3.5	--	--	0.0	F.SAND, trace silt, orangish brown, loose, wet		
			88%			0.0			
23						0.0			
						0.0			
24	24.0					0.0			
						0.0			
25						0.0			
						0.0		25.7	1.00
26		S-7	3.0	--	--	0.0	F. SAND, trace silt, brownish gray, trace orange staining, loose, wet		
			75%			0.0			
27						0.0			
28	28.0							28.0	-1.30
29							Termination Depth at 28.0-ft		

DRILLING COMPANY: Parratt-Wolff BAKER REP.: David D. Schilling

DRILLER: Phillip Nichols BORING NO.: SB16 SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

PROJ. NO.: CTO-0143 BORING NO.: SB18

COORDINATES: EAST: 2499954.750 NORTH: 337513.24

ELEVATION: SURFACE: 27.03

Rig: Ingersoll Rand A300								
	Macro Core	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	2-in	--	--	--	6/23/03	0.0 - 16.0	Sunny, sl brzy, 70s	--
Length	4-ft	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: Sample ID is as follows: "SWMU311-SB18-__", with the suffix shown below

SAMPLE TYPE

S = Sample A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Elevation (Ft. MSL)
							ASPHALT and subbase	
1							0.8	26.23
						0.0	F SAND, some silt, trace clay; brown; moist	
2		S-1	2.1	--		0.0		
			53%		02	0.0	some silt, little clay	
3					02MS	0.0		
					/MSD		trace silt & clay; gray; damp	
4	4.0							
						0.0		
5						0.0		
						0.0	some silt, little clay; brown; damp	
6		S-2	3.0	--		0.0		
			75%			0.0		
7						0.0	trace silt& clay; gray	
							some silt, little clay; brown	
8	8.0				04			
						0.0	trace silt& clay; gray	
9						0.0		
		S-3	3.1	--		0.0	some silt, little clay; gray & orangish-brown	
10			78%			0.0	w/ rusty zones & laminae	
						0.0	Match to Sheet 2	

DRILLING COMPANY Parratt-Wolff BAKER REP.: Mark DeJohn

DRILLER: Arnold Chapel BORING NO.: SB18 SHEET 1 OF 2

Baker

Baker Environmental

TEST BORING RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

CTO NO.: CTO-0143 BORING NO.: SB18

SAMPLE TYPE	DEFINITIONS
S = Sample A = Auger	SPT = Standard Penetration Test (ASTM D1586)
T = Shelby Tube W = Wash	PID = Photo Ionization Detector Measurement
R = Air Rotary C = Core	MSL = Mean Sea Level
D = Direct Push P = Piston N = No Sample	ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description		Elevation (Ft. MSL)
11						0	Continued from Sheet 1		
12	12.0				06		zones of trace silt & clay	12.0	15.03
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									

DRILLING COMPANY: Parratt-Wolff BAKER REP.: Mark DeJohn

DRILLER: Arnold Chapel BORING NO.: SB18 SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

PROJ. NO.: CTO-0143 BORING NO.: SB20

COORDINATES: EAST: 2499878.650 NORTH: 337447.7

ELEVATION: SURFACE: 27.30

Rig: Ingersoll Rand	Macro Core	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	2-in	--	--	--	6/23/03	0.0 - 16.0	Sunny, sl brzy, 70s	8.0
Length	4-ft	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: Sample ID is as follows: "SWMU311-SB20-__", with the suffix shown below

SAMPLE TYPE

S = Sample A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description		Elevation (Ft. MSL)
					00	0.1	ASPHALT	0.3	27.00
1						0	SAND & GRAVEL, sub-base	0.7	26.60
						0	F.SAND, trace silt, brown, loose, damp		
2		S-1	3.3	--	01	0		1.7	25.60
			83%			0	F.SAND, trace silt, dark gray, loose, moist,		
3						0	slight petroleum odor (oil)		
4	4.0							4.0	23.30
						0			
5						0		5.1	22.20
						0	F.SAND, trace silt, brownish gray, very loose,		
6		S-2	4.0	--	03	0	wet		
			100%		03D	0			
7						0		7.0	20.30
						0	F.SAND, trace silt, brownish gray, loose, moist		
8	8.0					0		8.0	19.30
						0	F.SAND, trace silt, brownish gray, very loose,		
9						0	saturated		
		S-3	4.0	--		0			
10			100%			0			
						0	Match to Sheet 2		

DRILLING COMPANY Parratt-Wolff BAKER REP.: David D. Schilling

DRILLER: Lewis LeFever BORING NO.: SB20 SHEET 1 OF 2

Baker

Baker Environmental

TEST BORING RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

CTO NO.: CTO-0143 BORING NO.: SB20

SAMPLE TYPE

S = Sample A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description		Elevation (Ft. MSL)
11						0	Continued from Sheet 1	11.0	16.30
						0	CLAY, some sand, gray, firm, plastic, moist		
12	12.0				06	0		12.0	15.30
						0	F.SAND, trace silt, brownish gray, very loose,		
13						0	saturated		
						0			
14		S-4	2.1 53%	--	--	0		14.1	13.20
15									
16								16.0	11.30
							Termination Depth = 16.0		
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									

DRILLING COMPANY: Parratt-Wolff BAKER REP.: David D. Schilling

DRILLER: Lewis LeFever BORING NO.: SB20 SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

PROJ. NO.: CTO-0143 BORING NO.: SB25

COORDINATES: EAST: 64789456.123 NORTH: 123456.789

ELEVATION: SURFACE: 28.20

Rig: Ingersoll Rand A200								
	Macro Core	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	2-in	--	--	--	7/9/03	0.0 - 16.0	P sunny, brzy, 90s	11.0
Length	4-ft	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: Sample ID is as follows: "SWMU311-SB25-__", with the suffix shown below

SAMPLE TYPE

S = Sample A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description		Elevation (Ft. MSL)
1									
2		S-1	2.3 58%	--	--	--	SILT, trace f sand, clay & roots; brown; damp		
3									
4	4.0							4.0	24.20
5							F SAND, little silt, trace clay; gray; damp		
6		S-2	2.7 68%	--	--	--	brown		
7									
8	8.0						tan		
9							some silt, little clay; orangish-brown; moist		
10		S-3	4.0 100%	--	05	--		9.5	18.70
							Match to Sheet 2		

DRILLING COMPANY Parratt-Wolff BAKER REP.: Mark DeJohn

DRILLER: Lewis LaFever BORING NO.: SB25 SHEET 1 OF 2

Baker

Baker Environmental

TEST BORING RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

CTO NO.: CTO-0143 BORING NO.: SB25

SAMPLE TYPE

S = Sample A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description		Elevation (Ft. MSL)
11							Continued from Sheet 1		
12	12.0						CLAY & F SAND, some silt; greenish-gray; moist, wet at 11.0-ft; mod petro odor		
13									
14		S-4	2.2 55%	--	--	--			
15								15.0	13.20
16	16.0						F/M SAND, some silt, little clay; light greenish-gray; wet; strong petro odor	16.0	12.20
17							Termination Depth at 16.0-ft		
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									

DRILLING COMPANY: Parratt-Wolff BAKER REP.: Mark DeJohn

DRILLER: Lewis LaFever BORING NO.: SB25 SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

PROJ. NO.: CTO-0143 BORING NO.: SB26

COORDINATES: EAST: 64789456.123 NORTH: 123456.789

ELEVATION: SURFACE: 28.2

Rig: Ingersoll Rand A200								
	Macro Core	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	2-in	--	--	--	7/9/03	0.0 - 16.0	P sunny, brzy, 90s	14.0
Length	4-ft	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: Sample ID is as follows: "SWMU311-SB26-__", with the suffix shown below

SAMPLE TYPE

S = Sample A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description		Elevation (Ft. MSL)
1									
2		S-1	1.2 30%	--	--	--	SILT, little f sand, trace clay; dark gray; damp		
3									
4	4.0							4.0	24.20
5									
6		S-2	2.7 68%	--	--	--	F SAND, little silt, trace clay; tan; damp		
7									
8	8.0								
9									
10		S-3	4.0 100%	--	--	--	tan & oragnish-brown laminae; moist	9.6	18.60
							Match to Sheet 2		

DRILLING COMPANY Parratt-Wolff BAKER REP.: Mark DeJohn

DRILLER: Lewis LaFever BORING NO.: SB26 SHEET 1 OF 2

Baker

Baker Environmental

TEST BORING RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

CTO NO.: CTO-0143 BORING NO.: SB26

SAMPLE TYPE

S = Sample A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description		Elevation (Ft. MSL)
11							Continued from Sheet 1		
12	12.0						CLAY, little silt; light greenish-gray; damp		
13									
14		S-4	2.2 55%	--	07	--		14.0	14.20
15							F SAND, some silt, trace clay; light greenish-gray; wet at 14.0-ft		
16	16.0							16.0	12.20
17							Termination Depth at 16.0-ft		
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									

DRILLING COMPANY: Parratt-Wolff BAKER REP.: Mark DeJohn

DRILLER: Lewis LaFever BORING NO.: SB26 SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

PROJ. NO.: CTO-0143 BORING NO.: 311-PZ05

COORDINATES: EAST: 2499974.753 NORTH: 337403.101

ELEVATION: SURFACE: NA TOP OF PVC CASING: 29.15

Rig: Ingersol Rand	Macro Spoon	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	--	2-in	--	--	7/7/2003	0.0 - 20.0	NA	--
Length	--	4-ft	--	--				
Type	---	SS	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: Piezometer was installed beside 360-SB05

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Sch 40 PVC Casing	1-in	0.0	15.0
Sch 40 10-Slot PVC Screen	1-in	15.0	20.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1								
2								
3								
4								
5								
6	D-N	--	--	--	--	See log for 311-SB05		
7								
8								
9								
10						Match to Sheet 2		

DRILLING CO.: Parratt-Wolff BAKER REP.: David D. Schilling

DRILLER: Lewis Lafever BORING NO.: 311-PZ05 SHEET 1 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

CTO NO.: CTO-0143 BORING NO.: 311-PZ05

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
11						Continued from Sheet 1		
12								
13								
14								
15								
16	D-N	--	--	--	--	See log for 311-SB05		
17								
18								
19								
20								
						Termination Depth at 20.0		
21								
22								
23								
24								
25								
26								
27								
28								
29								

DRILLING CO.: Parratt-Wolff BAKER REP.: David D. Schilling

DRILLER: Lewis Lafever BORING NO.: 311-PZ05 SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

PROJ. NO.: CTO-0143 BORING NO.: 311-PZ18

COORDINATES: EAST: 2499954.750 NORTH: 337513.24

ELEVATION: SURFACE: NA TOP OF PVC CASING: 27.08

Rig: Ingersol Rand

	Macro Spoon	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	--	2-in	--	--	7/7/2003	0.0 - 20.0	NA	--
Length	--	4-ft	--	--				
Type	---	SS	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: Piezometer was installed beside 311-SB18

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Sch 40 PVC Casing	1-in	0.0	15.0
Sch 40 10-Slot PVC Screen	1-in	15.0	20.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1								
2								
3								
4								
5								
6	D-N	--	--	--	--	See log for 311-SB18		
7								
8								
9								
10						Match to Sheet 2		

DRILLING CO.: Parratt-Wolff BAKER REP.: David D. Schilling

DRILLER: Lewis Lafever BORING NO.: 311-PZ18 SHEET 1 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

CTO NO.: CTO-0143 BORING NO.: 311-PZ18

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
11						Continued from Sheet 1		
12								
13								
14								
15								
16	D-N	--	--	--	--	See log for 311-SB18		
17								
18								
19								
20								
21						Termination Depth at 20.0		
22								
23								
24								
25								
26								
27								
28								
29								

DRILLING CO.: Parratt-Wolff BAKER REP.: David D. Schilling

DRILLER: Lewis Lafever BORING NO.: 311-PZ18 SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311

PROJ. NO.: CTO-0143 BORING NO.: 311-PZ20

COORDINATES: EAST: 2499878.650 NORTH: 337447.7

ELEVATION: SURFACE: NA TOP OF PVC CASING: 27.30

Rig: Ingersol Rand	Macro Spoon	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	--	2-in	--	--	7/7/2003	0.0 - 20.0	NA	--
Length	--	4-ft	--	--				
Type	---	SS	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: Piezometer was installed beside 311-SB2(

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Sch 40 PVC Casing	1-in	0.0	15.0
Sch 40 10-Slot PVC Screen	1-in	15.0	20.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1						Notes: The piezometer was installed using the same quantities of sand and hole plug, but an accurate measurement could not be obtained because the hole collapsed near the surface.		
2								
3								
4								
5								
6	D-N	--	--	--	--	See log for 311-SB2(		
7								
8								
9								
10						Match to Sheet 2		

DRILLING CO.: Parratt-Wolff BAKER REP.: David D. Schilling

DRILLER: Lewis Lafever BORING NO.: 311-PZ20 SHEET 1 OF 2

Baker
Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Camp Lejeune RCRA Program - SWMU 311
CTO NO.: CTO-0143 BORING NO.: 311-PZ20

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston N = No Sample

DEFINITIONS
SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
11						Continued from Sheet 1		
12								
13								
14								
15								
16	D-N	--	--	--	--	See log for 311-SB20		
17								
18								
19								
20								
21						Termination Depth at 20.0		
22								
23								
24								
25								
26								
27								
28								
29								

DRILLING CO.: Parratt-Wolff
DRILLER: Lewis Lafever

BAKER REP.: David D. Schilling
BORING NO.: 311-PZ20 SHEET 2 OF 2

Baker

Baker Environmental, Inc.

APPENDIX B

Chain-of-Custody Documentation

BA ENVIRONMENTAL

NUMBER OF COOLERS 1

CHAIN OF CUSTODY NUMBER: 04

PAGE NUMBER: 1 OF 2

R295741

CUSTOMER INFORMATION

Company: Baker Environmental
Project Number: 26007-143-6000-05210
Address: 100 Airside Business Park
100 Airside Drive
Moon Twp, PA 15108
Phone: 1-800 553-1153
Fax: (412)269-2002

Project Name: MCB Camp Lejeune: RCRA
Address: Lot 203, Piney Green Road
Camp Lejeune, NC 28542
Contact: Michelle Joy
Phone Number: (412)269-6135
Fax Number: (412)269-6100

	Sample Identification	Matrix	Sample Date	Sample Time	Number of Containers	TCL VOCs (OLMO 4.2)	TCL SVOCs (OLMO 4.2)	TCL Pesticides (OLMO 4.2)	RCRA Metals (ILMO 4.1)		TCLP VOCs	TCLP SVOCs	TCLP Pesticides	TCLP Metals								COMMENTS/ PRECAUTIONS
1	SWMU311-SB10-02	SU	6 18 03	1645	4	X			X													
2	SWMU311-SB10-04	SU	6 18 03	1650	1				X													QUICK EXTRACTION SAMPLE
3	SWMU311-SB10-08	SU	6 18 03	1705	1				X													QUICK EXTRACTION SAMPLE
4	SWMU311-SB11-02	SU	6 18 03	1532	1				X													QUICK EXTRACTION SAMPLE
5	SWMU311-SB11-03	SU	6 18 03	1545	4	X			X													QUICK EXTRACTION SAMPLE
6	SWMU311-SB11-06	SU	6 18 03	1610	1				X													Quick Extraction
7	SWMU311-SB04-01	SU	6 19 03	0828	4	X			X													
8	SWMU311-SB04-04	SU	6 19 03	0832	1				X													
9	SWMU311-SB04-06	SU	6 19 03	0838	1				X													
10	SWMU311-SB06-01	SU	6 19 03	0930	4	X			X													
11	SWMU311-SB06-04	SU	6 19 03	0938	1				X													
12	SWMU311-SB15-01	SU	6 19 03	0815	1				X													
13	SWMU311-SB15-02	SU	6 19 03	0830	1				X													
14	SWMU311-SB15-08	SU	6 19 03	0855	4	X			X													
15	SWMU311-SB16-01	SU	6 19 03	0955	1				X													
16	SWMU311-SB16-05	SU	6 19 03	1013	1				X													
17	SWMU311-SB16-08	SU	6 19 03	1040	4	X			X													
18	SWMU311-SB16-08D	SU	6 19 03	1040	4	X			X													
19	SWMU360-SB05-04	SU	6 19 03	1240	1			X	X													
20	SWMU360-SB05-06	SU	6 19 03	1247	4	X		X	X													
1	SWMU360-SB05-08	SU	6 19 03	1253	1			X	X													
2	TB02	LB	6 19 03	1430	3	X																
3	SWMU360-SB01-03	SU	6 19 03	1430	1			X	X													

Matrix: A - Air, SS - Surface Soil, SW - Surface Water, GW - Groundwater; SU - Subsurface Soil, W - Waste, LB - Lab Supplied Water (Trip or Field Blank)

NOTES:

FED EX TRACKING NUMBER:

1.) Relinquished By: Robert M. Suk II		2.) Relinquished By:		SPECIAL INSTRUCTIONS
Signature:	Date: 6/19/03	Signature:	Date: 6/20/03	
Company: Baker Environmental	Time: 1630	Company: Fed Ex	Time: 930	
1.) Received By:		2.) Received By:		
Signature:	Date:	Signature: C. Wawer	Date: 6/20/03	
Company:	Time:	Company: Chemtech	Time: 930	

BAKER ENVIRONMENTAL

R3029

NUMBER OF COOLERS 4

CHAIN OF CUSTODY NUMBER: 12

PAGE NUMBER: 3 OF 3

CUSTOMER INFORMATION

Company: Baker Environmental
Project Number: 26607-143-0000-05206
Address: 100 Airside Business Park
100 Airside Drive
Moon Twp, PA 15108
Phone: 1-800-553-1153
Fax: (412)269-2002

Project Name: MCB Camp Lejeune RCRA
Address: Lot 204, Piney Green Road
Camp Lejeune, NC 28542
Contact: Michelle Jew
Phone Number: (412)269-6135
Fax Number: (412)269-6100

	Sample Identification	Matrix	Sample Date	Sample Time	Number of Containers	TCL VOCs (OLMO 4.2)	TCL SVOCs (OLMO 4.2)	TCL Pesticides (OLMO 4.2)	RCRA Metals (ILMO 4.1)		TCLP VOCs	TCLP SVOCs	TCLP Pesticides	TCLP Metals								COMMENTS/ PRECAUTIONS
10	SWMU360-SB13-02	SU	6 20 03	1425	1			X	X													
11	SWMU360-SB13-05	SU	6 20 03	1440	1			X	X													
12	SWMU360-SB14-10	SU	6 22 03	1623	1			X	X													
13	SWMU360-SB10-01	SU	6 22 03	1610	1	X		X	X													
14	SWMU360-SB10-03	SU	6 22 03	1628	1			X	X													
15	SWMU360-SB10-05	SU	6 22 03	1646	1			X	X													
16	ER01	LB	6 17 03	1800	7	X	X	X	X													
17	ER02	LB	6 18 03	1800	7	X	X	X	X													
18	ER03	LB	6 19 03	1800	7	X	X	X	X													
19	ER04	LB	6 20 03	1800	7	X	X	X	X													
20	ER05	LB	6 21 03	1800	7	X	X	X	X													
21	ER06	LB	6 22 03	1800	7	X	X	X	X													
22	SWMU311-SB18-02	SU	6 23 03	0735	4	X			X													
23,24	SWMU311-SB18-02MS MSD	SU	6 23 03	0735	4	X			X													
	SWMU311-SB18-04	SU	6 23 03	0740	1				X													
	SWMU311-SB18-06	SU	6 23 03	0745	1				X													
	SWMU311-SB20-01	SU	6 23 03	0748	1				X													
	SWMU311-SB20-03	SU	6 23 03	0800	4	X			X													
	SWMU311-SB20-03D	SU	6 23 03	0800	4	X			X													
	SWMU311-SB20-06	SU	6 23 03	0827	1				X													
	TB04	LB	6/23/03	1630	3	X																

Matrix: A - Air, SS - Surface Soil, SW - Surface Water, GW - Groundwater, SU - Subsurface Soil, W - Waste, LB - Lab Supplied Water (Trip or Field Blank)

NOTES: Samples SWMU311-SB18-04 TO TB04 is in Project R3030

FED EX TRACKING NUMBER:

1.) Relinquished By: Robert M. Sok II		2.) Relinquished By:		SPECIAL INSTRUCTIONS
Signature: [illegible]	Date 6/23/03	Signature: FedEx	Date 06/25/03	
Company: Baker Environmental	Time 1700	Company: FedEx	Time 09:45	
1.) Received By:		2.) Received By: 3P6/25/03		
Signature: Sunny Patel	Date 6/25/03	Signature: [illegible]	Date	
Company: Chemtech	Time 0945	Company:	Time	

BAKER ENVIRONMENTAL

R3031

NUMBER OF COOLERS 3

CHAIN OF CUSTODY NUMBER: 14

PAGE NUMBER: 1 OF 2

CUSTOMER INFORMATION

Company: Baker Environmental
Project Number: 26007-143-0000-05206
Address: 100 Airside Business Park, 100 Airside Drive, Moon Twp, PA 15108
Phone: 1-800-553-1153
Fax: (412)269-2602

Project Name: MCB Camp Lejeune RCRA
Address: Lot 205, Piney Green Road, Camp Lejeune, NC 28542
Contact: Michelle Jay
Phone Number: (412)269-6135
Fax Number: (412)269-6100

	Sample Identification	Matrix	Sample Date	Sample Time	Number of Containers	TCL VOCs (OLMO 4.2)	TCL SVOCs (OLMO 4.2)	TCL Pesticides (OLMO 4.2)	RCRA Metals (ILMO 4.1)	COMMENTS/ PRECAUTIONS
4	SWMU311-SB07-01	SU	6 24 03	1617	1				X	
5	SWMU311-SB07-04	SU	6 24 03	1630	1				X	
6	SWMU311-SB07-08	SU	6 24 03	1650	4	X			X	
7	SWMU43-SS05	SS	6 24 03	0835	1			X	X	CHECK EXTRACTION
8	SWMU43-SS06	SS	6 24 03	0836	1			X	X	
9	TB06	LB	6 25 03	1415	3	X				
10	SWMU43-SS07	SS	6 25 03	1312	1			X	X	
11	SWMU43-SS08	SS	6 25 03	1238	1			X	X	
12	SWMU43-SS09	SS	6 25 03	1309	1			X	X	
13	SWMU43-SS10	SS	6 25 03	1305	1			X	X	
14	SWMU43-SS10D	SS	6 25 03	1305	1			X	X	
15	SWMU43-SS11	SS	6 25 03	1303	1			X	X	
16	SWMU43-SS12	SS	6 25 03	1258	1			X	X	
17	SWMU43-SS13	SS	6 25 03	1252	1			X	X	
18	SWMU43-SS13D	SS	6 25 03	1252	1			X	X	
19	SWMU43-SS14	SS	6 25 03	1245	1			X	X	
	SWMU43-SS15	SS	6 25 03	1247	1			X	X	
	SWMU43-SS16	SS	6 25 03	1240	1			X	X	
	SWMU43-SS17	SS	6 25 03	1236	1			X	X	
	SWMU43-SS18	SS	6 25 03	1250	1			X	X	
	SWMU43-SS19	SS	6 25 03	1256	1			X	X	
	SWMU43-SS20	SS	6 25 03	1234	1			X	X	
20	SWMU43-SS21	SS	6 25 03	1220	1			X	X	

Matrix: A - Air, SS - Surface Soil, SW - Surface Water, GW - Groundwater, SU - Subsurface Soil, W - Waste, LB - Lab Supplied Water (Trip or Field Blank)

NOTES: Samples SWMU43-SS15 TO SWMU43-SS20 Join Project # R3050

FED EX TRACKING NUMBER: 8390 3018 3942

1.) Relinquished By: Robert M. Sok II		2.) Relinquished By:		SPECIAL INSTRUCTIONS
Signature	Date 6/25/03	Signature FedEx	Date 6/26/03	
Company Baker Environmental	Time 1700	Company FedEx	Time 09:45	
1.) Received By:		2.) Received By:		
Signature Suyoung Patel	Date 6/26/03	Signature	Date	
Company Chemtech	Time 09:45	Company	Time	

Baker

Baker Environmental, Inc.

APPENDIX C

Aquifer Pumping Tests Data Compilation

Barrie
12 Sep 94

SUMMARY OF GROUNDWATER DATA AND AQUIFER CHARACTERISTICS
MARINE CORPS BASE, CAMP LEJEUNE
JACKSONVILLE, NORTH CAROLINA

FILE: CLS-1A1. wp
CLS-1B1. wks

SUMMARY

This study examines the utility of exploratory aquifer tests (pump tests) at investigation sites across Marine Corps Base, Camp Lejeune (MCB-CL). The study reviews the available information on the relevant water-bearing layers, considers the general characteristics and applicability of aquifer tests, and concludes:

- That available information is satisfactorily complete to allow appropriate designs of groundwater systems in the main operating areas of MCB-CL;
- That quantified characterization of the water-bearing layers in explored areas of MCB-CL can be extended to other areas having similar geologic terrane;
- That exploratory tests are no longer routinely required or advisable;
- That reconnaissance testing (well-head tests or slug tests) of each newly installed or otherwise uncharacterized data station is highly advisable; and,
- That performance testing of groundwater extraction systems should be the recommended form of evaluating and adjusting withdrawal systems.

BACKGROUND

This study considers the aquifer characteristics (especially, the Coefficient of Transmissivity) and the production capacities (available discharge rates) of the two water-bearing layers relevant to the studies at MCB-CL. These water-bearing layers are the (shallow or surficial) water table and the Upper Castle Hayne Aquifer.

The water table at MCB-CL occupies the water-bearing zone within 25 to 35 feet of the surface; the Castle Hayne, immediately below this. However, the separation of the water table and the Castle Hayne is not always obvious. Usually, this separation is effected only by the low permeability material of the water table transiting to the significantly more permeable material of the Upper Castle Hayne; there is rarely an aquiclude or aquitard of vertically extensive clay separating the water table from the Castle Hayne.

The data available for this summary derive from three main sources:

- Assessment of Hydrologic and Hydrogeologic Data at Camp Lejeune Marine Corps Base, North Carolina; U.S. Geological Survey, Water-Resources Investigation Report 89-4096; 1989
- Wellhead Management Program Engineering Study 91-36; Geophex, Ltd.; 22Jan91
- Various site investigations by Baker Environmental, Inc., and reported to LANTDIV and MCB-CL

DISTRIBUTION OF DATA

The data available from the various sources have been compiled on Tables 1, 2 and 3, with Table 3 summarizing the relevant flow information. The accompanying map indicates the distribution of stations from which data are available.

The tabulated data indicate the main characteristics of each water-bearing layer:

- There is low available production from the water table.
- There is an excessive availability of production from the Castle Hayne compared to the probably acceptable levels of treatment volumes foreseeable in groundwater remediation systems.

The water table had production capacities of less than 5 gallons per minute (gpm) in all cases tested. The specific capacities of the discharge wells were always less than 1 gallon per minute per foot of drawdown (gpm/ft). The transmissivities calculated were generally near or below 1000 gallons per day per foot of drawdown (gpd/ft); only the deeper wells, which intercepted at least part of the Castle Hayne, had transmissivities in a range indicative of an acceptably producing zone. The hydraulic conductivity values were commonly in the range of tenths of feet per day (ft/d). The low production rates, low transmissivities and low hydraulic conductivities indicate that the water table is only marginally, at best, under Darcian conditions. Calculations based on these data would, therefore, be highly unreliable. However, the available information all indicate an expectably low rate of groundwater discharge, which in turn would produce only a narrow radius of effect around an individual production well:

> The standard equation for calculation of the radius of capture around an individual well is $r_c=720Q/\pi Ti$. With a discharge rate (Q) of 3 gpm, a transmissivity (T) of 500 gpd/ft and a representative gradient of 0.005, the radius of capture would be 275 ft. However, this calculation applies only to Darcian conditions in a homogeneous medium; the water table at MCB-CL is marginally Darcian and is highly non-homogeneous. The calculation of radius must, therefore, be in some degree of error, with no more usable data or calculation possible.

The Castle Hayne has production capacities generally ranging above 200 gpm. The estimated transmissivities are at least in the range of several tens of thousands gpd/ft, with specific capacities usually about 5 to 10 gpm/ft. The calculated hydraulic conductivities are usually in the scores of feet per day. The available discharge from the Castle Hayne is, therefore, much greater than that from the water table. The limiting factor in remediation schemes for the Castle Hayne then becomes the amount of water that can be treated by an affordable system, usually less than 500 gpm; this value of 500 gpm would be available from one or two wells in the Castle Hayne. The high values of aquifer parameters, the relatively low total discharge and the low number of production wells would conspire to limit the radius of effect available to a remediation scheme:

> The standard equation for calculation of the radius of capture around an individual well is $r_c=720Q/\pi Ti$. With a Q of 500 gpm, a T of 50000 gpd/ft and a representative gradient of 0.005, the radius of capture would be only 460 ft.

COMPARABILITY OF DATA ACROSS MCB-CL

The stratigraphic sequences of MCB-CL containing the water table and the Upper Castle Hayne have been well characterized. The available information indicates that the lithology and the hydrologic conditions can be correlated stratigraphically across the base (Tables 1 and 2). From these correlations, aquifer performance can be predicted sufficiently for an engineering design whose final criteria for suitability are performance-based.

The upper water-bearing zone is a highly variable layering and intercalation of clay, silt and sand. This variability, however, is found within recognizable limits. These limits correspond to the range of hydrologic characteristics described previously. Similar correlation is available for the lithology and hydrology of the Upper Castle Hayne.

In areas not near stations catalogued in Tables 1, 2 and 3, a reconnaissance comparison of well-head tests (slug tests) and an examination of lithologic descriptions will likely be sufficient to support the engineering evaluation of the site. There is ample demonstration that lithology has a significant influence on the hydrology of a site, and that, for a given geologic terrane, the influence is fairly consistent. The geologic terrane of MCB-CL has been broadly characterized and correlated between lithologic (stratigraphic descriptions) and hydrologic (aquifer tests and well-head tests) sequences. Lithologic descriptions can now provide a good indication of hydrologic conditions at MCB-CL in areas of similar terrane.

GENERAL APPLICABILITY OF AQUIFER TESTS

Aquifer (pump) tests are an extremely dangerous activity at contamination sites. While the information available from aquifer tests is required for engineering design of withdrawal systems, aquifer tests should not be a reconnaissance or an initial step in the investigation. Full consideration must be made of the redistribution of contaminants expectable from the test, of the change in structural support of disposal features by relaxation or increase of hydrostatic loading, and so forth.

Consideration must also be made of alternative sources of acceptable data on the aquifer. In the case of MCB-CL, alternatives to exploratory aquifer tests are available from the tabulation and correlation of aquifer characteristics, production performance and geologic terrane presently available.

From the available information and in light of the relative consistency of the geologic terrane of MCB-CL, exploratory tests at MCB-CL are not generally required. Therefore, exploratory tests are not advisable and should not form part of the initial investigation of a site. While they may be useful in certain circumstances after the initial investigation of a site, they should not, in the general case, be part of the investigation. Sufficiently satisfactory information is presently available to allow the initial engineering design of a groundwater response.

While exploratory aquifer tests are not advisable, performance tests of a newly installed system are highly recommended. These tests, to some extent, are a normal part of the initial operation of a system. Only minor additional monitoring and modification of the system during operation would provide data directly relevant to the long-term operation of that system.

In the Coastal Plain of MCB-CL, the information from an exploratory data station not coincident with the long-term extraction system is not fully transferable. That is, if the test station and the

recovery station are not the same, the aquifer parameters and calculations based on those parameters will differ. This means that data from an exploratory station are no more reliably usable that the data presently available, unless the exploratory station is collocated with the recovery system. However, if the exploratory and recovery stations are identical, and considering that alternative sources of acceptable data on the aquifer are available and that a performance test must be run as part of the initial operation of a recovery system, the exploratory test represents a superfluous duplication of effort.

TABLE 1
CAMP LEJEUNE PUMP TEST DATA

Well Number	Well Depth (ft,BGS)	Well Diameter (in)	Total Aquifer Thickness (ft)	Screened Length (ft)	Screened Interval (ft,BGS)	Water-level Drawdown During Pumping (ft,BGS)	Pumping Rate (Recovery wells) GPM	Duration of Pumping (min)	Specific Capacity (pumping rate/ drawdown)	T (square ft/ day)	K (ft/day)	S	Soils (ft,BGS)
013RW-01*	23	2	15	20	3-23	8.773	1	480	0.11	7.17	0.48	NA	0-10 silt/clay, 10-23 sand.
013MW-18	13	2	15	10	3-13	0.297	NA	480	NA	105.98	7.06	1.40E-02	0-7 silt/clay, 7-13 sand.
013MW-21	14	2	15	10	4-14	0.31	NA	480	NA	82.27	5.48	2.77E-02	0-4 silt/sand, 0-14 clay/silt
108RW-01*	15	2	9	9.1	2.45-11.55	6.38	0.5	485	0.08	5.30	0.59	NA	very fine sand
108MW-04		2	9				NA	485	NA	118.63	13.18	1.33E-02	
108MW-15	12.5	2	9	9.03	2.79-11.82		NA	485	NA	56.78	6.31	7.33E-03	0-8 sand/silt, 8-10 silt/clay
109MW-15		2	15			0.939	NA	460	NA	76.26	5.08	1.11E-02	
109MW-17	14.5	2	15	10	4.5-14.5	0.545	NA	460	NA	163.10	10.87	7.30E-03	0-15 fine sand
109RW-01*	15	2	15	9.5	2-11.5	6.265	3	460	0.48	7.80	0.52	NA	0-4 sand, 4-8 silt, 8-15 sand
110RW-01* (Drawdown,Theis)	21.8	2	50	19.2	2-21.2	9.53	3	475	0.31	200.02	4.00	NA	0-10.5 sand/silt, 10.5-15 sand/clay, 15-21.5 sand/clay, 21.5- sand
110RW-01* (Drawdown,Cooper)										161.86	3.24	NA	
110RW-01* Recovery(Theis)										106.06	2.12	NA	
110DW-01 (Drawdown,Theis)	30.3	2	50	4.8	24.9-29.7	0.02	3	475	NA	7080.48	142.00	4.52E-03	0-4 sand/silt, 4-10.5 clay, 10.5-15.5 sand/silt,15.5-20.5 clay, 20.5-on sand
110DW-01 (Drawdown,Cooper)									NA	7099.20	142	4.51E-03	
110DW-02 (Drawdown,Theis)	30	2	50	4.7	24.7-29.4	0.52	NA	475	NA	5398.56	108.00	1.51E-03	0-3 sand and silt with clay layers, 3-11 sand and silt, 11-30 sand with some limited clay layers
110DW-02 (Drawdown,Cooper)									NA	5400.00	108	1.51E-03	
110DW-03 (Drawdown,Theis)	30	2	50	4.9	24.5-29.4	0.47	NA	475	NA	2952.00	59.00	7.48E-02	0-6 sand and silt , 6-12 sand, 12-23 sand/clay, 23-30 sand
110DW-03 (Drawdown,Cooper)									NA	3225.60	64	5.85E-02	

T = Transmissivity
K = Hydraulic Conductivity
S = Storativity
* = Pumping well
NA - Not applicable

WHERE ON BASE
ARE THESE WELLS
LOCATED? (HADNOT,
RIFLE RANGE, MCAS,
COURTHOUSE BAY?)

TABLE 2

HYDRAULIC CONDUCTIVITY TEST RESULTS (SLUG TEST)

	Well Number	Well Depth (ft,BGS)	Well Diameter (in)	Saturated Aquifer Thickness* (ft)	Screened Length (ft)	Screened Interval (ft,BGS)	K Rising (ft/day)	Soils (ft,BGS)
[illegible]	013MW-03	14	2	1	9.8	4-13.8	0.75	0-6 clay, 6-14 silt
	013MW-04	14	2	8.13	9.8	4-13.8	0.27	0-8 clay, 8-14 silt
	013MW-11	16	2	9.14	10	6-16	0.37	0-4 sand/silt, 4-14 clay, 14-16 sand
	013MW-21	14	2	9.2	10	4-14	0.46	0-4 silt/sand, 4-14 clay
RIFLE RANGE UST	108MW-08	12.8	2	8.83	9.7	2.7-12.4	0.59	0-8 very fine sand, 8-12 clayey peat, 12-13 sandy clay
	108MW-09	12.8	2	7.81	9.7	2.8-12.5	0.53	0-13 silt/sand
	108MW-13	10.8	2	NA	9.02	0.69-9.71	0.061	0-2 very fine sand, 8-9.5 sandy clay
	108MW-17	13.1	2	NA	9.03	3.39-12.42	0.59	0-8 fine grained sand, 8-9 clayey peat, 9-12.5 sandy clay
[illegible] UST	109MW-17	14.5	2	9.04	10	4.5-14.5	9.00	0-15 fine sand
	109MW-18	14	2	10.19	10	4.5-14.5	5.70	0-3 sand, 3-10 silt, 10-14 sand
[illegible] WASTEWATER TREATMENT	110MW-07	11.96	2	9	9.8	1.5-11.3	0.0115	0-2 clay/silt, 2-4 clay/sand, 4-6 sand, 6-10 silt/clay, 10-14 silt /sand
	110MW-09	14.2	2	9.47	9.8	3.8-13.6	0.16	0-6 sand/silt, 6-9 clay/silt, 9-12 sand/silt, 12-14 clay
	110DW-03	30	6	22.04	4.9	24.5-29.4	1.07	0-3 sand, 3-4 clay, 4-10 sand/silt, 10-12 sand, 12-13 clay,13-22 silt/clay, 22-30 sand
AMP JEGER	41GW-07	20.5	2	12.03	10	10.5-20.5	1.15	1-5 silty sand, 5-9 clay, 9-10 silty sand, 10-12 fill, 12-16 silty sand with 1 ft clay layer,16-21 sand
	41GW-08	15	2	9.48	10	5-15	0.14	0-1 silty sand, 1-6 sand, 6-14 clay with sand and silt, 14-16 silty sand
	41GW-09	21	2	11.89	10	11-21	3.67	0-5 clay and sand, 5-21 silty sand
	41GW-10	13	2	8.59	10	3-13	0.94	0-2 silty sand, 2-7 sand, 7-9 silty sand and clay, 9-12 lithified sandstone, 12-13 sand. 13-14 lithified sandstone
	41GW-12	16	2	12.45	10	6-16	4.57	0-4 silty sand, 4-14 sand, 14-17 lithified sandstone
RIFLE RANGE DUMP	69GW-09	20.5	2	14.22	10	10.5-20.5	1.7	1-4 Sand/silt, 4-10 clay some sand, 10-21 sand/silt
	69GW-10	16	2	10.5	10	6-16	0.17	1-17 sand/silt
	69GW-12	12.5	2	11.27	10.5	2-12.5	0.12	0-13.5 sand/silt
	69GW-02D	125	2	22.1	10	40-50	0.29	0-125 silty sand ** 0-50
	69GW-12D	58	2	53.83	10	48-58	6.66	0-58 silty sand **
MESS HALL	74GW-03A	18	2	13.58	10	8-18	0.59	0-17 silty sand, 17-18.5 sandy clay
	74GW-06	16.5	2	8.18	9.74	15.5-26	6.33	1-26 sand/silt
	74GW-08	23	2	10.51	10	13-23	3.55	0-1 silty sand, 1-24 sand

* Values taken from AQTESOL results. (Bottom of screened interval- water level)

** Due to depth, soils were very generally described.

K = Hydraulic Conductivity

TABLE 3

BARONE:8SEP94:CL5-1A1:1/5

-CL5 CTO-232 CL5-1B1.wks 8SEP94 MCB-CAMP LEJEUNE

STATION	b ft	Q gpm	Sc gpm/ft	T ft-sq/d	T gpd/ft	K ft/d
013RW-01	15	1.0	0.11	7.2	54	0.5
013MW-1	15			106.0	793	7.1
013MW-2	15			82.3	615	5.5
013MW-03	1					0.8
013MW-04	8					0.3
013MW-11	9					0.4
013MW-21	8					0.5
41GW-07						1.2
41GW-08						0.1
41GW-09						3.7
41GW-10						0.9
41GW-12						4.6
69GW-09						1.7
69GW-10						0.2
69GW-12						0.1
69GW-02DW						0.3
69GW-12DW						6.7
74GW-03A						0.6
74GW-06						6.3
74GW-08						3.6
108RW-01	9	0.5	0.08	5.3	40	0.6
MW-0	9			118.6	887	13.2
MW-1	9			56.8	425	6.3
108MW-08	9					0.6
108MW-09	8					0.5
108MW-13	8					0.1
108MW-17	8					0.6
109MW-1	15			76.3	570	5.1
109MW-1	15			163.1	1220	10.9
109RW-01	15	3.0	0.48	7.8	58	0.5
109MW-17	15					9.0
109MW-18	15					5.7
110RW-01	50	3.0	0.31	200.0	1496	4.0
110RW-01	50	3.0	0.31	161.9	1211	3.2
110RW-01	50	3.0		106.1	793	2.1
110DW-01	50			7080	52962	142.0
110DW-01	50			7099	53102	142.0
110DW-02	50			5399	40381	108.0
110DW-02	50			5400	40392	108.0
110DW-03	50			2952	22081	59.0
110DW-03	50			3226	24127	64.0
110MW-07	9					0.1
110MW-09	9					0.2
110DW-03	22					5.8

STATION	b ft	Q gpm	Sc gpm/ft	T ft-sq/d	T gpd/ft	K ft/d
BB-43	275	170	5.0	8900	66572	32.4
BB-44	275	450	10.0	17900	133892	65.1
BB-222	275	329	9.4	10600	79288	38.5
HP-612	285	275	5.4	7900	59092	27.7
HP-614	285	323	4.9	6600	49368	23.2
HP-621	300	200	9.1	24500	183260	81.7
HP-628	320	160	3.4	6400	47872	20.0
HP-629	300	210	5.7	7900	59092	26.3
HP-634	300	163	4.5	4300	32164	14.3
HP-636	300	211	6.8	6900	51612	23.0
HP-643	295	278	5.3	9700	72556	32.9
HP-644	300	246	4.3	8100	60588	27.0
HP-646	305	304	10.6	20200	151096	66.2
HP-647	305	500	9.8	18700	139876	61.3
HP-648	310	250	2.9	5600	41888	18.1
HP-649	310	257	2.6	5000	37400	16.1
HP-651	305	270	3.8	7300	54604	23.9
HP-652	320	218	2.2	4400	32912	13.8
HP-663	325	350	4.8	6400	47872	19.7
HP-699	275	250	5.7	7700	57596	28.0
HP-700	270	250	6.8	11500	86020	42.6
HP-701	275	250	7.2	12400	92752	45.1
[illegible] 705	295	250	9.0	13100	97988	44.4
[illegible] 706	300	250	3.8	4700	35156	15.7
HP-709	310	200	4.4	8500	63580	27.4
HP-710	310	200	5.1	9900	74052	31.9
HP-711	320	200	6.8	10700	80036	33.4
LCH-4006	295	540	10.0	14500	108460	49.2
LCH-4007	295	275	11.8	13700	102476	46.4
M-267	260	170	7.7	10300	77044	39.6
M-628	260	70	3.0	6100	45628	23.5
RR-229	290	429	12.2	19400	145112	66.9
TT-25	280	150	5.0	7200	53856	25.7

STATION	PUMPING LEVEL	Q gpm	Sc gpm/ft
HP-602	44	154	3.5
HP-603	30	129	4.3
HP-606	38	267	7.0
HP-607	46	246	5.3
HP-608	21	208	9.9
HP-609	45	199	4.4
HP-610	14	214	15.3
HP-613	17	157	9.2
HP-616	15	178	11.9
HP-620	9	224	24.9
HP-622	55	330	6.0
HP-623	30	210	7.0
HP-628	45	172	3.8
HP-629	45	216	4.8
HP-632	21	224	10.7
HP-633	18	205	11.4
HP-634	36	219	6.1
HP-635	33	151	4.6
HP-636	35	149	4.3
HP-637	40	130	3.3
HP-638	84	201	2.4
HP-639	52	[--]	0.0
HP-640	28	210	7.5
HP-641	44	351	8.0
HP-642	32	[--]	0.0
HP-643	35	269	7.7
HP-644	52	230	4.4
HP-645	40	192	4.8
HP-646	11	154	14.0
HP-647	26	302	11.6
HP-648	84	263	3.1
HP-649	80	100	1.3
HP-650	75	480	6.4
HP-651	69	242	3.5
HP-652	82	216	2.6
HP-653	29	197	6.8
HP-654	30	175	5.8
HP-655		[--]	ERR
HP-660		150	ERR
HP-661	37	275	7.4
HP-662	53	148	2.8
HP-663	23	100	4.3
HP-698	33	216	6.5
HP-699	21	140	6.7

STATION	PUMPING LEVEL	Q gpm	Sc gpm/ft
HP-700	39	192	4.9
HP-701	36	236	6.6
HP-703	33	293	8.9
HP-704	38	159	4.2
HP-705	25	214	8.6
HP-706	33	214	6.5
HP-707	51	50	1.0
HP-708	42	219	5.2
HP-709	52	239	4.6
HP-710	29	115	4.0
HP-711	56	235	4.2
HP-5186	38	336	8.8
LCH-4007	34	150	4.4
LCH-4009	22	349	15.9
TT-23	36	160	4.4
TT-25	22	130	5.9
TT-26	32	127	4.0
TT-31	28	111	4.0
TT-52	18	236	13.1
TT-54	20	119	6.0
TT-67	29	119	4.1
RR-45	11	192	17.5
RR-47	5	140	28.0
[illegible]97	14	170	12.1
[illegible]-229	35	[--]	0.0
BB-44	11	125	11.4
BB-47	6	341	56.8
BB-218	17	192	11.3
BB-220	13	119	9.2
BB-221	19	230	12.1
TC-325	8	100	12.5
TC-502	1	180	180.0
TC-504	35	203	5.8
TC-600	32	172	5.4
TC-604	16	137	8.6
TC-700	28	125	4.5
TC-901	37	[--]	0.0
TC-1000	25	110	4.4
TC-1001	16	160	10.0
TC-1251	6	150	25.0
TC-1253	5	128	25.6
TC-1254	3	122	40.7
TC-1255	36	104	2.9
TC-1256	48	108	2.3

STATION	PUMPING LEVEL	Q gpm	Sc gpm/ft
AS-108	8	226	28.3
AS-131	11	310	28.2
AS-190	60	220	3.7
AS-191	16	220	13.8
AS-203	19	220	11.6
AS-4140	6	110	18.3
AS-4150	10	128	12.8
AS-5001	27	185	6.9
AS-5009	53	111	2.1
BA-164	21	214	10.2
BA-190	17	303	17.8

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APPENDIX D

Background Data Summary

APPENDIX D

STATISTICS SUMMARY FOR INORGANICS IN SUB-SURFACE SANDS
BASE BACKGROUND STUDY
MCB, CAMP LEJEUNE, NORTH CAROLINA

	Distribution	Frequency of Detection	Range	Arithmetic Mean Half Non-Detects	Arithmetic Mean + 2 Standard Deviations	Log Arithmetic Mean Half Non-Detects	Log Arithmetic Mean + 2 Standard Deviations
METALS (mg/kg)							
Aluminum	Lognormal	29/29	260J - 9900	3,608	14,538	2,540	16,984
Antimony	Neither	11/29	ND - 0.41J	0.188	0.597	0.165	0.458
Arsenic	Neither	6/29	ND - 1.4	0.288	1.62	0.204	0.844
Barium	Lognormal	29/29	0.67J - 18.2	5.67	23.9	4.18	22.0
Beryllium	Neither	16/29	ND - 0.097J	0.034	0.140	0.024	0.164
Cadmium	Neither	0/29	ND	0.0112	0.0136	0.0112	0.0124
Calcium	Lognormal	19/29	ND - 499	58.2	426	32.8	252
Chromium	Lognormal	29/29	0.83 - 13.2	4.43	17.1	3.35	16.3
Cobalt	Neither	18/29	ND - 1.4	0.226	1.26	0.133	1.06
Copper	Lognormal	15/29	ND - 3.3	0.761	4.31	0.472	3.10
Iron	Lognormal	29/29	81.5 - 4600	1,212	5,881	773	6,311
Lead	Normal	29/29	1.1J - 6	2.88	8.16	2.61	6.55
Magnesium	Lognormal	29/29	13.5J - 216	93.8	361	70.1	369
Manganese	Lognormal	29/29	0.75J - 7.1	2.69	8.90	2.32	7.10
Mercury	Lognormal	19/29	ND - 0.061J	0.0313	0.0937	0.0276	0.0797
Nickel	Lognormal	23/29	ND - 3.6	0.779	4.29	0.42	5.10
Potassium	Lognormal	29/29	16J - 292	81.3	373	57.4	302
Selenium	Neither	11/29	ND - 0.47J	0.206	0.687	0.179	0.507
Silver	Neither	1/29	ND - 0.1J	0.0465	0.0889	0.0460	0.0633
Sodium	Normal	0/29	ND	35.4	83.3	33.1	70.8
Thallium	Neither	0/29	ND	0.184	0.225	0.183	0.206
Vanadium	Lognormal	29/29	0.6J - 13.7	4.92	19.7	3.56	20.3
Zinc	Lognormal	12/29	ND - 7.9	1.54	8.83	0.83	9.12

Background range = 2*standard deviation
Log mean + 2 STD was converted after the mean + 2 STD were added together

APPENDIX D

STATISTICS SUMMARY FOR INORGANICS IN SUB-SURFACE SOIL
AOC 5 BACKGROUND STUDY
MCB, CAMP LEJEUNE, NORTH CAROLINA

	Distribution	Frequency of Detection	Range	Arithmatic Mean Half Non-Detects	Standard Deviation	Arithmatic Mean + 2 Std Dev	Log Arithmatic Mean Half Non-Detects	Log Standard Deviation	Transformed Mean + 2 Std Dev	Untransformed Mean + 2 Std Dev
METALS (mg/kg)										
Aluminum	Normal	17/17	95.9 - 9880	4249.1706	2914.3817	10077.93	7.99	1.11	10.21	27173.57
Antimony	Neither	3/17	ND - 0.41J	0.1597	0.1006	0.36	-1.96	0.47	-1.02	0.36
Arsenic	Neither	5/17	ND - 3.1	0.4424	0.7297	1.90	-1.38	0.89	0.4	1.49
Barium	Lognormal	17/17	0.76J - 19.9	6.7565	4.9308	16.62	1.64	0.81	3.26	26.05
Beryllium	Lognormal	16/17	ND - 0.12J	0.05	0.0337	0.12	-3.21	0.68	-1.85	0.16
Cadmium	Neither	0/17	ND	0.0115	0.0004	0.01	-4.47	0.04	-4.39	0.01
Calcium	Lognormal	16/17	ND - 930	224.7882	246.9464	718.68	4.88	1.11	7.1	1211.97
Chromium	Normal	17/17	0.58J - 11.1	6.2576	3.0167	12.29	1.66	0.72	3.1	22.20
Cobalt	Neither	10/17	ND - 0.36J	0.16	0.1142	0.39	-2.14	0.86	-0.42	0.66
Copper	Normal	12/17	ND - 1.6	0.7956	0.5244	1.84	-0.53	0.89	1.25	3.49
Iron	Normal	17/17	111 - 4300	1531.8824	1124.97	3781.82	7.02	0.92	8.86	7044.48
Lead	Lognormal	17/17	1.6 - 6.4J	3.7765	1.6593	7.10	1.23	0.46	2.15	8.58
Magnesium	Normal	17/17	8.4J - 443	161.7529	120.8211	403.40	4.73	0.99	6.71	820.57
Manganese	Normal	17/17	0.56J - 5.4J	2.9529	1.5748	6.10	0.89	0.71	2.31	10.07
Mercury	Neither	5/17	ND - 0.049	0.0197	0.0128	0.05	-4.09	0.58	-2.93	0.05
Nickel	Normal	16/17	ND - 1.4	0.7235	0.3829	1.49	-0.55	0.83	1.11	3.03
Potassium	Normal	17/17	13.3J - 314	134.8471	90.262	315.37	4.65	0.81	6.27	528.48
Selenium	Neither	2/17	ND - 0.6J	0.17	0.1292	0.43	-1.91	0.46	-0.99	0.37
Silver	Neither	0/17	ND	0.0459	0.0016	0.05	-3.08	0.03	-3.02	0.05
Sodium	Lognormal	0/17	ND	42.2941	8.4194	59.13	3.73	0.18	4.09	59.74
Thallium	Neither	0/17	ND	0.1894	0.0061	0.20	-1.66	0.03	-1.6	0.20
Vanadium	Normal	17/17	0.4J - 12.5	5.9353	3.4977	12.93	1.55	0.82	3.19	24.29
Zinc	Neither	7/17	ND - 67.5	5.8294	15.9547	37.74	0.63	1.18	2.99	19.89

APPENDIX D

STATISTICS SUMMARY FOR INORGANICS IN SHALLOW GROUNDWATER
BASE BACKGROUND STUDY
MCB, CAMP LEJEUNE, NORTH CAROLINA

	Minimum Non-Detect	Maximum Non-Detect	Minimum Detected	Maximum Detected	Frequency of Detection	Arithmatic Mean Half Non-Detects	Standard Deviation	Arithmatic Mean Plus 2 Standard Deviations	Log Arithmatic Mean Half Non-Detects	Log Standard Deviation	Log Arithmatic Mean Plus 2 Standard Deviations
METALS (ug/L)											
Aluminum	19.6 U	180 U	294	3650	16/24	942.9	1079.8	3102.6	333.6	6.17	346.0
Antimony	2.2 U	4 U	0	0	0/24	1.64	0.39	2.42	1.58	1.30	4.18
Arsenic	2 U	2.4 U	6.6 J	19	4/24	2.88	4.62	12.1	1.57	2.48	6.54
Barium	22.8 U	55.7 U	9.2 J	143 J	21/24	43.1	33.2	109.4	33.1	2.10	37.31
Beryllium	0.2 U	1.2 U	0	0	0/24	0.15	0.13	0.42	0.13	1.72	3.56
Cadmium	0.3 U	0.4 U	0	0	0/24	0.18	0.03	0.23	0.18	1.15	2.48
Calcium	0	0	501 J	176000 J	24/24	34539.2	48613.0	131765.2	11849.0	4.95	11858.9
Chromium	0.5 UJ	1.7 U	0.66 J	8.4	11/24	1.56	2.10	5.76	0.77	3.25	7.28
Cobalt	0.7 U	2.9 U	0.73 J	5.6 J	10/24	1.70	1.86	5.42	0.95	2.97	6.90
Copper	1 U	4.3 U	5.1 J	5.1 J	1/24	1.38	1.14	3.66	1.01	2.23	5.46
Iron	44.1 U	46.9 U	140 J	32700 J	22/24	2999.6	6623.0	16245.5	943.9	5.31	954.5
Lead	1.1 U	1.8 U	1.5 J	4	10/24	1.40	1.10	3.61	1.08	2.03	5.15
Magnesium	0	0	728 J	11500	24/24	3181.5	2574.6	8330.7	2416.32	2.12	2420.6
Manganese	0	0	4.7 J	359	24/24	106.8	92.2	291.2	66.7	3.10	72.9
Mercury	0.1 U	0.1 U	0	0	0/24	0.05	0	0.05	0.05	1	2.05
Nickel	0.9 U	1.3 U	2 J	16.5 J	15/24	3.99	3.99	12.0	2.25	3.25	8.76
Potassium	353 U	745 U	677 J	4410	22/24	1638.7	892.0	3422.7	1380.2	1.95	1384.1
Selenium	2.1 UJ	4.6 U	0	0	0/24	1.57	0.63	2.83	1.46	1.48	4.42
Silver	0.5 U	0.9 U	0.79 J	0.95 J	2/24	0.39	0.18	0.74	0.35	1.49	3.34
Sodium	0	0	3370	23000	24/24	11254.2	6674.4	24602.9	9509.1	1.82	9512.7
Thallium	2.2 U	6 U	0	0	0/24	1.89	0.96	3.81	1.67	1.67	5.00
Vanadium	0.4 U	3.3 U	0.82 J	11.5 J	11/24	2.36	3.09	8.55	1	4.06	9.11
Zinc	1.6 U	10.1 U	4.6 J	129 J	14/24	21.0	31.04	83.11	8.76	4.06	16.9

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APPENDIX E

Summary of Analytical Data

SUBSURFACE SOILS ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-SB04-01	SWMU311-SB04-04	SWMU311-SB04-06	SWMU311-SB05-02	SWMU311-SB05-04	SWMU311-SB06-01	SWMU311-SB06-04
SAMPLE DATE	06-19-2003	06-19-2003	06-19-2003	06-18-2003	06-18-2003	06-19-2003	06-19-2003
DEPTH RANGE	1-3	7-9	11-13	3-5	7-9	1-3	7-9
VOLATILES (ug/kg)							
1,1,1-Trichloroethane	11 U	NA	NA	NA	12 U	12 U	NA
1,1,2,2-Tetrachloroethane	11 U	NA	NA	NA	12 U	12 U	NA
1,1,2-Trichloroethane	11 U	NA	NA	NA	12 U	12 U	NA
1,1,2-Trichlorotrifluoroethane	11 U	NA	NA	NA	12 U	12 U	NA
1,1-Dichloroethane	11 U	NA	NA	NA	12 U	12 U	NA
1,1-Dichloroethene	11 U	NA	NA	NA	12 U	12 U	NA
1,2,4-Trichlorobenzene	11 U	NA	NA	NA	12 U	12 U	NA
1,2-Dibromo-3-Chloropropane	11 U	NA	NA	NA	12 U	12 U	NA
1,2-Dibromoethane	11 U	NA	NA	NA	12 U	12 U	NA
1,2-Dichlorobenzene	11 U	NA	NA	NA	12 U	12 U	NA
1,2-Dichloroethane	11 U	NA	NA	NA	12 U	12 U	NA
1,2-Dichloropropane	11 U	NA	NA	NA	12 U	12 U	NA
1,3-Dichlorobenzene	11 U	NA	NA	NA	12 U	12 U	NA
1,4-Dichlorobenzene	11 U	NA	NA	NA	12 U	12 U	NA
2-Butanone	11 U	NA	NA	NA	12 U	12 U	NA
2-Hexanone	11 U	NA	NA	NA	12 U	12 U	NA
4-Methyl-2-Pentanone	11 U	NA	NA	NA	12 U	12 U	NA
Acetone	11 U	NA	NA	NA	12 U	12 U	NA
Benzene	11 U	NA	NA	NA	12 U	12 U	NA
Bromodichloromethane	11 U	NA	NA	NA	12 U	12 U	NA
Bromoform	11 U	NA	NA	NA	12 U	12 U	NA
Bromomethane	11 U	NA	NA	NA	12 U	12 U	NA
Carbon Disulfide	11 U	NA	NA	NA	12 U	12 U	NA
Carbon Tetrachloride	11 U	NA	NA	NA	12 U	12 U	NA
Chlorobenzene	11 U	NA	NA	NA	12 U	12 U	NA
Chloroethane	11 U	NA	NA	NA	12 U	12 U	NA
Chloroform	11 U	NA	NA	NA	12 U	12 U	NA
Chloromethane	11 U	NA	NA	NA	12 U	12 U	NA
cis-1,2-Dichloroethene	11 U	NA	NA	NA	12 U	12 U	NA
cis-1,3-Dichloropropene	11 U	NA	NA	NA	12 U	12 U	NA
Cyclohexane	11 U	NA	NA	NA	12 U	12 U	NA
Dibromochloromethane	11 U	NA	NA	NA	12 U	12 U	NA
Dichlorodifluoromethane	11 U	NA	NA	NA	12 U	12 U	NA
Ethyl Benzene	11 U	NA	NA	NA	12 U	12 U	NA
Isopropylbenzene	11 U	NA	NA	NA	12 U	12 U	NA
m/p-Xylenes	11 U	NA	NA	NA	12 U	12 U	NA
Methyl Acetate	11 U	NA	NA	NA	12 U	12 U	NA

SUBSURFACE SOILS ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-SB04-01	SWMU311-SB04-04	SWMU311-SB04-06	SWMU311-SB05-02	SWMU311-SB05-04	SWMU311-SB06-01	SWMU311-SB06-04
SAMPLE DATE	06-19-2003	06-19-2003	06-19-2003	06-18-2003	06-18-2003	06-19-2003	06-19-2003
DEPTH RANGE	1-3	7-9	11-13	3-5	7-9	1-3	7-9
VOLATILES (ug/kg)							
Methyl tert-butyl Ether	11 U	NA	NA	NA	12 U	12 U	NA
Methylcyclohexane	11 U	NA	NA	NA	12 U	12 U	NA
Methylene Chloride	1.9 J	NA	NA	NA	12 U	2.5 J	NA
o-Xylene	11 U	NA	NA	NA	12 U	12 U	NA
Styrene	11 U	NA	NA	NA	12 U	12 U	NA
t-1,3-Dichloropropene	11 U	NA	NA	NA	12 U	12 U	NA
Tetrachloroethene	11 U	NA	NA	NA	12 U	12 U	NA
Toluene	11 U	NA	NA	NA	12 U	12 U	NA
trans-1,2-Dichloroethene	11 U	NA	NA	NA	12 U	12 U	NA
Trichloroethene	11 U	NA	NA	NA	12 U	12 U	NA
Trichlorofluoromethane	11 U	NA	NA	NA	12 U	12 U	NA
Vinyl Chloride	11 U	NA	NA	NA	12 U	12 U	NA
METALS (mg/kg)							
Arsenic	0.62 U	0.62 U	4.5	0.62 U	0.65 U	0.67 U	0.68 U
Barium	11.5 J	2.9 J	14.9 J	12 J	7.1 J	20.7 J	7.4 J
Cadmium	0.09 U	0.09 U	0.1 U	1.1 J	0.09 U	0.1 U	0.1 U
Chromium	4.4	0.88 J	5	5.7	2.8	4.4	3.7
Lead	4.2	1	4.1	51.2 J	2.1 J	3.7	2.8
Mercury	0.1 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U
Selenium	0.66 UJ	0.68 J	0.71 UJ	0.67 UJ	0.7 UJ	1.1 J	0.73 UJ
Silver	0.36 J	0.22 UJ	0.43 J	0.22 UJ	0.23 UJ	0.44 J	0.38 J

SUBSURFACE SOILS ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-SB07-01	SWMU311-SB07-04	SWMU311-SB07-08	SWMU311-SB10-02	SWMU311-SB10-04	SWMU311-SB10-08	SWMU311-SB11-02
SAMPLE DATE	06-24-2003	06-24-2003	06-24-2003	06-18-2003	06-18-2003	06-18-2003	06-18-2003
DEPTH RANGE	13-15	7-9	15-17	3-5	7-9	15-17	3-5
VOLATILES (ug/kg)							
1,1,1-Trichloroethane	NA	NA	12 U	12 U	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	12 U	12 U	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	12 U	12 U	NA	NA	NA
1,1,2-Trichlorotrifluoroethane	NA	NA	12 U	12 U	NA	NA	NA
1,1-Dichloroethane	NA	NA	12 U	12 U	NA	NA	NA
1,1-Dichloroethene	NA	NA	12 U	12 U	NA	NA	NA
1,2,4-Trichlorobenzene	NA	NA	12 U	12 U	NA	NA	NA
1,2-Dibromo-3-Chloropropane	NA	NA	12 U	12 U	NA	NA	NA
1,2-Dibromoethane	NA	NA	12 U	12 U	NA	NA	NA
1,2-Dichlorobenzene	NA	NA	12 U	12 U	NA	NA	NA
1,2-Dichloroethane	NA	NA	12 U	12 U	NA	NA	NA
1,2-Dichloropropane	NA	NA	12 U	12 U	NA	NA	NA
1,3-Dichlorobenzene	NA	NA	12 U	12 U	NA	NA	NA
1,4-Dichlorobenzene	NA	NA	12 U	12 U	NA	NA	NA
2-Butanone	NA	NA	12 U	12 U	NA	NA	NA
2-Hexanone	NA	NA	12 U	12 U	NA	NA	NA
4-Methyl-2-Pentanone	NA	NA	12 U	12 U	NA	NA	NA
Acetone	NA	NA	41	12 U	NA	NA	NA
Benzene	NA	NA	12 U	12 U	NA	NA	NA
Bromodichloromethane	NA	NA	12 U	12 U	NA	NA	NA
Bromoform	NA	NA	12 U	12 U	NA	NA	NA
Bromomethane	NA	NA	12 U	12 U	NA	NA	NA
Carbon Disulfide	NA	NA	28	12 U	NA	NA	NA
Carbon Tetrachloride	NA	NA	12 U	12 U	NA	NA	NA
Chlorobenzene	NA	NA	12 U	12 U	NA	NA	NA
Chloroethane	NA	NA	12 U	12 U	NA	NA	NA
Chloroform	NA	NA	12 U	12 U	NA	NA	NA
Chloromethane	NA	NA	12 U	12 U	NA	NA	NA
cis-1,2-Dichloroethene	NA	NA	12 U	12 U	NA	NA	NA
cis-1,3-Dichloropropene	NA	NA	12 U	12 U	NA	NA	NA
Cyclohexane	NA	NA	12 U	12 U	NA	NA	NA
Dibromochloromethane	NA	NA	12 U	12 U	NA	NA	NA
Dichlorodifluoromethane	NA	NA	12 U	12 U	NA	NA	NA
Ethyl Benzene	NA	NA	12 U	12 U	NA	NA	NA
Isopropylbenzene	NA	NA	12 U	12 U	NA	NA	NA
m/p-Xylenes	NA	NA	12 U	12 U	NA	NA	NA
Methyl Acetate	NA	NA	12 U	12 U	NA	NA	NA

SUBSURFACE SOILS ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-SB07-01	SWMU311-SB07-04	SWMU311-SB07-08	SWMU311-SB10-02	SWMU311-SB10-04	SWMU311-SB10-08	SWMU311-SB11-02
SAMPLE DATE	06-24-2003	06-24-2003	06-24-2003	06-18-2003	06-18-2003	06-18-2003	06-18-2003
DEPTH RANGE	13-15	7-9	15-17	3-5	7-9	15-17	3-5
VOLATILES (ug/kg)							
Methyl tert-butyl Ether	NA	NA	12 U	12 U	NA	NA	NA
Methylcyclohexane	NA	NA	12 U	12 U	NA	NA	NA
Methylene Chloride	NA	NA	12 U	2.6 J	NA	NA	NA
o-Xylene	NA	NA	12 U	12 U	NA	NA	NA
Styrene	NA	NA	12 U	12 U	NA	NA	NA
t-1,3-Dichloropropene	NA	NA	12 U	12 U	NA	NA	NA
Tetrachloroethene	NA	NA	12 U	12 U	NA	NA	NA
Toluene	NA	NA	12 U	12 U	NA	NA	NA
trans-1,2-Dichloroethene	NA	NA	12 U	12 U	NA	NA	NA
Trichloroethene	NA	NA	12 U	12 U	NA	NA	NA
Trichlorofluoromethane	NA	NA	12 U	12 U	NA	NA	NA
Vinyl Chloride	NA	NA	12 U	12 U	NA	NA	NA
METALS (mg/kg)							
Arsenic	0.9 J	0.69 U	2.5	0.67 U	0.74 J	1.1 J	0.61 U
Barium	18.3 J	5.8 J	3.6 J	6.9 J	8.1 J	5.4 J	6.5 J
Cadmium	0.1 U	0.1 U	0.1 U	0.1 U	0.09 U	0.1 U	0.09 U
Chromium	0.15 U	0.15 U	0.15 U	1.4 J	4.8	7.4	2.9
Lead	5 J	2.3 J	2 J	2.2	3	4.8	2.8
Mercury	0.12 U	0.11 U	0.12 U	0.12 U	0.11 U	0.12 U	0.1 U
Selenium	1.7	0.74 U	0.73 U	0.72 UJ	0.69 UJ	0.74 UJ	0.67 J
Silver	0.25 UJ	0.25 UJ	0.24 UJ	0.35 J	0.33 J	0.36 J	0.51 J

SUBSURFACE SOILS ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-SB11-03	SWMU311-SB11-06	SWMU311-SB15-01	SWMU311-SB15-02	SWMU311-SB15-08	SWMU311-SB16-01	SWMU311-SB16-05
SAMPLE DATE	06-18-2003	06-18-2003	06-19-2003	06-19-2003	06-19-2003	06-19-2003	06-19-2003
DEPTH RANGE	5-7	11-13	1-3	3-5	15-17	1-3	9-11
VOLATILES (ug/kg)							
1,1,1-Trichloroethane	13 U	NA	NA	NA	13 U	NA	NA
1,1,2,2-Tetrachloroethane	13 U	NA	NA	NA	13 U	NA	NA
1,1,2-Trichloroethane	13 U	NA	NA	NA	13 U	NA	NA
1,1,2-Trichlorotrifluoroethane	13 U	NA	NA	NA	13 U	NA	NA
1,1-Dichloroethane	13 U	NA	NA	NA	13 U	NA	NA
1,1-Dichloroethene	13 U	NA	NA	NA	13 U	NA	NA
1,2,4-Trichlorobenzene	13 U	NA	NA	NA	13 U	NA	NA
1,2-Dibromo-3-Chloropropane	13 U	NA	NA	NA	13 U	NA	NA
1,2-Dibromoethane	13 U	NA	NA	NA	13 U	NA	NA
1,2-Dichlorobenzene	13 U	NA	NA	NA	13 U	NA	NA
1,2-Dichloroethane	13 U	NA	NA	NA	13 U	NA	NA
1,2-Dichloropropane	13 U	NA	NA	NA	13 U	NA	NA
1,3-Dichlorobenzene	13 U	NA	NA	NA	13 U	NA	NA
1,4-Dichlorobenzene	13 U	NA	NA	NA	13 U	NA	NA
2-Butanone	13 U	NA	NA	NA	13 U	NA	NA
2-Hexanone	13 U	NA	NA	NA	13 U	NA	NA
4-Methyl-2-Pentanone	13 U	NA	NA	NA	13 U	NA	NA
Acetone	13 U	NA	NA	NA	13 U	NA	NA
Benzene	13 U	NA	NA	NA	13 U	NA	NA
Bromodichloromethane	13 U	NA	NA	NA	13 U	NA	NA
Bromoform	13 U	NA	NA	NA	13 U	NA	NA
Bromomethane	13 U	NA	NA	NA	13 U	NA	NA
Carbon Disulfide	13 U	NA	NA	NA	13 U	NA	NA
Carbon Tetrachloride	13 U	NA	NA	NA	13 U	NA	NA
Chlorobenzene	13 U	NA	NA	NA	13 U	NA	NA
Chloroethane	13 U	NA	NA	NA	13 U	NA	NA
Chloroform	13 U	NA	NA	NA	13 U	NA	NA
Chloromethane	13 U	NA	NA	NA	13 U	NA	NA
cis-1,2-Dichloroethene	13 U	NA	NA	NA	13 U	NA	NA
cis-1,3-Dichloropropene	13 U	NA	NA	NA	13 U	NA	NA
Cyclohexane	13 U	NA	NA	NA	13 U	NA	NA
Dibromochloromethane	13 U	NA	NA	NA	13 U	NA	NA
Dichlorodifluoromethane	13 U	NA	NA	NA	13 U	NA	NA
Ethyl Benzene	13 U	NA	NA	NA	13 U	NA	NA
Isopropylbenzene	13 U	NA	NA	NA	13 U	NA	NA
m/p-Xylenes	13 U	NA	NA	NA	13 U	NA	NA
Methyl Acetate	13 U	NA	NA	NA	13 U	NA	NA

SUBSURFACE SOILS ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-SB11-03	SWMU311-SB11-06	SWMU311-SB15-01	SWMU311-SB15-02	SWMU311-SB15-08	SWMU311-SB16-01	SWMU311-SB16-05
SAMPLE DATE	06-18-2003	06-18-2003	06-19-2003	06-19-2003	06-19-2003	06-19-2003	06-19-2003
DEPTH RANGE	5-7	11-13	1-3	3-5	15-17	1-3	9-11
VOLATILES (ug/kg)							
Methyl tert-butyl Ether	13 U	NA	NA	NA	13 U	NA	NA
Methylcyclohexane	13 U	NA	NA	NA	13 U	NA	NA
Methylene Chloride	2.3 J	NA	NA	NA	13 U	NA	NA
o-Xylene	13 U	NA	NA	NA	13 U	NA	NA
Styrene	13 U	NA	NA	NA	13 U	NA	NA
t-1,3-Dichloropropene	13 U	NA	NA	NA	13 U	NA	NA
Tetrachloroethene	13 U	NA	NA	NA	13 U	NA	NA
Toluene	13 U	NA	NA	NA	13 U	NA	NA
trans-1,2-Dichloroethene	13 U	NA	NA	NA	13 U	NA	NA
Trichloroethene	13 U	NA	NA	NA	13 U	NA	NA
Trichlorofluoromethane	13 U	NA	NA	NA	13 U	NA	NA
Vinyl Chloride	13 U	NA	NA	NA	13 U	NA	NA
METALS (mg/kg)							
Arsenic	0.74 U	0.72 U	0.66 J	0.73 U	0.75 U	0.64 U	2.1 J
Barium	2.5 J	24.4 J	2.2 J	8.8 J	30.7 J	9.8 J	18 J
Cadmium	0.11 U	0.1 U	0.09 U	0.1 U	0.11 J	0.09 J	0.1 U
Chromium	4.3	5.5	2.4	5.2	6.7	5.1	7.4
Lead	3.1	8.6	1.8	10.5	6.5	7.6	6.3
Mercury	0.12 U	0.12 U	0.11 U	0.12 U	0.13 U	0.1 U	0.12 U
Selenium	1.1 J	0.77 UJ	1.3 J	0.78 UJ	0.8 UJ	0.68 UJ	0.74 UJ
Silver	0.39 J	0.41 J	0.37 J	0.35 J	0.65 J	0.54 J	0.43 J

SUBSURFACE SOILS ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-SB16-08	SWMU311-SB18-02	SWMU311-SB18-04	SWMU311-SB18-06	SWMU311-SB20-01	SWMU311-SB20-03	SWMU311-SB20-06
SAMPLE DATE	06-19-2003	06-23-2003	06-23-2003	06-23-2003	06-23-2003	06-23-2003	06-23-2003
DEPTH RANGE	15-17	3-5	7-9	11-13	1-3	5-7	11-13
VOLATILES (ug/kg)							
1,1,1-Trichloroethane	12 U	11 U	NA	NA	NA	12 U	NA
1,1,2,2-Tetrachloroethane	12 U	11 U	NA	NA	NA	12 U	NA
1,1,2-Trichloroethane	12 U	11 U	NA	NA	NA	12 U	NA
1,1,2-Trichlorotrifluoroethane	12 U	11 U	NA	NA	NA	12 U	NA
1,1-Dichloroethane	12 U	11 U	NA	NA	NA	12 U	NA
1,1-Dichloroethene	12 U	11 U	NA	NA	NA	12 U	NA
1,2,4-Trichlorobenzene	12 U	11 U	NA	NA	NA	12 U	NA
1,2-Dibromo-3-Chloropropane	12 U	11 R	NA	NA	NA	12 U	NA
1,2-Dibromoethane	12 U	11 U	NA	NA	NA	12 U	NA
1,2-Dichlorobenzene	12 U	11 U	NA	NA	NA	12 U	NA
1,2-Dichloroethane	12 U	11 U	NA	NA	NA	12 U	NA
1,2-Dichloropropane	12 U	11 U	NA	NA	NA	12 U	NA
1,3-Dichlorobenzene	12 U	11 U	NA	NA	NA	12 U	NA
1,4-Dichlorobenzene	12 U	11 U	NA	NA	NA	12 U	NA
2-Butanone	12 U	11 U	NA	NA	NA	12 U	NA
2-Hexanone	12 U	11 U	NA	NA	NA	12 U	NA
4-Methyl-2-Pentanone	12 U	11 U	NA	NA	NA	12 U	NA
Acetone	22	11 UJ	NA	NA	NA	12 J	NA
Benzene	12 U	11 U	NA	NA	NA	12 U	NA
Bromodichloromethane	12 U	11 U	NA	NA	NA	12 U	NA
Bromoform	12 U	11 U	NA	NA	NA	12 U	NA
Bromomethane	12 U	11 U	NA	NA	NA	12 U	NA
Carbon Disulfide	12 U	11 U	NA	NA	NA	12 U	NA
Carbon Tetrachloride	12 U	11 U	NA	NA	NA	12 U	NA
Chlorobenzene	12 U	11 U	NA	NA	NA	12 U	NA
Chloroethane	12 U	11 U	NA	NA	NA	12 U	NA
Chloroform	12 U	11 U	NA	NA	NA	12 U	NA
Chloromethane	12 U	11 U	NA	NA	NA	12 U	NA
cis-1,2-Dichloroethene	12 U	11 U	NA	NA	NA	12 U	NA
cis-1,3-Dichloropropene	12 U	11 U	NA	NA	NA	12 U	NA
Cyclohexane	12 U	11 U	NA	NA	NA	12 U	NA
Dibromochloromethane	12 U	11 U	NA	NA	NA	12 U	NA
Dichlorodifluoromethane	12 U	11 U	NA	NA	NA	12 U	NA
Ethyl Benzene	12 U	11 U	NA	NA	NA	12 U	NA
Isopropylbenzene	12 U	11 U	NA	NA	NA	12 U	NA
m/p-Xylenes	12 U	11 U	NA	NA	NA	12 U	NA
Methyl Acetate	12 U	11 U	NA	NA	NA	12 U	NA

SUBSURFACE SOILS ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-SB16-08	SWMU311-SB18-02	SWMU311-SB18-04	SWMU311-SB18-06	SWMU311-SB20-01	SWMU311-SB20-03	SWMU311-SB20-06
SAMPLE DATE	06-19-2003	06-23-2003	06-23-2003	06-23-2003	06-23-2003	06-23-2003	06-23-2003
DEPTH RANGE	15-17	3-5	7-9	11-13	1-3	5-7	11-13
VOLATILES (ug/kg)							
Methyl tert-butyl Ether	12 U	11 U	NA	NA	NA	12 U	NA
Methylcyclohexane	12 U	11 U	NA	NA	NA	12 U	NA
Methylene Chloride	3 J	11 U	NA	NA	NA	12 U	NA
o-Xylene	12 U	11 U	NA	NA	NA	12 U	NA
Styrene	12 U	11 U	NA	NA	NA	12 U	NA
t-1,3-Dichloropropene	12 U	11 U	NA	NA	NA	12 U	NA
Tetrachloroethene	1.3 J	11 U	NA	NA	NA	12 U	NA
Toluene	12 U	11 U	NA	NA	NA	12 U	NA
trans-1,2-Dichloroethene	12 U	11 U	NA	NA	NA	12 U	NA
Trichloroethene	12 U	11 U	NA	NA	NA	12 U	NA
Trichlorofluoromethane	12 U	11 U	NA	NA	NA	12 U	NA
Vinyl Chloride	12 U	11 U	NA	NA	NA	12 U	NA
METALS (mg/kg)							
Arsenic	0.69 U	0.61 U	0.58 U	0.65 U	0.7 U	0.64 U	0.72 U
Barium	2.8 J	7.2 J	1.6 J	2 J	4.8 J	8.9 J	25.4 J
Cadmium	0.1 U	0.09 U	0.08 U	0.09 U	0.1 U	0.09 U	0.1 U
Chromium	2.5	0.13 U	0.12 U	0.14 U	0.15 U	0.14 U	0.15 U
Lead	1.6	1.8	1	1.2	4.7	3.9	5.8
Mercury	0.11 U	0.11 U	0.1 U	0.12 U	0.12 U	0.11 U	0.13 U
Selenium	0.74 UJ	0.65 UJ	0.62 U	0.7 U	0.96 J	0.69 U	0.87 J
Silver	0.49 J	0.22 UJ	0.21 UJ	0.23 UJ	0.25 UJ	0.23 UJ	0.26 UJ

SUBSURFACE SOIL DUPLICATE ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-SB16-08D	SWMU311-SB20-03D
SAMPLE DATE	06-19-2003	06-23-2003
DEPTH RANGE	15-17	5-7
VOLATILES (ug/kg)		
1,1,1-Trichloroethane	NA	12 U
1,1,2,2-Tetrachloroethane	NA	12 U
1,1,2-Trichloroethane	NA	12 U
1,1,2-Trichlorotrifluoroethane	NA	12 U
1,1-Dichloroethane	NA	12 U
1,1-Dichloroethene	NA	12 U
1,2,4-Trichlorobenzene	NA	12 U
1,2-Dibromo-3-Chloropropane	NA	12 U
1,2-Dibromoethane	NA	12 U
1,2-Dichlorobenzene	NA	12 U
1,2-Dichloroethane	NA	12 U
1,2-Dichloropropane	NA	12 U
1,3-Dichlorobenzene	NA	12 U
1,4-Dichlorobenzene	NA	12 U
2-Butanone	NA	12 U
2-Hexanone	NA	12 U
4-Methyl-2-Pentanone	NA	12 U
Acetone	NA	24 J
Benzene	NA	12 U
Bromodichloromethane	NA	12 U
Bromoform	NA	12 U
Bromomethane	NA	12 U
Carbon Disulfide	NA	12 U
Carbon Tetrachloride	NA	12 U
Chlorobenzene	NA	12 U
Chloroethane	NA	12 U
Chloroform	NA	12 U
Chloromethane	NA	12 U
cis-1,2-Dichloroethene	NA	12 U
cis-1,3-Dichloropropene	NA	12 U
Cyclohexane	NA	12 U
Dibromochloromethane	NA	12 U
Dichlorodifluoromethane	NA	12 U
Ethyl Benzene	NA	12 U
Isopropylbenzene	NA	12 U
m/p-Xylenes	NA	12 U
Methyl Acetate	NA	12 U
Methyl tert-butyl Ether	NA	12 U
Methylcyclohexane	NA	12 U
Methylene Chloride	NA	12 U
o-Xylene	NA	12 U
Styrene	NA	12 U
t-1,3-Dichloropropene	NA	12 U
Tetrachloroethene	NA	12 U
Toluene	NA	12 U
trans-1,2-Dichloroethene	NA	12 U
Trichloroethene	NA	12 U
Trichlorofluoromethane	NA	12 U
Vinyl Chloride	NA	12 U

SUBSURFACE SOIL DUPLICATE ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-SB16-08D	SWMU311-SB20-03D
SAMPLE DATE	06-19-2003	06-23-2003
DEPTH RANGE	15-17	5-7
METALS (mg/kg)		
Arsenic	0.72 U	0.64 U
Barium	4.6 J	7.9 J
Cadmium	0.1 U	0.09 U
Chromium	3.2	0.14 U
Lead	2.4	3.9
Mercury	0.12 U	0.11 U
Selenium	0.77 UJ	0.68 U
Silver	0.56 J	0.23 UJ

SURFACE SOIL ANALYTICAL RESULTS - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D.	SWMU311-SB04-00	SWMU311-SB06-00	SWMU311-SB07-00	SWMU311-SB15-00	SWMU311-SB16-00	SWMU311-SB20-00
Lab Sample I.D.	Missing	Missing	Missing	Missing	Missing	Missing
Sample Date	06-19-2003	06-19-2003	06-24-2003	06-19-2003	06-19-2003	06-23-2003
Depth Range	0-1	0-1	0-1	0-1	0-1	0-1
Volatiles (ug/kg)						
1,1-Dichloroethene	2 U	2 U	2 U	2 U	2 U	2 U
Benzene	2 U	2 U	2 U	2 U	2 U	2 U
cis-1,2-Dichloroethene	2 U	2 U	2 U	2 U	2 U	2 U
Methylene Chloride	2 U	2 U	2 U	2 U	2 U	2 U
Tetrachloroethene	2 U	2 U	2 U	2 U	2 U	2 U
Trichloroethene	2 U	2 U	2 U	2 U	2 U	2 U
trans 1,2-Dichloroethene	2 U	2 U	2 U	2 U	2 U	2 U

SUBSURFACE SOILS ANALYTICAL RESULTS - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D.	SWMU311-SB04-01	SWMU311-SB04-02	SWMU311-SB04-06	SWMU311-SB04-08	SWMU311-SB05-02
Lab Sample I.D.	Missing	Missing	Missing	Missing	Missing
Sample Date	06-19-2003	06-19-2003	06-19-2003	06-19-2003	06-18-2003
Depth Range	1-3	3-5	11-13	15-17	3-5
Volatiles					
1,1,1,2-Tetrachloroethane	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA
1,1-Dichloroethene	2 U	2 U	2 U	2 U	2 U
1,1-Dichloropropene	NA	NA	NA	NA	NA
1,2,3-Trichlorobenzene	NA	NA	NA	NA	NA
1,2,3-Trichloropropane	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	NA	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	NA	NA	NA	NA	NA
1,2-Dichloroethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,3-Dichloropropane	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	NA	NA	NA	NA	NA
2,2-Dichloropropane	NA	NA	NA	NA	NA
2-Chlorotoluene	NA	NA	NA	NA	NA
4-Chlorotoluene	NA	NA	NA	NA	NA
Benzene	2 U	2 U	2 U	2 U	2 U
Bromobenzene	NA	NA	NA	NA	NA
Bromochloromethane	NA	NA	NA	NA	NA
Bromodichloroemethane	NA	NA	NA	NA	NA
Bromoform	NA	NA	NA	NA	NA
Bromomethane	NA	NA	NA	NA	NA
Carbon Tetrachloride	NA	NA	NA	NA	NA
Chlorobenzene	NA	NA	NA	NA	NA
Chloroethane	NA	NA	NA	NA	NA
Chloroform	NA	NA	NA	NA	NA

SUBSURFACE SOILS ANALYTICAL RESULTS - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D.	SWMU311-SB04-01	SWMU311-SB04-02	SWMU311-SB04-06	SWMU311-SB04-08	SWMU311-SB05-02
Lab Sample I.D.	Missing	Missing	Missing	Missing	Missing
Sample Date	06-19-2003	06-19-2003	06-19-2003	06-19-2003	06-18-2003
Depth Range	1-3	3-5	11-13	15-17	3-5
Volatiles (cont.)					
Chloromethane	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	2 U	2 U	2 U	2 U	2 U
cis-1,3-Dichloropropene	NA	NA	NA	NA	NA
Dibromochloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
Dichlorodifluoromethane	NA	NA	NA	NA	NA
Ethylbenzene	NA	NA	NA	NA	NA
Hexachlorobutadiene	NA	NA	NA	NA	NA
Isopropylbenzene	NA	NA	NA	NA	NA
meta,para-Xylene	NA	NA	NA	NA	NA
Methylene Chloride	2 U	2 U	2 U	2 U	2 U
Naphthalene	NA	NA	NA	NA	NA
n-Butylbenzene	NA	NA	NA	NA	NA
n-Propylbenzene	NA	NA	NA	NA	NA
ortho-Xylene	NA	NA	NA	NA	NA
para-Isopropyltoluene	NA	NA	NA	NA	NA
sec-Butylbenzene	NA	NA	NA	NA	NA
Styrene	NA	NA	NA	NA	NA
tert-Butylbenzene	NA	NA	NA	NA	NA
Tetrachloroethene	2 U	2 U	2 U	2 U	2 U
Toluene	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	2 U	2 U	2 U	2 U	2 U
trans-1,3-Dichloropropene	NA	NA	NA	NA	NA
Trichloroethene	2 U	2 U	2 U	2 U	2 U
Trichlorofluoromethane	NA	NA	NA	NA	NA
Vinyl Chloride	NA	NA	NA	NA	NA

SUBSURFACE SOILS ANALYTICAL RESULTS - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D.	SWMU311-SB05-04	SWMU311-SB06-01	SWMU311-SB06-04	SWMU311-SB06-06	SWMU311-SB07-01
Lab Sample I.D.	Missing	Missing	Missing	Missing	Missing
Sample Date	06-18-2003	06-19-2003	06-19-2003	06-19-2003	06-24-2003
Depth Range	7-9	1-3	7-9	11-13	1-3
Volatiles					
1,1,1,2-Tetrachloroethane	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA
1,1-Dichloroethene	2 U	2 U	2 U	2 U	2 U
1,1-Dichloropropene	NA	NA	NA	NA	NA
1,2,3-Trichlorobenzene	NA	NA	NA	NA	NA
1,2,3-Trichloropropane	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	NA	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	NA	NA	NA	NA	NA
1,2-Dichloroethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,3-Dichloropropane	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	NA	NA	NA	NA	NA
2,2-Dichloropropane	NA	NA	NA	NA	NA
2-Chlorotoluene	NA	NA	NA	NA	NA
4-Chlorotoluene	NA	NA	NA	NA	NA
Benzene	2 U	2 U	2 U	2 U	2 U
Bromobenzene	NA	NA	NA	NA	NA
Bromochloromethane	NA	NA	NA	NA	NA
Bromodichloroemethane	NA	NA	NA	NA	NA
Bromoform	NA	NA	NA	NA	NA
Bromomethane	NA	NA	NA	NA	NA
Carbon Tetrachloride	NA	NA	NA	NA	NA
Chlorobenzene	NA	NA	NA	NA	NA
Chloroethane	NA	NA	NA	NA	NA
Chloroform	NA	NA	NA	NA	NA

SUBSURFACE SOILS ANALYTICAL RESULTS - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D.	SWMU311-SB05-04	SWMU311-SB06-01	SWMU311-SB06-04	SWMU311-SB06-06	SWMU311-SB07-01
Lab Sample I.D.	Missing	Missing	Missing	Missing	Missing
Sample Date	06-18-2003	06-19-2003	06-19-2003	06-19-2003	06-24-2003
Depth Range	7-9	1-3	7-9	11-13	1-3
Volatiles (cont.)					
Chloromethane	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	2 U	2 U	2 U	2 U	2 U
cis-1,3-Dichloropropene	NA	NA	NA	NA	NA
Dibromochloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
Dichlorodifluoromethane	NA	NA	NA	NA	NA
Ethylbenzene	NA	NA	NA	NA	NA
Hexachlorobutadiene	NA	NA	NA	NA	NA
Isopropylbenzene	NA	NA	NA	NA	NA
meta,para-Xylene	NA	NA	NA	NA	NA
Methylene Chloride	2 U	2 U	2 U	2 U	2 U
Naphthalene	NA	NA	NA	NA	NA
n-Butylbenzene	NA	NA	NA	NA	NA
n-Propylbenzene	NA	NA	NA	NA	NA
ortho-Xylene	NA	NA	NA	NA	NA
para-Isopropyltoluene	NA	NA	NA	NA	NA
sec-Butylbenzene	NA	NA	NA	NA	NA
Styrene	NA	NA	NA	NA	NA
tert-Butylbenzene	NA	NA	NA	NA	NA
Tetrachloroethene	2 U	2 U	2 U	2 U	2 U
Toluene	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	2 U	2 U	2 U	2 U	2 U
trans-1,3-Dichloropropene	NA	NA	NA	NA	NA
Trichloroethene	2 U	2 U	2 U	2 U	2 U
Trichlorofluoromethane	NA	NA	NA	NA	NA
Vinyl Chloride	NA	NA	NA	NA	NA

SUBSURFACE SOILS ANALYTICAL RESULTS - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D.	SWMU311-SB07-03	SWMU311-SB07-06	SWMU311-SB07-08	SWMU311-SB10-02	SWMU311-SB10-04
Lab Sample I.D.	Missing	Missing	Missing	Missing	Missing
Sample Date	06-24-2003	06-24-2003	06-24-2003	06-18-2003	06-18-2003
Depth Range	5-7	11-13	15-17	3-5	7-9
Volatiles					
1,1,1,2-Tetrachloroethane	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA
1,1-Dichloroethene	2 U	2 U	2 U	2 U	2 U
1,1-Dichloropropene	NA	NA	NA	NA	NA
1,2,3-Trichlorobenzene	NA	NA	NA	NA	NA
1,2,3-Trichloropropane	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	NA	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	NA	NA	NA	NA	NA
1,2-Dichloroethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,3-Dichloropropane	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	NA	NA	NA	NA	NA
2,2-Dichloropropane	NA	NA	NA	NA	NA
2-Chlorotoluene	NA	NA	NA	NA	NA
4-Chlorotoluene	NA	NA	NA	NA	NA
Benzene	2 U	2 U	2 U	2 U	2 U
Bromobenzene	NA	NA	NA	NA	NA
Bromochloromethane	NA	NA	NA	NA	NA
Bromodichloroemethane	NA	NA	NA	NA	NA
Bromoform	NA	NA	NA	NA	NA
Bromomethane	NA	NA	NA	NA	NA
Carbon Tetrachloride	NA	NA	NA	NA	NA
Chlorobenzene	NA	NA	NA	NA	NA
Chloroethane	NA	NA	NA	NA	NA
Chloroform	NA	NA	NA	NA	NA

SUBSURFACE SOILS ANALYTICAL RESULTS - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D.	SWMU311-SB07-03	SWMU311-SB07-06	SWMU311-SB07-08	SWMU311-SB10-02	SWMU311-SB10-04
Lab Sample I.D.	Missing	Missing	Missing	Missing	Missing
Sample Date	06-24-2003	06-24-2003	06-24-2003	06-18-2003	06-18-2003
Depth Range	5-7	11-13	15-17	3-5	7-9
Volatiles (cont.)					
Chloromethane	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	2 U	2 U	2 U	2 U	2 U
cis-1,3-Dichloropropene	NA	NA	NA	NA	NA
Dibromochloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
Dichlorodifluoromethane	NA	NA	NA	NA	NA
Ethylbenzene	NA	NA	NA	NA	NA
Hexachlorobutadiene	NA	NA	NA	NA	NA
Isopropylbenzene	NA	NA	NA	NA	NA
meta,para-Xylene	NA	NA	NA	NA	NA
Methylene Chloride	2 U	2 U	2 U	2 U	2 U
Naphthalene	NA	NA	NA	NA	NA
n-Butylbenzene	NA	NA	NA	NA	NA
n-Propylbenzene	NA	NA	NA	NA	NA
ortho-Xylene	NA	NA	NA	NA	NA
para-Isopropyltoluene	NA	NA	NA	NA	NA
sec-Butylbenzene	NA	NA	NA	NA	NA
Styrene	NA	NA	NA	NA	NA
tert-Butylbenzene	NA	NA	NA	NA	NA
Tetrachloroethene	2 U	2 U	2 U	2 U	2 U
Toluene	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	2 U	2 U	2 U	2 U	2 U
trans-1,3-Dichloropropene	NA	NA	NA	NA	NA
Trichloroethene	2 U	2 U	2 U	2 U	2 U
Trichlorofluoromethane	NA	NA	NA	NA	NA
Vinyl Chloride	NA	NA	NA	NA	NA

SUBSURFACE SOILS ANALYTICAL RESULTS - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D.	SWMU311-SB10-06	SWMU311-SB11-02	SWMU311-SB11-03	SWMU311-SB11-06	SWMU311-SB11-08
Lab Sample I.D.	Missing	Missing	Missing	Missing	Missing
Sample Date	06-18-2003	06-18-2003	06-18-2003	06-18-2003	06-18-2003
Depth Range	11-13	3-5	5-7	11-13	15-17
Volatiles					
1,1,1,2-Tetrachloroethane	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA
1,1-Dichloroethene	2 U	2 U	2 U	2 U	2 U
1,1-Dichloropropene	NA	NA	NA	NA	NA
1,2,3-Trichlorobenzene	NA	NA	NA	NA	NA
1,2,3-Trichloropropane	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	NA	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	NA	NA	NA	NA	NA
1,2-Dichloroethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,3-Dichloropropane	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	NA	NA	NA	NA	NA
2,2-Dichloropropane	NA	NA	NA	NA	NA
2-Chlorotoluene	NA	NA	NA	NA	NA
4-Chlorotoluene	NA	NA	NA	NA	NA
Benzene	2 U	2 U	2 U	2 U	2 U
Bromobenzene	NA	NA	NA	NA	NA
Bromochloromethane	NA	NA	NA	NA	NA
Bromodichloroemethane	NA	NA	NA	NA	NA
Bromoform	NA	NA	NA	NA	NA
Bromomethane	NA	NA	NA	NA	NA
Carbon Tetrachloride	NA	NA	NA	NA	NA
Chlorobenzene	NA	NA	NA	NA	NA
Chloroethane	NA	NA	NA	NA	NA
Chloroform	NA	NA	NA	NA	NA

SUBSURFACE SOILS ANALYTICAL RESULTS - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D.	SWMU311-SB10-06	SWMU311-SB11-02	SWMU311-SB11-03	SWMU311-SB11-06	SWMU311-SB11-08
Lab Sample I.D.	Missing	Missing	Missing	Missing	Missing
Sample Date	06-18-2003	06-18-2003	06-18-2003	06-18-2003	06-18-2003
Depth Range	11-13	3-5	5-7	11-13	15-17
Volatiles (cont.)					
Chloromethane	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	2 U	2 U	2 U	2 U	2 U
cis-1,3-Dichloropropene	NA	NA	NA	NA	NA
Dibromochloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
Dichlorodifluoromethane	NA	NA	NA	NA	NA
Ethylbenzene	NA	NA	NA	NA	NA
Hexachlorobutadiene	NA	NA	NA	NA	NA
Isopropylbenzene	NA	NA	NA	NA	NA
meta,para-Xylene	NA	NA	NA	NA	NA
Methylene Chloride	2 U	2 U	2 U	2 U	2 U
Naphthalene	NA	NA	NA	NA	NA
n-Butylbenzene	NA	NA	NA	NA	NA
n-Propylbenzene	NA	NA	NA	NA	NA
ortho-Xylene	NA	NA	NA	NA	NA
para-Isopropyltoluene	NA	NA	NA	NA	NA
sec-Butylbenzene	NA	NA	NA	NA	NA
Styrene	NA	NA	NA	NA	NA
tert-Butylbenzene	NA	NA	NA	NA	NA
Tetrachloroethene	2 U	2 U	2 U	2 U	2 U
Toluene	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	2 U	2 U	2 U	2 U	2 U
trans-1,3-Dichloropropene	NA	NA	NA	NA	NA
Trichloroethene	2 U	2 U	2 U	2 U	2 U
Trichlorofluoromethane	NA	NA	NA	NA	NA
Vinyl Chloride	NA	NA	NA	NA	NA

SUBSURFACE SOILS ANALYTICAL RESULTS - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D.	SWMU311-SB15-00	SWMU311-SB15-01	SWMU311-SB15-02	SWMU311-SB15-05	SWMU311-SB16-01
Lab Sample I.D.	Missing	Missing	Missing	Missing	Missing
Sample Date	06-19-2003	06-19-2003	06-19-2003	06-19-2003	06-19-2003
Depth Range	0-1	1-3	3-5	9-11	1-3
Volatiles					
1,1,1,2-Tetrachloroethane	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA
1,1-Dichloroethene	2 U	2 U	2 U	2 U	2 U
1,1-Dichloropropene	NA	NA	NA	NA	NA
1,2,3-Trichlorobenzene	NA	NA	NA	NA	NA
1,2,3-Trichloropropane	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	NA	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	NA	NA	NA	NA	NA
1,2-Dichloroethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,3-Dichloropropane	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	NA	NA	NA	NA	NA
2,2-Dichloropropane	NA	NA	NA	NA	NA
2-Chlorotoluene	NA	NA	NA	NA	NA
4-Chlorotoluene	NA	NA	NA	NA	NA
Benzene	2 U	2 U	2 U	2 U	2 U
Bromobenzene	NA	NA	NA	NA	NA
Bromochloromethane	NA	NA	NA	NA	NA
Bromodichloroemethane	NA	NA	NA	NA	NA
Bromoform	NA	NA	NA	NA	NA
Bromomethane	NA	NA	NA	NA	NA
Carbon Tetrachloride	NA	NA	NA	NA	NA
Chlorobenzene	NA	NA	NA	NA	NA
Chloroethane	NA	NA	NA	NA	NA
Chloroform	NA	NA	NA	NA	NA

SUBSURFACE SOILS ANALYTICAL RESULTS - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D.	SWMU311-SB15-00	SWMU311-SB15-01	SWMU311-SB15-02	SWMU311-SB15-05	SWMU311-SB16-01
Lab Sample I.D.	Missing	Missing	Missing	Missing	Missing
Sample Date	06-19-2003	06-19-2003	06-19-2003	06-19-2003	06-19-2003
Depth Range	0-1	1-3	3-5	9-11	1-3
Volatiles (cont.)					
Chloromethane	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	2 U	2 U	2 U	2 U	2 U
cis-1,3-Dichloropropene	NA	NA	NA	NA	NA
Dibromochloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
Dichlorodifluoromethane	NA	NA	NA	NA	NA
Ethylbenzene	NA	NA	NA	NA	NA
Hexachlorobutadiene	NA	NA	NA	NA	NA
Isopropylbenzene	NA	NA	NA	NA	NA
meta,para-Xylene	NA	NA	NA	NA	NA
Methylene Chloride	2 U	2 U	2 U	2 U	2 U
Naphthalene	NA	NA	NA	NA	NA
n-Butylbenzene	NA	NA	NA	NA	NA
n-Propylbenzene	NA	NA	NA	NA	NA
ortho-Xylene	NA	NA	NA	NA	NA
para-Isopropyltoluene	NA	NA	NA	NA	NA
sec-Butylbenzene	NA	NA	NA	NA	NA
Styrene	NA	NA	NA	NA	NA
tert-Butylbenzene	NA	NA	NA	NA	NA
Tetrachloroethene	2 U	2 U	2 U	2 U	2 U
Toluene	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	2 U	2 U	2 U	2 U	2 U
trans-1,3-Dichloropropene	NA	NA	NA	NA	NA
Trichloroethene	2 U	2 U	2 U	2 U	2 U
Trichlorofluoromethane	NA	NA	NA	NA	NA
Vinyl Chloride	NA	NA	NA	NA	NA

SUBSURFACE SOILS ANALYTICAL RESULTS - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D.	SWMU311-SB16-03	SWMU311-SB16-05	SWMU311-SB18-02	SWMU311-SB18-04	SWMU311-SB18-06
Lab Sample I.D.	Missing	Missing	Missing	Missing	Missing
Sample Date	06-19-2003	06-19-2003	06-23-2003	06-23-2003	06-23-2003
Depth Range	5-7	9-11	3-5	7-9	11-13
Volatiles					
1,1,1,2-Tetrachloroethane	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA
1,1-Dichloroethene	2 U	2 U	2 U	2 U	2 U
1,1-Dichloropropene	NA	NA	NA	NA	NA
1,2,3-Trichlorobenzene	NA	NA	NA	NA	NA
1,2,3-Trichloropropane	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	NA	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	NA	NA	NA	NA	NA
1,2-Dichloroethane	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA
1,3,5-Trimethylbenzene	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	NA	NA	NA	NA	NA
1,3-Dichloropropane	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	NA	NA	NA	NA	NA
2,2-Dichloropropane	NA	NA	NA	NA	NA
2-Chlorotoluene	NA	NA	NA	NA	NA
4-Chlorotoluene	NA	NA	NA	NA	NA
Benzene	2 U	2 U	2 U	2 U	2 U
Bromobenzene	NA	NA	NA	NA	NA
Bromochloromethane	NA	NA	NA	NA	NA
Bromodichloroemethane	NA	NA	NA	NA	NA
Bromoform	NA	NA	NA	NA	NA
Bromomethane	NA	NA	NA	NA	NA
Carbon Tetrachloride	NA	NA	NA	NA	NA
Chlorobenzene	NA	NA	NA	NA	NA
Chloroethane	NA	NA	NA	NA	NA
Chloroform	NA	NA	NA	NA	NA

SUBSURFACE SOILS ANALYTICAL RESULTS - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D.	SWMU311-SB16-03	SWMU311-SB16-05	SWMU311-SB18-02	SWMU311-SB18-04	SWMU311-SB18-06
Lab Sample I.D.	Missing	Missing	Missing	Missing	Missing
Sample Date	06-19-2003	06-19-2003	06-23-2003	06-23-2003	06-23-2003
Depth Range	5-7	9-11	3-5	7-9	11-13
Volatiles (cont.)					
Chloromethane	NA	NA	NA	NA	NA
cis-1,2-Dichloroethene	2 U	2 U	2 U	2 U	2 U
cis-1,3-Dichloropropene	NA	NA	NA	NA	NA
Dibromochloromethane	NA	NA	NA	NA	NA
Dibromomethane	NA	NA	NA	NA	NA
Dichlorodifluoromethane	NA	NA	NA	NA	NA
Ethylbenzene	NA	NA	NA	NA	NA
Hexachlorobutadiene	NA	NA	NA	NA	NA
Isopropylbenzene	NA	NA	NA	NA	NA
meta,para-Xylene	NA	NA	NA	NA	NA
Methylene Chloride	2 U	2 U	2 U	2 U	2 U
Naphthalene	NA	NA	NA	NA	NA
n-Butylbenzene	NA	NA	NA	NA	NA
n-Propylbenzene	NA	NA	NA	NA	NA
ortho-Xylene	NA	NA	NA	NA	NA
para-Isopropyltoluene	NA	NA	NA	NA	NA
sec-Butylbenzene	NA	NA	NA	NA	NA
Styrene	NA	NA	NA	NA	NA
tert-Butylbenzene	NA	NA	NA	NA	NA
Tetrachloroethene	2 U	2 U	2 U	2 U	2 U
Toluene	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	2 U	2 U	2 U	2 U	2 U
trans-1,3-Dichloropropene	NA	NA	NA	NA	NA
Trichloroethene	2 U	2 U	2 U	2 U	2 U
Trichlorofluoromethane	NA	NA	NA	NA	NA
Vinyl Chloride	NA	NA	NA	NA	NA

SUBSURFACE SOILS ANALYTICAL RESULTS - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D.	SWMU311-SB20-01	SWMU311-SB20-03	SWMU311-SB20-06	SWMU311-SB25-05	SWMU311-SB26-07
Lab Sample I.D.	Missing	Missing	Missing	03-0309	03-0310
Sample Date	06-23-2003	06-23-2003	06-23-2003	Missing	Missing
Depth Range	1-3	5-7	11-13	9-11	13-15
Volatiles					
1,1,1,2-Tetrachloroethane	NA	NA	NA	200 U	200 U
1,1,1-Trichloroethane	NA	NA	NA	200 U	200 U
1,1,2,2-Tetrachloroethane	NA	NA	NA	200 U	200 U
1,1,2-Trichloroethane	NA	NA	NA	200 U	200 U
1,1-Dichloroethane	NA	NA	NA	200 U	200 U
1,1-Dichloroethene	2 U	2 U	2 U	200 U	200 U
1,1-Dichloropropene	NA	NA	NA	200 U	200 U
1,2,3-Trichlorobenzene	NA	NA	NA	200 U	200 U
1,2,3-Trichloropropane	NA	NA	NA	200 U	200 U
1,2,4-Trichlorobenzene	NA	NA	NA	200 U	200 U
1,2,4-Trimethylbenzene	NA	NA	NA	200 U	200 U
1,2-Dibromo-3-chloropropane	NA	NA	NA	200 U	200 U
1,2-Dibromoethane	NA	NA	NA	200 U	200 U
1,2-Dichlorobenzene	NA	NA	NA	200 U	200 U
1,2-Dichloroethane	NA	NA	NA	200 U	200 U
1,2-Dichloropropane	NA	NA	NA	200 U	200 U
1,3,5-Trimethylbenzene	NA	NA	NA	200 U	200 U
1,3-Dichlorobenzene	NA	NA	NA	200 U	200 U
1,3-Dichloropropane	NA	NA	NA	200 U	200 U
1,4-Dichlorobenzene	NA	NA	NA	200 U	200 U
2,2-Dichloropropane	NA	NA	NA	200 U	200 U
2-Chlorotoluene	NA	NA	NA	200 U	200 U
4-Chlorotoluene	NA	NA	NA	200 U	200 U
Benzene	2 U	2 U	2 U	200 U	200 U
Bromobenzene	NA	NA	NA	200 U	200 U
Bromochloromethane	NA	NA	NA	200 U	200 U
Bromodichloroemethane	NA	NA	NA	200 U	200 U
Bromoform	NA	NA	NA	200 U	200 U
Bromomethane	NA	NA	NA	200 U	200 U
Carbon Tetrachloride	NA	NA	NA	200 U	200 U
Chlorobenzene	NA	NA	NA	200 U	200 U
Chloroethane	NA	NA	NA	200 U	200 U
Chloroform	NA	NA	NA	200 U	200 U

SUBSURFACE SOILS ANALYTICAL RESULTS - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D.	SWMU311-SB20-01	SWMU311-SB20-03	SWMU311-SB20-06	SWMU311-SB25-05	SWMU311-SB26-07
Lab Sample I.D.	Missing	Missing	Missing	03-0309	03-0310
Sample Date	06-23-2003	06-23-2003	06-23-2003	Missing	Missing
Depth Range	1-3	5-7	11-13	9-11	13-15
Volatiles (cont.)					
Chloromethane	NA	NA	NA	200 U	200 U
cis-1,2-Dichloroethene	2 U	2 U	2 U	200 U	200 U
cis-1,3-Dichloropropene	NA	NA	NA	200 U	200 U
Dibromochloromethane	NA	NA	NA	200 U	200 U
Dibromomethane	NA	NA	NA	200 U	200 U
Dichlorodifluoromethane	NA	NA	NA	200 U	200 U
Ethylbenzene	NA	NA	NA	200 U	200 U
Hexachlorobutadiene	NA	NA	NA	200 U	200 U
Isopropylbenzene	NA	NA	NA	200 U	200 U
meta,para-Xylene	NA	NA	NA	200 U	200 U
Methylene Chloride	2 U	2 U	2 U	200 U	200 U
Naphthalene	NA	NA	NA	200 U	200 U
n-Butylbenzene	NA	NA	NA	200 U	200 U
n-Propylbenzene	NA	NA	NA	200 U	200 U
ortho-Xylene	NA	NA	NA	200 U	200 U
para-Isopropyltoluene	NA	NA	NA	200 U	200 U
sec-Butylbenzene	NA	NA	NA	200 U	200 U
Styrene	NA	NA	NA	200 U	200 U
tert-Butylbenzene	NA	NA	NA	200 U	200 U
Tetrachloroethene	2 U	2 U	2 U	200 U	200 U
Toluene	NA	NA	NA	200 U	200 U
trans-1,2-Dichloroethene	2 U	2 U	2 U	200 U	200 U
trans-1,3-Dichloropropene	NA	NA	NA	200 U	200 U
Trichloroethene	2 U	2 U	2 U	200 U	200 U
Trichlorofluoromethane	NA	NA	NA	200 U	200 U
Vinyl Chloride	NA	NA	NA	200 U	200 U

GROUNDWATER ANALYTICAL RESULTS - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D.	SWMU311-GW04	SWMU311-GW05	SWMU311-GW06	SWMU311-GW07	SWMU311-GW10
Lab Sample I.D.	Missing	Missing	Missing	Missing	Missing
Sample Date	06-19-2003	06-18-2003	06-19-2003	06-23-2003	06-18-2003
Volatiles (ug/L)					
1,1-DCE	1 U	1 U	1 U	1 U	1 U
Benzene	1 U	1 U	1 U	1 U	1 U
Cis-1,2-DCE	1 U	2	1 U	1 U	1 U
Methylene Chloride	1 U	1 U	1 U	1 U	1 U
PCE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TCE	1 U	1 U	1 U	1 U	1 U
trans 1,2-DCE	1 U	1 U	1 U	1 U	1 U

GROUNDWATER ANALYTICAL RESULTS - MOBILE LAB DATA
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

Site Sample I.D.	SWMU311-GW11	SWMU311-GW15	SWMU311-GW16	SWMU311-GW18	SWMU311-GW20
Lab Sample I.D.	Missing	Missing	Missing	Missing	Missing
Sample Date	06-18-2003	06-19-2003	06-19-2003	06-23-2003	06-23-2003
Volatiles (ug/L)					
1,1-DCE	1 U	1 U	1 U	1 U	1 U
Benzene	1 U	1 U	1 U	1 U	1 U
Cis-1,2-DCE	1 U	1 U	1 U	1 U	1 U
Methylene Chloride	1 U	1 U	1 U	1 U	1 U
PCE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TCE	1 U	1 U	1 U	1 U	1 U
trans 1,2-DCE	1 U	1 U	1 U	1 U	1 U

Baker

Baker Environmental, Inc.

APPENDIX F

Risk Assessment Data Sets

APPENDIX F

SURFACE SOIL ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-IS02-00	SWMU311-IS03-00	SWMU311-IS04-00	SWMU311-SB01-00	SWMU311-SB02-00	SWMU311-SB03-00	SWMU311-TW01-00	SWMU311-TW02-00	SWMU311-TW03-00
SAMPLE DATE	09-13-1997	09-13-1997	09-13-1997	03-24-2002	03-25-2002	03-25-2002	03-24-2002	03-24-2002	03-25-2002
DEPTH	0' - 2'	0' - 2'	0' - 2'	0' - 1'	0' - 1'	0' - 1'	0' - 1'	0' - 1'	0' - 1'
VOLATILES (ug/kg)									
1,1,1-Trichloroethane (TCA)	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
1,1,2,2-Tetrachloroethane	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
1,1,2-Trichloro-1,2,2-trifluoroethane	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
1,1,2-Trichloroethane	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
1,1-Dichloroethane	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
1,1-Dichloroethene	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
1,2,4-Trichlorobenzene	NA	NA	NA	6 U	5 UJ	6 U	6 U	5 UJ	5 U
1,2-Dibromo-3-chloropropane (DBCP)	NA	NA	NA	6 U	5 UJ	6 UJ	6 U	5 UJ	5 U
1,2-Dibromoethane (EDB)	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
1,2-Dichlorobenzene (o-)	1.2 U	1.2 U	1 U	6 U	5 UJ	6 U	6 U	5 UJ	5 U
1,2-Dichloroethane	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
1,2-Dichloroethene (cis)	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
1,2-Dichloroethene (trans)	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
1,2-Dichloropropane	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
1,3-Dichlorobenzene (m-)	1.2 U	1.2 U	1 U	6 U	5 UJ	6 U	6 U	5 UJ	5 U
1,3-Dichloropropene (cis)	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
1,3-Dichloropropene (trans)	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
1,4-Dichlorobenzene (p-)	1.2 U	1.2 U	1 U	6 U	5 UJ	6 U	6 U	5 UJ	5 U
2-Butanone (MEK)	NA	NA	NA	15 U	12 U	14 U	6 J	11 J	13 U
2-Hexanone (MBK)	NA	NA	NA	15 U	12 U	14 U	16 U	14 U	13 U
4-Methyl-2-pentanone (MIBK)	NA	NA	NA	15 U	12 U	2 J	16 U	14 U	13 U
Acetone	NA	NA	NA	14 J	4 J	8 J	17 J	34 J	7.5 J
Benzene	1.2 U	1.2 U	1 U	6 U	5 U	6 U	6 U	2 J	5 U
Bromodichloromethane	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
Bromoform	NA	NA	NA	14	5 U	6 U	12	19	6.75 J
Bromomethane	NA	NA	NA	6 UJ	5 UJ	6 UJ	6 UJ	5 UJ	5 UJ
Carbon Disulfide	NA	NA	NA	6 U	5 U	6 U	6 U	2 J	5 U
Carbon Tetrachloride	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
Chlorobenzene	1.2 U	1.2 U	1 U	6 U	5 U	6 U	6 U	5 U	5 U
Chloroethane	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
Chloroform	NA	NA	NA	6 U	5 U	6 U	2 J	5 U	1.5 J
Chloromethane	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
Cyclohexane	NA	NA	NA	6 U	5 U	6 U	6 U	1 J	5 U
Dibromochloromethane	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
Dichlorodifluoromethane	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
Ethylbenzene	1.2 U	1.2 U	1 U	6 U	5 U	6 U	6 U	2 J	5 U
Isopropylbenzene (Cumene)	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U

APPENDIX F (Continued)

SURFACE SOIL ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-IS02-00	SWMU311-IS03-00	SWMU311-IS04-00	SWMU311-SB01-00	SWMU311-SB02-00	SWMU311-SB03-00	SWMU311-TW01-00	SWMU311-TW02-00	SWMU311-TW03-00
SAMPLE DATE	09-13-1997	09-13-1997	09-13-1997	03-24-2002	03-25-2002	03-25-2002	03-24-2002	03-24-2002	03-25-2002
DEPTH	0' - 2'	0' - 2'	0' - 2'	0' - 1'	0' - 1'	0' - 1'	0' - 1'	0' - 1'	0' - 1'
VOLATILES (ug/kg) (Cont)									
Methyl Acetate	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
Methyl Cyclohexane	NA	NA	NA	6 U	5 U	6 U	6 U	1 J	5 U
Methyl Tert-Butyl Ether (MTBE)	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
Methylene Chloride	NA	NA	NA	21	13	13	30	18	17.5 J
Styrene	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
Tetrachloroethene (PCE)	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
Toluene	1.2 U	1.2 U	1 U	6 U	5 U	6 U	6 U	5 U	5 U
Trichloroethene (TCE)	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
Trichlorofluoromethane	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
Vinyl Chloride	NA	NA	NA	6 U	5 U	6 U	6 U	5 U	5 U
Xylenes, total	1.2 U	1.2 U	1 U	18 UJ	14 UJ	17 U	19 UJ	16 UJ	15.5 UJ
SEMIVOLATILES (ug/kg)									
1,2,4-Trichlorobenzene	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene (o-)	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene (m-)	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene (p-)	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
2,2'-Oxybis[1-chloropropane]	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
2,4-Dimethylphenol	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
2,4-Dinitrophenol	1900 U	1900 U	1700 U	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
2,6-Dinitrotoluene	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
2-Chlorophenol	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
2-Methylphenol (o-Cresol)	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
2-Nitroaniline	1900 U	1900 U	1700 U	NA	NA	NA	NA	NA	NA
2-Nitrophenol	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine	1900 U	1900 U	1700 U	NA	NA	NA	NA	NA	NA
3-Nitroaniline	1900 U	1900 U	1700 U	NA	NA	NA	NA	NA	NA
4,6-Dinitro-2-methylphenol	1900 U	1900 U	1700 U	NA	NA	NA	NA	NA	NA
4-Bromophenyl-phenylether	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
4-Chloroaniline	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
4-Methylphenol (p-Cresol)	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA

APPENDIX F (Continued)

SURFACE SOIL ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-IS02-00	SWMU311-IS03-00	SWMU311-IS04-00	SWMU311-SB01-00	SWMU311-SB02-00	SWMU311-SB03-00	SWMU311-TW01-00	SWMU311-TW02-00	SWMU311-TW03-00
SAMPLE DATE	09-13-1997	09-13-1997	09-13-1997	03-24-2002	03-25-2002	03-25-2002	03-24-2002	03-24-2002	03-25-2002
DEPTH	0' - 2'	0' - 2'	0' - 2'	0' - 1'	0' - 1'	0' - 1'	0' - 1'	0' - 1'	0' - 1'
SEMIVOLATILES (ug/kg) (Cont)									
4-Nitroaniline	1900 U	1900 U	1700 U	NA	NA	NA	NA	NA	NA
4-Nitrophenol	1900 U	1900 U	1700 U	NA	NA	NA	NA	NA	NA
Acenaphthene	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
Acenaphthylene	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
Anthracene	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	400 U	33 J	340 U	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	400 U	48 J	340 U	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	400 U	48 J	340 U	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	400 U	50 J	340 U	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	400 U	60 J	340 U	NA	NA	NA	NA	NA	NA
Bis(2-chloroethoxy)methane	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
Bis(2-chloroethyl)ether	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl) Phthalate (DEHP)	230 J	170 J	190 J	NA	NA	NA	NA	NA	NA
Butyl Benzyl Phthalate	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
Carbazole	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
Chrysene	400 U	49 J	340 U	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
Dibenzofuran	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
Diethyl Phthalate (DEP)	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
Dimethyl Phthalate	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
Di-n-butyl Phthalate (DBP)	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
Di-n-octyl Phthalate	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
Fluoranthene	400 U	65 J	340 U	NA	NA	NA	NA	NA	NA
Fluorene	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
Hexachlorocyclopentadiene	1900 U	1900 U	1700 U	NA	NA	NA	NA	NA	NA
Hexachloroethane	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	400 U	41 J	340 U	NA	NA	NA	NA	NA	NA
Isophorone	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
Naphthalene	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
Nitrobenzene	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
n-Nitrosodi-n-propylamine	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
n-Nitrosodiphenylamine	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
Pentachlorophenol	1900 U	1900 U	1700 U	NA	NA	NA	NA	NA	NA
Phenanthrene	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
Phenol	400 U	380 U	340 U	NA	NA	NA	NA	NA	NA
Pyrene	400 U	62 J	340 U	NA	NA	NA	NA	NA	NA

APPENDIX F (Continued)

SURFACE SOIL ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-IS02-00	SWMU311-IS03-00	SWMU311-IS04-00	SWMU311-SB01-00	SWMU311-SB02-00	SWMU311-SB03-00	SWMU311-TW01-00	SWMU311-TW02-00	SWMU311-TW03-00
SAMPLE DATE	09-13-1997	09-13-1997	09-13-1997	03-24-2002	03-25-2002	03-25-2002	03-24-2002	03-24-2002	03-25-2002
DEPTH	0' - 2'	0' - 2'	0' - 2'	0' - 1'	0' - 1'	0' - 1'	0' - 1'	0' - 1'	0' - 1'
METALS (mg/kg)									
Arsenic	1.2 U	1.2 U	1 U	0.29 U	0.27 U	0.24 U	0.31 J	0.27 U	0.25 J
Barium	24 U	23.2 U	20.8 U	8.5	12.8	9.3	11.6	10	13.65 J
Cadmium	5.2	0.74	0.52 U	0.096 J	0.034 U	0.041 J	0.056 J	0.033 U	0.10325 J
Chromium	28.8	6.1	6.4	5.4	4.8	3.3	10.4	4.8	5.2
Lead	211	15.6	1110	5.3 J	4.4 J	17.2 J	5.2 J	6.4 J	9.9 J
Mercury	0.09	0.038 U	0.034 U	0.041	0.02 J	0.021 J	0.053	0.034 J	0.0185 J
Selenium	0.6 U	0.58 U	0.52 U	0.55 U	0.56	0.47 U	0.91	0.51 U	0.495 U
Silver	1.2 U	1.2 U	1 U	0.11 U	0.1 U	0.091 U	0.11 U	0.1 U	0.0965 U

APPENDIX F (Continued)

SURFACE SOIL ANALYTICAL RESULTS - TRESPASSER ONLY
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-IS03-00	SWMU311-SB01-00	SWMU311-TW01-00	SWMU311-TW02-00
SAMPLE DATE	09-13-1997	03-24-2002	03-24-2002	03-24-2002
DEPTH	0' - 2'	0' - 1'	0' - 1'	0' - 1'
VOLATILES (ug/kg)				
1,1,1-Trichloroethane (TCA)	NA	6 U	6 U	5 U
1,1,2,2-Tetrachloroethane	NA	6 U	6 U	5 U
1,1,2-Trichloro-1,2,2-trifluoroethane	NA	6 U	6 U	5 U
1,1,2-Trichloroethane	NA	6 U	6 U	5 U
1,1-Dichloroethane	NA	6 U	6 U	5 U
1,1-Dichloroethene	NA	6 U	6 U	5 U
1,2,4-Trichlorobenzene	NA	6 U	6 U	5 UJ
1,2-Dibromo-3-chloropropane (DBCP)	NA	6 U	6 U	5 UJ
1,2-Dibromoethane (EDB)	NA	6 U	6 U	5 U
1,2-Dichlorobenzene (o-)	1.2 U	6 U	6 U	5 UJ
1,2-Dichloroethane	NA	6 U	6 U	5 U
1,2-Dichloroethene (cis)	NA	6 U	6 U	5 U
1,2-Dichloroethene (trans)	NA	6 U	6 U	5 U
1,2-Dichloropropane	NA	6 U	6 U	5 U
1,3-Dichlorobenzene (m-)	1.2 U	6 U	6 U	5 UJ
1,3-Dichloropropene (cis)	NA	6 U	6 U	5 U
1,3-Dichloropropene (trans)	NA	6 U	6 U	5 U
1,4-Dichlorobenzene (p-)	1.2 U	6 U	6 U	5 UJ
2-Butanone (MEK)	NA	15 U	6 J	11 J
2-Hexanone (MBK)	NA	15 U	16 U	14 U
4-Methyl-2-pentanone (MIBK)	NA	15 U	16 U	14 U
Acetone	NA	14 J	17 J	34 J
Benzene	1.2 U	6 U	6 U	2 J
Bromodichloromethane	NA	6 U	6 U	5 U
Bromoform	NA	14	12	19
Bromomethane	NA	6 UJ	6 UJ	5 UJ
Carbon Disulfide	NA	6 U	6 U	2 J
Carbon Tetrachloride	NA	6 U	6 U	5 U
Chlorobenzene	1.2 U	6 U	6 U	5 U
Chloroethane	NA	6 U	6 U	5 U
Chloroform	NA	6 U	2 J	5 U
Chloromethane	NA	6 U	6 U	5 U
Cyclohexane	NA	6 U	6 U	1 J
Dibromochloromethane	NA	6 U	6 U	5 U
Dichlorodifluoromethane	NA	6 U	6 U	5 U
Ethylbenzene	1.2 U	6 U	6 U	2 J
Isopropylbenzene (Cumene)	NA	6 U	6 U	5 U
Methyl Acetate	NA	6 U	6 U	5 U
Methyl Cyclohexane	NA	6 U	6 U	1 J

APPENDIX F (Continued)

SURFACE SOIL ANALYTICAL RESULTS - TRESPASSER ONLY
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-IS03-00	SWMU311-SB01-00	SWMU311-TW01-00	SWMU311-TW02-00
SAMPLE DATE	09-13-1997	03-24-2002	03-24-2002	03-24-2002
DEPTH	0' - 2'	0' - 1'	0' - 1'	0' - 1'
VOLATILES (ug/kg) (Cont)				
Methyl Tert-Butyl Ether (MTBE)	NA	6 U	6 U	5 U
Methylene Chloride	NA	21	30	18
Styrene	NA	6 U	6 U	5 U
Tetrachloroethene (PCE)	NA	6 U	6 U	5 U
Toluene	1.2 U	6 U	6 U	5 U
Trichloroethene (TCE)	NA	6 U	6 U	5 U
Trichlorofluoromethane	NA	6 U	6 U	5 U
Vinyl Chloride	NA	6 U	6 U	5 U
Xylenes, total	1.2 U	18 UJ	19 UJ	16 UJ
SEMIVOLATILES (ug/kg)				
1,2,4-Trichlorobenzene	380 U	NA	NA	NA
1,2-Dichlorobenzene (o-)	380 U	NA	NA	NA
1,3-Dichlorobenzene (m-)	380 U	NA	NA	NA
1,4-Dichlorobenzene (p-)	380 U	NA	NA	NA
2,2'-Oxybis[1-chloropropane]	380 U	NA	NA	NA
2,4,5-Trichlorophenol	380 U	NA	NA	NA
2,4,6-Trichlorophenol	380 U	NA	NA	NA
2,4-Dichlorophenol	380 U	NA	NA	NA
2,4-Dimethylphenol	380 U	NA	NA	NA
2,4-Dinitrophenol	1900 U	NA	NA	NA
2,4-Dinitrotoluene	380 U	NA	NA	NA
2,6-Dinitrotoluene	380 U	NA	NA	NA
2-Chloronaphthalene	380 U	NA	NA	NA
2-Chlorophenol	380 U	NA	NA	NA
2-Methylnaphthalene	380 U	NA	NA	NA
2-Methylphenol (o-Cresol)	380 U	NA	NA	NA
2-Nitroaniline	1900 U	NA	NA	NA
2-Nitrophenol	380 U	NA	NA	NA
3,3'-Dichlorobenzidine	1900 U	NA	NA	NA
3-Nitroaniline	1900 U	NA	NA	NA
4,6-Dinitro-2-methylphenol	1900 U	NA	NA	NA
4-Bromophenyl-phenylether	380 U	NA	NA	NA
4-Chloro-3-methylphenol	380 U	NA	NA	NA
4-Chloroaniline	380 U	NA	NA	NA
4-Chlorophenyl-phenylether	380 U	NA	NA	NA
4-Methylphenol (p-Cresol)	380 U	NA	NA	NA
4-Nitroaniline	1900 U	NA	NA	NA
4-Nitrophenol	1900 U	NA	NA	NA

APPENDIX F (Continued)

SURFACE SOIL ANALYTICAL RESULTS - TRESPASSER ONLY
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-IS03-00	SWMU311-SB01-00	SWMU311-TW01-00	SWMU311-TW02-00
SAMPLE DATE	09-13-1997	03-24-2002	03-24-2002	03-24-2002
DEPTH	0' - 2'	0' - 1'	0' - 1'	0' - 1'
SEMIVOLATILES (ug/kg) (Cont)				
Acenaphthene	380 U	NA	NA	NA
Acenaphthylene	380 U	NA	NA	NA
Anthracene	380 U	NA	NA	NA
Benzo(a)anthracene	33 J	NA	NA	NA
Benzo(a)pyrene	48 J	NA	NA	NA
Benzo(b)fluoranthene	48 J	NA	NA	NA
Benzo(g,h,i)perylene	50 J	NA	NA	NA
Benzo(k)fluoranthene	60 J	NA	NA	NA
Bis(2-chloroethoxy)methane	380 U	NA	NA	NA
Bis(2-chloroethyl)ether	380 U	NA	NA	NA
Bis(2-ethylhexyl) Phthalate (DEHP)	170 J	NA	NA	NA
Butyl Benzyl Phthalate	380 U	NA	NA	NA
Carbazole	380 U	NA	NA	NA
Chrysene	49 J	NA	NA	NA
Dibenz(a,h)anthracene	380 U	NA	NA	NA
Dibenzofuran	380 U	NA	NA	NA
Diethyl Phthalate (DEP)	380 U	NA	NA	NA
Dimethyl Phthalate	380 U	NA	NA	NA
Di-n-butyl Phthalate (DBP)	380 U	NA	NA	NA
Di-n-octyl Phthalate	380 U	NA	NA	NA
Fluoranthene	65 J	NA	NA	NA
Fluorene	380 U	NA	NA	NA
Hexachlorobenzene	380 U	NA	NA	NA
Hexachlorobutadiene	380 U	NA	NA	NA
Hexachlorocyclopentadiene	1900 U	NA	NA	NA
Hexachloroethane	380 U	NA	NA	NA
Indeno(1,2,3-cd)pyrene	41 J	NA	NA	NA
Isophorone	380 U	NA	NA	NA
Naphthalene	380 U	NA	NA	NA
Nitrobenzene	380 U	NA	NA	NA
n-Nitrosodi-n-propylamine	380 U	NA	NA	NA
n-Nitrosodiphenylamine	380 U	NA	NA	NA
Pentachlorophenol	1900 U	NA	NA	NA
Phenanthrene	380 U	NA	NA	NA
Phenol	380 U	NA	NA	NA
Pyrene	62 J	NA	NA	NA

APPENDIX F (Continued)

SURFACE SOIL ANALYTICAL RESULTS - TRESPASSER ONLY
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-IS03-00	SWMU311-SB01-00	SWMU311-TW01-00	SWMU311-TW02-00
SAMPLE DATE	09-13-1997	03-24-2002	03-24-2002	03-24-2002
DEPTH	0' - 2'	0' - 1'	0' - 1'	0' - 1'
METALS (mg/kg)				
Arsenic	1.2 U	0.29 U	0.31 J	0.27 U
Barium	23.2 U	8.5	11.6	10
Cadmium	0.74	0.096 J	0.056 J	0.033 U
Chromium	6.1	5.4	10.4	4.8
Lead	15.6	5.3 J	5.2 J	6.4 J
Mercury	0.038 U	0.041	0.053	0.034 J
Selenium	0.58 U	0.55 U	0.91	0.51 U
Silver	1.2 U	0.11 U	0.11 U	0.1 U

APPENDIX F (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-IS02-03	SWMU311-IS03-03	SWMU311-SB01-03	SWMU311-SB02-03	SWMU311-SB03-03	SWMU311-TW01-03	SWMU311-TW02-03	SWMU311-TW03-03
SAMPLE DATE	09-13-1997	09-13-1997	03-24-2002	03-25-2002	03-25-2002	03-24-2002	03-24-2002	03-25-2002
DEPTH	6' - 8'	6' - 8'	5' - 7'	5' - 7'	5' - 7'	5' - 7'	5' - 7'	5' - 7'
VOLATILES (ug/kg)								
1,1,1-Trichloroethane (TCA)	NA	NA	5 U	5 U	5 U	6 U	6 U	6 U
1,1,2,2-Tetrachloroethane	NA	NA	5 U	5 U	5 U	6 U	6 U	6 UJ
1,1,2-Trichloro-1,2,2-trifluoroethane	NA	NA	5 U	5 U	5 U	6 U	6 U	6 U
1,1,2-Trichloroethane	NA	NA	5 U	5 U	5 U	6 U	6 U	6 UJ
1,1-Dichloroethane	NA	NA	5 U	5 U	5 U	6 U	6 U	6 U
1,1-Dichloroethene	NA	NA	5 U	5 U	5 U	6 U	6 U	6 U
1,2,4-Trichlorobenzene	NA	NA	5 U	5 U	5 U	6 U	6 U	6 UJ
1,2-Dibromo-3-chloropropane (DBCP)	NA	NA	5 U	5 U	5 U	6 U	6 U	6 UJ
1,2-Dibromoethane (EDB)	NA	NA	5 U	5 U	5 U	6 U	6 U	6 UJ
1,2-Dichlorobenzene (o-)	530	1.1 U	5 U	5 U	5 U	6 U	6 U	6 UJ
1,2-Dichloroethane	NA	NA	5 U	5 U	5 U	6 U	6 U	6 U
1,2-Dichloroethene (cis)	NA	NA	5 U	5 U	5 U	6 U	6 U	6 U
1,2-Dichloroethene (trans)	NA	NA	5 U	5 U	5 U	6 U	6 U	6 U
1,2-Dichloropropane	NA	NA	5 U	5 U	5 U	6 U	6 U	6 U
1,3-Dichlorobenzene (m-)	140	1.1 U	5 U	5 U	5 U	6 U	6 U	6 UJ
1,3-Dichloropropene (cis)	NA	NA	5 U	5 U	5 U	6 U	6 U	6 U
1,3-Dichloropropene (trans)	NA	NA	5 U	5 U	5 U	6 U	6 U	6 UJ
1,4-Dichlorobenzene (p-)	220	1.1 U	5 U	5 U	5 U	6 U	6 U	6 UJ
2-Butanone (MEK)	NA	NA	13 U	13 U	14 U	15 U	14 U	14 U
2-Hexanone (MBK)	NA	NA	13 U	13 U	14 U	15 U	14 U	14 UJ
4-Methyl-2-pentanone (MIBK)	NA	NA	13 U	13 U	14 U	15 U	14 U	14 U
Acetone	NA	NA	3 J	5.5 J	2 J	2 J	6 J	14 UJ
Benzene	120 U	1.1 U	5 U	5 U	5 U	6 U	6 U	6 U
Bromodichloromethane	NA	NA	5 U	5 U	5 U	6 U	6 U	6 U
Bromoform	NA	NA	23	5 U	5 U	22	28	6 UJ
Bromomethane	NA	NA	5 UJ	5 UJ	5 UJ	6 UJ	6 UJ	6 UJ
Carbon Disulfide	NA	NA	5 U	5 U	5 U	6 U	6 U	6 U
Carbon Tetrachloride	NA	NA	5 U	5 U	5 U	6 U	6 U	6 U
Chlorobenzene	530	1.1 U	5 U	5 U	5 U	6 U	6 U	6 UJ
Chloroethane	NA	NA	5 U	5 U	5 U	6 U	6 U	6 U
Chloroform	NA	NA	5 U	5 U	5 U	1 J	2 J	6 U
Chloromethane	NA	NA	5 U	5 U	5 U	6 U	6 U	6 U
Cyclohexane	NA	NA	5 U	5 U	5 U	6 U	6 U	6 U
Dibromochloromethane	NA	NA	5 U	5 U	5 U	6 U	6 U	6 UJ
Dichlorodifluoromethane	NA	NA	5 U	5 U	5 U	6 U	6 U	6 U
Ethylbenzene	120 U	1.1 U	5 U	5 U	5 U	6 U	6 U	6 UJ

APPENDIX F (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-IS02-03	SWMU311-IS03-03	SWMU311-SB01-03	SWMU311-SB02-03	SWMU311-SB03-03	SWMU311-TW01-03	SWMU311-TW02-03	SWMU311-TW03-03
SAMPLE DATE	09-13-1997	09-13-1997	03-24-2002	03-25-2002	03-25-2002	03-24-2002	03-24-2002	03-25-2002
DEPTH	6' - 8'	6' - 8'	5' - 7'	5' - 7'	5' - 7'	5' - 7'	5' - 7'	5' - 7'
VOLATILES (ug/kg) (Cont)								
Isopropylbenzene (Cumene)	NA	NA	5 U	5 U	5 U	6 U	6 U	6 UJ
Methyl Acetate	NA	NA	5 U	5 U	5 U	6 U	6 U	6 U
Methyl Cyclohexane	NA	NA	5 U	5 U	5 U	6 U	6 U	6 U
Methyl Tert-Butyl Ether (MTBE)	NA	NA	5 U	5 U	5 U	6 U	6 U	6 U
Methylene Chloride	NA	NA	27	8.75	19	27	32	34
Styrene	NA	NA	5 U	5 U	5 U	6 U	6 U	6 UJ
Tetrachloroethene (PCE)	NA	NA	5 U	5 U	5 U	6 U	6 U	6 UJ
Toluene	200	1.1 U	5 U	5 U	5 U	6 U	6 U	6 UJ
Trichloroethene (TCE)	NA	NA	5 U	5 U	5 U	6 U	6 U	6 U
Trichlorofluoromethane	NA	NA	5 U	5 U	5 U	6 U	6 U	6 U
Vinyl Chloride	NA	NA	5 U	5 U	5 U	6 U	6 U	6 U
m/p-Xylenes	NA	NA	NA	NA	NA	NA	NA	NA
o-Xylene	NA	NA	NA	NA	NA	NA	NA	NA
Xylenes, total	2000	1.1 U	15 U	16 UJ	16 UJ	18 UJ	17 UJ	17 UJ
SEMIVOLATILES (ug/kg)								
1,2,4-Trichlorobenzene	4000 U	370 U	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene (o-)	4000 U	370 U	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene (m-)	4000 U	370 U	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene (p-)	4000 U	370 U	NA	NA	NA	NA	NA	NA
2,2'-Oxybis[1-chloropropane]	4000 U	370 U	NA	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	4000 U	370 U	NA	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol	4000 U	370 U	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol	4000 U	370 U	NA	NA	NA	NA	NA	NA
2,4-Dimethylphenol	4000 U	370 U	NA	NA	NA	NA	NA	NA
2,4-Dinitrophenol	19000 U	1800 U	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	4000 U	370 U	NA	NA	NA	NA	NA	NA
2,6-Dinitrotoluene	4000 U	370 U	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene	4000 U	370 U	NA	NA	NA	NA	NA	NA
2-Chlorophenol	4000 U	370 U	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	1300 J	370 U	NA	NA	NA	NA	NA	NA
2-Methylphenol (o-Cresol)	4000 U	370 U	NA	NA	NA	NA	NA	NA
2-Nitroaniline	19000 U	1800 U	NA	NA	NA	NA	NA	NA
2-Nitrophenol	4000 U	370 U	NA	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine	19000 U	1800 U	NA	NA	NA	NA	NA	NA
3-Nitroaniline	19000 U	1800 U	NA	NA	NA	NA	NA	NA

APPENDIX F (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-IS02-03	SWMU311-IS03-03	SWMU311-SB01-03	SWMU311-SB02-03	SWMU311-SB03-03	SWMU311-TW01-03	SWMU311-TW02-03	SWMU311-TW03-03
SAMPLE DATE	09-13-1997	09-13-1997	03-24-2002	03-25-2002	03-25-2002	03-24-2002	03-24-2002	03-25-2002
DEPTH	6' - 8'	6' - 8'	5' - 7'	5' - 7'	5' - 7'	5' - 7'	5' - 7'	5' - 7'
SEMIVOLATILES (ug/kg) (Cont)								
4,6-Dinitro-2-methylphenol	19000 U	1800 U	NA	NA	NA	NA	NA	NA
4-Bromophenyl-phenylether	4000 U	370 U	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	4000 U	370 U	NA	NA	NA	NA	NA	NA
4-Chloroaniline	4000 U	370 U	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	4000 U	370 U	NA	NA	NA	NA	NA	NA
4-Methylphenol (p-Cresol)	4000 U	370 U	NA	NA	NA	NA	NA	NA
4-Nitroaniline	19000 U	1800 U	NA	NA	NA	NA	NA	NA
4-Nitrophenol	19000 U	1800 U	NA	NA	NA	NA	NA	NA
Acenaphthene	4000 U	370 U	NA	NA	NA	NA	NA	NA
Acenaphthylene	4000 U	370 U	NA	NA	NA	NA	NA	NA
Anthracene	4000 U	370 U	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	4000 U	370 U	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	4000 U	370 U	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	4000 U	370 U	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	4000 U	370 U	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	4000 U	370 U	NA	NA	NA	NA	NA	NA
Bis(2-chloroethoxy)methane	4000 U	370 U	NA	NA	NA	NA	NA	NA
Bis(2-chloroethyl)ether	4000 U	370 U	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl) Phthalate (DEHP)	4000 U	800 J	NA	NA	NA	NA	NA	NA
Butyl Benzyl Phthalate	4000 U	370 U	NA	NA	NA	NA	NA	NA
Carbazole	4000 U	370 U	NA	NA	NA	NA	NA	NA
Chrysene	4000 U	370 U	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	4000 U	370 U	NA	NA	NA	NA	NA	NA
Dibenzofuran	4000 U	370 U	NA	NA	NA	NA	NA	NA
Diethyl Phthalate (DEP)	4000 U	370 U	NA	NA	NA	NA	NA	NA
Dimethyl Phthalate	4000 U	370 U	NA	NA	NA	NA	NA	NA
Di-n-butyl Phthalate (DBP)	4000 U	370 U	NA	NA	NA	NA	NA	NA
Di-n-octyl Phthalate	4000 U	370 U	NA	NA	NA	NA	NA	NA
Fluoranthene	4000 U	370 U	NA	NA	NA	NA	NA	NA
Fluorene	4000 U	370 U	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	4000 U	370 U	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene	4000 U	370 U	NA	NA	NA	NA	NA	NA
Hexachlorocyclopentadiene	19000 U	1800 U	NA	NA	NA	NA	NA	NA
Hexachloroethane	4000 U	370 U	NA	NA	NA	NA	NA	NA

APPENDIX F (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-IS02-03	SWMU311-IS03-03	SWMU311-SB01-03	SWMU311-SB02-03	SWMU311-SB03-03	SWMU311-TW01-03	SWMU311-TW02-03	SWMU311-TW03-03
SAMPLE DATE	09-13-1997	09-13-1997	03-24-2002	03-25-2002	03-25-2002	03-24-2002	03-24-2002	03-25-2002
DEPTH	6' - 8'	6' - 8'	5' - 7'	5' - 7'	5' - 7'	5' - 7'	5' - 7'	5' - 7'
SEMIVOLATILES (ug/kg) (Cont)								
Indeno(1,2,3-cd)pyrene	4000 U	370 U	NA	NA	NA	NA	NA	NA
Isophorone	4000 U	370 U	NA	NA	NA	NA	NA	NA
Naphthalene	4000 U	370 U	NA	NA	NA	NA	NA	NA
Nitrobenzene	4000 U	370 U	NA	NA	NA	NA	NA	NA
n-Nitrosodi-n-propylamine	4000 U	370 U	NA	NA	NA	NA	NA	NA
n-Nitrosodiphenylamine	4000 U	370 U	NA	NA	NA	NA	NA	NA
Pentachlorophenol	19000 U	1800 U	NA	NA	NA	NA	NA	NA
Phenanthrene	4000 U	370 U	NA	NA	NA	NA	NA	NA
Phenol	4000 U	370 U	NA	NA	NA	NA	NA	NA
Pyrene	4000 U	370 U	NA	NA	NA	NA	NA	NA
METALS (mg/kg)								
Arsenic	1.9	1.1 U	0.55 J	0.77 J	0.27 U	0.3 U	0.69 J	0.27 U
Barium	24.2 U	22.7 U	9	5.15	8.8	45	20.1	4
Cadmium	0.61	0.57 U	0.044 J	0.03075 J	0.033 U	0.27 J	0.052 J	0.033 U
Chromium	21	4.5	8.7	7.55	4.2	12.1	13.9	2.3
Lead	42.1	2.8	3.5 J	3.25 J	2.5 J	28.5 J	4.7 J	1.7 J
Mercury	0.057	0.037 U	0.019 U	0.01875 J	0.019 U	0.023 J	0.027 J	0.018 U
Selenium	0.6 U	0.57 U	0.51 U	0.4625	0.51 U	0.84	0.52 U	0.51 U
Silver	1.2 U	1.1 U	0.1 U	0.0995 U	0.1 U	0.11 U	0.102 U	0.1 U

APPENDIX F (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-SB04-01	SWMU311-SB04-04	SWMU311-SB05-02	SWMU311-SB05-04	SWMU311-SB06-01	SWMU311-SB06-04	SWMU311-SB07-04	SWMU311-SB10-02
SAMPLE DATE	06-19-2003	06-19-2003	06-18-2003	06-18-2003	06-19-2003	06-19-2003	06-24-2003	06-18-2003
DEPTH	1-3	7-9	3-5	7-9	1-3	7-9	7-9	3-5
VOLATILES (ug/kg)								
1,1,1-Trichloroethane (TCA)	11 U	NA	NA	12 U	12 U	NA	NA	12 U
1,1,2,2-Tetrachloroethane	11 U	NA	NA	12 U	12 U	NA	NA	12 U
1,1,2-Trichloro-1,2,2-trifluoroethane	11 U	NA	NA	12 U	12 U	NA	NA	12 U
1,1,2-Trichloroethane	11 U	NA	NA	12 U	12 U	NA	NA	12 U
1,1-Dichloroethane	11 U	NA	NA	12 U	12 U	NA	NA	12 U
1,1-Dichloroethene	11 U	NA	NA	12 U	12 U	NA	NA	12 U
1,2,4-Trichlorobenzene	11 U	NA	NA	12 U	12 U	NA	NA	12 U
1,2-Dibromo-3-chloropropane (DBCP)	11 U	NA	NA	12 U	12 U	NA	NA	12 U
1,2-Dibromoethane (EDB)	11 U	NA	NA	12 U	12 U	NA	NA	12 U
1,2-Dichlorobenzene (o-)	11 U	NA	NA	12 U	12 U	NA	NA	12 U
1,2-Dichloroethane	11 U	NA	NA	12 U	12 U	NA	NA	12 U
1,2-Dichloroethene (cis)	11 U	NA	NA	12 U	12 U	NA	NA	12 U
1,2-Dichloroethene (trans)	11 U	NA	NA	12 U	12 U	NA	NA	12 U
1,2-Dichloropropane	11 U	NA	NA	12 U	12 U	NA	NA	12 U
1,3-Dichlorobenzene (m-)	11 U	NA	NA	12 U	12 U	NA	NA	12 U
1,3-Dichloropropene (cis)	11 U	NA	NA	12 U	12 U	NA	NA	12 U
1,3-Dichloropropene (trans)	11 U	NA	NA	12 U	12 U	NA	NA	12 U
1,4-Dichlorobenzene (p-)	11 U	NA	NA	12 U	12 U	NA	NA	12 U
2-Butanone (MEK)	11 U	NA	NA	12 U	12 U	NA	NA	12 U
2-Hexanone (MBK)	11 U	NA	NA	12 U	12 U	NA	NA	12 U
4-Methyl-2-pentanone (MIBK)	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Acetone	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Benzene	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Bromodichloromethane	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Bromoform	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Bromomethane	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Carbon Disulfide	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Carbon Tetrachloride	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Chlorobenzene	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Chloroethane	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Chloroform	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Chloromethane	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Cyclohexane	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Dibromochloromethane	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Dichlorodifluoromethane	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Ethylbenzene	11 U	NA	NA	12 U	12 U	NA	NA	12 U

APPENDIX F (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-SB04-01	SWMU311-SB04-04	SWMU311-SB05-02	SWMU311-SB05-04	SWMU311-SB06-01	SWMU311-SB06-04	SWMU311-SB07-04	SWMU311-SB10-02
SAMPLE DATE	06-19-2003	06-19-2003	06-18-2003	06-18-2003	06-19-2003	06-19-2003	06-24-2003	06-18-2003
DEPTH	1-3	7-9	3-5	7-9	1-3	7-9	7-9	3-5
VOLATILES (ug/kg) (Cont)								
Isopropylbenzene (Cumene)	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Methyl Acetate	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Methyl Cyclohexane	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Methyl Tert-Butyl Ether (MTBE)	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Methylene Chloride	1.9 J	NA	NA	12 U	2.5 J	NA	NA	2.6 J
Styrene	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Tetrachloroethene (PCE)	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Toluene	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Trichloroethene (TCE)	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Trichlorofluoromethane	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Vinyl Chloride	11 U	NA	NA	12 U	12 U	NA	NA	12 U
m/p-Xylenes	11 U	NA	NA	12 U	12 U	NA	NA	12 U
o-Xylene	11 U	NA	NA	12 U	12 U	NA	NA	12 U
Xylenes, total	NA	NA	NA	NA	NA	NA	NA	NA
SEMIVOLATILES (ug/kg)								
1,2,4-Trichlorobenzene	11 U	NA	NA	12 U	12 U	NA	NA	12 U
1,2-Dichlorobenzene (o-)	11 U	NA	NA	12 U	12 U	NA	NA	12 U
1,3-Dichlorobenzene (m-)	11 U	NA	NA	12 U	12 U	NA	NA	12 U
1,4-Dichlorobenzene (p-)	11 U	NA	NA	12 U	12 U	NA	NA	12 U
2,2'-Oxybis[1-chloropropane]	NA	NA	NA	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	NA	NA	NA	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dimethylphenol	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrophenol	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA
2,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene	NA	NA	NA	NA	NA	NA	NA	NA
2-Chlorophenol	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylphenol (o-Cresol)	NA	NA	NA	NA	NA	NA	NA	NA
2-Nitroaniline	NA	NA	NA	NA	NA	NA	NA	NA
2-Nitrophenol	NA	NA	NA	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine	NA	NA	NA	NA	NA	NA	NA	NA
3-Nitroaniline	NA	NA	NA	NA	NA	NA	NA	NA

APPENDIX F (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-SB04-01	SWMU311-SB04-04	SWMU311-SB05-02	SWMU311-SB05-04	SWMU311-SB06-01	SWMU311-SB06-04	SWMU311-SB07-04	SWMU311-SB10-02
SAMPLE DATE	06-19-2003	06-19-2003	06-18-2003	06-18-2003	06-19-2003	06-19-2003	06-24-2003	06-18-2003
DEPTH	1-3	7-9	3-5	7-9	1-3	7-9	7-9	3-5
SEMIVOLATILES (ug/kg) (Cont)								
4,6-Dinitro-2-methylphenol	NA	NA	NA	NA	NA	NA	NA	NA
4-Bromophenyl-phenylether	NA	NA	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	NA	NA	NA	NA	NA	NA	NA	NA
4-Chloroaniline	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	NA	NA	NA	NA	NA	NA	NA	NA
4-Methylphenol (p-Cresol)	NA	NA	NA	NA	NA	NA	NA	NA
4-Nitroaniline	NA	NA	NA	NA	NA	NA	NA	NA
4-Nitrophenol	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthylene	NA	NA	NA	NA	NA	NA	NA	NA
Anthracene	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-chloroethoxy)methane	NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-chloroethyl)ether	NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl) Phthalate (DEHP)	NA	NA	NA	NA	NA	NA	NA	NA
Butyl Benzyl Phthalate	NA	NA	NA	NA	NA	NA	NA	NA
Carbazole	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	NA	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	NA	NA	NA	NA	NA	NA	NA	NA
Diethyl Phthalate (DEP)	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl Phthalate	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-butyl Phthalate (DBP)	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-octyl Phthalate	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA
Fluorene	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorocyclopentadiene	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloroethane	NA	NA	NA	NA	NA	NA	NA	NA

APPENDIX F (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-SB04-01	SWMU311-SB04-04	SWMU311-SB05-02	SWMU311-SB05-04	SWMU311-SB06-01	SWMU311-SB06-04	SWMU311-SB07-04	SWMU311-SB10-02
SAMPLE DATE	06-19-2003	06-19-2003	06-18-2003	06-18-2003	06-19-2003	06-19-2003	06-24-2003	06-18-2003
DEPTH	1-3	7-9	3-5	7-9	1-3	7-9	7-9	3-5
SEMIVOLATILES (ug/kg) (Cont)								
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA	NA	NA	NA
Isophorone	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	NA	NA	NA	NA	NA	NA	NA	NA
Nitrobenzene	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosodi-n-propylamine	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosodiphenylamine	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	NA	NA	NA	NA	NA	NA	NA	NA
Phenol	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	NA	NA	NA	NA	NA	NA	NA	NA
METALS (mg/kg)								
Arsenic	0.62 U	0.62 U	0.62 U	0.65 U	0.67 U	0.68 U	0.69 U	0.67 U
Barium	11.5 J	2.9 J	12 J	7.1 J	20.7 J	7.4 J	5.8 J	6.9 J
Cadmium	0.09 U	0.09 U	1.1 J	0.09 U	0.1 U	0.1 U	0.1 U	0.1 U
Chromium	4.4	0.88 J	5.7	2.8	4.4	3.7	0.15 U	1.4 J
Lead	4.2	1	51.2 J	2.1 J	3.7	2.8	2.3 J	2.2
Mercury	0.1 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.12 U
Selenium	0.66 UJ	0.68 J	0.67 UJ	0.7 UJ	1.1 J	0.73 UJ	0.74 U	0.72 UJ
Silver	0.36 J	0.22 UJ	0.22 UJ	0.23 UJ	0.44 J	0.38 J	0.25 UJ	0.35 J

APPENDIX F (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-SB10-04	SWMU311-SB11-02	SWMU311-SB11-03	SWMU311-SB18-02	SWMU311-SB18-04	SWMU311-SB20-01	SWMU311-SB20-03
SAMPLE DATE	06-18-2003	06-18-2003	06-18-2003	06-23-2003	06-23-2003	06-23-2003	06-23-2003
DEPTH	7-9	3-5	5-7	3-5	7-9	1-3	5-7
VOLATILES (ug/kg)							
1,1,1-Trichloroethane (TCA)	NA	NA	13 U	11 U	NA	NA	12 U
1,1,2,2-Tetrachloroethane	NA	NA	13 U	11 U	NA	NA	12 U
1,1,2-Trichloro-1,2,2-trifluoroethane	NA	NA	13 U	11 U	NA	NA	12 U
1,1,2-Trichloroethane	NA	NA	13 U	11 U	NA	NA	12 U
1,1-Dichloroethane	NA	NA	13 U	11 U	NA	NA	12 U
1,1-Dichloroethene	NA	NA	13 U	11 U	NA	NA	12 U
1,2,4-Trichlorobenzene	NA	NA	13 U	11 U	NA	NA	12 U
1,2-Dibromo-3-chloropropane (DBCP)	NA	NA	13 U	11 R	NA	NA	12 U
1,2-Dibromoethane (EDB)	NA	NA	13 U	11 U	NA	NA	12 U
1,2-Dichlorobenzene (o-)	NA	NA	13 U	11 U	NA	NA	12 U
1,2-Dichloroethane	NA	NA	13 U	11 U	NA	NA	12 U
1,2-Dichloroethene (cis)	NA	NA	13 U	11 U	NA	NA	12 U
1,2-Dichloroethene (trans)	NA	NA	13 U	11 U	NA	NA	12 U
1,2-Dichloropropane	NA	NA	13 U	11 U	NA	NA	12 U
1,3-Dichlorobenzene (m-)	NA	NA	13 U	11 U	NA	NA	12 U
1,3-Dichloropropene (cis)	NA	NA	13 U	11 U	NA	NA	12 U
1,3-Dichloropropene (trans)	NA	NA	13 U	11 U	NA	NA	12 U
1,4-Dichlorobenzene (p-)	NA	NA	13 U	11 U	NA	NA	12 U
2-Butanone (MEK)	NA	NA	13 U	11 U	NA	NA	12 U
2-Hexanone (MBK)	NA	NA	13 U	11 U	NA	NA	12 U
4-Methyl-2-pentanone (MIBK)	NA	NA	13 U	11 U	NA	NA	12 U
Acetone	NA	NA	13 U	11 UJ	NA	NA	18 J
Benzene	NA	NA	13 U	11 U	NA	NA	12 U
Bromodichloromethane	NA	NA	13 U	11 U	NA	NA	12 U
Bromoform	NA	NA	13 U	11 U	NA	NA	12 U
Bromomethane	NA	NA	13 U	11 U	NA	NA	12 U
Carbon Disulfide	NA	NA	13 U	11 U	NA	NA	12 U
Carbon Tetrachloride	NA	NA	13 U	11 U	NA	NA	12 U
Chlorobenzene	NA	NA	13 U	11 U	NA	NA	12 U
Chloroethane	NA	NA	13 U	11 U	NA	NA	12 U
Chloroform	NA	NA	13 U	11 U	NA	NA	12 U
Chloromethane	NA	NA	13 U	11 U	NA	NA	12 U
Cyclohexane	NA	NA	13 U	11 U	NA	NA	12 U
Dibromochloromethane	NA	NA	13 U	11 U	NA	NA	12 U
Dichlorodifluoromethane	NA	NA	13 U	11 U	NA	NA	12 U
Ethylbenzene	NA	NA	13 U	11 U	NA	NA	12 U

APPENDIX F (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-SB10-04	SWMU311-SB11-02	SWMU311-SB11-03	SWMU311-SB18-02	SWMU311-SB18-04	SWMU311-SB20-01	SWMU311-SB20-03
SAMPLE DATE	06-18-2003	06-18-2003	06-18-2003	06-23-2003	06-23-2003	06-23-2003	06-23-2003
DEPTH	7-9	3-5	5-7	3-5	7-9	1-3	5-7
VOLATILES (ug/kg) (Cont)							
Isopropylbenzene (Cumene)	NA	NA	13 U	11 U	NA	NA	12 U
Methyl Acetate	NA	NA	13 U	11 U	NA	NA	12 U
Methyl Cyclohexane	NA	NA	13 U	11 U	NA	NA	12 U
Methyl Tert-Butyl Ether (MTBE)	NA	NA	13 U	11 U	NA	NA	12 U
Methylene Chloride	NA	NA	2.3 J	11 U	NA	NA	12 U
Styrene	NA	NA	13 U	11 U	NA	NA	12 U
Tetrachloroethene (PCE)	NA	NA	13 U	11 U	NA	NA	12 U
Toluene	NA	NA	13 U	11 U	NA	NA	12 U
Trichloroethene (TCE)	NA	NA	13 U	11 U	NA	NA	12 U
Trichlorofluoromethane	NA	NA	13 U	11 U	NA	NA	12 U
Vinyl Chloride	NA	NA	13 U	11 U	NA	NA	12 U
m/p-Xylenes	NA	NA	13 U	11 U	NA	NA	12 U
o-Xylene	NA	NA	13 U	11 U	NA	NA	12 U
Xylenes, total	NA	NA	NA	NA	NA	NA	NA
SEMIVOLATILES (ug/kg)							
1,2,4-Trichlorobenzene	NA	NA	13 U	11 U	NA	NA	12 U
1,2-Dichlorobenzene (o-)	NA	NA	13 U	11 U	NA	NA	12 U
1,3-Dichlorobenzene (m-)	NA	NA	13 U	11 U	NA	NA	12 U
1,4-Dichlorobenzene (p-)	NA	NA	13 U	11 U	NA	NA	12 U
2,2'-Oxybis[1-chloropropane]	NA	NA	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	NA	NA	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol	NA	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol	NA	NA	NA	NA	NA	NA	NA
2,4-Dimethylphenol	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrophenol	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA
2,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene	NA	NA	NA	NA	NA	NA	NA
2-Chlorophenol	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA
2-Methylphenol (o-Cresol)	NA	NA	NA	NA	NA	NA	NA
2-Nitroaniline	NA	NA	NA	NA	NA	NA	NA
2-Nitrophenol	NA	NA	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine	NA	NA	NA	NA	NA	NA	NA
3-Nitroaniline	NA	NA	NA	NA	NA	NA	NA

APPENDIX F (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-SB10-04	SWMU311-SB11-02	SWMU311-SB11-03	SWMU311-SB18-02	SWMU311-SB18-04	SWMU311-SB20-01	SWMU311-SB20-03
SAMPLE DATE	06-18-2003	06-18-2003	06-18-2003	06-23-2003	06-23-2003	06-23-2003	06-23-2003
DEPTH	7-9	3-5	5-7	3-5	7-9	1-3	5-7
SEMIVOLATILES (ug/kg) (Cont)							
4,6-Dinitro-2-methylphenol	NA	NA	NA	NA	NA	NA	NA
4-Bromophenyl-phenylether	NA	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	NA	NA	NA	NA	NA	NA	NA
4-Chloroaniline	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	NA	NA	NA	NA	NA	NA	NA
4-Methylphenol (p-Cresol)	NA	NA	NA	NA	NA	NA	NA
4-Nitroaniline	NA	NA	NA	NA	NA	NA	NA
4-Nitrophenol	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	NA	NA	NA	NA	NA	NA	NA
Acenaphthylene	NA	NA	NA	NA	NA	NA	NA
Anthracene	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	NA
Bis(2-chloroethoxy)methane	NA	NA	NA	NA	NA	NA	NA
Bis(2-chloroethyl)ether	NA	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl) Phthalate (DEHP)	NA	NA	NA	NA	NA	NA	NA
Butyl Benzyl Phthalate	NA	NA	NA	NA	NA	NA	NA
Carbazole	NA	NA	NA	NA	NA	NA	NA
Chrysene	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	NA	NA	NA	NA	NA	NA	NA
Diethyl Phthalate (DEP)	NA	NA	NA	NA	NA	NA	NA
Dimethyl Phthalate	NA	NA	NA	NA	NA	NA	NA
Di-n-butyl Phthalate (DBP)	NA	NA	NA	NA	NA	NA	NA
Di-n-octyl Phthalate	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	NA	NA	NA	NA	NA	NA	NA
Fluorene	NA	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	NA	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene	NA	NA	NA	NA	NA	NA	NA
Hexachlorocyclopentadiene	NA	NA	NA	NA	NA	NA	NA
Hexachloroethane	NA	NA	NA	NA	NA	NA	NA

APPENDIX F (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-SB10-04	SWMU311-SB11-02	SWMU311-SB11-03	SWMU311-SB18-02	SWMU311-SB18-04	SWMU311-SB20-01	SWMU311-SB20-03
SAMPLE DATE	06-18-2003	06-18-2003	06-18-2003	06-23-2003	06-23-2003	06-23-2003	06-23-2003
DEPTH	7-9	3-5	5-7	3-5	7-9	1-3	5-7
SEMIVOLATILES (ug/kg) (Cont)							
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA	NA	NA
Isophorone	NA	NA	NA	NA	NA	NA	NA
Naphthalene	NA	NA	NA	NA	NA	NA	NA
Nitrobenzene	NA	NA	NA	NA	NA	NA	NA
n-Nitrosodi-n-propylamine	NA	NA	NA	NA	NA	NA	NA
n-Nitrosodiphenylamine	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	NA	NA	NA	NA	NA	NA	NA
Phenol	NA	NA	NA	NA	NA	NA	NA
Pyrene	NA	NA	NA	NA	NA	NA	NA
METALS (mg/kg)							
Arsenic	0.74 J	0.61 U	0.74 U	0.61 U	0.58 U	0.7 U	0.64 U
Barium	8.1 J	6.5 J	2.5 J	7.2 J	1.6 J	4.8 J	8.4 J
Cadmium	0.09 U	0.09 U	0.11 U	0.09 U	0.08 U	0.1 U	0.09 U
Chromium	4.8	2.9	4.3	0.13 U	0.12 U	0.15 U	0.14 U
Lead	3	2.8	3.1	1.8	1	4.7	3.9
Mercury	0.11 U	0.1 U	0.12 U	0.11 U	0.1 U	0.12 U	0.11 U
Selenium	0.69 UJ	0.67 J	1.1 J	0.65 UJ	0.62 U	0.96 J	0.685 U
Silver	0.33 J	0.51 J	0.39 J	0.22 UJ	0.21 UJ	0.25 UJ	0.23 UJ

APPENDIX F (Continued)

GROUNDWATER ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID SAMPLE DATE	SWMU311-GW01 04-04-2002	SWMU311-GW02 04-04-2002	SWMU311-GW03 04-09-2002
VOLATILES (ug/L)			
1,1,1-Trichloroethane (TCA)	5 U	5 U	5 U
1,1,2,2-Tetrachloroethane	5 U	5 U	5 U
1,1,2-Trichloro-1,2,2-trifluoroethane	5 U	5 U	5 U
1,1,2-Trichloroethane	5 U	5 U	5 U
1,1-Dichloroethane	5 U	5 U	5 U
1,1-Dichloroethene	5 U	5 U	5 U
1,2,4-Trichlorobenzene	5 U	5 UJ	5 U
1,2-Dibromo-3-chloropropane (DBCP)	5 U	5 U	5 U
1,2-Dibromoethane (EDB)	5 U	5 U	5 U
1,2-Dichlorobenzene (o-)	5 U	5 U	5 U
1,2-Dichloroethane	5 U	5 U	5 U
1,2-Dichloroethene (cis)	5 U	5 U	5 U
1,2-Dichloroethene (trans)	5 U	5 U	5 U
1,2-Dichloropropane	5 U	5 U	5 U
1,3-Dichlorobenzene (m-)	5 U	5 U	5 U
1,3-Dichloropropene (cis)	5 U	5 U	5 U
1,3-Dichloropropene (trans)	5 U	5 U	5 U
1,4-Dichlorobenzene (p-)	5 U	5 U	5 U
2-Butanone (MEK)	13 U	13 U	13 U
2-Hexanone (MBK)	13 U	13 U	13 U
4-Methyl-2-pentanone (MIBK)	13 U	13 U	13 U
Acetone	9 U	5 U	13 U
Benzene	5 U	5 U	5 U
Bromodichloromethane	5 U	5 U	5 U
Bromoform	5 U	5 U	5 U
Bromomethane	5 UJ	5 UJ	5 U
Carbon Disulfide	5 U	5 U	5 U
Carbon Tetrachloride	5 U	5 U	5 U
Chlorobenzene	5 U	5 U	5 U
Chloroethane	5 U	5 U	5 U
Chloroform	5 U	5 U	5 U
Chloromethane	5 U	5 U	5 U
Cyclohexane	3 J	5 U	5 U
Dibromochloromethane	5 U	5 U	5 U
Dichlorodifluoromethane	5 U	5 U	5 U
Ethylbenzene	2 J	5 U	5 U
Isopropylbenzene (Cumene)	3 J	5 U	5 U

APPENDIX F (Continued)

GROUNDWATER ANALYTICAL RESULTS
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU311-GW01	SWMU311-GW02	SWMU311-GW03
SAMPLE DATE	04-04-2002	04-04-2002	04-09-2002
VOLATILES (ug/L) (Cont)			
Methyl Acetate	5 U	5 U	5 U
Methyl Cyclohexane	3 J	5 U	5 U
Methyl Tert-Butyl Ether (MTBE)	5 U	5 U	5 U
Methylene Chloride	5 U	5 U	5 U
Styrene	5 U	5 U	5 U
Tetrachloroethene (PCE)	5 U	5 U	5 U
Toluene	5 U	5 U	5 U
Trichloroethene (TCE)	5 U	5 U	5 U
Trichlorofluoromethane	5 U	5 U	5 U
Vinyl Chloride	5 U	5 U	5 U
Xylenes, total	3 J	5 U	5 U
METALS (ug/L)			
Arsenic	2.4 UJ	2.4 UJ	3.4 J
Barium	53.75	24.7	33 U
Cadmium	0.3 U	0.3 U	0.4 U
Chromium	12	0.6 U	0.5 UJ
Lead	10.6	1.8 U	1.1 U
Mercury	0.1 U	0.1 U	0.1 UJ
Selenium	4.6 UJ	4.6 UJ	2.1 UJ
Silver	0.9 U	0.9 U	0.5 U

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APPENDIX G

Statistical Summaries

APPENDIX G

SURFACE SOIL STATISTICAL SUMMARY
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

	Minimum Detected	Maximum Detected	Location of Maximum Detect	Frequency of Detection	Upper 95% Confidence Level	Log Upper 95% Confidence Level	W-Test Result
VOLATILES (ug/kg)							
2-Butanone (MEK)	6 J	11 J	SWMU311-TW02-00	2/6	8.89	9.22	LOGNORMAL
4-Methyl-2-pentanone (MIBK)	2 J	2 J	SWMU311-SB03-00	1/6	7.94	12.7	NORMAL
Acetone	4 J	34 J	SWMU311-TW02-00	6/6	23.0	47.2	LOGNORMAL
Benzene	2 J	2 J	SWMU311-TW02-00	1/9	2.65	4.67	LOGNORMAL
Bromoform	6.75 J	19	SWMU311-TW02-00	4/6	14.9	43.7	LOGNORMAL
Carbon Disulfide	2 J	2 J	SWMU311-TW02-00	1/6	3.00	3.11	LOGNORMAL
Chloroform	1.5 J	2 J	SWMU311-TW01-00	2/6	2.90	3.17	LOGNORMAL
Cyclohexane	1 J	1 J	SWMU311-TW02-00	1/6	3.14	4.27	LOGNORMAL
Ethylbenzene	2 J	2 J	SWMU311-TW02-00	1/9	2.65	4.67	LOGNORMAL
Methyl Cyclohexane	1 J	1 J	SWMU311-TW02-00	1/6	3.14	4.27	LOGNORMAL
Methylene Chloride	13	30	SWMU311-TW01-00	6/6	24.0	26.5	LOGNORMAL
SEMIVOLATILES (ug/kg)							
Benzo(a)anthracene	33 J	33 J	SWMU311-IS03-00	1/3	284	1,685,373	LOGNORMAL
Benzo(a)pyrene	48 J	48 J	SWMU311-IS03-00	1/3	275	50,807	LOGNORMAL
Benzo(b)fluoranthene	48 J	48 J	SWMU311-IS03-00	1/3	275	50,807	LOGNORMAL
Benzo(g,h,i)perylene	50 J	50 J	SWMU311-IS03-00	1/3	274	42,531	LOGNORMAL
Benzo(k)fluoranthene	60 J	60 J	SWMU311-IS03-00	1/3	268	10,606	LOGNORMAL
Bis(2-ethylhexyl) Phthalate (DEHP)	170 J	230 J	SWMU311-IS02-00	3/3	248	282	LOGNORMAL
Chrysene	49 J	49 J	SWMU311-IS03-00	1/3	274	46,430	LOGNORMAL
Fluoranthene	65 J	65 J	SWMU311-IS03-00	1/3	265	7,871	LOGNORMAL
Indeno(1,2,3-cd)pyrene	41 J	41 J	SWMU311-IS03-00	1/3	279	227,091	LOGNORMAL
Pyrene	62 J	62 J	SWMU311-IS03-00	1/3	266	9,385	LOGNORMAL
METALS (mg/kg)							
Arsenic	0.25 J	0.31 J	SWMU311-TW01-00	2/9	0.437	0.597	LOGNORMAL
Barium	8.5	13.65 J	SWMU311-TW03-00	6/9	12.1	12.3	LOGNORMAL
Cadmium	0.041 J	5.2	SWMU311-IS02-00	6/9	1.78	29.6	LOGNORMAL
Chromium	3.3	28.8	SWMU311-IS02-00	9/9	13.3	14.5	LOGNORMAL
Lead	4.4 J	1110	SWMU311-IS04-00	9/9	380	6,007	LOGNORMAL
Mercury	0.0185 J	0.09	SWMU311-IS02-00	7/9	0.0497	0.0575	LOGNORMAL
Selenium	0.56	0.91	SWMU311-TW01-00	2/9	0.510	0.532	LOGNORMAL

APPENDIX G (Continued)

SURFACE SOIL STATISTICAL SUMMARY - TRESPASSER ONLY
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

	Minimum Detected	Maximum Detected	Location of Maximum Detect	Frequency of Detection	Upper 95% Confidence Level	Log Upper 95% Confidence Level	W-Test Result
VOLATILES (ug/kg)							
2-Butanone (MEK)	6 J	11 J	SWMU311-TW02-00	2/3	12.5	25.7	LOGNORMAL
Acetone	14 J	34 J	SWMU311-TW02-00	3/3	39.9	191	LOGNORMAL
Benzene	2 J	2 J	SWMU311-TW02-00	1/4	3.49	26.2	LOGNORMAL
Bromoform	12	19	SWMU311-TW02-00	3/3	21.1	29.9	LOGNORMAL
Carbon Disulfide	2 J	2 J	SWMU311-TW02-00	1/3	3.64	5.32	LOGNORMAL
Chloroform	2 J	2 J	SWMU311-TW01-00	1/3	3.34	4.54	LOGNORMAL
Cyclohexane	1 J	1 J	SWMU311-TW02-00	1/3	4.28	152	LOGNORMAL
Ethylbenzene	2 J	2 J	SWMU311-TW02-00	1/4	3.49	26.2	LOGNORMAL
Methyl Cyclohexane	1 J	1 J	SWMU311-TW02-00	1/3	4.28	152	LOGNORMAL
Methylene Chloride	18	30	SWMU311-TW01-00	3/3	33.5	49.8	LOGNORMAL
SEMIVOLATILES (ug/kg)							
Benzo(a)anthracene	33 J	33 J	SWMU311-IS03-00	1/1	NA	NA	LOGNORMAL
Benzo(a)pyrene	48 J	48 J	SWMU311-IS03-00	1/1	NA	NA	LOGNORMAL
Benzo(b)fluoranthene	48 J	48 J	SWMU311-IS03-00	1/1	NA	NA	LOGNORMAL
Benzo(g,h,i)perylene	50 J	50 J	SWMU311-IS03-00	1/1	NA	NA	LOGNORMAL
Benzo(k)fluoranthene	60 J	60 J	SWMU311-IS03-00	1/1	NA	NA	LOGNORMAL
Bis(2-ethylhexyl) Phthalate (DEHP)	170 J	170 J	SWMU311-IS03-00	1/1	NA	NA	LOGNORMAL
Chrysene	49 J	49 J	SWMU311-IS03-00	1/1	NA	NA	LOGNORMAL
Fluoranthene	65 J	65 J	SWMU311-IS03-00	1/1	NA	NA	LOGNORMAL
Indeno(1,2,3-cd)pyrene	41 J	41 J	SWMU311-IS03-00	1/1	NA	NA	LOGNORMAL
Pyrene	62 J	62 J	SWMU311-IS03-00	1/1	NA	NA	LOGNORMAL
METALS (mg/kg)							
Arsenic	0.31 J	0.31 J	SWMU311-TW01-00	1/4	0.553	2.84	LOGNORMAL
Barium	8.5	11.6	SWMU311-TW01-00	3/4	12.2	12.9	LOGNORMAL
Cadmium	0.056 J	0.74	SWMU311-IS03-00	3/4	0.631	11,743	LOGNORMAL
Chromium	4.8	10.4	SWMU311-TW01-00	4/4	9.66	12.6	LOGNORMAL
Lead	5.2 J	15.6	SWMU311-IS03-00	4/4	14.0	29.3	LOGNORMAL
Mercury	0.034 J	0.053	SWMU311-TW01-00	3/4	0.0535	0.0957	LOGNORMAL
Selenium	0.91	0.91	SWMU311-TW01-00	1/4	0.808	2.36	LOGNORMAL

APPENDIX G (Continued)

SUBSURFACE SOIL STATISTICAL SUMMARY
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

	Minimum Detected	Maximum Detected	Location of Maximum Detect	Frequency of Detection	Upper 95% Confidence Level	Log Upper 95% Confidence Level	W-Test Result
VOLATILES (ug/kg)							
1,2-Dichlorobenzene (o-)	530	530	SWMU311-IS02-03	1/15	101	56.8	LOGNORMAL
1,3-Dichlorobenzene (m-)	140	140	SWMU311-IS02-03	1/15	29.2	23.2	LOGNORMAL
1,4-Dichlorobenzene (p-)	220	220	SWMU311-IS02-03	1/15	43.9	29.2	LOGNORMAL
Acetone	2 J	18 J	SWMU311-SB20-03	6/13	8.03	8.87	LOGNORMAL
Bromoform	22	28	SWMU311-TW02-03	3/13	13.7	17.4	LOGNORMAL
Chlorobenzene	530	530	SWMU311-IS02-03	1/15	101	56.8	LOGNORMAL
Chloroform	1 J	2 J	SWMU311-TW02-03	2/13	5.21	6.42	LOGNORMAL
Methylene Chloride	1.9 J	34	SWMU311-TW03-03	10/13	19.6	41.9	LOGNORMAL
Toluene	200	200	SWMU311-IS02-03	1/15	40.2	27.8	LOGNORMAL
Xylenes, total	2000	2000	SWMU311-IS02-03	1/8	728	108,897	LOGNORMAL
SEMIVOLATILES (ug/kg)							
2-Methylnaphthalene	1300 J	1300 J	SWMU311-IS02-03	1/2	4,262	56,220	LOGNORMAL
Bis(2-ethylhexyl) Phthalate (DEHP)	800 J	800 J	SWMU311-IS03-03	1/2	5,188	9,269	LOGNORMAL
METALS (mg/kg)							
Arsenic	0.55 J	1.9	SWMU311-IS02-03	5/23	0.57	0.56	LOGNORMAL
Barium	1.6 J	45	SWMU311-TW01-03	21/23	13.2	14.1	LOGNORMAL
Cadmium	0.031 J	1.1 J	SWMU311-SB05-02	6/23	0.223	0.201	LOGNORMAL
Chromium	0.88 J	21	SWMU311-IS02-03	18/23	6.61	58.0	LOGNORMAL
Lead	1	51.2 J	SWMU311-SB05-02	23/23	12.6	11.8	LOGNORMAL
Mercury	0.019 J	0.057	SWMU311-IS02-03	4/23	0.0501	0.0624	LOGNORMAL
Selenium	0.4625	1.1 J	SWMU311-SB06-01,SWMU311-SB11-03	7/23	0.571	0.573	LOGNORMAL
Silver	0.33 J	0.51 J	SWMU311-SB11-02	7/23	0.289	0.367	LOGNORMAL

APPENDIX G (Continued)

GROUNDWATER STATISTICAL SUMMARY
SWMU 311
RCRA INVESTIGATION - CTO-0143
MCB, CAMP LEJEUNE, NORTH CAROLINA

	Minimum Detected	Maximum Detected	Location of Maximum Detect	Frequency of Detection	Upper 95% Confidence Level	Log Upper 95% Confidence Level	W-Test Result
VOLATILES (ug/L)							
Cyclohexane	3 J	3 J	SWMU311-GW01	1/3	3.15	3.41	LOGNORMAL
Ethylbenzene	2 J	2 J	SWMU311-GW01	1/3	2.82	3.16	LOGNORMAL
Isopropylbenzene (Cumene)	3 J	3 J	SWMU311-GW01	1/3	3.15	3.41	LOGNORMAL
Methyl Cyclohexane	3 J	3 J	SWMU311-GW01	1/3	3.15	3.41	LOGNORMAL
Xylenes, total	3 J	3 J	SWMU311-GW01	1/3	3.15	3.41	LOGNORMAL
METALS (ug/L)							
Arsenic	3.4 J	3.4 J	SWMU311-GW03	1/3	4.07	98.3	LOGNORMAL
Barium	24.7	53.75	SWMU311-GW01	2/3	64.6	1,608	LOGNORMAL
Chromium	12	12	SWMU311-GW01	1/3	15.6	8.89.E+22	LOGNORMAL
Lead	10.6	10.6	SWMU311-GW01	1/3	13.6	8.31.E+11	LOGNORMAL

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APPENDIX H

HHRA Calculation Spreadsheets

ADULT MILITARY BASE PERSONNEL - CURRENT SCENARIO
ACCIDENTAL INGESTION OF SURFACE SOIL - SWMU 311
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLINA

CDI (mg/kg/d) = (C*IR*CF*FI*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

Parameter	Units	Description	Military Base Personnel	
CDI	mg/kg/d	Chronic daily intake	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFo	1/(mg/kg/d)	Oral cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDo	mg/kg/d	Oral reference dose	CS	
C	mg/kg	Concentration of chemical in soil	CS	
IR-S	mg/day	Ingestion rate of soil	100	
CF	kg/mg	Conversion factor	1.00E-06	
FI	NA	Fraction of soil ingested from site	1	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	4	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	1,460	

				Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Cadmium	5.2	NA	5.0E-04	2.9E-07	--	--	5.1E-06	1.0E-02	100.0%
Lead	1,110	NA	NA	6.2E-05	--	--	1.1E-03	--	--
				Total ILCR:	--	--	Total HI:	1.0E-02	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT MILITARY BASE PERSONNEL - CURRENT SCENARIO
DERMAL CONTACT WITH SURFACE SOIL - SWMU 311
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLINA

DAD (mg/kg/d) = (C*CF*AF*ABS*SA*EF*ED)/(BW*AT)
ILCR = CDI*CSFd
HQ = CDI/RfDd

Parameter	Units	Description	Military Base Personnel	
DAD	mg/kg/d	Dermally absorbed dose	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFd	1/(mg/kg/d)	Dermal cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDd	mg/kg/d	Dermal reference dose	CS	
C	mg/kg	Concentration of chemical in soil	CS	
CF	kg/mg	Conversion factor	1.00E-06	
AF	mg/cm2	Soil to skin adherence factor	0.2	
ABS	NA	Absorption fraction	CS	
SA	cm2/day	Skin surface area available for contact	3,300	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	4	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	1,460	

					Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	ABS	CSFd 1/(mg/kg/d)	RfDd (mg/kg/d)	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Cadmium	5.2	0.001	NA	2.5E-05	1.9E-09	--	--	3.4E-08	1.3E-03	100.0%
Lead	1,110	0.01	NA	NA	4.1E-06	--	--	7.2E-05	--	--
					Total ILCR:	--	--	Total HI:	1.3E-03	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT MILITARY BASE PERSONNEL - CURRENT SCENARIO
INHALATION OF FUGITIVE DUSTS EMANATING FROM SURFACE SOIL - SWMU 311
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLINA

CDI (mg/kg/d) = (Ca*RR*ET*EF*ED)/(BW*AT)
Where: Ca = C * (1/PEF)

ILCR = CDI*CSFi
HQ = CDI/RfDi

Parameter	Units	Description	Military Base Personnel	
CDI	mg/kg/d	Chronic daily intake	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFi	1/(mg/kg/d)	Inhalation cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDi	mg/kg/d	Inhalation reference dose	CS	
Ca	mg/m3	Concentration of chemical in air as fugitive dusts	CS	
C	mg/kg	Concentration of chemical in soil	CS	
PEF	m3/kg	Particulate emission factor	1.32E+09	
RR	m3/hour	Respiration rate	0.55	
ET	hours/day	Exposure time	8.0	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	4	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	1,460	

					Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	Ca (mg/m3)	CSFi 1/(mg/kg/d)	RfDi (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Cadmium	5.2	3.94E-09	6.3E+00	NA	9.7E-12	6.1E-11	100.0%	1.7E-10	--	--
Lead	1,110	8.41E-07	NA	NA	2.1E-09	--	--	3.6E-08	--	--
					Total ILCR:	6.1E-11	100.0%	Total HI:	--	--

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
ACCIDENTAL INGESTION OF SURFACE SOIL - SWMU 311
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLINA

CDI (mg/kg/d) = (C*IR*CF*FI*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

Parameter	Units	Description	Adult	Young Child	
CDI	mg/kg/d	Chronic daily intake	CS	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	CS	
CSFo	1/(mg/kg/d)	Oral cancer slope factor	CS	CS	
HQ	NA	Hazard quotient	CS	CS	
RfDo	mg/kg/d	Oral reference dose	CS	CS	
C	mg/kg	Concentration of chemical in soil	CS	CS	
IR-S	mg/day	Ingestion rate of soil	100	200	
CF	kg/mg	Conversion factor	1.00E-06	1.00E-06	
FI	NA	Fraction of soil ingested from site	1	1	
EF	days/year	Exposure frequency	350	350	
ED	years	Exposure duration	24	6	
BW	kg	Body weight	70	15	
AT-C	days	Averaging time, carcinogens	25,550	25,550	
AT-N	days	Averaging time, noncarcinogens	8,760	2,190	

				Adult						Young Child					
				Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Cadmium	5.2	NA	5.0E-04	2.4E-06	--	--	7.1E-06	1.4E-02	100.0%	5.7E-06	--	--	6.6E-05	1.3E-01	100.0%
Lead	1,110	NA	NA	5.2E-04	--	--	1.5E-03	--	--	1.2E-03	--	--	1.4E-02	--	--
				Total ILCR:	--	--	Total HI:	1.4E-02	100.0%	Total ILCR:	--	--	Total HI:	1.3E-01	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIC
DERMAL CONTACT WITH SURFACE SOIL - SWMU 31
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLIN,

DAD (mg/kg/d) = (C*CF*AF*ABS*SA*EF*ED)/(BW*AT
ILCR = CDI*CSFd
HQ = CDI/RfDd

Parameter	Units	Description	Adult	Young Child	
DAD	mg/kg/d	Dermally absorbed dose	CS	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	CS	
CSFd	1/(mg/kg/d)	Dermal cancer slope factor	CS	CS	
HQ	NA	Hazard quotient	CS	CS	
RfDd	mg/kg/d	Dermal reference dose	CS	CS	
C	mg/kg	Concentration of chemical in soil	CS	CS	
CF	kg/mg	Conversion factor	1.00E-06	1.00E-06	
AF	mg/cm2	Soil to skin adherence factor	0.07	0.2	
ABS	NA	Absorption fraction	CS	CS	
SA	cm2/day	Skin surface area available for contact	5,700	2,800	
EF	days/year	Exposure frequency	350	350	
ED	years	Exposure duration	24	6	
BW	kg	Body weight	70	15	
AT-C	days	Averaging time, carcinogens	25,550	25,550	
AT-N	days	Averaging time, noncarcinogens	8,760	2,190	

					Adult						Young Child					
					Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	ABS	CSFd 1/(mg/kg/d)	RfDd (mg/kg/d)	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Cadmium	5.2	0.001	NA	2.5E-05	9.7E-09	--	--	2.8E-08	1.1E-03	100.0%	1.6E-08	--	--	1.9E-07	7.4E-03	100.0%
Lead	1,110	0.01	NA	NA	2.1E-05	--	--	6.1E-05	--	--	3.4E-05	--	--	4.0E-04	--	--
					Total ILCR:	--	--	Total HI:	1.1E-03	100.0%	Total ILCR:	--	--	Total HI:	7.4E-03	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIC
INHALATION OF FUGITIVE DUSTS EMANATING FROM SURFACE SOIL - SWMU 31
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLIN.

CDI (mg/kg/d) = (Ca*RR*ET*EF*ED)/(BW*AT)
Where: Ca = C * (1/PEF)

ILCR = CDI*CSFi
HQ = CDI/RfDi

Parameter	Units	Description	Adult	Young Child	
CDI	mg/kg/d	Chronic daily intake	CS	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	CS	
CSFi	1/(mg/kg/d)	Inhalation cancer slope factor	CS	CS	
HQ	NA	Hazard quotient	CS	CS	
RfDi	mg/kg/d	Inhalation reference dose	CS	CS	
Ca	mg/m3	Concentration of chemical in air as fugitive dusts	CS	CS	
C	mg/kg	Concentration of chemical in soil	CS	CS	
PEF	m3/kg	Particulate emission factor	1.32E+09	1.32E+09	
RR	m3/hour	Respiration rate	0.55	0.31	
ET	hours/day	Exposure time	1.5	5.6	
EF	days/year	Exposure frequency	350	350	
ED	years	Exposure duration	24	6	
BW	kg	Body weight	70	15	
AT-C	days	Averaging time, carcinogens	25,550	25,550	
AT-N	days	Averaging time, noncarcinogens	8,760	2,190	

					Adult						Young Child					
					Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	Ca (mg/m3)	CSFi 1/(mg/kg/d)	RfDi (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Cadmium	5.2	3.94E-09	6.3E+00	NA	1.5E-11	9.6E-11	100.0%	4.5E-11	--	--	3.7E-11	2.3E-10	100.0%	4.3E-10	--	--
Lead	1,110	8.41E-07	NA	NA	3.3E-09	--	--	9.5E-09	--	--	7.9E-09	--	--	9.2E-08	--	--
					Total ILCR:	9.6E-11	100.0%	Total HI:	--	--	Total ILCR:	2.3E-10	100.0%	Total HI:	--	--

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
ACCIDENTAL INGESTION OF SUBSURFACE SOIL - SWMU 311
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLINA

CDI (mg/kg/d) = (C*IR*CF*FI*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

Parameter	Units	Description	Adult	Young Child	
CDI	mg/kg/d	Chronic daily intake	CS	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	CS	
CSFo	1/(mg/kg/d)	Oral cancer slope factor	CS	CS	
HQ	NA	Hazard quotient	CS	CS	
RfDo	mg/kg/d	Oral reference dose	CS	CS	
C	mg/kg	Concentration of chemical in soil	CS	CS	
IR-S	mg/day	Ingestion rate of soil	100	200	
CF	kg/mg	Conversion factor	1.00E-06	1.00E-06	
FI	NA	Fraction of soil ingested from site	1	1	
EF	days/year	Exposure frequency	350	350	
ED	years	Exposure duration	24	6	
BW	kg	Body weight	70	15	
AT-C	days	Averaging time, carcinogens	25,550	25,550	
AT-N	days	Averaging time, noncarcinogens	8,760	2,190	

				Adult						Young Child					
				Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Arsenic	0.6	1.5E+00	3.0E-04	2.6E-07	4.0E-07	100.0%	7.7E-07	2.6E-03	100.0%	6.2E-07	9.2E-07	100.0%	7.2E-06	2.4E-02	100.0%
				Total ILCR:	4.0E-07	100.0%	Total HI:	2.6E-03	100.0%	Total ILCR:	9.2E-07	100.0%	Total HI:	2.4E-02	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIC
DERMAL CONTACT WITH SUBSURFACE SOIL - SWMU 31
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLIN/

DAD (mg/kg/d) = (C*CF*AF*ABS*SA*EF*ED)/(BW*AT
ILCR = CDI*CSFd
HQ = CDI/RfDd

Parameter	Units	Description	Adult	Young Child	
DAD	mg/kg/d	Dermally absorbed dose	CS	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	CS	
CSFd	1/(mg/kg/d)	Dermal cancer slope factor	CS	CS	
HQ	NA	Hazard quotient	CS	CS	
RfDd	mg/kg/d	Dermal reference dose	CS	CS	
C	mg/kg	Concentration of chemical in soil	CS	CS	
CF	kg/mg	Conversion factor	1.00E-06	1.00E-06	
AF	mg/cm2	Soil to skin adherence factor	0.07	0.2	
ABS	NA	Absorption fraction	CS	CS	
SA	cm2/day	Skin surface area available for contact	5,700	2,800	
EF	days/year	Exposure frequency	350	350	
ED	years	Exposure duration	24	6	
BW	kg	Body weight	70	15	
AT-C	days	Averaging time, carcinogens	25,550	25,550	
AT-N	days	Averaging time, noncarcinogens	8,760	2,190	

					Adult						Young Child					
					Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	ABS	CSFd 1/(mg/kg/d)	RfDd (mg/kg/d)	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Arsenic	0.6	0.03	3.7E+00	1.2E-04	3.2E-08	1.2E-07	100.0%	9.2E-08	7.5E-04	100.0%	5.2E-08	1.9E-07	100.0%	6.0E-07	4.9E-03	100.0%
					Total ILCR:	1.2E-07	100.0%	Total HI:	7.5E-04	100.0%	Total ILCR:	1.9E-07	100.0%	Total HI:	4.9E-03	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIC
INHALATION OF FUGITIVE DUSTS EMANATING FROM SUBSURFACE SOIL - SWMU 31
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLIN

CDI (mg/kg/d) = (Ca*RR*ET*EF*ED)/(BW*AT)
Where: Ca = C * (1/PEF)

ILCR = CDI*CSFi
HQ = CDI/RfDi

Parameter	Units	Description	Adult	Young Child	
CDI	mg/kg/d	Chronic daily intake	CS	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	CS	
CSFi	1/(mg/kg/d)	Inhalation cancer slope factor	CS	CS	
HQ	NA	Hazard quotient	CS	CS	
RfDi	mg/kg/d	Inhalation reference dose	CS	CS	
Ca	mg/m3	Concentration of chemical in air as fugitive dusts	CS	CS	
C	mg/kg	Concentration of chemical in soil	CS	CS	
PEF	m3/kg	Particulate emission factor	1.32E+09	1.32E+09	
RR	m3/hour	Respiration rate	0.55	0.31	
ET	hours/day	Exposure time	1.5	5.6	
EF	days/year	Exposure frequency	350	350	
ED	years	Exposure duration	24	6	
BW	kg	Body weight	70	15	
AT-C	days	Averaging time, carcinogens	25,550	25,550	
AT-N	days	Averaging time, noncarcinogens	8,760	2,190	

					Adult						Young Child					
					Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	Ca (mg/m3)	CSFi 1/(mg/kg/d)	RfDi (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Arsenic	0.6	4.25E-10	1.5E+01	NA	1.6E-12	2.5E-11	100.0%	4.8E-12	--	--	4.0E-12	6.0E-11	100.0%	4.7E-11	--	--
					Total ILCR:	2.5E-11	100.0%	Total HI:	--	--	Total ILCR:	6.0E-11	100.0%	Total HI:	--	--

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
INGESTION OF GROUNDWATER AS DRINKING WATER - SWMU 311
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLINA

CDI (mg/kg/d) = (C*IR*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

Parameter	Units	Description	Adult	Young Child	
CDI	mg/kg/d	Chronic daily intake	CS	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	CS	
CSFo	1/(mg/kg/d)	Oral cancer slope factor	CS	CS	
HQ	NA	Hazard quotient	CS	CS	
RfDo	mg/kg/d	Oral reference dose	CS	CS	
C	mg/L	Concentration of chemical in water	CS	CS	
IR-W	L/day	Ingestion rate of water	2	1	
EF	days/year	Exposure frequency	350	350	
ED	years	Exposure duration	24	6	
BW	kg	Body weight	70	15	
AT-C	days	Averaging time, carcinogens	25,550	25,550	
AT-N	days	Averaging time, noncarcinogens	8,760	2,190	

				Adult						Young Child					
				Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/L)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Arsenic	0.0034	1.5E+00	3.0E-04	3.2E-05	4.8E-05	100.0%	9.3E-05	3.1E-01	73.9%	1.9E-05	2.8E-05	100.0%	2.2E-04	7.2E-01	73.9%
Chromium	0.012	NA	3.0E-03 (1)	1.1E-04	--	--	3.3E-04	1.1E-01	26.1%	6.6E-05	--	--	7.7E-04	2.6E-01	26.1%
				Total ILCR:	4.8E-05	100.0%	Total HI:	4.2E-01	100.0%	Total ILCR:	2.8E-05	100.0%	Total HI:	9.8E-01	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
DERMAL CONTACT WITH GROUNDWATER - SWMU 311
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLINA

DAD (mg/kg/d) = (C*CF*Kp*SA*EF*ED*ET)/(BW*AT)

ILCR = CDI*CSFo Adj CSF Adj = CSF/AD
HQ = CDI/RfDo Adj RfD Adj = RfD*AD

Parameter	Units	Description	Adult	Young Child	
DAD	mg/kg/d	Dermally absorbed dose	CS	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	CS	
CSFd	1/(mg/kg/d)	Dermal cancer slope factor	CS	CS	
HQ	NA	Hazard quotient	CS	CS	
RfDd	mg/kg/d	Dermal reference dose	CS	CS	
SA	cm2	Skin surface area available for contact	18,000	6,600	
EF	days/year	Exposure frequency	350	350	
ED	years	Exposure duration	24	6	
ET	hours/day	Exposure time	0.58	1.00	
BW	kg	Body weight	70	15	
AT-C	days	Averaging time, carcinogens	25,550	25,550	
AT-N	days	Averaging time, noncarcinogens	8,760	2,190	
C	mg/L	Concentration of chemical in water	CS	CS	
CF	L/cm3	Conversion factor	1.00E-03	1.00E-03	
Kp	cm/hour	Dermal permeability coefficient	CS	CS	
AD	NA	Adjustment for absorbed dose	CS	CS	

					Adult						Young Child					
					Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/L)	Kp (cm/hour)	CSFd 1/(mg/kg/d)	RfDd (mg/kg/d)	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Arsenic	0.0034	0.00060317	3.7E+00	1.2E-04	1.0E-07	3.7E-07	100.0%	2.9E-07	2.4E-03	9.3%	7.4E-08	2.7E-07	100.0%	8.7E-07	7.0E-03	9.3%
Chromium	0.012	0.00081063	NA	6.0E-05 (1)	4.8E-07	--	--	1.4E-06	2.3E-02	90.7%	3.5E-07	--	--	4.1E-06	6.8E-02	90.7%
					Total ILCR:	3.7E-07	100.0%	Total HI:	2.6E-02	100.0%	Total ILCR:	2.7E-07	100.0%	Total HI:	7.5E-02	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

Kp value is derived from the USEPA RAGS E Guidance unless otherwise noted

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
ACCIDENTAL INGESTION OF SURFACE SOIL - SWMU 311
CENTRAL TENDENCY
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLINA

CDI (mg/kg/d) = (C*IR*CF*FI*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

Parameter	Units	Description	Adult	Young Child	
CDI	mg/kg/d	Chronic daily intake	CS	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	CS	
CSFo	1/(mg/kg/d)	Oral cancer slope factor	CS	CS	
HQ	NA	Hazard quotient	CS	CS	
RfDo	mg/kg/d	Oral reference dose	CS	CS	
C	mg/kg	Concentration of chemical in soil	CS	CS	
IR-S	mg/day	Ingestion rate of soil	50	100	
CF	kg/mg	Conversion factor	1.00E-06	1.00E-06	
FI	NA	Fraction of soil ingested from site	1	1	
EF	days/year	Exposure frequency	234	234	
ED	years	Exposure duration	7	2	
BW	kg	Body weight	70	15	
AT-C	days	Averaging time, carcinogens	25,550	25,550	
AT-N	days	Averaging time, noncarcinogens	2,555	730	

				Adult						Young Child					
				Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Cadmium	5.2	NA	5.0E-04	2.4E-07	--	--	2.4E-06	4.8E-03	100.0%	6.3E-07	--	--	2.2E-05	4.4E-02	100.0%
Lead	1,110	NA	NA	5.1E-05	--	--	5.1E-04	--	--	1.4E-04	--	--	4.7E-03	--	--
				Total ILCR:	--	--	Total HI:	4.8E-03	100.0%	Total ILCR:	--	--	Total HI:	4.4E-02	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIC
DERMAL CONTACT WITH SURFACE SOIL - SWMU 31
CENTRAL TENDENCY
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLIN,

DAD (mg/kg/d) = (C*CF*AF*ABS*SA*EF*ED)/(BW*AT
ILCR = CDI*CSFd
HQ = CDI/RfDd

Parameter	Units	Description	Adult	Young Child	
DAD	mg/kg/d	Dermally absorbed dose	CS	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	CS	
CSFd	1/(mg/kg/d)	Dermal cancer slope factor	CS	CS	
HQ	NA	Hazard quotient	CS	CS	
RfDd	mg/kg/d	Dermal reference dose	CS	CS	
C	mg/kg	Concentration of chemical in soil	CS	CS	
CF	kg/mg	Conversion factor	1.00E-06	1.00E-06	
AF	mg/cm2	Soil to skin adherence factor	0.01	0.04	
ABS	NA	Absorption fraction	CS	CS	
SA	cm2/day	Skin surface area available for contact	5,700	2,800	
EF	days/year	Exposure frequency	234	234	
ED	years	Exposure duration	7	2	
BW	kg	Body weight	70	15	
AT-C	days	Averaging time, carcinogens	25,550	25,550	
AT-N	days	Averaging time, noncarcinogens	2,555	730	

					Adult						Young Child					
					Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	ABS	CSFd 1/(mg/kg/d)	RfDd (mg/kg/d)	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Cadmium	5.2	0.001	NA	2.5E-05	2.7E-10	--	--	2.7E-09	1.1E-04	100.0%	7.1E-10	--	--	2.5E-08	1.0E-03	100.0%
Lead	1,110	0.01	NA	NA	5.8E-07	--	--	5.8E-06	--	--	1.5E-06	--	--	5.3E-05	--	--
					Total ILCR:	--	--	Total HI:	1.1E-04	100.0%	Total ILCR:	--	--	Total HI:	1.0E-03	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIC
INHALATION OF FUGITIVE DUSTS EMANATING FROM SURFACE SOIL - SWMU 31
CENTRAL TENDENCY
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLIN.

CDI (mg/kg/d) = (Ca*RR*ET*EF*ED)/(BW*AT)
Where: Ca = C * (1/PEF)

ILCR = CDI*CSFi
HQ = CDI/RfDi

Parameter	Units	Description	Adult	Young Child	
CDI	mg/kg/d	Chronic daily intake	CS	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	CS	
CSFi	1/(mg/kg/d)	Inhalation cancer slope factor	CS	CS	
HQ	NA	Hazard quotient	CS	CS	
RfDi	mg/kg/d	Inhalation reference dose	CS	CS	
Ca	mg/m3	Concentration of chemical in air as fugitive dusts	CS	CS	
C	mg/kg	Concentration of chemical in soil	CS	CS	
PEF	m3/kg	Particulate emission factor	1.32E+09	1.32E+09	
RR	m3/hour	Respiration rate	0.55	0.31	
ET	hours/day	Exposure time	1.5	5.6	
EF	days/year	Exposure frequency	234	234	
ED	years	Exposure duration	7	2	
BW	kg	Body weight	70	15	
AT-C	days	Averaging time, carcinogens	25,550	25,550	
AT-N	days	Averaging time, noncarcinogens	2,555	730	

					Adult						Young Child					
					Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	Ca (mg/m3)	CSFi 1/(mg/kg/d)	RfDi (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Cadmium	5.2	3.94E-09	6.3E+00	NA	3.0E-12	1.9E-11	100.0%	3.0E-11	--	--	8.3E-12	5.2E-11	100.0%	2.9E-10	--	--
Lead	1,110	8.41E-07	NA	NA	6.4E-10	--	--	6.4E-09	--	--	1.8E-09	--	--	6.2E-08	--	--
					Total ILCR:	1.9E-11	100.0%	Total HI:	--	--	Total ILCR:	5.2E-11	100.0%	Total HI:	--	--

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
ACCIDENTAL INGESTION OF SUBSURFACE SOIL - SWMU 311
CENTRAL TENDENCY
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLINA

CDI (mg/kg/d) = (C*IR*CF*FI*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

Parameter	Units	Description	Adult	Young Child	
CDI	mg/kg/d	Chronic daily intake	CS	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	CS	
CSFo	1/(mg/kg/d)	Oral cancer slope factor	CS	CS	
HQ	NA	Hazard quotient	CS	CS	
RfDo	mg/kg/d	Oral reference dose	CS	CS	
C	mg/kg	Concentration of chemical in soil	CS	CS	
IR-S	mg/day	Ingestion rate of soil	50	100	
CF	kg/mg	Conversion factor	1.00E-06	1.00E-06	
FI	NA	Fraction of soil ingested from site	1	1	
EF	days/year	Exposure frequency	234	234	
ED	years	Exposure duration	7	2	
BW	kg	Body weight	70	15	
AT-C	days	Averaging time, carcinogens	25,550	25,550	
AT-N	days	Averaging time, noncarcinogens	2,555	730	

				Adult						Young Child					
				Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Arsenic	0.6	1.5E+00	3.0E-04	2.6E-08	3.9E-08	100.0%	2.6E-07	8.6E-04	100.0%	6.9E-08	1.0E-07	100.0%	2.4E-06	8.0E-03	100.0%
				Total ILCR:	3.9E-08	100.0%	Total HI:	8.6E-04	100.0%	Total ILCR:	1.0E-07	100.0%	Total HI:	8.0E-03	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIC
DERMAL CONTACT WITH SUBSURFACE SOIL - SWMU 31
CENTRAL TENDENCY
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLIN,

DAD (mg/kg/d) = (C*CF*AF*ABS*SA*EF*ED)/(BW*AT
ILCR = CDI*CSFd
HQ = CDI/RfDd

Parameter	Units	Description	Adult	Young Child	
DAD	mg/kg/d	Dermally absorbed dose	CS	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	CS	
CSFd	1/(mg/kg/d)	Dermal cancer slope factor	CS	CS	
HQ	NA	Hazard quotient	CS	CS	
RfDd	mg/kg/d	Dermal reference dose	CS	CS	
C	mg/kg	Concentration of chemical in soil	CS	CS	
CF	kg/mg	Conversion factor	1.00E-06	1.00E-06	
AF	mg/cm2	Soil to skin adherence factor	0.01	0.04	
ABS	NA	Absorption fraction	CS	CS	
SA	cm2/day	Skin surface area available for contact	5,700	2,800	
EF	days/year	Exposure frequency	234	234	
ED	years	Exposure duration	7	2	
BW	kg	Body weight	70	15	
AT-C	days	Averaging time, carcinogens	25,550	25,550	
AT-N	days	Averaging time, noncarcinogens	2,555	730	

					Adult						Young Child					
					Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	ABS	CSFd 1/(mg/kg/d)	RfDd (mg/kg/d)	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Arsenic	0.6	0.03	3.7E+00	1.2E-04	8.8E-10	3.2E-09	100.0%	8.8E-09	7.1E-05	100.0%	2.3E-09	8.4E-09	100.0%	8.1E-08	6.6E-04	100.0%
					Total ILCR:	3.2E-09	100.0%	Total HI:	7.1E-05	100.0%	Total ILCR:	8.4E-09	100.0%	Total HI:	6.6E-04	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIC
INHALATION OF FUGITIVE DUSTS EMANATING FROM SUBSURFACE SOIL - SWMU 31
CENTRAL TENDENCY
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLIN.

CDI (mg/kg/d) = (Ca*RR*ET*EF*ED)/(BW*AT)
Where: Ca = C * (1/PEF)

ILCR = CDI*CSFi
HQ = CDI/RfDi

Parameter	Units	Description	Adult	Young Child	
CDI	mg/kg/d	Chronic daily intake	CS	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	CS	
CSFi	1/(mg/kg/d)	Inhalation cancer slope factor	CS	CS	
HQ	NA	Hazard quotient	CS	CS	
RfDi	mg/kg/d	Inhalation reference dose	CS	CS	
Ca	mg/m3	Concentration of chemical in air as fugitive dusts	CS	CS	
C	mg/kg	Concentration of chemical in soil	CS	CS	
PEF	m3/kg	Particulate emission factor	1.32E+09	1.32E+09	
RR	m3/hour	Respiration rate	0.55	0.31	
ET	hours/day	Exposure time	1.5	5.6	
EF	days/year	Exposure frequency	234	234	
ED	years	Exposure duration	7	2	
BW	kg	Body weight	70	15	
AT-C	days	Averaging time, carcinogens	25,550	25,550	
AT-N	days	Averaging time, noncarcinogens	25,555	730	

					Adult						Young Child					
					Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	Ca (mg/m3)	CSFi 1/(mg/kg/d)	RfDi (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Arsenic	0.6	4.25E-10	1.5E+01	NA	3.2E-13	4.8E-12	100.0%	3.2E-12	--	--	8.9E-13	1.3E-11	100.0%	3.1E-11	--	--
					Total ILCR:	4.8E-12	100.0%	Total HI:	--	--	Total ILCR:	1.3E-11	100.0%	Total HI:	--	--

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
INGESTION OF GROUNDWATER AS DRINKING WATER - SWMU 311
CENTRAL TENDENCY
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLINA

CDI (mg/kg/d) = (C*IR*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

Parameter	Units	Description	Adult	Young Child	
CDI	mg/kg/d	Chronic daily intake	CS	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	CS	
CSFo	1/(mg/kg/d)	Oral cancer slope factor	CS	CS	
HQ	NA	Hazard quotient	CS	CS	
RfDo	mg/kg/d	Oral reference dose	CS	CS	
C	mg/L	Concentration of chemical in water	CS	CS	
IR-W	L/day	Ingestion rate of water	1.4	1	
EF	days/year	Exposure frequency	234	234	
ED	years	Exposure duration	7	2	
BW	kg	Body weight	70	15	
AT-C	days	Averaging time, carcinogens	25,550	25,550	
AT-N	days	Averaging time, noncarcinogens	2,555	730	

				Adult						Young Child					
				Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/L)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Arsenic	0.0034	1.5E+00	3.0E-04	4.4E-06	6.5E-06	100.0%	4.4E-05	1.5E-01	73.9%	4.2E-06	6.2E-06	100.0%	1.5E-04	4.8E-01	73.9%
Chromium	0.012	NA	3.0E-03 (1)	1.5E-05	--	--	1.5E-04	5.1E-02	26.1%	1.5E-05	--	--	5.1E-04	1.7E-01	26.1%
				Total ILCR:	6.5E-06	100.0%	Total HI:	2.0E-01	100.0%	Total ILCR:	6.2E-06	100.0%	Total HI:	6.6E-01	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
DERMAL CONTACT WITH GROUNDWATER - SWMU 311
CENTRAL TENDENCY
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLINA

DAD (mg/kg/d) = (C*CF*Kp*SA*EF*ED*ET)/(BW*AT)

ILCR = CDI*CSFo Adj CSF Adj = CSF/AD
HQ = CDI/RfDo Adj RfD Adj = RfD*AD

Parameter	Units	Description	Adult	Young Child	
DAD	mg/kg/d	Dermally absorbed dose	CS	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	CS	
CSFd	1/(mg/kg/d)	Dermal cancer slope factor	CS	CS	
HQ	NA	Hazard quotient	CS	CS	
RfDd	mg/kg/d	Dermal reference dose	CS	CS	
SA	cm2	Skin surface area available for contact	18,000	6,600	
EF	days/year	Exposure frequency	234	234	
ED	years	Exposure duration	7	2	
ET	hours/day	Exposure time	0.25	0.33	
BW	kg	Body weight	70	15	
AT-C	days	Averaging time, carcinogens	25,550	25,550	
AT-N	days	Averaging time, noncarcinogens	2,555	730	
C	mg/L	Concentration of chemical in water	CS	CS	
CF	L/cm3	Conversion factor	1.00E-03	1.00E-03	
Kp	cm/hour	Dermal permeability coefficient	CS	CS	
AD	NA	Adjustment for absorbed dose	CS	CS	

					Adult						Young Child					
					Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/L)	Kp (cm/hour)	CSFd 1/(mg/kg/d)	RfDd (mg/kg/d)	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Arsenic	0.0034	0.00060317	3.7E+00	1.2E-04	8.5E-09	3.1E-08	100.0%	8.5E-08	6.9E-04	9.3%	5.5E-09	2.0E-08	100.0%	1.9E-07	1.6E-03	9.3%
Chromium	0.012	0.00081063	NA	6.0E-05 (1)	4.0E-08	--	--	4.0E-07	6.7E-03	90.7%	2.6E-08	--	--	9.1E-07	1.5E-02	90.7%
					Total ILCR:	3.1E-08	100.0%	Total HI:	7.4E-03	100.0%	Total ILCR:	2.0E-08	100.0%	Total HI:	1.7E-02	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

Kp value is derived from the USEPA RAGS E Guidance unless otherwise noted

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
ACCIDENTAL INGESTION OF SURFACE SOIL - SWMU 311
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLINA

CDI (mg/kg/d) = (C*IR*CF*FI*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

Parameter	Units	Description	Construction Workers	
CDI	mg/kg/d	Chronic daily intake	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFo	1/(mg/kg/d)	Oral cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDo	mg/kg/d	Oral reference dose	CS	
C	mg/kg	Concentration of chemical in soil	CS	
IR-S	mg/day	Ingestion rate of soil	480	
CF	kg/mg	Conversion factor	1.00E-06	
FI	NA	Fraction of soil ingested from site	1	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	1	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	365	

				Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Cadmium	5.2	NA	5.0E-04	3.5E-07	--	--	2.4E-05	4.9E-02	100.0%
Lead	1,110	NA	NA	7.4E-05	--	--	5.2E-03	--	--
				Total ILCR:	--	--	Total HI:	4.9E-02	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
DERMAL CONTACT WITH SURFACE SOIL - SWMU 311
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLINA

DAD (mg/kg/d) = (C*CF*AF*ABS*SA*EF*ED)/(BW*AT)
ILCR = CDI*CSFd
HQ = CDI/RfDd

Parameter	Units	Description	Construction Workers	
DAD	mg/kg/d	Dermally absorbed dose	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFd	1/(mg/kg/d)	Dermal cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDd	mg/kg/d	Dermal reference dose	CS	
C	mg/kg	Concentration of chemical in soil	CS	
CF	kg/mg	Conversion factor	1.00E-06	
AF	mg/cm2	Soil to skin adherence factor	0.2	
ABS	NA	Absorption fraction	CS	
SA	cm2/day	Skin surface area available for contact	3,300	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	1	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	365	

					Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	ABS	CSFd 1/(mg/kg/d)	RfDd (mg/kg/d)	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Cadmium	5.2	0.001	NA	2.5E-05	4.8E-10	--	--	3.4E-08	1.3E-03	100.0%
Lead	1,110	0.01	NA	NA	1.0E-06	--	--	7.2E-05	--	--
					Total ILCR:	--	--	Total HI:	1.3E-03	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
INHALATION OF FUGITIVE DUSTS EMANATING FROM SURFACE SOIL - SWMU 311
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLINA

CDI (mg/kg/d) = (Ca*RR*ET*EF*ED)/(BW*AT)
Where: Ca = C * (1/PEF)

ILCR = CDI*CSFi
HQ = CDI/RfDi

Parameter	Units	Description	Construction Workers	
CDI	mg/kg/d	Chronic daily intake	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFi	1/(mg/kg/d)	Inhalation cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDi	mg/kg/d	Inhalation reference dose	CS	
Ca	mg/m3	Concentration of chemical in air as fugitive dusts	CS	
C	mg/kg	Concentration of chemical in soil	CS	
PEF	m3/kg	Particulate emission factor	9.35E+08	
RR	m3/hour	Respiration rate	3.30	
ET	hours/day	Exposure time	8.0	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	1	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	365	

					Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	Ca (mg/m3)	CSFi 1/(mg/kg/d)	RfDi (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Cadmium	5.2	5.56E-09	6.3E+00	NA	2.1E-11	1.3E-10	100.0%	1.4E-09	--	--
Lead	1,110	1.19E-06	NA	NA	4.4E-09	--	--	3.1E-07	--	--
					Total ILCR:	1.3E-10	100.0%	Total HI:	--	--

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
ACCIDENTAL INGESTION OF SUBSURFACE SOIL - SWMU 311
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLINA

CDI (mg/kg/d) = (C*IR*CF*FI*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

Parameter	Units	Description	Construction Workers	
CDI	mg/kg/d	Chronic daily intake	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFo	1/(mg/kg/d)	Oral cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDo	mg/kg/d	Oral reference dose	CS	
C	mg/kg	Concentration of chemical in soil	CS	
IR-S	mg/day	Ingestion rate of soil	480	
CF	kg/mg	Conversion factor	1.00E-06	
FI	NA	Fraction of soil ingested from site	1	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	1	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	365	

Parameter	C (mg/kg)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	Carcinogens			Noncarcinogens		
				CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Arsenic	0.56	1.5E+00	3.0E-04	3.8E-08	5.6E-08	100.0%	2.6E-06	8.8E-03	100.0%
				Total ILCR:	5.6E-08	100.0%	Total HI:	8.8E-03	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
DERMAL CONTACT WITH SUBSURFACE SOIL - SWMU 311
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLINA

DAD (mg/kg/d) = (C*CF*AF*ABS*SA*EF*ED)/(BW*AT)
ILCR = CDI*CSFd
HQ = CDI/RfDd

Parameter	Units	Description	Construction Workers	
DAD	mg/kg/d	Dermally absorbed dose	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFd	1/(mg/kg/d)	Dermal cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDd	mg/kg/d	Dermal reference dose	CS	
C	mg/kg	Concentration of chemical in soil	CS	
CF	kg/mg	Conversion factor	1.00E-06	
AF	mg/cm2	Soil to skin adherence factor	0.2	
ABS	NA	Absorption fraction	CS	
SA	cm2/day	Skin surface area available for contact	3,300	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	1	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	365	

					Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	ABS	CSFd 1/(mg/kg/d)	RfDd (mg/kg/d)	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Arsenic	0.56	0.03	3.7E+00	1.2E-04	1.6E-09	5.7E-09	100.0%	1.1E-07	8.8E-04	100.0%
					Total ILCR:	5.7E-09	100.0%	Total HI:	8.8E-04	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
INHALATION OF FUGITIVE DUSTS EMANATING FROM EXCAVATED SUBSURFACE SOIL - SWMU 311
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLINA

CDI (mg/kg/d) = (Ca*RR*ET*EF*ED)/(BW*AT)
Where: Ca = C * (1/PEF)

ILCR = CDI*CSFi
HQ = CDI/RfDi

Parameter	Units	Description	Construction Workers	
CDI	mg/kg/d	Chronic daily intake	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFi	1/(mg/kg/d)	Inhalation cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDi	mg/kg/d	Inhalation reference dose	CS	
Ca	mg/m3	Concentration of chemical in air as fugitive dusts	CS	
C	mg/kg	Concentration of chemical in soil	CS	
PEF	m3/kg	Particulate emission factor	9.35E+08	
RR	m3/hour	Respiration rate	3.30	
ET	hours/day	Exposure time	8.0	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	1	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	365	

					Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	Ca (mg/m3)	CSFi 1/(mg/kg/d)	RfDi (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Arsenic	0.56	6.00E-10	1.5E+01	NA	2.2E-12	3.3E-11	100.0%	1.6E-10	--	--
					Total ILCR:	3.3E-11	100.0%	Total HI:	--	--

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
ACCIDENTAL INGESTION OF SURFACE SOIL - SWMU 311
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLINA

CDI (mg/kg/d) = (C*IR*CF*FI*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

Parameter	Units	Description	Construction Workers	
CDI	mg/kg/d	Chronic daily intake	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFo	1/(mg/kg/d)	Oral cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDo	mg/kg/d	Oral reference dose	CS	
C	mg/kg	Concentration of chemical in soil	CS	
IR-S	mg/day	Ingestion rate of soil	480	
CF	kg/mg	Conversion factor	1.00E-06	
FI	NA	Fraction of soil ingested from site	1	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	1	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	365	

				Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Cadmium	5.2	NA	5.0E-04	3.5E-07	--	--	2.4E-05	4.9E-02	100.0%
Lead	1,110	NA	NA	7.4E-05	--	--	5.2E-03	--	--
				Total ILCR:	--	--	Total HI:	4.9E-02	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
DERMAL CONTACT WITH SURFACE SOIL - SWMU 311
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLINA

DAD (mg/kg/d) = (C*CF*AF*ABS*SA*EF*ED)/(BW*AT)
ILCR = CDI*CSFd
HQ = CDI/RfDd

Parameter	Units	Description	Construction Workers	
DAD	mg/kg/d	Dermally absorbed dose	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFd	1/(mg/kg/d)	Dermal cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDd	mg/kg/d	Dermal reference dose	CS	
C	mg/kg	Concentration of chemical in soil	CS	
CF	kg/mg	Conversion factor	1.00E-06	
AF	mg/cm2	Soil to skin adherence factor	0.2	
ABS	NA	Absorption fraction	CS	
SA	cm2/day	Skin surface area available for contact	3,300	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	1	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	365	

					Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	ABS	CSFd 1/(mg/kg/d)	RfDd (mg/kg/d)	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Cadmium	5.2	0.001	NA	2.5E-05	4.8E-10	--	--	3.4E-08	1.3E-03	100.0%
Lead	1,110	0.01	NA	NA	1.0E-06	--	--	7.2E-05	--	--
					Total ILCR:	--	--	Total HI:	1.3E-03	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
INHALATION OF FUGITIVE DUSTS EMANATING FROM SURFACE SOIL - SWMU 311
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLINA

CDI (mg/kg/d) = (Ca*RR*ET*EF*ED)/(BW*AT
Where: Ca = C * (1/PEF)

ILCR = CDI*CSFi
HQ = CDI/RfDi

Parameter	Units	Description	Construction Workers	
CDI	mg/kg/d	Chronic daily intake	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFi	1/(mg/kg/d)	Inhalation cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDi	mg/kg/d	Inhalation reference dose	CS	
Ca	mg/m3	Concentration of chemical in air as fugitive dusts	CS	
C	mg/kg	Concentration of chemical in soil	CS	
PEF	m3/kg	Particulate emission factor	9.35E+08	
RR	m3/hour	Respiration rate	3.30	
ET	hours/day	Exposure time	8.0	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	1	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	365	

					Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	Ca (mg/m3)	CSFi 1/(mg/kg/d)	RfDi (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Cadmium	5.2	5.56E-09	6.3E+00	NA	2.1E-11	1.3E-10	100.0%	1.4E-09	--	--
Lead	1,110	1.19E-06	NA	NA	4.4E-09	--	--	3.1E-07	--	--
					Total ILCR:	1.3E-10	100.0%	Total HI:	--	--

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
ACCIDENTAL INGESTION OF SUBSURFACE SOIL - SWMU 311
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLINA

CDI (mg/kg/d) = (C*IR*CF*FI*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

Parameter	Units	Description	Construction Workers	
CDI	mg/kg/d	Chronic daily intake	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFo	1/(mg/kg/d)	Oral cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDo	mg/kg/d	Oral reference dose	CS	
C	mg/kg	Concentration of chemical in soil	CS	
IR-S	mg/day	Ingestion rate of soil	480	
CF	kg/mg	Conversion factor	1.00E-06	
FI	NA	Fraction of soil ingested from site	1	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	1	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	365	

				Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Arsenic	0.56	1.5E+00	3.0E-04	3.8E-08	5.6E-08	100.0%	2.6E-06	8.8E-03	100.0%
				Total ILCR:	5.6E-08	100.0%	Total HI:	8.8E-03	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
DERMAL CONTACT WITH SUBSURFACE SOIL - SWMU 311
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLINA

DAD (mg/kg/d) = (C*CF*AF*ABS*SA*EF*ED)/(BW*AT)
ILCR = CDI*CSFd
HQ = CDI/RfDd

Parameter	Units	Description	Construction Workers	
DAD	mg/kg/d	Dermally absorbed dose	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFd	1/(mg/kg/d)	Dermal cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDd	mg/kg/d	Dermal reference dose	CS	
C	mg/kg	Concentration of chemical in soil	CS	
CF	kg/mg	Conversion factor	1.00E-06	
AF	mg/cm2	Soil to skin adherence factor	0.2	
ABS	NA	Absorption fraction	CS	
SA	cm2/day	Skin surface area available for contact	3,300	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	1	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	365	

					Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	ABS	CSFd 1/(mg/kg/d)	RfDd (mg/kg/d)	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Arsenic	0.56	0.03	3.7E+00	1.2E-04	1.6E-09	5.7E-09	100.0%	1.1E-07	8.8E-04	100.0%
					Total ILCR:	5.7E-09	100.0%	Total HI:	8.8E-04	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
INHALATION OF FUGITIVE DUSTS EMANATING FROM EXCAVATED SUBSURFACE SOIL - SWMU 311
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION - MCB, CAMP LEJEUNE, NORTH CAROLINA

CDI (mg/kg/d) = (Ca*RR*ET*EF*ED)/(BW*AT)
Where: Ca = C * (1/PEF)

ILCR = CDI*CSFi
HQ = CDI/RfDi

Parameter	Units	Description	Construction Workers	
CDI	mg/kg/d	Chronic daily intake	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFi	1/(mg/kg/d)	Inhalation cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDi	mg/kg/d	Inhalation reference dose	CS	
Ca	mg/m3	Concentration of chemical in air as fugitive dusts	CS	
C	mg/kg	Concentration of chemical in soil	CS	
PEF	m3/kg	Particulate emission factor	9.35E+08	
RR	m3/hour	Respiration rate	3.30	
ET	hours/day	Exposure time	8.0	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	1	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	365	

					Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	Ca (mg/m3)	CSFi 1/(mg/kg/d)	RfDi (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Arsenic	0.56	6.00E-10	1.5E+01	NA	2.2E-12	3.3E-11	100.0%	1.6E-10	--	--
					Total ILCR:	3.3E-11	100.0%	Total HI:	--	--

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

PARTICULATE EMISSION FACTOR - CONSTRUCTION
SWMU 311

$$PEF = Q/C_{sr} \times 1/F_D \times \left[\frac{T \times A_R}{556 \times (W/3)^{0.4} \times (365-p)/365 \times Sum(VKT)} \right]$$

$$Q/C_{sr} = A \times \exp\ (\ln A_S - B)^2/C)$$

Symbol	Definition (units)	Default	Reference
PEF	Particulate Emission Factor (m^3/kg)	9.35E+08	Site-specific
Q/C_{sr}	Inverse of a 1-h avg. air concentration along a straight road bisecting a 2.5 acre square site (g/m^2 -s/kg/m^3)	17.88416711	USEPA 2001
A	Constant (unitless)	12.9351	USEPA 2001
A_S	Areal extent of site surface soil contamination (acres)	2.5	Site-specific
B	Constant (unitless)	5.7383	USEPA 2001
C	Constant (unitless)	71.7711	USEPA 2001
F_D	Dispersion correction factor	0.185	USEPA 2001
T	Total time over which construction occurs (s)	2.16E+07	USEPA 2001
A_R	Surface area of contaminated road segment (m^2)	10121.45749	Site-specific
W	Mean vehicle weight (tons)	11	USEPA 2001
p	Number of days with at least 0.01 inches of precipitation (days/year)	120	USEPA 2001
Sum(VKT)	Sum of fleet vehicl kilometers traveled during the exposure duration (km)	36	USEPA 2001

96.6711735	$Q/C_{sr} \times 1/F_D$
2.1862E+11	$T \times A_R$
1.6815453	$(W/3)^{0.4}$
0.67123288	(365-p)/365
22592.2292	$556 \times (W/3)^{0.4} \times (365-p)/365 \times Sum(VKT)$
9676932.73	$T \times A_R/556 \times (W/3)^{0.4} \times (365-p)/365 \times Sum(VKT)$
935480444	PEF
0.91629073	$Ln\ A_S$
23.2517734	$(Ln\ A_S - B)^2$
0.32397126	$(Ln\ A_S - B)^2/C$
1.38260756	$e^{(Ln\ AS - B)2/C}$
17.8841671	$A \times e^{(Ln\ AS - B)2/C}$ Q/C_{sr}

W assumptions: 1 2-ton car and 1 20-ton truck = 2 vehicles

Sum(VKT) assumptions:

Assume that the site is 2.5 acres configured as a square with the unpaved road segment dividing the square evenly. The road length equals the square root of the 2.5 acres

2 vehicles x 0.10 km/day x 36 weeks/yr x 5 days/week = 36

10121.4575	2.5 acres/0.000247acres/m^2
100.605455	sqrt(10121.4575)
0.1	km

A_R assumptions:

Based on VKT, the road length is 100 m and assume the road width is 50 ft. (15.24 m).

USEPA 2001. Draft Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

ORAL ABSORPTION EFFICIENCIES TABLE

Table 6. Dermal risk values derived by calculation from gastrointestinal (GI) absorption data in chemical order

	CAS Number	GI Absorption Factor (%)[a]	GI Absorption Reference	Oral RfD (mg/kg/day) Chronic	Oral RfD (mg/kg/day) Subchronic	Oral Slope Factor $(mg/kg/day)^{-1}$	Dermal RfD (mg/kg/day) Chronic	Dermal RfD (mg/kg/day) Subchronic	Dermal Slope Factor $(mg/kg/day)^{-1}$
Acenaphthene	000083-32-9	31	2	6.00E-02[b]	6.00E-01[c]	NA	1.86E-02	1.86E-01	NA
Acenaphthylene	000208-96-8	31	2	NA	NA	NA	NA	NA	NA
* Acetone	000067-64-1	83	3	1.00E-01[b]	1.00E+00[c]	NA	8.30E-02	8.30E-01	NA
* Aldrin	000309-00-2	50	65	3.00E-05[b]	3.00E-05[c]	1.70E+01[b]	1.50E-05	1.50E-05	1.60E+01
* Aluminum	007429-90-5	10	4,5	NA	NA	NA	NA	NA	NA
Anthracene	000120-12-7	76	6	3.00E-01[b]	3.00E+00[c]	NA	2.28E-01	2.28E+00	NA
* Antimony (metallic)	007440-36-0	2.0	7	4.00E-04[b]	4.00E-04[c]	NA	8.00E-06	8.00E-06	NA
* Aroclor 1016	012674-11-2	90	46	7.00E-05[b]	NA	NA	6.30E-05	NA	NA
* Aroclor 1254	011097-69-1	90	46	2.00E-05[b]	5.00E-05[c]	NA	1.80E-05	4.50E-05	NA
* Aroclor 1260	011096-82-5	90	46	NA	NA	NA	NA	NA	NA
* Arsenic Salts	NA	80	26	NA	NA	NA	NA	NA	NA
* Arsenic, Inorganic	007440-38-2	44	8	1.00E-04[b]	3.00E-04[c]	1.50E+00[b]	1.23E-04	1.23E-04	3.66E+00
* Barium	007440-39-3	7.0	9	7.00E-02[b]	7.00E-02[c]	NA	4.90E-03	4.90E-03	NA
Benz[a]anthracene	000056-55-3	31	2	NA	NA	NA	NA	NA	NA
* Benzene	000071-43-2	97	10	NA	NA	2.90E-02[b]	NA	NA	2.99E-02
Benzene Hexachloride	NA	97	10	NA	NA	NA	NA	NA	NA
Benzene, Ethyldimethyl	NA	97	10	NA	NA	NA	NA	NA	NA
Benzene, Ethylmethyl	NA	97	10	NA	NA	NA	NA	NA	NA
Benzene, Methylpropenyl	NA	97	10	NA	NA	NA	NA	NA	NA
Benzene, Methylpropyl	NA	97	10	NA	NA	NA	NA	NA	NA
Benzene, Trimethyl	025551-13-7	97	10	NA	NA	NA	NA	NA	NA

07/26/96

ll by calculation
ata in chemical order

Oral Slope Factor $(mg/kg/day)^{-1}$	Dermal RfD (mg/kg/day) Chronic	Dermal RfD (mg/kg/day) Subchronic	Dermal Slope Factor $(mg/kg/day)^{-1}$
2.30E+02[b]	2.40E-03	2.40E-03	2.88E+02
7.30E+00[b]	NA	NA	2.35E+01
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	4.00E+00	4.00E+00	NA
NA	1.98E-01	6.60E-01	NA
4.30E+00[b]	5.00E-05	5.00E-05	4.30E+02
1.40E-02[b]	3.80E-03	3.80E-03	7.37E-02
NA	8.10E-02	8.10E-02	NA
6.20E-02[b]	1.96E-02	1.96E-02	6.33E-02
7.90E-03[b]	1.20E-02	1.20E-01	1.32E-02
NA	NA	NA	NA
NA	1.22E-01	1.22E+00	NA
NA	1.00E-05	NA	NA
NA	5.00E-05	NA	NA
2.00E-02[c]	NA	NA	2.84E-01
NA	6.30E-02	6.30E-02	NA
1.30E-01[b]	4.55E-04	4.55E-03	7.00E-01
4.10E+00[b]	3.00E-04	3.00E-05	2.60E+00
NA	NA	NA	NA

Table 6. Dermal risk values derived by calculation from gastrointestinal (GI) absorption data in chemical order

Chemical	CAS Number	GI Absorption Factor (%)[a]	GI Absorption Reference	Oral RfD (mg/kg/day) Chronic	Oral RfD (mg/kg/day) Subchronic	Oral Slope Factor (mg/kg/day)$^{-1}$	Dermal RfD (mg/kg/day) Chronic	Dermal RfD (mg/kg/day) Subchronic	Dermal Slope Factor (mg/kg/day)$^{-1}$
Chlorobenzene	000108-90-7	31	23	2.00E-02[b]	2.00E-01[c]	NA	6.20E-03	6.20E-02	NA
Chloroform	000067-66-3	20	24	1.00E-02[b]	1.00E-02[c]	6.10E-03[b]	2.00E-03	2.00E-03	3.05E-02
Chromium (III) (Insoluble Salts)	016065-83-1	0.50	74	1.00E+00[b]	1.00E+00[c]	NA	5.00E-03	5.00E-03	NA
Chromium (VI)	018540-29-9	2.0	25	5.00E-03[b]	2.00E-02[c]	NA	1.00E-04	4.00E-04	NA
Chromium Salts	NA	2.0	74	NA	NA	NA	NA	NA	NA
Chrysene	000218-01-9	31	2	NA	NA	NA	NA	NA	NA
Cobalt	007440-48-4	80	26	NA	NA	NA	NA	NA	NA
Copper	007440-50-8	30	27	NA	NA	NA	NA	NA	NA
Cresol, p-	000106-44-5	65	72	5.00E-03[c]	5.00E-03[c]	NA	3.25E-03	3.25E-03	NA
Cyanide (CN-)	000057-12-5	17	37	2.00E-02[b]	2.00E-02[c]	NA	3.40E-03	3.40E-03	NA
DDD	000072-54-8	70	28	NA	NA	2.40E-01[b]	NA	NA	3.43E-01
DDE	000072-55-9	70	28	NA	NA	3.40E-01[b]	NA	NA	4.86E-01
DDT	000050-29-3	70	28	5.00E-04[b]	5.00E-04[c]	3.40E-01[b]	3.50E-04	3.50E-04	4.86E-01
Dibenz[a,h]anthracene	000053-70-3	31	2	NA	NA	NA	NA	NA	NA
Dibromochloromethane	000124-48-1	60	69	2.00E-02[b]	2.00E-01[c]	8.40E-02[b]	1.20E-02	1.20E-01	1.40E-01
Dibutyl Phthalate	000084-74-2	100	29	1.00E-01[b]	1.00E+00[c]	NA	1.00E-01	NA	NA
Dichlorobenzene, 1,4-	000106-46-7	90	82	NA	NA	2.40E-02[c]	NA	NA	2.67E-02
Dichlorodifluoromethane	000075-71-8	23	12	2.00E-01[c]	9.00E-01[c]	NA	4.60E-02	2.07E-01	NA
Dichloroethane, 1,1-	000075-34-3	100	80	1.00E-01[c]	1.00E+00[c]	NA	1.00E-01	NA	NA
Dichloroethane, 1,2-	000107-06-2	100	30	NA	NA	9.10E-02[b]	NA	NA	9.10E-02
Dichloroethylene, 1,1-	000075-35-4	100	31	9.00E-03[b]	9.00E-03[c]	6.00E-01[b]	9.00E-03	9.00E-01	6.00E-01

Table 6. Dermal risk values derived by calculation from gastrointestinal (GI) absorption data in chemical order

Chemical	CAS Number	GI Absorption Factor (%)[a]	GI Absorption Reference	Oral RfD (mg/kg/day)		Oral Slope Factor (mg/kg/day)$^{-1}$	Dermal RfD (mg/kg/day)		Dermal Slope Factor (mg/kg/day)$^{-1}$
				Chronic	Subchronic		Chronic	Subchronic	
Dichloroethylene, 1,2-cis-	000156-59-2	100	83	1.00E-02[c]	1.00E-01[c]	NA	1.00E-02	1.00E-01	NA
Dichloroethylene, 1,2-trans-	000156-60-5	100	83	2.00E-02[b]	2.00E-01[c]	NA	2.00E-02	2.00E-01	NA
Dichlorophenol, 2,4-	000120-83-2	82	81	3.00E-03[b]	3.00E-03[c]	NA	2.46E-03	2.46E-03	NA
Dichloropropane, 1,2-	000078-87-5	74	68	NA	NA	6.80E-02[c]	NA	NA	9.19E-02
Dichloropropene, 1,3-	000542-75-6	55	73	3.00E-04[b]	3.00E-03[c]	1.80E-01[c]	1.65E-04	1.65E-03	3.27E-01
Dieldrin	000060-57-1	50	65	5.00E-05[b]	5.00E-05[c]	1.60E+01[b]	2.50E-05	2.50E-05	3.20E+01
Diethyl Phthalate	000084-66-2	90	79	8.00E-01[b]	8.00E+00[c]	NA	7.20E-01	7.20E+00	NA
Dimethylphthalate	000131-11-3	90	79	NA	NA	NA	NA	NA	NA
Dinitro-o-cresol, 4,6-	000534-52-1	100	12	NA	NA	NA	NA	NA	NA
Dinitrobenzene, 1,2-	000528-29-0	93	32	4.00E-04[c]	4.00E-03[c]	NA	3.72E-04	3.72E-03	NA
Dinitrobenzene, 1,3-	000099-65-0	65	32	1.00E-04[b]	1.00E-03[c]	NA	6.50E-05	6.50E-04	NA
Dinitrophenol, 2,4-	000051-28-5	100	81	2.00E-03[b]	2.00E-03[c]	NA	2.00E-03	2.00E-03	NA
Dinitrotoluene, 2,4-	000121-14-2	85	33	2.00E-03[b]	2.00E-03[c]	6.80E-01[b,d]	1.70E-03	1.70E-03	8.00E-01
Dinitrotoluene, 2,6-	000606-20-2	85	33	1.00E-03[c]	1.00E-02[c]	6.80E-01[b,d]	8.50E-04	8.50E-03	8.00E-01
Dinitrotoluene, 2-Amino-4,6-	035572-78-2	50	85	NA	NA	NA	NA	NA	NA
Endrin	000072-20-8	2.0	77	3.00E-04[b]	3.00E-04[c]	NA	6.00E-06	6.00E-06	NA
Ethylbenzene	000100-41-4	97	10	1.00E-01[b]	NA	NA	9.70E-02	NA	NA
Fluoranthene	000206-44-0	31	2	4.00E-02[b]	4.00E-01[c]	NA	1.24E-02	1.24E-01	NA
Fluoride	007782-41-4	97	34	6.00E-02[b]	6.00E-02[c]	NA	5.82E-02	5.82E-02	NA
Heptachlor	000076-44-8	72	35	5.00E-04[b]	5.00E-04[c]	4.50E+00[b]	3.60E-04	3.60E-04	6.25E+00
Heptachlor Epoxide	001024-57-3	72	35	1.30E-05[b]	1.30E-05[c]	9.10E+00[b]	9.36E-06	9.36E-06	1.26E+01

Table 6. Dermal risk values derived by calculation from gastrointestinal (GI) absorption data in chemical order

Chemical	CAS Number	GI Absorption Factor (%)[a]	GI Absorption Reference	Oral RfD (mg/kg/day)		Oral Slope Factor $(mg/kg/day)^{-1}$	Dermal RfD (mg/kg/day)		Dermal Slope Factor $(mg/kg/day)^{-1}$
				Chronic	Subchronic		Chronic	Subchronic	
Hexachlorocyclohexane, Alpha-	000319-84-6	97	10	NA	NA	6.30E+00[b]	NA	NA	6.49E+00
Hexachlorocyclohexane, Beta-	000319-85-7	91	10	NA	NA	1.80E+00[b]	NA	NA	1.98E+00
Hexachlorocyclohexane, Gamma-	000058-89-9	97	10	3.00E-04[b]	3.00E-03[c]	1.30E+00[c]	2.91E-04	2.91E-03	1.34E+00
Hexahydro-1,3,5-trinitro-1,3,5-triazine	000121-82-4	100	92	3.00E-03[b]	3.00E-03[c]	1.10E-01[b]	3.00E-03	3.00E-03	1.10E-01
Hexane, N-	000110-54-3	80	85	6.00E-02[c]	6.00E-01[c]	NA	4.80E-02	4.80E-01	NA
Hexanone, 2-	000591-78-6	66	36	NA	NA	NA	NA	NA	NA
Hydrogen Cyanide	000074-90-8	17	37	2.00E-02[b]	NA	NA	3.40E-03	NA	NA
Indeno[1,2,3-cd]pyrene	000193-39-5	31	2	NA	NA	NA	NA	NA	NA
Iron	007439-89-6	15	26	NA	NA	NA	NA	NA	NA
Isopropanol	000067-63-0	100	12	NA	NA	NA	NA	NA	NA
Lead And Compounds	007439-92-1	15	26	NA	NA	NA	NA	NA	NA
Lithium	007439-93-2	80	26	NA	NA	NA	NA	NA	NA
Magnesium	007439-95-4	20	26	NA	NA	NA	NA	NA	NA
Manganese (Diet)	007439-96-5	4.0	38	1.40E-01[b]	1.40E-01[c]	NA	5.60E-03	5.60E-03	NA
Manganese (Water)	007439-96-5	4.0	38	1.40E-01[b]	5.00E-03[c]	NA	5.60E-03	2.00E-04	NA
Mercury (elemental)	007439-97-6	0.01	26, 39	3.00E-04[c]	3.00E-04[c]	NA	3.00E-06	3.00E-08	NA
Mercury, Inorganic Salts	VARIOUS	7.0	26	NA	NA	NA	NA	NA	NA
Methyl Ethyl Ketone	000078-93-3	80	1	6.00E-01[b]	2.00E+00[c]	NA	4.80E-01	1.60E+00	NA
Methyl Isobutyl Ketone	000108-10-1	80	1	8.00E-02[c]	8.00E-01[c]	NA	6.40E-02	6.40E-01	NA
Methyl Mercury	022967-92-6	90	26, 39, 40	1.00E-04[b]	1.00E-04[c]	NA	9.00E-05	9.00E-05	NA
Methyl-5-Nitroaniline, 2-	000099-55-8	50	85	NA	NA	3.10E-02[c]	NA	NA	6.60E-02

Table 6. Dermal risk values derived by calculation from gastrointestinal (GI) absorption data in chemical order

Chemical	CAS Number	GI Absorption Factor (%)[a]	GI Absorption Reference	Oral RfD (mg/kg/day) Chronic	Oral RfD (mg/kg/day) Subchronic	Oral Slope Factor (mg/kg/day)$^{-1}$	Dermal RfD (mg/kg/day) Chronic	Dermal RfD (mg/kg/day) Subchronic	Dermal Slope Factor (mg/kg/day)$^{-1}$
Pyrene	000129-00-0	31	2	3.00E-02 [b]	3.00E-01 [c]	NA	9.30E-03	9.30E-02	NA
Radium 226	013982-63-3	20	88	NA	NA	NA	NA	NA	NA
Radium 228	015262-20-1	20	88	NA	NA	NA	NA	NA	NA
Selenious Acid	007783-00-8	87	47	5.00E-03 [b]	5.00E-03 [c]	NA	4.35E-03	4.35E-03	NA
Selenite	014124-67-5	70	48	NA	NA	NA	NA	NA	NA
Selenium	007782-49-2	44	47	5.00E-03 [b]	5.00E-03 [c]	NA	2.20E-03	2.20E-03	NA
Silver	007440-22-4	18	49	5.00E-03 [b]	5.00E-03 [c]	NA	9.00E-04	9.00E-04	NA
Sodium	007440-23-5	100	91	NA	NA	NA	NA	NA	NA
Strontium-90	010098-97-2	16	84	NA	NA	NA	NA	NA	NA
Sulfate	014808-79-8	20	50	NA	NA	NA	NA	NA	NA
TCDD, 2,3,7,8-	001746-01-6	50	93	NA	NA	1.50E+05 [c]	NA	NA	3.00E+05
Tetrachloroethane, 1,1,2,2-	000079-34-5	70	51	NA	NA	2.00E-01 [b]	NA	NA	2.86E-01
Tetrachloroethylene	000127-18-4	100	63	1.00E-02 [b]	1.00E-01 [c]	NA	1.00E-02	1.00E-01	NA
Thallium	007440-28-0	15	52	NA	NA	NA	NA	NA	NA
Thorium	007440-29-1	1.0	53	NA	NA	NA	NA	NA	NA
Tin	007440-31-5	10	26	6.00E-01 [c]	6.00E-01 [c]	NA	6.00E-02	6.00E-02	NA
Titanium	007440-32-6	3.0	26	NA	NA	NA	NA	NA	NA
Toluene	000108-88-3	80	54	2.00E-01 [b]	2.00E+00 [c]	NA	1.60E-01	1.60E+00	NA
Trichlorobenzene, 1,2,4-	000120-82-1	97	89	1.00E-02 [b]	1.00E-02 [c]	NA	9.70E-03	9.70E-03	NA
Trichloroethane, 1,1,1-	000071-55-6	90	55	NA	NA	NA	NA	NA	NA
Trichloroethane, 1,1,2-	000079-00-5	81	56	4.00E-03 [b]	4.00E-02 [c]	5.70E-02 [b]	3.24E-03	3.24E-02	7.04E-02

Table 6. Dermal risk values derived by calculation from gastrointestinal (GI) absorption data in chemical order

Chemical	CAS Number	GI Absorption Factor (%)[a]	GI Absorption Reference	Oral RfD (mg/kg/day)		Oral Slope Factor (mg/kg/day)$^{-1}$	Dermal RfD (mg/kg/day)		Dermal Slope Factor (mg/kg/day)$^{-1}$
				Chronic	Subchronic		Chronic	Subchronic	
Trichloroethylene	000079-01-6	15	57	NA	NA	NA	NA	NA	NA
Trichlorofluoromethane	000075-69-4	23	12	3.00E-01[b]	7.00E-01[c]	NA	6.90E-02	1.61E-01	NA
Trinitrobenzene, 1,3,5-	000099-35-4	65	32	5.00E-05[b]	5.00E-04[c]	NA	3.25E-05	3.25E-04	NA
Trinitrophenylmethylnitramine	000479-45-8	50	85	1.00E-02[c]	1.00E-01[c]	NA	5.00E-03	5.00E-02	NA
Trinitrotoluene, 2,4,6-	000118-96-7	60	87	5.00E-01[b]	5.00E-04[c]	3.00E-02[b]	3.00E-04	3.00E-04	5.00E-02
Uranium	007440-61-1	85	26	NA	NA	NA	NA	NA	NA
Uranium (Soluble Salts)	NA	85	26	3.00E-03[b]	NA	NA	2.55E-03	NA	NA
Vanadium, Metallic	007440-62-2	1.0	58, 59	7.00E-03[c]	7.00E-03[c]	NA	7.00E-05	7.00E-05	NA
Vinyl Acetate	000108-05-4	65	60	1.00E+00[c]	1.00E+00[c]	NA	6.50E-01	6.50E-01	NA
Vinyl Chloride	000075-01-4	100	66	NA	NA	1.90E+00[c]	NA	NA	1.90E+00
Xylene, Mixture	001330-20-7	92	61	2.00E+00[b]	NA	NA	1.84E+00	NA	NA
Zinc (Metallic)	007440-66-6	20	62	3.00E-01[b]	3.00E-01[c]	NA	6.00E-02	6.00E-02	NA
Zirconium	007440-67-7	80	12	NA	NA	NA	NA	NA	NA

[a] GI absoprtion factors obtained from literature by BEIA staff
[b] Source: Integrated Risk Information System (IRIS)
[c] Source: Health and Environmental Affects Summary Table (HEAST) 1995
[d] Listed as "Dinitrotoluene mixture, 2,4-/2,6-" in IRIS. The value is based on a study using technical grade DNT.
[e] Interim U.S. EPA Region IV default value

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Reference Number	Reference
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References for Table 6 GI absorption data

Reference Number	Reference
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APPENDIX I

RAGS Part D Tables

TABLE 1
SELECTION OF EXPOSURE PATHWAYS
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	Surface Soil	Surface Soil	Surface Soil	Military Base Personnel	Adult	Ingestion Dermal	On-Site	Quant	Current personnel may access site for work/training related activities
				Trespassers	Adult and Adolescent	Ingestion Dermal	On-Site	Quant	Current access of the site without permission
		Air	Fugitive Dusts	Military Base Personnel	Adult	Inhalation	On-Site	Quant	Current personnel may access site for work/training related activities
				Trespassers	Adult and Adolescent	Inhalation	On-Site	Quant	Current access of the site without permission
Future	Surface Soil	Surface Soil	Surface Soil	Construction Workers	Adult	Ingestion Dermal	On-Site	Quant	Future potential excavation or construction activities for development.
				Residents	Adult and Young Child	Ingestion Dermal	On-Site	Quant	Future potential residential development.
		Air	Fugitive Dusts	Construction Workers	Adult	Inhalation	On-Site	Quant	Future potential excavation or construction activities for development.
				Residents	Adult and Young Child	Inhalation	On-Site	Quant	Future potential residential development.
	Subsurface Soil	Subsurface Soil	Subsurface Soil	Construction Workers	Adult	Ingestion Dermal	On-Site	Quant	Future potential excavation or construction activities for development.
				Residents	Adult and Young Child	Ingestion Dermal	On-Site	Quant	Future potential residential development.
		Air	Fugitive Dusts	Construction Workers	Adult	Inhalation	On-Site	Quant	Future potential excavation or construction activities for development.
				Residents	Adult and Young Child	Inhalation	On-Site	Quant	Future potential residential development.
	Groundwater	Groundwater	Groundwater	Residents	Adult and Young Child	Ingestion Dermal	On-Site	Quant	Future potential residential development.
		Air	Volatiles in air	Residents	Adult	Inhalation	On-Site	Quant	Future potential residential development.

TABLE 2.1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current, Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil

CAS Number	Chemical	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (1)	Screening (2) Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (3) Contaminant Deletion or Selection
	VOLATILES (ug/kg)															
78-93-3	2-Butanone (MEK)	6	J	11	J	µg/kg	SWMU311-TW02-00	2/6	12U - 15U	11	NA	7.33E+05 N	N/A	N/A	NO	BSL
108-10-1	4-Methyl-2-pentanone (MIBK)	2	J	2	J	µg/kg	SWMU311-SB03-00	1/6	12U - 16U	2	NA	7.87E+04 N	N/A	N/A	NO	BSL
67-64-1	Acetone	4	J	34	J	µg/kg	SWMU311-TW02-00	6/6	(4)	34	NA	1.57E+05 N	N/A	N/A	NO	BSL
71-43-2	Benzene	2	J	2	J	µg/kg	SWMU311-TW02-00	1/9	1U - 6U	2	NA	6.01E+02 C	N/A	N/A	NO	BSL
75-25-2	Bromoform	6.75	J	19		µg/kg	SWMU311-TW02-00	4/6	5U - 6U	19	NA	6.16E+04 C	N/A	N/A	NO	BSL
75-15-0	Carbon Disulfide	2	J	2	J	µg/kg	SWMU311-TW02-00	1/6	5U - 6U	2	NA	3.55E+04 N	N/A	N/A	NO	BSL
67-66-3	Chloroform	1.5	J	2	J	µg/kg	SWMU311-TW01-00	2/6	5U - 6U	2	NA	3.56E+03 C	N/A	N/A	NO	BSL
110-82-7	Cyclohexane	1	J	1	J	µg/kg	SWMU311-TW02-00	1/6	5U - 6U	1	NA	1.40E+05 S	N/A	N/A	NO	BSL
100-41-4	Ethylbenzene	2	J	2	J	µg/kg	SWMU311-TW02-00	1/9	1U - 6U	2	NA	8.92E+03 C	N/A	N/A	NO	BSL
108-87-2	Methyl Cyclohexane	1	J	1	J	µg/kg	SWMU311-TW02-00	1/6	5U - 6U	1	NA	2.59E+05 N	N/A	N/A	NO	BSL
75-09-2	Methylene Chloride	13		30		µg/kg	SWMU311-TW01-00	6/6	(4)	30	NA	9.11E+03 C	N/A	N/A	NO	BSL
	SEMIVOLATILES (ug/kg)															
56-55-3	Benzo(a)anthracene	33	J	33	J	µg/kg	SWMU311-IS03-00	1/3	340U - 400U	33	NA	6.21E+02 C	N/A	N/A	NO	BSL
50-32-8	Benzo(a)pyrene	48	J	48	J	µg/kg	SWMU311-IS03-00	1/3	340U - 400U	48	NA	6.21E+01 C	N/A	N/A	NO	BSL
205-99-2	Benzo(b)fluoranthene	48	J	48	J	µg/kg	SWMU311-IS03-00	1/3	340U - 400U	48	NA	6.21E+02 C	N/A	N/A	NO	BSL
191-24-2	Benzo(g,h,i)perylene	50	J	50	J	µg/kg	SWMU311-IS03-00	1/3	340U - 400U	50	NA	2.32E+05 N(2)	N/A	N/A	NO	BSL
207-08-9	Benzo(k)fluoranthene	60	J	60	J	µg/kg	SWMU311-IS03-00	1/3	340U - 400U	60	NA	6.21E+03 C	N/A	N/A	NO	BSL
117-81-7	Bis(2-ethylhexyl) Phthalate (DEHP)	170	J	230	J	µg/kg	SWMU311-IS02-00	3/3	(4)	230	NA	3.47E+04 C	N/A	N/A	NO	BSL
218-01-9	Chrysene	49	J	49	J	µg/kg	SWMU311-IS03-00	1/3	340U - 400U	49	NA	6.21E+04 C	N/A	N/A	NO	BSL
206-44-0	Fluoranthene	65	J	65	J	µg/kg	SWMU311-IS03-00	1/3	340U - 400U	65	NA	2.29E+05 N	N/A	N/A	NO	BSL
193-39-5	Indeno(1,2,3-cd)pyrene	41	J	41	J	µg/kg	SWMU311-IS03-00	1/3	340U - 400U	41	NA	6.21E+02 C	N/A	N/A	NO	BSL
129-00-0	Pyrene	62	J	62	J	µg/kg	SWMU311-IS03-00	1/3	340U - 400U	62	NA	2.32E+05 N	N/A	N/A	NO	BSL
	METALS (mg/kg)															
7440-38-2	Arsenic	0.25	J	0.31	J	mg/kg	SWMU311-TW01-00	2/9	0.24U - 1.2U	0.31	0.742	3.90E-01 C	N/A	N/A	NO	BSL
7440-39-3	Barium	8.5		13.65	J	mg/kg	SWMU311-TW03-00	6/9	20.8U - 24U	13.65	23.4	5.37E+02 N	N/A	N/A	NO	BSL
7440-43-9	Cadmium	0.041	J	5.2		mg/kg	SWMU311-IS02-00	6/9	0.033U - 0.52U	5.2	0.0340	3.70E+00 N	N/A	N/A	YES	ASL
7440-47-3	Chromium	3.3		28.8		mg/kg	SWMU311-IS02-00	9/9	(4)	28.8	11.4	3.01E+01 C(6)	N/A	N/A	NO	BSL
7439-92-1	Lead	4.4	J	1,110		mg/kg	SWMU311-IS04-00	9/9	(4)	1,110	13.4	4.00E+02 N	N/A	N/A	YES	ASL
7439-97-6	Mercury	0.0185	J	0.09		mg/kg	SWMU311-IS02-00	7/9	0.034U - 0.038U	0.09	0.0694	2.35E+00 N(7)	N/A	N/A	NO	BSL
7782-49-2	Selenium	0.56		0.91		mg/kg	SWMU311-TW01-00	2/9	0.47U - 0.6U	0.91	0.651	3.91E+01 N	N/A	N/A	NO	BSL

(1) MCB Camp Lejeune Base Background Study, Final (Baker, 2001): 2 * Mean (1/2 nondetects) - Soil Associatio
(2) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals
USEPA Region IX COC Screening Value (derived from USEPA Region IX PRG Table)
(3) Rationale Codes Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)

(4) No detection limits given; analyte detected in every sample.
(5) Screening value for pyrene used as a surrogate.
(6) Screening value for chromium VI used.
(7) Screening values for mercuric chloride used as a surrogate.

Definitions: NA = Not Analyzed
COPC = Chemical of Potential Concern
ARAR/TBC = arplicable or Relevant and arpropriate Requirement/To Be Considered

J - Analyte present - Reported value is estimated
U - Not detected

C = Carcinogenic
N = Non-Carcinogenic
S = Soil Saturation

mg/kg = milligrams per kilogram
ug/kg = microgram per kilogram

TABLE 2.2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN (TRESPASSER ONLY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil

CAS Number	Chemical	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (1)	Screening (2) Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (3) Contaminant Deletion or Selection
	VOLATILES (ug/kg)															
78-93-3	2-Butanone (MEK)	6	J	11	J	µg/kg	SWMU311-TW02-00	2/3	15U - 15U	11	NA	7.33E+05 N	N/A	N/A	NO	BSL
67-64-1	Acetone	14	J	34	J	µg/kg	SWMU311-TW02-00	3/3	(4)	34	NA	1.57E+05 N	N/A	N/A	NO	BSL
71-43-2	Benzene	2	J	2	J	µg/kg	SWMU311-TW02-00	1/4	1.2U - 6U	2	NA	6.01E+02 C	N/A	N/A	NO	BSL
75-25-2	Bromoform	12		19		µg/kg	SWMU311-TW02-00	3/3	(4)	19	NA	6.16E+04 C	N/A	N/A	NO	BSL
75-15-0	Carbon Disulfide	2	J	2	J	µg/kg	SWMU311-TW02-00	1/3	6U - 6U	2	NA	3.55E+04 N	N/A	N/A	NO	BSL
67-66-3	Chloroform	2	J	2	J	µg/kg	SWMU311-TW01-00	1/3	5U - 6U	2	NA	3.56E+03 C	N/A	N/A	NO	BSL
110-82-7	Cyclohexane	1	J	1	J	µg/kg	SWMU311-TW02-00	1/3	6U - 6U	1	NA	1.40E+05 S	N/A	N/A	NO	BSL
100-41-4	Ethylbenzene	2	J	2	J	µg/kg	SWMU311-TW02-00	1/4	1.2U - 6U	2	NA	8.92E+03 C	N/A	N/A	NO	BSL
108-87-2	Methyl Cyclohexane	1	J	1	J	µg/kg	SWMU311-TW02-00	1/3	6U - 6U	1	NA	2.59E+05 N	N/A	N/A	NO	BSL
75-09-2	Methylene Chloride	18		30		µg/kg	SWMU311-TW01-00	3/3	(4)	30	NA	9.11E+03 C	N/A	N/A	NO	BSL
	SEMIVOLATILES (ug/kg)															
56-55-3	Benzo(a)anthracene	33	J	33	J	µg/kg	SWMU311-IS03-00	1/1	(4)	33	NA	6.21E+02 C	N/A	N/A	NO	BSL
50-32-8	Benzo(a)pyrene	48	J	48	J	µg/kg	SWMU311-IS03-00	1/1	(4)	48	NA	6.21E+01 C	N/A	N/A	NO	BSL
205-99-2	Benzo(b)fluoranthene	48	J	48	J	µg/kg	SWMU311-IS03-00	1/1	(4)	48	NA	6.21E+02 C	N/A	N/A	NO	BSL
191-24-2	Benzo(g,h,i)perylene	50	J	50	J	µg/kg	SWMU311-IS03-00	1/1	(4)	50	NA	2.32E+05 N(5)	N/A	N/A	NO	BSL
207-08-9	Benzo(k)fluoranthene	60	J	60	J	µg/kg	SWMU311-IS03-00	1/1	(4)	60	NA	6.21E+03 C	N/A	N/A	NO	BSL
117-81-7	Bis(2-ethylhexyl) Phthalate (DEHP)	170	J	170	J	µg/kg	SWMU311-IS03-00	1/1	(4)	170	NA	3.47E+04 C	N/A	N/A	NO	BSL
218-01-9	Chrysene	49	J	49	J	µg/kg	SWMU311-IS03-00	1/1	(4)	49	NA	6.21E+04 C	N/A	N/A	NO	BSL
206-44-0	Fluoranthene	65	J	65	J	µg/kg	SWMU311-IS03-00	1/1	(4)	65	NA	2.29E+05 N	N/A	N/A	NO	BSL
193-39-5	Indeno(1,2,3-cd)pyrene	41	J	41	J	µg/kg	SWMU311-IS03-00	1/1	(4)	41	NA	6.21E+02 C	N/A	N/A	NO	BSL
129-00-0	Pyrene	62	J	62	J	µg/kg	SWMU311-IS03-00	1/1	(4)	62	NA	2.32E+05 N	N/A	N/A	NO	BSL
	METALS (mg/kg)															
7440-38-2	Arsenic	0.31	J	0.31	J	mg/kg	SWMU311-TW01-00	1/4	0.27U - 1.2U	0.31	0.742	3.90E-01 C	N/A	N/A	NO	BSL
7440-39-3	Barium	8.5		11.6		mg/kg	SWMU311-TW01-00	3/4	23.2U - 23.2U	11.6	23.4	5.37E+02 N	N/A	N/A	NO	BSL
7440-43-9	Cadmium	0.056	J	0.74		mg/kg	SWMU311-IS03-00	3/4	0.033U - 0.033U	0.74	0.0340	3.70E+00 N	N/A	N/A	NO	BSL
7440-47-3	Chromium	4.8		10.4		mg/kg	SWMU311-TW01-00	4/4	(4)	10.4	11.4	3.01E+01 C(6)	N/A	N/A	NO	BSL
7439-92-1	Lead	5.2	J	16		mg/kg	SWMU311-IS03-00	4/4	(4)	16	13.4	4.00E+02 N	N/A	N/A	NO	BSL
7439-97-6	Mercury	0.034	J	0.053		mg/kg	SWMU311-TW01-00	3/4	0.038U - 0.038U	0.053	0.0694	2.35E+00 N(7)	N/A	N/A	NO	BSL
7782-49-2	Selenium	0.91		0.91		mg/kg	SWMU311-TW01-00	1/4	0.51U - 0.58U	0.91	0.651	3.91E+01 N	N/A	N/A	NO	BSL

(1) MCB Camp Lejeune Base Background Study, Final (Baker, 2001): 2 * Mean (1/2 nondetects) - Soil Associatio
(2) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals
USEPA Region IX COC Screening Value (derived from USEPA Region IX PRG Table)
(3) Rationale Codes Deletion Reason: Below Screening Level (BSL)

(4) No detection limits given; analyte detected in every sample.
(5) Screening value for pyrene used as a surrogate.
(6) Screening value for chromium VI used.
(7) Screening values for mercuric chloride used as a surrogate.

Definitions: NA = Not Analyzed
COPC = Chemical of Potential Concern
ARAR/TBC = arplicable or Relevant and arpropriate Requirement/To Be Considered

J - Analyte present - Reported value is estimated
U - Not detected

C = Carcinogenic
N = Non-Carcinogenic
S = Soil Saturation

mg/kg = milligrams per kilogram
ug/kg = microgram per kilogram

TABLE 2.3
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Subsurface Soil

CAS Number	Chemical	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (1)	Screening (2) Toxicity Value RESIDENTIAL	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (3) Contaminant Deletion or Selection
	VOLATILES (ug/kg)															
95-50-1	1,2-Dichlorobenzene (o-)	530		530		µg/kg	SWMU311-IS02-03	1/15	1.1U - 13U	530	NA	3.70E+05 S	N/A	N/A	NO	BSL
541-73-1	1,3-Dichlorobenzene (m-)	140		140		µg/kg	SWMU311-IS02-03	1/15	1.1U - 13U	140	NA	1.59E+03 N	N/A	N/A	NO	BSL
106-46-7	1,4-Dichlorobenzene (p-)	220		220		µg/kg	SWMU311-IS02-03	1/15	1.1U - 13U	220	NA	3.45E+03 C	N/A	N/A	NO	BSL
67-64-1	Acetone	2	J	18	J	µg/kg	SWMU311-SB20-03	6/13	11UJ - 14UJ	18	NA	1.57E+05 N	N/A	N/A	NO	BSL
75-25-2	Bromoform	22		28		µg/kg	SWMU311-TW02-03	3/13	5U - 13U	28	NA	6.16E+04 C	N/A	N/A	NO	BSL
108-90-7	Chlorobenzene	530		530		µg/kg	SWMU311-IS02-03	1/15	1.1U - 13U	530	NA	1.51E+04 N	N/A	N/A	NO	BSL
67-66-3	Chloroform	1	J	2	J	µg/kg	SWMU311-TW02-03	2/13	5U - 13U	2	NA	3.56E+03 C	N/A	N/A	NO	BSL
75-09-2	Methylene Chloride	1.9	J	34		µg/kg	SWMU311-TW03-03	10/13	11U - 12U	34	NA	9.11E+03 C	N/A	N/A	NO	BSL
108-88-3	Toluene	200		200		µg/kg	SWMU311-IS02-03	1/15	1.1U - 13U	200	NA	5.20E+05 S	N/A	N/A	NO	BSL
1330-20-7	Xylenes, total	2,000		2,000		µg/kg	SWMU311-IS02-03	1/8	1.1U - 18UJ	2,000	NA	2.75E+04 N	N/A	N/A	NO	BSL
	SEMIVOLATILES (ug/kg)															
91-57-6	2-Methylnaphthalene	1,300	J	1,300	J	µg/kg	SWMU311-IS02-03	1/2	370U - 370U	1,300	NA	5.59E+03 N(5)	N/A	N/A	NO	BSL
117-81-7	Bis(2-ethylhexyl) Phthalate (DEHP)	800	J	800	J	µg/kg	SWMU311-IS03-03	1/2	4000U - 4000U	800	NA	3.47E+04 C	N/A	N/A	NO	BSL
	METALS (mg/kg)															
7440-38-2	Arsenic	0.55	J	1.9		mg/kg	SWMU311-IS02-03	5/23	0.27U - 1.1U	1.9	0.553	3.90E-01 C	N/A	N/A	YES	ASL
7440-39-3	Barium	1.6	J	45		mg/kg	SWMU311-TW01-03	21/23	22.7U - 24.2U	45	13.5	5.37E+02 N	N/A	N/A	NO	BSL
7440-43-9	Cadmium	0.03075	J	1.1	J	mg/kg	SWMU311-SB05-02	6/23	0.033U - 0.57U	1.1	ND	3.70E+00 N	N/A	N/A	NO	BSL
7440-47-3	Chromium	0.88	J	21		mg/kg	SWMU311-IS02-03	18/23	0.12U - 0.15U	21	12.5	3.01E+01 C(6)	N/A	N/A	NO	BSL
7439-92-1	Lead	1		51.2	J	mg/kg	SWMU311-SB05-02	23/23	(4)	51.2	7.55	4.00E+02 N	N/A	N/A	NO	BSL
7439-97-6	Mercury	0.01875	J	0.057		mg/kg	SWMU311-IS02-03	4/23	0.018U - 0.12U	0.057	0.0394	2.35E+00 N(7)	N/A	N/A	NO	BSL
7782-49-2	Selenium	0.4625		1.1	J	mg/kg	11-SB06-01,SWMU311-	7/23	0.51U - 0.74U	1.1	0.286	3.91E+01 N	N/A	N/A	NO	BSL
7440-22-4	Silver	0.33	J	0.51	J	mg/kg	SWMU311-SB11-02	7/23	0.0995U - 1.2U	0.51	ND	3.91E+01 N	N/A	N/A	NO	BSL

(1) MCB Camp Lejeune Base Background Study, Final (Baker, 2001): 2 * Mean (1/2 nondetects) - Soil Associatior
(2) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals
USEPA Region IX COC Screening Value (derived from USEPA Region IX PRG Table)
(3) Rationale Codes Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)

(4) No detection limits given; analyte detected in every sample.
(5) Screening values for naphthalene used as a surrogate
(6) Screening value for chromium VI used.
(7) Screening values for mercuric chloride used as a surrogate.

Definitions: NA = Not Analyzed
ND = Not Detected
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered

J - Analyte present - Reported value is estimated
U - Not detected
UJ - Reported quantitation limit is qualified as estimated

C = Carcinogenic
N = Non-Carcinogenic
S = Soil Saturation

mg/kg = milligrams per kilogram
ug/kg = microgram per kilogram

TABLE 2.4
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Subsurface Soil

CAS Number	Chemical	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (1)	Screening (2) Toxicity Value INDUSTRIAL	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (3) Contaminant Deletion or Selection
	VOLATILES (ug/kg)															
95-50-1	1,2-Dichlorobenzene (o-)	530		530		µg/kg	SWMU311-IS02-03	1/15	1.1U - 13U	530	NA	3.70E+05 S	N/A	N/A	NO	BSL
541-73-1	1,3-Dichlorobenzene (m-)	140		140		µg/kg	SWMU311-IS02-03	1/15	1.1U - 13U	140	NA	6.27E+03 N	N/A	N/A	NO	BSL
106-46-7	1,4-Dichlorobenzene (p-)	220		220		µg/kg	SWMU311-IS02-03	1/15	1.1U - 13U	220	NA	7.87E+03 C	N/A	N/A	NO	BSL
67-64-1	Acetone	2	J	18	J	µg/kg	SWMU311-SB20-03	6/13	11UJ - 14UJ	18	NA	6.04E+05 N	N/A	N/A	NO	BSL
75-25-2	Bromoform	22		28		µg/kg	SWMU311-TW02-03	3/13	5U - 13U	28	NA	2.18E+05 C	N/A	N/A	NO	BSL
108-90-7	Chlorobenzene	530		530		µg/kg	SWMU311-IS02-03	1/15	1.1U - 13U	530	NA	5.30E+04 N	N/A	N/A	NO	BSL
67-66-3	Chloroform	1	J	2	J	µg/kg	SWMU311-TW02-03	2/13	5U - 13U	2	NA	1.17E+04 C	N/A	N/A	NO	BSL
75-09-2	Methylene Chloride	1.9	J	34		µg/kg	SWMU311-TW03-03	10/13	11U - 12U	34	NA	2.05E+04 C	N/A	N/A	NO	BSL
108-88-3	Toluene	200		200		µg/kg	SWMU311-IS02-03	1/15	1.1U - 13U	200	NA	5.20E+05 S	N/A	N/A	NO	BSL
1330-20-7	Xylenes, total	2,000		2,000		µg/kg	SWMU311-IS02-03	1/8	1.1U - 18UJ	2,000	NA	4.20E+05 S	N/A	N/A	NO	BSL
	SEMIVOLATILES (ug/kg)															
91-57-6	2-Methylnaphthalene	1,300	J	1,300	J	µg/kg	SWMU311-IS02-03	1/2	370U - 370U	1,300	NA	1.88E+04 N (5)	N/A	N/A	NO	BSL
117-81-7	Bis(2-ethylhexyl) Phthalate (DEHP)	800	J	800	J	µg/kg	SWMU311-IS03-03	1/2	4000U - 4000U	800	NA	1.23E+05 C	N/A	N/A	NO	BSL
	METALS (mg/kg)															
7440-38-2	Arsenic	0.55	J	1.9		mg/kg	SWMU311-IS02-03	5/23	0.27U - 1.1U	1.9	0.553	1.59E+00 C	N/A	N/A	YES	ASL
7440-39-3	Barium	1.6	J	45		mg/kg	SWMU311-TW01-03	21/23	22.7U - 24.2U	45	13.5	6.66E+03 N	N/A	N/A	NO	BSL
7440-43-9	Cadmium	0.03075	J	1.1	J	mg/kg	SWMU311-SB05-02	6/23	0.033U - 0.57U	1.1	ND	4.51E+01 N	N/A	N/A	NO	BSL
7440-47-3	Chromium	0.88	J	21		mg/kg	SWMU311-IS02-03	18/23	0.12U - 0.15U	21	12.5	6.40E+01 C (6)	N/A	N/A	NO	BSL
7439-92-1	Lead	1		51.2	J	mg/kg	SWMU311-SB05-02	23/23	(4)	51.2	7.55	7.50E+01 N	N/A	N/A	NO	BSL
7439-97-6	Mercury	0.01875	J	0.057		mg/kg	SWMU311-IS02-03	4/23	0.018U - 0.12U	0.057	0.0394	3.07E+01 N (7)	N/A	N/A	NO	BSL
7782-49-2	Selenium	0.4625		1.1	J	mg/kg	11-SB06-01,SWMU311-	7/23	0.51U - 0.74U	1.1	0.286	5.11E+02 N	N/A	N/A	NO	BSL
7440-22-4	Silver	0.33	J	0.51	J	mg/kg	SWMU311-SB11-02	7/23	0.0995U - 1.2U	0.51	ND	5.11E+02 N	N/A	N/A	NO	BSL

(1) MCB Camp Lejeune Base Background Study, Final (Baker, 2001): 2 * Mean (1/2 nondetects) - Soil Associatior
(2) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals
USEPA Region IX COC Screening Value (derived from USEPA Region IX PRG Table)
(3) Rationale Codes Deletion Reason: Below Screening Level (BSL)

(4) No detection limits given; analyte detected in every sample.
(5) Screening values for naphthalene used as a surrogate
(6) Screening value for chromium VI used.
(7) Screening values for mercuric chloride used as a surrogate.

Definitions: NA = Not Analyzed
ND = Not Detected
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered

J - Analyte present - Reported value is estimated
U - Not detected
UJ - Reported quantitation limit is qualified as estimated

C = Carcinogenic
N = Non-Carcinogenic
S = Soil Saturation

mg/kg = milligrams per kilogram
ug/kg = microgram per kilogram

TABLE 2.5
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Groundwater

CAS Number	Chemical	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value	Screening (1) Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (2) Contaminant Deletion or Selection
	VOLATILES (ug/L)															
110-82-7	Cyclohexane	3	J	3	J	µg/L	SWMU311-GW01	1/3	5U - 5U	3	NA	3.47E+03 N	N/A	N/A	NO	BSL
100-41-4	Ethylbenzene	2	J	2	J	µg/L	SWMU311-GW01	1/3	5U - 5U	2	NA	2.91E+00 C	700	MCL	NO	BSL
98-82-8	Isopropylbenzene (Cumene)	3	J	3	J	µg/L	SWMU311-GW01	1/3	5U - 5U	3	NA	6.58E+01 N	70	NC WQC	NO	BSL
108-87-2	Methyl Cyclohexane	3	J	3	J	µg/L	SWMU311-GW01	1/3	5U - 5U	3	NA	5.22E+02 N	N/A	N/A	NO	BSL
1330-20-7	Xylenes, total	3	J	3	J	µg/L	SWMU311-GW01	1/3	5U - 5U	3	NA	2.10E+01 N	10,000	MCL	NO	BSL
	METALS (ug/L)															
7440-38-2	Arsenic	3.4	J	3.4	J	µg/L	SWMU311-GW03	1/3	2.4UJ - 2.4UJ	3.4	NA	4.48E-02 C	10	MCL	YES	ASL
7440-39-3	Barium	24.7		53.75		µg/L	SWMU311-GW01	2/3	33U - 33U	53.75	NA	2.55E+02 N	2,000	MCL	NO	BSL
7440-47-3	Chromium	12		12		µg/L	SWMU311-GW01	1/3	0.5UJ - 0.6U	12	NA	1.09E+01 N (3)	100	MCL	YES	ASL
7439-92-1	Lead	10.6		10.6		µg/L	SWMU311-GW01	1/3	1.1U - 1.8U	10.6	NA	1.50E+01 N (4)	15	MCL (4)	NO	BSL

(1) All non-carcinogenic RBCs were divided by 10 to account for potential additive effects of chemicals
USEPA Region IX COC Screening Value (derived from USEPA Region IX PRG Table)

(2) Rationale Codes Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)

(3) Screening value for chromium VI used.
(4) Action level for lead.

Definitions: NA = Not Analyzed
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
MCL = Maximum Contaminant Level
NC WQC = North Carolina Water Quality Criteria (EHNR)

J - Analyte present - Reported value is estimated
U - Not detected
UJ - Reported quantitation limit is qualified as estimated

C = Carcinogenic
N = Non-Carcinogenic
ug/L = microgram per liter

TABLE 2.6
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Groundwater

CAS Number	Chemical	Minimum Concentration	Minimum Qualifier	Maximum Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value	Screening (1) Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (2) Contaminant Deletion or Selection
	VOLATILES (ug/L)															
110-82-7	Cyclohexane	3	J	3	J	µg/L	SWMU311-GW01	1/3	5U - 5U	3	NA	N/A	N/A	N/A	YES	NSC
100-41-4	Ethylbenzene	2	J	2	J	µg/L	SWMU311-GW01	1/3	5U - 5U	2	NA	2.90E+01	700	MCL	NO	BSL
98-82-8	Isopropylbenzene (Cumene)	3	J	3	J	µg/L	SWMU311-GW01	1/3	5U - 5U	3	NA	7.00E+01	70	NC DENR	NO	BSL
108-87-2	Methyl Cyclohexane	3	J	3	J	µg/L	SWMU311-GW01	1/3	5U - 5U	3	NA	N/A	N/A	N/A	YES	NSC
1330-20-7	Xylenes, total	3	J	3	J	µg/L	SWMU311-GW01	1/3	5U - 5U	3	NA	5.30E+02	10,000	MCL	NO	BSL
	METALS (ug/L)															
7440-38-2	Arsenic	3.4	J	3.4	J	µg/L	SWMU311-GW03	1/3	2.4UJ - 2.4UJ	3.4	NA	1.00E+01	10	MCL	NO	BSL
7440-39-3	Barium	24.7		53.75		µg/L	SWMU311-GW01	2/3	33U - 33U	53.75	NA	2.00E+03	2,000	MCL	NO	BSL
7440-47-3	Chromium	12		12		µg/L	SWMU311-GW01	1/3	0.5UJ - 0.6U	12	NA	5.00E+01	100	MCL	NO	BSL
7439-92-1	Lead	10.6		10.6		µg/L	SWMU311-GW01	1/3	1.1U - 1.8U	10.6	NA	1.50E+01	15	MCL (4)	NO	BSL

(1) North Carolina Department of Environment and Natural Resources (NC DENR) Target Groundwater Concentration

(2) Rationale Codes
Selection Reason: No Screening Criteria (NSC)
Deletion Reason: Below Screening Level (BSL)

(3) Screening value for chromium VI used.
(4) Action level for lead.

Definitions: N/A = Not Applicable
NA = Not Analyzed
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered

MCL = Maximum Contaminant Level
NC DENR = North Carolina Department of Environment and Natural Resou

J - Analyte present - Reported value is estimated
U - Not detected
UJ - Reported quantitation limit is qualified as estimated

ug/L = microgram per liter

TABLE 3.1
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current, Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil

Chemical of Potential Concern	Units	Arithmetic Mean	95% Upper Confidence Level (95% UCL)	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure			Central Tendency		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale	Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Cadmium	mg/kg	0.73	29.6	5.2		mg/kg	5.2	Max	(1)	5.2	Max	(1)
Lead	mg/kg	154	6,007	1,110		mg/kg	1,110	Max	(1)	1,110	Max	(1)

EPC = Exposure Point Concentration
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.

(1) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.

TABLE 3.2
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Subsurface Soil

Chemical of Potential Concern	Units	Arithmetic Mean	95% Upper Confidence Level (95% UCL)	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure			Central Tendency		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale	Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Arsenic	mg/kg	0.44	0.6	1.9		mg/kg	0.6	W-Lognormal	(1)	0.6	W-Lognormal	(1)

EPC = Exposure Point Concentration
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.

(1) Conservative estimate of the arithmetic average concentration (95% UCL), based on the Shapiro-Wilks (W-) or D-Agostino (D-) distribution tests

TABLE 3.3
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Groundwater, total inorganics

Chemical of Potential Concern	Units	Arithmetic Mean	95% Upper Confidence Level (95% UCL)	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure			Central Tendency		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale	Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Arsenic	mg/L	0.0019	0.0983	0.0034	J	mg/L	0.0034	Max	(1)	0.0034	Max	(1)
Chromium	mg/L	0.0042	8.89E+19	0.012		mg/L	0.012	Max	(1)	0.012	Max	(1)

EPC = Exposure Point Concentration
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.

(1) Region 4 Human Health Risk Assessment Bulletin, 1996

TABLE 4.1.1
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Military Base Personnel
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	--	--	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	100	USEPA, 1993	--	--	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	--	--	
	FI	Fraction Ingested from Source	NA	1	Prof Judge	--	--	
	EF	Exposure Frequency	days/year	250	USEPA, 2001	--	--	
	ED	Exposure Duration	years	4	Std Tour of Duty	--	--	
	BW	Body Weight	kg	70	USEPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	1,460	USEPA, 1989	--	--	
Dermal	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	--	--	CDI (mg/kg-day) =
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	--	--	C x CF x SA x AF x ABS x EF x ED x
	SA	Surface Area Available for Contact	cm2/day	3,300	USEPA, 2001	--	--	1/BW x1/AT
	AF	Soil to Skin Adherence Factor	mg/cm2	0.2	USEPA, 2001	--	--	
	ABS	Absorption Factor	NA	(1)	USEPA, 2001	--	--	
	EF	Exposure Frequency	days/year	250	USEPA, 2001	--	--	
	ED	Exposure Duration	years	4	Std Tour of Duty	--	--	
	BW	Body Weight	kg	70	USEPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	1,460	USEPA, 1989	--	--	

Notes

(1) If available, ABS values from ORNL or RAGS Part E were used. Otherwise, USEPA Region IV default values of 0.01% organics and 0.001% for inorganics were used for ABS values

Prof Judge - Professional Judgment
Std Tour of Duty - Standard Tour of Duty

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 4.1.1a
VALUES USED FOR DAILY INTAKE CALCULATION:
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Military Base Personnel
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	--	--	CDI (mg/kg-day) =
	RR	Respiration Rate	m3/hour	0.55	USEPA, 1997	--	--	C x IR x ET x EF x ED x 1/PEF x
	ET	Exposure Time	hours/day	8	Prof Judge	--	--	1/BW x1/AT
	EF	Exposure Frequency	days/year	250	USEPA, 2001	--	--	
	ED	Exposure Duration	years	4	Std Tour of Duty	--	--	
	PEF	Particulate Emission Factor	m3/kg	1.32E+09	Cowherd, et al., 1995	--	--	
	BW	Body Weight	kg	70	USEPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	1,460	USEPA, 1989	--	--	

Notes

Std Tour of Duty - Standard Tour of Duty

Sources:

Cowherd, et al., 1995: Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination. OHEA. EPA/600/8-85/002.
USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 4.2.1
VALUES USED FOR DAILY INTAKE CALCULATION
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	100	USEPA, 1993	50	USEPA, 1993	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	1.00E-06	USEPA, 1989	
	FI	Fraction Ingested from Source	NA	1	Prof Judge	1	Prof Judge	
	EF	Exposure Frequency	days/year	350	USEPA, 2001	234	USEPA, 1993	
	ED	Exposure Duration	years	24	USEPA, 1993	7	USEPA, 1993	
	BW	Body Weight	kg	70	USEPA, 1997	70	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, 1989	2,555	USEPA, 1989	
Dermal	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	CDI (mg/kg-day) =
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	1.00E-06	USEPA, 1989	C x CF x SA x AF x ABS x EF x ED x
	SA	Surface Area Available for Contact	cm2/day	5,700	USEPA, 2001	5,700	USEPA, 2001	1/BW x1/AT
	AF	Soil to Skin Adherence Factor	mg/cm2	0.07	USEPA, 2001	0.01	USEPA, 2001	
	ABS	Absorption Factor	NA	(1)	USEPA, 2001	(1)	USEPA, 2001	
	EF	Exposure Frequency	days/year	350	USEPA, 2001	234	USEPA, 1993	
	ED	Exposure Duration	years	24	USEPA, 1993	7	USEPA, 1993	
	BW	Body Weight	kg	70	USEPA, 1997	70	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, 1989	2,555	USEPA, 1989	

Notes

(1) If available, ABS values from ORNL or RAGS Part E were used. Otherwise, USEPA Region IV default values of 0.01% organics and 0.001% for inorganics were used for ABS values

Prof Judge - Professional Judgment

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 4.2.1a
VALUES USED FOR DAILY INTAKE CALCULATION:
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	CDI (mg/kg-day) =
	RR	Respiration Rate	m3/hour	0.55	USEPA, 1997	0.55	USEPA, 1997	C x IR x ET x EF x ED x 1/PEF x
	ET	Exposure Time	hours/day	1.5	USEPA, 1997	1.5	USEPA, 1997	1/BW x1/AT
	EF	Exposure Frequency	days/year	350	USEPA, 2001	234	USEPA, 1993	
	ED	Exposure Duration	years	24	USEPA, 1993	7	USEPA, 1993	
	PEF	Particulate Emission Factor	m3/kg	1.32E+09	Cowherd, et al., 1995	1.32E+09	Cowherd, et al., 1995	
	BW	Body Weight	kg	70	USEPA, 1997	70	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, 1989	2,555	USEPA, 1989	

Notes

Sources:

Cowherd, et al., 1995: Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination. OHEA. EPA/600/8-85/002.
USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 4.2.2
VALUES USED FOR DAILY INTAKE CALCULATION:
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Subsurface Soil
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	100	USEPA, 1993	50	USEPA, 1993	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	1.00E-06	USEPA, 1989	
	FI	Fraction Ingested from Source	NA	1	Prof Judge	1	Prof Judge	
	EF	Exposure Frequency	days/year	350	USEPA, 2001	234	USEPA, 1993	
	ED	Exposure Duration	years	24	USEPA, 1993	7	USEPA, 1993	
	BW	Body Weight	kg	70	USEPA, 1997	70	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, 1989	2,555	USEPA, 1989	
Dermal	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	CDI (mg/kg-day) =
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	1.00E-06	USEPA, 1989	C x CF x SA x AF x ABS x EF x ED x
	SA	Surface Area Available for Contact	cm2/day	5,700	USEPA, 2001	5,700	USEPA, 2001	1/BW x1/AT
	AF	Soil to Skin Adherence Factor	mg/cm2	0.07	USEPA, 2001	0.01	USEPA, 2001	
	ABS	Absorption Factor	NA	(1)	USEPA, 2001	(1)	USEPA, 2001	
	EF	Exposure Frequency	days/year	350	USEPA, 2001	234	USEPA, 1993	
	ED	Exposure Duration	years	24	USEPA, 1993	7	USEPA, 1993	
	BW	Body Weight	kg	70	USEPA, 1997	70	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, 1989	2,555	USEPA, 1989	

Notes

(1) If available, ABS values from ORNL or RAGS Part E were used. Otherwise, USEPA Region IV default values of 0.01% organics and 0.001% for inorganics were used for ABS values

Prof Judge - Professional Judgment

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 4.2.2a
VALUES USED FOR DAILY INTAKE CALCULATION
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	CDI (mg/kg-day) =
	RR	Respiration Rate	m3/hour	0.55	USEPA, 1997	0.55	USEPA, 1997	C x IR x ET x EF x ED x 1/PEF x
	ET	Exposure Time	hours/day	1.5	USEPA, 1997	1.5	USEPA, 1997	1/BW x1/AT
	EF	Exposure Frequency	days/year	350	USEPA, 2001	234	USEPA, 1993	
	ED	Exposure Duration	years	24	USEPA, 1993	7	USEPA, 1993	
	PEF	Particulate Emission Factor	m3/kg	1.32E+09	Cowherd, et al., 1995	1.32E+09	Cowherd, et al., 1995	
	BW	Body Weight	kg	70	USEPA, 1997	70	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, 1989	2,555	USEPA, 1989	

Notes

Sources:

Cowherd, et al., 1995: Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination. OHEA. EPA/600/8-85/002.
USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 4.2.3
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tap Water - Drinking Water Scenario
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	C	Contaminant Concentration in Groundwater	mg/L	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-W	Ingestion Rate of Groundwater	L/day	2	USEPA, 1993	1.4	USEPA, 1993	C x IR-W x EF x ED x 1/BW x 1/AT
	EF	Exposure Frequency	days/year	350	USEPA, 1993	234	USEPA, 1993	
	ED	Exposure Duration	years	24	USEPA, 2001	7	USEPA, 2001	
	BW	Body Weight	kg	70	USEPA, 1997	70	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, 1989	2,555	USEPA, 1989	
Dermal	C	Contaminant Concentration in Groundwater	mg/L	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	CDI (mg/kg-day) =
	CF	Conversion Factor	L/cm3	1.00E-03	USEPA, 1989	1.00E-03	USEPA, 1989	C x CF x SA x PC x ET x EF x ED x
	SA	Surface Area Available for Contact	cm2	18,000	USEPA, 2001	18,000	USEPA, 2001	1/BW x1/AT
	PC	Permeability Constant	cm/hour	Chemical Specific	USEPA, 1992	Chemical Specific	USEPA, 1992	
	ET	Exposure Time	hours/day	0.58	USEPA, 2001	0.25	USEPA, 2001	
	EF	Exposure Frequency	days/year	350	USEPA, 1993	234	USEPA, 1993	
	ED	Exposure Duration	years	24	USEPA, 2001	7	USEPA, 2001	
	BW	Body Weight	kg	70	USEPA, 1997	70	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, 1989	2,555	USEPA, 1989	

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002
USEPA, 1992: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual Supplemental Guidance: Dermal Risk Assessment.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa

TABLE 4.2.3a
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air
Exposure Point: Tap
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	C	Contaminant Concentration in Groundwater	mg/L	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-W	Ingestion Rate of Groundwater	L/day	2	USEPA, 1993	1.4	USEPA, 1993	C x IR-W x EF x ED x 1/BW x 1/AT
	EF	Exposure Frequency	days/year	350	USEPA, 1993	234	USEPA, 1993	
	ED	Exposure Duration	years	24	USEPA, 2001	7	USEPA, 2001	
	BW	Body Weight	kg	70	USEPA, 1997	70	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, 1989	2,555	USEPA, 1989	

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa

TABLE 4.3.1
VALUES USED FOR DAILY INTAKE CALCULATION:
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	200	USEPA, 1993	100	USEPA, 1993	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	1.00E-06	USEPA, 1989	
	FI	Fraction Ingested from Source	NA	1	Prof Judge	1	Prof Judge	
	EF	Exposure Frequency	days/year	350	USEPA, 2001	234	USEPA, 2001	
	ED	Exposure Duration	years	6	USEPA, 1993	2	USEPA, 1993	
	BW	Body Weight	kg	15	USEPA, 1997	15	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	USEPA, 1989	730	USEPA, 1989	
Dermal	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	CDI (mg/kg-day) =
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	1.00E-06	USEPA, 1989	C x CF x SA x AF x ABS x EF x ED x
	SA	Surface Area Available for Contact	cm2/day	2,800	USEPA, 2001	2,800	USEPA, 2001	1/BW x1/AT
	AF	Soil to Skin Adherence Factor	mg/cm2	0.2	USEPA, 2001	0.04	USEPA, 2001	
	ABS	Absorption Factor	NA	(1)	USEPA, 2001	(1)	USEPA, 2001	
	EF	Exposure Frequency	days/year	350	USEPA, 2001	234	USEPA, 2001	
	ED	Exposure Duration	years	6	USEPA, 1993	2	USEPA, 1993	
	BW	Body Weight	kg	15	USEPA, 1997	15	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	USEPA, 1989	730	USEPA, 1989	

Notes

(1) If available, ABS values from ORNL or RAGS Part E were used. Otherwise, USEPA Region IV default values of 0.01% organics and 0.001% for inorganics were used for ABS values

Prof Judge - Professional Judgment

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 4.3.1a
VALUES USED FOR DAILY INTAKE CALCULATION:
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	CDI (mg/kg-day) =
	RR	Respiration Rate	m3/hour	0.308	USEPA, 1997	0.308	USEPA, 1997	C x IR x ET x EF x ED x 1/PEF x
	ET	Exposure Time	hours/day	5.57	USEPA, 1997	5.57	USEPA, 1997	1/BW x1/AT
	EF	Exposure Frequency	days/year	350	USEPA, 2001	234	USEPA, 2001	
	ED	Exposure Duration	years	6	USEPA, 1993	2	USEPA, 1993	
	PEF	Particulate Emission Factor	m3/kg	1.32E+09	Cowherd, et al., 1995	1.32E+09	Cowherd, et al., 1995	
	BW	Body Weight	kg	15	USEPA, 1997	15	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	USEPA, 1989	730	USEPA, 1989	

Notes

Sources:

Cowherd, et al., 1995: Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination. OHEA. EPA/600/8-85/002.
USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 4.3.2
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Subsurface Soil
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	200	USEPA, 1993	100	USEPA, 1993	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	1.00E-06	USEPA, 1989	
	FI	Fraction Ingested from Source	NA	1	Prof Judge	1	Prof Judge	
	EF	Exposure Frequency	days/year	350	USEPA, 2001	234	USEPA, 2001	
	ED	Exposure Duration	years	6	USEPA, 1993	2	USEPA, 1993	
	BW	Body Weight	kg	15	USEPA, 1997	15	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	USEPA, 1989	730	USEPA, 1989	
Dermal	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	CDI (mg/kg-day) =
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	1.00E-06	USEPA, 1989	C x CF x SA x AF x ABS x EF x ED x
	SA	Surface Area Available for Contact	cm2/day	2,800	USEPA, 2001	2,800	USEPA, 2001	1/BW x1/AT
	AF	Soil to Skin Adherence Factor	mg/cm2	0.2	USEPA, 2001	0.04	USEPA, 2001	
	ABS	Absorption Factor	NA	(1)	USEPA, 2001	(1)	USEPA, 2001	
	EF	Exposure Frequency	days/year	350	USEPA, 2001	234	USEPA, 2001	
	ED	Exposure Duration	years	6	USEPA, 1993	2	USEPA, 1993	
	BW	Body Weight	kg	15	USEPA, 1997	15	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	USEPA, 1989	730	USEPA, 1989	

Notes

(1) If available, ABS values from ORNL or RAGS Part E were used. Otherwise, USEPA Region IV default values of 0.01% organics and 0.001% for inorganics were used for ABS values

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Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 4.3.2a
VALUES USED FOR DAILY INTAKE CALCULATION:
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	CDI (mg/kg-day) =
	RR	Respiration Rate	m3/hour	0.308	USEPA, 1997	0.308	USEPA, 1997	C x IR x ET x EF x ED x 1/PEF x
	ET	Exposure Time	hours/day	5.57	USEPA, 1997	5.57	USEPA, 1997	1/BW x1/AT
	EF	Exposure Frequency	days/year	350	USEPA, 2001	234	USEPA, 2001	
	ED	Exposure Duration	years	6	USEPA, 1993	2	USEPA, 1993	
	PEF	Particulate Emission Factor	m3/kg	1.32E+09	Cowherd, et al., 1995	1.32E+09	Cowherd, et al., 1995	
	BW	Body Weight	kg	15	USEPA, 1997	15	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	USEPA, 1989	730	USEPA, 1989	

Notes

Sources:

Cowherd, et al., 1995: Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination. OHEA. EPA/600/8-85/002.
USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 4.3.3
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tap Water - Drinking Water Scenario
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	C	Contaminant Concentration in Groundwater	mg/L	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-W	Ingestion Rate of Groundwater	L/day	1	USEPA, 1989	1	USEPA, 1989	C x IR-W x EF x ED x 1/BW x 1/AT
	EF	Exposure Frequency	days/year	350	USEPA, 1993	234	USEPA, 1993	
	ED	Exposure Duration	years	6	USEPA, 2001	2	USEPA, 1993	
	BW	Body Weight	kg	15	USEPA, 1997	15	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	USEPA, 1989	730	USEPA, 1989	
Dermal	C	Contaminant Concentration in Groundwater	mg/L	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific	CDI (mg/kg-day) =
	CF	Conversion Factor	L/cm3	1.00E-03	USEPA, 1989	1.00E-03	USEPA, 1989	C x CF x SA x PC x ET x EF x ED x
	SA	Surface Area Available for Contact	cm2	6,600	USEPA, 2001	6,600	USEPA, 2001	1/BW x1/AT
	PC	Permeability Constant	cm/hour	Chemical Specific	USEPA, 1992	Chemical Specific	USEPA, 1992	
	ET	Exposure Time	hours/day	1	USEPA, 2001	0.33	USEPA, 2001	
	EF	Exposure Frequency	days/year	350	USEPA, 1993	234	USEPA, 1993	
	ED	Exposure Duration	years	6	USEPA, 2001	2	USEPA, 1993	
	BW	Body Weight	kg	15	USEPA, 1997	15	USEPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	25,550	USEPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	2,190	USEPA, 1989	730	USEPA, 1989	

Notes

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002
USEPA, 1992: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual Supplemental Guidance: Dermal Risk Assessment.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa

TABLE 4.4.1
VALUES USED FOR DAILY INTAKE CALCULATION:
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Construction Workers
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	--	--	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	480	USEPA, 1993	--	--	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	--	--	
	FI	Fraction Ingested from Source	NA	1	Prof Judge	--	--	
	EF	Exposure Frequency	days/year	250	USEPA, 2001	--	--	
	ED	Exposure Duration	years	1	Prof Judge	--	--	
	BW	Body Weight	kg	70	USEPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	365	USEPA, 1989	--	--	
Dermal	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	--	--	CDI (mg/kg-day) =
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	--	--	C x CF x SA x AF x ABS x EF x ED x
	SA	Surface Area Available for Contact	cm2/day	3,300	USEPA, 2001	--	--	1/BW x1/AT
	AF	Soil to Skin Adherence Factor	mg/cm2	0.2	USEPA, 2001	--	--	
	ABS	Absorption Factor	NA	(1)	USEPA, 2001	--	--	
	EF	Exposure Frequency	days/year	250	USEPA, 2001	--	--	
	ED	Exposure Duration	years	1	Prof Judge	--	--	
	BW	Body Weight	kg	70	USEPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	365	USEPA, 1989	--	--	

Notes

(1) If available, ABS values from ORNL or RAGS Part E were used. Otherwise, USEPA Region IV default values of 0.01% organics and 0.001% for inorganics were used for ABS values

Prof Judge - Professional Judgment

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 4.4.1a
VALUES USED FOR DAILY INTAKE CALCULATION:
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Construction Workers
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	--	--	CDI (mg/kg-day) =
	RR	Respiration Rate	m3/hour	3.3	USEPA, 1997	--	--	C x IR x ET x EF x ED x 1/PEF x
	ET	Exposure Time	hours/day	8	USEPA, 1991	--	--	1/BW x1/AT
	EF	Exposure Frequency	days/year	250	USEPA, 2001	--	--	
	ED	Exposure Duration	years	1	Prof Judge	--	--	
	PEF	Particulate Emission Factor	m3/kg	9.35E+08	Site-specific	--	--	
	BW	Body Weight	kg	70	USEPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	365	USEPA, 1989	--	--	

Notes

Prof Judge - Professional Judgment

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1991: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual Supplemental Guidance: Standard Default Exposure Factors.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 4.4.2
VALUES USED FOR DAILY INTAKE CALCULATION:
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Subsurface Soil
Receptor Population: Construction Workers
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	--	--	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	480	USEPA, 1993	--	--	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	--	--	
	FI	Fraction Ingested from Source	NA	1	Prof Judge	--	--	
	EF	Exposure Frequency	days/year	250	USEPA, 2001	--	--	
	ED	Exposure Duration	years	1	Prof Judge	--	--	
	BW	Body Weight	kg	70	USEPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	365	USEPA, 1989	--	--	
Dermal	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	--	--	CDI (mg/kg-day) =
	CF	Conversion Factor	kg/mg	1.00E-06	USEPA, 1989	--	--	C x CF x SA x AF x ABS x EF x ED x
	SA	Surface Area Available for Contact	cm2/day	3,300	USEPA, 2001	--	--	1/BW x1/AT
	AF	Soil to Skin Adherence Factor	mg/cm2	0.2	USEPA, 2001	--	--	
	ABS	Absorption Factor	NA	(1)	USEPA, 2001	--	--	
	EF	Exposure Frequency	days/year	250	USEPA, 2001	--	--	
	ED	Exposure Duration	years	1	Prof Judge	--	--	
	BW	Body Weight	kg	70	USEPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	365	USEPA, 1989	--	--	

Notes

(1) If available, ABS values from ORNL or RAGS Part E were used. Otherwise, USEPA Region IV default values of 0.01% organics and 0.001% for inorganics were used for ABS values

Prof Judge - Professional Judgment

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 4.4.2a
VALUES USED FOR DAILY INTAKE CALCULATION:
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Construction Workers
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	C	Contaminant Concentration in Soil	mg/kg	Chemical Specific	Chemical Specific	--	--	CDI (mg/kg-day) =
	RR	Respiration Rate	m3/hour	3.3	USEPA, 1997	--	--	C x IR x ET x EF x ED x 1/PEF x
	ET	Exposure Time	hours/day	8	USEPA, 1991	--	--	1/BW x1/AT
	EF	Exposure Frequency	days/year	250	USEPA, 2001	--	--	
	ED	Exposure Duration	years	1	Prof Judge	--	--	
	PEF	Particulate Emission Factor	m3/kg	9.35E+08	Site-specific	--	--	
	BW	Body Weight	kg	70	USEPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	365	USEPA, 1989	--	--	

Notes

Prof Judge - Professional Judgment

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
USEPA, 1991: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual Supplemental Guidance: Standard Default Exposure Factors.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2001: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE 5.1
NON-CANCER TOXICITY DATA -- ORAL/DERMAL
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal RfD (2)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ (3) (MM/DD/YY)
Arsenic	Chronic	3.00E-04	mg/kg/day	41.0%	1.23E-04	mg/kg/day	Skin / CVS	3/1	IRIS	9/20/2002
Cadmium	Chronic	5.00E-04	mg/kg/day	5.0%	2.50E-05	mg/kg/day	Kidney	10/1	IRIS	12/30/2002
Chromium	Chronic	3.00E-03	mg/kg/day	2.0%	6.00E-05	mg/kg/day	NOEL	300/3	IRIS	9/20/2002
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

(1) Refer to table presented as subsection of Appendix H
(2) Adjusted dermal RfD = Oral RfD * Adj Factor
(3) For IRIS values, provide the date IRIS was searched.
For HEAST values, provide the date of HEAST.
For NCEA values, provide the date of the article provided by NCEA.

Target Organ Abbreviations:
CVS = Cardiovascular System
NOEL = No Observed Effect Level

Sources:
IRIS = Integrated Risk Information System

NA = Not Applicable

TABLE 5.2
NON-CANCER TOXICITY DATA -- INHALATION
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Chemical of Potential Concern	Chronic/ Subchronic	Value Inhalation RfC	Units	Adjusted Inhalation RfD (1)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfC:RfD: Target Organ	Dates (2) (MM/DD/YY)
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	Chronic	NA	NA	NA	NA	Kidney	1/1	NA	3/4/1999
Chromium	Subchronic	8.0E-06	mg/m3	2.20E-06	mg/kg/day	RsS	90/1 (aerosols), 300/1 (particulates)	IRIS	9/20/2002
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

(1) Provide equation used for derivation in text.
(2) For IRIS values, provide the date IRIS was searched.
For HEAST values, provide the date of HEAST.
For NCEA values, provide the date of the article provided by NCEA.

NA = Not Applicable

Target Organ Abbreviations:
RsS = Respiratory System

Sources:
IRIS = Integrated Risk Information System

TABLE 6.1
CANCER TOXICITY DATA -- ORAL/DERMAL
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Chemical of Potential Concern	Oral Cancer Slope Factor	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal Cancer Slope Factor (2)	Units	Weight of Evidence/ Cancer Guideline Description	Source	Date (3) (MM/DD/YY)
Arsenic	1.50E+00	41%	3.66E+00	$(mg/kg/day)^{-1}$	A	IRIS	9/20/2002
Cadmium	NA	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA

Notes:

(1) Refer to table presented as subsection of Appendix H
(2) Adjusted dermal CSF = Oral CSF / Adj Factor
(3) For IRIS values, provide the date IRIS was searched.
For HEAST values, provide the date of HEAST.
For NCEA values, provide article date provided by NCEA.

NA = Not Applicable

Sources:
IRIS = Integrated Risk Information System

EPA Group:
A - Human carcinogen
B1 - Probable human carcinogen - indicates that limited human data are available
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as a human carcinogen
E - Evidence of noncarcinogenicity

Weight of Evidence:
Known/Likely (EPA classes A, B1, B2, C)
Cannot be Determined (EPA class D)
Not Likely (EPA class E)

TABLE 6.2
CANCER TOXICITY DATA -- INHALATION
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Chemical of Potential Concern	Unit Risk	Units	Adjustment (1)	Inhalation Cancer Slope Factor	Units	Weight of Evidence/ Cancer Guideline Description	Source	Date (2) (MM/DD/YY)
Arsenic	4.3E+00	mg/m3	3,500	1.51E+01	mg/kg/day	A	IRIS	9/20/2002
Cadmium	1.8E-03	ug/m3	3,500	6.30E+00	mg/kg/day	B1	IRIS	12/30/2002
Chromium	1.2E-02	ug/m3	3,500	2.94E+02	mg/kg/day	A	IRIS	7/1/1997
Lead	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

(1) Adjustment Factor applied to Unit Risk to calculate Inhalation Slope Factor = 70kg x 1/20m3/day x 1000ug/mg
(2) For IRIS values, provide the date IRIS was searched.
For HEAST values, provide the date of HEAST.
For NCEA values, provide the date of the article provided by NCEA.

EPA Group:
A - Human carcinogen
B1 - Probable human carcinogen - indicates that limited human data are available
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as a human carcinogen
E - Evidence of noncarcinogenicity

Sources:

IRIS = Integrated Risk Information System

NA = Not Applicable

Weight of Evidence:
Known/Likely (EPA classes A, B1, B2, C)
Cannot be Determined (EPA class D)
Not Likely (EPA class E)

TABLE 7.1.1 RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Military Base Personnel
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Cadmium	5.2	mg/kg	5.2	mg/kg	M	5.1E-06	mg/kg-day	5.0E-04	mg/kg-day	--	--	1.0E-02
	Lead	1,110	mg/kg	1,110	mg/kg	M	1.1E-03	mg/kg-day	NA	--	--	--	--
	(Total)												1.0E-02
Dermal	Cadmium	5.2	mg/kg	5.2	mg/kg	M	3.4E-08	mg/kg-day	2.5E-05	mg/kg-day	--	--	1.3E-03
	Lead	1,110	mg/kg	1,110	mg/kg	M	7.2E-05	mg/kg-day	NA	--	--	--	--
	(Total)												1.3E-03
												Total Hazard Index Across All Exposure Routes/Pathways	1.2E-02

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/kg - milligram per kilogram
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.1.1a RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Military Base Personnel
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	Cadmium	5.2	mg/kg	3.94E-09	mg/m^3	R	1.7E-10	mg/kg-day	NA	--	7.0E-04	mg/m3	--
	Lead	1,110	mg/kg	8.41E-07	mg/m^3	R	3.6E-08	mg/kg-day	NA	--	NA	--	--
	(Total)												--
							Total Hazard Index Across All Exposure Routes/Pathways						--

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/m^3 - milligram per cubic meter
mg/kg-day - milligram per kilogram per day

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.2.1 RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Cadmium	5.2	mg/kg	5.2	mg/kg	M	7.1E-06	mg/kg-day	5.0E-04	mg/kg-day	--	--	1.4E-02
	Lead	1,110	mg/kg	1,110	mg/kg	M	1.5E-03	mg/kg-day	NA	--	--	--	--
	(Total)												1.4E-02
Dermal	Cadmium	5.2	mg/kg	5.2	mg/kg	M	2.8E-08	mg/kg-day	2.5E-05	mg/kg-day	--	--	1.1E-03
	Lead	1,110	mg/kg	1,110	mg/kg	M	6.1E-05	mg/kg-day	NA	--	--	--	--
	(Total)												1.1E-03
									Total Hazard Index Across All Exposure Routes/Pathways				1.5E-02

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/kg - milligram per kilogram
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.2.1a RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	Cadmium	5.2	mg/kg	3.94E-09	mg/m^3	R	4.5E-11	mg/kg-day	NA	--	7.0E-04	mg/m3	--
	Lead	1,110	mg/kg	8.41E-07	mg/m^3	R	9.5E-09	mg/kg-day	NA	--	NA	--	--
	(Total)												--
								Total Hazard Index Across All Exposure Routes/Pathways					--

NOTES:

EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/m^3 - milligram per cubic meter
mg/kg-day - milligram per kilogram per day

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.2.2 RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Subsurface Soil
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Arsenic	0.6	mg/kg	0.6	mg/kg	M	7.7E-07	mg/kg-day	3.0E-04	mg/kg-day	--	--	2.6E-03
	(Total)												2.6E-03
Dermal	Arsenic	0.6	mg/kg	0.6	mg/kg	M	9.2E-08	mg/kg-day	1.2E-04	mg/kg-day	--	--	7.5E-04
	(Total)												7.5E-04
												Total Hazard Index Across All Exposure Routes/Pathways	3.3E-03

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/kg - milligram per kilogram
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.2.2a RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	Arsenic	0.6	mg/kg	4.25E-10	mg/m^3	R	4.8E-12	mg/kg-day	NA	--	NA	--	--
	(Total)												--
												Total Hazard Index Across All Exposure Routes/Pathways	--

NOTES:

EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/m^3 - milligram per cubic meter
mg/kg-day - milligram per kilogram per day

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.2.3 RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tap
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Arsenic	0.0034	mg/L	0.0034	mg/L	M	9.3E-05	mg/kg-day	3.0E-04	mg/kg-day	--	--	3.1E-01
	Chromium	0.012	mg/L	0.012	mg/L	M	3.3E-04	mg/kg-day	3.0E-03	mg/kg-day	--	--	1.1E-01
	(Total)												4.2E-01
Dermal	Arsenic	0.0034	mg/L	0.0034	mg/L	M	2.9E-07	mg/kg-day	1.2E-04	mg/kg-day	--	--	2.4E-03
	Chromium	0.012	mg/L	0.012	mg/L	M	1.4E-06	mg/kg-day	6.0E-05	mg/kg-day	--	--	2.3E-02
	(Total)												2.6E-02
												Total Hazard Index Across All Exposure Routes/Pathways	4.5E-01

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/L - milligram per liter
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.3.1 RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Cadmium	5.2	mg/kg	5.2	mg/kg	M	6.6E-05	mg/kg-day	5.0E-04	mg/kg-day	--	--	1.3E-01
	Lead	1,110	mg/kg	1,110	mg/kg	M	1.4E-02	mg/kg-day	NA	--	--	--	--
	(Total)												1.3E-01
Dermal	Cadmium	5.2	mg/kg	5.2	mg/kg	M	1.9E-07	mg/kg-day	2.5E-05	mg/kg-day	--	--	7.4E-03
	Lead	1,110	mg/kg	1,110	mg/kg	M	4.0E-04	mg/kg-day	NA	--	--	--	--
	(Total)												7.4E-03
									Total Hazard Index Across All Exposure Routes/Pathways				1.4E-01

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/kg-day - milligram per kilogram per day

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.3.1a RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	Cadmium	5.2	mg/kg	3.94E-09	mg/m^3	R	4.3E-10	mg/kg-day	NA	--	7.0E-04	mg/m3	--
	Lead	1,110	mg/kg	8.41E-07	mg/m^3	R	9.2E-08	mg/kg-day	NA	--	NA	--	--
	(Total)												--
												Total Hazard Index Across All Exposure Routes/Pathways	--

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/m^3 - milligram per cubic meter
mg/kg-day - milligram per kilogram per day

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.3.2 RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Subsurface Soil
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Arsenic	0.6	mg/kg	0.6	mg/kg	M	7.2E-06	mg/kg-day	3.0E-04	mg/kg-day	--	--	2.4E-02
	(Total)												2.4E-02
Dermal	Arsenic	0.6	mg/kg	0.6	mg/kg	M	6.0E-07	mg/kg-day	1.2E-04	mg/kg-day	--	--	4.9E-03
	(Total)												4.9E-03
												Total Hazard Index Across All Exposure Routes/Pathways	2.9E-02

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/kg - milligram per kilogram
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.3.2a RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	Arsenic (Total)	0.6	mg/kg	4.25E-10	mg/m^3	R	4.7E-11	mg/kg-day	NA	--	NA	--	--
													--
						Total Hazard Index Across All Exposure Routes/Pathways							--

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/m^3 - milligram per cubic meter
mg/kg-day - milligram per kilogram per day

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.3.3 RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tap
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Arsenic	0.0034	mg/L	0.0034	mg/L	M	2.2E-04	mg/kg-day	3.0E-04	mg/kg-day	--	--	7.2E-01
	Chromium	0.012	mg/L	0.012	mg/L	M	7.7E-04	mg/kg-day	3.0E-03	mg/kg-day	--	--	2.6E-01
	(Total)												9.8E-01
Dermal	Arsenic	0.0034	mg/L	0.0034	mg/L	M	8.7E-07	mg/kg-day	1.2E-04	mg/kg-day	--	--	7.0E-03
	Chromium	0.012	mg/L	0.012	mg/L	M	4.1E-06	mg/kg-day	6.0E-05	mg/kg-day	--	--	6.8E-02
	(Total)												7.5E-02
												Total Hazard Index Across All Exposure Routes/Pathways	1.1E+00

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/L - milligram per liter
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.2.1 CT
CALCULATION OF NON-CANCER HAZARDS
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Cadmium	5.2	mg/kg	5.2	mg/kg	M	2.4E-06	mg/kg-day	5.0E-04	mg/kg-day	--	--	4.8E-03
	Lead	1,110	mg/kg	1,110	mg/kg	M	5.1E-04	mg/kg-day	NA	--	--	--	--
	(Total)												4.8E-03
Dermal	Cadmium	5.2	mg/kg	5.2	mg/kg	M	2.7E-09	mg/kg-day	2.5E-05	mg/kg-day	--	--	1.1E-04
	Lead	1,110	mg/kg	1,110	mg/kg	M	5.8E-06	mg/kg-day	NA	--	--	--	--
	(Total)												1.1E-04
												Total Hazard Index Across All Exposure Routes/Pathways	4.9E-03

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/kg - milligram per kilogram
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.2.1a CT
CALCULATION OF NON-CANCER HAZARDS
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	Cadmium	5.2	mg/kg	3.94E-09	mg/m^3	R	3.0E-11	mg/kg-day	NA	--	7.0E-04	mg/m3	--
	Lead	1,110	mg/kg	8.41E-07	mg/m^3	R	6.4E-09	mg/kg-day	NA	--	NA	--	--
	(Total)												--
							Total Hazard Index Across All Exposure Routes/Pathways						--

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/m^3 - milligram per cubic meter
mg/kg-day - milligram per kilogram per day

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.2.2 CT
CALCULATION OF NON-CANCER HAZARDS
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Subsurface Soil
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Arsenic	0.6	mg/kg	0.6	mg/kg	M	2.6E-07	mg/kg-day	3.0E-04	mg/kg-day	--	--	8.6E-04
	(Total)												8.6E-04
Dermal	Arsenic	0.6	mg/kg	0.6	mg/kg	M	8.8E-09	mg/kg-day	1.2E-04	mg/kg-day	--	--	7.1E-05
	(Total)												7.1E-05
								Total Hazard Index Across All Exposure Routes/Pathways					9.3E-04

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/kg - milligram per kilogram
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.2.2a CT
CALCULATION OF NON-CANCER HAZARDS
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	Arsenic	0.6	mg/kg	4.25E-10	mg/m^3	R	3.2E-12	mg/kg-day	NA	--	NA	--	--
	(Total)												--
							Total Hazard Index Across All Exposure Routes/Pathways						--

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/m^3 - milligram per cubic meter
mg/kg-day - milligram per kilogram per day

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.2.3 CT
CALCULATION OF NON-CANCER HAZARDS
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tap
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Arsenic	0.0034	mg/L	0.0034	mg/L	M	4.4E-05	mg/kg-day	3.0E-04	mg/kg-day	--	--	1.5E-01
	Chromium	0.012	mg/L	0.012	mg/L	M	1.5E-04	mg/kg-day	3.0E-03	mg/kg-day	--	--	5.1E-02
	(Total)												2.0E-01
Dermal	Arsenic	0.0034	mg/L	0.0034	mg/L	M	8.5E-08	mg/kg-day	1.2E-04	mg/kg-day	--	--	6.9E-04
	Chromium	0.012	mg/L	0.012	mg/L	M	4.0E-07	mg/kg-day	6.0E-05	mg/kg-day	--	--	6.7E-03
	(Total)												7.4E-03
												Total Hazard Index Across All Exposure Routes/Pathways	2.0E-01

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/L - milligram per liter
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.3.1 CT
CALCULATION OF NON-CANCER HAZARDS
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Cadmium	5.2	mg/kg	5.2	mg/kg	M	for VOCs by	mg/kg-day	5.0E-04	mg/kg-day	--	--	4.4E-02
	Lead	1,110	mg/kg	1,110	mg/kg	M	4.7E-03	mg/kg-day	NA	--	--	--	--
	(Total)												4.4E-02
Dermal	Cadmium	5.2	mg/kg	5.2	mg/kg	M	2.5E-08	mg/kg-day	2.5E-05	mg/kg-day	--	--	1.0E-03
	Lead	1,110	mg/kg	1,110	mg/kg	M	5.3E-05	mg/kg-day	NA	--	--	--	--
	(Total)												1.0E-03
												Total Hazard Index Across All Exposure Routes/Pathways	4.5E-02

NOTES:

EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/kg-day - milligram per kilogram per day

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.3.1a CT
CALCULATION OF NON-CANCER HAZARDS
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	Cadmium	5.2	mg/kg	3.94E-09	mg/m^3	R	for VOCs by	mg/kg-day	NA	--	7.0E-04	mg/m3	--
	Lead	1,110	mg/kg	8.41E-07	mg/m^3	R	6.2E-08	mg/kg-day	NA	--	NA	--	--
	(Total)												--
							Total Hazard Index Across All Exposure Routes/Pathways						--

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/m^3 - milligram per cubic meter
mg/kg-day - milligram per kilogram per day

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.3.2 CT
CALCULATION OF NON-CANCER HAZARDS
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Subsurface Soil
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Arsenic	0.6	mg/kg	0.6	mg/kg	M	for VOCs by	mg/kg-day	3.0E-04	mg/kg-day	--	--	8.0E-03
	(Total)												8.0E-03
Dermal	Arsenic	0.6	mg/kg	0.6	mg/kg	M	8.1E-08	mg/kg-day	1.2E-04	mg/kg-day	--	--	6.6E-04
	(Total)												6.6E-04
												Total Hazard Index Across All Exposure Routes/Pathways	8.7E-03

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/kg - milligram per kilogram
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.3.2a CT
CALCULATION OF NON-CANCER HAZARDS
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	Arsenic (Total)	0.6	mg/kg	4.25E-10	mg/m^3	R	for VOCs by	mg/kg-day	NA	--	NA	--	--
													--
							Total Hazard Index Across All Exposure Routes/Pathways						--

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/m^3 - milligram per cubic meter
mg/kg-day - milligram per kilogram per day

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.3.3 CT
CALCULATION OF NON-CANCER HAZARDS
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tap
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Arsenic	0.0034	mg/L	0.0034	mg/L	M	for VOCs by	mg/kg-day	3.0E-04	mg/kg-day	--	--	4.8E-01
	Chromium	0.012	mg/L	0.012	mg/L	M	5.1E-04	mg/kg-day	3.0E-03	mg/kg-day	--	--	1.7E-01
	(Total)												6.6E-01
Dermal	Arsenic	0.0034	mg/L	0.0034	mg/L	M	1.9E-07	mg/kg-day	1.2E-04	mg/kg-day	--	--	1.6E-03
	Chromium	0.012	mg/L	0.012	mg/L	M	9.1E-07	mg/kg-day	6.0E-05	mg/kg-day	--	--	1.5E-02
	(Total)												1.7E-02
												Total Hazard Index Across All Exposure Routes/Pathways	6.7E-01

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/L - milligram per liter
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.4.1 RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Construction Workers
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Cadmium	5.2	mg/kg	5.2	mg/kg	M	2.4E-05	mg/kg-day	5.0E-04	mg/kg-day	--	--	4.9E-02
	Lead	1,110	mg/kg	1,110	mg/kg	M	5.2E-03	mg/kg-day	NA	--	--	--	--
	(Total)												4.9E-02
Dermal	Cadmium	5.2	mg/kg	5.2	mg/kg	M	3.4E-08	mg/kg-day	2.5E-05	mg/kg-day	--	--	1.3E-03
	Lead	1,110	mg/kg	1,110	mg/kg	M	7.2E-05	mg/kg-day	NA	--	--	--	--
	(Total)												1.3E-03
												Total Hazard Index Across All Exposure Routes/Pathways	5.0E-02

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/kg - milligram per kilogram
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.4.1a RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Construction Workers
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	Cadmium	5.2	mg/kg	3.94E-09	mg/m^3	R	1.4E-09	mg/kg-day	NA	--	7.0E-04	mg/m3	--
	Lead	1,110	mg/kg	8.41E-07	mg/m^3	R	3.1E-07	mg/kg-day	NA	--	NA	--	--
	(Total)												--
												Total Hazard Index Across All Exposure Routes/Pathways	--

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/m^3 - milligram per cubic meter
mg/kg-day - milligram per kilogram per day

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.4.2 RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Subsurface Soil
Receptor Population: Construction Workers
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Ingestion	Arsenic	0.56	mg/kg	0.56	mg/kg	M	2.6E-06	mg/kg-day	3.0E-04	mg/kg-day	--	--	8.8E-03
	(Total)												8.8E-03
Dermal	Arsenic	0.56	mg/kg	0.56	mg/kg	M	1.1E-07	mg/kg-day	1.2E-04	mg/kg-day	--	--	8.8E-04
	(Total)												8.8E-04
												Total Hazard Index Across All Exposure Routes/Pathways	9.7E-03

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/kg - milligram per kilogram
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 7.4.2a RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Construction Workers
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose (2)	Reference Dose Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
Inhalation	Arsenic (Total)	0.56	mg/kg	4.25E-10	mg/m^3	R	1.6E-10	mg/kg-day	NA	--	NA	--	--
													--
								Total Hazard Index Across All Exposure Routes/Pathways					--

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/m^3 - milligram per cubic meter
mg/kg-day - milligram per kilogram per day

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.
(2) Specify if subchronic.

TABLE 8.1.1 RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Military Base Personnel
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Cadmium	5.2	mg/kg	5.2	mg/kg	M	2.9E-07	mg/kg-day	NA	--	--
	Lead	1,110	mg/kg	1,110	mg/kg	M	6.2E-05	mg/kg-day	NA	--	--
	(Total)										--
Dermal	Cadmium	5.2	mg/kg	5.2	mg/kg	M	1.9E-09	mg/kg-day	NA	--	--
	Lead	1,110	mg/kg	1,110	mg/kg	M	4.1E-06	mg/kg-day	NA	--	--
	(Total)										--
										Total Risk Across All Exposure Routes/Pathways	--

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/kg - milligram per kilogram
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.1.1a RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Military Base Personnel
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	Cadmium	5.2	mg/kg	3.94E-09	mg/m^3	R	9.7E-12	mg/kg-day	6.3E+00	$(mg/kg\text{-}day)^{-1}$	6.1E-11
	Lead	1,110	mg/kg	8.41E-07	mg/m^3	R	2.1E-09	mg/kg-day	NA	--	--
	(Total)										6.1E-11
										Total Risk Across All Exposure Routes/Pathways	6.1E-11

NOTES:

EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/m^3 - milligram per cubic meter
mg/kg-day - milligram per kilogram per day

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.2.1 RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Cadmium	5.2	mg/kg	5.2	mg/kg	M	2.4E-06	mg/kg-day	NA	--	--
	Lead	1,110	mg/kg	1,110	mg/kg	M	5.2E-04	mg/kg-day	NA	--	--
	(Total)										--
Dermal	Cadmium	5.2	mg/kg	5.2	mg/kg	M	9.7E-09	mg/kg-day	NA	--	--
	Lead	1,110	mg/kg	1,110	mg/kg	M	2.1E-05	mg/kg-day	NA	--	--
	(Total)										--
										Total Risk Across All Exposure Routes/Pathways	--

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/kg - milligram per kilogram
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.2.1a RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	Cadmium	5.2	mg/kg	3.94E-09	mg/m^3	R	1.5E-11	mg/kg-day	6.3E+00	$(mg/kg\text{-}day)^{-1}$	9.6E-11
	Lead	1,110	mg/kg	8.41E-07	mg/m^3	R	3.3E-09	mg/kg-day	NA	--	--
	(Total)										9.6E-11
										Total Risk Across All Exposure Routes/Pathways	9.6E-11

NOTES:

EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/m^3 - milligram per cubic meter
mg/kg-day - milligram per kilogram per day

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.2.2 RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Subsurface Soil
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Arsenic	0.6	mg/kg	0.6	mg/kg	M	2.6E-07	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	4.0E-07
	(Total)										4.0E-07
Dermal	Arsenic	0.6	mg/kg	0.6	mg/kg	M	3.2E-08	mg/kg-day	3.7E+00	(mg/kg-day) $^{-1}$	1.2E-07
	(Total)										1.2E-07
										Total Risk Across All Exposure Routes/Pathways	5.1E-07

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.2.2a RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	Arsenic	0.6	mg/kg	4.25E-10	mg/m^3	R	1.6E-12	mg/kg-day	1.5E+01	$(mg/kg\text{-}day)^{-1}$	2.5E-11
	(Total)										2.5E-11
										Total Risk Across All Exposure Routes/Pathways	2.5E-11

NOTES:

EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/m^3 - milligram per cubic meter
mg/kg-day - milligram per kilogram per day

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.2.3 RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tap
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Arsenic	0.0034	mg/L	0.0034	mg/L	M	3.2E-05	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	4.8E-05
	Chromium	0.012	mg/L	0.012	mg/L	M	1.1E-04	mg/kg-day	NA	--	--
	(Total)										4.8E-05
Dermal	Arsenic	0.0034	mg/L	0.0034	mg/L	M	1.0E-07	mg/kg-day	3.7E+00	(mg/kg-day) $^{-1}$	3.7E-07
	Chromium	0.012	mg/L	0.012	mg/L	M	4.8E-07	mg/kg-day	NA	--	--
	(Total)										3.7E-07
										Total Risk Across All Exposure Routes/Pathways	4.8E-05

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/L - milligram per liter
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.3.1 RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Cadmium	5.2	mg/kg	5.2	mg/kg	M	5.7E-06	mg/kg-day	NA	--	--
	Lead	1,110	mg/kg	1,110	mg/kg	M	1.2E-03	mg/kg-day	NA	--	--
	(Total)										--
Dermal	Cadmium	5.2	mg/kg	5.2	mg/kg	M	1.6E-08	mg/kg-day	NA	--	--
	Lead	1,110	mg/kg	1,110	mg/kg	M	3.4E-05	mg/kg-day	NA	--	--
	(Total)										--
										Total Risk Across All Exposure Routes/Pathways	--

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/kg - milligram per kilogram
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.3.1a RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	Cadmium	5.2	mg/kg	3.94E-09	mg/m^3	R	3.7E-11	mg/kg-day	6.3E+00	$(mg/kg\text{-}day)^{-1}$	2.3E-10
	Lead	1,110	mg/kg	8.41E-07	mg/m^3	R	7.9E-09	mg/kg-day	NA	--	--
	(Total)										2.3E-10
										Total Risk Across All Exposure Routes/Pathways	2.3E-10

NOTES:

EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/m^3 - milligram per cubic meter
mg/kg-day - milligram per kilogram per day

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.3.2 RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Subsurface Soil
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Arsenic	0.6	mg/kg	0.6	mg/kg	M	6.2E-07	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	9.2E-07
	(Total)										9.2E-07
Dermal	Arsenic	0.6	mg/kg	0.6	mg/kg	M	5.2E-08	mg/kg-day	3.7E+00	(mg/kg-day) $^{-1}$	1.9E-07
	(Total)										1.9E-07
										Total Risk Across All Exposure Routes/Pathways	1.1E-06

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/kg - milligram per kilogram
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.3.2a RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	Arsenic	0.6	mg/kg	4.25E-10	mg/m^3	R	4.0E-12	mg/kg-day	1.5E+01	$(mg/kg\text{-}day)^{-1}$	6.0E-11
	(Total)										6.0E-11
										Total Risk Across All Exposure Routes/Pathways	6.0E-11

NOTES:

EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/m^3 - milligram per cubic meter
mg/kg-day - milligram per kilogram per day

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.3.3 RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tap
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Arsenic	0.0034	mg/L	0.0034	mg/L	M	1.9E-05	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	2.8E-05
	Chromium	0.012	mg/L	0.012	mg/L	M	6.6E-05	mg/kg-day	NA	--	--
	(Total)										2.8E-05
Dermal	Arsenic	0.0034	mg/L	0.0034	mg/L	M	7.4E-08	mg/kg-day	3.7E+00	(mg/kg-day) $^{-1}$	2.7E-07
	Chromium	0.012	mg/L	0.012	mg/L	M	3.5E-07	mg/kg-day	NA	--	--
	(Total)										2.7E-07
										Total Risk Across All Exposure Routes/Pathways	2.8E-05

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/L - milligram per liter
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.2.1 CT
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Cadmium	5.2	mg/kg	5.2	mg/kg	M	2.4E-07	mg/kg-day	NA	--	--
	Lead	1,110	mg/kg	1,110	mg/kg	M	5.1E-05	mg/kg-day	NA	--	--
	(Total)										--
Dermal	Cadmium	5.2	mg/kg	5.2	mg/kg	M	2.7E-10	mg/kg-day	NA	--	--
	Lead	1,110	mg/kg	1,110	mg/kg	M	5.8E-07	mg/kg-day	NA	--	--
	(Total)										--
										Total Risk Across All Exposure Routes/Pathways	--

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/kg - milligram per kilogram
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.2.1a CT
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	Cadmium	5.2	mg/kg	3.94E-09	mg/m^3	R	3.0E-12	mg/kg-day	6.3E+00	$(mg/kg\text{-}day)^{-1}$	1.9E-11
	Lead	1,110	mg/kg	8.41E-07	mg/m^3	R	6.4E-10	mg/kg-day	NA	--	--
	(Total)										1.9E-11
										Total Risk Across All Exposure Routes/Pathways	1.9E-11

NOTES:

EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/m^3 - milligram per cubic meter
mg/kg-day - milligram per kilogram per day

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.2.2 CT
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Subsurface Soil
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Arsenic	0.6	mg/kg	0.6	mg/kg	M	2.6E-08	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	3.9E-08
	(Total)										3.9E-08
Dermal	Arsenic	0.6	mg/kg	0.6	mg/kg	M	8.8E-10	mg/kg-day	3.7E+00	(mg/kg-day) $^{-1}$	3.2E-09
	(Total)										3.2E-09
										Total Risk Across All Exposure Routes/Pathways	4.2E-08

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/kg - milligram per kilogram
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.2.2a CT
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	Arsenic	0.6	mg/kg	4.25E-10	mg/m^3	R	3.2E-13	mg/kg-day	1.5E+01	$(mg/kg\text{-}day)^{-1}$	4.8E-12
	(Total)										4.8E-12
										Total Risk Across All Exposure Routes/Pathways	4.8E-12

NOTES:

EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/m^3 - milligram per cubic meter
mg/kg-day - milligram per kilogram per day

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.2.3 CT
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tap
Receptor Population: Residents
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Arsenic	0.0034	mg/L	0.0034	mg/L	M	4.4E-06	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	6.5E-06
	Chromium	0.012	mg/L	0.012	mg/L	M	1.5E-05	mg/kg-day	NA	--	--
	(Total)										6.5E-06
Dermal	Arsenic	0.0034	mg/L	0.0034	mg/L	M	8.5E-09	mg/kg-day	3.7E+00	(mg/kg-day) $^{-1}$	3.1E-08
	Chromium	0.012	mg/L	0.012	mg/L	M	4.0E-08	mg/kg-day	NA	--	--
	(Total)										3.1E-08
										Total Risk Across All Exposure Routes/Pathways	6.6E-06

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/L - milligram per liter
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.3.1 CT
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Cadmium	5.2	mg/kg	5.2	mg/kg	M	6.3E-07	mg/kg-day	NA	--	--
	Lead	1,110	mg/kg	1,110	mg/kg	M	1.4E-04	mg/kg-day	NA	--	--
	(Total)										--
Dermal	Cadmium	5.2	mg/kg	5.2	mg/kg	M	7.1E-10	mg/kg-day	NA	--	--
	Lead	1,110	mg/kg	1,110	mg/kg	M	1.5E-06	mg/kg-day	NA	--	--
	(Total)										--
										Total Risk Across All Exposure Routes/Pathways	--

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/kg - milligram per kilogram
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.3.1a CT
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	Cadmium	5.2	mg/kg	3.94E-09	mg/m^3	R	8.3E-12	mg/kg-day	6.3E+00	$(mg/kg\text{-}day)^{-1}$	5.2E-11
	Lead	1,110	mg/kg	8.41E-07	mg/m^3	R	1.8E-09	mg/kg-day	NA	--	--
	(Total)										5.2E-11
										Total Risk Across All Exposure Routes/Pathways	5.2E-11

NOTES:

EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/m^3 - milligram per cubic meter
mg/kg-day - milligram per kilogram per day

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.3.2 CT
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Subsurface Soil
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Arsenic	0.6	mg/kg	0.6	mg/kg	M	6.9E-08	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	1.0E-07
	(Total)										1.0E-07
Dermal	Arsenic	0.6	mg/kg	0.6	mg/kg	M	2.3E-09	mg/kg-day	3.7E+00	(mg/kg-day) $^{-1}$	8.4E-09
	(Total)										8.4E-09
										Total Risk Across All Exposure Routes/Pathways	1.1E-07

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/kg - milligram per kilogram
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.3.2a CT
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	Arsenic	0.6	mg/kg	4.25E-10	mg/m^3	R	8.9E-13	mg/kg-day	1.5E+01	$(mg/kg\text{-}day)^{-1}$	1.3E-11
	(Total)										1.3E-11
										Total Risk Across All Exposure Routes/Pathways	1.3E-11

NOTES:

EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/m^3 - milligram per cubic meter
mg/kg-day - milligram per kilogram per day

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.3.3 CT
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tap
Receptor Population: Residents
Receptor Age: Young Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Arsenic	0.0034	mg/L	0.0034	mg/L	M	4.2E-06	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	6.2E-06
	Chromium	0.012	mg/L	0.012	mg/L	M	1.5E-05	mg/kg-day	NA	--	--
	(Total)										6.2E-06
Dermal	Arsenic	0.0034	mg/L	0.0034	mg/L	M	5.5E-09	mg/kg-day	3.7E+00	(mg/kg-day) $^{-1}$	2.0E-08
	Chromium	0.012	mg/L	0.012	mg/L	M	2.6E-08	mg/kg-day	NA	--	--
	(Total)										2.0E-08
										Total Risk Across All Exposure Routes/Pathways	6.2E-06

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/L - milligram per liter
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.4.1 RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Construction Workers
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Cadmium	5.2	mg/kg	5.2	mg/kg	M	3.5E-07	mg/kg-day	NA	--	--
	Lead	1,110	mg/kg	1,110	mg/kg	M	7.4E-05	mg/kg-day	NA	--	--
	(Total)										--
Dermal	Cadmium	5.20	mg/kg	5.20	mg/kg	M	4.8E-10	mg/kg-day	NA	--	--
	Lead	1110	mg/kg	1110	mg/kg	M	1.0E-06	mg/kg-day	NA	--	--
	(Total)										--
										Total Risk Across All Exposure Routes/Pathways	--

NOTES:
EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.
mg/kg - milligram per kilogram
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.4.1a RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Construction Workers
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	Cadmium	5.2	mg/kg	3.94E-09	mg/m^3	R	2.1E-11	mg/kg-day	6.3E+00	$(mg/kg\text{-}day)^{-1}$	1.3E-10
	Lead	1,110	mg/kg	8.41E-07	mg/m^3	R	4.4E-09	mg/kg-day	NA	--	--
	(Total)										1.3E-10
										Total Risk Across All Exposure Routes/Pathways	1.3E-10

NOTES:

EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/m^3 - milligram per cubic meter
mg/kg-day - milligram per kilogram per day

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.4.2 RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil
Exposure Point: Subsurface Soil
Receptor Population: Construction Workers
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Arsenic	0.56	mg/kg	0.56	mg/kg	M	3.8E-08	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	5.6E-08
	(Total)										5.6E-08
Dermal	Arsenic	0.56	mg/kg	0.56	mg/kg	M	1.6E-09	mg/kg-day	3.7E+00	(mg/kg-day) $^{-1}$	5.7E-09
	(Total)										5.7E-09
										Total Risk Across All Exposure Routes/Pathways	6.2E-08

NOTES:

EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/kg-day - milligram per kilogram per day
(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 8.4.2a RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Construction Workers
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Inhalation	Arsenic	0.56	mg/kg	4.25E-10	mg/m^3	R	2.2E-12	mg/kg-day	1.5E+01	$(mg/kg\text{-}day)^{-1}$	3.3E-11
	(Total)										3.3E-11
										Total Risk Across All Exposure Routes/Pathways	3.3E-11

NOTES:

EPC - Exposure Point Concentration
NA - Toxicity criterion not available.
-- - Not applicable.

mg/kg - milligram per kilogram
mg/m^3 - milligram per cubic meter
mg/kg-day - milligram per kilogram per day

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for risk calculation.

TABLE 9.1.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Receptor Population: Military Base Personnel
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Cadmium	--	6.1E-11	--	6.1E-11	Cadmium	Kidney	1.0E-02	--	1.3E-03	1.2E-02
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	--	6.1E-11	--	6.1E-11	(Total)		1.0E-02	--	1.3E-03	1.2E-02

Total Risk Across Surface Soil: 6.1E-11
Total Risk Across All Media and All Exposure Routes: 6.1E-11

Total Hazard Index Across Surface Soil: 0.01
zard Index Across All Media and All Exposure Routes: 0.01

All Exposure Routes:
Total Kidney HI = 0.01

TABLE 9.2.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Cadmium	--	9.6E-11	--	9.6E-11	Cadmium	Kidney	1.4E-02	--	1.1E-03	1.5E-02
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	--	9.6E-11	--	9.6E-11	(Total)		1.4E-02	--	1.1E-03	1.5E-02
Subsurface Soil	Subsurface Soil	Subsurface Soil	Arsenic	4.0E-07	2.5E-11	1.2E-07	5.1E-07	Arsenic	(o) Skin / CVS	2.6E-03	--	7.5E-04	3.3E-03
			(Total)	4.0E-07	2.5E-11	1.2E-07	5.1E-07	(Total)		2.6E-03	--	7.5E-04	3.3E-03
Groundwater	Groundwater	Tap	Arsenic	4.8E-05	--	3.7E-07	4.8E-05	Arsenic	(o) Skin / CVS	3.1E-01	--	2.4E-03	3.1E-01
			Chromium	--	--	--	--	Chromium	(o) NOEL, (i) RsS	1.1E-01	--	2.3E-02	1.3E-01
			(Total)	4.8E-05	--	3.7E-07	4.8E-05	(Total)		4.2E-01	--	2.6E-02	4.5E-01

Notes:
Target Organ Abbreviations:
CVS = Cardiovascular System
RsS = Respiratory System
NOEL = No Observed Effect Level

(o) Oral exposure
(i) Inhalation exposure

Total Risk Across Surface Soil	9.6E-11
Total Risk Across Subsurface Soil	5.1E-07
Total Risk Across Groundwater	4.8E-05
Total Risk Across All Media and All Exposure Routes	4.9E-05

Total Hazard Index Across Surface Soil	0.02
Total Hazard Index Across Subsurface Soil	0.00
Total Hazard Index Across Groundwater	0.45
ıl Hazard Index Across All Media and All Exposure Routes	0.46

All Exposure Routes:
Total Kidney HI = 0.02

Oral and Dermal Exposure Routes:
Oral / Dermal Cardiovascular System HI = 0.32
Oral / Dermal Skin HI = 0.32

Inhalation Exposure Routes:
Inhalation Respiratory System HI = 0.00E+00

TABLE 9.2.CT
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Cadmium	--	1.9E-11	--	1.9E-11	Cadmium	Kidney	4.8E-03	--	1.1E-04	4.9E-03
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	--	1.9E-11	--	1.9E-11	(Total)		4.8E-03	--	1.1E-04	4.9E-03
Subsurface Soil	Subsurface Soil	Subsurface Soil	Arsenic	3.9E-08	4.8E-12	3.2E-09	4.2E-08	Arsenic	(o) Skin / CVS	8.6E-04	--	7.1E-05	9.3E-04
			(Total)	3.9E-08	4.8E-12	3.2E-09	4.2E-08	(Total)		8.6E-04	--	7.1E-05	9.3E-04
Groundwater	Groundwater	Tap	Arsenic	6.5E-06	--	3.1E-08	6.6E-06	Arsenic	(o) Skin / CVS	1.5E-01	--	6.9E-04	1.5E-01
			Chromium	--	--	--	--	Chromium	(o) NOEL, (i) RsS	5.1E-02	--	6.7E-03	5.8E-02
			(Total)	6.5E-06	--	3.1E-08	6.6E-06	(Total)		2.0E-01	--	7.4E-03	2.0E-01

Notes:
Target Organ Abbreviations:
CVS = Cardiovascular System
RsS = Respiratory System
NOEL = No Observed Effect Level

(o) Oral exposure
(i) Inhalation exposure

Total Risk Across Surface Soil	1.9E-11
Total Risk Across Subsurface Soil	4.2E-08
Total Risk Across Groundwater	6.6E-06
Total Risk Across All Media and All Exposure Routes	6.6E-06

Total Hazard Index Across Surface Soil	0.00
Total Hazard Index Across Subsurface Soil	0.00
Total Hazard Index Across Groundwater	0.20
ıl Hazard Index Across All Media and All Exposure Routes	0.21

All Exposure Routes:
Total Kidney HI = 0.00

Oral and Dermal Exposure Routes:
Oral / Dermal Cardiovascular System HI = 0.15
Oral / Dermal Skin HI = 0.15

Inhalation Exposure Routes:
Inhalation Respiratory System HI = 0.00E+00

TABLE 9.3.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Young Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Cadmium	--	2.3E-10	--	2.3E-10	Cadmium	Kidney	1.3E-01	--	7.4E-03	1.4E-01
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	--	2.3E-10	--	2.3E-10	(Total)		1.3E-01	--	7.4E-03	1.4E-01
Subsurface Soil	Subsurface Soil	Subsurface Soil	Arsenic	9.2E-07	6.0E-11	1.9E-07	1.1E-06	Arsenic	(o) Skin / CVS	2.4E-02	--	4.9E-03	2.9E-02
			(Total)	9.2E-07	6.0E-11	1.9E-07	1.1E-06	(Total)		2.4E-02	--	4.9E-03	2.9E-02
Groundwater	Groundwater	Tap	Arsenic	2.8E-05	--	2.7E-07	2.8E-05	Arsenic	(o) Skin / CVS	7.2E-01	--	7.0E-03	7.3E-01
			Chromium	--	--	--	--	Chromium	(o) NOEL, (i) RsS	2.6E-01	--	6.8E-02	3.2E-01
			(Total)	2.8E-05	--	2.7E-07	2.8E-05	(Total)		9.8E-01	--	7.5E-02	1.1E+00

Notes:
Target Organ Abbreviations:
CVS = Cardiovascular System
RsS = Respiratory System
NOEL = No Observed Effect Level

(o) Oral exposure
(i) Inhalation exposure

Total Risk Across Surface Soil	2.3E-10
Total Risk Across Subsurface Soil	1.1E-06
Total Risk Across Groundwater	2.8E-05
Total Risk Across All Media and All Exposure Routes	2.9E-05

Total Hazard Index Across Surface Soil	0.14
Total Hazard Index Across Subsurface Soil	0.03
Total Hazard Index Across Groundwater	1.06
al Hazard Index Across All Media and All Exposure Routes	1.22

All Exposure Routes:
Total Kidney HI = 0.14

Oral and Dermal Exposure Routes:
Oral / Dermal Cardiovascular System HI = 0.76
Oral / Dermal Skin HI = 0.76

Inhalation Exposure Routes:
Inhalation Respiratory System HI = 0.00E+00

TABLE 9.3.CT
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Young Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Cadmium	--	5.2E-11	--	5.2E-11	Cadmium	Kidney	4.4E-02	--	1.0E-03	4.5E-02
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	--	5.2E-11	--	5.2E-11	(Total)		4.4E-02	--	1.0E-03	4.5E-02
Subsurface Soil	Subsurface Soil	Subsurface Soil	Arsenic	1.0E-07	1.3E-11	8.4E-09	1.1E-07	Arsenic	(o) Skin / CVS	8.0E-03	--	6.6E-04	8.7E-03
			(Total)	1.0E-07	1.3E-11	8.4E-09	1.1E-07	(Total)		8.0E-03	--	6.6E-04	8.7E-03
Groundwater	Groundwater	Tap	Arsenic	6.2E-06	--	2.0E-08	6.2E-06	Arsenic	(o) Skin / CVS	4.8E-01	--	1.6E-03	4.9E-01
			Chromium	--	--	--	--	Chromium	(o) NOEL, (i) RsS	1.7E-01	--	1.5E-02	1.9E-01
			(Total)	6.2E-06	--	2.0E-08	6.2E-06	(Total)		6.6E-01	--	1.7E-02	6.7E-01

Notes:
Target Organ Abbreviations:
CVS = Cardiovascular System
RsS = Respiratory System
NOEL = No Observed Effect Level

(o) Oral exposure
(i) Inhalation exposure

Total Risk Across Surface Soil	5.2E-11
Total Risk Across Subsurface Soil	1.1E-07
Total Risk Across Groundwater	6.2E-06
Total Risk Across All Media and All Exposure Routes	6.4E-06

Total Hazard Index Across Surface Soil	0.05
Total Hazard Index Across Subsurface Soil	0.01
Total Hazard Index Across Groundwater	0.67
al Hazard Index Across All Media and All Exposure Routes	0.73

All Exposure Routes:
Total Kidney HI = 0.05

Oral and Dermal Exposure Routes:
Oral / Dermal Cardiovascular System HI = 0.49
Oral / Dermal Skin HI = 0.49

Inhalation Exposure Routes:
Inhalation Respiratory System HI = 0.00E+00

TABLE 9.4.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Cadmium	--	1.3E-10	--	1.3E-10	Cadmium	Kidney	4.9E-02	--	1.3E-03	5.0E-02
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	--	1.3E-10	--	1.3E-10	(Total)		4.9E-02	--	1.3E-03	5.0E-02
Subsurface Soil	Subsurface Soil	Subsurface Soil	Arsenic	5.6E-08	3.3E-11	5.7E-09	6.2E-08	Arsenic	(o) Skin / CVS	8.8E-03	--	8.8E-04	9.7E-03
			(Total)	5.6E-08	3.3E-11	5.7E-09	6.2E-08	(Total)		8.8E-03	--	8.8E-04	9.7E-03

Notes:
Target Organ Abbreviations:
CVS = Cardiovascular System

(o) Oral exposure
(i) Inhalation exposure

Total Risk Across Surface Soil	1.3E-10
Total Risk Across Subsurface Soil	6.2E-08
Total Risk Across All Media and All Exposure Routes	6.2E-08

All Exposure Routes:
Total Kidney HI = 0.05

Total Hazard Index Across Surface Soil	0.05
Total Hazard Index Across Subsurface Soil	0.01
Total Hazard Index Across All Media and All Exposure Routes	0.06

Oral and Dermal Exposure Routes:
Oral / Dermal Cardiovascular System HI = 0.01
Oral / Dermal Skin HI = 0.01

TABLE 10.1.RME
RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Young Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Tap	Arsenic	2.8E-05	--	2.7E-07	2.8E-05	Arsenic	(o) Skin / CVS	7.2E-01	--	7.0E-03	7.3E-01
			Chromium	--	--	--	--	Chromium	(o) NOEL, (i) RsS	2.6E-01	--	6.8E-02	3.2E-01
			(Total)	2.8E-05	--	2.7E-07	2.8E-05	(Total)		9.8E-01	--	7.5E-02	**1.1E+00**

Notes:
Target Organ Abbreviations:
CVS = Cardiovascular System
RsS = Respiratory System
NOEL = No Observed Effect Level

(o) Oral exposure
(i) Inhalation exposure

Total Risk Across Groundwater: 2.8E-05
Total Risk Across All Media and All Exposure Routes: 2.8E-05

Total Hazard Index Across Groundwater: 1.06
al Hazard Index Across All Media and All Exposure Routes: 1.06

Inhalation Exposure Routes:
Inhalation Respiratory System HI = 0.00E+00

Oral and Dermal Exposure Routes:
Oral / Dermal Cardiovascular System HI = 0.73
Oral / Dermal Skin HI = 0.73

TABLE 10.1.CT
RISK ASSESSMENT SUMMARY
CENTRAL TENDENCY
SWMU 311
RCRA FACILITY INVESTIGATION
MCB, CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Young Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Tap	Arsenic	6.2E-06	--	2.0E-08	6.2E-06	Arsenic	(o) Skin / CVS	4.8E-01	--	1.6E-03	4.9E-01
			Chromium	--	--	--	--	Chromium	(o) NOEL, (i) RsS	1.7E-01	--	1.5E-02	1.9E-01
			(Total)	6.2E-06	--	2.0E-08	6.2E-06	(Total)		6.6E-01	--	1.7E-02	6.7E-01

Notes:
Target Organ Abbreviations:
CVS = Cardiovascular System
RsS = Respiratory System
NOEL = No Observed Effect Level

(o) Oral exposure
(i) Inhalation exposure

Total Risk Across Groundwater: 6.2E-06
Total Risk Across All Media and All Exposure Routes: 6.2E-06

Total Hazard Index Across Groundwater: 0.67
al Hazard Index Across All Media and All Exposure Routes: 0.67

Inhalation Exposure Routes:
Inhalation Respiratory System HI = 0.00E+00

Oral and Dermal Exposure Routes:
Oral / Dermal Cardiovascular System HI = 0.49
Oral / Dermal Skin HI = 0.49

Baker

Baker Environmental, Inc.

APPENDIX J

Checklist for Ecological Assessment

Checklist for Ecological Assessment/Sampling

I. **SITE DESCRIPTION**

1. Site Name: Solid Waste Management Unit 311

   Location: Marine Corps Base Camp Lejeune

   County: Onslow City: Jacksonville State: North Carolina

2. Latitude: N/A Longitude: N/A

3. What is the approximate area of the site: area of oil/water separator approx 10' x 22'
   Area enclosing washpad (fenced) approx. 350' x 170' = 59,500 ft² = 0.553 hectare

4. Is this the first site visit? ☐ Yes ☒ No. If no, attach trip report of previous site visit(s), if available.

   Date(s) of previous site visit(s): ——

   First visit by ecologist.

5. Please attach to the checklist USGS topographic map(s) of the site, if available.

6. Are aerial or other site photographs available? ☒ Yes ☐ No. If yes, please attach any available photo(s) to the site map at the conclusion of this section.

   (Aerial photograph - see Figure 7-1 of text)

   Site photographs attached

7. The land use of the site is:

_____ % Urban

_____ % Rural

_____ % Residential

100 % Industrial (___ light ___ heavy)

_____ % Agricultural

(Crops: _____)

_____ % Recreational

(Describe: note if it is a park etc.)

_____

_____

_____ % Undisturbed

_____ % Other

The area surrounding the site is:
_____ mile radius

_____ % Urban

_____ % Rural

_____ % Residential

_____ % Industrial (___light ____heavy)

_____ % Agricultural

(Crops: _____)

_____ % Recreational

(Describe: note if it is a park, etc.)

_____

_____

_____ % Undisturbed

_____ % Other

8. Has any movement of soil taken place at the site? ☐___ Yes ☒___ No. If yes, please identify the most likely cause of this disturbance:

☐ Agricultural Use ☐ Heavy Equipment ☐ Mining

☐ Natural Events ☐ Erosion ☐ Other

Please describe:

No evidence of soil movement. Site is paved-(Area surrounding wash rack). Area surrounding oil/water separator is grass-covered - maintained lawn.
Drainage ditch along Michael Rd - grass filled w/some gravel.
PM-reports that this ditch is occassionally scoured/cleaned out by Base personnel (to maintain drainage + keep clear of debris?) - Limited erosion may occur w/in drainage channel.

9. Do any potential sensitive environmental areas exist adjacent to or in proximity to the site, e.g., Federal and State parks, National and State monuments, wetlands, prairie potholes? *Remember, flood plains and wetlands are not always obvious; do not answer "no" without confirming information.*

NO

Please provide the source(s) of the information used to identify these sensitive areas, and indicate their general location on the site map.

Consulted "Inventory of the Rare Species, Natural Communities, and Critical Areas of Camp Lejeune Marine Corps Base, North Carolina" (LeBlond et al. 1994)

10. What type of facility is located at the site?

☐ Chemical ☐ Manufacturing ☐ Mixing ☐ Waste disposal

☐ Other (specify) Vehicle Wash Rack

11. What are the suspected contaminants of concern at the site? If know, what are the maximum concentration levels?

Oils/lubricants/etc. from vehicles

12. Check any potential routes of off-site migration of contaminants observed at the site:

☐ Swales ☐ Depressions ☒ Drainage ditches

☒ Runoff ☐ Windblown particulates ☐ Vehicular traffic

☐ Other (specify)

13. If known, what is the approximate depth to the water table? 15'. Also perched water @ 7-8' bgs

14. Is the direction of surface runoff apparent from site observations? ☒ yes ☐ no. If yes, to which of the following does the surface runoff discharge? Indicate all that apply.

☐ Surface water ☐ Groundwater ☒ Sewer ☐ Collection impoundment

Site is relatively flat w/in fenced area. Outside fence - drainge to ditches along Michael Road.

15. Is there a navigable waterbody or tributary to a navigable waterbody? ☐ yes ☒ no

Not on site

16. Is there a waterbody anywhere on or in the vicinity of the site? If yes, also complete Section III: Aquatic Habitat Checklist – Non-Flowing Systems and/or Section IV: Aquatic Habitat Checklist – Flowing Systems.

☒ yes (approx. distance 2,250' NW) ☐ no

Cogdels Creek

17. Is there evidence of flooding? ☐ yes ☒ no *Wetlands and flood plains are not always obvious; do not answer "no" without confirming information.* If yes, complete Section V: Wetland Habitat Checklist.

18. If a field guide was used to aid any of the identifications, please provide a reference. Also, estimate the time spent identifying fauna. [Use a blank sheet if additional space is needed for text.]

N/A

19. Are any threatened and/or endangered species (plant or animal) known to inhabit the area of the site? ☐ yes ☒ no *If yes, you are required to verify this information with the U.S. Fish and Wildlife Service.* If species' identities are known, please list them next.

20. Record weather conditions at the time this checklist was prepared:

Date: 11 July 2003

~80°F Temperature (°C/°F) _____ Normal daily high temperature

_____ Wind (direction/speed) None Precipitation (rain,snow)

_____ Cloud cover

Sunny, mild. Blue skies - cumulous clouds

IA. SUMMARY OF OBSERVATIONS AND SITE SETTING

Industrial setting with limited habitat.
No wildlife observed during site visit with the exception of insects.
Maintained lawn area could be foraging area for avian species, small mammals (squirrels), etc. Possibly larger receptors in wooded area few hundred yds. Southeast of site.
Evaluate potential impacts from exposure to surface soils in this area.
Evaluate potential for groundwater impacts - potential for discharge to Cogdels Creek.

Due to lack of terrestrial habitat, the Terrestrial Habitat Checklist was not completed.

Due to the distance to Cogdels Creek (~ 2500 ft), the Aquatic Habitat Checklist was not completed.

Completed by Heather G Wojdak Affiliation Baker Environmental, Inc.

Additional Preparers N/A

Site Manager Jim Culp / Scott Moffett

Date 11 July 2003

Photographs of SWMU 311 taken 11 July 2003

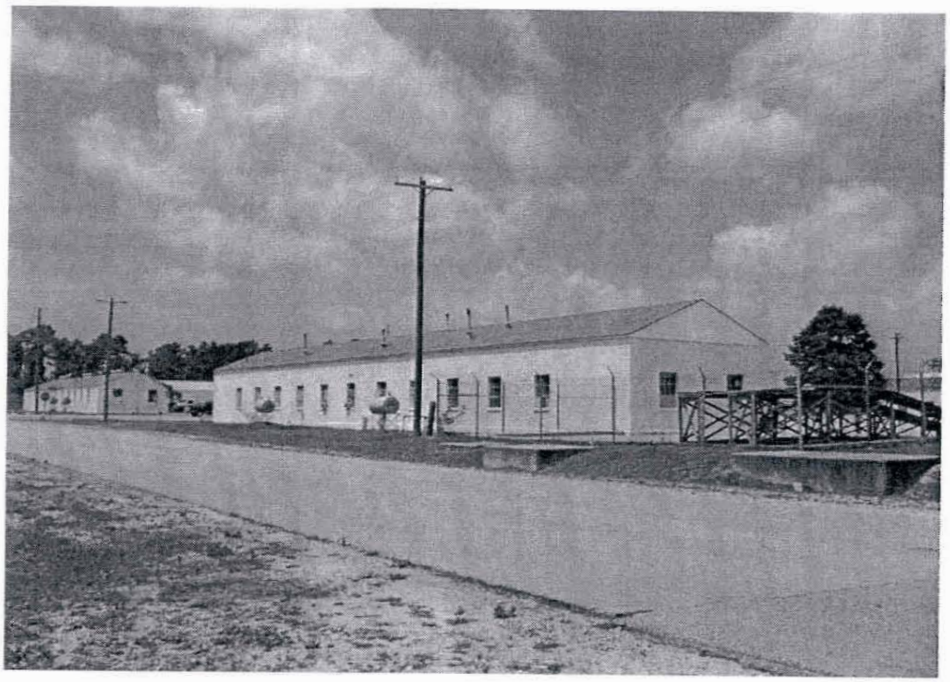

Photo 1. Building 1605 as viewed from Michael Road. Wash rack to right of image. Oil/water separator includes cement structures between wash rack and road.

Photo 2. View from oil/water separator facing northeast. Drainage ditch along Michael Road. Building 1604.

Photographs of SWMU 311 taken 11 July 2003

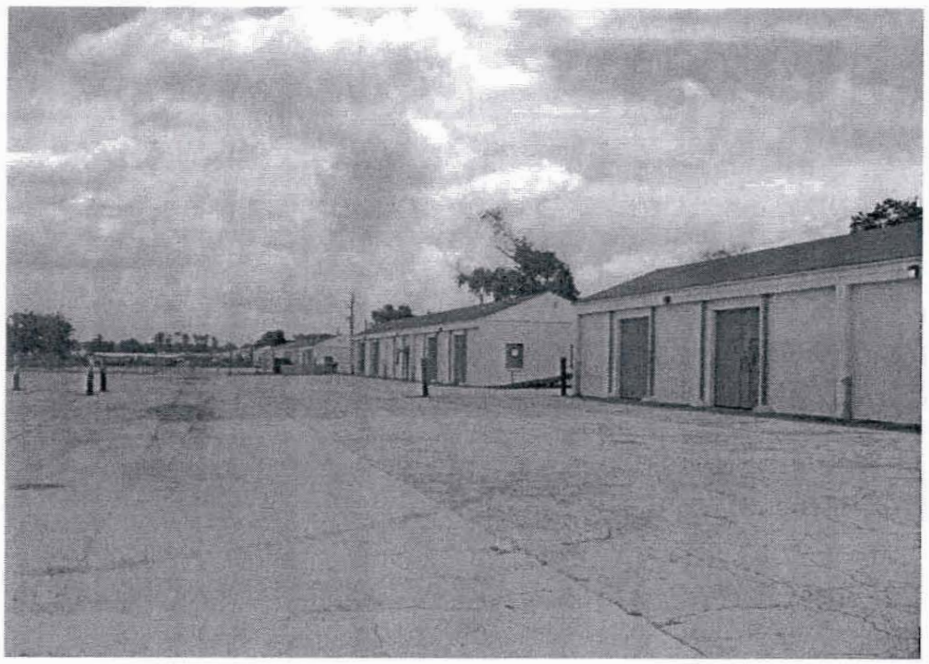

Photo 3. Buildings 1604 and 1605 as viewed from inside the fence line. Ramp from wash rack is just visible between the buildings.

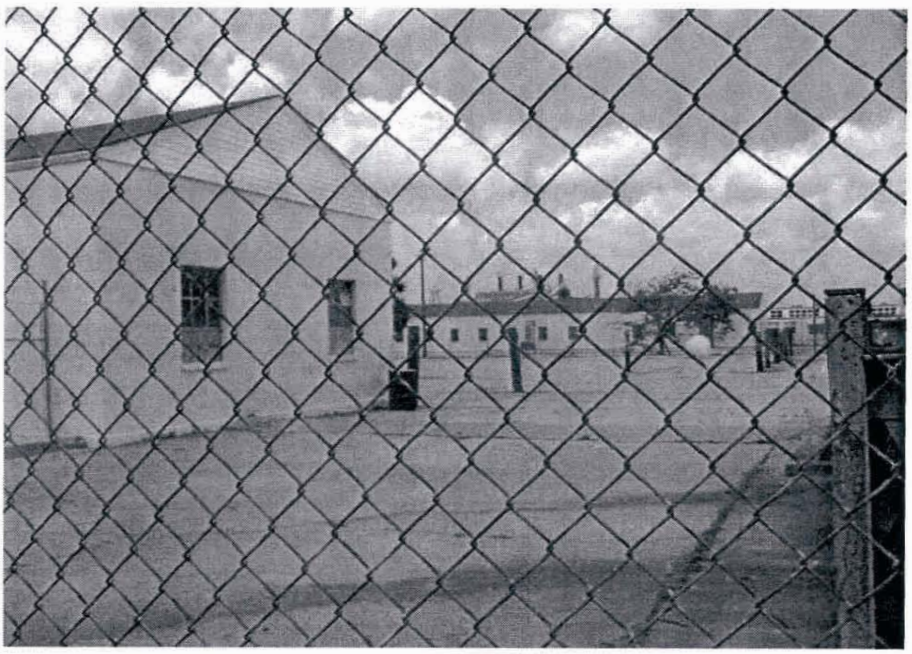

Photo 4. View from oil/water separator toward wash rack. Top of wash rack ramp is visible on far right of photograph.

Photographs of SWMU 311 taken 11 July 2003

Photo 5. View from Michael Road toward Cogdels Creek (approx. 2,500 ft. in distance). Drainage ditch is present in shade of tree in center of image.

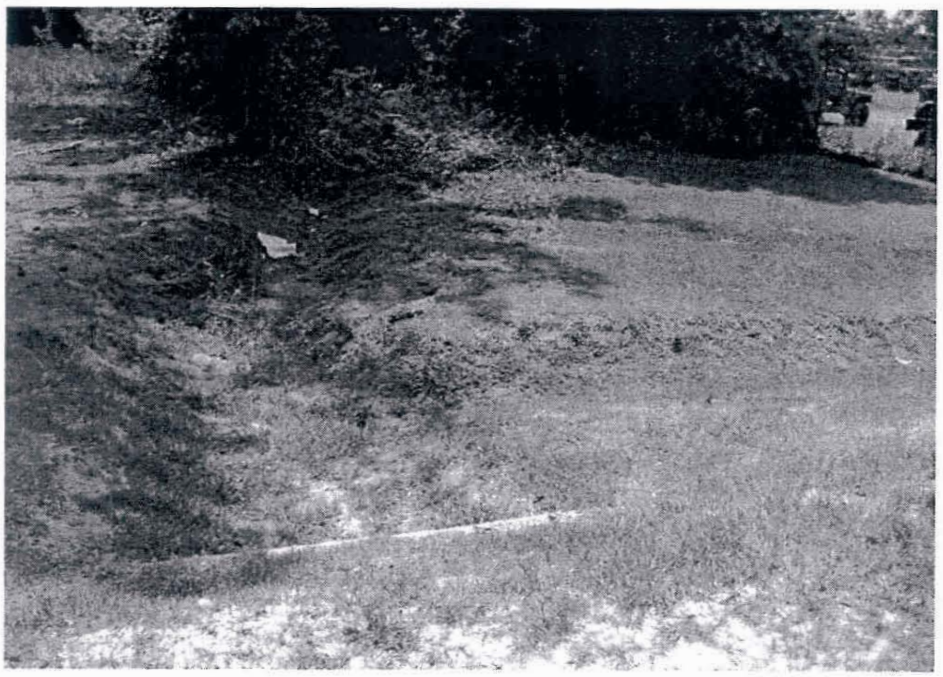

Photo 6. Drainage ditch located across Michael Road southeast of oil/water separator.