8/5/05-03858

Final

SWMU 46
RCRA Facility Investigation Report

RCRA Program
Marine Corps Base
Camp Lejeune, North Carolina

Prepared For

NAVFAC
Naval Facilities Engineering Command
MID-ATLANTIC

Norfolk, Virginia

Contract No. N62470-02-D-3052
CTO-0041

August 2005

Prepared by

CH2M HILL

Baker
Environmental, Inc.

TABLE OF CONTENTS

Page

LIST OF ACRONYMS v

EXECUTIVE SUMMARY ES-1

1.0 **INTRODUCTION** 1-1
- 1.1 Regulatory History 1-1
- 1.2 Site Description and History 1-2
- 1.3 Previous Investigations 1-2
- 1.4 Purpose/Objectives 1-4
- 1.5 References 1-4

2.0 **FIELD INVESTIGATION** 2-1
- 2.1 Geophysical Survey 2-1
- 2.2 Test Trenching 2-3
- 2.3 Soil Borings 2-4
- 2.4 Analytical Program for Soils 2-6
- 2.5 Groundwater Investigation 2-6
- 2.6 Analytical Program for Groundwater Samples 2-7
- 2.7 Survey 2-7
- 2.8 Quality Assurance/Quality Control Samples 2-7
- 2.9 Decontamination Procedures 2-8
- 2.10 Investigation Derived Waste 2-9
- 2.11 Data Management and Tracking 2-10
- 2.12 References 2-10

3.0 **PHYSICAL CHARACTERISTICS** 3-1
- 3.1 Topography and Surface Features 3-1
- 3.2 Potable Water Supply 3-1
- 3.3 Geologic and Hydrogeologic Framework 3-2
  - 3.3.1 Regional Framework 3-2
  - 3.3.2 Site-Specific Framework 3-4

4.0 **ANALYTICAL RESULTS AND EXTENT OF CONTAMINATION** 4-1
- 4.1 Data Quality 4-1
  - 4.1.1 Laboratory and Non-Site Related Contaminants 4-1
  - 4.1.2 Naturally Occurring Inorganic Elements 4-3
- 4.2 Comparison Criteria and Standards 4-5
- 4.3 Data Usability 4-7
- 4.4 Nature and Extent of Contamination 4-7
  - 4.4.1 Soil Investigation 4-8
  - 4.4.2 Groundwater Investigation 4-10
  - 4.4.3 Summary 4-10
- 4.5 References 4-11

5.0 **FATE AND TRANSPORT** 5-1
- 5.1 Chemical and Physical Properties Impacting Fate and Transport 5-1
- 5.2 Contaminant Transport Pathways 5-3
  - 5.2.1 Wind-blown Dust 5-4
  - 5.2.2 Leaching of Soil Contaminants to Groundwater 5-4
- 5.3 References 5-5

QC Review Page

Final

SWMU 46

RCRA Facility Investigation Report

MCB Camp Lejeune

Jacksonville, North Carolina

Contract Task Order Number – 0041
Contract Number N62470-02-D-3052
Navy CLEAN III Program

Prepared by

Baker Environmental

August 2005

Approved by: James S. Culp Date: 8/22/05
James S. Culp, P.G.
Project Manager, Baker Environmental

Approved by: Louise Palmer Date: 8/22/05
Louise A. Palmer, P.E.
Project Manager, CH2M HILL

TABLE OF CONTENTS
(continued)

6.0 **HUMAN HEALTH RISK ASSESSMENT** **6-1**
6.1 Site Location and Characterization 6-1
6.2 Hazard Identification 6-2
6.2.1 Data Evaluation 6-2
6.2.2 Identification of Data Suitable for Use in a Quantitative Risk Assessment 6-3
6.2.3 Criteria for Selecting Chemicals of Potential Concern 6-5
6.2.4 Selection of COPCs 6-10
6.2.5 Summary of COPCs 6-13
6.3 Exposure Assessment 6-13
6.3.1 Potential Human Receptors 6-14
6.3.2 Conceptual Site Model 6-17
6.3.3 Quantification of Exposure 6-17
6.3.4 Data Analysis 6-18
6.3.5 Calculation of Chronic Daily Intakes 6-21
6.3.6 Exposure Input Parameters 6-26
6.4 Toxicity Assessment 6-31
6.4.1 Reference Doses 6-32
6.4.2 Carcinogenic Slope Factors 6-32
6.4.3 Dermal Absorption Efficiency 6-33
6.4.4 Lead 6-34
6.5 Risk Characterization 6-35
6.5.1 Quantification and Characterization of Carcinogenic Risks 6-35
6.5.2 Quantification and Characterization of Noncarcinogenic Risks 6-36
6.5.3 Potential Human Health Effects 6-37
6.6 Sources of Uncertainty 6-40
6.6.1 Sampling and Analysis 6-41
6.6.2 Selection of COPCs 6-42
6.6.3 Exposure Assessment 6-43
6.6.4 Toxicological Assessment 6-44
6.6.5 Human Risk Characterization 6-45
6.7 Summary of the Baseline HHRA 6-46
6.8 References 6-47

7.0 **ECOLOGICAL RISK ASSESSMENT** **7-1**
7.1 Step 1 – Screening-Level Problem Formulation and Ecological Effects Evaluation 7-3
7.1.1 Ecological Setting 7-4
7.1.2 Fate and Transport Mechanisms 7-6
7.1.3 Potentially Complete Exposure Pathways 7-6
7.1.4 Conclusions of Step 1 7-11
7.2 Step 2 - Screening-Level Preliminary Exposure Estimate and Risk Calculation 7-11
7.2.1 Data Used in the SLERA 7-11
7.2.2 Abiotic Screen 7-13
7.2.3 Uncertainties Associated with the SLERA 7-18
7.3 Step 3A – Refinement of the List of Chemicals of Potential Concern 7-24
7.3.1 Refinement of Exposure and Effects Level Estimates 7-24
7.3.2 Comparison to Background Data 7-25
7.3.3 Frequency and Distribution of Detections 7-27

TABLE OF CONTENTS
(continued)

7.3.4 Considerations of Bioaccumulative Potential 7-27
7.3.5 Groundwater Considerations 7-28
7.3.6 Additional Considerations 7-28
7.4 Risk Characterization 7-29
7.4.1 Surface Soil 7-30
7.4.2 Groundwater 7-32
7.5 Uncertainties Associated with Step 3A of the BERA 7-32
7.6 Summary 7-33
7.7 References 7-34

8.0 CONCLUSIONS AND RECOMMENDATIONS 8-1
8.1 Conclusions 8-1
8.2 Recommendations 8-2

LIST OF TABLES

Table 2-1 Sample Summary Table
Table 2-2 Test Trench Details
Table 2-3 Monitoring Well Construction Details

Table 3-1 Geologic and Hydrogeologic Units in the Coastal Plain of North Carolina

Table 4-1 QA/QC Sample Summary
Table 4-2 Analytical Data Summary – Surface Soil
Table 4-3 Analytical Data Summary – Subsurface Soil
Table 4-4 Analytical Data Summary – Test Trenches
Table 4-5 Analytical Data Summary – Groundwater

Table 5-1 Organic Constituent Physical and Chemical Properties
Table 5-2 Relative Mobility of Metals as a Function of Environmental Conditions

Table 6-1 Summary of Uncertainties in the Results of the Human Health Risk Assessment

Table 7-1 Summary of the Analytical Data Used in the Screening Level Ecological Risk Assessment
Table 7-2 Ecological Screening Values
Table 7-3 Selection of Ecological COPCs in Surface Soil
Table 7-4 Selection of Ecological COPCs in Groundwater
Table 7-5 Media-specific Screening Values for Step 3A
Table 7-6 Refined Assessment of Ecological Contaminants of Potential Concern in Surface Soil
Table 7-7 Refined Assessment of Ecological Contaminants of Potential Concern in Groundwater

LIST OF FIGURES

Figure 1-1 SWMU Location at MCB Camp Lejeune
Figure 1-2 Phase II Confirmatory Investigation Constituents exceeding Screening Criteria in Soil

LIST OF FIGURES
(continued)

Figure 1-3	Phase II Confirmatory Investigation Constituents exceeding Screening Criteria in Groundwater
Figure 2-1	EM-31 Conductivity Map
Figure 2-2	EM-31 Inphase Map
Figure 2-3	Analytical Signal from Total Field Magnetics Map
Figure 2-4	Test Trench Location Map
Figure 2-5	Test Trench Record – SWMU 46 – TT01
Figure 2-6	Test Trench Record – SWMU 46 – TT02
Figure 2-7	Test Trench Record – SWMU 46 – TT03
Figure 2-8	Test Trench Record – SWMU 46 – TT04
Figure 2-9	Test Trench Record – SWMU 46 – TT05
Figure 2-10	Test Trench Record – SWMU 46 – TT06
Figure 2-11	Test Trench Record – SWMU 46 – TT07
Figure 2-12	Test Trench Record – SWMU 46 – TT08
Figure 2-13	Soil Boring Location Map
Figure 3-1	Surficial Aquifer Potentiometric Surface
Figure 4-1	Constituents Exceeding Screening Criteria in Soil
Figure 4-2	Constituents Exceeding Screening Criteria in Test Trenches
Figure 6-1	Flowchart of Potential Exposure Pathways and Receptors
Figure 6-2	Probability Density Function – Blood Lead Concentrations, Surface Soil
Figure 6-3	Probability Density Function – Blood Lead Concentrations, Subsurface Soil
Figure 6-4	Probability Density Function – Blood Lead Concentrations, Groundwater
Figure 7-1	Aerial View
Figure 7-2	Ecological Conceptual Model
Figure 7-3	Detections of Category 1 Ecological COPCs in Surface Soil Exceeding Screening Values
Figure 7-4	Detections of Category 1 Ecological COPCs in Groundwater Exceeding Screening Values

LIST OF APPENDICES

Appendix A	Geophysical Report
Appendix B	Test Boring and Well Construction/Development/Sampling Records
Appendix C	Chain-of-Custody Documentation
Appendix D	Technical Memorandum (Baker 1994)
Appendix E	Background Criteria Tables
Appendix F	Summary of Analytical Results
Appendix G	Risk Assessment Data Sets
Appendix H	RAGS Part D Tables
Appendix I	Statistical Summaries
Appendix J	Human Health Risk Calculation Spread Sheets
Appendix K	Checklist for Ecological Assessment
Appendix L	Groundwater Data Used in the Ecological Risk Assessment

ACRONYMS AND ABBREVIATIONS

ABS	Absorbed Fraction
AF	Adherence Factor
AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirement
A_R	Surface area of contaminated road segment
ASTM	American Society for Testing and Materials
AT	Averaging Time
AT_c	Averaging Time Carcinogens
AT_{nc}	Averaging Time Non-carcinogens
ATSDR	Agency for Toxic Substance and Disease Registry
B	Dimensionless ratio of the permeability coefficient of a compound
Baker	Baker Environmental, Inc.
bgs	below the ground surface
Base	MCB Camp Lejeune, North Carolina
BERA	Baseline ERA
BTAG	Biological Technical Assistance Group
BW	Body Weight
C	Celsius
Ca	Chemical Concentration in Air as Fugitive Dust
Cs	Chemical Concentration in Soil
Cw	Chemical Concentration in Water
$CaCO_3/L$	Calcium Carbonate per Liter
CCME	Canadian Council of Ministers of the Environment
CDI	Chronic Daily Intake
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CF	Conversion Factor
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
CNO	Chief of Naval Operations
COC	Chain-of-Custody
COPCs	Chemicals of Potential Concern
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
DA_{event}	Absorbed dose per event
DAD	Dermally-Absorbed Dose
DoN	Department of the Navy
DOT	United States Department of Transportation
ED	Exposure Duration

ACRONYMS AND ABBREVIATIONS
(continued)

EF	Exposure Frequency
EnSafe	Environmental Safety and Designs, Inc.
ERA	Ecological Risk Assessment
ET	Exposure Time
ft/d	feet per day
FA	Fraction Absorbed
F_D	dispersion correction factor (unitless)
FI	Fraction of soil ingested from the source
gpm	Gallons Per Minute
gpd	Gallons Per Day
GPS	Global Positioning System
GPR	Ground Penetrating Radar
HA	Health Advisories
HEAST	Health Effects Assessment Summary Table
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
HSWA	Hazardous and Solid Waste Amendments
ID	Inside Diameter
ILCR	Incremental Lifetime Cancer Risk
IDW	Investigation Derived Waste
IEUBK	Integrated Exposure Uptake Biokinetic
IMAC	Interim Maximum Allowable Concentrations
IR	Installation Restoration
IR	Ingestion Rate
IRIS	Integrated Risk Information System
J	Estimated Result (data qualifier)
K_d	Distribution Coefficient for the Solute within the soil
K_{oc}	Organic Carbon Adsorption Coefficient
K_{ow}	Octanol/Water Partition Coefficient
K_p	Dermal permeability coefficient of compound in water
kg	kilograms
2L Standards	North Carolina Water Quality Standards for Groundwater
MCAS	Marine Corps Air Station
MCB	Marine Corps Base
MCL	Maximum Contaminant Level
MCLGs	Maximum Contaminant Levels Goals
MDL	Maximum Detection Limit
mg	milligrams
mg/kg	milligrams per kilogram

ACRONYMS AND ABBREVIATIONS
(continued)

mg/kg/day	milligrams per kilogram per day
MHSPE	Ministry of Housing, Spatial Planning and Environment
MI	Mobility Index
MS/MSD	Matrix Spike/Matrix Spike Duplicate
msl	Mean Sea Level
n	number of samples
NAPL	Non-aqueous phase liquid
NAWQC	National Ambient Water Quality Criterion
NCAC	North Carolina Administrative Code
NCP	National Contingency Plan
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
NPL	National Priorities List
OEPA	Ohio Environmental Protection Agency
OLM	EPA Contracted Methods for Contract Laboratory Protocols - Organics
OSWER	Office of Solid Waste and Emergency Response
p	number of days with at least 0.01 inches of precipitation (days/year)
PE	Polyethylene
PEF	Particulate Emission Factor
PID	Photo Ionization Detector
PRGs	Preliminary Remediation Goals
PVC	Polyvinyl Chloride
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
Q/C_{sr}	Inverse of 1-h average air concentration along a straight road segment bisecting a 0.69 acre square site
R	rejected (data qualifier)
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
RFI	RCRA Facility Investigation
RME	Reasonable Maximum Exposure
RPD	Relative Percent Difference
RR	Respiration Rate
S	Water Solubility
SA	Surface Area

ACRONYMS AND ABBREVIATIONS
(continued)

SLERA	Screening Level Ecological Risk Assessment
SOP	Standard Operating Procedure
SQL	Sample Quantitation Level
SSSV	Surface Soil Screening Value
STGCs	Soil-to-Groundwater concentrations
S.U.	Standard Units
SVOCs	Semi-Volatile Organic Compounds
SWMUs	Solid Waste Management Units
SWSV	Surface Water Screening Value
t^*	Time to reach steady state
τ_{event}	Lag time per event
t_{event}	Duration of the event
T	Total time over which construction occurs (s)
TAL	Target Analyte List
TCL	Target Compound List
TSD	Treatment, Storage, and Disposal (Facility)
the Base	Marine Corps base Camp Lejeune
the SWMU	Solid Waste Management Unit 46
TOC	Total Organic Carbon
U	Not Detected (data qualifier)
UJ	Estimated, Not Detected (data qualifier)
UCL	Upper Confidence Limit
ug/L	micrograms per Liter
USGS	United States Geological Survey
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOCs	Volatile Organic Compounds
VKT	Vehicle Kilometers Traveled
VP	Vapor Pressure
W	Mean vehicle weight
WQPs	Water Quality Parameters
ug/L	micrograms per Liter
ug/dl	micrograms per deciliter

EXECUTIVE SUMMARY

This document presents the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report for Solid Waste Management Unit (SWMU) 46 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 46 (if any) based on risk to human health and the environment.

The field program was conducted in conjunction with three other SWMUs (SWMU 261/297, 269 and SWMU 303/318) and initiated in March 2004 and completed in April 2004. The field program consisted of a geophysical survey, soil borings, collection of surface and subsurface soil samples, and installation of a permanent monitoring well. Samples were submitted to a fixed-base laboratory and analyzed for Volatile Organic Compounds (VOCs), Semi-volatile Organic Compounds (SVOCs), pesticides and metals.

Constituent concentrations in surface and subsurface soil are compared to four criteria; United States Environmental Protection Agency (USEPA) Region IX Soil Preliminary Remediation Goals (PRGs), North Carolina Soil-to-Groundwater values (STGCs), AOC 3 background, and Base background concentrations. Constituent concentrations in groundwater are compared to three criteria; North Carolina Groundwater Quality Standards (2L Standards), USEPA Region IX Tap Water PRGs, and base-wide background concentrations.

To facilitate a comprehensive understanding of the nature and extent of contamination at the SWMU, data from this RFI was supplemented with the data from the Phase I and Phase II CSIs, which include volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, and RCRA metals. Samples collected under the Phase I and Phase II CSIs showed elevated concentrations of arsenic, cadmium, chromium, mercury, lead, and silver in the surface and subsurface soils at SWMU 46.

Based on the results of these investigations (Phase I CSI, Phase II CSI, and RFI), two different portions of the site have been identified as areas of potential concern. These two areas include the soil mounds identified during the Phase I CSI and the area encompassing the old Montford Point Landfill identified during this RFI. The metals detected during the Phase I and Phase II CSIs around the old soil mounds have not been defined. Additional soil sampling during this RFI identified more metal contamination in surface and subsurface soils at the SWMU. Subsurface

soil samples collected during the test trenching in the old landfill identified SVOCs, metals and pesticide contamination.

Arsenic, barium, cadmium, chromium, mercury, lead, and silver were detected in surface and subsurface soil samples collected from the soil borings and the landfill debris at concentrations exceeding the established screening criteria. Pesticides detected at concentrations exceeding the screening criteria included 4,4'-DDD, 4,4'-DDT, alpha-chlordane, and gamma-chlordane. These pesticides were detected at higher concentrations in the subsurface soil samples collected from the landfill debris than seen in the surface soil samples. Therefore, at this time, it is suspected that the detections of these pesticides would not be from routine application processes. Additional surface soil sampling will be needed to confirm the presence and concentrations of these pesticides in surface soils. Benzo(a)anthracene was the only SVOC detected in the debris above the screening criteria at one subsurface soil sample.

The baseline Human Health Risk Assessment (HHRA) for SWMU 46 evaluated current land use scenarios for 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 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 calculated that exceeded the United States Environmental Protection Agency (USEPA) acceptable range for the future adult or young child resident. Also, the total HI for the adult resident did not exceed the USEPA's acceptable hazard level.

The total site HI for the child resident exceeded the USEPA's acceptable hazard level. Chromium was retained as a COPC in all media at SWMU 46 and its HQ exceeded 1.0 when summed over all exposure pathways. This indicates adverse health effects may occur for the future child resident receptor upon exposure to chromium in groundwater and soil investigated at SWMU 46. The maximum detected concentration of chromium in groundwater was used in the risk calculations to maintain a conservative approach. If this concentration were to be removed from the groundwater data set, the remaining chromium concentrations in groundwater would not produce an unacceptable hazard level.

There were no carcinogenic risks calculated that exceeded USEPA's acceptable range for the future construction worker. However, the total site HI for the construction worker exceeded the USEPA's acceptable hazard level. Inhalation of chromium in fugitive dusts from subsurface soil

contributed predominantly to the elevated HI. Therefore, based on the quantitative results of the baseline HHRA, adverse health effects may occur for the future construction worker receptor upon exposure to surface and subsurface soil investigated at SWMU 46.

The USEPA lead IEUBK model was used to determine if exposure to site media would result in unacceptable blood lead levels in younger children upon exposure to surface soil, subsurface soil, and groundwater at SWMU 46. The model indicated no adverse health effects resulting from exposure to surface soil. The results of the model indicate that the potential for adverse health effects from exposure to lead in subsurface soil and groundwater may occur in the future child resident. The maximum detected concentration of lead in groundwater was used in the model to maintain a conservative approach. If this concentration were to be removed from the groundwater data set, the remaining lead concentrations in groundwater would not produce unacceptable blood lead levels in the IEUBK model.

Based upon the results of the ERA, terrestrial receptors that may forage or live in the vicinity of the SWMU 46 study area may be at risk from chromium, lead, and mercury in surface soils. Chromium concentrations throughout the study area were in excess of USEPA Region IV soil screening values, indicating that unacceptable risk may be posed to terrestrial receptors. Lead and mercury concentrations on site may pose adverse effects to terrestrial flora and fauna. Potential aquatic receptors in off-site habitats are not estimated to be at unacceptable levels of risk from groundwater contamination associated with SWMU 46.

Further action at this SWMU should consist of surface and subsurface soil sampling to delineate the existing soil contamination identified in the vicinity of the soil mounds and the old landfill. Monitoring wells should be installed in and around the old landfill to assess the condition of groundwater at the SWMU.

1.0 INTRODUCTION

This report presents the investigation procedures and results of the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at Solid Waste Management Unit (SWMU) 46 (the SWMU) at Marine Corps Base (MCB) Camp Lejeune, North Carolina (the Base). The SWMU location at the Base is depicted on Figure 1-1. This report has been prepared by Baker Environmental, Inc. (Baker) under Contract Task Order (CTO) 0041 of the Department of the Navy's (DoN's) Comprehensive Long-Term Environmental Action Navy (CLEAN) Program. Baker was subcontracted to CH2M Hill for implementation of this project.

1.1 Regulatory History

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 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 at nearly 500 of these SWMUs. The findings from the RFA are presented in RCRA Facility Assessment Report for Marine Corps Base, Camp Lejeune, North Carolina (Environmental Safety and Design, Inc. [EnSafe], 1996).

The 1996 RFA Report identified 41 Installation Restoration (IR) Program 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 2003 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 these 47 SWMUs, it was recommended that 30 SWMUs required no further action, five SWMUs required interim measures, one SWMU required an RFI/interim measures, and 11 SWMUs required RFIs. The findings from the Phase I and II CSIs are presented in the Phase I Confirmatory Sampling Report (Baker, 2001) and Draft Phase II Confirmatory Sampling Report (Baker, 2002).

1.2 Site Description and History

SWMU 46, also recognized as Former IR Site 15, is the Montford Point Dump Site located inside Camp Johnson (Figure 1-1). The site was previously used to dispose sewage treatment sludge and other materials including litter, asphalt, and sand. The dumpsite was operated between 1948 and 1958. During the site visit conducted by Baker in October 1996, it was noted that a number of soil mounds were located throughout the site. During the Phase II Confirmatory Sampling Investigations (CSIs) it was believed that most of the soil mounds had been removed. Upon closer inspection during the RFI, it appears that the soil mounds still exist, however the treeline has over taken them, thus giving the appearance that they had been removed from the open field. The SWMU is presently covered with grass and surrounded by trees.

1.3 Previous Investigations

A Phase I CSI was conducted in September 1997. The purpose of the investigation was to determine if material disposed at the site during landfill operation or in the recent past has impacted surface and subsurface soils in the vicinity of the SWMU. Surface and subsurface soil samples were collected from four soil borings advanced around the portion of the SWMU where mounded material had been observed. The samples were submitted to Quanterra Laboratories and analyzed for semi-volatile organic compounds (SVOCs) and RCRA metals. The analytical results were compared to background criteria, North Carolina Department of Environmental and Natural Resources (NC DENR) soil to groundwater screening criteria and United States Environmental Protection Agency (USEPA) Region IX residential Preliminary Remediation Goals (PRGs). Based on the evaluation of the results, arsenic, lead, and cadmium exceeded the

regulatory driven criteria and established background/secondary criteria. Therefore, further investigation at SWMU 46 was recommended in the form of a Phase II CSI.

The Phase II CSI was conducted on March 23 and April 2 through 6, 2002. The purpose of the investigation was to: (1) further evaluate potential impacts to soil at the SWMU, (2) determine if groundwater had been impacted as a result of a release(s) from the SWMU, and (3) attempt to determine the boundaries and approximate depth of the old landfill. The sample locations were selected based on the results of the Phase I CSI. The field investigation included the following:

- Surface and subsurface soil sampling at six temporary well borings
- Groundwater sampling at six temporary wells
- Geophysical survey

Several metals were detected in soil at concentrations exceeding the applicable screening criteria. Metals that exceeded both the AOC and Base background screening criteria, and NC DENR soil to groundwater screening criteria and/or Region IX industrial PRGs in soils included arsenic, mercury, chromium, cadmium, lead, and silver (Figure 1-2). Lead was the only metal that exceeded the Base background screening criteria and 2L standards in groundwater (Figure 1-3).

The geophysical survey results showed a significant anomaly consistent with that of a small landfill. The anomalous response was located near the central portion of the field and trends southwest and northeast beyond the limits of the area investigated. The boundaries of the landfill to the southwest and northeast were not determined after the Phase II CSI due to the limitations of the geophysical survey.

The conclusion of Phase II CSI identified the following metals as COPCs in soil:

- Arsenic
- Mercury
- Chromium
- Cadmium
- Lead
- Silver

Lead was the only COPC identified in groundwater at the conclusion of the Phase II CSI.

1.4 Purpose/Objectives

The primary goals of this RFI were to adequately characterize SWMU 46 and determine the potential for future corrective action (if any) based on risks to human health and the environment. Specifically, the objectives of this RFI were as follows:

- Define the extent and boundaries of the old Montford Point landfill.
- Collect information to supplement and/or verify the environmental setting at the SWMU including hydrogeology, geology, hydrology, topography, aquifer characteristics, and any other man-made 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, soil, surface water and sediment in the vicinity of the SWMU. Characterization will include definition of the extent, origin, direction and rate of movement of any contamination.
- Assess the risk of site contaminants to potential receptors in the vicinity of the SWMU.
- Evaluate potential receptors by collecting data describing human populations and environmental systems susceptible to contaminant exposure.
- Provide recommendations for site management.

As this report will verify, the primary goals established for this RFI were met and provided pertinent information to determine the future corrective action at SWMU 46.

1.5 References

Baker, 2002 — Baker Environmental, Inc. Phase II - SWMU Confirmatory Sampling Report, Marine Corps Base Camp Lejeune, North Carolina. Revised

Draft. Prepared for the Naval Facilities Engineering Command, Atlantic Division, Norfolk, Virginia. April 2001.

Baker, 2001 — Baker Environmental, Inc. Phase I - SWMU Confirmatory Sampling Report, Marine Corps Base Camp Lejeune, North Carolina. Revised Final. Prepared for the Naval Facilities Engineering Command, Atlantic Division, Norfolk, Virginia. November 2001.

EnSafe, 1996 — Environmental and Safety Designs, Inc. RCRA Facility Assessment Report for Marine Corps Base Camp Lejeune, North Carolina. Final. Prepared for the Naval Facilities Engineering Command, Atlantic Division, Norfolk, Virginia. July 25, 1996

FIGURES

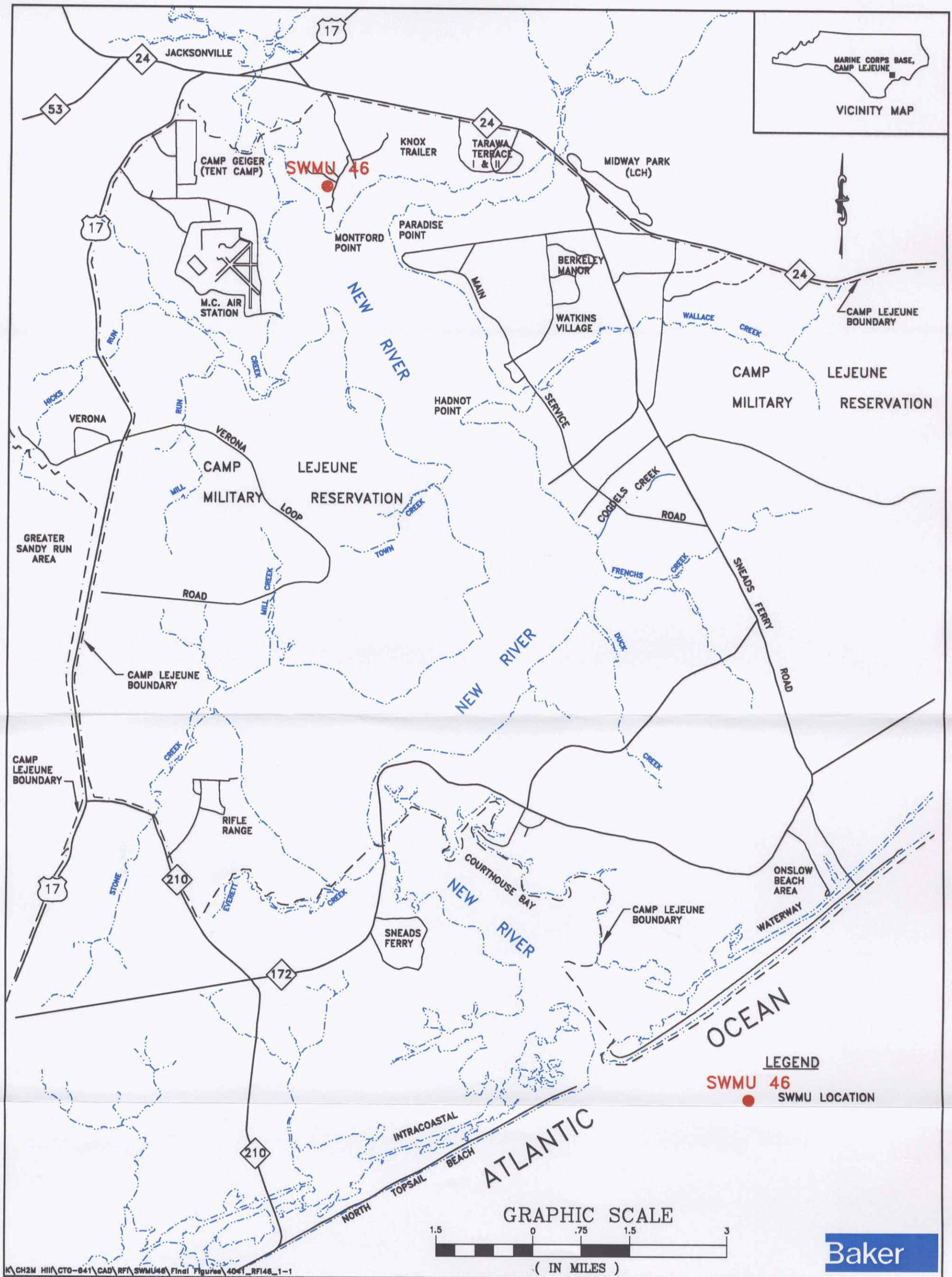
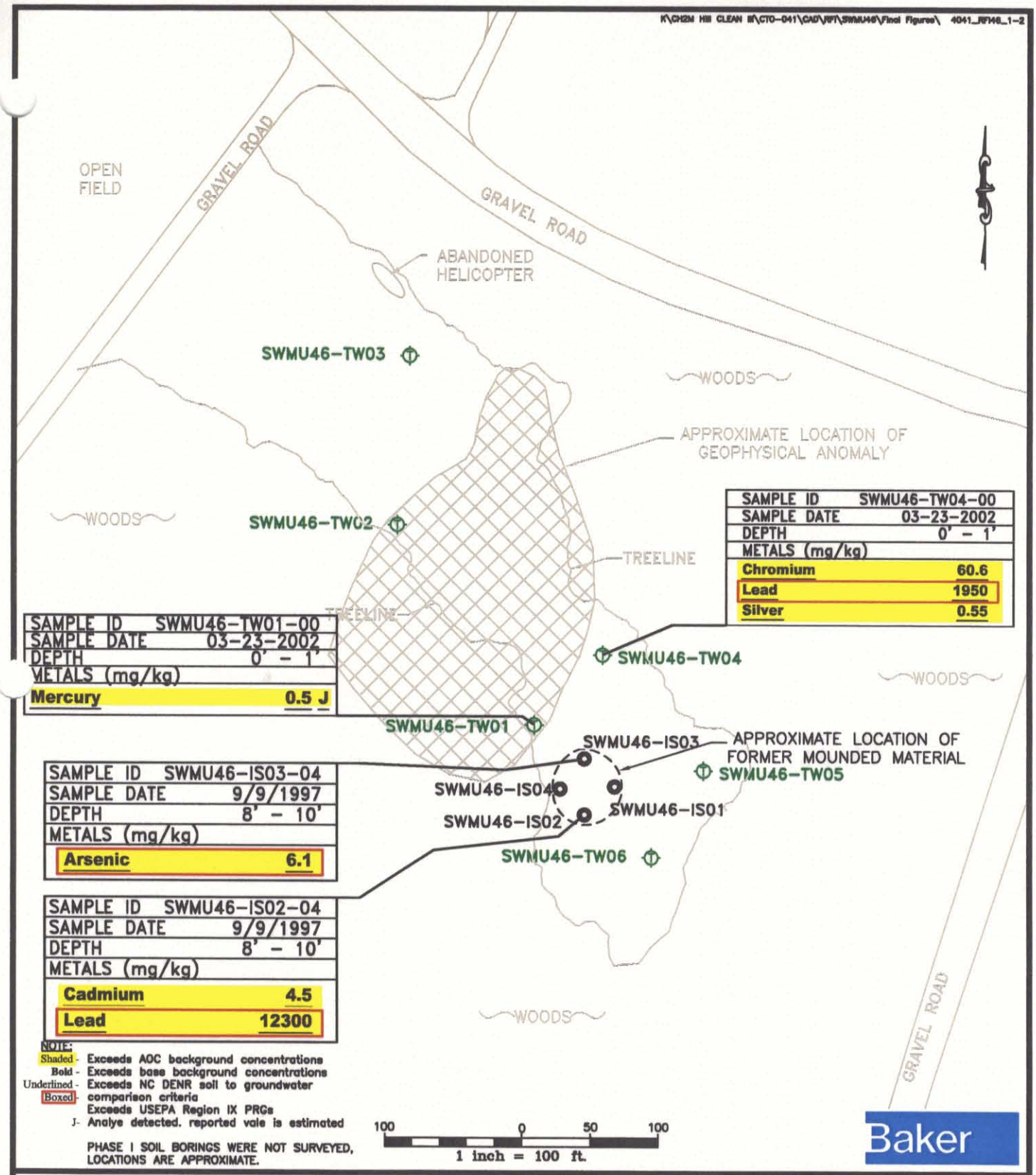


FIGURE 1-1

SWMU LOCATION AT MCB CAMP LEJEUNE
RCRA FACILITY INVESTIGATION (RFI) - SWMU 46
CTO - 0041

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

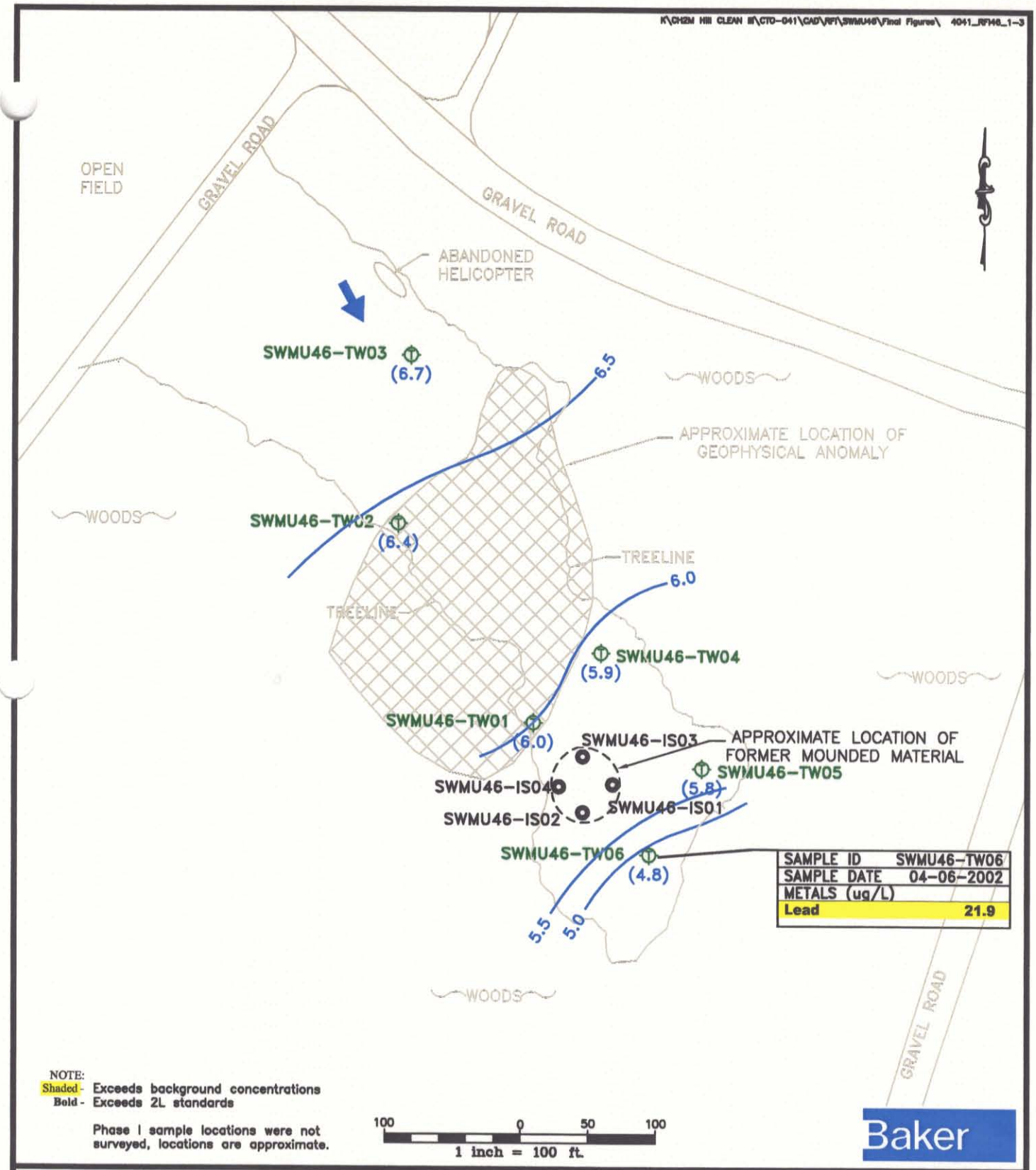


LEGEND

- TEMPORARY WELL
- PHASE I SOIL BORING
- APPROXIMATE LOCATION OF GEOPHYSICAL ANOMALY FROM PHASE II SURVEY

SOURCE: MCB CAMP LEJEUNE MARCH 2000

FIGURE 1-2
PHASE II CONFIRMATORY INVESTIGATION
CONSTITUENTS EXCEEDING SCREENING CRITERIA IN SOIL
SWMU 46
CTO-0091
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

- TEMPORARY WELL
- PHASE I SOIL BORING
- APPROXIMATE LOCATION OF GEOPHYSICAL ANOMALY FROM PHASE II SURVEY
- GROUNDWATER FLOW DIRECTION
- 6.0 — GROUNDWATER CONTOUR

SOURCE: MCB CAMP LEJEUNE MARCH 2000

FIGURE 1-3
PHASE II CONFIRMATORY INVESTIGATION CONSTITUENTS EXCEEDING SCREENING CRITERIA IN GROUNDWATER
SWMU 46
CTO-0091
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

2.0 FIELD INVESTIGATION

The field investigation for the RFI was conducted by Baker from February through April, 2004 and included the following tasks:

- Geophysical Survey
- Surface and Subsurface Soil Sampling
- Test Trenching
- Monitoring Well Installation and Development
- Groundwater Sampling
- Field Quality Assurance/Quality Control (QA/QC)
- Laboratory Analytical Program
- Investigation Derived Waste (IDW) Handling
- Site Survey

The following sections present a general overview of the investigation procedures; detailed investigation procedures are presented in the Site-Specific Work Plans for SWMUs 46, 261/297, 269, and 303/318 (Baker, 2004) and Master Project Plans (Baker, 2003) for the RCRA Program. A summary of the sampling and analytical program is presented on Table 2-1.

2.1 Geophysical Survey

Naeva Geophysics Inc., based in Charlottesville, VA conducted a surface geophysical survey at SWMU 46 on April 2 and 3, 2002 during the Phase II CSI. A 25-foot grid was established across the open field at the SWMU. The survey included an electromagnetic survey (EM), total field magnetic survey, and Ground Penetrating Radar (GPR) survey. The equipment selected for this investigation included a Geonics EM-31 DL terrain conductivity meter, Scintrex Smartmag cesium –vapor magnetometer and a Sensor and Software Pulse Ekko Ground Penetrating Radar system equipped with a 200 MHz antenna. Preliminary results were evaluated in the field and an area of anomalous response was identified with both EM and total geophysical methods. The anomalous response was located near the central portion of the field and extended southwest and northeast beyond the limits of the established grid area. As a result, additional lines were cut into the woods to the southwest and northeast. Results showed a significant anomaly consistent with that of a small landfill. This large anomaly is approximately 200 feet wide and trends southwest

and northeast beyond the limits of the area investigated. The amplitude of the results suggested a significant concentration of metals exists in the subsurface.

GPR data showed significant subsurface disturbances consistent with the horizontal limits defined by the EM and magnetic surveys. The GPR data also suggested varying concentrations of metallic debris exist within the fill area. The depth of material was not clear but may terminate shallower than approximately 10 feet.

Based on the results of the Phase II CSI geophysical survey, a supplemental survey was conducted for this RFI to expand on the existing survey and define the limits of the old landfill. The supplemental geophysical survey was conducted on March 2 through 4, 2004. The objective was to delineate the actual boundaries of the old landfill and locate positions for the test trenching activities to be conducted during this RFI.

A grid was established off of the original survey to the northeast and southwest. The expanded grid was marked at 50-foot line spacings instead of the 25-foot line spacing used during the Phase II CSI geophysical survey. The 50-foot line spacing was utilized to cover more area and help facilitate the objective of defining the landfill boundaries. One line was added to northeast and three lines to the southwest. The vegetation was very thick and clearing and grubbing activities were necessary prior to establishing the survey lines. Naeva Geophysics Inc. performed EM and magnetic surveys across the established grid. Based on preliminary field results, additional lines were needed to confirm and define the main body of the landfill. Another line was added to the northeast and also to the southwest. These results showed the extension of the landfill was defined laterally to the southeast and northwest.

Based on the final results, the boundaries of the landfill have been defined. However, isolated anomalies, soil mounds and scattered surface debris seem to exist throughout the area. The data from the two geophysical surveys were combined and are graphically presented in Figures 2-1, 2-2, and 2-3. The landfill appears to extend approximately 250 feet north/south and 375 feet east/west based on the total field magnetics seen in Figure 2-3. The geophysical report is presented as Appendix A.

2.2 Test Trenching

Based on the results from the geophysical survey, eight test trenches where positioned to confirm the landfill boundaries and anomalies, and to describe the debris within the landfill and native soils directly adjacent to the debris. Prior to any excavation activities, a utility clearance was completed at all test trench locations by Locating Contractors, Inc. of Jacksonville, North Carolina. Subsurface soil samples were collected to characterize and evaluate the debris and native soils, and determine the impact, if any, from the disposal activities at SWMU 46. The test trenches were designated as SWMU46-TT01 through SWMU46-TT08 (Figure 2-4). These trenches were excavated with a backhoe operated by Parrott Wolff, Inc. of Hillsboro, North Carolina to depths ranging from six to eight feet below ground surface (bgs).

During the trenching activities, six of the eight trenches encountered groundwater. It should be noted that groundwater was approximately five feet higher during this RFI than was observed during the Phase II CSI. The test trenches could not extend deeper than the encountered groundwater because the combination of groundwater and sandy soils caused the sidewalls of the trenches to collapse. Therefore, collecting subsurface soil samples below the deeper pockets of debris was not possible. Samples were collected adjacent to the debris in these situations. In most cases it was possible to sample native soils below the shallower debris as it pinched out towards the ground surface. Lengths of the trenches ranged from approximately 20 to 80 feet long. Seven of the eight trenches were orientated in a northwest to southeast direction. Only SWMU46-TT03 was orientated in a southwest and northeast direction. A table providing the test trench details including samples collected, depth, and orientation is presented as Table 2-2.

Two subsurface soil samples were collected from each of the test trenches except for test trench SWMU46-TT01. One sample was collected from the debris in each trench to determine if contamination exists in the landfill debris and one sample was collected from the soil beneath or adjacent to the debris to assess whether the native soils had been impacted by the debris. All of the soil samples collected from the test trenches were sent to Chemtech laboratory in Mountainside, New Jersey.

In general, the debris encountered during trenching activities at SWMU 46 consisted of miscellaneous metal debris (cable, wire, car parts, pipes, conduit, strapping and bedsprings, etc.), glass bottles, ceramic pieces, ash, and pieces of burned wood and other burned debris. Varying

concentrations of metal debris was encountered in every trench. The metal concentrations would explain the magnetic and conductive responses seen in the geophysical surveys.

Test trench SWMU46-TT01 was positioned in the middle of the estimated landfill to verify a highly conductive and magnetic anomaly found during the geophysical survey. A large metal corrugated pipe was encountered during the excavating. It is assumed that it was the reason for the anomaly seen in the geophysical survey. During the excavation of SWMU46-TT01, groundwater was encountered at a depth of 7.5 feet and prevented the field crew from excavating the trench deeper to define the total depth of the debris. Because of the positioning of the test trench (in the middle of the debris disposed in the landfill) and the fact that groundwater was encountered at a relatively shallow depth, no sample was collected from the native soils beneath or adjacent to the debris. Test trench records for all eight trenches are provided as Figures 2-5 through Figure 2-12.

As indicated in a previous paragraph, one of the goals of the test trenching was to verify the geophysical results, due to their technical limitation. The magnetic anomaly interpreted in the geophysical survey corresponded exactly with the actual boundary of the debris as seen in the trenches in most of the locations. In some cases, as in SWMU46-TT02 and SWMU46-TT06, the geophysical anomaly was larger than the actual debris boundaries seen in the trenches. The anomaly is based on the magnetic response from the concentration of ferrous iron in the debris. A higher concentration of ferrous iron would give a larger magnetic response, therefore giving a larger magnetic anomaly. However, at test trench location SWMU46-TT03, debris was found to exist outside the response seen from the magnetic survey. In this case, the actual debris found in the trench consisted of mostly glass bottles and miscellaneous burned debris, which would not be detected by the geophysical survey. However, metal debris was only found in the southern end of this trench and seemed to match up with the magnetic response.

2.3 Soil Borings

The soil investigation at SWMU 46 consisted of five soil borings in addition to the eight test trenches discussed in the previous paragraphs. These borings were advanced to determine if soils in the vicinity of the SWMU have been impacted during historic operations at this SWMU. All of the soil samples collected from the soil borings were sent to Chemtech laboratory in Mountainside, New Jersey. Prior to sampling, utility clearance was completed at all locations by Locating Contractors, Inc. of Jacksonville, North Carolina.

One surface and one subsurface soil sample was collected from each of the five soil borings. These soil borings were designated as SWMU46-SB01 through SWMU46-SB05 (Figure 2-13). 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. A four foot long Geoprobe® Macro Core sampler was continuously driven from ground surface to the water table. The sampler was driven to desired depth and pulled from the hole. The sampler was disassembled and the Geoprobe® sleeve handed to the geologist for logging. Measurements with a Photo Ionization Detector (PID) were collected every foot where possible. A small ¼-inch diameter hole was drilled into the Geoprobe® sleeve ½-foot below the top of sample and a PID measurement was recorded. This was repeated at 1-foot intervals over the length of the sample, thus providing a profile of the sample. Upon completion, the sleeve was cut open length-wise to reveal the soil profile. Samples were collected from the acetate sleeves based on the location of the highest PID reading, in areas of observable staining, and/or utilizing geological judgment. Samples collected from the soil borings were analyzed for RCRA metals. Soils were logged noting relative grain size, color, moisture, evidence of contamination, and any other relevant properties following procedures outlined in Appendix A of the Master Project Plans (Baker 2003) (SOP F101 – Borehole and Sample Logging). Discarded soil was placed in five gallon buckets and later transferred to 55-gallon drums located on-site. The sampler was decontaminated following procedures outlined in Section 2.5 and reassembled prior to use. Borings were backfilled with sodium bentonite. A summary of surface and subsurface soil samples collected is presented in Table 2-1. Test Boring Records were prepared for each soil boring and are presented in Appendix B.

During the site visit conducted on March 31, 2004, Base personnel directed Baker to collect a surface soil sample from one of the debris piles located in the northwestern area of the site. SWMU36-DP01 was collected from the debris pile on April 5, 2005. The sample was collected using a stainless steel spoon and following surface soil sample procedures outlined in the Master Project Plans (Baker 2003). The surface soil sample was analyzed for VOCs, SVOCs, pesticides and RCRA metals.

2.4 Analytical Program for Soils

All soil samples collected at the SWMU were submitted to a fixed-based laboratory for analysis. Surface and subsurface soil samples collected from the soil borings were analyzed for RCRA metals (OLMO 4.1). Subsurface soil samples collected from the test trenching activities were collected and analyzed for TCL VOCs (OLMO 4.2), TCL SVOCs (OLMO 4.2), TCL pesticides (OLMO 4.2) and RCRA metals (OLMO 4.1).

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, 2003). 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 C. Samples were shipped via Fed-Ex to Chemtech laboratory in Mountainside, New Jersey for analysis.

2.5 Groundwater Investigation

The groundwater investigation at SWMU 46 consisted of the installation of one monitoring well (SWMU46-MW01). Results from a sample collected from temporary well SWMU46-TW06 during the Phase II CSI showed lead exceeded the established screening criteria in groundwater. The actual results were suspect due to the elevated turbidity during sampling. Monitoring well SWMU46-MW01 was installed adjacent to the former location of SWMU46-TW06 to confirm and verify the existence of lead in groundwater.

The monitoring well was installed, developed, and subsequently sampled using procedures outlined in the Site-Specific Work Plans (Baker 2004) and Master Project Plans (Baker 2003). The monitoring well boring was drilled using 6 ¼-inch inside diameter (ID), hollow-stem augers and set at 16 feet bgs. SWMU46-MW01 was installed using 2-inch ID, Schedule 40, polyvinyl chloride (PVC) well casing and ten feet of 0.010-inch slot well screen. The monitoring well was completed with a watertight, locking cap and lock installed on the PVC riser and a flush mount well cover for protection. The Well construction details and water level measurements are presented in Table 2-3. The well development record is presented in Appendix B.

A groundwater sample was collected from SWMU46-MW01 using low-flow sampling procedures and analyzed for RCRA metals. The groundwater sampling field parameters are

presented in Appendix B. A quick turn around was requested for this sample to facilitate field decisions and the need for additional well installations at SWMU 46. Lead was not detected in the analytical results. Therefore, no additional wells were installed during this investigation.

2.6 Analytical Program for Groundwater Samples

One groundwater sample was collected from SWMU46-MW01 and analyzed for RCRA metals (OLMO 4.1). The groundwater sample was prepared and handled according to USEPA Region IV Standard Operating Procedures (SOPs) as outlined in the Master Project Plans (Baker, 2003). Chain-of-Custody documentation, which included information such as the sample number, date, time of sampling, and sampling party accompanied the sample to the laboratory and is provided in Appendix C. As with the soil samples, the groundwater sample was shipped via Fed-Ex to Chemtech laboratory in Mountainside, New Jersey for analysis.

2.7 Survey

The monitoring well, soil borings, test trenches and sample locations were surveyed using mapping-grade global positioning system (GPS) equipment 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. Only one monitoring well was installed during this investigation. Therefore, the groundwater elevation relative to msl is not relevant at this time. This monitoring well will be surveyed in a subsequent investigation when additional wells are installed.

2.8 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 2003). 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 will conform to accepted QA requirements.

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

- Equipment rinsate blanks – To verify that the reusable sampling equipment has not contributed to contamination of the samples.
- Field blanks – To verify that the water used in decontamination has not contributed to contamination of the samples.
- Trip blanks – To verify that the sample containers and method of sample container handling used throughout the sampling program have not contributed to contamination of the samples.
- Field duplicates - To verify the reproducibility of the laboratory results and degree of variability of reported concentrations.
- Matrix Spike/Matrix Spike Duplicates (MS/MSDs) - An MS is an aliquot of a matrix (i.e., water or soil) fortified with known quantities of specific compounds and subjected to the entire analytical procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery. An MSD is a second aliquot of the same matrix as the matrix spike that is spiked in order to determine the precision of the method.

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

2.9 Decontamination Procedures

Specific decontamination procedures are presented in the Master Project Plans (Baker 2003). These procedures were for reusable equipment. Sampling equipment used during the RFI at SWMU 46 included stainless steel spoons, Geoprobe® Macro Core acetate liners, casings, and drive shoes, PE tubing, and silicone tubing. The only reusable equipment used at SWMU 46 included the Geoprobe® Macro Core drive shoe and casing. Between samples and borings, the Geoprobe® Macro Core drive shoe and casing was decontaminated by Alquinox® and potable water wash and potable water rinse.

After the installation of the monitoring well (SWMU46-MW01), all reusable equipment including augers and bit were decontaminated by high pressure steam cleaning. This was completed at the temporary decontamination pad built at SWMU 303/318.

2.10 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 at Lot 203.

Soil cuttings were generated during direct push drilling activities. Excess soil samples were minimal and temporarily containerized in 5-gallon buckets and then transferred to DOT-approved, 55-gallon drums located onsite. The drums were clearly marked to indicate contents, the borehole from which the cuttings were removed, the date, CTO number, and the site. All soil IDW generated during RFI activities at SWMU 46 was combined into one 55-gallon drum.

Liquid IDW generated during decontamination and monitoring well development and sampling was combined into two 55-gallon drums placed onsite.

All soil and liquid IDW generated during the RFI activities at SWMU 46 was sampled and disposed of by the RAC subcontractor on the Base (Shaw Environmental, Inc.).

2.11 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 independent data validator, who then check for completeness and correctness. The data was imported into database after the validation was complete. Once in the database, the data was 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, Intergrate Incorporated™, was subcontracted for data validation. The laboratory analytical results were evaluated to assess the technical adequacy and usability of the data. The data was technically reviewed based on specifications set forth in the Naval Energy and Environmental Support Activity (NEESA) and USEPA guidance documents.

2.12 References

Baker, 2004 — Baker Environmental, Inc. Site-Specific Work Plans for SWMUs 46, 261/297, 269, and 303/318. RCRA Program, Marine Corps Base Camp Lejeune. Final. Prepared for the Naval Facilities Engineering Command, Atlantic Division, Norfolk, Virginia. January 2004.

Baker, 2003 — Baker Environmental, Inc. Master Project Plans. RCRA Program, Marine Corps Base Camp Lejeune. Draft. Prepared for the Naval Facilities Engineering Command, Atlantic Division, Norfolk, Virginia. March 2003.

TABLES

TABLE 2-1

SAMPLE SUMMARY TABLE
SWMU 46
RCRA FACILITY INVESTIGATION - CTO 0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	Date Sampled	Sample Interval (Feet)	Media		Analysis				Corresponding SWMU	Comments
			Soil	Groundwater	TCL VOCs (OLMO 4.2)	TCL SVOCs (OLMO 4.2)	TCL Pesticides (OLMO 4.2)	RCRA Metals (ILMO 4.1)		
Soil Boring Samples										
SWMU46-SB01-00	3/22/2004	0-1	X					X		
SWMU46-SB01-03	3/22/2004	5-7	X					X		
SWMU46-SB02-00	3/22/2004	0-1	X					X		
SWMU46-SB02-00 MS/MSD	3/22/2004	0-1	X					X		
SWMU46-SB02-04	3/22/2004	7-9	X					X		
SWMU46-SB03-00	3/22/2004	0-1	X					X		
SWMU46-SB03-00 D	3/22/2004	0-1	X					X		
SWMU46-SB03-02	3/22/2004	3-5	X					X		
SWMU46-SB04-00	3/22/2004	0-1	X					X		
SWMU46-SB04-02	3/22/2004	3-5	X					X		
SWMU46-SB05-00	3/22/2004	0-1	X					X		
SWMU46-SB05-04	3/22/2004	7-9	X					X		
Monitoring Well Samples										
SWMU46-MW01	3/21/2004	NA		X				X		
Surface Soil Samples										
SWMU46-DP01	4/5/2004	0-1	X		X	X	X	X		Debris Pile sample
SWMU46-DP01 D	4/5/2004	0-1	X			X		X		Debris Pile sample
Test Trench Samples										
SWMU46-TT01-01	4/1/2004	6-7	X		X	X	X	X		
SWMU46-TT02-01	4/1/2004	4-5	X		X	X	X	X		
SWMU46-TT02-02	4/1/2004	6-7	X		X	X	X	X		
SWMU46-TT03-01	4/2/2004	6	X		X	X	X	X		
SWMU46-TT03-02	4/2/2004	4-5	X		X	X	X	X		
SWMU46-TT04-01	4/2/2004	5-6	X		X	X	X	X		
SWMU46-TT04-02	4/2/2004	5-6	X		X	X	X	X		
SWMU46-TT05-01	4/5/2004	3	X		X	X	X	X		
SWMU46-TT05-02	4/5/2004	3	X		X	X	X	X		
SWMU46-TT06-01	4/5/2004	5	X		X	X	X	X		
SWMU46-TT06-02	4/5/2004	3	X		X	X	X	X		
SWMU46-TT07-01	4/5/2004	4-5	X		X	X	X	X		
SWMU46-TT07-01 D	4/5/2004	4-5	X		X	X	X	X		
SWMU46-TT07-02	4/5/2004	5-6	X		X	X	X	X		
SWMU46-TT08-01	4/2/2004	2-4	X		X	X	X	X		
SWMU46-TT08-01 MS/MSD	4/2/2004	2-4	X		X	X	X	X		
SWMU46-TT08-02	4/2/2004	5-6	X		X	X	X	X		
QA/QC Samples										
ER03	3/22/2004	NA			X	X	X	X	46, 261, 269, 318	geoprobe sleeve and shoe
ER06	4/6/2004	NA			X	X	X	X	46, 261	stainless steel spoon
FB01	3/23/2004	NA			X	X	X	X	46, 261, 269, 318	Polytank on drill rig
FB02	4/4/2004	NA			X	X	X	X	46, 261, 269, 318	MCAS source - Helocopter Washpad
FB03	4/6/2004	NA			X	X	X	X	46, 261, 269, 318	Lab grade water
TB03	3/19/2004	NA			X				46, 261, 269, 318	
TB05	4/1/2004	NA			X				46, CDV	
TB06	4/2/2004	NA			X				46	
TB07	4/5/2004	NA			X				46, 261, 269, 318	

Notes:

D = Duplicate sample

ER = Equipment rinseate sample

FB = Field blank sample

TB = Trip blank sample

MS/MSD = Matrix spike/matrix spike duplicate sample

TABLE 2-2

TEST TRENCH DETAILS
SWMU 46
RCRA FACILITY INVESTIGATION - CTO-0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

Test Trench Designation	Sample Designation	Debris/Native Soils	Depth of Samples		Sample Collection [2]	Approximate Total Trench Depth	Was water encountered in trench?	Test Trench Orientation
			FROM	TO				
SWMU46-TT01	SWMU46-TT01-01	Debris	6	7		8	yes	NW-SE
SWMU46-TT02	SWMU46-TT02-01	Native Soils	4	5	adjacent	8	yes	NW-SE
	SWMU46-TT02-02	Debris	6	7				
SWMU46-TT03	SWMU46-TT03-01	Native Soils	6 [1]	-	below/adjacent	8	no	SW-NE
	SWMU46-TT03-02	Debris	4	5				
SWMU46-TT04	SWMU46-TT04-01	Debris	5	6		6	yes	NW-SE
	SWMU46-TT04-02	Native Soils	5	6	adjacent			
SWMU46-TT05	SWMU46-TT05-01	Native Soils	3 [1]	-	below/adjacent	7	yes	NW-SE
	SWMU46-TT05-02	Debris	3 [1]	-				
SWMU46-TT06	SWMU46-TT06-01	Native Soils	5 [1]	-	below/adjacent	6 to 7	yes, flowing	NW-SE
	SWMU46-TT06-02	Debris	3 [1]	-				
SWMU46-TT07	SWMU46-TT07-01	Debris	4	5		6 to 7	yes	NW-SE
	SWMU46-TT07-02	Native Soils	5	6	below/adjacent			
SWMU46-TT08	SWMU46-TT08-01	Debris	2	4		8	no	NW-SE
	SWMU46-TT08-02	Native Soils	5	6	below			

Notes:

[1] Depth from which sample was collected.

[2] Sample Collection refers to the location of the collected sample in reference to the debris.

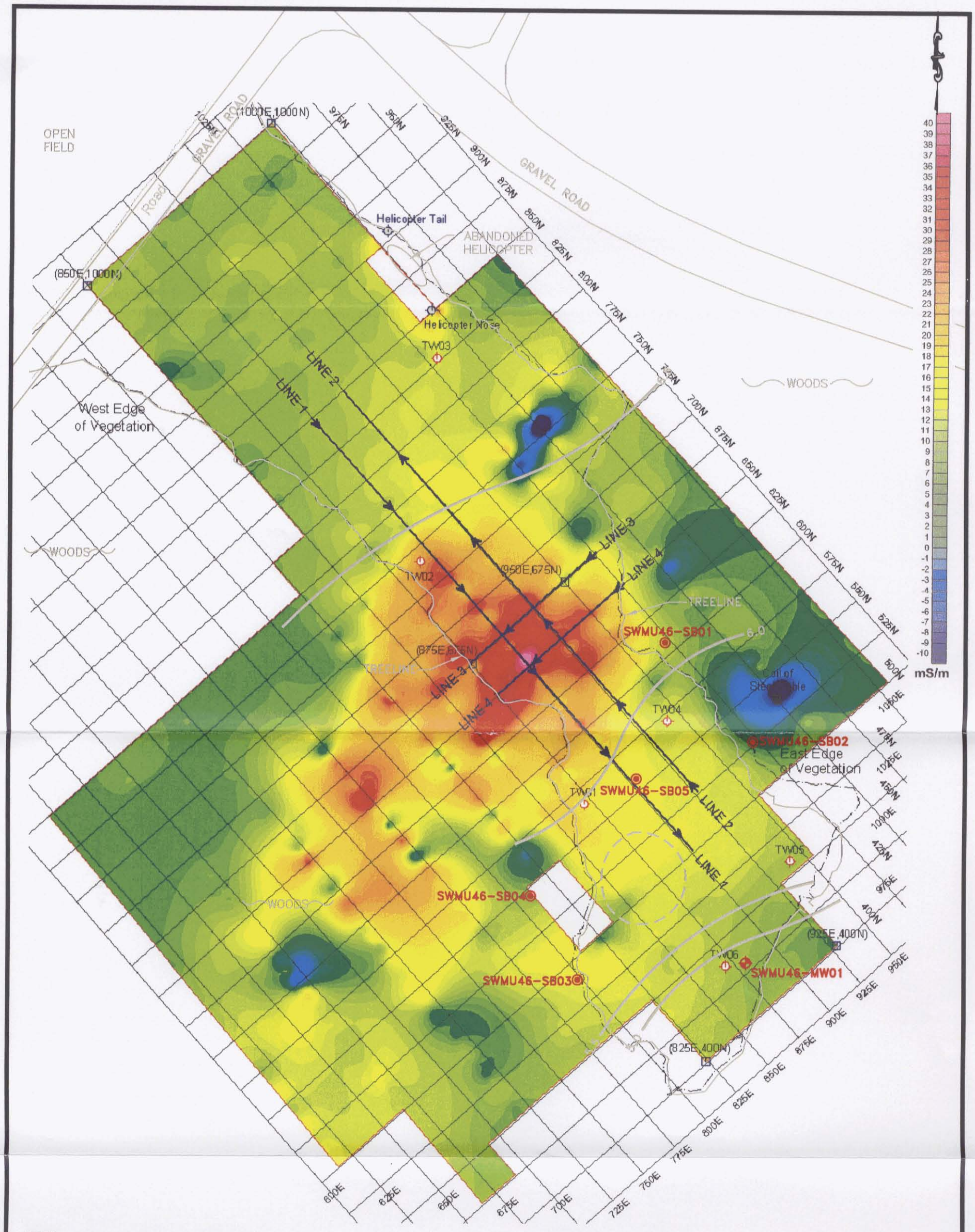
TABLE 2-3

MONITORING WELL CONSTRUCTION DETAILS
SWMU 46
RCRA FACILITY INVESTIGATION - CTO-0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

Well Identification	Date Installed	Consultant Supervising Well Installation	Top of PVC Casing Elevation (feet, above msl)	Ground Surface Elevation (feet, above msl)	Boring Depth (feet, bgs)	Well Depth (feet, bgs)	Depth to Sand Pack (feet, bgs)	Depth to Bentonite (feet, bgs)	Screen Interval Depth (feet, bgs)	Depth to Groundwater (feet, below top of casing)	Groundwater Elevation (feet, bgs)
SWMU46-TW01	3/23/2002	BAKER	17.57	17.4	17	17	5	3	7	11.6	6.0
SWMU46-TW02	3/23/2002	BAKER	17.39	17.1	16	16	4	2	6	11	6.4
SWMU46-TW03	3/23/2002	BAKER	18.06	17.8	17	17	5	3	7	11.33	6.7
SWMU46-TW04	3/23/2002	BAKER	17.22	16.9	17	17	5	3	7	11.28	5.9
SWMU46-TW05	3/23/2002	BAKER	16.46	16.1	16	16	4	2	6	10.62	5.8
SWMU46-TW06	3/23/2002	BAKER	15.12	14.6	16	16	4	2	6	10.32	4.8
SWMU46-MW01	3/18/2004	BAKER	NS	NS	12	16	4	1	6	4.74	NS

Notes:
msl - meas sea level
bgs - below ground surface
PVC - polyvinyl chloride
NA - Not Applicable
NS - Not Surveyed

FIGURES



NOTE:
PLEASE SEE COMPLETE GEOPHYSICAL REPORT IN APPENDIX A (NAEVA GEOPHYSICS INC.) FOR ADDITIONAL INFORMATION.

K\CH2M HILL CLEAN II\CTO-041\CAD\RFI\SWMU46\Final Figures\ 4041_RFI46_2-1

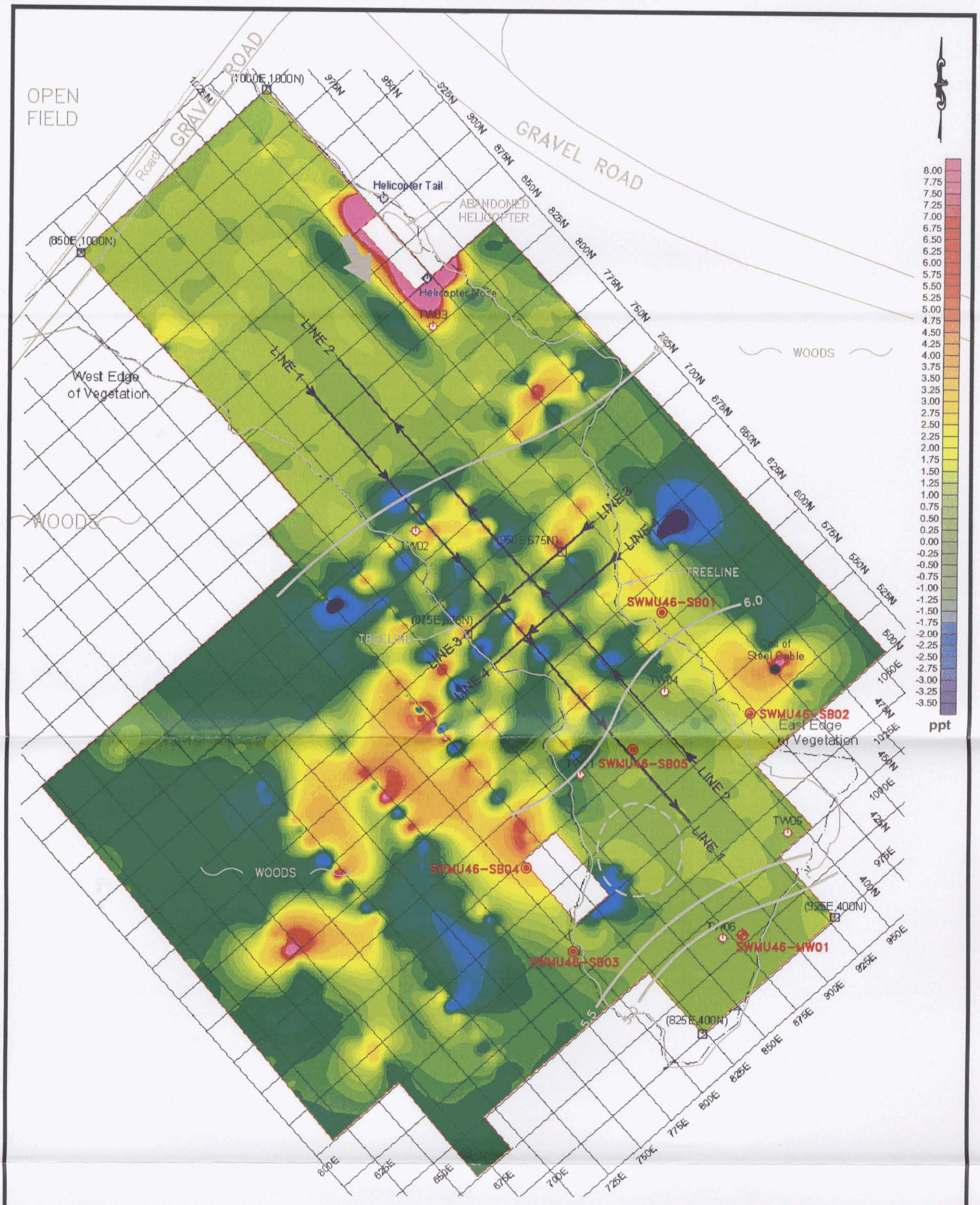
60 0 30 60
1 inch = 60 ft.

Baker

LEGEND
- SOIL BORING SAMPLE LACATION
- MONITORING WELL SAMPLE LOCATION
- GPR GEOPHYSICAL LINES

FIGURE 2-1
EM31 CONDUCTIVITY
SWMU 46
CTO-0041

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



NOTE:
PLEASE SEE COMPLETE GEOPHYSICAL REPORT IN APPENDIX A (NAEVA GEOPHYSICS INC.) FOR ADDITIONAL INFORMATION.

K\CH2M HILL CLEAN II\CTO-041\CAD\RFI\SWMU46\Final Figures\ 4041_RFI46_2-2

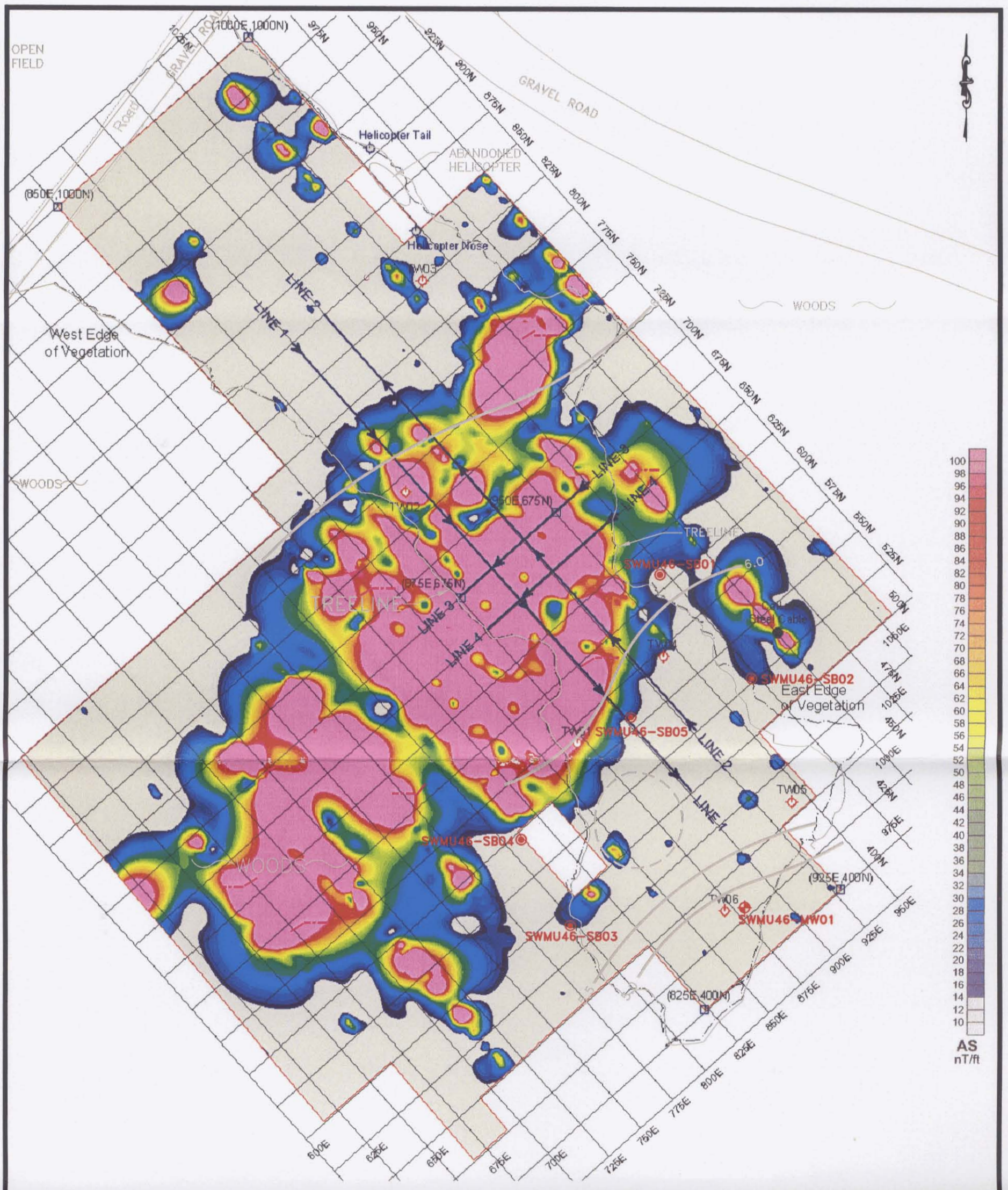
60 0 30 60
1 inch = 60 ft.

Baker

LEGEND
- SOIL BORING SAMPLE LACATION
- MONITORING WELL SAMPLE LOCATION
- GPR GEOPHYSICAL LINES

FIGURE 2-2
EM31 INPHASE MAP
SWMU 46
CTO-0041

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



NOTE:
PLEASE SEE COMPLETE GEOPHYSICAL REPORT IN APPENDIX A (NAEVA GEOPHYSICS INC.) FOR ADDITIONAL INFORMATION.

K:\CH2M Hill CLEAN III\CTO-041\CAD\RFI\SWMU46\Final Figures\4041_RFI46_2-3

60 0 30 60
1 inch = 60 ft.

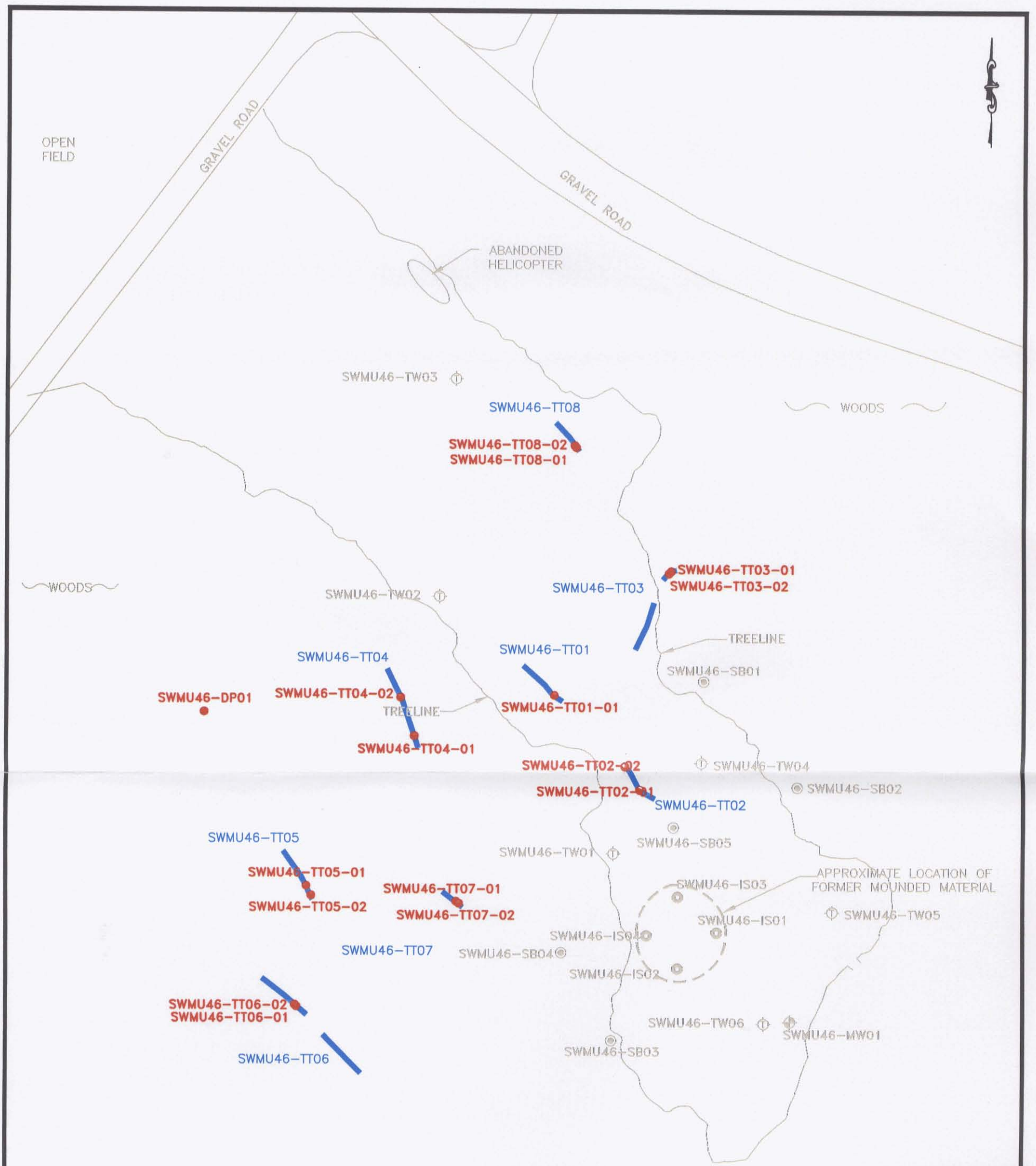
Baker

LEGEND
- SOIL BORING SAMPLE LACATION
- MONITORING WELL SAMPLE LOCATION
- GPR GEOPHYSICAL LINES

FIGURE 2-3

ANALYTIC SIGNAL FROM TOTAL FIELD MAGNETICS
SWMU 46
CTO-0041

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



60 0 30 60

1 inch = 60 ft.

Baker

K\CH2M HILL CLEAN III\CTO-041\CAD\RFI\SWMU46\Final Figures\4041_RFI46_2-4

LEGEND

SWMU46-TT07-01 – TEST TRENCH SAMPLE LOCATION

SWMU46-TT06 – TEST TRENCH LOCATION

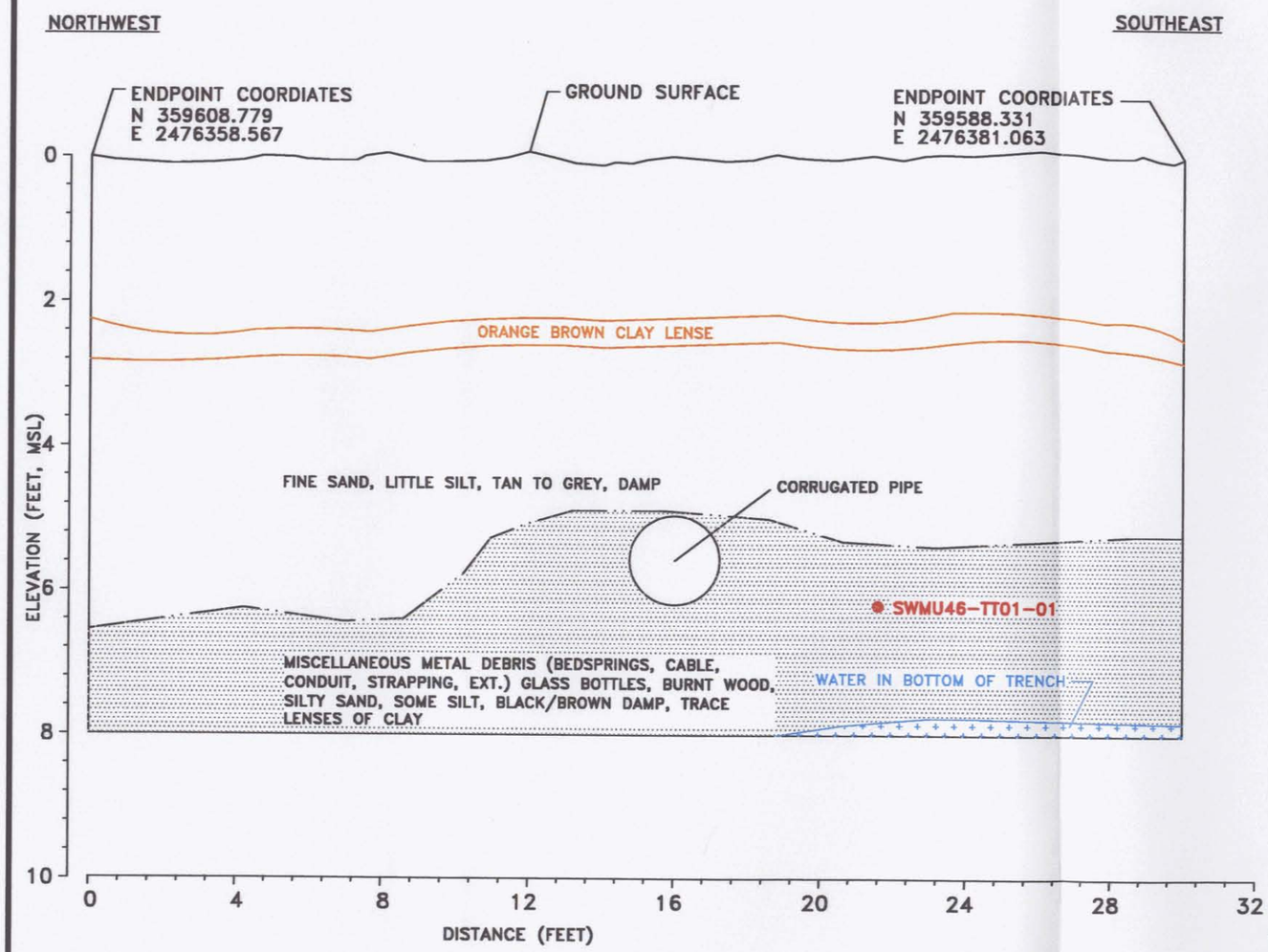
FIGURE 2-4

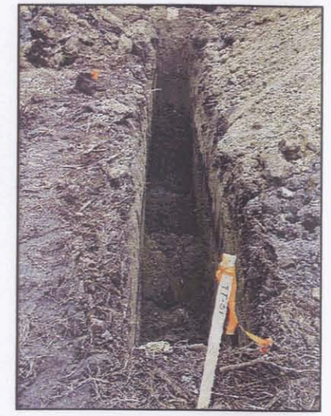
TEST TRENCH LOCATION MAP
SWMU 46
CTO-0041

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

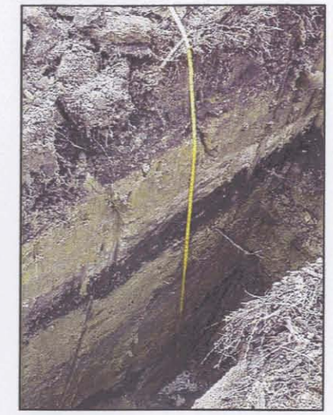
K:\CH2M HILL CLEAN II\CTO-041\CAD\RFI\SWMU46\Final Figures\4041_RFI46_2-5

TEST TRENCH CROSS SECTION



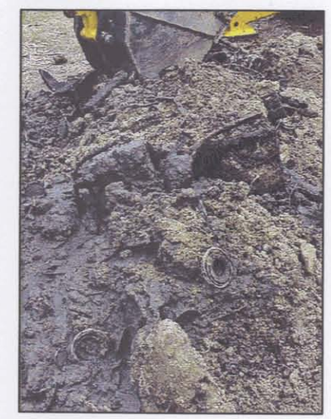


VIEW LOOKING: NORTHEAST



VIEW LOOKING: NORTHWEST

DEBRIS FROM SOUTHEAST END
(Conduit, Cable, Glass, etc.)



DEBRIS FROM SOUTHEAST END
(Metal pieces, bedsprings, etc.)

2 0 1 2
1 inch = 2 ft.
VERTICAL SCALE

4 0 2 4
1 inch = 4 ft.
HORIZONTAL SCALE

Baker

DATE: 4/01/04
CONTRACTOR: Parratt Wolff, Inc.
EQUIPMENT: Backhoe, JVC
BAKER REPRESENTATIVE: Robert Sok, P.G.
WEATHER: Partly cloudy, ~72 F
VIEW LOOKING: northeast

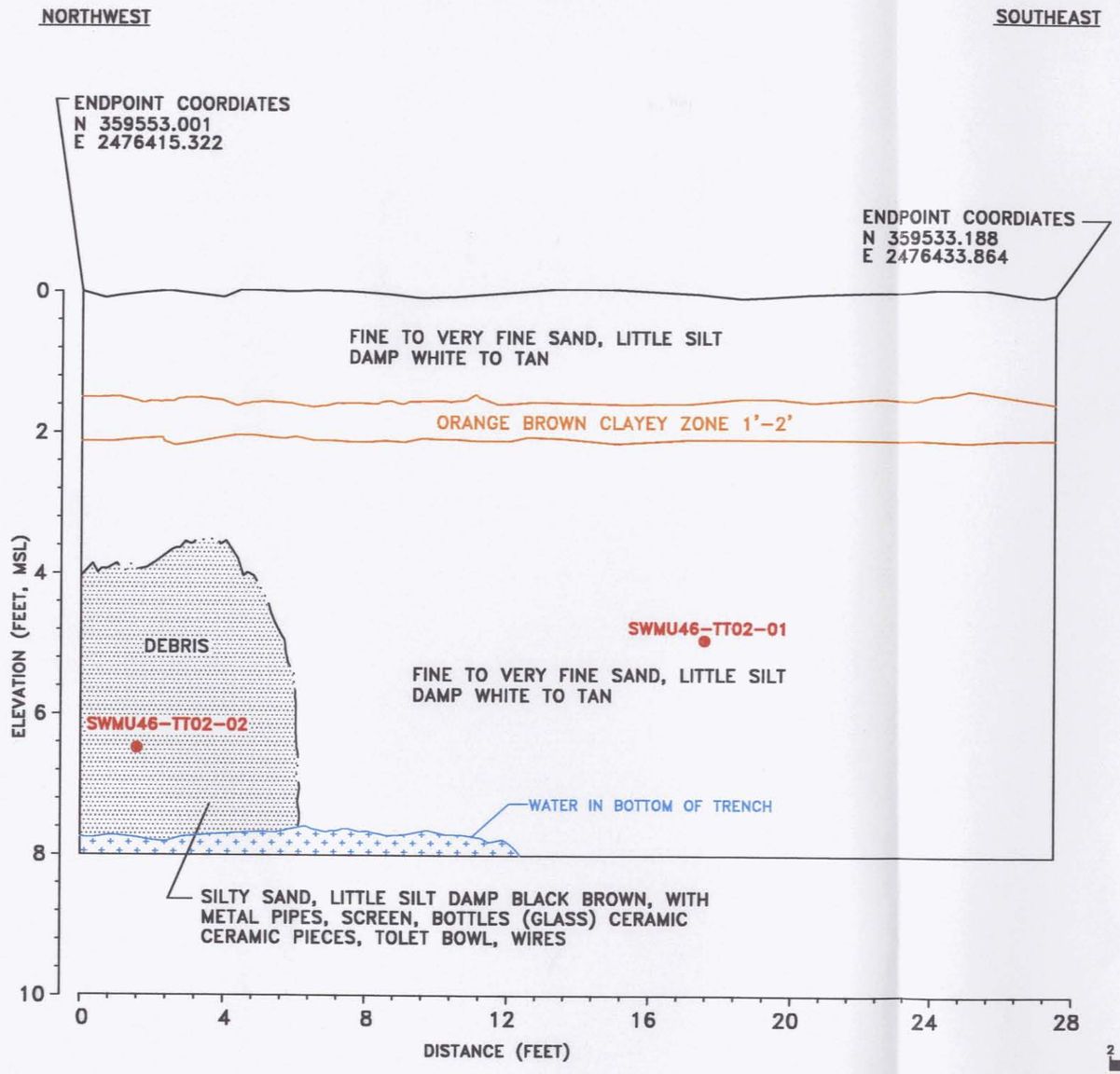
LEGEND

SWMU46-TT02-01
● – TEST TRENCH SAMPLE
– APPROXIMATE DEBRIS BOUNDARY
– DEBRIS
– WATER

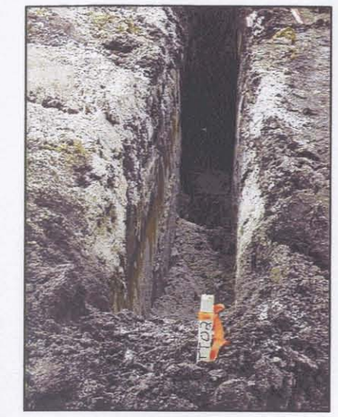
FIGURE 2-5
TEST TRENCH RECORD
SWMU46-TT01
CTO-0041
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

TEST TRENCH CROSS SECTION

K:\CH2M HILL CLEAN III\CTO-041\CAD\RFI\SWMU46\Final Figures\4041_RF146_2-6



VIEW LOOKING: SOUTHEAST/DEBRIS PILE
(ceramic pieces, metal pipes, etc.)



VIEW LOOKING: NORTHWEST

DEBRIS FROM THE NORTHWEST END OF TRENCH
(glass bottles, wire, misc. metal, etc.)

VIEW LOOKING: SOUTHEAST

2 0 1 2
1 inch = 2 ft.
VERTICAL SCALE

4 0 2 4
1 inch = 4 ft.
HORIZONTAL SCALE

Baker

DATE: 4/01/04
CONTRACTOR: Parratt Wolff, Inc.
EQUIPMENT: Backhoe, JVC
BAKER REPRESENTATIVE: Robert Sok, P.G.
WEATHER: Partly cloudy, ~72 F
VIEW LOOKING: northeast

LEGEND

SWMU46-TT02-02
● - TEST TRENCH SAMPLE
—·—·— APPROXIMATE DEBRIS BOUNDARY
▒ - DEBRIS

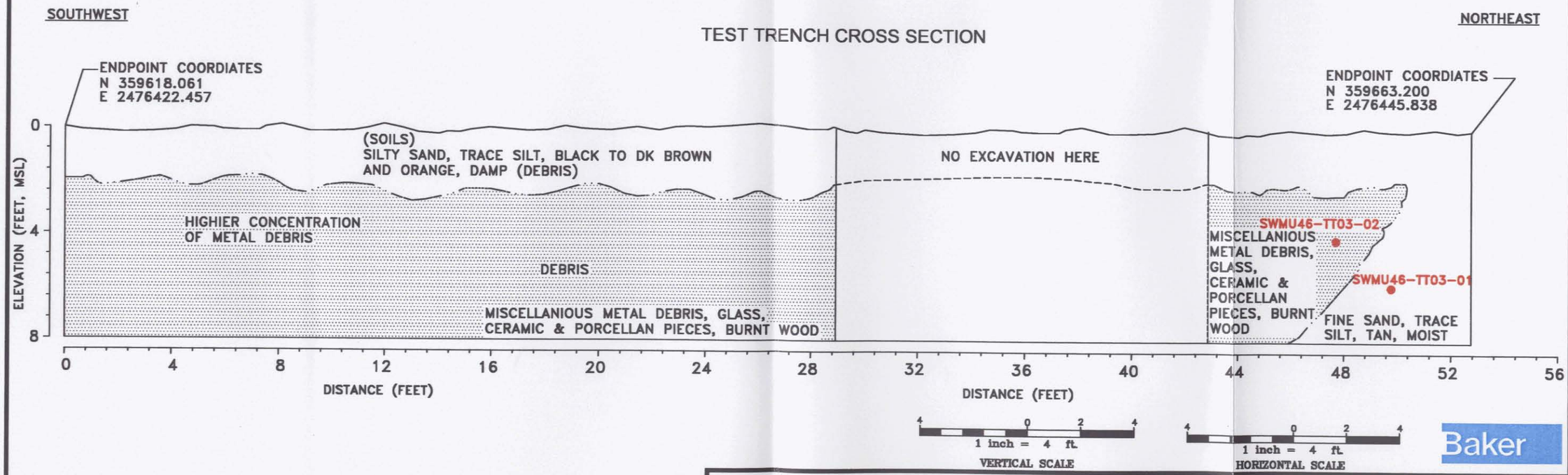
FIGURE 2-6
TEST TRENCH RECORD
SWMU46-TT02
CTO-0041
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

VIEW LOOKING: NORTHEAST

VIEW LOOKING: SOUTHWEST

DEBRIS PILE (glass bottles and misc. metal pieces, etc.)

TEST TRENCH CROSS SECTION



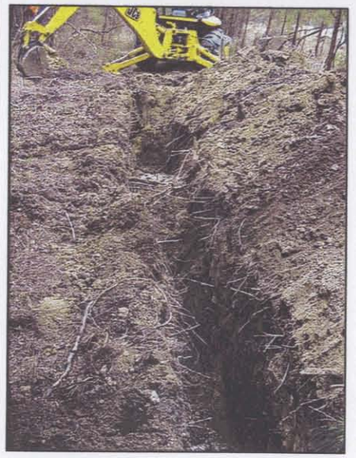
Baker

DATE: 4/01/04 AND 4/02/04
CONTRACTOR: Parratt Wolff, Inc.
EQUIPMENT: Backhoe, JVC
BAKER REPRESENTATIVE: Robert Sok, P.G.
WEATHER: Partly cloudy, ~72 F
VIEW LOOKING: northwest

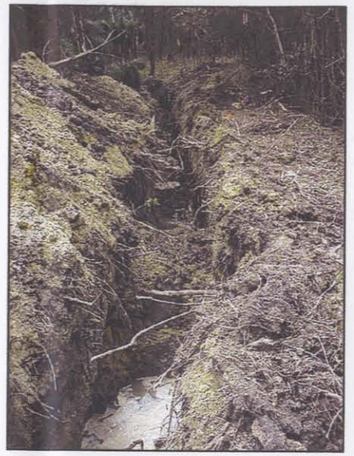
LEGEND

SWMU46-TT03-02 ● – TEST TRENCH SAMPLE
– APPROXIMATE DEBRIS BOUNDARY
– DEBRIS

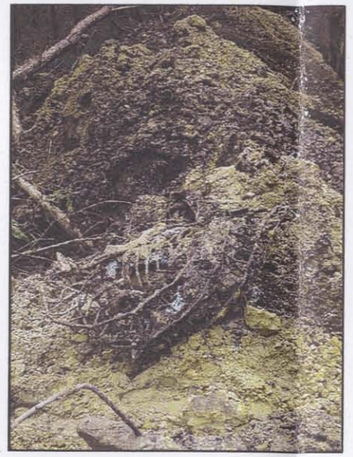
FIGURE 2-7
TEST TRENCH RECORD
SWMU46-TT03
CTO-0041
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



VIEW LOOKING: NORTHWEST

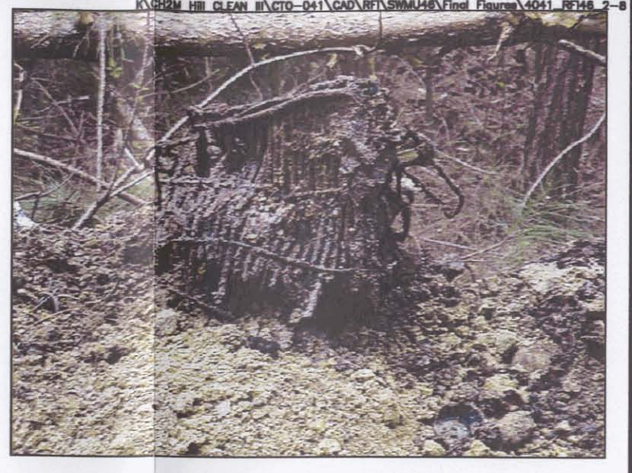


VIEW LOOKING: SOUTHEAST



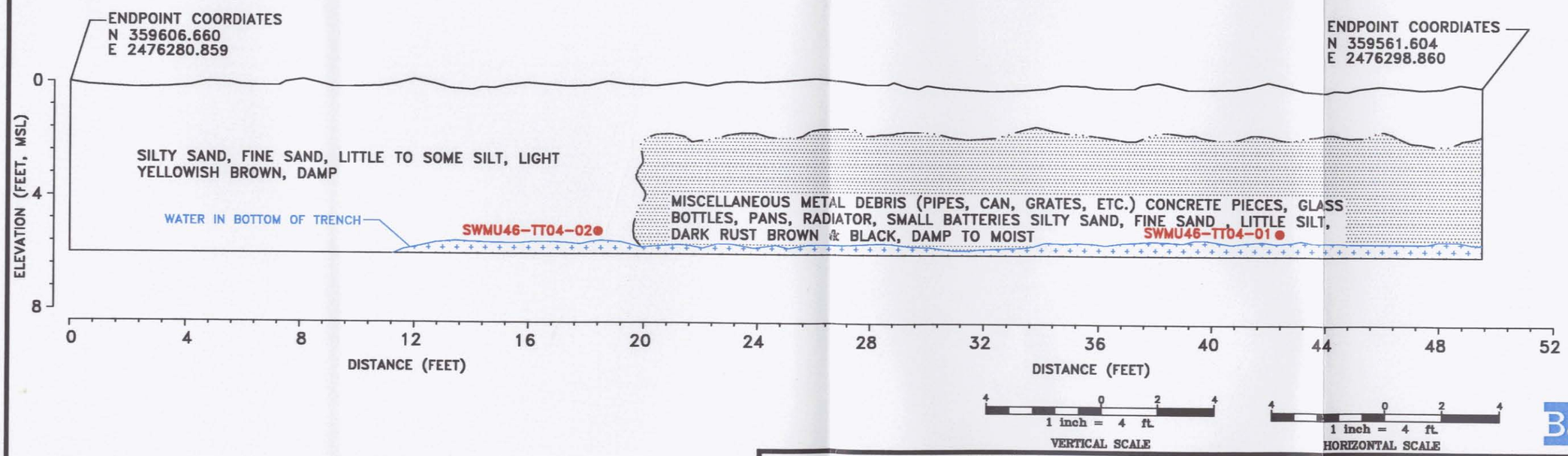
METAL DEBRIS

VIEW LOOKING: SOUTHEAST



LARGE PIECE OF METAL DEBRIS (radiator)

TEST TRENCH CROSS SECTION



Baker

DATE: 4/02/04
CONTRACTOR: Parratt Wolff, Inc.
EQUIPMENT: Backhoe, JVC
BAKER REPRESENTATIVE: Robert Sok, P.G.
WEATHER: Partly cloudy, ~74 F
VIEW LOOKING: northeast

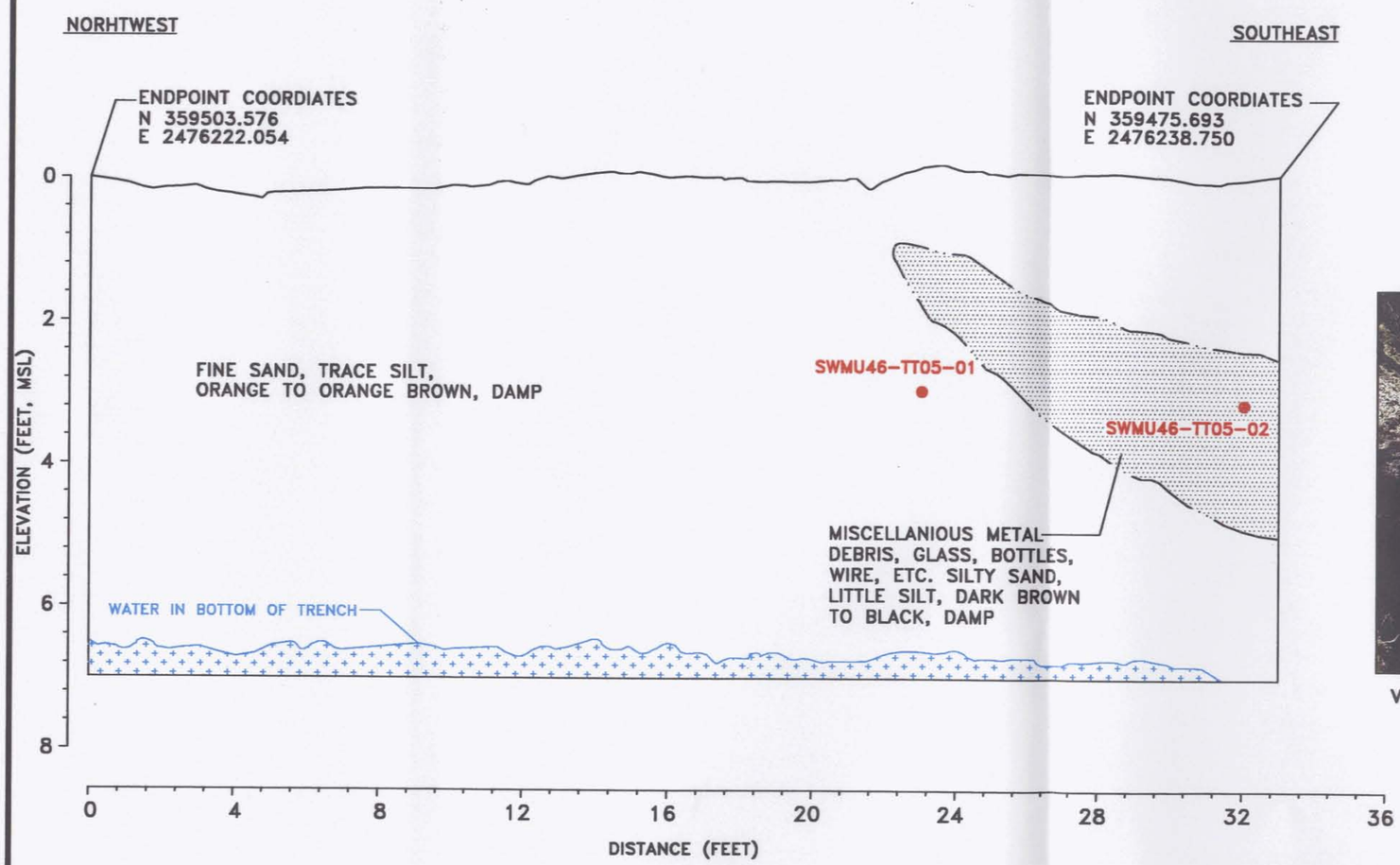
LEGEND

SWMU46-TT04-01
● – TEST TRENCH SAMPLE
—·—·— APPROXIMATE DEBRIS BOUNDARY
▒ – DEBRIS

FIGURE 2-8
TEST TRENCH RECORD
SWMU46-TT04
CTO-0041
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

K:\CH2M HILL CLEAN III\CTO-041\CAD\RFI\SWMU46\Final Figures\4041_RFI46_2-9

TEST TRENCH CROSS SECTION



DEBRIS (glass bottles, metal pieces, etc.)

VIEW LOOKING: NORTHWEST

VIEW LOOKING: SOUTHEAST

2 0 1 2
1 inch = 2 ft.
VERTICAL SCALE

4 0 2 4
1 inch = 4 ft.
HORIZONTAL SCALE

Baker

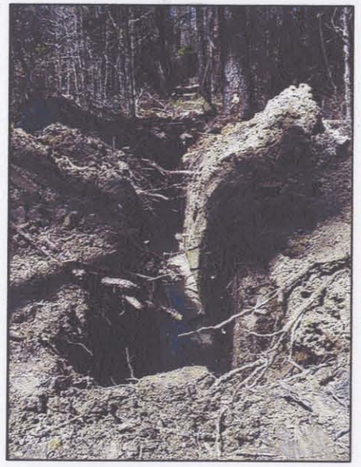
DATE: 4/05/04
CONTRACTOR: Parratt Wolff, Inc.
EQUIPMENT: Backhoe, JVC
BAKER REPRESENTATIVE: Robert Sok, P.G.
WEATHER: Partly Sunny, ~70 F
VIEW LOOKING: northeast

LEGEND

SWMU46-TT05-02
● - TEST TRENCH SAMPLE
- APPROXIMATE DEBRIS BOUNDARY
- DEBRIS
- WATER

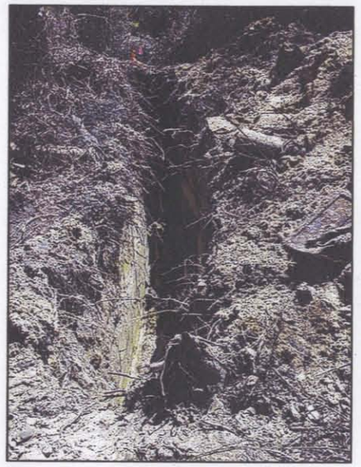
FIGURE 2-9
TEST TRENCH RECORD
SWMU46-TT05
CTO-0041
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

K:\CH2M Hill CLEAN III\CTO-041\CAD\RFI\SWMU46\Final Figures\4041_RFI46_2-10



VIEW LOOKING: NORTHWEST

NORTHWEST



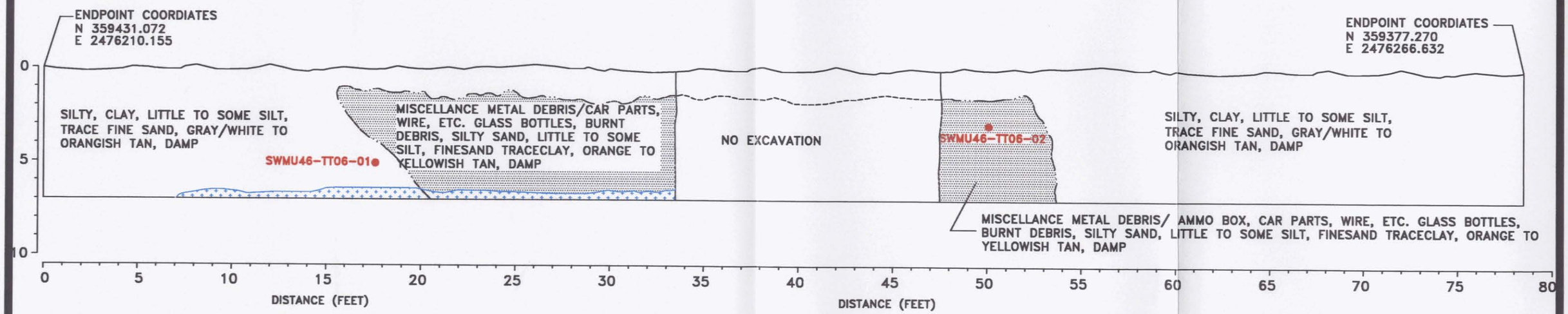
VIEW LOOKING: SOUTHEAST

DEBRIS INCLUDING VEHICLE HOOD

WATER FLOWING INTO TRENCH

SOUTHEAST

TEST TRENCH CROSS SECTION



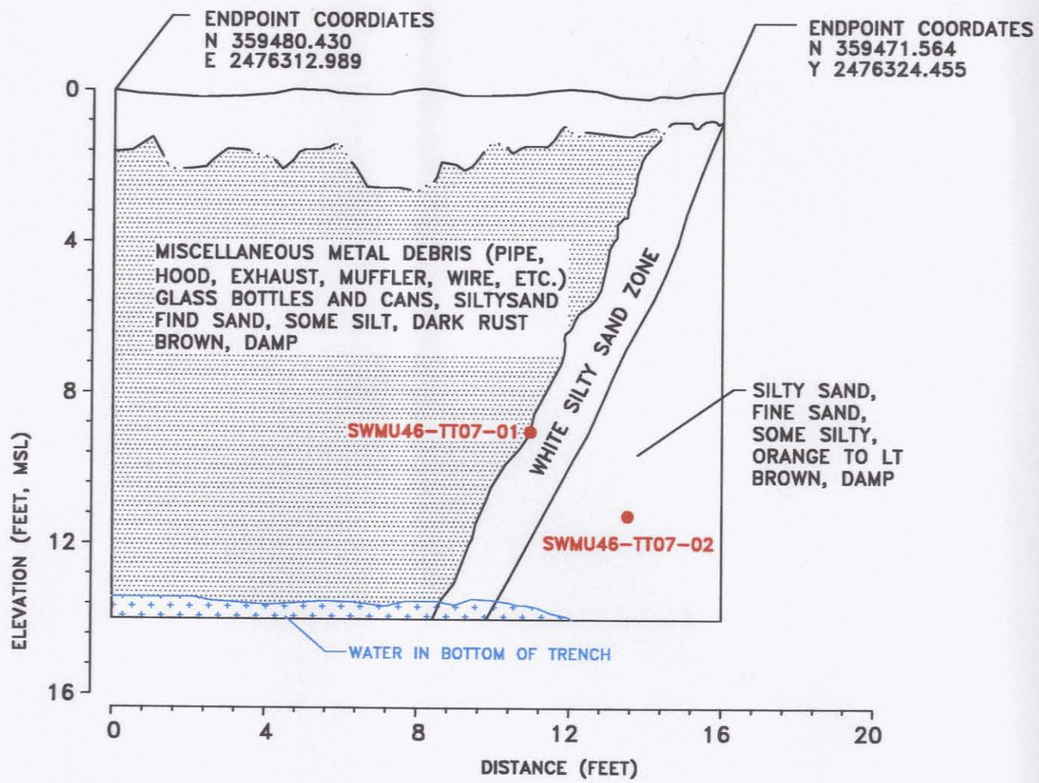
Baker

ATE: 4/05/04
ONTRACTOR: Parratt Wolff, Inc.
QUIPMENT: Backhoe, JVC
AKER REPRESENTATIVE: Robert Sok, P.G.
EATHER: Partly Sunny, ~70 F
IEW LOOKING: northeast

LEGEND

SWMU46-TT06-01
● – TEST TRENCH SAMPLE
– APPROXIMATE DEBRIS BOUNDARY
– DEBRIS

FIGURE 2-10
TEST TRENCH RECORD
SWMU46-TT06
CTO-0041
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



METAL DEBRIS AND GLASS BOTTLE

EDGE OF DEBRIS TO THE SOUTH

VIEW LOOKING: NORTHWEST AT TT07

METAL PIPES AND DEBRIS

VIEW OF DEBRIS CONTACT AND WHITE SILTY SAND ZONE

4 0 2 4
1 inch = 4 ft.
VERTICAL SCALE

4 0 2 4
1 inch = 4 ft.
HORIZONTAL SCALE

Baker

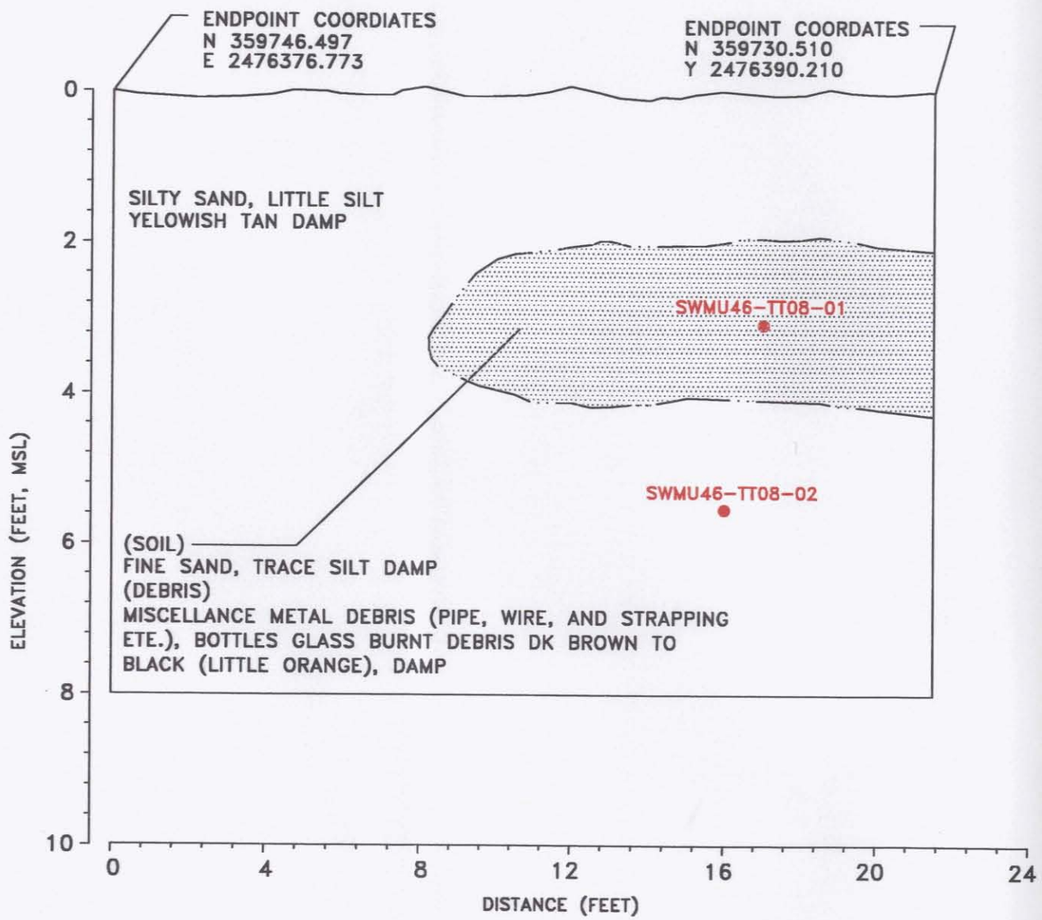
DATE: 4/05/04
CONTRACTOR: Parratt Wolff, Inc.
EQUIPMENT: Backhoe, JVC
BAKER REPRESENTATIVE: Robert Sok, P.G.
WEATHER: Partly Sunny, ~70 F
VIEW LOOKING: northeast

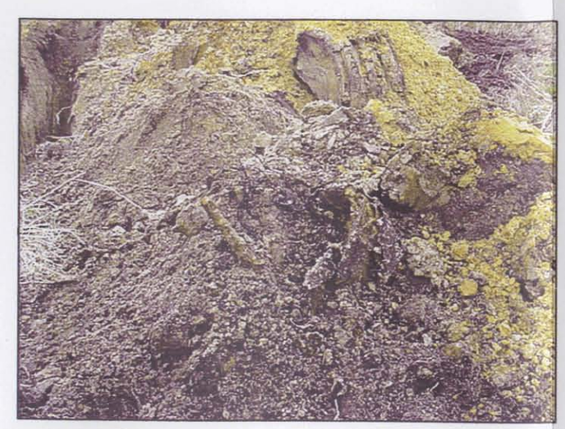
LEGEND

SWMU46-TT08-01 ● – TEST TRENCH SAMPLE
—··— – APPROXIMATE DEBRIS BOUNDARY
▒ – DEBRIS

FIGURE 2-11
TEST TRENCH RECORD
SWMU46-TT07
CTO-0041
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

TEST TRENCH CROSS SECTION

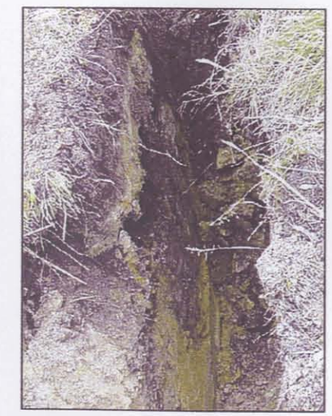




MISC. METAL DEBRIS

VIEW LOOKING: SOUTHEAST

VIEW LOOKING: NORTHWEST



VIEW SHOWING DEBRIS LENSE

2 0 1 2
1 inch = 2 ft.
VERTICAL SCALE

4 0 2 4
1 inch = 4 ft.
HORIZONTAL SCALE

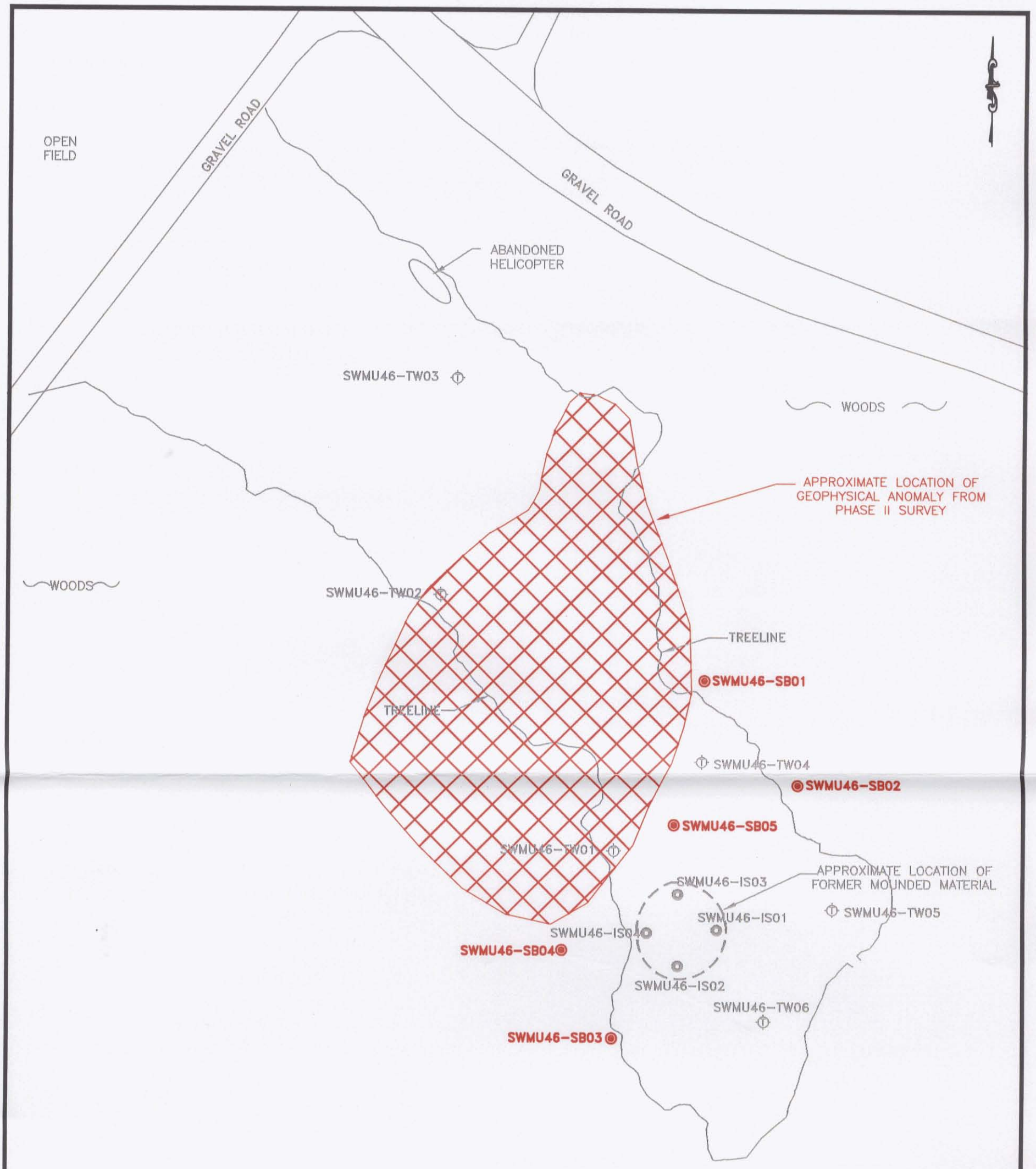
Baker

DATE: 4/02/04
CONTRACTOR: Parratt Wolff, Inc.
EQUIPMENT: Backhoe, JVC
BAKER REPRESENTATIVE: Robert Sok, P.G.
WEATHER: Partly cloudy, ~72 F
VIEW LOOKING: northeast

LEGEND

SWMU46-TT08-01
● – TEST TRENCH SAMPLE
– APPROXIMATE DEBRIS BOUNDARY
– DEBRIS

FIGURE 2-12
TEST TRENCH RECORD
SWMU46-TT08
CTO-0041
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



60 0 30 60

1 inch = 60 ft.

Baker

K:\CH2M HILL CLEAN II\CTO-041\CAD\RFI\SWMU46\Final Figures\4041_RFI46_2-13

LEGEND

- RFI SOIL BORING LOCATION
- PHASE I SOIL BORING LOCATION
- PHASE II TEMPORARY WELL LOCATION
- APPROXIMATE LOCATION OF GEOPHYSICAL ANOMALY FROM PHASE II SURVEY

FIGURE 2-13

SOIL BORING LOCATION MAP
SWMU 46
CTO-0041

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

3.0 PHYSICAL CHARACTERISTICS

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 SWMU. The subsections that follow present information to support an interpretation of the physical environment, including topography and surface hydrology, potable water supply, and geology and hydrogeology from a regional and SWMU-specific perspective.

3.1 Topography and Surface Features

The overall topography of SWMU 46 area is flat. There is no obvious slope in the immediate vicinity of the SWMU. Mounded areas of soil and debris exist in the wooded areas surrounding the open field. Low lying areas exist throughout the site. These areas are evident during rain events as rainwater collects and creates intermittent pools of water. A small ditch was observed to the southwest of the SWMU, which was most likely created during historic training activities and/or for fire protection. This ditch is found in the middle of the woods and also collects rainwater during rain events.

3.2 Potable 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 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, MCAS New River, Courthouse Bay, and Onslow Beach having a maximum total capacity of 15.8 million 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 Camp Lejeune Wellhead Protection Plan (AH Environmental Consultants [AH], 2002).

The Camp Lejeune Wellhead Protection Plan (AH, 2002) was prepared to update the existing wellhead protection areas for the current well fields on the Base. After review of this plan, it was noted that there are no active supply wells in the Montford Point and Camp Johnson area of the Base. Therefore, no supply wells are in the vicinity of SWMU 46.

3.3 Geologic and Hydrogeologic Framework

Site-specific geologic and hydrogeologic information was obtained from soil samples from 6 temporary well borings (Phase II CSI), 9 soil borings (Phase I CSI and RFI), 8 test trenches and 1 monitoring well advanced at SWMU 46. In addition, available geologic publications and mapping were reviewed. This information is discussed in context of the regional framework presented below.

3.3.1 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. 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 3 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 and 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 limier 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 (Cardinell, 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 D. 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 ft/d. Estimated hydraulic conductivity values range from 14 to 91 ft/d.

3.3.2 Site-Specific Framework

Holocene/Pleistocene age sediments of the undifferentiated formation are present at the surface throughout the vicinity of the SWMU. These sediments consist primarily of fine sand with varying amounts of silt. Some thin clay lenses are present at the site within the fine sand unit (from approximately 2 to 4-feet bgs). The borings advanced at the SWMU extended no deeper than 12 feet bgs and the bottom of the undifferentiated formation was not encountered.

The uppermost aquifer encountered at the SWMU is the surficial aquifer, which is interpreted to be the saturated portion of the undifferentiated formation. Groundwater level measurements were collected from the six temporary monitoring wells prior to sampling in March 2002 and are summarized on Table 2-3. The water table was measured in the wells at depths ranging from 10.3 to 11.6 feet bgs. Groundwater elevations in the temporary wells ranged from 4.8 to 6.7 feet above msl.

An interpretive groundwater contour map for March 2002 is provided as Figure 3-1. Review of Figure 3-1 shows that groundwater at the SWMU flows to the southeast towards the New River at a hydraulic gradient of approximately 0.0047 feet/foot.

The groundwater velocity estimates could not be determined at this time. Data needed to determine groundwater velocity has not been collected at SWMU 46. Future monitoring well installation, Shelby tube samples and slug testing will be required in a subsequent investigation to obtain the necessary data (hydraulic conductivity, permeability, etc.) to establish hydrogeological characteristics at the SWMU.

Surface water flow at SWMU 46 is limited. Evidence of surficial groundwater flow in and around the SWMU was not apparent during the investigations conducted at SWMU 46. Due to the undeveloped nature of the study area, it is likely that rainwater would directly infiltrate into the underlying soils.

3.4 References

AH, 2002 — AH Environmental Consultants Wellhead Protection Plan – 2002 Prepared for the Naval Facilities Engineering Command, Atlantic Division, Norfolk, Virginia. August 2002.

Cardinell, et al., 1993 — Hydrogeologic Framework of U.S. Marine Corps Base at Camp Lejeune, North Carolina USGS. Water-Resources Investigations Report 93-4049.

Harned, et al., 1989 — Harned, Douglas A., et al, Assessment of Hydrologic and Hydrogeologic Data at Camp Lejeune Marine Corps Base. North Carolina. U.S. Geological Survey, Water-Resources Investigations Report 89-4096. 1989.

TABLES

TABLE 3-1

GEOLOGIC AND HYDROGEOLOGIC UNITS IN THE COASTAL PLAIN OF NORTH CAROLINA
SWMU 46
RCRA FACILITY INVESTIGATION - CTO-0041
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 Confining Unit
		Pungo River Formation [1]	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
		Cape Fear Formation	Upper Cape Fear Confining Unit
			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:

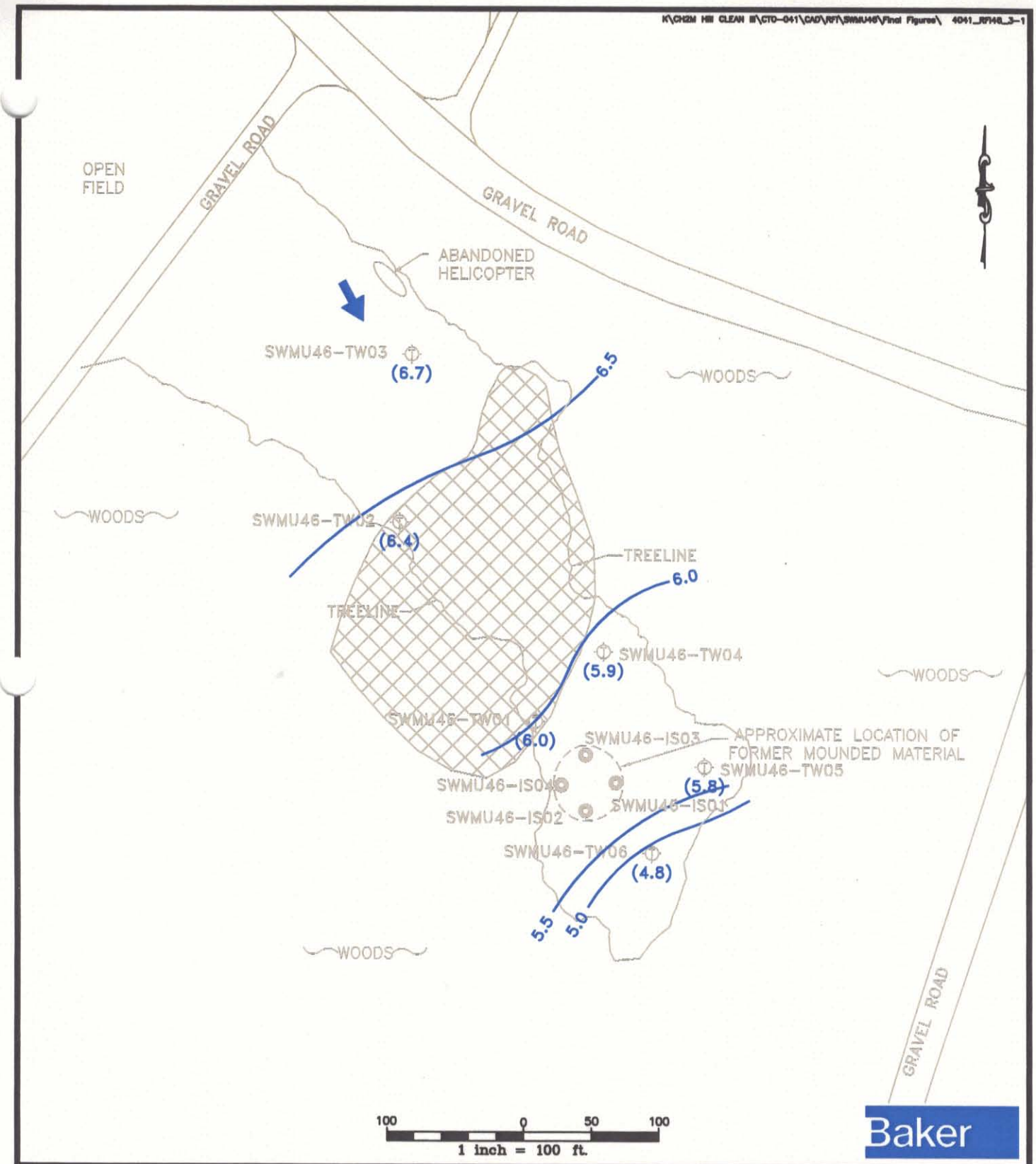
[1] Geologic and hydrologic units not present beneath Camp Lejeune.

[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



LEGEND

- TEMPORARY WELL
- PHASE I SOIL BORING
- APPROXIMATE LOCATION OF GEOPHYSICAL ANOMALY FROM PHASE II SURVEY
- GROUNDWATER FLOW DIRECTION
- —6.0— GROUNDWATER CONTOUR

SOURCE: MCB CAMP LEJEUNE MARCH 2000

FIGURE 3-1
SURFICIAL AQUIFER
POTENTIOMETRIC SURFACE
(MARCH 2002)
RCRA FACILITY INVESTIGATION – SWMU 46
CTO-041
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 SWMU 46. This contaminant characterization was accomplished by fixed-base laboratory analysis of soil and groundwater samples. Sections 4.1 through 4.3 discuss data quality, comparison criteria, and provide information regarding data usability. Section 4.4 discusses the nature and extent of the constituents of concern.

4.1 Data Quality

This data collected during this RFI was analyzed for VOCs, SVOCs, pesticides and RCRA metals. Fixed-base laboratory data were validated using procedures established by the National Functional Guidelines for Organic and Inorganic Analyses (USEPA, 1994). 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. Compounds reported from a dilution were assigned a "D" qualifier. Any analysis that indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification" were assigned the "N" qualifier.

4.1.1 Laboratory and Non-Site Related Contaminants

Some organic and inorganic constituents detected in soil and groundwater at SWMU 46 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 (see Table 4-1). Rinsate blanks were collected from the sampling equipment to ensure that decontamination procedures were effective in cleaning the field equipment. Field blanks were collected from potable water transported and temporarily stored on the drill rig (poly-tank) (FB01), the potable water source at MCAS obtained from the helicopter wash pad (FB02) and the deionized water supplied by the laboratory for use in blank samples (FB03).

Common laboratory contaminants (i.e., acetone, 2-butanone, methylene chloride, toluene, and phthalate esters) were considered as positive results in field samples 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 unless the history of the site included the use of that chemical (USEPA, 1989). The only common laboratory contaminant found in blank samples for SWMU 46 was acetone.

Other constituents contained in blanks that are not considered common laboratory contaminants were considered as positive results in field samples only when observed concentrations exceeded five times the maximum concentration detected in any blank (USEPA, 1989). All TCL compounds of less than five times the maximum level of contamination noted in any blank were considered to be not detected in that sample. The maximum concentrations of all other detected blank contaminants were as follows:

Bromodichloromethane	34 µg/L
Chloroform	50 µg/L
Dibromochloromethane	21 µg/L
Barium (total)	6.4 µg/L

Cadmium (total)	0.33 J µg/L
Chromium (total)	1.2 J µg/L
Benzaldehyde	0.3 J µg/L
Bis(2-Ethylhexyl) Phthalate	0.7 J µg/L
Di-N-Butyl Phthalate	0.4 J µg/L

The detections of VOCs (bromodichoromethane, chloroform and dibromochloromethane) typically are associated with disinfection byproducts and may be related to the use of base potable water during equipment decontamination. The low detections of benzaldehyde, bis(2-Ethylhexyl) phthalate and di-n-butyl phthalate are associated with plasticizers. The presences of these compounds in FB01 are likely associated with the poly-tank used for temporary water storage on the drill rig and not related to any former activities at this SWMU.

4.1.2 Naturally Occurring Inorganic Elements

A soil base background study was conducted at MCB, Camp Lejeune in June and July 2000. A subsequent base-wide groundwater investigation was conducted in March and April 2002 to establish background concentrations. 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.

As a part of the background soil investigation, 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.

For the groundwater investigation, temporary groundwater monitoring wells were installed in 25 of the 50 locations previously selected for the soil investigation 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 the monitoring wells and analyzed for TAL inorganics analysis utilizing Method 601 OB/7471A. The inorganic analysis results were subsequently validated.

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

The surface soil and subsurface soil data sets were segregated according to soil type. Groundwater data sets were segregated according to depth. After the data sets had been segregated, 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.

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). This investigation differed from the base-wide investigation in that the purpose of this data set was to establish a background for the area of the base where these SWMUs were located. These samples should reflect impacts on the area from Base activities not associated with the SWMU. 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. These results were also statistically evaluated.

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 concentrations (STGCs), and background. Within the background criterion are base-wide background and AOC 3 background. Constituent concentrations in groundwater are compared to three main criteria; North Carolina Water Groundwater Quality Standards (2L Standards), USEPA Region IX tap water PRGs, and base-wide background. The paragraphs that follow discuss details regarding each screening criteria.

Region IX Industrial Soil and Tap Water PRGs - (USEPA, 2003) - 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 combines 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. The land use in and around SWMU 46 is mostly woods and areas used for training activities. Industrial PRGs were used in assessing SWMU 46.

North Carolina Soil-to-Groundwater Concentrations – (NC, 1996) - Soil-to-Groundwater concentrations numbers 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, Soil-to-Groundwater concentrations were calculated using the recommended 2L, or if not available the Maximum Contaminant Levels Goals (MCLG), which is based on a 10^{-6} carcinogenic risk.

North Carolina Water Quality Standards for Groundwater (NC, 2002) - 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.

Base Background (Soil and Groundwater)/AOC-Specific Background (Soil) - It was apparent from statistical analysis that detected inorganic constituents 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 following background criteria were used to evaluate the site-specific data and are presented in Appendix E:

- Base Background – fine sand surface soil data set
- Base Background - sand subsurface soil data set
- Base Background - shallow groundwater data set
- Base Background - deep groundwater data set
- AOC-Specific Background – AOC 3 surface and subsurface soil data set

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

Data usability refers to the validity of the data and how the data is used to determine the extent of contamination. The data validation did not report on any significant problems with the data set. For soils and groundwater, the fixed-base laboratory was able to achieve method detection limits below PRGs, STGCs, NC 2L Standards and Region IX Tap Water standards.

In accordance to NC 2L Groundwater Quality Standards, the extent of the VOC constituents will be to "practical quantitation limits" (detection limits). The extent of metal constituents will be based on background comparisons.

The Phase II CSI data was used to remove SWMUs from further investigation or to screen (reduce) the list of constituents for subsequent investigations. Thus, the CSI data is 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 was applied.

4.4 Nature and Extent of Contamination

This section presents the results of the soil and groundwater investigations performed at SWMU 46. Summaries of analytical detections obtained from the fixed-base laboratory are presented in Table 4-2 through Table 4-5. A complete summary of laboratory analytical data is presented in Appendix F.

4.4.1 Soil Investigation

The soil investigation at SWMU 46 was conducted utilizing soil borings and test trenches to evaluate the surface and subsurface soils. Surface and subsurface soil samples were collected from five soil borings around SWMU 46 to determine the extent of soil contamination found during previous investigations around the former soil mounds and in the temporary well borings. Subsurface soil samples were also collected from eight test trenches excavated in and around the geophysical boundaries of the old landfill. The test trench samples were collected to determine the existing conditions of the debris in the landfill and the impact to soils beneath and adjacent to the debris. Soil samples were collected as previously described in Section 2.1 and Section 2.1.1.

Results of the soil samples collected from the soil borings showed that contamination exists in the surface and subsurface soil. Arsenic, cadmium, chromium, lead, mercury and silver were all detected at concentrations exceeding the screening criteria in surface soil sample SWMU46-SB01-00 (Figure 4-1). All of these metals exceeded background criteria and the STGCs. Arsenic was also detected in surface soil samples SWMU46-SB03-00 and SWMU46-SB04-00 exceeding background and the USEPA Region IX PRG of 1.59 mg/kg. However, these detections did not exceed the STGC for arsenic (5.24 mg/kg). Arsenic, cadmium, chromium, lead, mercury and silver were all detected at concentrations exceeding the screening criteria in subsurface soil sample SWMU46-SB04-02. All of these metal concentrations exceeded the STGCs except for arsenic (4.5 mg/kg). Lead has been a COPC from previous investigations as seen in Figure 1-2 where concentrations of 1950 mg/kg (SWMU46-TW04-00) and 12,300 mg/kg (SWMU46-IS02-04) were detected during the Phase I and Phase II CSIs. Results from this RFI showed lead detected at a concentration of 3010 mg/kg in SWMU46-SB04-02 and at a concentration of 528 mg/kg in SWMU46-SB01-00. These concentrations exceed the STGC of 270 mg/kg. The analytical data summaries for the surface and subsurface soil sampling and presented as Tables 4-2 and 4-3.

A surface soil sample (SWMU46-DP01) was collected from a debris pile in the northwestern portion of the site as directed by Base personnel. Mercury was detected at a concentration of 0.96 mg/kg (Figure 4-2). This detection exceeds the established background criteria and the STGC of 0.0154 mg/kg. No other constituents exceeded the screening criteria at this surface soil location. The analytical data summary for this sample is presented in Table 4-4.

Results from the test trench sampling conducted during this investigation showed that contamination exists in the debris associated with the old landfill. All subsurface soil samples collected from the debris in the test trenches showed elevated concentrations of RCRA metals exceeding the established screening criteria. Arsenic, barium, cadmium, chromium, lead, mercury and silver where all detected at concentrations exceeding the established STGCs in one or more of the subsurface soil samples (Figure 4-2).

In addition to the inorganic contamination in the debris, benzo(a)anthracene was detected in subsurface soil sample SWMU46-TT01-01 at a concentration of 450 ug/kg exceeding the STGC (343 ug/kg). All the other detections of SVOCs were located in subsurface soil sample SWMU46-TT01-01 and none of these detections exceeded the applicable screening criteria. Benzene, toluene and trifluoromethane were the only VOCs detected in the test trench samples. However, these detections were very low and did not exceed the established screening criteria.

Four pesticides (4,4'-DDD, 4,4'-DDT, alpha-chlordane, and gamma-chlordane) were detected in the test trench samples exceeding the STGCs (Figure 4-2). The pesticides were detected both in the debris and in the native soils adjacent to the debris. Higher concentrations of pesticides were located in soil samples collected from the debris. Subsurface soil sample SWMU46-TT04-02 was the only sample in adjacent soils to have detections of pesticides (4,4'-DDT, alpha-chlordane, and gamma-chlordane) exceeding the STGCs. Five of the eight subsurface soil samples collected from the debris had detections of pesticides exceeding the STGCs. 4,4'-DDD was detected at concentrations ranging from 520 to 2300 ug/kg, thus exceeding the STGC of 129 ug/kg. 4,4'-DDT was detected at concentrations ranging from 3000 to 27,000 ug/kg also exceeding the STGC of 1360 ug/kg. Alpha-chlordane and gamma-chlordane were detected at concentrations ranging from 180 to 430 ug/kg, exceeding the STGC of 27.8 ug/kg. The analytical data summary for test trench samples is presented as Table 4-4.

Subsurface soil samples collected from the native soils contained detectable concentrations of RCRA metals exceeding background criteria, STGCs or the USEPA Region IX PRGs. However, none of the detected concentrations exceeded both the background criteria and the STGCs or USEPA Region IX PRGs (Table 4-4).

4.4.2 Groundwater Investigation

The groundwater investigation at SWMU 46 consisted of the installation of one monitoring well. During the second phase of confirmatory sampling at SWMU 46, lead was detected in the groundwater sample from temporary monitoring well SWMU46-TW06 at a concentration that exceeded the NC 2L standards and base background comparison criteria (see Figure 1-3). The sample was turbid and the silt that caused the turbidity may have been the source of the detected contamination. One well (SWMU46-MW01) was installed next to SWMU46-TW06 to determine whether or not the lead detection in the Phase II CSI was representative of aquifer conditions.

Results from the groundwater sampling at SWMU46-MW01 revealed no RCRA metal concentrations (particularly lead) in excess of the NC 2L standards. Barium was the only RCRA metal detected in the sample. The concentration was 64.7 ug/L and is above the base background screening criteria (Table 4-5). However, the concentration is below the NC 2L standard of 2000 ug/L. Based on these results, it was determined in the field that the conditional monitoring wells proposed in the work plan would not be installed at this time.

4.4.3 Summary

Previous investigations gave indication of inorganic contamination in soils, including arsenic, mercury, chromium, cadmium, lead and silver. The findings of this RFI show that contamination exists in the debris contained in the old landfill and have impacted the surface and subsurface soils.

In summary, earlier indications of potentially significant soil contamination at SWMU 46 were indicated in the RFI findings:

- Arsenic, cadmium, chromium, lead, mercury and silver were all detected at concentrations exceeding the established screening criteria in surface and subsurface soils and in the samples collected from the debris contained within the landfill.

- Benzo(a) anthracene, alpha-chlordane, 4,4'-DDD, 4,4'-DDT, and gamma-chlordane were also detected at concentrations exceeding the established screening criteria in subsurface samples collected from the test trenches

4.4 References

Baker, 2001a — Baker Environmental, Inc. Final Base Background Study (Soil), Marine Corps Base Camp Lejeune, North Carolina Prepared for the Naval Facilities Engineering Command, Atlantic Division, Norfolk, Virginia. April 2001.

Baker, 2001b — Baker Environmental, Inc. Area of Concern Background Study (Final), Marine Corps Base Camp Lejeune, North Carolina Prepared for the Naval Facilities Engineering Command, Atlantic Division, Norfolk, Virginia. April 2001.

Baker, 2002a — Baker Environmental, Inc. Base Background Groundwater Study. Draft. Prepared for the Naval Facilities Engineering Command, Atlantic Division, Norfolk, Virginia. August 2002

NC, 2002 — North Carolina Department of Environment, Health, and Natural Resources. Permanent Groundwater Standards per 15A NCAC 2L .0202 http://gw.ehnr.state.nc.us/ADA_Webpage/Adobe/gwStandards.pdf. August 2002 and Interim Groundwater Standards per NCAC 2L .0202(c) http://gw.ehnr.state.nc.us/new_page_7.htm. May 1999

USEPA, 1989 — Risk Assessment Guidance for Superfund Volume I. Human Health Evaluation Manual (Part A) Interim Final. United States Environmental Protection Agency, Office of Solid Waste and Emergency Response. Washington, D.C. EPA/540/1-89-002. December 1989.RAGS part about lab contaminants

USEPA, 1991 — United States Environmental Protection Agency. National Functional Guidelines for Organic Data Review. Draft. USEPA Hazardous Site Evaluation Division. June, 1991.

USEPA, 2003 United States Environmental protection Agency, Region IX Preliminary remediation Goals. http://www.epa.gov/region09/waste/sfund/prg/index.htm. October 2003.

TABLES

TABLE 4-1

QA/QC SAMPLE SUMMARY - SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	ER03	ER06	TB03	TB05	TB06	TB07	FB01	FB02	FB03
SAMPLE DATE	22-Mar-04	06-Apr-04	19-Mar-04	01-Apr-04	02-Apr-04	05-Apr-04	23-Mar-04	04-Apr-04	06-Apr-04
VOLATILES (ug/L)									
Acetone	3 J	10 UJ	3 J	10 UJ	10 UJ	10 UJ	3 J	10 UJ	10 UJ
Bromodichloromethane	10 U	10 U	10 U	10 U	10 U	10 U	4 J	34	10 U
Chloroform	10 U	10 U	10 U	10 U	10 U	10 U	8 J	50	10 U
Dibromochloromethane	10 U	10 U	10 U	10 U	10 U	10 U	2 J	21	10 U
SEMIVOLATILES (ug/L)									
Benzaldehyde	10 U	10 U	NA	NA	NA	NA	0.3 J	10 U	10 U
Bis(2-Ethylhexyl) Phthalate	10 U	10 U	NA	NA	NA	NA	0.7 J	10 U	10 U
Di-N-Butyl Phthalate	0.4 J	10 U	NA	NA	NA	NA	0.3 J	10 U	10 U
METALS (ug/L)									
Barium	0.23 U	0.23 U	NA	NA	NA	NA	6.4	0.89 J	0.23 U
Cadmium	0.33 B	0.55 U	NA	NA	NA	NA	0.25 U	0.25 U	5 U
Silver	1.16 U	1.16 U	NA	NA	NA	NA	1.2 J	1.16 U	1.16 U

Notes:

U = Non-detected chemical
J = Estimated Value.
UJ = Non-detected, Estimated Value
NA = Not analyzed.
ug/L = micrograms per liter

TABLE 4-2

ANALYTICAL DATA SUMMARY
SURFACE SOIL - SWMU 46
RCRA FACILITY INVESTIGATION (CTO - 0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	Background AOC 3 Surface Soil	RFI Background Base Surface Soil - Fine Sand	North Carolina Soil to Groundwater	USEPA Region IX Industrial Soil PRGs	SWMU46-SB01-00	SWMU46-SB02-00	SWMU46-SB03-00	SWMU46-SB03-00 D	SWMU46-SB04-00	SWMU46-SB05-00
Date					22-Mar-04	22-Mar-04	22-Mar-04	22-Mar-04	22-Mar-04	22-Mar-04
Depth Range (ft)					0-1	0-1	0-1	0-1	0-1	0-1
METALS (mg/kg)										
Arsenic	1.19	0.67	5.24	1.59	**7.7**	1.4 U	**2.9**	2.3 U	**2.8**	1.6 U
Barium	25.3	16.8	848	66577	**131** J	8 J	14.6 J	7.9 J	17 J	14.6 J
Cadmium	ND	0.05	2.72	451	**3.2**	1.8 U	1.7 U	0.04 U	**0.4** J	0.05 U
Chromium	6.19	15.2	27.2	448	**36.5** J	4.6 J	6.9 J	6.1 J	7.2 J	5.3 J
Lead	11.9	20.9	270	750	**528** J	**48.4** J	**58.6** J	10.6 J	**55.9** J	5.4 J
Mercury	0.04	0.10	0.02	307	**0.83**	0.04 J	0.04 J	0.01 U	0.04 J	0.03 J
Silver	ND	ND	0.22	5110	3.9	0.21 U	0.2 U	0.2 U	0.21 U	0.21 U

Notes:

Shaded values exceed AOC 3 background concentrations for surface soil.
Bolded values exceed Base background concentrations for surface soil - fine sand.
Underlined values exceed North Carolina Soil to Groundwater criteria.
Boxed values exceed USEPA Region IX Industrial Soil PRGs.
U - Not Detected
J - Analyte detected. Reported value is estimated.
mg/kg - milligrams per kilogram
PRG - Preliminary Remediation Goals

TABLE 4-3

ANALYTICAL DATA SUMMARY
SUBSURFACE SOIL - SWMU 46
RCRA FACILITY INVESTIGATION (CTO - 0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	Background AOC 3 Subsurface Soil	**RFI Background Base Subsurface Soil - Sand**	North Carolina Soil to Groundwater	USEPA Region IX Industrial Soil PRGs	SWMU46-SB01-03	SWMU46-SB02-04	SWMU46-SB03-02	SWMU46-SB04-02	SWMU46-SB05-04
Date					22-Mar-04	22-Mar-04	22-Mar-04	22-Mar-04	22-Mar-04
Depth Range (ft bgs)					5-7	7-9	3-5	3-5	7-9
METALS (mg/kg)									
Arsenic	3.47	1.62	5.24	1.59	0.42 U	0.41 U	1.3 U	4.5	1.4 U
Barium	37.7	22	848	66577	0.96 J	0.74 J	0.85 J	209 J	0.88 J
Cadmium	ND	ND	2.72	451	0.05 U	0.05 U	0.04 U	6	0.06 J
Chromium	19.5	16.3	27.2	448	2.9 UJ	2.9 UJ	2.4 UJ	39.4 J	1.8 J
Lead	20.7	8.16	270	750	1.4 J	2.2 J	1.5 J	3010 J	1.8 J
Mercury	0.06	0.08	0.02	307	0.01 U	0.01 U	0.01 U	0.11 J	0.01 U
Silver	0.20	ND	0.22	5110	0.23 U	0.22 U	0.19 U	9.5	0.2 U

Notes:

Shaded values exceed AOC 3 background concentrations for subsurface soil.
Bolded values exceed Base background concentrations for subsurface soil - sand .
Underlined values exceed North Carolina Soil to Groundwater criteria.
Boxed values exceed USEPA Region IX Industrial Soil PRGs.
U - Not Detected
J - Analyte detected. Reported value is estimated.
UJ - Non-detected, estimated value.
mg/kg - milligrams per kilogram
PRG - Preliminary Remediation Goals

TABLE 4-4

ANALYTICAL DATA SUMMARY
TEST TRENCHES - SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	Background AOC 3 Subsurface Soil	RFI Background Base Subsurface Soil - Sand	North Carolina Soil to Groundwater	USEPA Region IX Industrial Soil PRGs	SWMU46-TT01-01	SWMU46-TT02-01	SWMU46-TT02-02	SWMU46-TT03-01	SWMU46-TT03-02	SWMU46-TT04-01	SWMU46-TT04-02
Date					01-Apr-04	01-Apr-04	01-Apr-04	02-Apr-04	02-Apr-04	02-Apr-04	02-Apr-04
Depth Range (ft bgs)					6-7	4-5	6-7	6	4-5	5-6	5-6
VOLATILES (ug/kg)											
BENZENE	NE	NE	5.62	1315	12 U	12 U	14 UJ	13 U	4 J	11 UJ	10 U
TOLUENE	NE	NE	7270	520000	12 U	12 U	14 UJ	13 U	3 J	11 UJ	10 U
TRICHLOROFLUOROMETHANE	NE	NE	31500	2000000	2 J	9 J	4 J	2 J	2 J	5 J	2 J
SEMIVOLATILES (ug/kg)											
2,4-dinitrophenol	NE	NE	NE	1231213	1100 UJ	980 U	1000 U	990 U	950 U	970 UJ	930 UJ
3,3'-dichlorobenzidine	NE	NE	NE	3830	440 UJ	390 UJ	420 UJ	390 U	380 UJ	390 UJ	370 UJ
ANTHRACENE	NE	NE	995000	100000000	163 J	390 U	420 U	390 U	380 U	390 U	370 U
BENZO(A)ANTHRACENE	NE	NE	343	2110	450	390 U	420 U	390 UJ	380 U	390 U	370 U
BENZO(B)FLUORANTHENE	NE	NE	1180	2110	480	390 U	420 U	390 U	380 U	390 U	370 U
BENZO(K)FLUORANTHENE	NE	NE	11800	1280 (1)	240 J	390 U	420 U	390 U	380 U	390 U	370 U
CHRYSENE	NE	NE	38200	12830 (1)	830	390 U	420 U	390 U	380 U	390 U	370 U
FLUORANTHENE	NE	NE	276000	22000353	2200	390 U	420 U	390 U	380 U	390 U	370 U
PHENANTHRENE	NE	NE	59600	NE	800	390 U	420 U	390 U	380 U	390 U	370 U
PYRENE	NE	NE	286000	29126201	2400	390 U	420 U	390 U	380 U	390 U	370 U
PESTICIDES / PCBs (ug/kg)											
4,4'-DDD	NE	NE	129	9951	620 D	3.9 U	35	3.9 U	110 DJ	1600	110 NJ
4,4'-DDE	NE	NE	NE	7025	180 D	3.9 U	38	3.9 U	170 DJ	4400 D	400
4,4'-DDT	NE	NE	1360	7025	16	3.9 U	11	3.9 U	38 J	27000 D	3000 D
ALDRIN	NE	NE	NE	101	2.5 J	2 U	2.1 U	2 U	1.9 U	99 U	19 U
ALPHA-BHC	NE	NE	NE	359	1.7	2 U	2.1 U	2 U	1.9 U	99 U	19 U
ALPHA-CHLORDANE	NE	NE	27.8	6468	4.5 U	2 U	2.1 U	2 U	1.6 J	99 U	180
ENDOSULFAN I	NE	NE	NE	NE	4.5 U	2 U	2.1 U	2 U	1.9 U	99 U	19 U
GAMMA-CHLORDANE	NE	NE	27.8	6468	4.5 U	2 U	2.1 U	2 U	1.9 U	99 U	200
METALS (mg/kg)											
ARSENIC	3.47	1.62	5.24	1.59	2.5 J	0.48 UJ	13.9 J	0.85 J	11.6 J	8 J	1.7 J
BARIUM	37.74	21.98	848	66577	341	1.5 J	1410	1.2 J	266	110	10.6 J
CADMIUM	ND	ND	2.72	451	1.8	0.06 J	8.4	0.07 J	4.5	3.7	0.24 J
CHROMIUM	19.51	16.28	27.2	448	16.1	1.5 J	150	1.2 J	80.6	18	4.9
LEAD	20.70	8.16	270	750	1080 J	1.8 J	2930 J	1.6 J	899 J	253 J	8.5 J
MERCURY	0.061	0.080	0.0154	307	0.1 J	0.01 U	0.15	0.01 U	0.14	0.25	0.05 J
SELENIUM	0.785	0.687	12.2	5110	0.79 U	0.58 U	1.6 J	0.7 U	1.5 J	1.1	0.72 U
SILVER	0.204	ND	0.223	5110	0.3 J	0.11 U	20.1	0.17 J	5.4	1.7 J	0.14 U

TABLE 4-4

ANALYTICAL DATA SUMMARY
TEST TRENCHES - SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	Background AOC 3 Subsurface Soil	RFI Background Base Subsurface Soil - Sand	North Carolina Soil to Groundwater	USEPA Region IX Industrial Soil PRGs	SWMU46-TT05-01	SWMU46-TT05-02	SWMU46-TT06-01	SWMU46-TT06-02	SWMU46-TT07-01	SWMU46-TT07-01D	SWMU46-TT07-02
Date					05-Apr-04	05-Apr-04	05-Apr-04	05-Apr-04	05-Apr-04	05-Apr-04	05-Apr-04
Depth Range (ft bgs)					3	3	5	3	4-5	4-5	5-6
VOLATILES (ug/kg)											
BENZENE	NE	NE	5.62	1315	12 U	2 J	10 U	12 U	3 J	11 UJ	12 UJ
TOLUENE	NE	NE	7270	520000	12 U	12 UJ	10 U	12 U	2 J	11 UJ	12 UJ
TRICHLOROFLUOROMETHANE	NE	NE	31500	2000000	1 J	2 J	1 J	2 J	3 J	3 J	3 J
SEMIVOLATILES (ug/kg)											
2,4-dinitrophenol	NE	NE	NE	1231213	910 UJ	1000 UJ	980 UUJ	970 UJ	970 UJ	1000 U	910 U
3,3'-dichlorobenzidine	NE	NE	NE	3830	360 JU	410 UJ	390 UJ	390 UJ	390 UJ	400 UJ	360 UJ
ANTHRACENE	NE	NE	995000	100000000	360 U	410 U	390 U	390 U	390 U	400 U	360 U
BENZO(A)ANTHRACENE	NE	NE	343	2110	360 U	410 U	390 U	390 U	390 U	400 U	360 U
BENZO(B)FLUORANTHENE	NE	NE	1180	2110	360 U	410 U	390 U	390 U	390 U	400 U	360 U
BENZO(K)FLUORANTHENE	NE	NE	11800	1280 (1)	360 U	410 U	390 U	390 U	390 U	400 U	360 U
CHRYSENE	NE	NE	38200	12830 (1)	360 U	410 U	390 U	390 U	390 U	400 U	360 U
FLUORANTHENE	NE	NE	276000	22000353	360 U	410 U	390 U	390 U	390 U	400 U	360 U
PHENANTHRENE	NE	NE	59600	NE	360 U	410 U	390 U	390 U	390 U	400 U	360 U
PYRENE	NE	NE	286000	29126201	360 U	410 U	390 U	390 U	390 U	400 U	360 U
PESTICIDES / PCBs (ug/kg)											
4,4'-DDD	NE	NE	129	9951	15	2300 D	3.9 U	420 D	520 D	990 D	18
4,4'-DDE	NE	NE	NE	7025	4.7	970 D	3.6 J	970 D	240 D	290 D	54
4,4'-DDT	NE	NE	1360	7025	57 D	3100 D	4.5	160 D	120	73	11
ALDRIN	NE	NE	NE	101	1.9 U	11 U	2 U	5 U	4 U	5.1 U	1.8 U
ALPHA-BHC	NE	NE	NE	359	1.9 U	11 U	2 U	5 U	4 U	5.1 U	1.8 U
ALPHA-CHLORDANE	NE	NE	27.8	6468	6	400 D	2.4	140 D	2.8 JP	5.1 U	1.8 U
ENDOSULFAN I	NE	NE	NE	NE	1.9 U	9.5 NJ	2 U	5 U	2.5 JP	5.1 U	1.8 U
GAMMA-CHLORDANE	NE	NE	27.8	6468	5.6	430 D	1.7 J	180 DNJ	4 U	5.1 U	1.8 U
METALS (mg/kg)											
ARSENIC	3.47	1.62	5.24	1.59	0.83 J	6.1 J	1.8 J	3.8 J	7 J	19 J	0.88 J
BARIUM	37.74	21.98	848	66577	5.8 J	323	35.8 J	137	101	110	5.4 J
CADMIUM	ND	ND	2.72	451	0.09 J	3.6 J	0.15 J	1.5	2.8	3	0.07 J
CHROMIUM	19.51	16.28	27.2	448	1.4 J	42.4	8.6	9.5	19	40.8	3.7
LEAD	20.70	8.16	270	750	1.8 J	819 J	5.7 J	141 J	1040 J	456 J	8 J
MERCURY	0.061	0.080	0.0154	307	0.02 J	0.05 J	0.03 J	0.04 J	0.19	0.19	0.02 J
SELENIUM	0.785	0.687	12.2	5110	0.63 U	3.43 U	0.71 U	0.67 U	0.76 U	1.7	0.71 U
SILVER	0.204	ND	0.223	5110	0.12 U	1.6 J	0.13 U	0.13 U	0.61 J	0.73 J	0.13 U

TABLE 4-4

ANALYTICAL DATA SUMMARY
TEST TRENCHES - SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	Background AOC 3 Subsurface Soil	RFI Background Base Subsurface Soil - Sand	North Carolina Soil to Groundwater	USEPA Region IX Industrial Soil PRGs	SWMU46-TT08-01	SWMU46-TT08-02	SWMU46-DP01	SWMU46-DP01 D
Date					02-Apr-04	02-Apr-04	05-Apr-04	05-Apr-04
Depth Range (ft bgs)					2-4	5-6	0-1	0-1
VOLATILES (ug/kg)								
BENZENE	NE	NE	5.62	1315	10 U	11 U	12 UJ	NA
TOLUENE	NE	NE	7270	520000	10 U	11 U	12 UJ	NA
TRICHLOROFLUOROMETHANE	NE	NE	31500	2000000	2 J	2 J	2 J	NA
SEMIVOLATILES (ug/kg)								
2,4-dinitrophenol	NE	NE	NE	1231213	970 U	970 U	970 UJ	960 UJ
3,3'-dichlorobenzidine	NE	NE	NE	3830	380 UJ	390 UJ	390 UJ	380 UJ
ANTHRACENE	NE	NE	995000	100000000	380 U	390 U	390 U	380 U
BENZO(A)ANTHRACENE	NE	NE	343	2110	380 U	390 U	390 U	380 U
BENZO(B)FLUORANTHENE	NE	NE	1180	2110	380 U	390 U	390 U	380 U
BENZO(K)FLUORANTHENE	NE	NE	11800	1280 (1)	380 U	390 U	390 U	380 U
CHRYSENE	NE	NE	38200	12830 (1)	380 U	390 U	390 U	380 U
FLUORANTHENE	NE	NE	276000	22000353	380 U	390 U	390 U	380 U
PHENANTHRENE	NE	NE	59600	NE	380 U	390 U	390 U	380 U
PYRENE	NE	NE	286000	29126201	380 U	390 U	390 U	380 U
PESTICIDES / PCBs (ug/kg)								
4,4'-DDD	NE	NE	129	9951	22	3.9 U	3.3 J	NA
4,4'-DDE	NE	NE	NE	7025	17	3.9 U	12	NA
4,4'-DDT	NE	NE	1360	7025	6.8	3.9 U	14	NA
ALDRIN	NE	NE	NE	101	2 U	2 U	2 U	NA
ALPHA-BHC	NE	NE	NE	359	2 U	2 U	2 U	NA
ALPHA-CHLORDANE	NE	NE	27.8	6468	2 U	2 U	2 U	NA
ENDOSULFAN I	NE	NE	NE	NE	2 U	2 U	2 U	NA
GAMMA-CHLORDANE	NE	NE	27.8	6468	2 U	2 U	2 U	NA
METALS (mg/kg)								
ARSENIC	3.47	1.62	5.24	1.59	**3.3** J	0.62 UJ	0.69 J	1.3 J
BARIUM	37.74	21.98	848	66577	**23.5** J	4.4 J	15.5 J	15.4 J
CADMIUM	ND	ND	2.72	451	1 J	0.13 J	0.26 J	0.28 J
CHROMIUM	19.51	16.28	27.2	448	5.1	2.6	3.5	3.4
LEAD	20.70	8.16	270	750	**122** J	2.2 J	**35.2** J	**41** J
MERCURY	0.061	0.080	0.0154	307	0.02 J	0.01 J	**0.96**	**0.62**
SELENIUM	0.785	0.687	12.2	5110	0.77 U	0.76 U	0.72 U	**0.76** J
SILVER	0.204	ND	0.223	5110	0.14 U	0.14 U	0.14 U	0.14 U

Notes:

Chlordane North Carolina Soil to GW value was used for alpha- and gamma-chlordane.
(1) Cal-based PRG value.
Shaded values exceed AOC 3 background concentrations for subsurface soil.
Bolded values exceed Base background concentrations for subsurface soil - sand.
Underlined values exceed North Carolina Soil to Groundwater criteria.
Boxed values exceed USEPA Region IX Industrial Soil PRGs.
U - Non Detected

J - Analyte detected. Reported value is estimated.
mg/kg - milligrams per kilogram
PRG - Preliminary Remediation Goals
DNJ - Reported value froma dilution, tentatively identified analyte, estimated value.
D - Reported value from a dilution.
UUJ - Non-detected, estimated value.

TABLE 4-5

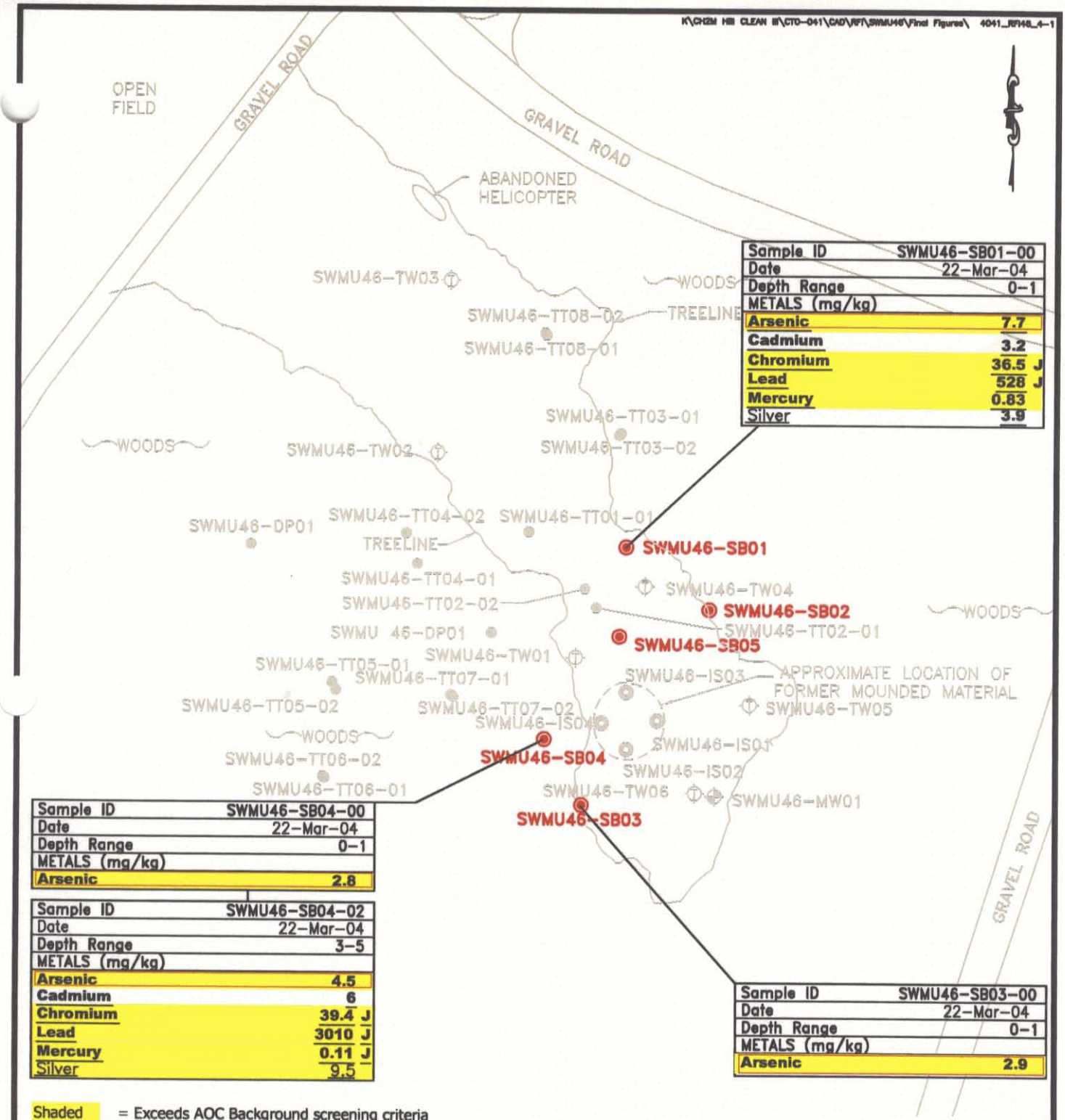
ANALYTICAL DATA SUMMARY
GROUNDWATER - SWMU 46
RCRA FACILITY INVESTIGATION (CTO - 0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID Date	**Base Background GW - Shallow**	North Carolina 2L Standards	USEPA Region IX Tap Water PRGs	SWMU46-MW01 21-Mar-04
METALS (ug/L)				
Barium	37.3	2000	2555	**64.7**

Notes:

Bolded values exceed base background shallow groundwater criteria.
Underlined values exceed North Carolina 2L Standard criteria.
Boxed values exceed USEPA Region IX Tap Water PRGs.
ug/L - micrograms per liter
PRG - Preliminary Remediation Goals

FIGURES



Sample ID	SWMU46-SB01-00
Date	22-Mar-04
Depth Range	0-1
METALS (mg/kg)	
Arsenic	**7.7**
Cadmium	**3.2**
Chromium	**36.5 J**
Lead	**528 J**
Mercury	**0.83**
Silver	3.9

Sample ID	SWMU46-SB04-00
Date	22-Mar-04
Depth Range	0-1
METALS (mg/kg)	
Arsenic	**2.8**

Sample ID	SWMU46-SB04-02
Date	22-Mar-04
Depth Range	3-5
METALS (mg/kg)	
Arsenic	**4.5**
Cadmium	**6**
Chromium	**39.4 J**
Lead	**3010 J**
Mercury	**0.11 J**
Silver	9.5

Sample ID	SWMU46-SB03-00
Date	22-Mar-04
Depth Range	0-1
METALS (mg/kg)	
Arsenic	**2.9**

Shaded = Exceeds AOC Background screening criteria
BOLD = Exceeds Base Background screening criteria
Underline = Exceeds North Carolina Soil to Groundwater screening values
Box = Exceeds USEPA Region IX Industrial PRG screening values

100 0 50 100
1 inch = 100 ft.

Baker

LEGEND

- PHASE I SOIL BORING
- PHASE II TEMPORARY WELL
- RFI SOIL BORING
- RFI TEST TRENCH SAMPLE LOCATION
- RFI MONITORING WELL SAMPLE LOCATION

FIGURE 4-1

CONSTITUENTS EXCEEDING SCREENING CRITERIA IN SOIL BORINGS

RCRA FACILITY INVESTIGATION-SWMU 46
CTO-0041

MARINE CORPS BASE, CAMP LEJEUNE
CAMP LEJEUNE

K:\CH2M HILL CLEAN III\CTO-041\CAD\RFI\SWMU46\Final Figures\ 4041_RFI46_4-2

Sample ID	SWMU46-TT04-02
Date	02-Apr-04
Depth Range	3-5
PESTICIDES (ug/kg)	
4,4'-DDT	3000 D
ALPHA-CHLORDANE	180
GAMMA-CHLORDANE	200

Sample ID	SWMU46-TT04-01
Date	02-Apr-04
Depth Range	1-3
PESTICIDES (ug/kg)	
4,4'-DDD	1600
4,4'-DDT	27000 D
METALS (mg/kg)	
ARSENIC	**8 J**
CADMIUM	3.7
MERCURY	**0.25**
SILVER	1.7 J

Sample ID	SWMU46-TT03-02
Date	02-Apr-04
Depth Range	3-5
METALS (mg/kg)	
ARSENIC	**11.6 J**
CADMIUM	4.5
CHROMIUM	**80.6**
LEAD	**899 J**
MERCURY	**0.14**
SILVER	5.4

Sample ID	SWMU46-DP01
Date	05-Apr-04
Depth Range	0-0
METALS (mg/kg)	
MERCURY	**0.96**

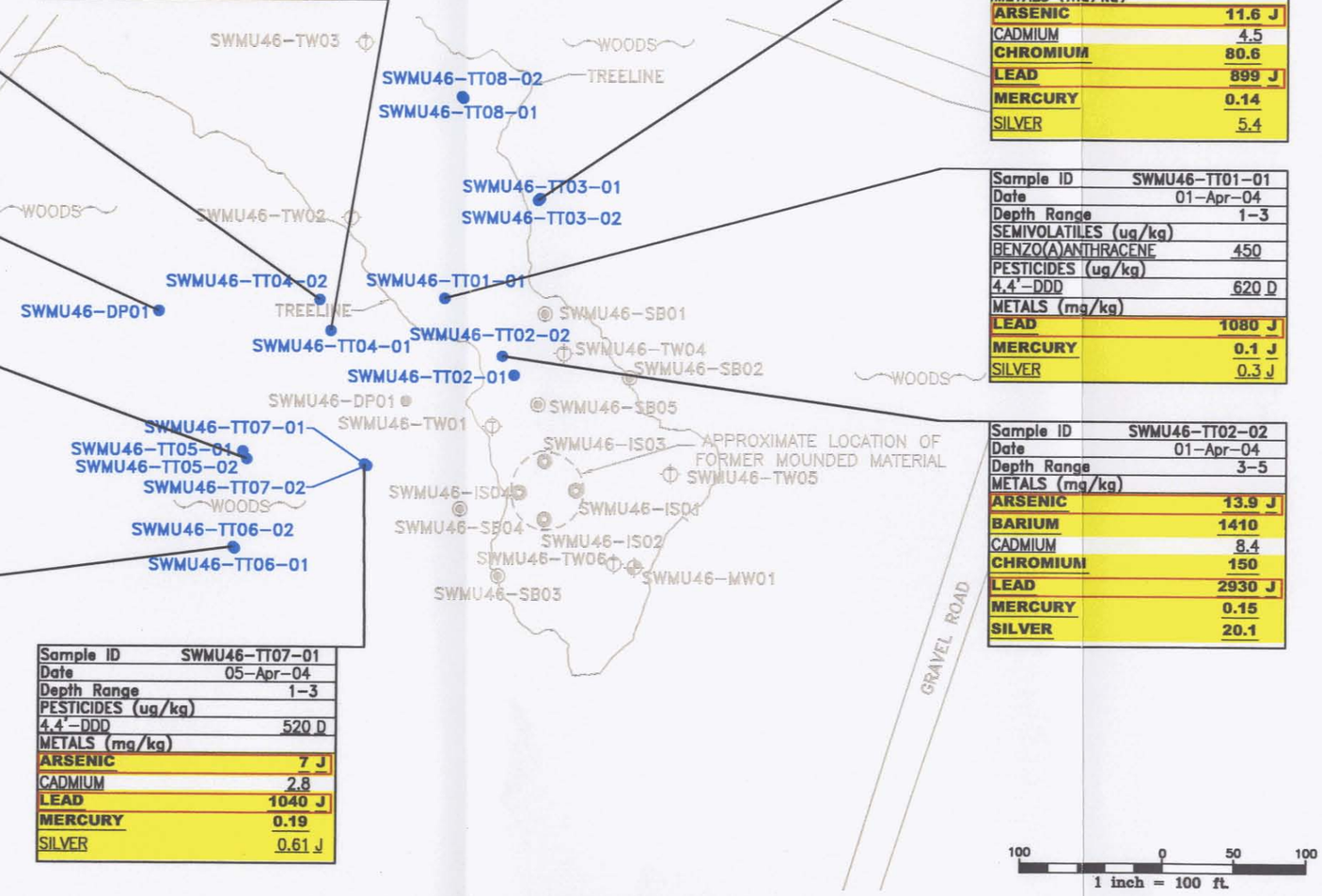
Sample ID	SWMU46-TT01-01
Date	01-Apr-04
Depth Range	1-3
SEMIVOLATILES (ug/kg)	
BENZO(A)ANTHRACENE	450
PESTICIDES (ug/kg)	
4,4'-DDD	620 D
METALS (mg/kg)	
LEAD	**1080 J**
MERCURY	**0.1 J**
SILVER	0.3 J

Sample ID	SWMU46-TT05-02
Date	05-Apr-04
Depth Range	3-5
PESTICIDES (ug/kg)	
4,4'-DDD	2300 D
4,4'-DDT	3100 D
ALPHA-CHLORDANE	400 D
GAMMA-CHLORDANE	430 D
METALS (mg/kg)	
ARSENIC	**6.1 J**
CADMIUM	3.6 J
CHROMIUM	**42.4**
LEAD	**819 J**
SILVER	1.6 B

Sample ID	SWMU46-TT02-02
Date	01-Apr-04
Depth Range	3-5
METALS (mg/kg)	
ARSENIC	**13.9 J**
BARIUM	**1410**
CADMIUM	8.4
CHROMIUM	**150**
LEAD	**2930 J**
MERCURY	**0.15**
SILVER	**20.1**

Sample ID	SWMU46-TT06-02
Date	05-Apr-04
Depth Range	3-5
PESTICIDES (ug/kg)	
4,4'-DDD	420 D
ALPHA-CHLORDANE	140 D
GAMMA-CHLORDANE	180 DNJ
METALS (mg/kg)	
ARSENIC	**3.8 J**

Sample ID	SWMU46-TT07-01
Date	05-Apr-04
Depth Range	1-3
PESTICIDES (ug/kg)	
4,4'-DDD	520 D
METALS (mg/kg)	
ARSENIC	**7 J**
CADMIUM	2.8
LEAD	**1040 J**
MERCURY	**0.19**
SILVER	0.61 J



100 0 50 100
1 inch = 100 ft.

Baker

Shaded = Exceeds AOC Background screening criteria
BOLD = Exceeds Base Background screening criteria
Underline = Exceeds North Carolina Soil to Groundwater screening values
Box = Exceeds USEPA Region IX Industrial PRG screening values

LEGEND

- PHASE I SOIL BORING
- PHASE II TEMPORARY WELL
- RFI SOIL BORING
- RFI TEST TRENCH SAMPLE LOCATION
- RFI MONITORING WELL SAMPLE LOCATION

FIGURE 4-2
CONSTITUENTS EXCEEDING SCREENING CRITERIA IN TEST TRENCHES
RCRA FACILITY INVESTIGATION - SWMU 46
CTO-0041
MARINE CORPS BASE, CAMP LEJEUNE
CAMP LEJEUNE

5.0 FATE AND TRANSPORT

The potential for a contaminant to migrate and persist in an environmental medium is critical when evaluating the potential for a constituent to elicit an adverse human health or ecological effect. The environmental mobility of a constituent is influenced by several factors, including the following:

- Its physical and chemical properties
- The physical characteristics of the site
- The site chemistry

The following sections present a discussion of the various physical and chemical properties and potential transport pathways with respect to those constituents detected at concentrations exceeding the regulatory-driven screening values, as well as the background screening values, and discussed in Section 4.4 (e.g., cadmium, chromium, lead, and mercury).

5.1 Chemical and Physical Properties Impacting Fate and Transport

Table 5-1 presents the physical and chemical properties associated with the organic compounds detected during this investigation. 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 the weight 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, pesticides are very immobile.

Metals are inherent to soil and groundwater. For this reason, concentrations of metals must be discussed with respect to background or natural concentrations. It is important to note that the fate of metals is significantly affected by soil/aquifer matrix and groundwater chemistry. The concentration of metals and their movement are dependent on such things as ion exchange capacity, pH, and redox potential. Table 5-2 presents an assessment of relative environmental mobility of metals as a function of Eh and pH. As shown on Table 5-2, arsenic and cadmium exhibits a medium relative mobility, chromium and lead exhibit very low to low relative mobilities.

5.2 Contaminant Transport Pathways

Based on the evaluation of existing conditions at SWMU 46, the following potential contaminant transport pathways have been identified:

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

The paragraphs that follow describe the potential transport pathways listed above with respect to significant constituents discussed in Section 4.4. Specific fate and transport concerns are discussed in Section 5.3.

5.2.1 Wind-blown Dust

Wind serves as a constituent transport pathway agent by eroding exposed soil and sediment and blowing it off site. This process is influenced by wind velocity, the grain size/density of the soil/sediment particles, moisture conditions, and the amount of vegetative cover over the soil or sediment.

Metals were observed in surface soil samples collected at SWMU 46. A large part of the area surrounding the SWMU is heavily vegetated. This vegetation minimizes the likelihood of dust generation. However, the field area of the SWMU is covered with patches of grass or is bare and subject to vehicle access and training activities. Thus, there is a likelihood of transport by wind-blown dust.

5.2.2 Leaching of Soil Constituents to Groundwater

Arsenic, barium, cadmium, chromium, lead, mercury, silver, benzo(a) anthracene, alpha-chlordane, 4,4'-DDD, 4,4'-DDT, and gamma-chlordane were all detected in soil. The extent of leaching of these COPCs from soil to groundwater cannot be determined at this time. These COPCs were detected in surface and subsurface soil samples and also detected in the landfill debris at various concentrations and locations. Groundwater samples collected at SWMU 46 have been limited to six temporary wells and one monitoring well. Most of these groundwater sample locations are not positioned to determine if leaching of soil contaminants to groundwater is a problem at the SWMU. Only lead was detected in groundwater collected at SWMU46-TW06 (Figure 1-3). However, during this RFI SWMU46-MW01 was placed adjacent to the former SWMU46-TW06 location to verify the detection of lead in groundwater. Lead was not detected in the groundwater sample from SWMU46-MW01.

Even though the extent of leaching cannot be determined at this time, some generalizations can be made about conditions that exist at SWMU 46. Contaminants 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

Elevated concentrations of metals and pesticides were identified at the SWMU. The strong affinity of these COPCs identified for soil and the low mobility suggests that constituent leaching may be minimal at SWMU 46. However, further investigation of the groundwater is needed to confirm this scenario.

5.3 References

Laskowski, 1983 — Laskowski, D.A., Goring, C.A., McCall, P.J., and Swann, R.L., "Terrestrial Environment in Environmental Risk Analysis for Chemicals." Environment in Environmental Risk Analysis for Chemicals. Conways, R.A., ed., Van Nostrand Reinhold Co. New York, 1983.

Lyman et al., 1982 — Lyman, W.J., Rechl, W.F., and Rosenblatt, D.H., Handbook of Chemical Property Estimation Methods. McGraw-Hill. New York, 1982.

TABLES

TABLE 5-1

ORGANIC CONSTITUENT PHYSICAL AND CHEMICAL PROPERTIES
SWMU-46
RCRA FACILITY INVESTIGATION - CTO-0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

Constituents of Potential Concern	log K_{ow} (unitless)	Specific Gravity (unitless)	Henry's Law Constant (atm-m^3/mol)	Mobility Index Input Parameters			Mobility Index	Comments
				Vapor Pressure (mm Hg)	Water Solubility (mg/L)	Koc (mL/g)		
4,4-DDD	6.20	1.385	7.96E-06	1.89E-06	0.1	770000	-12.61	very immobile
4,4-DDE	7.00	NA	6.80E-05	6.50E-06	0.01	4400000	-13.83	very immobile
4,4-DDT	6.19	0.99	5.13E-04	5.50E-06	0.005	243000	-12.95	very immobile
alpha-chlordane	2.64	NA	2.41E-02	1.00E-05	0.56	140000	-10.40	very immobile
gamma-chlordane	2.64	1.6	2.41E-02	1.00E-05	0.56	140000	-10.40	very immobile

Notes:
Sources:
Superfund Public Health Evaluation Manual (EPA 540/1-86/060)
Risk Assessment Information System (RAIS) - http://risk.lsd.ornl.gov/cgi-bin/tox/ Updated as of April 2000
Environmental Fate Data Base: CHEMFATE Chemical Search http://esc-plaza.syrres.com/efdb/Chemfate.htm
NA - Not available

TABLE 5-2

RELATIVE MOBILITIES OF METALS AS A FUNCTION OF ENVIRONMENTAL CONDITIONS (Eh, pH)
SWMU-46
RCRA FACILITY INVESTIGATION - CTO-0041
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 COPCs at SWMU 46

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 46 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, 2000) was also utilized throughout the baseline HHRA process. Soil and groundwater data from the Phase I (Baker, 2001) and Phase II (2002) CSI Reports and the 2004 RFI 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. References are provided in Section 6.8.

6.1 Site Location and Characterization

The following information on SWMU 46 is provided in order to characterize the exposure setting. This background section will provide an overview of the characteristics of SWMU 46 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 46, a complete discussion is included in Section 1.0 of this RFI report.

SWMU 46, also recognized as Former IR Site 15, is the Montford Point Dump Site. The site was previously used to dispose sewage treatment sludge and other materials including litter, asphalt, and sand. The site was operated between 1948 and 1958. During the site visit conducted by

Baker in October 1996, it was noted that a number of soil mounds were located throughout the site. However, during the Phase I and Phase II CSIs, it appeared that most of the mounded material had been removed. During the RFI, it was discovered that the soil mounds had been overtaken by the treeline; thus giving the appearance that they had been removed. The SWMU is presently covered with grass and surrounded by trees.

The SWMU 46 study area is approximately 3.4 acres. The limits of the study area are the gravel roads to the west, north, and east, while the southern limit is determined to be approximately 250 feet south of the currently interpreted landfill boundary.

Activities conducted during previous investigations are included in Section 1.3 and those conducted during the RFI are summarized in Section 2.0. The laboratory results from the Phase I (Baker, 2001) and Phase II (Baker, 2002) CSI Reports and RFI (2004) sampling activities that were 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, Phase II CSI, and the 2004 RFI field investigations at SWMU 46 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 presents the criteria that were used to review, reduce, and summarize the analytical data. These criteria are consistent with USEPA guidance for data reduction.

Data available for the HHRA at SWMU 46 include surface soil, subsurface soil, and groundwater data collected for the Phase I CSI (Baker 2001), Phase II 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 was not detected in the samples (e.g., semivolatiles), then chemicals in that group 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 (conducted in September 1997), surface (0-2 feet bgs) and subsurface (8-10 feet bgs) soil samples were collected from each of four soil borings advanced around the portion of the SWMU where mounded material had been observed. Phase I soil samples were analyzed for SVOCs and RCRA metals. VOC analysis was not included in the Phase I investigation because there was no indication that VOCs were disposed at the SWMU.

As part of the Phase II CSI (conducted in March and April 2002), surface (0-1 foot bgs) and subsurface (7-9 feet bgs or 9-11 feet bgs) soil samples were collected from six temporary well borings and groundwater was sampled from six temporary wells. Soil and groundwater samples were analyzed for RCRA metals. SVOC analyses was not included in the Phase II study because the only SVOC detected during Phase I (bis[2-ethylhexyl]phthalate) was detected at concentrations less than NC DENR soil to groundwater screening criteria, USEPA Region IX residential PRGs, and Base and AOC background values (Baker, 2001).

The RFI field investigation included the collection of five surface soil samples (0-1 foot bgs), five subsurface soil samples (3-5, 5-7, or 7-9 feet bgs), fifteen test trench samples (sampled from 1-3 feet bgs and 3-5 feet bgs at each of eight trenches, shallow sample from SWMU46-TT01 not collected), and one groundwater sample from a groundwater monitoring well. Surface and subsurface soil samples from soil borings and groundwater samples collected during the RFI field investigation were analyzed for RCRA metals. Test trench samples were analyzed for TCL VOCs, TCL SVOCs, TCL pesticides, and RCRA metals. Groundwater samples were additionally analyzed in the field for pH, specific conductance, dissolved oxygen, temperature, and turbidity.

A subset of the available data was used for the SWMU 46 HHRA. All surface soil samples collected from 0-1 feet bgs were 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, 2000). However, the four surface soil samples collected from 0-2 feet bgs during the Phase I investigation were included in the HHRA data set because they were collected from the area immediately surrounding the approximate location of former mounded material in areas 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. 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. Additionally, the soil data collected during Phase I is the only data that includes SVOC analytical results. This uncertainty is addressed in Section 6.6.1. Subsurface soil data from 1 to 11 feet bgs was used in the HHRA. For this HHRA, the subsurface soil and test trench sample results were combined into one subsurface soil data set. All available groundwater data were included in the risk evaluation. These data are presented in full in Appendix G.

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. It is recognized that the use of this data adds uncertainty to the risk assessment. This uncertainty is addressed in Section 6.6.1.

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 46 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 G 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, 2000), 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 2.1 through 2.5 of Appendix H 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 $1x10^{-06}$. 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 February 2003 (USEPA, 2003).

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. It should be noted that in Section 4.0 of this document, industrial soil PRGs were used to assist in evaluation of the laboratory analytical results and extent of contamination based on the nature of land use at SWMU 46 and the surrounding area. However, in accordance with USEPA Region IV guidance and because of the potential for residential use of this site (albeit unlikely), residential soil PRGs were used as screening criteria for soil (USEPA, 2000) in this HHRA. USEPA Region IV guidance recommends industrial screening criteria be used for comparison to subsurface soil data only for construction worker scenarios. Therefore, in the event that constituents in subsurface soil exceeded residential soil PRGs, industrial PRGs were also used for comparison to the subsurface soil when considering the construction worker 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 Part A 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.

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, 2001a). 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) as directed by NC DENR. 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 46 is included within AOC 3. Therefore, surface and subsurface soil data from the SWMU were compared to the AOC 3 background data set. The complete set of background data collected for each AOC is presented in the AOC Background Study (Baker, 2001a). Background soil data are presented in Tables 2.1 and 2.2 of Appendix H.

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 46 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 2.3 and 2.4 of Appendix H.

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 NCWQS 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 (NCWQSs) - Groundwater - NCWQSs (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, 1996).

6.2.4 Selection of COPCs

As discussed previously, three environmental media (i.e., surface soil, subsurface soil, and groundwater) were sampled at SWMU 46 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 G. Tables 2.1 through 2.5 of Appendix H 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 46. 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 SVOCs and RCRA metals. As part of the Phase II CSI, surface soil samples (0-1 foot bgs) were collected and analyzed for RCRA metals. For the RFI field investigation, surface soil samples (0-1 foot bgs) were collected and analyzed for RCRA metals. One SVOC and metals were detected in the surface soil. SWMU 46 surface soil data summary and COPC selection results are presented in Table 2.1 of Appendix H.

There were no positively detected SVOCs that exceeded residential soil PRGs. Therefore, SVOCs were not retained as surface soil COPCs.

The following inorganics were detected at maximum concentrations greater than their respective residential soil PRGs: arsenic, chromium, and lead. Therefore, these metals were retained as surface soil COPCs.

Subsurface Soil

Subsurface soil samples (8-10 feet bgs) collected during Phase I were analyzed for SVOCs and RCRA metals. As part of the Phase II CSI, subsurface soil samples (7-9 feet bgs or 9-11 feet bgs) were collected and analyzed for RCRA metals. For the RFI field investigation, subsurface soil samples (3-5, 5-7, or 7-9 feet bgs) and test trench samples (sampled from 1-3 feet bgs and 3-5 feet bgs were collected. For this HHRA, the subsurface soil and test trench sample results were combined into one subsurface soil data set. Subsurface soil samples were analyzed for RCRA metals. Test trench samples were analyzed for TCL VOCs, TCL SVOCs, TCL pesticides, and RCRA metals. VOCs, SVOCs, pesticides and metals were detected in the subsurface soil. SWMU 46 subsurface soil data summary and COPC selection results are presented in Tables 2.2 and 2.3 of Appendix H.

VOCs were detected in the subsurface soil samples at concentrations below corresponding residential and industrial soil PRGs. Therefore, VOCs were not retained as subsurface soil COPCs.

SVOCs were detected in the subsurface soil samples at concentrations below corresponding residential and industrial soil PRGs. Therefore, SVOCs were not retained as subsurface soil COPCs.

4,4'-DDE and 4,4'-DDT were detected in the subsurface soil samples at concentrations greater than corresponding residential soil PRGs. Therefore, these pesticides were retained as subsurface soil COPCs for the residential scenario. 4,4'-DDT also exceeded its industrial soil PRG and therefore, was also retained as a COPC for the construction scenario.

Subsurface soil samples were analyzed for RCRA metals. Arsenic, barium, cadmium, chromium, and lead were detected at concentrations greater than corresponding residential soil PRGs. Therefore, these metals were retained as subsurface soil COPCs for the residential scenario. Additionally, arsenic, chromium, and lead were detected at concentrations greater than corresponding industrial soil PRGs. Therefore, these metals were retained as subsurface soil COPCs for the construction scenario.

Groundwater

As part of the Phase II CSI, groundwater was sampled from six temporary wells and analyzed for RCRA metals. The RFI field investigation included the collection of one groundwater sample from a groundwater monitoring well. The data and COPC selection summary for groundwater samples collected at SWMU 46 is presented in Tables 2.4 and 2.5 of Appendix H. Table 2.4 presents the comparison of groundwater data to tap water PRGs. Table 2.5 presents the comparison of groundwater data to NC 2L Standards. Note that COPCs were not selected based on the comparison with NC 2L Standards. Table 2.5 is for presentation purposes only.

Chromium was detected in the groundwater samples at a maximum concentration that exceeded its tap water PRG. Therefore, it was retained as a groundwater COPC. Lead was detected in groundwater at a maximum concentration that exceeded its Action Level of 15 μg/L and was therefore, retained as a groundwater COPC. Lead also exceeded its NC 2L Standard.

6.2.5 Summary of COPCs

The following chemicals exceeded the residential PRG values in the environmental media obtained from SWMU 46 during the Phase I CSI, Phase II CSI, and RFI field investigations, and were therefore retained as COPCs for further analysis.

Surface Soil: arsenic, chromium, and lead.

Subsurface Soil (residential): 4,4'-DDE, 4,4'-DDT, arsenic, barium, cadmium, chromium, and lead.

Subsurface Soil (industrial): 4,4'-DDT, arsenic, chromium, and lead.

Groundwater: chromium and lead.

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 46 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), USEPA Region IV Bulletin (USEPA, 2000), 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 Adult and Adolescent (7-16 years) Trespassers
- Current Military Base Personnel
- Future Resident Adults and Children (1-6 years)
- Future Construction Workers

SWMU 46 was previously used to dispose sewage treatment sludge and other materials including litter, asphalt, and sand. The dumpsite was operated between 1948 and 1958. During the site visit conducted by Baker in October 1996, it was noted that a number of soil mounds were located throughout the site. The SWMU is approximately 3.4 acres in size and presently covered with grass and surrounded by trees. Access to the study area is not restricted. Current receptors include military Base personnel who may be involved in maintenance activities or military training operations in the area and trespassers (i.e., adult and adolescent receptors).

Current adult military Base personnel who work or train in the study area may be exposed to COPCs and media of concern at SWMU 46. These include military personnel stationed at the Base. A standard tour of duty of four years was assumed. Military personnel were evaluated for incidental ingestion of and dermal contact with surface soil and inhalation of fugitive dusts from the surface soil. Although unlikely, trespassers could access the study area. Adult and adolescent trespassers were evaluated for incidental ingestion of and dermal contact with surface soil and inhalation of fugitive dusts from the surface soil.

At present, groundwater is not utilized for potable purposes. For the current receptors (trespassers and 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, current 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 46, 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 considered in the risk evaluation for future residents were approximately 0 to 11 feet bgs. Groundwater at SWMU 46 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 VOC analysis was not completed for the groundwater samples collected at SWMU 46.

Future construction workers that may perform excavation and construction at the site were also evaluated for incidental ingestion and dermal contact exposures to excavated surface and subsurface soil, as well as the inhalation of fugitive dusts emanating from surface and subsurface soil during excavation/construction activities. The depths of subsurface soil samples considered in the risk evaluation for construction workers were approximately 0 to 11 feet bgs.

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

Current Adult and Adolescent (Ages 7-16 Years) Trespassers

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

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

Future Construction Workers

- Incidental Ingestion of Surface Soil
- Dermal Contact with Surface Soil
- Inhalation of Fugitive Dusts from Surface Soil
- Incidental Ingestion of Subsurface Soil
- Dermal Contact with Subsurface Soil
- Inhalation of Fugitive Dusts Emanating from 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 46 are summarized in the conceptual site model in Figure 6-1 of this HHRA. Current exposures evaluated at SWMU 46 are military Base personnel and trespassers. 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 46 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. 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

USEPA recommends using the average concentration to represent "a reasonable estimate of the concentration likely to be contacted over time" (USEPA, 1989). This concentration, commonly termed the exposure point concentration (EPC), is a conservative estimate of exposure of individuals to chemicals of potential concern at hazardous waste sites. The EPC is determined for each individual exposure unit within a site. An exposure unit is the area throughout which a receptor moves and encounters an environmental medium for the duration of the exposure. Unless there is site-specific evidence to the contrary, an individual receptor is assumed to be equally exposed to media within all portions of the exposure unit over the time frame of the risk assessment (USEPA, 2002).

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 46. Therefore, the maximum detected concentrations of the COPCs retained in groundwater were used as the exposure concentrations.

As stated in the USEPA 2002 supplemental guidance, the project team has the ultimate responsibility for deciding how best to represent the concentration data for a site. Site-specific conditions, including the representativeness of the data collection process and the limits of the available statistical methods for calculating a UCL, were considered. In particular, sampling was focused on areas of suspected contamination. Analytical methods were selected to focus on and narrow the list of contaminants of concern. As a result, the assumption of random sampling is not met for the statistical methods described in the 2002 guidance. Furthermore, the structure of the combined data sets from the analytical programs does not lend itself to "constructing" a stratified random sampling scheme from available data. Consequently, the project team chose to use the method described below for calculating and selecting EPCs. Defaulting to the 95 percent UCL of the lognormal distribution (calculated via the Land method) in the event that the distribution cannot be determined based on the W-test tends to yield a higher (i.e., more conservative) UCL and is also recommended in USEPA Region IV HHRA guidance.

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. If the data were lognormally distributed, the 95% UCL of the arithmetic mean of the log-transformed data was used. 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, 2000). If the 95% UCL of the arithmetic mean exceeds the maximum detected concentration in a given data set, the maximum detected concentration was used to represent the concentration term for that COPC.

The 95% UCL for a normal distribution was calculated using the following equation (USEPA, 2002):

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

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, 2002):

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

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

Frequency of detection, as well as maximum detected values, are presented in Tables 2.1 through 2.5 of Appendix H. 95% UCL values, mean values, and results of the W-test derived for COPCs in all media at SWMU 46 are presented on Tables 3.1 through 3.4 of Appendix H and in Appendix I. 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 J.

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 and groundwater) are found in the Statistical Summaries presented in Appendix I. 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 46, 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 Soil

Incidental Ingestion of Soil

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

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

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 J.

Dermal Contact with Soil

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

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

Where:

DAD	=	Dermally Absorbed Dose, mg/kg-day
Cs	=	Chemical concentration in the soil, mg/kg
AF	=	Adherence Factor, milligram per square centimeter day ($mg/cm^2 \cdot d$)
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 J.

Inhalation of Fugitive Dust from 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).

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

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 inhaled dose were calculated and are presented in Appendix J.

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):

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

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 ingested dose were calculated and are presented in Appendix J.

Dermal Contact with Groundwater

The absorbed dose associated with potential dermal contact with COPCs in groundwater was calculated using the following equation (USEPA, 1989 and 2001):

$$CDI = \frac{DA_{event} * EF * ED * CF * SA}{BW \; x \; AT}$$

Where:

CDI	=	Chronic Daily Intake, mg/kg-day
DA_{event}	=	Absorbed dose per event (mg/cm^2-event) (assume 1 event/day)
EF	=	Exposure Frequency, days/year
ED	=	Exposure Duration, years

CF	=	Conversion Factor, 1 L/1000 cm^3
SA	=	Surface Area of exposed skin, cm^2
BW	=	average Body Weight, kg
AT	=	Averaging Time, days

The following equations are used to calculate DA_{event} for organic compounds:

If $t_{event} \leq t^*$, then

$$DA_{event} = 2FA * K_p * C_w * \sqrt{\frac{6\tau_{event} * t_{event}}{\pi}}$$

If $t_{event} > t^*$, then

$$DA_{event} = FA * K_p * C_w \left[\frac{t_{event}}{1+B} + 2\tau_{event} \left(\frac{1+3B+3B^2}{(1+B)^2} \right) \right]$$

Where:

DA_{event}	=	Absorbed dose per event (mg/cm^2-event)
FA	=	Fraction absorbed (dimensionless)
K_p	=	Dermal permeability coefficient of compound in water (cm/hour)
Cw	=	Chemical concentration in water (mg/cm^3)
τ_{event}	=	Lag time per event (hour /event)
t_{event}	=	Event duration (hour /event) (assume 1 event/day)
t^*	=	Time to reach steady-state (hour) = $2.4\tau_{event}$
B	=	Dimensionless ratio of the permeability coefficient of a compound

through the stratum corneum relative to its permeability coefficient across the viable epidermis (ve) (dimensionless).

The following equation is used to calculate DA_{event} for inorganic and highly ionized organic chemicals:

$$DA_{event} = K_p * C_w * t_{event}$$

Where:

DA_{event}	=	Absorbed dose per event (mg/cm^2-event)
K_p	=	Dermal permeability coefficient of compound in water (cm/ hour)
C_w	=	Chemical concentration in water (mg/cm^3)
t_{event}	=	Event duration (hours/event) (assume 1 event/day)

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

6.3.6 Exposure Input Parameters

Tables 4.1.1 through 4.6.2a of Appendix H 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 Adult and Adolescent (7 - 16 years) Trespassers

This scenario assumes that current adult and adolescent (7 - 16 years) trespassers could come into contact with surface soil at SWMU 46. These receptors were 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 Tables 4.1.1 through 4.2.1a of Appendix H.

A 70 kg adult and a 45 kg adolescent (USEPA, 1997) were assumed to have exposure durations of 24 years (USEPA, 1993) and 10 years (USEPA, 2000), respectively. The ET was estimated to be 1.5 hours per day for an adult and 4.04 hours per day for an adolescent (USEPA, 1997). The ingestion rate was assumed to be 100 mg/day for both the adolescent and the adult (USEPA, 1993), with a 100% fraction ingested from the source (professional judgment). The EF was assumed to be 52 events/year, based on anticipated exposures of two days/week (i.e., a weekend) for 6 months (professional judgment). Respiration rates of 0.55 m^3/hr and 0.576 m^3/hr for the

adult and adolescent (USEPA, 1997), respectively, were also used. The respiration rate for the adult represents an average of 11.3 m^3/day for women and 15.2 m^3/day for men. The respiration rate used for the adolescent represents the average for an individual aged 9 to 18 years old. ATs of 8,760 days for adults and 3,650 days for adolescents for noncarcinogens, and 25,550 days for carcinogens were also used (USEPA, 1989).

The USEPA recommended weighted SAF of 0.07 mg/cm^2 for the residential adult was used for the adult trespasser (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 conservatively used for the adolescent trespasser 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, 2000) were also used to estimate soil exposures. Skin surface areas of 5,300 cm^2 for the adolescent (representing 50th percentile body-part SAF [average of male/female] for the head, forearms, hands, lower legs and feet of a <7 to <18 year old) and 5,700 cm^2 for the adult (USEPA 2001) were assumed for the surface soil scenario.

6.3.6.2 Current Military Personnel

This scenario assumes that current adult Base military personnel working on-site could come into contact with surface soil at SWMU 46. 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 Tables 4.3.1 and 4.3.1a of Appendix H.

The ingestion rate for military personnel exposed to surface soil was assumed to be 100 mg/day (USEPA, 1993), and the fraction ingested was assumed to be 100 percent (professional judgment). 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 workday. 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, 2000) were also used to estimate soil exposures.

6.3.6.3 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 46. 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 soil. Therefore, these receptors were evaluated for potential exposure to surface soil and subsurface soil via incidental 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 4.4.1 through 4.5.3 of Appendix H. Unless otherwise noted, the CT exposure parameters are the same as for RME.

Future adult and young child residents could contact surface 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 (professional judgment), over 350 days/year (USEPA, 2001). 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). USEPA recommended SAF values of 0.01 mg/cm^2 for the adult and 0.04 mg/cm^2 for the child were used for the CT exposure scenario (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, 2000) 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 ingestion and dermal contact. Inhalation of VOCs while showering was not evaluated for SWMU 46 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, 2001) were assumed for the groundwater scenario for the young child and adult, respectively. For the RME scenario, exposure times of 0.58 hour/day and 1 hour/day were assumed for the adult and young child residents (USEPA, 2001). For CT exposure, 0.25 hour/day and 0.33 hour/day were assumed for the adult and young child (USEPA, 2001). All other exposure parameters were the same as the soil exposure parameters.

6.3.6.4 Future Adult Construction Workers

Potential exposures to soil COPCs may occur to construction workers while performing soil excavation and construction activities at SWMU 46. Exposure pathways evaluated include incidental ingestion, dermal contact, and inhalation of fugitive dust of surface soil and subsurface soil. A summary of the exposure parameters is discussed in the following paragraphs and presented on Tables 4.6.1 and 4.6.2a of Appendix H. 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 (professional judgment) 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, 2001a) 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, 2000) 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. The study area surrounding SWMU 46 is approximately 3.4 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 calculated the construction scenario PEF:

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

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 0.23 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) (8 hours/day for 250 days or 7.2×10^6 seconds)
A_R	=	surface area of contaminated road segment (m^2) (1,798 m^2)
W	=	mean vehicle weight (8 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) (885 km assuming a site area of 3.44 acres)

The following assumptions were incorporated into the above-referenced parameters used to calculate the site-specific construction worker scenario. The SWMU covers a small area and is in an industrialized area of the Base. Therefore, it was assumed that daily unpaved road traffic would consist of at most 20 cars (2 tons per car) and 10 trucks (20 tons per truck). A_R is based on a road length of 118 m and assumes a road width of 15.24 m. VKT is based on 30 vehicles traveling a road length of 118 m (or 0.118 km) for five days per week for 50 weeks (considering an EF of 250 days per year). Thus, a construction worker scenario PEF of 2.46×10^6 m^3/kg was calculated. This calculation is also presented in Appendix J.

6.4 Toxicity Assessment

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 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).

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 5.1 through 6.2 of Appendix H for the identified COPCs. The hierarchy (USEPA, 2003a) for choosing these toxicity values was:

- Tier 1 - Integrated Risk Information System (IRIS, 2004)
- Tier 2 - USEPA's Provisional Peer Reviewed Toxicity Values (PPRTVs) (database of values developed on a chemical-specific basis when requested by USEPA's Superfund program)
- Tier 3 – Other Toxicity Values (includes additional USEPA and non-USEPA sources of toxicity information)

IRIS is the generally preferred source of human health toxicity values. IRIS generally contains RfDs, RfCs, CSFs, drinking water unit risk values, and inhalation unit risk values that have gone through a peer review and USEPA consensus review process. IRIS normally represents the official Agency scientific position regarding the toxicity of the chemicals based on the data available at the time of the review.

The second tier is USEPA's PPRTVs. Generally, PPRTVs are derived for one of two reasons. First, the Superfund Health Risk Technical Support Center (STSC) reviews the toxicity values in the Health Effects Assessment Summary Table (HEAST), which is now a Tier 3 source. As the reviews are completed, those toxicity values will be removed from HEAST, and any new toxicity value developed in such a review becomes a PPRTV and placed in the PPRTV database. Second, Regional Superfund Offices may request a PPRTV for contaminants lacking a relevant IRIS value. The STSC uses the same methodologies for both situations.

The third tier includes other sources of information. These sources should provide toxicity information based on similar methods and procedures as those used for Tiers 1 and 2, contain values which are peer reviewed, are available to the public, and are transparent about the methods and processes used to develop the values. Tier 3 sources include, but are not limited to, the following:

- The California Environmental Protection Agency (Cal EPA) toxicity values
- The Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels
- HEAST toxicity values.

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). 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. Recommended oral absorption efficiencies for those compounds/analytes with chemical-specific dermal absorption factors from soil were obtained from RAGS Part E (USEPA, 2001). 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. The oral-to-dermal extrapolation values used in this baseline HHRA for SWMU 46 are presented in Tables 5.1 and 6.1 of Appendix H.

6.4.4 Lead

Lead was identified as a COPC in samples collected from surface soil, subsurface soil, and groundwater at SWMU 46. 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 (USEPA, 1994). At SWMU 46, the maximum concentration of lead found in surface soil (1,950 mg/kg) and subsurface soil (12,300 mg/kg) exceeded the OSWER action level for residential soil, and the maximum concentration of lead in groundwater (21.9 μg/L) exceeded the Federal MCL of 15 μg/L. Consequently, the lead IEUBK model was utilized to evaluate the risk associated with exposure to lead in the surface soil, subsurface soil, and groundwater. As recommended by guidance, the arithmetic means for lead in surface soil and subsurface soil were used as the exposure point concentrations for the IEUBK model. The maximum concentration

for lead in groundwater was used as the exposure point concentration for the IEUBK model since the guidance does not recommend a specific exposure point concentration for groundwater. 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 46. 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 46 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 1×10^{-06} 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^{-06} to 1×10^{-04}, 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. 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. 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, was 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, current adult and adolescent trespassers, future residents, and future construction workers at SWMU 46. 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 46 are presented in Appendix J. Please note that the full set of RAGS Part D tables is presented in Appendix H.

The total site carcinogenic and noncarcinogenic risks estimated for all current and future receptors evaluated in this baseline HHRA are presented in Tables 9.1 through 9.6 of Appendix H.

6.5.3.1 Current Adult and Adolescent Trespassers

Tables 9.1RME and 9.2RME of Appendix H present all potential pathway-specific and total site risks estimated for current adult and adolescent trespassers 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 adult and adolescent trespassers.

6.5.3.2 Current Military Base Personnel

Table 9.3RME of Appendix H 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.

6.5.3.3 Future Adult and Child Residents

Tables 9.4RME through 9.5CT of Appendix H 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 soil, subsurface soil, groundwater, and inhalation of fugitive dusts from surface soil and subsurface soil and VOCs in groundwater. As shown in Tables 9.4RME and 9.5RME, the total ILCRs did not exceed the USEPA acceptable range of 1×10^{-06} to 1×10^{-04} for the future adult and child residents. Also, the total HI for the adult resident did not exceed the USEPA's acceptable hazard level of 1.0.

As shown in Table 9.5RME, the total HI for the child resident exceeded the USEPA's acceptable hazard level of 1.0 (2.8). Potential exposure to subsurface soil comprised the elevated hazard value. Ingestion of 4,4'-DDT and arsenic in the subsurface soil contributed predominately (approximately 42 percent and 24 percent to the subsurface soil ingestion pathway, respectively). As shown in Table 9.5CT, the total site HI value calculated for the young child resident (1.1) also exceeded 1.0 under the CT exposure scenario. Tables 9.5RME and 9.5CT also show that in both exposure scenarios there were no individual target organs or effects with HIs above 1.0. However, chromium was retained as a COPC in all media at SWMU 46 and its HQ exceeds 1.0 when summed over all exposure pathways.

Therefore, based on the quantitative results of the baseline HHRA, adverse health effects may occur for the future child resident receptor upon exposure chromium in groundwater and soil investigated at SWMU 46. However, it should be noted that the maximum detected concentration of chromium in the groundwater used in the risk calculation was likely the result of high turbidity of the sample (SWMU46-GW06) collected from a temporary well during the Phase II. A monitoring well was installed at the former location of the temporary well and sampled as part of the RFI (SWMU46-MW01) and chromium was not detected in this sample. The maximum detected concentration was used in the risk calculation to maintain a conservative approach. If this concentration were to be removed from the groundwater data set, the remaining chromium concentrations in groundwater would not produce an unacceptable hazard level. Furthermore, it is unlikely that the shallow groundwater at the SWMU would be used as potable water source, and it is a conservative measure to assume such.

6.5.3.4 Future Construction Workers

Tables 9.6RME and 9.6CT of Appendix H present all potential pathway-specific and total site risks estimated for future construction workers evaluated for ingestion and dermal exposures to site COPCs in surface and subsurface soil, and inhalation of fugitive dusts from surface and subsurface soil.

There were no carcinogenic risks calculated that exceeded USEPA's acceptable range of 1×10^{-06} to 1×10^{-04} for the future construction worker. However, the total site HI for the construction worker exceeded the USEPA's acceptable hazard level of 1.0 (2.95). Inhalation of chromium in fugitive dusts from subsurface soil and surface soil contributed predominantly to the elevated HI. The HQ for chromium summed over all pathways was 2.48 and contributed approximately 84 percent to the total site HI. As shown in Table 9.6CT, the total site HI value calculated for the future construction worker (1.06) slightly exceeded 1.0 under the CT exposure scenario.

Therefore, based on the quantitative results of the baseline HHRA, adverse health effects may occur for the future construction worker receptor upon exposure to surface soil and subsurface soil investigated at SWMU 46.

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, subsurface soil, and groundwater at SWMU 46. 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 arithmetic means for lead in surface soil (201 mg/kg) and subsurface soil (745 mg/kg) and the maximum detected concentration for lead in groundwater (21.9 μg/L) were used in the model. The remaining model parameters used were the default factors supplied in the model (USEPA, 2001b). The concentration in surface soil resulted in approximately a 1.3 percent probability that blood lead levels would exceed 10 μg/dl, which is below the acceptable level of 5 percent. The concentration in subsurface soil resulted in approximately a 33 percent probability that blood lead levels would exceed 10 μg/dl, which is above the acceptable level. It should be noted, however, that if the maximum detected concentration of lead in subsurface soil were to be removed from

the data set, it is likely that the remaining lead concentrations in subsurface soil would still result in unacceptable blood lead levels in the IEUBK model. The concentration in groundwater resulted in approximately a 7 percent probability that blood lead levels would exceed 10 μg/dl, which is above the acceptable level. In this case, it should be noted that the maximum detected concentration of lead in the groundwater used in the model was likely the result of high turbidity of the sample (SWMU46-GW06) collected from a temporary well during the Phase II. A monitoring well was installed at the former location of the temporary well and sampled as part of the RFI (SWMU46-MW01) and lead was not detected in this sample. The maximum detected concentration was used in the model to maintain a conservative approach. If this concentration were to be removed from the groundwater data set, the remaining lead concentrations in groundwater would not produce unacceptable blood lead levels in the IEUBK model.

These results exceed the acceptable level and are presented graphically in Figures 6-2 through 6-4. This indicates that the potential for adverse health effects from exposure to lead in subsurface soil and groundwater may occur in the future child resident.

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 46:

- 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 6-1 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 46, 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.

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, 2000). However, the five 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 are the only data that include VOC and SVOC analytical results.

It is noted that the use of the 0-2 feet 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, 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 detected concentrations of mercury were below USEPA Region IX residential PRGs, and all reported values were qualified as estimated. 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 46, 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 mean 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 46.

As stated in the 2002 guidance, the project team has the ultimate responsibility for deciding how best to represent the concentration data for a site. Site-specific conditions, including the representativeness of the data collection process and the limits of the available statistical methods for calculating a UCL, were considered. Sampling and analytical methodologies were included in

approved, final work plans for each investigation. In particular, sampling was focused on areas of suspected contamination. Analytical methods were selected to focus on and narrow the list of contaminants of concern. As a result, the assumption of random sampling is not met for the statistical methods described in the 2002 guidance. Furthermore, the structure of the combined data sets from the analytical programs does not lend itself to "constructing" a stratified random sampling scheme from available data. Consequently, the project team chose to use the method described in Section 6.3.4 for calculating and selecting EPCs. Defaulting to the 95 percent UCL of the lognormal distribution (calculated via the Land method) in the event that the distribution cannot be determined based on the W-test tends to yield a higher (i.e., more conservative) UCL and is also recommended in USEPA Region IV HHRA guidance. It is recognized that bias is introduced in the EPC estimates through the use of the combined data sets from the different investigations. However, defaulting to the 95 percent UCL calculated via the Land method is likely to overestimate potential risk, which maintains a conservative approach.

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 46 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 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 calculated that exceeded the USEPA acceptable range of 1×10^{-06} to 1×10^{-04} for the future adult or young child resident. Also, the total HI for the adult resident did not exceed the USEPA's acceptable hazard level of 1.0.

The total site HI for the child resident exceeded the USEPA's acceptable hazard level of 1.0. Chromium was retained as a COPC in all media at SWMU 46 and its HQ exceeded 1.0 when summed over all exposure pathways. This indicates adverse health effects may occur for the future child resident receptor upon exposure to chromium in groundwater and soil investigated at SWMU 46. However, it should be noted that the maximum detected concentration of chromium in the groundwater used in the risk calculation was likely the result of high turbidity of the sample (SWMU46-GW06) collected from a temporary well during the Phase II. A monitoring well was installed at the former location of the temporary well and sampled as part of the RFI (SWMU46-MW01) and chromium was not detected in this sample. The maximum detected concentration was used in the risk calculation to maintain a conservative approach. If this concentration were to be removed from the groundwater data set, the remaining chromium concentrations in groundwater would not produce an unacceptable hazard level. Furthermore, it is unlikely that the shallow groundwater at the SWMU would be used as potable water source, and it is a conservative measure to assume such.

There were no carcinogenic risks calculated that exceeded USEPA's acceptable range of 1×10^{-06} to 1×10^{-04} for the future construction worker. However, the total site HI for the construction worker exceeded the USEPA's acceptable hazard level of 1.0. Inhalation of chromium in fugitive dusts from subsurface soil contributed predominantly to the elevated HI. Therefore, based on the quantitative results of the baseline HHRA, adverse health effects may occur for the future construction worker receptor upon exposure to surface and subsurface soil investigated at SWMU 46.

The USEPA lead IEUBK model was used to determine if exposure to site media would result in unacceptable blood lead levels in younger children upon exposure to surface soil, subsurface soil, and groundwater at SWMU 46. The model indicated no adverse health effects resulting from exposure to surface soil. The results of the model indicate that the potential for adverse health effects from exposure to lead in subsurface soil and groundwater may occur in the future child resident. It should be noted, that if the maximum detected concentration of lead were to be removed from the data set, it is likely that the remaining lead concentrations in subsurface soil would still result in unacceptable blood lead levels in the IEUBK model. It should also be noted that the maximum detected concentration of lead in the groundwater used in the model was likely the result of high turbidity of the sample (SWMU46-GW06) collected from a temporary well during the Phase II. A monitoring well was installed at the former location of the temporary well and sampled as part of the RFI (SWMU46-MW01) and lead was not detected in this sample. The maximum detected concentration was used in the model to maintain a conservative approach. If this concentration were to be removed from the groundwater data set, the remaining lead concentrations in groundwater would not produce unacceptable blood lead levels in the IEUBK model.

6.8 References

Baker, 2001 — Baker Environmental, Inc. Phase I - SWMU Confirmatory Sampling Report, Marine Corps Base Camp Lejeune. Prepared for the Naval Facilities Engineering Command, Atlantic Division, Norfolk, Virginia. November 2001.

Baker, 2001a — Baker Environmental, Inc. Area of Concern Background Study (Final), Marine Corps Base Camp Lejeune, North Carolina Prepared for the Naval Facilities Engineering Command, Atlantic Division, Norfolk, Virginia. April 2001.

Baker, 2002 — Baker Environmental, Inc. Phase II - SWMU Confirmatory Sampling Report (Revised Draft), Marine Corps Base Camp Lejeune, North Carolina Prepared for the Naval Facilities Engineering Command, Atlantic Division, Norfolk, Virginia. April 2001.

Baker, 2002a — Baker Environmental, Inc. Base Background Groundwater Study. Draft. Prepared for the Naval Facilities Engineering Command, Atlantic Division, Norfolk, Virginia. August 2002

Cowherd, et al., 1985 — Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination. Prepared for EPA Office of Health and Environmental Assessment. EPA/600/8-85/002.

Gilbert, 1987 — Gilbert, Richard O. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold. New York, New York. 1987.

HEAST, 1997 — Health Effects Assessment Summary Tables. Office of Research and Development. Office of Emergency and Remedial Response. U.S. Environmental Protection Agency.

IRIS, 2004 — Integrated Risk Information System. Accessed through Chemical Information Systems, Inc., Baltimore, MD. http://www.epa.gov/iris.

NCEA, 2000 — National Center for Environmental Assessment, USEPA. http://www.epa.gov/ncea.

NC, 2002 — North Carolina Department of Environment, Health, and Natural Resources. Permanent Groundwater Standards per 15A NCAC 2L .0202 http://gw.ehnr.state.nc.us/ADA_Webpage/Adobe/gwStandards.pdf. August 2002 and Interim Groundwater Standards per NCAC 2L .0202(c) http://gw.ehnr.state.nc.us/new_page_7.htm. May 1999

OEPA, 1999 — Ohio Environmental Protection Agency. Closure Plan Review Guidance for RCRA Facilities. March 1999.

USEPA, 1989 — Risk Assessment Guidance for Superfund Volume I. Human Health Evaluation Manual (Part A) Interim Final. United States Environmental Protection Agency, Office of Solid Waste and Emergency Response. Washington, D.C. EPA/540/1-89-002. December 1989.

USEPA, 1990 United States Environmental Protection Agency. National Oil and Hazardous Substances Pollution Contingency Plan. Office of Emergency and Remedial Response. Washington, D.C. 55 FR 8665. March, 1990.

USEPA, 1991 United States Environmental Protection Agency. National Functional Guidelines for Organic Data Review. Draft. USEPA Hazardous Site Evaluation Division. June, 1991.

USEPA, 1991a United States Environmental Protection Agency. Risk Assessment Guidance for Superfund Volume I. Human Health Evaluation Manual Supplemental Guidance. "Standard Default Exposure Factors" Interim Final. Office of Solid Waste and Emergency Response. Washington, D.C. OSWER Directive 9285.6-03. March 25, 1991.

USEPA, 1992 United States Environmental Protection Agency. Dermal Exposure Assessment: Principles and Applications. Interim Report. Office of Health and Environmental Assessment. Washington, D.C. EPA/600/8-91/011B. January, 1992.

USEPA, 1993 United States Environmental Protection Agency. Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure. Draft. Washington, D.C. November 4, 1993.

USEPA, 1994 United States Environmental Protection Agency. Revised Soil Lead Guidance for CERCLA Sites and Corrective Action Facilities. OSWER Directive 9355.4-12, July 14, 1994.

USEPA, 1996 United States Environmental Protection Agency. Drinking Water Regulations and Health Advisories. Office of Water. Washington, D.C. October, 1996.

USEPA, 1997 United States Environmental Protection Agency. Exposure Factors Handbook, Volume 1: General Factors. Office of Research and Development. Washington, D.C. August, 1997.

USEPA, 1998 United States Environmental Protection Agency. Risk Assessment Guidance for Superfund: Volume I Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessment), Interim. Office of Emergency and Remedial Response. Publication 9285.7-01D. January 1998.

USEPA, 2000 United States Environmental Protection Agency. Supplemental Guidance to RAGS: Region IV Bulletins. Office of Health Assessment. Atlanta, GA. May 2000.

USEPA, 2001 United States Environmental Protection Agency. RAGS Part E, Supplemental Guidance for Dermal Risk Assessment Interim. EPA/540/R/99/005. September 2001.

USEPA, 2001a United States Environmental Protection Agency. Draft Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24. March 2001.

USEPA, 2001b United States Environmental Protection Agency. Integrated Exposure Uptake Biokinetic Model for Lead (IEUBK) Windows® version. www.epa.gov/superfund/programs/lead. October 2001.

USEPA, 2003 United States Environmental Protection Agency, Region IX Preliminary Remediation Goals. http://www.epa.gov/region09/waste/sfund/prg/index.htm. February 2003.

USEPA, 2003a United States Environmental Protection Agency. Human Health Toxicity Values in Superfund Risk Assessments. OSWER Directive 9285.7-53. December 5, 2003.

TABLES

TABLE 6-1

SUMMARY OF UNCERTAINTIES IN THE RESULTS OF THE
HUMAN HEALTH RISK ASSESSMENT
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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
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 IV 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

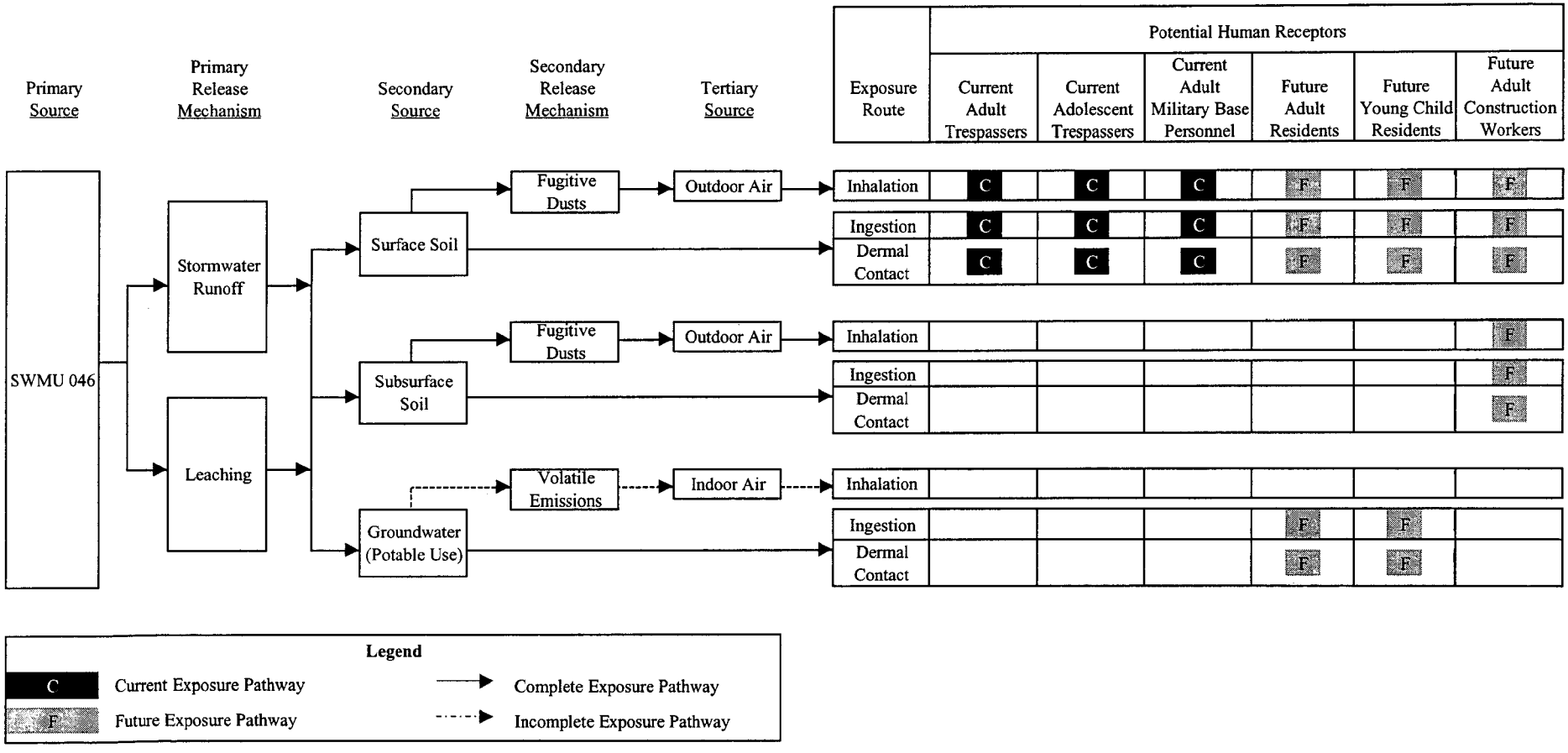
Notes:

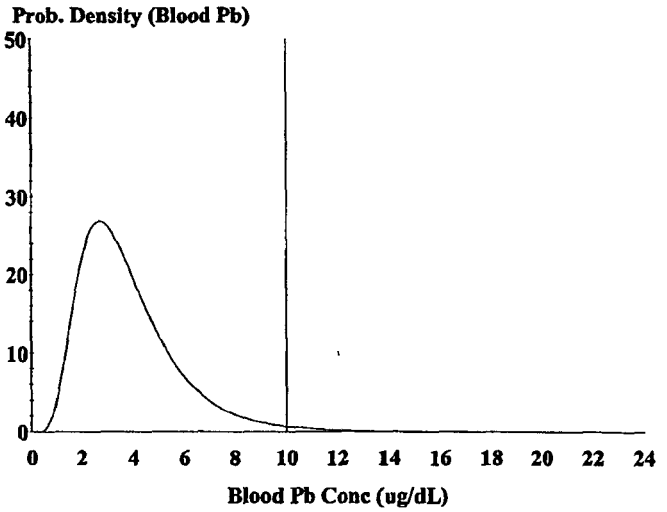
Low - Assumptions categorized as "low" may effect risk estimates by less than one order of magnitude.
Moderate - Assumptions categorized as "moderate" may effect estimates of risk by between one and two orders of magnitude.
High - Assumptions categorized as "high" may effect estimates of risk by more 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 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA

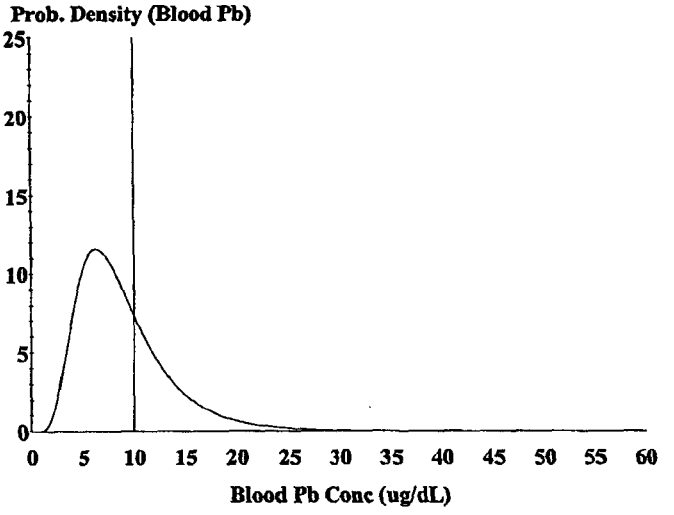




Cutoff = 10.000 ug/dl
Geo Mean = 3.534
GSD = 1.600
% Above = 1.344
% Below = 98.656

Age Range = User Designated: Ages 12 - 72 months
Time Step = Every 4 Hours
Run Mode = Research

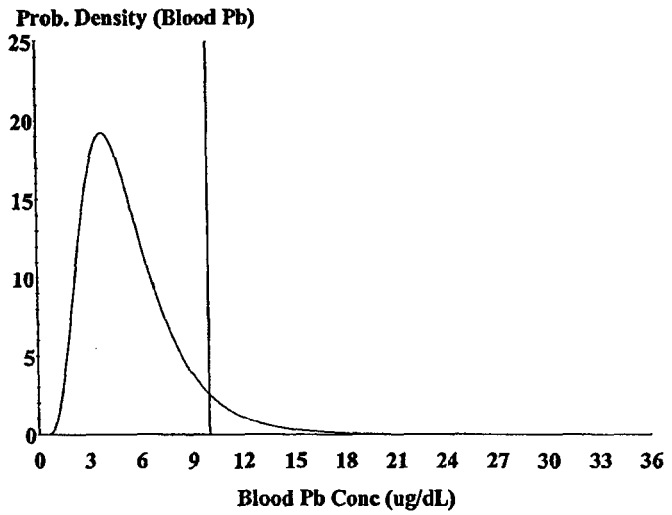
FIGURE 6-2
PROBABILITY DENSITY FUNCTION – BLOOD LEAD CONCENTRATIONS, SURFACE SOIL
SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA



Cutoff = 10.000 ug/dl
Geo Mean = 8.170
GSD = 1.600
% Above = 33.360
% Below = 66.640

Age Range = User Designated: Ages 12 - 72 months
Time Step = Every 4 Hours
Run Mode = Research

FIGURE 6-3
PROBABILITY DENSITY FUNCTION – BLOOD LEAD CONCENTRATIONS, SUBSURFACE SOIL
SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA



Cutoff = 10.000 ug/dl
Geo Mean = 4.926
GSD = 1.600
% Above = 6.595
% Below = 93.405

Age Range = User Designated: Ages 12 - 72 months
Time Step = Every 4 Hours
Run Mode = Research

FIGURE 6-4
PROBABILITY DENSITY FUNCTION – BLOOD LEAD CONCENTRATIONS, GROUNDWATER
SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
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 Constituents of Potential Concern [COPCs]).

Because no risk assessment guidance has been developed specifically for the RCRA program, guidance designed for Comprehensive Environmental Response, Compensation and Liability Act (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 Region IV, Memorandum 4WD-OTS, 2000 (USEPA 2000b).

- 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 Division of Waste Management. October 2003b.

The ERA process under CERCLA consists of eight steps (USEPA 1997a):

1. Preliminary Problem Formulation and Ecological Effects Evaluation
2. Preliminary Exposure Estimate and Risk Calculation
3. Baseline Risk Assessment Problem Formulation
4. Study Design and Data Quality Objectives
5. Field Verification of Sampling Design
6. Site Investigation and Analysis of Exposure and Effects
7. Risk Characterization
8. Risk Management

The Navy Policy for Conducting ERAs (CNO 1999) clarifies and interprets the USEPA process and organizes the eight steps into three tiers. Under both Navy and EPA policy, if the results of Step 1 and Step 2 (Navy Tier 1) indicate that, based on a set of conservative exposure assumptions, there are chemicals present in environmental media that may present a risk to receptor species/communities, the ERA process proceeds to the baseline ERA. According to Superfund guidance (USEPA, 1997a), Step 3 represents the problem formulation phase of the baseline ERA and includes a refinement of conservative exposure assumptions. Under Navy policy, the baseline ERA is defined as Tier 2, and the refinement of conservative exposure assumptions is identified as Step 3a. Step 3a precedes the baseline risk assessment problem formulation (Step 3b). In Step 3a, the conservative exposure assumptions applied in Tier 1 are refined and risk estimates are recalculated using the same conceptual site model. The evaluation of risks in Step 3a may also include consideration of background data, chemical bioavailability, and the frequency of detection. If the re-evaluation of the conservative exposure assumptions supports an acceptable risk determination, the site may exit the ERA process.

Step 1: Preliminary Problem Formulation and Ecological Effects Evaluation

This step is designed to help answer the question "Is there an ecology here to protect?"

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

Step 2: Preliminary Exposure Estimate and Risk Calculation

This step is designed to help answer the question "Are risks to ecological receptors present at the site?"

- Data Collection and Evaluation
- Abiotic Screen
- Uncertainty and Data Gaps
- Scientific/Management Decision Point
- SLERA Summary

Step 3A: Refining the List of COPCs

- Refinement of Exposure and Effects Level Estimates
- Additional Considerations
- Uncertainty Associated with Step 3A
- Step 3A Summary

It should be 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 (NCDENR 2003b):

- There is adequate information to conclude that the ecological risks are negligible
- The site has inadequate data to complete the risk characterization. Data gaps need to be filled prior to completion of the screening process.
- The information indicates a potential for adverse ecological effects and a more thorough assessment is warranted.

The following sections describe the general technical approach and results of the risk evaluation at SWMU 46.

7.1 Step 1 – Preliminary 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 ecology here to protect?" (NCDENR 2003b).

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, a summary of hazardous wastes generated, and 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 is provided in Section 2.0 of the Phase II CSI Report (Baker 2002b). Information on the site-specific ecological setting follows.

The ecological setting of SWMU 46 was evaluated via examination of historical information and a site visit conducted by an ecologist on March 31, 2004. During the site visit, which lasted approximately one hour, the Checklist for Ecological Assessments/Sampling (Appendix A, NCDENR 2003b) was completed. This checklist, including photographs of the site taken during the site visit, is presented as Appendix K.

SWMU 46 – Montford Point Dump Site, was used to dispose sewage treatment sludge and other materials including litter, asphalt, and sand. The dumpsite was operated between 1948 and 1958. An aerial view of the site is provided as Figure 7-1.

The study area consists of an open field surrounded by upland forest (Photo 1, Appendix K). The field is a mix of various herbaceous species and grasses with some areas of bare dirt. Tire tracks from large vehicles were observed throughout the field, and bullet casings were found in the field near the gravel access road. An abandoned helicopter is also present in this area, and is used for military training activities (Photo 3, Appendix K). During the site visit conducted by Baker in October 1996, it was noted that a number of soil mounds were located throughout the site. However, during the Phase I and Phase II CSIs, it had be thought that most of the mounded

material had been removed. During the RFI field activities it became apparent that the soil mounds still exist but that the treeline had overtaken them and obscured them from view.

The trees surrounding the site are predominantly pine with some deciduous species (e.g., holly, oak, gum). Ground vegetation within the wooded area was sparse as the result of a dense layer of pine needles (Photo 9, Appendix K). Evidence of small mammals (piles of nut husks) and birds (birdsong) were observed. The mounds present within the tree line are described as piles approximately 3 feet tall and 4 feet in diameter of what appeared to be dirt covered with pine needles (Photo 10, Appendix K). A gum tree growing on one mound was estimated to be between 25 to 35 years old based on diameter (approximately 9 inches) [rings were counted on a gum tree stump of similar size located nearby], suggesting that the mounding has been present in this area for at least that long.

The site visit was conducted under dry conditions following an evening of heavy rain. No evidence of soil erosion or surface runoff was observed at the site. Due to the relatively flat topography of the area, precipitation is likely to infiltrate to the groundwater table. The surficial aquifer is located within 15 feet of the ground surface (Baker 2002b). Groundwater flow direction is to the southeast, toward Northeast Creek (near its confluence with the New River). Northeast Creek is located approximately 2500 feet southeast of the SWMU. The New River is located approximately 1500 feet southwest of SWMU 46 (Figure 1-1).

No permanent aquatic habitat is present on or near the site. An intermittent wet spot was identified at the site in the vicinity of the SWMU during the March 2004 site visit. This area was approximately 15 feet by 10 feet of shallow (1-4 inches) water that collected in what appears to have been a depression resulting from excavation activities. This wet spot was not present during previous site visits. A variety of frogs were observed, and vegetation in the wet spot included common rush (*Juncus effusus*) and water pennywort (*Hydrocotyle* sp.)(Photo 7, Appendix K). Algae were present in the water column. Although this area is serving as aquatic habitat at the SWMU, it is not a naturally occurring habitat and it is anticipated that it will not persist at the site. A pile of telephone poles was adjacent to the wetspot (Photo 8, Appendix K).

No protected species have been reported or observed at SWMU 46. 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 46 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:

- 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, 2000b) 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 in this report.

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 46 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 downgradient 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 invertebrates may be exposed to chemicals in soil through dermal adsorption and ingestion. Likewise, aquatic invertebrates may be exposed to chemicals in sediment and/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 dermal and ingestion 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 (with the exception of the inhalation route) 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., polychlorinated biphenyls [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.

For upper trophic level receptors, certain potential exposure pathways and/or routes (e.g., dermal contact and inhalation), although potentially complete, are considered insignificant relative to other pathways (e.g., ingestion) due to low potential for exposure. The relative insignificance of the dermal exposure pathway is supported by evidence outlined in Suter II et al. (2000) and USEPA (2000c), the low potential exposure frequency and duration, and the protection offered by feathers, fur, and scales to avian, mammalian, and reptilian receptors, respectively. Literature reviews indicate that dermal exposures to wildlife from classes of chemicals known or suspected

to be of concern via dermal adsorption (VOCs, organophosphate pesticides, and petroleum compounds) are often overestimated in laboratory studies (where feathers/fur are removed) and do not represent realistic exposure scenarios (USEPA, 2000c). Moreover, in developing soil screening levels for 24 important compounds identified from National Priorities List (NPL) sites and Biological Technical Assistant Group (BTAG) recommendations, USEPA calculated that the contribution of dermal exposures to the total dose received by terrestrial receptors to be 0.5 percent or less and therefore omitted the dermal pathway from in their exposure estimates (USEPA, 2000c).

Inhalation of gaseous chemicals and chemicals adhered to particulate matter (e.g., soil) is also considered insignificant relative to ingestion pathways. As described above for dermal exposures, this approach is consistent with Suter II et al. (2000) and USEPA (1997b and 2000c), which recognize the relatively small contribution the inhalation pathway contributes to exposure estimates. For example, USEPA (2000c) estimates the expected contribution of exposure to dust particles and VOCs via inhalation to be 0.01 percent and 0.5 percent or less, respectively relative to ingestion. When present, vegetative groundcover and litter layers further minimize suspension of dust and the potential for inhalation exposures to chemicals adhered to particulate matter.

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 46 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 disposal, 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 3.3.2), groundwater flow direction in the surficial

aquifer is to the southeast. There is the potential for discharge of groundwater to Northeast Creek located 2500 feet southeast of the SWMU.

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. It is noted that 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 site is migrating to a surface water body. However, because groundwater flow is in the direction of Northeast Creek, located approximately 2500 feet from the SWMU, as a conservative measure, the surface water and sediment exposure pathway for aquatic receptors was evaluated. Because Northeast creek is a tributary to the New River, which is tidally influenced, and because the point of potential discharge of groundwater from the SWMU into the creek would be just upgradient from the confluence of these two water bodies, groundwater analytical data was compared to surface water screening values for brackish water. This evaluation assumes discharge of groundwater to suitable aquatic habitat with no dilution or natural attenuation.

Subsurface and Surface Soil Exposure Pathway. The release source for the subsurface and surface soil exposure pathway is the material that was disposed at the former dump site. Chemicals may remain in site soils or migrate via leaching/desorption to groundwater. Due to the flat topography of the site and a lack of evidence of soil erosion following precipitation events, the surface runoff exposure pathway is determined to be of limited importance. The potential for contaminant migration via fugitive dust emissions is addressed in the air exposure pathway.

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. Mammals, amphibians, and reptiles may be exposed to chemicals in surface soil through incidental ingestion and food chain transfer. For all potential terrestrial receptors, 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 (generally soil at depths greater than 1 foot bgs) is not considered a complete exposure pathway for terrestrial receptors for the following reasons (Suter II 1995):

- 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 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 occur. Terrestrial mammals, birds, amphibians, and reptiles may be exposed to chemicals in fugitive dust emissions and volatilization through inhalation. As discussed above, the SWMU is covered by herbaceous plants and vegetation, which will serve to minimize fugitive dust emissions to ambient air and would also limit the area over which volatilization of chemicals could potentially occur. Burrowing mammals may be exposed to volatile emissions in subterranean passageways; however, VOCs were not considered chemicals of concern at the SWMU and were not evaluated

in site media. Furthermore, as discussed previously, the inhalation exposure pathway is considered insignificant relative to the ingestion pathway. For these reasons, the air exposure pathway is considered insignificant and is not evaluated in this risk assessment. 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 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 ecology at the site to protect. Terrestrial habitat on site includes an open field surrounded by a forest dominated by pine. Potential migration of contaminated groundwater to Northeast Creek, an off-site aquatic habitat, is also a concern. 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 46 include surface soil, subsurface soil, and groundwater data collected for the Phase I CSI (Baker 2001a), Phase II CSI (Baker 2002b), 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 was not detected in the samples (e.g. semivolatiles), then chemicals in that group 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 (conducted in September 1997), surface (0-2 feet bgs) and subsurface (8-10 feet bgs) soil samples were collected from each of four soil borings advanced around the portion of the SWMU where mounded material had been observed. Phase I soil samples were analyzed for SVOCs and RCRA metals. VOC analysis was not included in the Phase I investigation because there was no indication that VOCs were disposed at the SWMU.

As part of the Phase II CSI (conducted in March and April 2002), surface (0-1 foot bgs) and subsurface (7-9 feet bgs or 9-11 feet bgs) soil samples were collected from six temporary well borings and groundwater was sampled from six temporary wells. Soil and groundwater samples were analyzed for RCRA metals. SVOC analyses was not included in the Phase II study because the only SVOC detected during Phase I (bis[2-ethylhexyl]phthalate) was detected at concentrations less than NC DENR soil to groundwater screening criteria, USEPA Region IX residential PRGs, and Base and AOC background values (Baker 2001a).

The RFI field investigation included the collection of five surface soil samples (0-1 foot bgs), five subsurface soil samples (3-5, 5-7, or 7-9 feet bgs), fifteen test trench samples (sampled from 1-3 feet bgs and 3-5 feet bgs at each of eight trenches, shallow sample from SWMU46-TT01 not collected), and one groundwater sample from a groundwater monitoring well. Surface and subsurface soil samples from soil borings and groundwater samples collected during the RFI field investigation were analyzed for RCRA metals. Test trench samples were analyzed for TCL VOCs (OLMO 4.2), TCL SVOCs (OLMO 4.2), TCL pesticides (OLMO 4.2), and RCRA metals (ILMO 4.1). Groundwater samples were additionally analyzed in the field for pH, specific conductance, dissolved oxygen, temperature, and turbidity.

A subset of the available data was used for the SWMU 46 SLERA. All surface soil samples collected from 0-1 feet bgs 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 four 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 closest to the suspected source area, from 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 alter the concentration of any contaminants that may be present in the top foot of soil. This uncertainty is addressed in Section 7.2.3. No other subsurface soil data were included in SLERA. All available groundwater data were included in the risk evaluation. Groundwater sample SWMU46-TW03, although collected some distance upgradient from the SWMU, was included as a site sample rather than a site-specific background sample because soils above this sample were disturbed (evidence of vehicle traffic in this area) and due to the shallow depth to groundwater. Surface soil and groundwater data used for the ecological risk assessment are the same as those used for the human health risk assessment. These data are summarized on Table 7-1 and are presented in full in Appendix L.

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. As addressed above, 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 are those provided in the NCDENR SLERA Guidance (2003b) and are consistent with ecological screening values established by USEPA Region IV (USEPA 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. USEPA Region IV chemical-specific surface water (used to screen groundwater concentrations) and 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

Surface water screening values (SWSVs) used in this evaluation are brackish surface water screening values representing the minimum of USEPA Region IV freshwater and marine screening values obtained from the NCDENR Guidelines for Performing SLERAs (NCDENR 2003b). Surface water was not sampled at this site; however, brackish surface water screening values were used to screen groundwater contaminant concentrations. For screening values that are dependent on water hardness or pH (see below), freshwater and marine values are calculated with available site-specific data (if available) or default values before selecting the brackish criterion.

The chronic freshwater SWSVs for the RCRA metals cadmium and lead as well as 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, copper, lead, nickel, and zinc 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) (NCDENR 2003b) was used in place of a mean of site-specific hardness value to calculate SWSVs for total recoverable metals as follows (NCDENR 2003b, USEPA 2002a):

- Cadmium: $\text{SWSV} = e^{(0.7409*\ln(\text{hardness value})-4.719)}$
- Lead: $\text{SWSV} = e^{(1.273*\ln(\text{hardness value})-4.705)}$

It should be noted that the equation for cadmium provided by NCDENR (2003b) is a National Ambient Water Quaility Criterion (NAWQC). This equation has been updated to reflect the most recent NAWQC (USEPA 2002a).

In the SLERA, only total recoverable metals data for groundwater were considered. This is done as a conservative measure. Groundwater does not represent an exposure point for ecological receptors. The dissolved fraction of metals in groundwater is more likely to migrate through the aquifer than the total fraction; therefore, the use of total groundwater data is likely to overestimate potential risks to receptors in surface water bodies into which the groundwater may discharge. Dissolved groundwater data was not available at this SWMU. 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 standard units (S.U.) was used to adjust the chronic criterion for this organic chemical (USEPA 2002a).

Surface Water Screening Values – North Carolina Water Quality Standards

North Carolina Surface Water Quality Standards for Aquatic Life were obtained from the North Carolina guidelines for performing SLERAs (NCDENR 2003b). These standards were originally published as North Carolina Administrative Code (NCAC) Section 15A NCAC 2B (NCDENR 2003a).

Soil Screening Values

Soil screening values (SSSV) used in this evaluation were obtained from the NCDENR Guidelines for Performing SLERAs (NCDENR 2003b). The recommended soil screening values presented by NCDENR are consistent with values recommended by USEPA Region IV in the Ecological Risk Assessment Bulletins. The original sources for these values include the following: Beyer (1990), Efroymson et al. (1997a), Efroymson et al. (1997b), Canadian Council of Ministers of the Environment (CCME 1997), the Dutch Ministry of Housing, Spatial Planning and Environment MHSPE 1994), and Crommentuijn et al. (1997).

7.2.2.2 Hazard Quotient Calculation

A hazard quotient (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 2003b). HQs 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 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 equal to or 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 2003b):

- Category 1 – Chemicals whose maximum detection exceeds the USEPA Region IV 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 USEPA Region IV media specific ecological screening value (HQ>1.0; chemical not detected).
- Category 3 – Chemicals that have no USEPA Region IV 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 USEPA Region IV ecological screening value (No screening value; chemical not detected).
- Category 5 – Chemicals for which the maximum detection or 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 46. 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.

7.2.2.3 Results of the Abiotic Screen

The results of the abiotic screen for surface soil and groundwater are presented in the sections that follow. 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

Four surface soil samples collected from 0-2 feet bgs and 11 surface soil samples collected from 0-1 feet bgs were evaluated in the SLERA. As discussed in Section 7.2.1, the four 0-2 foot samples were analyzed for SVOCs and RCRA metals and the eleven 0-1 foot samples were analyzed for RCRA metals. Table 7-3 presents HQ calculations for surface soil. Fifty-four chemicals were identified as ecological COPCs in surface soils. Five metals (cadmium, chromium, lead, mercury, and silver) were identified as Category 1 COPCs because maximum detected concentrations exceeded soil screening values. Screening HQs for Category 1 COPCs ranged from 1.95 (mercury) to 151.50 (chromium), indicating the potential for unacceptable ecological risks. Figure 7-3 presents analytical data of Category 1 COPCs and indicates detected concentrations that exceeded USEPA Region IV soil screening values.

Eleven SVOCs were not detected but were identified as Category 2 COPCs because their MDL exceeded soil screening values. HQs for Category 2 COPCs ranged from 3.70 (for five SVOCs) to 900 (for pentachlorophenol).

One SVOC (bis(2-ethylhexyl)phthalate) was identified as a Category 3 COPC because it was detected at the site but lacked a soil screening value with which to evaluate potential risks.

Finally, 37 SVOCs were identified as Category 4 COPCs because they were not detected and are lacking soil screening values.

7.2.2.3.2 Groundwater

Groundwater data used in the SLERA included six samples collected from temporary monitoring wells in April 2002 and analyzed for RCRA metals; and one groundwater monitoring well sample collected in March 2004 and analyzed for RCRA metals. All monitoring wells at the SWMU were screened in the surficial aquifer. Groundwater data were compared to brackish surface water screening values. Table 7-4 presents HQ calculations for groundwater. Six of the eight RCRA metals were identified as ecological COPCs in groundwater. Chromium and lead were identified as Category 1 COPCs because maximum detected concentrations exceeded brackish surface water screening values. Chromium was also classified as a Category 5 COPC because the maximum detected concentration exceeded NCWQS for brackish water aquatic life. HQs (calculated with USEPA Region IV screening values) for Category 1 COPCs were 3.38 (for chromium) and 16.63 (for lead). Figure 7-4 presents analytical data of Category 1 COPCs and indicates detected concentrations that exceed USEPA Region IV screening values or NCWQS for freshwater aquatic life.

Cadmium, mercury, and silver were classified as Category 2 COPCs because they were not detected in groundwater but their MDLs exceeded the USEPA Region IV SWSV. HQs for cadmium, mercury and silver were 3.64, 8.33 and 96.67, respectively. Each of the Category 2 COPCs were also identified as COPCs in Category 5 because MDLs exceeded the NCWQS for aquatic life.

Barium was identified as a Category 3 COPC because it was detected in groundwater but lacked a freshwater SWSV with which to evaluate potential risks.

There were no RCRA metals classified as Category 4 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 46 and their effects on risk conclusions are presented and discussed below.

Limitations of Available Data Set

- Surface soil samples collected in 1997 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 approximate location of former mounded material in areas 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 alter the concentration of any contaminants that may be present in the top foot of soil (e.g., those deposited directly on to soils, as would be the expected nature of contamination at the SWMU).

  Additional uncertainty is introduced into the risk assessment by the use of the 1997 surface soil samples because these samples were not validated by an independent third-party data validator. Therefore, there is some uncertainty regarding the quality of these data. However, as described above, due to the location of these samples and their representation of the source of contamination 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.

- Surface soil samples collected in 1997 were not analyzed for VOCs and those samples collected in 2002 and 2004 were not analyzed for VOCs or SVOCs. VOC and SVOC analysis was excluded from the CSI and RFI sampling plan because VOCs were not suspected contaminants of concern at the SWMU and the sole SVOC detected in surface soil during Phase I (bis[2-ethylhexyl]phthalate) was detected at concentrations less than AOC background, Base background, NC DENR soil to groundwater screening criteria, and USEPA Region IX residential PRGs (Baker 2001a). Because SVOCs were not detected at levels of concern in Phase I of the SWMU investigation they were not considered to be of concern at the SWMU and were not included in analyses for subsequent investigations. The exclusion of VOCs and SVOCs from requested analyses in subsequent phases of investigation at this SWMU is in agreement with the phased nature of the investigation (see Section 7.2.1).

- 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 direct evidence that groundwater from the site reaches a surface water body. The 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.

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). Method detection limits indicate the maximum concentration above which it can be stated with certainty that a given chemical is not present in site media. There is some potential for non-detected chemicals to be present at the site at concentrations below the method detection limit; however, generally each chemical is as likely to be absent from the site or present at levels so low as to not pose unacceptable risk to ecological receptors. Therefore, 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 further consideration. 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. This uncertainty is reduced in Step 3a of the baseline ERA though the introduction of additional available toxicological data from the literature for those chemicals lacking Region IV ecological screening values.

- Some compounds detected in environmental media are known to be common laboratory contaminants. This includes the phthalate ester bis(2-ethylhexyl)phthalate, which was detected in the Phase I investigation (USEPA 1989). While validation of the data removes uncertainty involving laboratory contamination, Phase I data were not validated; therefore, there is the possibility that detections of such compounds in site media reflect laboratory conditions and not site conditions. This chemical was identified as an ecological COPC even though the detection my not represent site conditions.

Exposure Point Concentrations

- As is typical in a SLERA, a finite number of samples of abiotic 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 1993), which specify the use of average media concentrations. The use of mean concentrations to estimate exposure in a refinement (Step 3a of the baseline ERA) 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. 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. Because the dissolved fraction of metals in groundwater is more likely to migrate through the aquifer than the total fraction, the use of total recoverable metals data may overestimate potential risks to receptors in surface water bodies into which the groundwater may discharge. This is especially the case when high turbidity was an issue during groundwater collection. As indicated previously, dissolved groundwater data was not available at this SWMU.

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 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.

- 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.

- Surface water screening values for many chemicals were derived from literature-based toxicological data for a limited number of species. Uncertainty is added to the risk assessment when criteria, toxicological benchmarks, and literature-based toxicity data are used as screening values for a particular community of species that did not contribute to their development. For example, many of the surface water screening values are based

on laboratory toxicity studies that used invertebrates and/or fish as test species. As such, they may understate or overstate potential risks to amphibians.

- 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 fresh 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 due to the distance from the nearest downgradient water body from the site (2500 feet to Northeast Creek) and because no direct connection between the source of contamination at the site and this off-site aquatic habitat has been 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 46 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. However, it should be noted that many of the USEPA Region IV screening values do take into consideration potential upper trophic level risks when toxicological data are available. An separate evaluation of risks to upper trophic level receptors (e.g., food web modeling) is beyond the scope of the SLERA. The bioaccumulative potential of individual chemicals identified as COPCs in the SLERA is considered qualitatively 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 46 indicated that, based on a set of conservative exposure assumptions, there are multiple chemicals that may present a risk to ecological receptors at or in the vicinity of the site. Therefore, SWMU 46 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 USEPA Region IV media screening values. In Step 3a, screening values were introduced, when available, for chemicals that did not have screening values established by USEPA Region IV. 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 were those provided by NCDENR for chemical classes (e.g., the screening value for total PAHs is applied to individual PAHs), and USEPA Region V soil ecological screening values for RCRA hazardous constituents (USEPA 2003).

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. However, if maximum HQs indicated risk levels of particular concern, the spatial distribution of exceedences was further evaluated to identify any potential hot spots of contamination that may be driving unacceptable risk. Only if no hot spots were identified was a mean HQ less than one used as a sole criteria for eliminating a COPC from further consideration.

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 tables by the comment "Mean HQ < 1.0."

7.3.2 Comparison to Background Data

Inorganics in surface soils and groundwater that were selected as COPCs based on the SLERA were compared to background data. Two sets of background data are available at Camp Lejeune, Base Background data (Baker 2001a) and Area of Concern Background Data (Baker 2001b). The Base background soil study (Baker, 2001a) included surface and subsurface soil sampling at 50

borings advanced in areas of the Base that had no known history of any activity that may have biased inorganic concentrations in the soils. The purpose of the AOC background soil study (Baker, 2001b) was to establish background concentrations of inorganics for the group of SWMUs located within the AOCs that would be representative of conditions immediately surrounding to the SWMU (resultant of Base activities in that area). The AOCs were established based on geographical location, geology, and type of SWMU(s). The ERA background comparison focuses on AOC Background data because these data represent a more limited geographical area of sampling in the vicinity of the SWMU, are more representative of site-specific background conditions, and are more likely to help assess whether the presence of measured constituents may be attributed to the specific SWMU under consideration or to a broader area of activity within the AOC. The use of AOC background data in lieu of Base background data was supported by NCDENR. Base background data were considered for some chemicals within the Risk Characterization section of this report (Section 7.4). Surface soil samples for the AOC background study 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 46 is included within AOC 3, which is located on the eastern side of MCB Camp Lejeune. Therefore, surface soil data from SWMU 46 are compared to the AOC 3 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 46 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 IV Human Health Risk Assessment Bulletins, Supplement to RAGS, maximum site concentrations were compared to two times the base background mean (USEPA 2001). 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 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 46. 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

As addressed in Section 7.2.3, 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 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." The magnitude and frequency with which sample quantitation limits exceeded screening values and the likelihood for a chemical to be site-related, even if not detected (based on site history and presence of chemical precursors or daughter products at the site), were considered prior to removing a chemical from further consideration based on detection frequency. It should be noted that the exclusion of non-detected chemicals from further evaluation is considered reasonable and appropriate as this approach follows that outlined in the National Contingency Plan (NCP) (40 CFR 300 Appendix A), which does not establish a release when the sample measurement is less than the contract required detection limit as determined by an EPA-certified laboratory.

It should be noted that COPCs detected infrequently may also be removed from further consideration after evaluation of a variety of factors including the distribution of detections, the magnitude of potential risks, and the 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 Bioaccumulative Potential

The USEPA has identified certain chemicals as "important bioaccumulative chemicals" (USEPA 2000a). Bioaccumuative 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 chemical identified as a COPC in Step 2 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 Groundwater Considerations

In the SLERA, only total recoverable metals data for groundwater were considered. The dissolved fraction of metals in groundwater is more likely to migrate through the aquifer to surface water; therefore, the comparison of total metals data in groundwater to surface water screening values is a conservative approach. In the refined risk evaluation, dissolved data may be considered if available, as this data may provide a more realistic estimate of the concentration of metals that could migrate to off-site aquatic habitat. As stated previously, no dissolved groundwater data were available at this SWMU.

In addition, 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, the mean HQ for each of the groundwater COPCs with the exception of silver would be less than 1.0 (Table 7-7). Considerations of dilution were not used as 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.

No chemical-specific considerations were relevant for surface soil. Chemical-specific considerations for COPCs are addressed in the following paragraphs.

Lead was identified as a groundwater COPC in Category 1. Lead was detected in five of seven groundwater samples and had a maximum HQ (calculated with the USEPA Region IV freshwater screening value) of 16.63 and a mean HQ of 4.21. The maximum detected concentration of lead was 21.9 µg/L, detected in SWMU46-GW06. This sample was collected during the Phase II investigation, and was noted to have an elevated turbidity, which may have resulted in the elevated metals concentrations in that sample (Baker 2002b). The next highest detection of lead in groundwater was 4.6J µg/L, which is less than the NCWQS for brackish water aquatic life and less than four times the USEPA Region IV brackish surface water screening value. If a dilution factor of 10 were assumed to account for the dilution likely to occur upon migration and discharge of groundwater to surface water (Buchmann 1999), this 4.6J µg/L concentration of lead would equate to a 0.46J µg/L concentration in an off-site aquatic habitat into which the groundwater may discharge, which is less than the USEPA Region IV surface water screening value (1.32 µg/L). The RFI investigation included the sampling of groundwater from permanent monitoring well SWMU46-MW01, which was located in close proximity to SWMU46-GW06. SWMU46-MW01 is also the farthest downgradient groundwater sample location. Lead was not detected above detection limits in SWMU46-MW01 in 2004. Based on this information, lead is not migrating from the SWMU at ecologically significant concentrations and is unlikely to do so in the future. No further ecological evaluation of lead in groundwater at SWMU 46 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 54 chemicals identified as ecological COPCs in surface soil based on Steps 1 and 2 of the SLERA, chromium, lead, and mercury are recommended for further action or evaluation based on the results of Step 3a.

Chromium was detected in each of 15 surface soil samples at concentrations exceeding the soil screening value of 0.4 mg/kg. The USEPA Region IV soil screening value is based on toxic effects to terrestrial invertebrates. Eight of 15 sample concentrations exceeded a screening value protective of terrestrial plant populations (5 mg/kg, USEPA 2003a), and two of 15 exceeded a screening value protective of terrestrial microorganisms (10 mg/kg, Efroymson et al., 1997b). The maximum HQ for chromium (calculated with the 0.4 mg/kg screening value) was 151.50 and the mean HQ was 28.40. The screening value for chromium was derived from an earthworm study on the hexavalent form of the metal (Cr^{6+}) applied as potassium dichromate ($K_2Cr_2O_7$), a soluble salt (Efroymson et al. 1997b). Chromium occurs naturally in the hexavalent state and the trivalent state (Cr^{3+}). The form that is found in soils is a function of organic matter content, ferrous ion content, redox state, and pH (USEPA 2000c). The relative toxicity of Cr^{6+} and Cr^{3+} to soil invertebrates is unclear (Efroymson et al. 1997b); however, Cr^{6+} is more easily passed through cell membranes (Efroymson et al. 1997b) and shows a slightly greater toxicity to mammals (USEPA 2000c). If Cr^{6+} is also more toxic than $Cr^{3+}$to soil organisms, the use of a soil screening value derived from Cr^{6+} may overestimate potential risk. Chromium detections on site ranged from 3.5 to 60.6 mg/kg, while detections in AOC 3 background samples (Baker 2001b) ranged from 1.3 to 6.4 mg/kg. Detections in Base-wide background concentrations (Baker 2001a) ranged from 0.24 J mg/kg to 12.6 mg/kg (mean concentration 3.03 mg/kg). Typical background concentrations of chromium in the eastern United States range from 5 mg/kg to greater than 50 mg/kg (USEPA 2000c). The pattern of detections in the study area indicates widespread presence of chromium at levels less than 10 mg/kg (less than the maximum Base background level), with two hot spots of contamination: one at SWMU46-SB01-00 (36.5J mg/kg) and the other at SWMU46-TW04-00 (60.6 mg/kg). These hot spots are located near each other north of the approximate location of former mounded material. If these hotspots were removed, the mean concentration of chromium at the site would be 5.63 mg/kg (still in excess of the invertebrate and plant screening values, indicating unacceptable risk, but within the range of AOC and Base background levels). Hexavalent chromium (but not trivalent chromium) was identified as an important bioaccumulative chemical by the USEPA (2000a). Based upon the above considerations, chromium is identified as risk driving ecological COPC in surface soils and

may cause adverse effects to terrestrial flora and fauna and upper trophic level receptors. Additional action or evaluation of chromium, specifically addressing identified hot spots of contamination, is recommended to be protective of the terrestrial habitat at the SWMU.

Lead was detected in each of the 15 surface soil samples. Four of the detected concentrations were in excess of the soil screening value (50 mg/kg). The maximum detected concentration (1950 mg/kg; maximum HQ = 39.00) was located at SWMU46-TW04-00. A concentration of 528J mg/kg was detected in sample SWMU46-SB01-00. These two samples are located within 40 feet of each other north of the approximate location of former mounded material (Figure 7-3). Lead was detected at 242 mg/kg in sample SWMU46-TW06-00, which is located southeast of the location of former mounded material. Finally, lead concentrations in SWMU46-SB04-00 (55.9J mg/kg, located west of the location of former mounded material) just exceeded the soil screening value. Lead detections on site ranged from 4.7 to 1950 mg/kg, while detections in AOC 3 background samples ranged from 2.4J to 12.9J mg/kg and Base background concentrations ranged from 0.45 – 38.5J mg/kg. The mean concentration of lead in the study area was 200.87 mg/kg, resulting in a mean HQ of 4.02, which indicates some potential for adverse impacts to populations of ecological receptors. The Federal USEPA has published Eco-SSL Guidance for Lead (USEPA 2003b) that provides a soil invertebrate screening value of 1,700 mg/kg and a plant screening value of 110 mg/kg. All but one of the detections were less than the invertebrate screening value, indicating that risks to terrestrial fauna are likely to be restricted to the hot spot of contamination near SWMU46-TW04. Both maximum and mean SWMU concentrations exceeded the plant screening value, indicating some potential for unacceptable risk to terrestrial flora. Lead was identified as an important bioaccumulative chemical by the USEPA (USEPA 2000a). The Eco-SSL Guidance for lead recommends an avian screening value of 16 mg/kg and a mammalian screening value of 59 mg/kg. Based upon the above considerations, lead is identified as risk driving ecological COPC in surface soils and may cause adverse effects to terrestrial flora and fauna and upper trophic level receptors. Although the highest levels of concern are located in the vicinity of samples (SWMU46-TW04, SWMU46-SB01-00, and SWMU46-TW06-00), adverse impacts may be contributed by the site as a whole. Additional action or evaluation of lead is recommended to be protective of the terrestrial habitat at SWMU 46.

Mercury was detected in 13 of 15 surface soil samples at concentrations ranging from 0.025J to 0.83 mg/kg. Two of the detected concentrations were in excess of the soil screening value (0.1 mg/kg). The maximum detected concentration (0.83 mg/kg; maximum HQ = 8.30) was located at

SWMU46-SB01-00. A concentration of 0.5J mg/kg was detected in sample SWMU46-TW01-00. These samples are located north of the approximate location of former mounded material (Figure 7-3). Mercury detections on site exceeded AOC 3 background concentrations, which ranged from 0.021J to 0.042 mg/kg, and Base background concentrations, which ranged from 0.02J to 0.12J mg/kg. The mean concentration of mercury in the study area was 0.12 mg/kg, resulting in a mean HQ of 1.24, which indicates some potential for adverse impacts to populations of ecological receptors. Mercury was identified as an important bioaccumulative chemical by the USEPA (USEPA 2000a); therefore, risks to upper trophic level ecological receptors are also a concern. Based upon the above considerations, further action or evaluation of mercury in surface soils at SWMU 46 is recommended to be protective of the environment.

7.4.2 Groundwater

Groundwater in the surficial aquifer was evaluated for the potential to cause adverse effects to ecological receptors assuming that the groundwater discharges in to a surface water body. The nearest downgradient surface water body, Northeast Creek, is located approximately 2500 feet southeast of the site. It is noted that there is no direct evidence that groundwater from the surficial aquifer is currently discharging to this creek; however, the groundwater assessment was conducted as a conservative measure. Groundwater samples were analyzed for RCRA metals. Six of the eight RCRA metals were identified as groundwater ecological COPCs in the SLERA. Based on additional considerations addressed in Step 3a of the BERA, none are estimated to pose unacceptable risks to ecological receptors. Additional ecological evaluation of groundwater at SWMU 46 is not recommended.

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 listed in Section 7.2.3, the following is identified as an uncertainty of Step 3a of the BERA at SWMU 46.

Background Comparison

- The AOC 3 background soil samples and Base-wide background samples were collected from 0 to 1 foot bgs. Surface soil samples collected at SWMU 46 during the Phase I investigation were collected from 0 to 2 feet bgs, while surface soil samples collected

from subsequent investigations were collected from 0 to 1 foot bgs. As discussed in Section 7.2.3, the inclusion of soils from the 1 to 2 foot depth interval in Phase I samples adds uncertainty to the surface soil evaluation because contaminant concentrations in the upper foot of these samples may be diluted by constituent concentrations in soils from the 1 to 2 foot interval, or, if contamination is greater in the subsurface soils, data may indicate contaminant concentrations that are greater than those present in the biologically active surface zone. Because background data includes only those soils from 0 to 1 foot bgs, the comparison of these soils to site samples may not accurately indicate if site concentrations reflect background conditions or not. For example, if site concentrations are artificially elevated due to naturally occurring increased concentrations of some metals within the 1 to 2 foot bgs depth interval, comparison of site data to background data collected only from 0 to 1 foot bgs will not indicate that site conditions are at background levels.

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 vicinity of the SWMU 46 study area may be at risk from chromium, lead, and mercury in surface soils. Details regarding exact areas of concern are provided in Section 7.4, Risk Characterization.

Chromium concentrations throughout the study area were in excess of USEPA Region IV soil screening values, indicating that unacceptable risk may be posed to terrestrial receptors. Two hot spots of chromium contamination were identified: one in the vicinity of sample SWMU46-SB01-00 and the other in the vicinity of SWMU46-TW04-00, which are located north of the approximate location of former mounded material indicated on Figure 7-3. If these hot spots were removed, mean chromium concentrations on site would still be in excess of USEPA Region IV soil screening values; however, they would be within the range of AOC 3 and Base-wide background concentrations.

Lead concentrations on site may pose adverse effects to terrestrial flora and fauna and upper trophic level receptors. Although the highest levels of concern are located in the vicinity of samples SWMU46-TW04, SWMU46-SB01-00, and SWMU46-TW06-00, adverse impacts may be contributed by the site as a whole.

Mercury concentrations on site may pose adverse effects to terrestrial flora and fauna. Although only two detections of mercury (SWMU46-SB01-00 and SWMU46-TW01-00) exceeded USEPA Region IV soil screening value (0.1 mg/kg), based on the bioaccumulative nature of this chemical and its widespread presence at the study area, potential risk to upper trophic level receptors is also a concern. Additional action or evaluation of mercury is recommended to be protective of terrestrial receptors at SWMU 46.

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 46. No further ecological evaluation of groundwater is recommended.

7.7 References

Baker, 2001a — Baker Environmental, Inc. Phase I - SWMU Confirmatory Sampling Report (Revised Final), Marine Corps Base Camp Lejeune, North Carolina. Prepared for the Naval Facilities Engineering Command, Atlantic Division, Norfolk, Virginia. November 2001.

Baker, 2001b — Baker Environmental, Inc. Area of Concern Background Study (Final), Marine Corps Base Camp Lejeune, North Carolina Prepared for the Naval Facilities Engineering Command, Atlantic Division, Norfolk, Virginia. April 2001.

Baker, 2002a — Baker Environmental, Inc. Base Background Groundwater Study. Draft. Prepared for the Naval Facilities Engineering Command, Atlantic Division, Norfolk, Virginia. August 2002.

Baker, 2002b — Baker Environmental, Inc. Phase II - SWMU Confirmatory Sampling Report (Revised Draft), Marine Corps Base Camp Lejeune, North Carolina. Prepared for the Naval Facilities Engineering Command, Atlantic Division, Norfolk, Virginia. November 2002.

Beyer, 1990 — Beyer, W.N. 1990. Evaluating Soil Contamination. U.S. Fish and Wildlife Service., Biol. Rep. 90(2). 25pp.

Buchman, 1999 — Buchman, M.F. NOAA screening quick reference tables. NOAA HAZMAT Report 99-1, Seattle, WA. 12 pp.

CCME, 1997 — Canadian Council of Ministers of the Environment (CCME). Recommended Canadian Soil Quality Guidelines. CCME, Winnipeg, Manitoba. March 1997.

CNO, 1999 — Chief of Naval Operations . Navy policy for conducting ecological risk assessments. Memorandum from Chief of Naval Operations to Commander, Naval Facilities Engineering Command. Ser N453E/9U595355. April 5, 1999.

Crommentuijn, 1997 — Crommentuijn, T.; Polder, M.D.; Plassche, E.J. van de. 1997. Maximum Permissible Concentrations and Negligible Concentrations for metals, taking background concentrations into account. RIVM Rapport #601501001.

Efroymson, 1997a — Efroymson, R.A., M.E. Will, G.W. Suter II and A.C. Wooten. 1997a. Toxicological Benchmarks for Screening Contaminants of Concern on Terrestrial Plants: 1997 Revision. Environmental Risk Assessment Program, Oak Ridge National Laboratory, Issued November 1997.

Efroymson, 1997b — Efroymson, R.A., M.E. Will, and G.W. Suter II. 1997b. Toxicological Benchmarks for Potential Contaminants of Concern for Effects on Soil and Litter Invertebrates and Herterotrophic Process: 1997 Revision. Environmental Sciences Division, Oak Ridge National Laboratory. November 1997.

Franson, 1992 — Franson, M.H. (ed). 1992. Standard methods for examination of water and wastewater, 18th Edition. American Public Health Association, Washington D.C..

LeBlond et al. 1994 — LeBlond, Richard J., John Fussell, and Alvin L. Braswell. 1994. Inventory of the Rare Species, Natural Communities, and Critical Areas of Camp Lejeune Marine Corps Base, North Carolina. For the North Carolina Natural Heritage Program, Division of Parks and Recreation, Department of Environment, Health, and Natural Resources, Raleigh, North Carolina. February 1994.

MHSPE, 1994. — Ministry of Housing, Spatial Planning and Environment (MHSPE). 1994. Intervention values. Directorate-General for Environmental Protection, Department of Soil Protection, The Hague, Netherlands. 9 May. DBO/07494013.

NCDENR, 2003a. — North Carolina Department of Environment and Natural Resources, Division of Water Quality. "Redbook" Surface Waters and Wetland Standards. (North Carolina Administrative Code (NCAC) 15A NCAC 02B.0100 & .0200) Amended effective: April 1, 2003. (http://h2o.enr.state.nc.us/admin/rules/rb040103.pdf)

NCDENR, 2003b — Interim Final. Guidelines for Performing Screening Level Ecological Risk Assessments Within the North Carolina Division of Waste Management, North Carolina Department of Environment and Natural Resources, Division of Waste Management. October 2003.

OEPA, 1999 — Ohio Environmental Protection Agency. Closure Plan Review Guidance for RCRA Facilities. March 1999.

Suter 1995 — Suter, G.W. II. 1995. Guide for Performing Screening Ecological Risk Assessments at DOE Facilities. Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-153

Suter et al., 2000. — Suter, G.W. II, R.E. Efroymson, B.E. Sample, and D.S. Jones. 2000. Ecological Risk Assessment for Contaminated Sites. Lewis Publishers, Boca Raton, FL. 261/2978 pp.

USEPA, 1989 Risk Assessment Guidance for Superfund Volume I. Human Health Evaluation Manual (Part A) Interim Final. United States Environmental Protection Agency, Office of Solid Waste and Emergency Response. Washington, D.C. EPA/540/1-89-002. December 1989.RAGS part about lab contaminants

USEPA, 1993 Wildlife Exposure Factors Handbook. Office of Research and Development, Washington, D.C. EPA/600/R-93/187a.

USEPA, 1997a. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (Interim Final). U.S. Environmental Protection Agency, Environmental Response Team, EPA/540/R-97-006. June 5, 1997.

USEPA, 2000a Bioaccumulation Testing and Interpretation for the Purpose of Sediment Quality Assessment, Status and Needs. U.S. Environmental Protection Agency, Office of Water and Office of Solid Waste, EPA-823-R-00-001. February 2000.

USEPA, 2000b USEPA Region IV. Amended Guidance on Ecological Risk Assessment at Military Bases: Process Considerations, Timing of Activities, and Inclusion of Stakeholders. U. S. Environmental Protection Agency Region IV, Memorandum 4WD-OTS, June 23, 2000.

USEPA, 2000c Draft Ecological Soil Screening Level Guidance. Office of Emergency and Remedial Response. July 2000.

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

USEPA, 2002a National Recommended Water Quality Criteria: 2002. EPA 822-R-02-047 Office of Water. November 2002.

USEPA, 2002b National Functional Guidelines for Organic and Inorganic Analyses United States Environmental Protection Agency, Office of Emergency and Remedial Response. Washington, D.C. EPA-540-R-01-008. July 2002.

USEPA, 2003 United States Environmental Protection Agency, Region 5, RCRA. *Ecological Screening Levels*. 22 August 2003.

TABLES

TABLE 7-1
SUMMARY OF ANALYTICAL DATA USED IN THE SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT
SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA

Media	Sample ID	Date Sampled	Sample Interval or Well Depth (Feet below ground surface)	Analysis				Comments
				TCL VOCs (OLMO 4.2)	TCL SVOCs (OLMO 4.2)	RCRA Metals (ILMO 4.1)	Field parameters [1]	
Surface Soil	SWMU46-IS01-00	9/9/1997	0-2		X	X		
	SWMU46-IS02-00	9/9/1997	0-2		X	X		
	SWMU46-IS03-00	9/9/1997	0-2		X	X		
	SWMU46-IS04-00	9/9/1997	0-2		X	X		
	SWMU46-TW01-00	3/23/2002	0-1			X		
	SWMU46-TW02-00	3/23/2002	0-1			X		
	SWMU46-TW03-00	3/23/2002	0-1			X		
	SWMU46-TW04-00	3/23/2002	0-1			X		
	SWMU46-TW05-00	3/23/2002	0-1			X		
	SWMU46-TW06-00	3/23/2002	0-1			X		
	SWMU46-SB01-00	3/22/2004	0-1			X		
	SWMU46-SB02-00	3/22/2004	0-1			X		
	SWMU46-SB03-00	3/22/2004	0-1			X		
	SWMU46-SB04-00	3/22/2004	0-1			X		
	SWMU46-SB05-00	3/22/2004	0-1			X		
Groundwater	SWMU46-GW01	4/6/2002	17			X		Temporary Well
	SWMU46-GW02	4/6/2002	16			X		Temporary Well
	SWMU46-GW03	4/6/2002	17			X		Temporary Well
	SWMU46-GW04	4/6/2002	17			X		Temporary Well
	SWMU46-GW05	4/6/2002	16			X		Temporary Well
	SWMU46-GW06	4/6/2002	16			X		Temporary Well
	SWMU46-MW01	3/21/2004	16			X	X	Monitoring Well

Notes:
[1] pH, specific conductance, dissolved oxygen, temperature, and turbidity

TABLE 7-2
ECOLOGICAL SCREENING VALUES
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJUENE, NORTH CAROLINA

	USEPA Region IV Recommended Surface Soil Screening Values	
Analyte	**(ug/kg) or (mg/kg) [1,2]**	**Comment**
Semivolatile Organics:		
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	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	NA	
2,6-Dinitrotoluene	NA	
2-Chloronaphthalene	1000	value for chloronapthalene
2-Chlorophenol	NA	
2-Methylnaphthalene	NA	
2-Methylphenol	500	value for cresols
2-Nitroaniline	NA	
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	NA	
4-Chloroaniline	NA	
4-Chlorophenyl-Phenylether	10	value for chlorophenols
4-Methylphenol	500	value for cresols
4-Nitroaniline	NA	
4-Nitrophenol	7,000	
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	100,000	
Dimethylphthalate	200,000	
Di-n-butylphthalate	200,000	
Di-n-octylphthalate	NA	
Fluoranthene	NA	
Fluorene	NA	
Hexachlorobenzene	2.5	
Hexachlorobutadiene	100	value for aliphatic chlorinated hydrocarbons

TABLE 7-2
ECOLOGICAL SCREENING VALUES
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJUENE, NORTH CAROLINA

	USEPA Region IV Recommended Surface Soil Screening Values	
Analyte	**(ug/kg) or (mg/kg) [1,2]**	**Comment**
Semivolatile Organics (Cont):		
Hexachlorocyclopentadiene	10,000	
Hexachloroethane	100	value for aliphatic chlorinated hydrocarbons
Indeno(1,2,3-cd)pyrene	NA	
Isophorone	NA	
Naphthalene	NA	
Nitrobenzene	40,000	
n-Nitroso-di-n-propylamine	NA	
n-Nitrosodiphenylamine	20,000	
Pentachlorophenol	2	
Phenanthrene	NA	
Phenol	50	
Pyrene	NA	
PAHs (total)	1000	
Phthalates (total)	100	
Total Inorganics:		
Arsenic	10	
Barium	165	
Cadmium	1.6	
Chromium VI	0.4	Value for Chromium (total)
Lead	50	
Mercury	0.1	
Selenium	0.81	
Silver	2	

Notes:
NA = Not Applicable/ Not Established
(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) Values obtained from *Guidelines for Performing Screening Level Ecological Risk Assessments Within the North Carolina Division of Waste Management* (NCDENR 2003)

TABLE 7-2
ECOLOGICAL SCREENING VALUES
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJUENE, NORTH CAROLINA

	USEPA Region IV Recommended Brackish Surface Water Screening Values	
Analyte	(ug/L) [1]	Comment
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	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	
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	

TABLE 7-2
ECOLOGICAL SCREENING VALUES
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJUENE, NORTH CAROLINA

	USEPA Region IV Recommended Brackish Surface Water Screening Values	
Analyte	**(ug/L) [1]**	**Comment**
Semivolatile Organics (Cont):		
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)	17	Value for acenaphthene
Phthalates (total)	NA	
Total Inorganics:		
Arsenic	36	Trivalent (+3) form
Barium	NA	
Cadmium	0.161931454	Hardness = 50 mg CaCO3/L (default)(2)
Chromium VI	11	
Lead	1.316537634	Hardness = 50 mg CaCO3/L (default)
Mercury	0.012	
Selenium	5	
Silver	0.012	

Notes:

Brackish screening values represent the minimum of available freshwater and marine screening values

NA = Not Applicable/ Not Established

USEPA = United States Environmental Protection Agency

[1] Values obtained from *Guidelines for Performing Screening Level Ecological Risk Assessments Within the North Carolina Division of Waste Management* (NCDENR 2003)

[2] USEPA Region IV hardness based calculation updated to reflect current ambient water quality criteria (USEPA 2002).

TABLE 7-2
ECOLOGICAL SCREENING VALUES
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJUENE, NORTH CAROLINA

	North Carolina Surface Water Quality Standard for Aquatic Life - Brackish	
Analyte	**(ug/L) [1]**	**Comment**
Semivolatile Organics:		
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	
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	

TABLE 7-2
ECOLOGICAL SCREENING VALUES
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJUENE, NORTH CAROLINA

	North Carolina Surface Water Quality Standard for Aquatic Life - Brackish	
Analyte	**(ug/L) [1]**	**Comment**
Semivolatile Organics (Cont):		
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	
Phthalates (total)	NA	
Total Inorganics:		
Arsenic	50	
Barium	NA	
Cadmium	0.4	
Chromium VI	NA	
Lead	25	
Mercury	0.012	
Selenium	5	
Silver	0.06	

Notes:
Brackish screening values represent the minimum of available freshwater and marine screening values.
NA = Not Applicable/ Not Established
[1] Values obtained from *Guidelines for Performing Screening Level Ecological Risk Assessments Within the North Carolina Division of Waste Management* (NCDENR 2003).
Original reference: North Carolina Water Quality Standards (North Carolina Administrative Code. Title 15A, Subchapter 2L) October 25, 1995. Last updated 1 April 2003.

TABLE 7-3
SELECTION OF ECOLOGICAL COPCs IN SURFACE SOIL
SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	Contaminant Frequency/Range					EPA Region IV ESV	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)									
1,2,4-Trichlorobenzene	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
1,2-Dichlorobenzene (o-)	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
1,3-Dichlorobenzene (m-)	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
1,4-Dichlorobenzene (p-)	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
2,2'-Oxybis[1-chloropropane]	0/4	NA	NA	350U - 370U	370.00	100	3.70	Yes	2
2,4,5-Trichlorophenol	0/4	NA	NA	350U - 370U	370.00	4000	0.09	No	
2,4,6-Trichlorophenol	0/4	NA	NA	350U - 370U	370.00	10000	0.04	No	
2,4-Dichlorophenol	0/4	NA	NA	350U - 370U	370.00	3	123.33	Yes	2
2,4-Dimethylphenol	0/4	NA	NA	350U - 370U	370.00	500	0.74	No	
2,4-Dinitrophenol	0/4	NA	NA	1700U - 1800U	1800.00	20000	0.09	No	
2,4-Dinitrotoluene	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
2,6-Dinitrotoluene	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
2-Chloronaphthalene	0/4	NA	NA	350U - 370U	370.00	1000	0.37	No	
2-Chlorophenol	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
2-Methylnaphthalene	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
2-Methylphenol (o-Cresol)	0/4	NA	NA	350U - 370U	370.00	500	0.74	No	
2-Nitroaniline	0/4	NA	NA	1700U - 1800U	1800.00	NA	NA	Yes	4
2-Nitrophenol	0/4	NA	NA	350U - 370U	370.00	7000	0.05	No	
3,3'-Dichlorobenzidine	0/4	NA	NA	1700U - 1800U	1800.00	100	18.00	Yes	2
3-Nitroaniline	0/4	NA	NA	1700U - 1800U	1800.00	NA	NA	Yes	4
4,6-Dinitro-2-methylphenol	0/4	NA	NA	1700U - 1800U	1800.00	NA	NA	Yes	4
4-Bromophenyl-phenylether	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
4-Chloro-3-methylphenol	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
4-Chloroaniline	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
4-Chlorophenyl-phenylether	0/4	NA	NA	350U - 370U	370.00	10	37.00	Yes	2
4-Methylphenol (p-Cresol)	0/4	NA	NA	350U - 370U	370.00	500	0.74	No	
4-Nitroaniline	0/4	NA	NA	1700U - 1800U	1800.00	NA	NA	Yes	4

TABLE 7-3
SELECTION OF ECOLOGICAL COPCs IN SURFACE SOIL
SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	Contaminant Frequency/Range					EPA Region IV ESV	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)									
4-Nitrophenol	0/4	NA	NA	1700U - 1800U	1800.00	7000	0.26	No	
Acenaphthene	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
Acenaphthylene	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
Anthracene	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
Benzo(a)anthracene	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
Benzo(a)pyrene	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
Benzo(b)fluoranthene	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
Benzo(g,h,i)perylene	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
Benzo(k)fluoranthene	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
Bis(2-chloroethoxy)methane	0/4	NA	NA	350U - 370U	370.00	100	3.70	Yes	2
Bis(2-chloroethyl)ether	0/4	NA	NA	350U - 370U	370.00	100	3.70	Yes	2
Bis(2-ethylhexyl) Phthalate (BEHP)	1/4	42J - 42J	SWMU46-IS03-00	350U - 370U	42.00	NA	NA	Yes	3
Butyl Benzyl Phthalate	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
Carbazole	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
Chrysene	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
Dibenz(a,h)anthracene	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
Dibenzofuran	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
Diethyl Phthalate (DEP)	0/4	NA	NA	350U - 370U	370.00	100000	<0.01	No	
Dimethyl Phthalate	0/4	NA	NA	350U - 370U	370.00	200000	<0.01	No	
Di-n-butyl Phthalate (DBP)	0/4	NA	NA	350U - 370U	370.00	200000	<0.01	No	
Di-n-octyl Phthalate	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
Fluoranthene	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
Fluorene	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
Hexachlorobenzene	0/4	NA	NA	350U - 370U	370.00	2.5	148.00	Yes	2
Hexachlorobutadiene	0/4	NA	NA	350U - 370U	370.00	100	3.70	Yes	2
Hexachlorocyclopentadiene	0/4	NA	NA	1700U - 1800U	1800.00	10000	0.18	No	
Hexachloroethane	0/4	NA	NA	350U - 370U	370.00	100	3.70	Yes	2
Indeno(1,2,3-cd)pyrene	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
Isophorone	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
Naphthalene	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
Nitrobenzene	0/4	NA	NA	350U - 370U	370.00	40000	<0.01	No	
Nitrosodi-n-propylamine, n-	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
Nitrosodiphenylamine, n-	0/4	NA	NA	350U - 370U	370.00	20000	0.02	No	
Pentachlorophenol	0/4	NA	NA	1700U - 1800U	1800.00	2	900.00	Yes	2
Phenanthrene	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4
Phenol	0/4	NA	NA	350U - 370U	370.00	50	7.40	Yes	2
Pyrene	0/4	NA	NA	350U - 370U	370.00	NA	NA	Yes	4

TABLE 7-3
SELECTION OF ECOLOGICAL COPCs IN SURFACE SOIL
SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	Contaminant Frequency/Range					EPA Region IV ESV	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]				
Metals (mg/kg)									
Arsenic	11/15	0.59J - 7.7	SWMU46-SB01-00	0.28U - 1.6U	7.70	10	0.77	No	
Barium	11/15	8J - 131J	SWMU46-SB01-00	21U - 22.3U	131.00	165	0.79	No	
Cadmium	7/15	0.051J - 3.2	SWMU46-SB01-00	0.034U - 1.8U	3.20	1.6	2.00	Yes	1
Chromium	15/15	3.5 - 60.6	SWMU46-TW04-00	NA	60.60	0.4	151.50	Yes	1
Lead	15/15	4.7 - 1950	SWMU46-TW04-00	NA	1950.00	50	39.00	Yes	1
Mercury	13/15	0.025J - 0.83	SWMU46-SB01-00	0.036U - 0.037U	0.83	0.1	8.30	Yes	1
Selenium	3/15	0.53J - 0.68	SWMU46-TW06-00	0.42U - 1.05U	0.68	0.81	0.84	No	
Silver	2/15	0.55 - 3.9	SWMU46-SB01-00	0.093U - 1.1U	3.90	2	1.95	Yes	1

Notes:

[1] Maximum concentration. If contaminant was not detected, equals the maximum detection limit.

U = Chemical was not detected above the method detection limit
J = Estimated Value

COPC = Contaminant of Potential Concern
EPA = Environmental Protection Agency
ESV = Ecological Screening Value
Hazard Quotient = Contaminant Concentration/ ESV
MDL = Maximum Detection Limit
mg/kg = milligram per kilogram
NA = Not Available
SQL = Sample Quantitation Limit
ug/kg = microgram per kilogram

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 exceeds 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 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA

Analyte	Contaminant Frequency/Range					EPA Region IV Brackish 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]						
Metals (ug/L)											
Arsenic	2/7	4.2J - 5.7J	SWMU46-GW06	2.13U - 2.4U	5.70	36	0.16	50	No	No	
Barium	7/7	59.4 - 152	SWMU46-GW01	NA	152.00	NA	NA	NA	NA	Yes	3
Cadmium	0/7	NA	NA	0.25U - 0.59U	0.59	0.16193	3.64	0.4	Yes	Yes	2 , 5
Chromium	6/7	0.83J - 31.4	SWMU46-GW06	0.88U	31.40	9.3	3.38	20	Yes	Yes	1 , 5
Lead	5/7	2.2J - 21.9	SWMU46-GW06	1.56U - 1.8UJ	21.90	1.31654	16.63	25	No	Yes	1
Mercury	0/7	NA	NA	0.01U - 0.1U	0.10	0.012	8.33	0.012	Yes	Yes	2 , 5
Selenium	0/7	NA	NA	2.32U - 4.6U	4.60	5	0.92	5	No	No	
Silver	0/7	NA	NA	0.9U - 1.16U	1.16	0.012	96.67	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
EPA = Environmental Protection Agency
Hazard Quotient = Contaminant Concentration/ CSV
J = Estimated Value
MDL = Maximum detection limit
mg/L = miligram per liter
NA = Not Available
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

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 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJUENE, NORTH CAROLINA

Analyte	Step 3A Soil Screening Values		
	(ug/kg) or (mg/kg) (1)	Reference (2)	Comment
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		
Semivolatile Organics (Cont.):			
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	
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
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	

TABLE 7-5
MEDIA-SPECIFIC SCREENING VALUES FOR STEP 3A
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJUENE, NORTH CAROLINA

Analyte	Step 3A Soil Screening Values		
	(ug/kg) or (mg/kg) [1]	Reference [2]	Comment
Semivolatile Organics (Cont.):			
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		
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 VI	0.4		Value for Chromium (total)
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 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJUENE, NORTH CAROLINA

Analyte	USEPA Region IV Recommended Surface Water Screening Values - Brackish Water [1]		
	(ug/L)	Reference	Comment
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
Semivolatile Organics (Cont.):			
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	
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	0.299		
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		
Hexachloroethane	9.4		
Indeno(1,2,3-cd)pyrene	4.31	USEPA, 2003	
Isophorone	129		

TABLE 7-5
MEDIA-SPECIFIC SCREENING VALUES FOR STEP 3A
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJUENE, NORTH CAROLINA

Analyte	USEPA Region IV Recommended Surface Water Screening Values - Brackish Water [1]		
	(ug/L)	Reference	Comment
Semivolatile Organics (Cont.):			
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		
Total Inorganics:			
Arsenic	36		Trivalent (+3) form
Barium	220	USEPA, 2003	
Cadmium	0.1619	NCDENR 2003, USEPA 2002	Hardness = 50 mg CaCO3/L (default)(2)
Chromium VI	11		
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
[1] Brackish screening value is the minimum of freshwater and salt water screening values.
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 46
RCRA FACILITY INVESTIGATION (CTO-0041)
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]	Maximum Site Concentration	2 X Mean Background [4] Concentration	Maximum Site Concentration Less than 2X Background?	Frequency of Detection	Contaminant Detected?			
Semivolatiles (ug/kg)												
1,2,4-Trichlorobenzene	4	178.75	50	3.58	ND	NA	NA	0/4	No	Yes	No	Not Detected
1,2-Dichlorobenzene (o-)	4	178.75	50	3.58	ND	NA	NA	0/4	No	Yes	No	Not Detected
1,3-Dichlorobenzene (m-)	4	178.75	50	3.58	ND	NA	NA	0/4	No	Yes	No	Not Detected
1,4-Dichlorobenzene (p-)	4	178.75	50	3.58	ND	NA	NA	0/4	No	Yes	No	Not Detected
2,2'-Oxybis[1-chloropropane]	2	178.75	100	1.79	ND	NA	NA	0/4	No	No	No	Not Detected
2,4-Dichlorophenol	2	178.75	3	59.58	ND	NA	NA	0/4	No	No	No	Not Detected
2,4-Dinitrotoluene	4	178.75	1280	0.14	ND	NA	NA	0/4	No	No	No	Mean HQ < 1.0
2,6-Dinitrotoluene	4	178.75	32.8	5.45	ND	NA	NA	0/4	No	No	No	Not Detected
2-Chlorophenol	4	178.75	2.5	71.50	ND	NA	NA	0/4	No	No	No	Not Detected
2-Methylnaphthalene	4	178.75	3240	0.06	ND	NA	NA	0/4	No	No	No	Mean HQ < 1.0
2-Nitroaniline	4	875.00	74100	0.01	ND	NA	NA	0/4	No	No	No	Mean HQ < 1.0
3,3'-Dichlorobenzidine	2	875.00	100	8.75	ND	NA	NA	0/4	No	No	No	Not Detected
3-Nitroaniline	4	875.00	NA	NA	ND	NA	NA	0/4	No	No	No	Not Detected
4,6-Dinitro-2-methylphenol	4	875.00	NA	NA	ND	NA	NA	0/4	No	No	No	Not Detected
4-Bromophenyl-phenylether	4	178.75	NA	NA	ND	NA	NA	0/4	No	Yes	No	Not Detected
4-Chloro-3-methylphenol	4	178.75	2.5	71.50	ND	NA	NA	0/4	No	No	No	Not Detected
4-Chloroaniline	4	178.75	1100	0.16	ND	NA	NA	0/4	No	No	No	Mean HQ < 1.0
4-Chlorophenyl-phenylether	2	178.75	10	17.88	ND	NA	NA	0/4	No	Yes	No	Not Detected
4-Nitroaniline	4	875.00	NA	NA	ND	NA	NA	0/4	No	No	No	Not Detected
Acenaphthene	4	178.75	1000	0.18	ND	NA	NA	0/4	No	Yes	No	Mean HQ < 1.0
Acenaphthylene	4	178.75	1000	0.18	ND	NA	NA	0/4	No	Yes	No	Mean HQ < 1.0
Anthracene	4	178.75	1000	0.18	ND	NA	NA	0/4	No	Yes	No	Mean HQ < 1.0
Benzo(a)anthracene	4	178.75	1000	0.18	ND	NA	NA	0/4	No	Yes	No	Mean HQ < 1.0
Benzo(a)pyrene	4	178.75	1000	0.18	ND	NA	NA	0/4	No	Yes	No	Mean HQ < 1.0
Benzo(b)fluoranthene	4	178.75	1000	0.18	ND	NA	NA	0/4	No	Yes	No	Mean HQ < 1.0
Benzo(g,h,i)perylene	4	178.75	1000	0.18	ND	NA	NA	0/4	No	Yes	No	Mean HQ < 1.0
Benzo(k)fluoranthene	4	178.75	1000	0.18	ND	NA	NA	0/4	No	Yes	No	Mean HQ < 1.0
Bis(2-chloroethoxy)methane	2	178.75	100	1.79	ND	NA	NA	0/4	No	No	No	Not Detected
Bis(2-chloroethyl)ether	2	178.75	100	1.79	ND	NA	NA	0/4	No	No	No	Not Detected
Bis(2-ethylhexyl) Phthalate (BEHP)	3	145.50	100	0.42	42 J	NA	NA	1/4	Yes	No	No	Mean HQ < 1.0
Butyl Benzyl Phthalate	4	178.75	100	1.79	ND	NA	NA	0/4	No	No	No	Not Detected
Carbazole	4	178.75	NA	NA	ND	NA	NA	0/4	No	No	No	Not Detected
Chrysene	4	178.75	1000	0.18	ND	NA	NA	0/4	No	Yes	No	Mean HQ < 1.0
Dibenz(a,h)anthracene	4	178.75	1000	0.18	ND	NA	NA	0/4	No	Yes	No	Mean HQ < 1.0
Dibenzofuran	4	178.75	NA	NA	ND	NA	NA	0/4	No	No	No	Not Detected

TABLE 7-6
REFINED ASSESSMENT OF ECOLOGICAL CONTAMINANTS OF POTENTIAL CONCERN IN SURFACE SOIL
SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
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]	Maximum Site Concentration	2 X Mean Background [4] Concentration	Maximum Site Concentration Less than 2X Background?	Frequency of Detection	Contaminant Detected?			
Semivolatiles (ug/kg)			0									
Di-n-octyl Phthalate	4	178.75	100	1.79	ND	NA	NA	0/4	No	No	No	Not Detected
Fluoranthene	4	178.75	1000	0.18	ND	NA	NA	0/4	No	Yes	No	Mean HQ < 1.0
Hexachlorobenzene	2	178.75	2.5	71.50	ND	NA	NA	0/4	No	Yes	No	Not Detected
Hexachlorobutadiene	2	178.75	100	1.79	ND	NA	NA	0/4	No	Yes	No	Not Detected
Hexachloroethane	2	178.75	100	1.79	ND	NA	NA	0/4	No	Yes	No	Not Detected
Indeno(1,2,3-cd)pyrene	4	178.75	1000	0.18	ND	NA	NA	0/4	No	Yes	No	Mean HQ < 1.0
Isophorone	4	178.75	139000	<0.01	ND	NA	NA	0/4	No	No	No	Mean HQ < 1.0
Naphthalene	4	178.75	1000	0.18	ND	NA	NA	0/4	No	No	No	Mean HQ < 1.0
Nitrosodi-n-propylamine, n-	4	178.75	544	0.33	ND	NA	NA	0/4	No	No	No	Mean HQ < 1.0
Pentachlorophenol	2	875.00	2	437.50	ND	NA	NA	0/4	No	Yes	No	Not Detected
Phenanthrene	4	178.75	1000	0.18	ND	NA	NA	0/4	No	Yes	No	Mean HQ < 1.0
Phenol	2	178.75	50	3.58	ND	NA	NA	0/4	No	No	No	Not Detected
Pyrene	4	178.75	1000	0.18	ND	NA	NA	0/4	No	Yes	No	Mean HQ < 1.0
METALS (mg/kg)												
Cadmium	1	0.47	1.6	0.30	3	0.04	No	7/15	Yes	Yes	No	Mean HQ < 1.0
Chromium	1	11.36	0.4	28.40	61	6.37	No	15/15	Yes	Yes	Yes	Mean HQ > 1.0
Lead	1	200.87	50	4.02	1950	12.43	No	15/15	Yes	Yes	Yes	Mean HQ > 1.0
Mercury	1	0.12	0.1	1.24	1	0.06	No	13/15	Yes	Yes	Yes	Mean HQ > 1.0
Silver	1	0.49	2	0.24	4	0.10	No	2/15	Yes	Yes	No	Mean HQ < 1.0

Notes:
COPC = Ecological Contaminant of Potential Concern
HQ = Hazard Quotient
mg/kg = milligram per kilogram
ug/kg = microgram per kilogram
NA = Not Applicable
ND = Not Detected
J = Estimated Value.

[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 3 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 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA

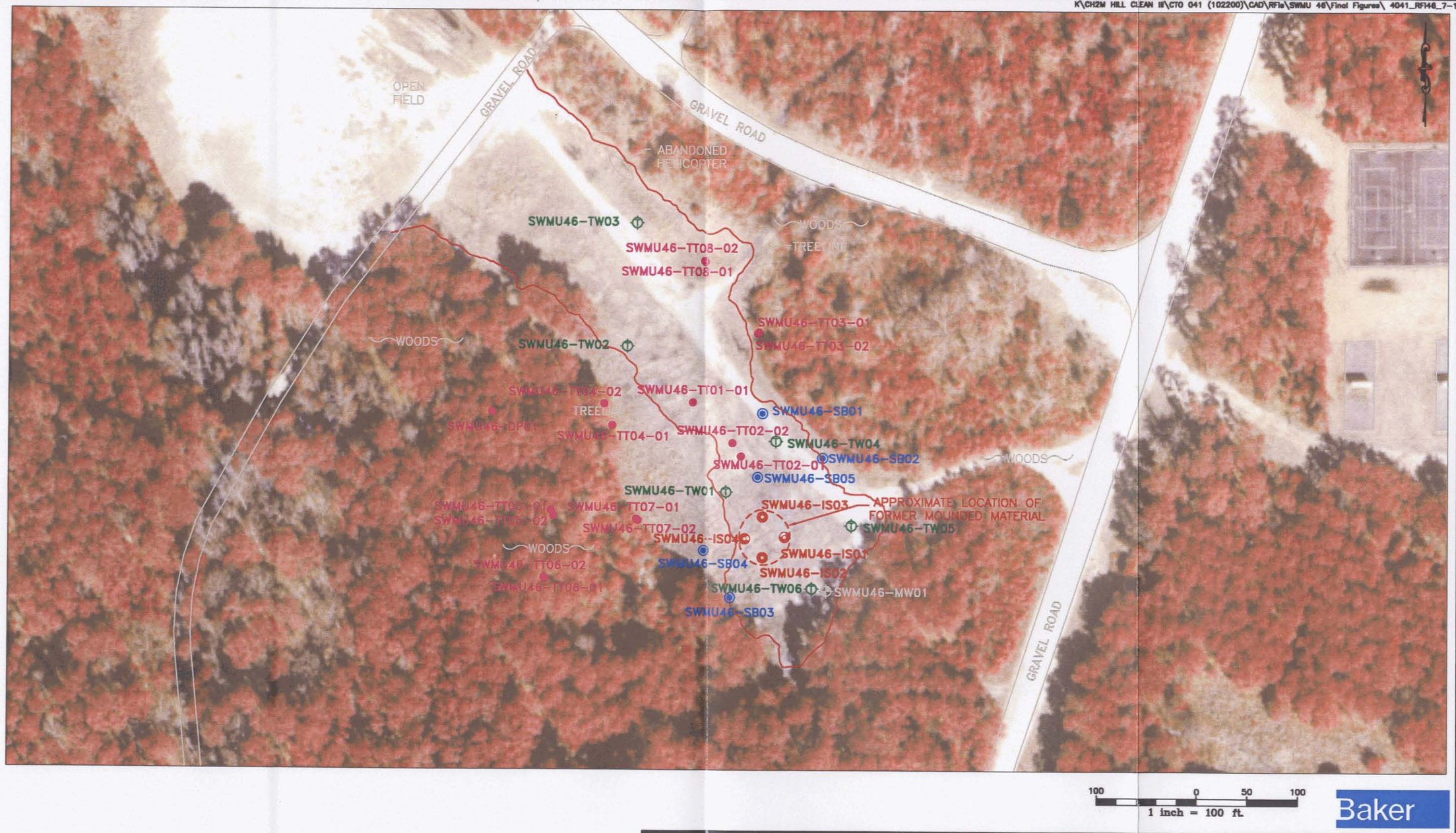
Ecological Contaminant of Potential Concern based on Steps 1 and 2	Contaminant Category [1]	Refined Risk Screening					Background Comparison			Frequency of Detection		Important Bioaccumulative Chemical? [5]	Further Evaluation Recommended based on Step 3A?	Comments
		Arithmetic Mean (Half Non-Detects)	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 Less than 2X Mean Background?	Frequency of Detection	Contaminant Detected?			
Metals (ug/L)														
Barium	3	86.1	220	NA	0.39	NA	152.00	86.24	No	7/7	Yes	No	No	Mean HQ < 1.0
Cadmium	2, 5	0.1671	0.162	0.4	1.03	0.42	ND	0.36	No	0/7	No	Yes	No	Not Detected
Chromium	1, 5	6.21	9.3	20	0.67	0.31	31.40	3.13	No	6/7	Yes	Yes	No	Mean HQ < 1.0
Lead	1	5.54	1.317	25	4.21	0.22	21.90	2.80	No	5/7	Yes	Yes	No	See text
Mercury	2, 5	0.0436	0.012	0.012	3.63	3.63	ND	0.10	No	0/7	No	Yes	No	Not Detected
Silver	2, 5	0.4686	0.012	0.06	39.05	7.81	ND	0.77	No	0/7	No	Yes	No	Not Detected

Notes:
HQ = Hazard Quotient
COPC = Ecological Contaminant of Potential Concern
ug/L = microgram per liter
NA = Not Applicable
ND = Not Detected
NE = Note Established

[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 document *Bioaccumulation Testing and Interpretation for the Purpose of Sediment Quality Assessment, Status and Needs* (EPA-823-R-00-001, February 2000).

FIGURES

K:\CH2M HILL CLEAN III\CTO 041 (102200)\CAD\RFIs\SWMU 46\Final Figures\ 4041_RFI46_7-1



Baker

LEGEND

- PHASE I SOIL BORING
- PHASE II TEMPORARY WELL
- RFI TEST TRENCH SAMPLE (SWMU46-TT02-01)
- RFI SURFACE SOIL SAMPLE LACATION (SWMU46-DP01)
- RFI MONITORING WELL SAMPLE LOCATION
- RFI SOIL BORING

FIGURE 7-1

AERIAL VIEW

RCRA FACILITY INVESTIGATION - SWMU 46

CTO-0041

MARINE CORPS BASE, CAMP LEJEUNE

CAMP LEJEUNE

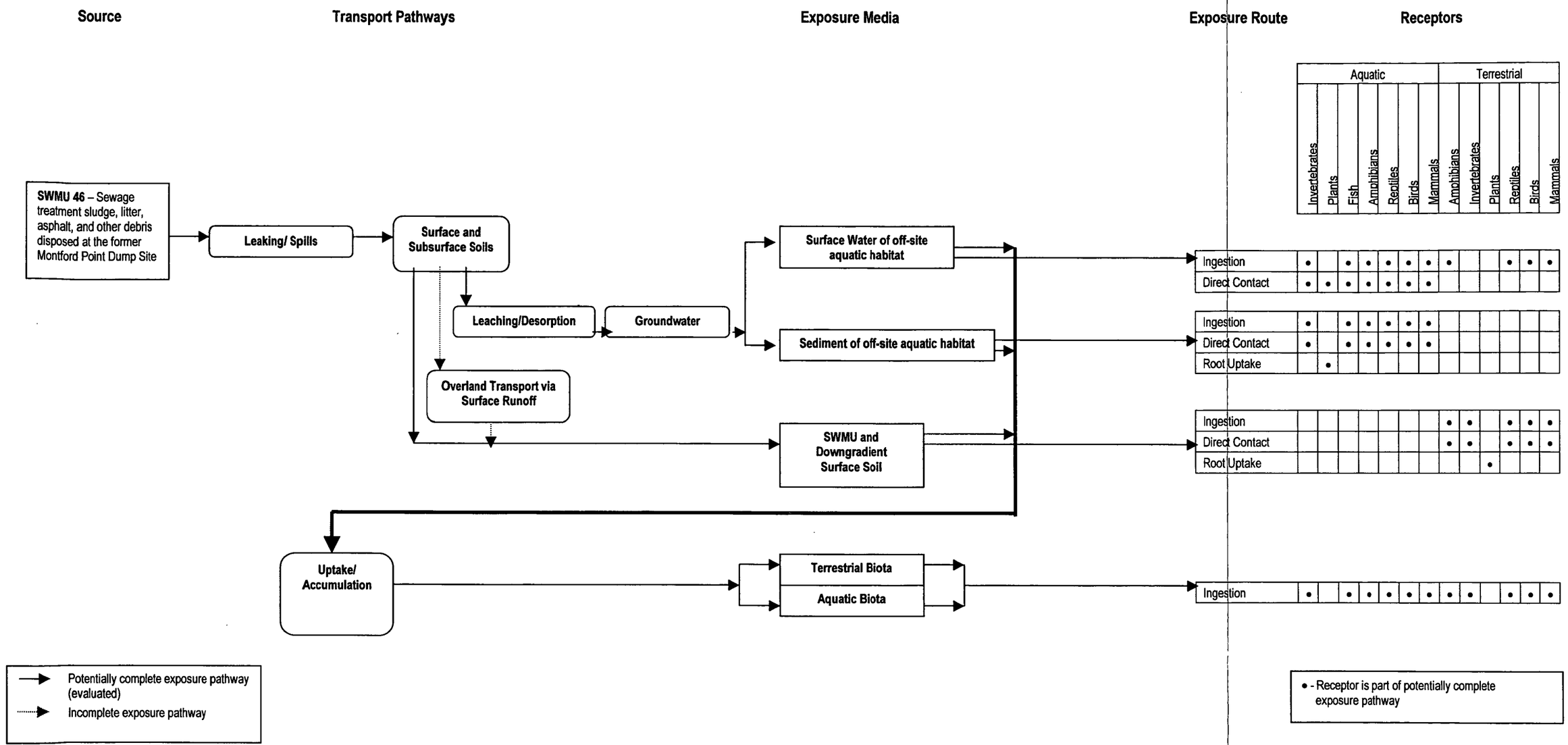
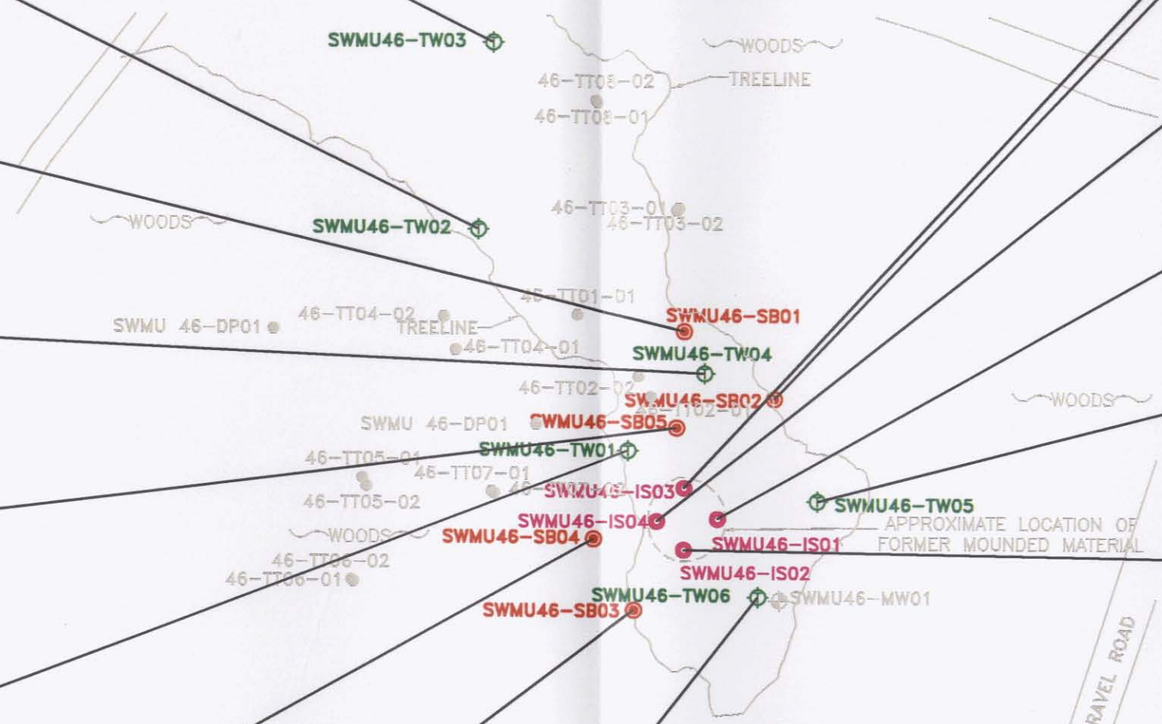


FIGURE 7-2. ECOLOGICAL CONCEPTUAL MODEL
SWMU 46, MCB CAMP LEJEUNE



SAMPLE ID	SWMU46-TW03-00
SAMPLE DATE	03-23-2002
DEPTH	0'-1'
METALS (mg/kg)	
Cadmium	0.13 J
Chromium	**4.2**
Lead	11.4
Mercury	0.04 J
Silver	0.095 U

SAMPLE ID	SWMU46-TW02-00
SAMPLE DATE	03-23-2002
DEPTH	0'-1'
METALS (mg/kg)	
Cadmium	0.051 J
Chromium	**4.6**
Lead	16.5
Mercury	0.061 J
Silver	0.095 U

SAMPLE ID	SWMU46-SWMU46-SB01-00
SAMPLE DATE	3/22/2004
DEPTH	0-1
METALS (mg/kg)	
Cadmium	**3.2**
Chromium	**36.5 J**
Lead	**528 J**
Mercury	**0.83**
Silver	**3.9**

SAMPLE ID	SWMU46-TW04-00
SAMPLE DATE	03-23-2002
DEPTH	0'-1'
METALS (mg/kg)	
Cadmium	0.51 J
Chromium	**60.6**
Lead	**1950**
Mercury	0.075 J
Silver	0.55

SAMPLE ID	SWMU46-SWMU46-SB05-00
SAMPLE DATE	3/22/2004
DEPTH	0-1
METALS (mg/kg)	
Cadmium	0.05 U
Chromium	**5.3 J**
Lead	5.4 J
Mercury	0.03 J
Silver	0.21 U

SAMPLE ID	SWMU46-TW01-00
SAMPLE DATE	03-23-2002
DEPTH	0'-1'
METALS (mg/kg)	
Cadmium	0.034 U
Chromium	**4**
Lead	4.7
Mercury	**0.5 J**
Silver	0.1 U

SAMPLE ID	SWMU46-SWMU46-SB04-00
SAMPLE DATE	3/22/2004
DEPTH	0-1
METALS (mg/kg)	
Cadmium	0.4 J
Chromium	**7.2 J**
Lead	**55.9 J**
Mercury	0.04 J
Silver	0.21 U

SAMPLE ID	SWMU46-SWMU46-SB03-00
SAMPLE DATE	3/22/2004
DEPTH	0-1
METALS (mg/kg)	
Cadmium	0.87 U
Chromium	**6.5 J**
Lead	34.6 J
Mercury	0.025 J
Silver	0.2 U

SAMPLE ID	SWMU46-TW06-00
SAMPLE DATE	03-23-2002
DEPTH	0'-1'
METALS (mg/kg)	
Cadmium	0.25 J
Chromium	**8**
Lead	**242**
Mercury	0.047 J
Silver	0.099 U

SAMPLE ID	SWMU46-IS03-00
SAMPLE DATE	09-09-1997
DEPTH	0'-2'
METALS (mg/kg)	
Cadmium	0.53 U
Chromium	**3.5**
Lead	28.9
Mercury	0.053
Silver	1.1 U

SAMPLE ID	SWMU46-SWMU46-SB02-00
SAMPLE DATE	3/22/2004
DEPTH	0-1
METALS (mg/kg)	
Cadmium	1.8 U
Chromium	**4.6 J**
Lead	48.4 J
Mercury	0.04 J
Silver	0.21 U

SAMPLE ID	SWMU46-IS04-00
SAMPLE DATE	09-09-1997
DEPTH	0'-2'
METALS (mg/kg)	
Cadmium	0.56 U
Chromium	**4.1**
Lead	5.7
Mercury	0.037 U
Silver	1.1 U

SAMPLE ID	SWMU46-IS01-00
SAMPLE DATE	09-09-1997
DEPTH	0'-2'
METALS (mg/kg)	
Cadmium	0.53 U
Chromium	**9.3**
Lead	38.6
Mercury	0.048
Silver	1.1 U

SAMPLE ID	SWMU46-TW05-00
SAMPLE DATE	03-23-2002
DEPTH	0'-1'
METALS (mg/kg)	
Cadmium	0.12 J
Chromium	**4.9**
Lead	34.9
Mercury	0.04 J
Silver	0.093 U

SAMPLE ID	SWMU46-IS02-00
SAMPLE DATE	09-09-1997
DEPTH	0'-2'
METALS (mg/kg)	
Cadmium	0.55 U
Chromium	**7.1**
Lead	8
Mercury	0.036 U
Silver	1.1 U

USEPA Region IV Soil Screening Value	
METALS (mg/kg)	
Cadmium	1.6
Chromium	0.4
Lead	50
Mercury	0.1
Silver	2.0

Notes:
Bold font indicates detected concentrations that exceed USEPA Region IV Soil Screening Values.
mg/kg = milligram per kilogram

100 0 50 100
1 inch = 100 ft.

Baker

LEGEND

- PHASE I SOIL BORING
- PHASE II TEMPORARY WELL
- RFI SOIL BORING
- RFI MONITORING WELL SAMPLE LOCATION
- RFI TEST TRENCH SAMPLE

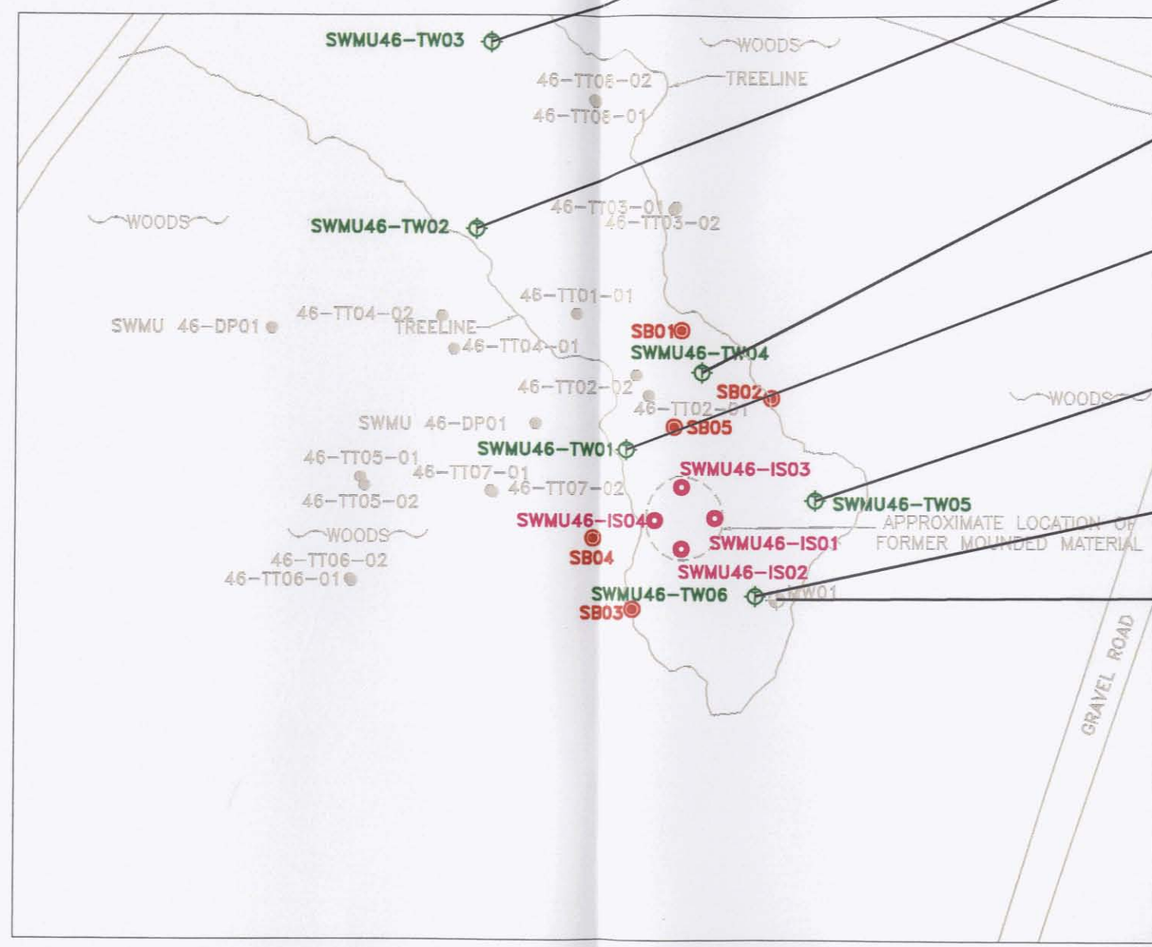
FIGURE 7-3

CATEGORY 1 ECOLOGICAL CONTAMINANTS OF POTENTIAL CONCERN IN SURFACE SOIL

RCRA FACILITY INVESTIGATION – SWMU 46
CTO-0041

MARINE CORPS BASE, CAMP LEJEUNE
CAMP LEJEUNE

K:\CH2M HILL CLEAN III\CTO 041\ (102200)\CAD\RFIs\SWMU 46\Final Figures\ 4041_RFI_7-4



SAMPLE ID	SWMU46-GW03
SAMPLE DATE	04-06-2002
METALS (ug/L)	
Chromium	2.1 J
Lead	1.8 UJ

SAMPLE ID	SWMU46-GW02
SAMPLE DATE	04-06-2002
METALS (ug/L)	
Chromium	0.83 J
Lead	**4.6 J**

SAMPLE ID	SWMU46-GW04
SAMPLE DATE	04-06-2002
METALS (ug/L)	
Chromium	1 J
Lead	**4.4 J**

SAMPLE ID	SWMU46-GW01
SAMPLE DATE	04-06-2002
METALS (ug/L)	
Chromium	4.7 J
Lead	**4 J**

SAMPLE ID	SWMU46-GW05
SAMPLE DATE	04-06-2002
METALS (ug/L)	
Chromium	3 J
Lead	**2.2 J**

SAMPLE ID	SWMU46-GW06
SAMPLE DATE	04-06-2002
METALS (ug/L)	
Chromium	***31.4***
Lead	**21.9**

SAMPLE ID	SWMU46-MW01
SAMPLE DATE	03-21-2004
METALS (ug/L)	
Chromium	0.88 U
Lead	1.56 U

USEPA Region IV Brackish Surface Water Screening Value	
METALS (ug/L)	
Chromium	9.3
Lead	1.32

NCWQS Brackish water aquatic life	
METALS (ug/L)	
Chromium	20
Lead	25

100 0 50 100
1 inch = 100 ft.

Baker
Baker Environmental, Inc.

Notes:
Bold font indicates detected concentrations in excess of USEPA Region IV Brackish Surface Water Screening Values.
Italic font indicates detected concentrations in excess of North Carolina Water Quality Standards for brackish water aquatic life.
ug/L = microgram per liter

LEGEND
- PHASE II TEMPORARY WELL
- PHASE II SURFACE SOIL SAMPLE
- PHASE I SOIL BORING
- PHASE I SURFACE SOIL
- SURFACE SOIL SAMPLE LACATION
- MONITORING WELL SAMPLE LOCATION

FIGURE 7-4
DETECTIONS OF CATEGORY 1 ECOLOGICAL COPCs IN GROUNDWATER EXCEEDING SCREENING VALUES
CTO-0041

MARINE CORPS BASE, CAMP LEJEUNE
CAMP LEJEUNE

8.0 CONCLUSIONS AND RECOMMENDATIONS

This section provides a discussion of conclusions that can be rendered based on the data collected from the Phase I and II CSIs and the RFI. Recommendations for future actions are presented after the conclusions.

8.1 Conclusions

It is evident that SWMU 46 has been impacted by pesticide and metals contamination in soil:

- Surface and subsurface soil contamination exists in the area of the soil mounds. These soil mounds are located in the southeastern portion of the SWMU. Contaminants in soil include arsenic, cadmium, chromium, mercury, lead, and silver. This area of contamination has not be defined or delineated.

- Subsurface soil contamination exists within the landfill debris. SVOCs, pesticides and metals were detected above the established screening criteria. Those contaminants include: Benzo(a)anthracene, 4,4'-DDD, 4,4'-DDT, alpha-chlordane, and gamma-chlordane.

- Based on comparison of samples collected from inside the landfill debris with those collected from the adjacent native soils, pesticide concentrations are higher in the debris than seen in the native soils adjacent to the debris. This provides evidence that the pesticide concentrations within the debris are not likely from base wide pesticide application, but may be from the result of disposal activities.

- The results of the baseline HHRA for SWMU 46 found that there were 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 calculated that exceeded the United States Environmental Protection Agency (USEPA) acceptable range for the future adult or young child resident. Also, the total HI for the adult resident did not exceed the USEPA's acceptable hazard level.

- The total site HI for the child resident exceeded the USEPA's acceptable hazard level. Chromium was retained as a COPC in all media at SWMU 46 and its HQ exceeded 1.0 when summed over all exposure pathways. This indicates adverse health effects may occur for the future child resident receptor upon exposure to chromium in groundwater and soil investigated at SWMU 46. The maximum detected concentration of chromium in groundwater was used in the risk calculations to maintain a conservative approach. If this concentration were to be removed from the groundwater data set, the remaining chromium concentrations in groundwater would not produce an unacceptable hazard level.

- There were no carcinogenic risks calculated that exceeded USEPA's acceptable range for the future construction worker. However, the total site HI for the construction worker exceeded the USEPA's acceptable hazard level. Inhalation of chromium in fugitive dusts from subsurface soil contributed predominantly to the elevated HI. Therefore, adverse health effects may occur for the future construction worker receptor upon exposure to surface and subsurface soil investigated at SWMU 46.

- The USEPA lead IEUBK model was used to determine if exposure to site media would result in unacceptable blood lead levels in younger children upon exposure to surface soil, subsurface soil, and groundwater at SWMU 46. The model indicated no adverse health effects resulting from exposure to surface soil. The results of the model indicate that the potential for adverse health effects from exposure to lead in subsurface soil and groundwater may occur in the future child resident.

- The results of the Ecological Risk Assessment (ERA) found that terrestrial receptors that may forage or live in the vicinity of the SWMU 46 study area may be at risk from chromium, lead, and mercury in surface soils.

8.2 Recommendations

Based on the preceding conclusions, the following recommendations are made:

- Additional surface and subsurface soil sampling to delineate the existing soil contamination identified in the vicinity of the soil mounds and the old landfill.

- Monitoring wells need to be installed in and around the old landfill to assess the condition of groundwater at the SWMU.

- Further characterization of the landfill debris is needed to aid in future site management decisions.

Baker

Baker Environmental, Inc.

APPENDIX A

Geophysical Report

Results of Geophysical Investigation

SWMU 46
Camp Johnson – Camp LeJeune
Jacksonville, North Carolina

Prepared for: **CH2M Hill**
Herndon, Virginia

Dates of Investigation: **March 2-4, 2004**

Prepared by:

Robert W. Gimpel
Geologist - Project Manager

Introduction

Survey Design

Methods

Results

Conclusions

Plate 1: EM-31 Quadrature Phase (terrain conductivity) contour map

Plate 2: EM-31 In-Phase contour map

Plate 3: Analytic signal from total field magnetics contour map

SWMU 46
Camp Johnson - Camp LeJeune
Jacksonville, North Carolina

Introduction

On March 2nd, 3rd, and 4th, 2004, NAEVA Geophysics, Inc. conducted a geophysical investigation at a site identified as SWMU 46 of Camp Johnson located within Camp LeJeune in Jacksonville, North Carolina. The area of investigation (AOI) was approximately 3 acres in size. The purpose of the investigation was to attempt to delineate the northeastern and southwestern boundaries of a suspected landfill area identified in a previous NAEVA investigation (April 2-3, 2002).

Survey Design

The AOI was in the wooded areas northeast and southwest of the original investigation area. NAEVA established a 425-foot east-west oriented baseline along Line 775 North, which was deemed sufficiently north of the suspected landfill boundary. NAEVA personnel used a transit to establish a grid of parallel survey lines spaced 50 feet apart, along which 25-foot stations were marked using temporary plastic pin flags. Two lines were added to the northeast side, and four lines were added on the southwest side.

Methods

The equipment selected for this investigation included a Geonics EM-31 DL terrain conductivity meter and a Scintrex Smartmag cesium-vapor magnetometer in conjunction with an Envi-Mag proton-precession magnetometer.

The Geonics EM-31 is an electromagnetic (EM) frequency-domain instrument primarily used to measure ground conductivity. The EM-31 provides an output of both the quadrature-phase (terrain conductivity) and in-phase (response to metal) components of an induced electromagnetic field, which are recorded simultaneously.

The quadrature-phase is a measurement of the conductivity in milliSiemens per meter (mS/m). Terrain conductivity is a function of porosity, degree of saturation, and the conductivity of the subsurface materials. The absolute values of terrain conductivity are not usually

diagnostic, but their spatial variations are important. The ability to identify lateral variations in the conductivity of the shallow subsurface makes quadrature-phase EM-31 data very useful in the delineation of boundaries between different fill types.

The in-phase data from the EM-31 is primarily used in searching for buried metal, and is measured in units of relative parts per thousand (ppt) of the electromagnetic field. A negative instrument response is usually expected over areas containing shallow, buried metal (both ferrous and nonferrous).

Total field magnetic surveys are useful in identifying buried ferrous materials. Ferrous material typically manifests a remnant magnetic field that varies in orientation from that of the Earth's magnetic field. The summation of the two fields results in distortions (anomalies) in the overall (total) field. These local, high frequency (short wavelength) anomalies in the Earth's magnetic field can therefore be interpreted as subsurface ferrous material. Field data collected in the survey area with the cesium-vapor "Smartmag" is corrected for daily fluctuations in the earth's field by matching the time stamps of each reading with the base station proton-precession magnetometer.

EM-31 and Smartmag data were collected continuously (2 readings per second) along the traverses spaced 50 feet apart. The EM-31 data were stored in a data logger and then downloaded into a laptop computer for processing using Geonics' DAT-31. The magnetics data were stored in the operating consoles and downloaded into a laptop computer immediately after collection for diurnal correction and processing using Scintrex's Envimag software. Once the data were preliminarily processed, it was contoured in the field using Golden's Surfer software. Final presentation quality geophysical maps incorporated current data and data from the 2002 survey. Final geophysical maps were produced using Oasis Montaj's Geosoft software.

Results

An area of anomalous response that is consistent with a small landfill is observed with both EM and total field geophysical methods. The feature is located in the central portion of the area. Suspected boundaries between landfill and non-landfill material have been identified along the northeast and southwest sides.

In the quadrature (conductivity) phase component of the EM-31 data (Plate 1), the highest amplitudes are within the central portion of the anomalous feature. Elevated conductivity readings are observed to decrease away from the peak response in a relatively circular shape. The northeastern boundary of the anomaly is essentially unchanged by the additional data. To the southwest, however, a significant lobe extends southwest and then southeast from the largest portion of the anomaly. Two smaller anomalies are observed on the northeast side, one of which appears immediately north of the circular feature appears as a "low" or negative value in the quadrature-phase data, and appears to be separate from the larger anomalous area. A second low anomaly was observed in the extreme eastern portion of the investigation area, but this anomaly was caused by a large coil of steel cable.

The in-phase (metal-detection) component of the EM-31 (Figure 2) exhibits a series of discrete anomalies concentrated within the elevated conductivity defined by the quadrature phase. The small, high and low-amplitude anomalies serve to confirm the presence of metal existing in the subsurface that corresponds to the elevated conductivity readings.

Total field magnetics data (Figure 3) exhibits a large anomalous feature located in the central portion of the survey area consistent with the other data sets. The anomalous feature was confirmed to terminate at the approximate area suspected before, while the anomaly extendedly 150 feet or more to the southwest. A single lobe of the magnetic anomaly extends beyond the investigation area, but this may be caused by several large pieces of scrap metal that were observed on the surface. Multiple magnetic peaks within the anomalous area correlate well with the anomalous conductivity data response. Several additional anomalies are observed in the northern and southern portions of the survey area that are slightly exhibited in the in-phase data. The isolated ferrous metal sources of these anomalies are not necessarily associated with the potential landfill feature.

Conclusions

The large anomalous area identified with the geophysical methods has a lateral surface expression of approximately 250 feet (grid) north/south and 375 feet (grid) east/west. The extreme amplitude of the anomalous area suggests a significant concentration of metal exists in the subsurface. Numerous smaller anomalies scattered throughout the investigation area likely represent discrete metal objects that are not necessarily related to landfill material.

Baker

Baker Environmental, Inc.

APPENDIX B

Test Boring and Well Construction/Development/Sampling Records

Baker
Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	RCRA Facility Investigation -CTO -0041		
PROJECT NO.:	102200	Well Name:	SWMU46-MW01
COORDINATES: EAST:	2476510.495	NORTH:	359403.402
ELEVATION: SURFACE:	NA	TOP OF PVC CASING:	NA

Rig: Ingersol Rand 300	Split Spoon	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)			6.25 in.		3/18/2004	16	Partly cloudy, 74 F	4.0'
Length			5 ft.					
Type			HAS					
Hammer Wt.								
Fall								

Remarks: Adjacent to former location of SWMU46 - TW06

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample M = Macro sampler

WELL INFORMATION

Description	Type	Diam. (in)	Top Depth (Ft.)	Bottom Depth (Ft.)
Well Casing	PVC, Schedule 40	2 in.	0.3	6
Well Screen	PVC, Schedule 40, 0.010 slot	2.0" OD	6	16

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	USCS CODES	PID (ppm) ps/bg	Visual Description	Well Detail	Bore Detail	Elevation (Ft. MSL)
1				SM	0.0	F. SAND, trace silt, damp, loose, light brown			
					1.0	1.6			
2	M-1	2.7		CL		CLAY, trace sand, moist, firm, semi-plastic, orange & gray mottled			
		67.5%			0.0	2.6			
3				SM		F. SAND, trace silt, damp, loose, orange & gray mottled			
4	4.0				NA	4.0			
5				SM	0.0	F. SAND, trace silt, wet, loose, light gray, orange staining			
					0.0				
6	M-2	2.5							
		62.5%			NA				
7									
					NA				
8	8.0								
9				SM	0.0				
10		M-3	3.3		0.0	10.2			

DRILLING CO.:	PARRATT-WOLFF, INC.	BAKER REP.:	DAVID SCHILLING
DRILLER:	Steve Smith	BORING NO.:	SWMU46-MW01 SHEET 1 OF 2

Baker
Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: RCRA Facility Investigation -CTO -0041
PROJECT NO.: 102200 BORING NO.: SWMU46-MW01

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	USCS CODES	PID (ppm) ps/bg	Visual Description	Well Detail	Bore Detail	Elevation (Ft. MSL)
11			82.5%		SP	0.0	M. SAND, trace silt, wet, loose, orangish brown			
12	12.0					NA	11.3			
13										
14		NA	NA						No Recovery	
15										
16	16.0						16.0			
17							Termination Depth = 16.0'			
18										
19										
20										
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										

DRILLING CO.: PARRATT-WOLFF, INC. BAKER REP.: DAVID SCHILLING
DRILLER: Steve Smith BORING NO.: SWMU46-MW01 SHEET 2 OF 2

Baker
Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	RCRA Facility Investigation - CTO-0041		
PROJECT NO.:	102200	BORING NAME:	SWMU 46-SB01
COORDINATES: EAST:	2476461.067	NORTH:	359601.706
ELEVATION: SURFACE:	NA	DIAMETER: (inches)	2

Rig: INGERSOL RAND 300	Split Spoon	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)					3/22/2004	12'	Sunny 40's - 50's	6.0'
Length								
Type								
Hammer Wt.								
Fall								

Remarks: 4' Macrocore (2") used for soil sampling

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample M = Macro

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.,%)	Sample Interval	USCS CODES	PID (ppm) ps/bg	Visual Description		Bore Detail	Elevation (Ft. MSL)
1				00		0.0	F. SAND, little silt, glass and rock frags; trace roots; dk brown; damp			
					SM	NA				
2		M-1	1.0 25.0%					2.2		
						NA				
3					CL					
						NA				
4	4.0							4.0		
5						0.0	Same as above, except trace clay; tan; moist			
						0.0				
6		M-2	2.0 50.0%	03	SM					
						0.0	wet at 6.0'			
7										
						NA				
8	8.0									
9		M-3	2.9 72.5%		SM	0.0	F/M SAND, little silt, trace clay, orangish brown and grey			
10						0.0				

DRILLING CO.:	PARRATT WOLFF INC	BAKER REP.:	Mark DeJohn
DRILLER:	Richard Navatka	BORING NO.:	SWMU 46-SB01 SHEET 1 OF 2

Baker
Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: RCRA Facility Investigation - CTO-0041
PROJECT NO.: 102200 BORING NO.: SWMU 46-SB01

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	USCS CODES	PID (ppm) ps/bg	Visual Description	Bore Detail	Elevation (Ft. MSL)
11		M-3	2.9 72.5%		SM	0.0 NA	FINE SAND, some silt, trace clay; gray		
12	12.0								
13							Termination depth 12'		
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

DRILLING CO.: PARRATT WOLFF INC BAKER REP.: Mark DeJohn
DRILLER: Richard Navatka BORING NO.: SWMU 46-SB01 SHEET 2 OF 2

Baker
Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	RCRA Facility Investigation -CTO -0041		
PROJECT NO.:	102200	BORING NAME:	SWMU 46-SB02
COORDINATES: EAST:	2476514.242	NORTH:	359540.934
ELEVATION: SURFACE:	NA	DIAMETER: (inches)	2

Rig: INGERSOL RAND 300	Split Spoon	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)					3/22/2004	12'	Sunny 40's - 50's	8.0'
Length								
Type								
Hammer Wt.								
Fall								

Remarks: 4' Macrocore (2") used for soil sampling

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample M = Macro

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.,%)	Sample Interval	USCS CODES	PID (ppm) ps/bg	Visual Description	Bore Detail	Elevation (Ft. MSL)
1			00		0.0	F. SAND, little silt and rock fragments; dark brown; damp		
2	M-1	3.8 95.0%		SM	0.0			
3					1.0	sone silt, little clay; orangish brown; damp		
4	4.0				0.0	trace silt; grey; damp		
5					0.0			
6	M-2	2.7 67.5%		SM	0.0	little silt, trace clay; grey; moist, wet at tip		
7					0.0			
8	8.0		04		NA	tan with trace orange-brown laminae; moist to wet water at 8.0'		
9	M-3	3.0 75.0%		SM	0.0			
10					0.0	moist zone		

DRILLING CO.:	PARRATT WOLFF INC	BAKER REP.:	Mark DeJohn
DRILLER:	Richard Navatka	BORING NO.:	SWMU 46-SB02 SHEET 1 OF 2

Baker
Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: RCRA Facility Investigation -CTO -0041
PROJECT NO.: 102200 BORING NO.: SWMU 46-SB02

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.,%)	Sample Interval	USCS CODES	PID (ppm) ps/bg	Visual Description	Bore Detail	Elevation (Ft. MSL)
11		M-3	3.0 75.0%		SM	0.0 NA	FINE SAND, little silt, trace clay; orangish brown and grey layers; wet		
12	12.0						12.0		
13							Termination depth 12'		
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

DRILLING CO.: PARRATT WOLFF INC BAKER REP.: Mark DeJohn
DRILLER: Richard Navatka BORING NO.: SWMU 46-SB02 SHEET 2 OF 2

Baker
Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	RCRA Facility Investigation -CTO -0041		
PROJECT NO.:	102200	BORING NAME:	SWMU 46-SB03A
COORDINATES: EAST:	2476402.367	NORTH:	359413.176
ELEVATION: SURFACE:	NA	DIAMETER: (inches)	2

Rig: INGERSOL RAND 300	Split Spoon	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)					3/22/2004	8'	Sunny 40's - 50's	4.0
Length								
Type								
Hammer Wt.								
Fall								

Remarks: 4' Macrocore (2") used for soil sampling

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample M = Macro

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.,%)	Sample Interval	USCS CODES	PID (ppm) ps/bg	Visual Description		Bore Detail	Elevation (Ft. MSL)
				00	SM		F. SAND, little silt, roots; dark brown	0.4		
1				MS/MSD	SM		F. SAND, some silt, trace clay; tan; damp	1.0		
2		M-1	3.4 85.0%		CL		CLAY, trace silt, trace clay; orange-brown; da	2.3		
3					SM		F. SAND, some silt, trace clay; orange-brown; damp			
4	4.0			02			trace silt; grey			
5							water at 4.0' wet			
6		M-2	2.4 60.0%		SM		trace orange-brown layering			
7										
8	8.0							8.0		
9							Termination depth 8'			
10										

DRILLING CO.:	PARRATT WOLFF INC	BAKER REP.:	Mark DeJohn
DRILLER:	Richard Navatka	BORING NO.:	SWMU 46-SB03A SHEET 1 OF 1

Baker
Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	RCRA Facility Investigation -CTO -0041		
PROJECT NO.:	102200	BORING NAME:	SWMU 46-SB04
COORDINATES:	EAST: 2476373.363	NORTH:	359462.208
ELEVATION:	SURFACE: NA	DIAMETER: (inches)	2

Rig: INGERSOL RAND 300	Split Spoon	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)					3/22/2004	8'	Sunny 40's - 50's	5.0
Length								
Type								
Hammer Wt.								
Fall								

Remarks: 4' Macrocore (2") used for soil sampling

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample M = Macro

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.,%)	Sample Interval	USCS CODES	PID (ppm) ps/bg	Visual Description	Bore Detail	Elevation (Ft. MSL)
1		M-1	2.9 72.5%	00	FI		F. SAND, little silt, trace clay, roots; brown; gl fragments		
2							rust orange-brown layering		
3							some glass fragment layers, soft blue-grey mat		
4	4.0			02			black; rust and orange-brown layers		
5		M-2	2.2 55.0%		FI		porceilin fragments wet at 5.0'		
6									
7					SM		F. SAND, little silt, trace clay; grey becoming tan and grey layering with trace black laminse; wet		
8	8.0						8.0		
9							Termination depth 8'		
10									

DRILLING CO.:	PARRATT WOLFF INC	BAKER REP.:	Mark DeJohn
DRILLER:	Richard Navatka	BORING NO.:	SWMU 46-SB04 SHEET 1 OF 1

Baker
Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	RCRA Facility Investigation - CTO-0041		
PROJECT NO.:	102200	BORING NAME:	SWMU 46-SB05
COORDINATES: EAST:	2476441.769	NORTH:	359517.609
ELEVATION: SURFACE:	NA	DIAMETER: (inches)	2

Rig: INGERSOL RAND 300	Split Spoon	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)					3/22/2004	12'	Sunny 40's - 50's	8.0'
Length								
Type								
Hammer Wt.								
Fall								

Remarks: 4' Macrocore (2") used for soil sampling

SAMPLE TYPE
S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample M = Macro

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.,%)	Sample Interval	USCS CODES	PID (ppm) ps/bg	Visual Description	Bore Detail	Elevation (Ft. MSL)
1			00		0.0	F. SAND, little silt, trace clay; brown; damp orangish brown		
				SM				
2	M-1	3.7 92.5%			0.0	2.2		
3				CL	1.0	CLAY, little silt, orangish brown with grey laminae; damp		
4	4.0				0.0	3.4 F. SAND, trace silt; grey; damp		
5					0.0			
6	M-2	2.8 70.0%		SM	0.0			
7					0.0	tan; moist		
8	8.0		04		NA			
9	M-3	3.7 92.5%		SM	0.0	little silt, trace clay, orangish brown and grey layers; wet at 8.0'		
10					0.0	moist zone		

DRILLING CO.:	PARRATT WOLFF INC	BAKER REP.:	Mark DeJohn
DRILLER:	Richard Navatka	BORING NO.:	SWMU 46-SB05 SHEET 1 OF 2

Baker
Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: RCRA Facility Investigation - CTO-0041
PROJECT NO.: 102200 BORING NO.: SWMU 46-SB05

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	USCS CODES	PID (ppm) ps/bg	Visual Description	Bore Detail	Elevation (Ft. MSL)
11	M-3	3.7 92.5%		SM	0.0 NA	FINE SAND, little silt, trace clay; orangish brown and grey layers; wet		
12 12.0						Termination depth 12'		
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

DRILLING CO.: PARRATT WOLFF INC BAKER REP.: Mark DeJohn
DRILLER: Richard Navatka BORING NO.: SWMU 46-SB05 SHEET 2 OF 2

Baker

Baker Environmental

WELL DEVELOPMENT RECORD

Project: Camp Lejeune RCRA Program - SWMU 46

Project. No: CTO-041 Monitoring Well ID: 46-MW01

Date: 3/20/04

Depth to Water: 4.74 (Top/PVC) Well Diameter: 2 (inches)

Total Well Depth: 16.00 (Top/PVC) Gallons/foot: 0.163

Well Volume: 1.84 (Gallons) Avg. Flow Rate: 0.8 gpm

Time	Gallons Removed	Well Volume	Temperature (°C)	Specific Conductance (µS)	pH (SU)	Turbidity (NTU)	Comments
1215	15	8.2	(1)	(1)	(1)	Er-2[2]	
1230	25	13.6	(1)	(1)	(1)	Er-2	
1245	35	19.1	(1)	(1)	(1)	Er-2	
1300	45	24.5	(1)	(1)	(1)	850	
1315	55	30.0	(1)	(1)	(1)	605	Raised tubing approx 5'
1330	65	35.4	(1)	(1)	(1)	Er-2	
1400	80	43.6	(1)	(1)	(1)	Er-2	
1415	85	46.3	(1)	(1)	(1)	Er-2	
1430	90	49.0	(1)	(1)	(1)	Er-2	
1445	100	54.5	(1)	(1)	(1)	Er-2	

Notes: (1) Measurements not taken; development based on turbidity and well volume

(2) Value is over range of instrument

APPENDIX B

SUMMARY OF GROUNDWATER SAMPLING FIELD PARAMETERS
SWMU 46
RCRA FACILITY INVESTIGATION, CTO - 041
MCB, CAMP LEJEUNE, NORTH CAROLINA

Well Number	Sampling Date	Well Depth (ft)[1]	Depth to Water (ft)[1]	Purge Volume (gal)	Field Parameters					
					Well Volume	Specific Cond.[2] (ms/cm)	pH (SU)[3]	Temp. (deg. C)	Dissolved Oxygen (mg/l)	Turbidity (NTU)[4]
SWMU 46-MW01	3/21/2004	16.0	4.74	1.84	1	0.161	3.42	13.43	4.06	24.7
					2	0.157	3.41	13.67	3.74	6.94
					3	0.153	3.38	13.63	2.94	1.4
					3.5	0.152	3.39	13.64	3.48	1.19
					4	***0.152***	***3.40***	***13.63***	***3.43***	***0.62***

Notes:

[1] - Measured from top of PVC Casing

[2] - Specific Conductance at 25 deg. C

[3] - SU = Standard Units

[4] - NTU = Nephelometric Turbidity Units

The bold and italicized parameters where taken immediately prior to sampling the well.

NR= Readings were not taken because these parameters were stable.

>1100 indicates that turbidity was outside of meter's range of detection

(-) = initial parameters not recorded

Baker

Baker Environmental, Inc.

APPENDIX C

Chain-of-Custody Documentation

MICHAEL BAKER JR., INC.

NUMBER OF COOLERS 1

CHAIN OF CUSTODY NUMBER: 01

PAGE NUMBER: 1 OF 1

CUSTOMER INFORMATION

Company: Michael Baker Jr., Inc.
Project Number: 102200 FI.SG
Address: 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)	pH (SW 846, Method 9045C)											COMMENTS/ PRECAUTIONS
SWMU318-SB01-00	SS	3/16/04	1401	1		X		X												
SWMU318-SB01-04	SU	3/16/04	1410	1		X		X												
SWMU318-SB02-00	SS	3/16/04	1445	3	X															
SWMU318-SB02-01	SU	3/16/04	1450	1		X		X												
SWMU318-SB02-01D	SU	3/16/04	1450	1		X		X												
SWMU318-SB03-01	SU	3/16/04	1551	1		X		X												
SWMU318-SB04-01	SS	3/16/04	1503	3	X															
SWMU318-SB04-02	SU	3/16/04	1510	1		X		X												
SWMU318-SB04-04	SU	3/16/04	1515	1		X		X												
SWMU318-SB06-00	SS	3/16/04	1600	3	X															
SWMU318-SB06-00 D	SS	3/16/04	1600	3	X															
TB01	LB	3/16/04	1630	3	X															
SWMU318-SB06-01	SU	3/16/04	1610	1		X		X												
SWMU318-SB06-01D	SU	3/16/04	1610	1		X														
SWMU318-SB06-02	SU	3/16/04	1625	1		X		X												
SWMU318-SB02-04	SU	3/16/04	1522	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. Sok II		2.) Relinquished By:		SPECIAL INSTRUCTIONS
Signature:	Date:	Signature:	Date:	
Company: Michael Baker Jr., Inc.	Time:	Company	Time:	
1.) Received By:		**2.) Received By:**		
Signature:	Date:	Signature:	Date:	
Company	Time:	Company	Time:	

MICHAEL BAKER JR., INC.

NUMBER OF COOLERS 2

CHAIN OF CUSTODY NUMBER: 02

PAGE NUMBER: 1 OF 1

CUSTOMER INFORMATION

Company: Michael Baker Jr., Inc.
Project Number: 102200 FI.SG
Address: 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)	pH (SW 846, Method 9045C)											COMMENTS/ PRECAUTIONS
SWMU318-GW05	GW	3/17/04	0955	2		X														
SWMU318-GW06-01	GW	3/17/04	1215	2		X														
SWMU318-GW02	GW	3/17/04	1810	2		X														
SWMU318-GW02 D	GW	3/17/04	1810	2		X														
SWMU318-GW08-01	GW	3/17/04	1620	2		X														
SWMU318-GW04	GW	3/18/04	0825	2		X														
SWMU318-GW04-01	GW	3/18/04	0915	3	X															
SWMU318-GW03	GW	3/18/04	1130	2		X														
SWMU318-GW07	GW	3/18/04	1525	3	X															
TB02	LB	3/18/04	NA	3	X															
SWMU318-GW07-01	GW	3/18/04	1545	2		X														
ER01	LB	3/18/04	1615	5	X	X														
SWMU318-SB05-02	SU	3/16/04	1650	1		X		X												
SWMU318-SB05-02D	SU	3/16/04	1650	1		X														
SWMU318-SB05-03	SU	3/16/04	1718	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. Sok II		2.) Relinquished By:		SPECIAL INSTRUCTIONS
Signature:	Date:	Signature:	Date:	
Company: Michael Baker Jr., Inc.	Time:	Company	Time:	
1.) Received By:		2.) Received By:		
Signature:	Date:	Signature:	Date:	
Company	Time:	Company	Time:	

MICHAEL BAKER JR., INC.

NUMBER OF COOLERS _____

CHAIN OF CUSTODY NUMBER: 03

CUSTOMER INFORMATION

Company: Michael Baker Jr., Inc.
Project Number: 102200 FI.SG
Address: 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)	pH (SW 846, Method 9045C)											COMMENTS/ PRECAUTIONS
SWMU318-GW01	GW	3/19/04	0905	5	X	X														
SWMU318-GW09-01	GW	3/19/04	1000	2		X														
SWMU269-GW16-01	GW	3/19/04	1710	3	X															
SWMU269-GW16-01 MS/MSD	GW	3/19/04	1710	6	X															
SWMU318-SB03-00	SS	3/17/04	1338	1		X		X												
SWMU318-GW10-01	GW	3/20/04	1215	3	X															
SWMU318-GW13	GW	3/20/04	1450	3	X															
SWMU318-GW12-01	GW	3/20/04	1530	2		X														
SWMU318-GW10	GW	3/20/04	1130	2		X														
SWMU318-GW13	GW	3/20/04	1450	2		X														
SWMU318-GW11-01	GW	3/20/04	1055	2		X														
ER02	GW	3/20/04	1650	5	X	X														
SWMU318-SB07-00	SS	3/20/04	0839	1		X														
SWMU318-SB07-02	SU	3/20/04	0841	1		X														
SWMU318-SB08-00	SS	3/20/04	0808	1		X														
SWMU318-SB08-04	SU	3/20/04	0815	1		X														
SWMU46-MW01	GW	3/21/04	1350					X												QUICK TURN SAMPLE
TB03	LB	3/19/04	NA	3	X															
ER03	LB	3/22/04	1010	6	X	X		X												
SWMU46-SB05-00	SS	3/22/04	0826	1				X												
SWMU46-SB05-04	SU	3/22/04	0829	1				X												
SWMU46-SB01-00	SS	3/22/04	0905	1				X												
SWMU46-SB01-03	SU	3/22/04	0908	1				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. Sok II		2.) Relinquished By:		SPECIAL INSTRUCTIONS
Signature:	Date:	Signature:	Date:	
Company: Michael Baker Jr., Inc.	Time:	Company	Time:	
1.) Received By:		**2.) Received By:**		
Signature:	Date:	Signature:	Date:	
Company	Time:	Company	Time:	

MICHAEL BAKER JR., INC.

NUMBER OF COOLERS _____

CHAIN OF CUSTODY NUMBER: 04

CUSTOMER INFORMATION

Company: Michael Baker Jr., Inc.
Project Number: 102200 FI.SG
Address: 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, Pincy 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)	pH (SW 846, Method 9045C)											COMMENTS/ PRECAUTIONS
SWMU46-SB02-00	SS	3/22/04	0926	1				X												
SWMU46-SB02-00 MS/MSD	SS	3/22/04	0926	2				X												
SWMU46-SB02-04	SU	3/22/04	0927	1				X												
SWMU46-SB03-00	SS	3/22/04	1045	1				X												
SWMU46-SB03-00 D	SS	3/22/04	1045	1				X												
SWMU46-SB03-02	SU	3/22/04	1050	1				X												
SWMU46-SB04-00	SS	3/22/04	1055	1				X												
SWMU46-SB04-02	SU	3/22/04	1105	1				X												
SWMU318-GW15	GW	3/22/04	1410	2		X														
SWMU261-SS04	SS	3/21/04	1400	2				X	X											
SWMU261-SS05	SS	3/21/04	1410	2				X	X											
SWMU261-SS05 D	SS	3/21/04	1410	1				X												
SWMU318-SB09-00	SS	3/22/04	1613	4	X	X		X												
SWMU318-SB09-02	SU	3/22/04	1615	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. Sok II		2.) Relinquished By:		SPECIAL INSTRUCTIONS
Signature:	Date:	Signature:	Date:	
Company: Michael Baker Jr., Inc.	Time:	Company	Time:	
1.) Received By:		2.) Received By:		
Signature:	Date:	Signature:	Date:	
Company	Time:	Company	Time:	

MICHAEL BAKER JR., INC.

NUMBER OF COOLERS 2

CHAIN OF CUSTODY NUMBER: 05

PAGE NUMBER: 1 OF 1

CUSTOMER INFORMATION

Company: Michael Baker Jr., Inc.
Project Number: 102200 FI.SG
Address: 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)	pH (SW 846, Method 9045C)						% SOLIDS/MOISTURE						COMMENTS/ PRECAUTIONS
SWMU318-SB02-00	SS	3/16/04	1445	1											X						
SWMU318-SB02-00D	SS	3/16/04	1445	1											X						EXTRA VOLUME FOR % SOLIDS
SWMU318-SB04-01	SU	3/16/04	1503	1											X						
SWMU318-SB06-00	SS	3/16/04	1600	1											X						
SWMU318-SB10-00	SS	3/23/04	0732	1		X															
SWMU318-SB10-00 MS/MSD	SS	3/23/04	0732	2		X															
SWMU318-SB10-03	SU	3/23/04	0740	2		X															
FB01	LB	3/23/04	1030	6	X	X		X													
ER04	LB	3/23/04	1045	6	X	X		X													
TB04	LB	3/23/04	NA	3	X																
SWMU318-SB11-01	SU	3/23/04	1725	1		X		X													
SWMU318-SB11-03	SU	3/23/04	1735	1		X		X													
SWMU318-SB12-01	SU	3/23/04	1645	1		X		X													
SWMU318-SB12-04	SU	3/23/04	1650	1		X		X													
SWMU318-GW14-01	GW	3/23/04	1540	2		X															
SWMU318-GW14-01 MS/MSD	GW	3/23/04	1540	4		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. Sok II		2.) Relinquished By:		SPECIAL INSTRUCTIONS
Signature:	Date:	Signature:	Date:	
Company: Michael Baker Jr., Inc.	Time:	Company	Time:	
1.) Received By:		**2.) Received By:**		
Signature:	Date:	Signature:	Date:	
Company	Time:	Company	Time:	

MICHAEL BAKER JR., INC.

NUMBER OF COOLERS 1

CHAIN OF CUSTODY NUMBER: 06

PAGE NUMBER: 1 OF 1

CUSTOMER INFORMATION

Company: Michael Baker Jr., Inc.
Project Number: 102200 FLSG
Address: 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)	pH (SW 846, Method 9045C)						% SOLIDS/MOISTURE						COMMENTS/ PRECAUTIONS
Copy from Baker COC																					
CDV01	SS	4/1/04	0930	1			x	x													
CDV02	SS	4/1/04	0940	1			x	x													
46-TT01-01	SB	4/1/04	1345	4	x	x	x	x													
46-TT02-01	SB	4/1/04	1515	4	x	x	x	x													
46-TT02-02	SB	4/1/04	1530	4	x	x	x	x													
TB05		4/1/04		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:

FED EX TRACKING NUMBER:

1.) Relinquished By: Robert M. Sok II		2.) Relinquished By:		SPECIAL INSTRUCTIONS
Signature:	Date:	Signature:	Date:	
Company: Michael Baker Jr., Inc.	Time:	Company	Time:	
1.) Received By:		2.) Received By:		
Signature:	Date:	Signature:	Date:	
Company	Time:	Company	Time:	

MICHAEL BAKER JR., INC.

NUMBER OF COOLERS 1

CHAIN OF CUSTODY NUMBER: 07

PAGE NUMBER: 1 OF 1

CUSTOMER INFORMATION

Company: Michael Baker Jr., Inc.
Project Number: 102200 FI.SG
Address: 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)	pH (SW 846, Method 9045C)						% SOLIDS/MOISTURE						COMMENTS/ PRECAUTIONS
Copy from Baker COC																					
46-TT03-01	SB	4/2/04	0845	4	x	x	x	x													
46-TT03-02	SB	4/2/04	0900	4	x	x	x	x													
46-TT08-01	SB	4/2/04	1015	4	x	x	x	x													
46-TT08-01 MS	SB	4/2/04	1015	4	x	x	x	x													
46-TT08-01 MSD	SB	4/2/04	1015	4	x	x	x	x													
46-TT08-02	SB	4/2/04	1035	4	x	x	x	x													
TB06				3	x																
46-TT04-01	SB	4/2/04	1520	4	x	x	x	x													
46-TT04-02	SB	4/2/04	1530	4	x	x	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. Sok II		2.) Relinquished By:		SPECIAL INSTRUCTIONS
Signature:	Date:	Signature:	Date:	
Company: Michael Baker Jr., Inc.	Time:	Company	Time:	
1.) Received By:		**2.) Received By:**		
Signature:	Date:	Signature:	Date:	
Company	Time:	Company	Time:	

MICHAEL BAKER JR., INC.

NUMBER OF COOLERS 4

CHAIN OF CUSTODY NUMBER: 08

PAGE NUMBER: 1 OF 2

CUSTOMER INFORMATION

Company: Michael Baker Jr., Inc.
Project Number: 102200 FI.SG
Address: 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)	pH (SW 846, Method 9045C)						% SOLIDS/MOISTURE						COMMENTS/ PRECAUTIONS
SWMU261-MW01	GW	4/2/04	1610	1				X													
SWMU261-MW01D	GW	4/2/04	1610	1				X													
SWMU261-MW03	GW	4/2/04	1840	1				X													
IR86-MW27	GW	4/3/04	1650	5	X	X		X													
SWMU269-MW01	GW	4/3/04	1400	5	X	X															
SWMU269-MW02	GW	4/3/04	1255	5	X	X															
SWMU269-MW02 D	GW	4/3/04	1255	5	X	X															
SWMU269-MW03	GW	4/3/04	1150	5	X	X															
SWMU269-MW04	GW	4/3/04	1100	5	X	X															
SWMU318-MW01	GW	4/3/04	1605	6	X	X		X													
SWMU318-MW02	GW	4/4/04	1050	6	X	X		X													
SWMU318-MW02 D	GW	4/4/04	1050	6		X															
SWMU318-MW02 MS/MSD	GW	4/4/04	1050	6				X													
SWMU318-MW03	GW	4/4/04	1230	6	X	X		X													
FB02	WATER	4/4/04	1300	6	X	X		X													
SWMU46-DP01	SU	4/5/04	1115	1	X	X	X	X													
SWMU46-DP01 D	SU	4/5/04	1115	1		X		X													
SWMU46-SW01	SW	4/5/04	1315	8	X	X	X	X													
SWMU46-SD01	SD	4/5/04	1355	2	X	X	X	X													
SWMU46-TT05-01	SU	4/5/04	1310	4	X	X	X	X													
SWMU46-TT05-02	SU	4/5/04	1315	4	X	X	X	X													
SWMU46-TT06-01	SU	4/5/04	1105	4	X	X	X	X													
SWMU46-TT06-02	SU	4/5/04	1133	4	X	X	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. Sok II		2.) Relinquished By:		SPECIAL INSTRUCTIONS
Signature:	Date:	Signature:	Date:	
Company: Michael Baker Jr., Inc.	Time:	Company	Time:	
1.) Received By:		**2.) Received By:**		
Signature:	Date:	Signature:	Date:	
Company	Time:	Company	Time:	

MICHAEL BAKER JR., INC.

NUMBER OF COOLERS 4

CHAIN OF CUSTODY NUMBER: 09

CUSTOMER INFORMATION

Company: Michael Baker Jr., Inc.
Project Number: 102200 FI.SG
Address: 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)	pH (SW 846, Method 9045C)												COMMENTS/ PRECAUTIONS
SWMU46-TT07-01	SU	4/5/04	1545	4	X	X	X	X													
SWMU46-TT07-02	SU	4/5/04	1555	4	X	X	X	X													
SWMU46-TT07-01 D	SU	4/5/04	1545	4	X	X	X	X													
TB07	LB	4/5/04	NA	3	X																
SWMU318-MW03 D	GW	4/4/04	1230	6	X																
IR86-MW25IW	GW				X	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. Sok II		2.) Relinquished By:		SPECIAL INSTRUCTIONS
Signature:	Date:	Signature:	Date:	
Company: Michael Baker Jr., Inc.	Time:	Company	Time:	
1.) Received By:		2.) Received By:		
Signature:	Date:	Signature:	Date:	
Company	Time:	Company	Time:	

MICHAEL BAKER JR., INC.

NUMBER OF COOLERS 2

CHAIN OF CUSTODY NUMBER: 10

PAGE NUMBER: 1 OF 1

CUSTOMER INFORMATION

Company: Michael Baker Jr., Inc.
Project Number: 102200 FI.SG
Address: 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)	pH (SW 846, Method 9045C)						% SOLIDS/MOISTURE						COMMENTS/ PRECAUTIONS
ER05	LB	4/6/04	0815	8	X	X	X	X													
ER06	LB	4/6/04	0830	8	X	X	X	X													
FB03	LB	4/6/04	0845	8	X	X	X	X													
TB08	LB	4/6/04.	NA	3	X																
GDV-01	SS	4/6/04	1035	1			X	X													
GDV-02	SS	4/6/04	1040	1			X	X													
GDV-02D	SS	4/6/04	1040	1			X	X													
SWMU261-MW02	GW	4/5/04	2010	1				X													
SWMU261-MW02F	GW	4/5/04	2010					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. Sok II		2.) Relinquished By:		SPECIAL INSTRUCTIONS
Signature:	Date:	Signature:	Date:	
Company: Michael Baker Jr., Inc.	Time:	Company	Time:	
1.) Received By:		2.) Received By:		
Signature:	Date:	Signature:	Date:	
Company	Time:	Company	Time:	

Baker

Baker Environmental, Inc.

APPENDIX D

Technical Memorandum (Baker 1994)

Bauer
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 I
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)
AMPHIBIOUS FUEL FARM	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 RANGES 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
BLDG 447 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
BLDG 211 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 JEIGER	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	0-50 ~~0-125~~ silty sand **
	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

MCB-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
108MW-0	9			118.6	887	13.2
108MW-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
HP-705	295	250	9.0	13100	97988	44.4
HP-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
RR-97	14	170	12.1
RR-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

Baker

Baker Environmental, Inc.

APPENDIX E

Background Criteria Tables

APPENDIX E

BASE BACKGROUND CRITERIA - SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

METALS (mg/kg)	AOC 2 - SS	AOC 2 - SB	AOC 3 - SS	AOC 3 - SB	AOC 5 - SS	AOC 5 - SB	AOC 7 - SS	AOC 7 - SB	AOC 9 - SS	AOC 9 - SB
Aluminum	16373.68	15719.64	5823.89	10692.12	7139.10	10077.93	17154.23	14764.78	7499.00	8398.12
Antimony	0.88	0.54	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic	1.71	13.56	1.19	3.47	1.80	1.90	2.66	2.93	1.14	9.01
Barium	32.62	46.53	25.28	37.74	38.86	26.05	36.23	19.36	30.88	19.42
Beryllium	0.24	0.28	0.10	0.47	0.22	0.16	0.19	0.08	0.08	0.27
Cadmium	ND	ND	ND	ND	ND	ND	2.44	ND	0.85	ND
Calcium	25084.36	982.40	40538.20	2779.43	12835.88	1211.97	194852.86	10721.43	12964.89	5653.33
Chromium	19.03	37.71	6.19	19.51	16.44	12.29	26.58	27.39	9.45	16.44
Cobalt	0.76	1.36	0.33	1.11	0.99	0.39	1.26	0.54	0.96	0.48
Copper	6.82	5.31	2.26	3.36	7.69	1.84	13.20	5.47	9.39	5.31
Iron	15521.79	30638.11	3260.83	9959.94	6438.17	3781.82	10829.18	10301.04	4698.63	11731.12
Lead	22.65	15.24	11.89	20.70	68.93	8.58	24.98	15.18	40.04	10.91
Magnesium	589.93	1012.32	459.65	1540.71	372.41	403.40	1540.71	363.14	295.55	454.86
Manganese	14.15	27.96	34.47	23.10	17.52	6.10	33.12	32.79	26.05	12.18
Mercury	0.10	0.07	0.04	0.06	0.07	0.05	0.05	0.08	0.12	0.05
Nickel	3.40	4.57	1.14	1.38	2.17	1.49	3.96	2.44	2.25	1.86
Potassium	330.81	1312.91	152.93	1176.15	225.88	315.37	555.57	550.04	162.76	365.04
Selenium	1.21	0.86	0.53	0.78	1.00	ND	2.66	0.67	ND	1.50
Silver	0.23	0.35	ND	0.20	ND	ND	ND	ND	ND	ND
Sodium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Thallium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	29.67	68.03	8.83	31.82	12.43	12.93	32.46	23.34	14.30	43.82
Zinc	21.54	15.33	20.49	7.93	10.00	37.74	71.52	35.16	54.05	ND

APPENDIX E

BASE BACKGROUND CRITERIA - SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

METALS (mg/kg)	SS - Fine Sand	SS - Silt-Loam	SB - Sand	SB - Silt	SB - Clay	SS - Combined	SB - Combined	GW - Shallow	GW - Deep
Aluminum	6,070	16,559	16,984	17,327	17,101	8,965	13,061	3102.6	438.4
Antimony	0.556	0.602	0.597	ND	ND	0.564	0.392	ND	ND
Arsenic	0.671	1.34	1.62	3.01	11.4	0.879	5.29	12.1	13.8
Barium	16.8	23.3	22.0	22.58	28.5	19.4	37.34	37.31	35.3
Beryllium	0.0974	0.406	0.140	0.242	1.062	0.252	0.432	ND	ND
Cadmium	0.0549	ND	ND	ND	ND	0.053	ND	ND	ND
Calcium	37,271	31,229	252	3,395	1,939	33,240	944	11858.9	17688.5
Chromium	15.2	12.25	16.3	25.0	27.3	8.93	30.9	5.76	40.2
Cobalt	0.317	0.602	1.26	0.640	5.26	0.412	2.33	5.42	20.2
Copper	12.4	6.65	3.10	2.93	6.70	11.2	7.03	ND	24.4
Iron	3,162	11,002	6,311	22,471	17,120	6,097	16,984	954.5	2115.4
Lead	20.9	26.0	8.16	9.19	13.7	25.8	12.6	3.61	30.9
Magnesium	639	361	369	478	1,300	804	1,022	2420.6	2648.2
Manganese	37.7	66.1	7.10	18.5	53.68	43.8	23.6	72.9	63.9
Mercury	0.100	0.128	0.0797	0.129	0.0889	0.120	0.096	ND	ND
Nickel	1.54	1.88	5.10	2.58	9.88	1.65	4.73	12.0	37.4
Potassium	268	201	302	1,086	989	384	1,043	3422.7	1576.5
Selenium	0.463	2.88	0.687	0.625	1.68	1.25	0.682	ND	ND
Silver	ND	ND	ND	ND	0.327	0.372	0.180	ND	ND
Sodium	ND	ND	ND	ND	ND	ND	ND	9512.7	58504.8
Thallium	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	17.5	28.5	20.3	58.0	43.7	28.5	44.7	8.6	14.4
Zinc	30.6	27.7	9.12	19.30	37.0	31.2	21.5	16.9	18.3

Baker

Baker Environmental, Inc.

APPENDIX F

Summary of Analytical Results

APPENDIX F

SUMMARY OF ANALYTICAL RESULTS
SURFACE SOIL - SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	SWMU46-SB01-00	SWMU46-SB02-00	SWMU46-SB03-00	SWMU46-SB03-00 D	SWMU46-SB04-00	SWMU46-SB05-00
Date	22-Mar-04	22-Mar-04	22-Mar-04	22-Mar-04	22-Mar-04	22-Mar-04
Depth Range	0-1	0-1	0-1	0-1	0-1	0-1
METALS (mg/kg)						
Arsenic	7.7	1.4 U	2.9	2.3 U	2.8	1.6 U
Barium	131 J	8 J	14.6 J	7.9 J	17 J	14.6 J
Cadmium	3.2	1.8 U	1.7 U	0.04 U	0.4 J	0.05 U
Chromium	36.5 J	4.6 J	6.9 J	6.1 J	7.2 J	5.3 J
Lead	528 J	48.4 J	58.6 J	10.6 J	55.9 J	5.4 J
Mercury	0.83	0.04 J	0.04 J	0.01 U	0.04 J	0.03 J
Selenium	0.48 U	0.42 U	1.7 U	0.4 U	0.42 U	0.42 U
Silver	3.9	0.21 U	0.2 U	0.2 U	0.21 U	0.21 U
Total Solids	74	91	85	87	88	87

Notes:

U - Non Detected
J - Analyte detected. Reported value is estimated.
mg/kg - milligrams per kilogram

APPENDIX F

SUMMARY OF ANALYTICAL RESULTS
SUBSURFACE SOIL - SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	SWMU46-SB01-03	SWMU46-SB02-04	SWMU46-SB03-02	SWMU46-SB04-02	SWMU46-SB05-04
Date	22-Mar-04	22-Mar-04	22-Mar-04	22-Mar-04	22-Mar-04
Depth Range	5-7	7-9	3-5	3-5	7-9
METALS (mg/kg)					
Arsenic	0.42 U	0.41 U	1.3 U	4.5	1.4 U
Barium	0.96 J	0.74 J	0.85 J	209 J	0.88 J
Cadmium	0.05 U	0.05 U	0.04 U	6	0.06 J
Chromium	2.9 UJ	2.9 UJ	2.4 UJ	39.4 J	1.8 J
Lead	1.4 J	2.2 J	1.5 J	3010 J	1.8 J
Mercury	0.01 U	0.01 U	0.01 U	0.11 J	0.01 U
Selenium	0.46 U	0.44 U	0.38 U	2 UJ	0.39 U
Silver	0.23 U	0.22 U	0.19 U	9.5	0.2 U
Total Solids	76	76	92	84	81

Notes:

U - Non Detected
J - Analyte detected. Reported value is estimated.
mg/kg - milligrams per kilogram
UJ - Non-detected, estimated value.

APPENDIX F

SUMMARY OF ANALYTICAL RESULTS
TEST TRENCHES - SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	SWMU46-TT01-01	SWMU46-TT02-01	SWMU46-TT02-02	SWMU46-TT03-01	SWMU46-TT03-02	SWMU46-TT04-01
Date	01-Apr-04	01-Apr-04	01-Apr-04	02-Apr-04	02-Apr-04	02-Apr-04
Depth Range	1-3	1-3	3-5	1-3	3-5	1-3
VOLATILES (ug/kg)						
1,1,1-Trichloroethane	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
1,1,2,2-Tetrachloroethane	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
1,1,2-Trichloro-1,2,2-Trifluoroethane	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
1,1,2-Trichloroethane	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
1,1-Dichloroethane	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
1,1-Dichloroethene	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
1,2,4-Trichlorobenzene	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
1,2-Dibromo-3-Chloropropane	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
1,2-Dichlorobenzene	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
1,2-Dichloroethane	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
1,2-Dichloroethylene (Total)	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
1,2-Dichloropropane	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
1,3-Dichlorobenzene	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
1,4-Dichlorobenzene	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
2-Butanone	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
2-Hexanone	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
4-Methyl-2-Pentanone	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Acetone	40 U	10 U	19 UJ	13 U	11 UJ	11 UJ
Benzene	12 U	12 U	14 UJ	13 U	4 J	11 UJ
Bromodichloromethane	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Bromoform	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Bromomethane	12 UJ	12 UJ	14 UJ	13 UJ	11 UJ	11 UJ
Carbon Disulfide	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Carbon Tetrachloride	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Chlorobenzene	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Chloroethane	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Chloroform	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Chloromethane	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Cis-1,2-Dichloroethene	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Cis-1,3-Dichloropropene	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Cyclohexane	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Dibromochloromethane	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Dichlorodifluoromethane	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Ethylbenzene	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Ethylene Dibromide	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Isopropylbenzene	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
M-,P-Xylene	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ

APPENDIX F

SUMMARY OF ANALYTICAL RESULTS
TEST TRENCHES - SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	SWMU46-TT01-01	SWMU46-TT02-01	SWMU46-TT02-02	SWMU46-TT03-01	SWMU46-TT03-02	SWMU46-TT04-01
Date	01-Apr-04	01-Apr-04	01-Apr-04	02-Apr-04	02-Apr-04	02-Apr-04
Depth Range	1-3	1-3	3-5	1-3	3-5	1-3
VOLATILES (ug/kg)						
Methyl Acetate	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Methyl Tert-Butyl Ether	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Methylcyclohexane	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Methylene Chloride	13 U	20 U	16 UJ	14 U	12 UJ	15 UJ
O-Xylene	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Styrene	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Tetrachloroethene	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Toluene	12 U	12 U	14 UJ	13 U	3 J	11 UJ
Trans-1,2-Dichloroethene	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Trans-1,3-Dichloropropene	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Trichloroethene	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Trichlorofluoromethane	2 J	9 J	4 J	2 J	2 J	5 J
Vinyl Chloride	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
Xylenes (Total)	12 U	12 U	14 UJ	13 U	11 UJ	11 UJ
SEMIVOLATILES (ug/kg)						
1,1-Biphenyl	440 U	390 U	420 U	390 U	380 U	390 U
2,2'-Oxybis (1-Chloropropane)	440 U	390 U	420 U	390 U	380 U	390 U
2,4,5-Trichlorophenol	1100 U	980 U	1000 U	990 U	950 U	970 U
2,4,6-Trichlorophenol	440 U	390 U	420 U	390 U	380 U	390 U
2,4-Dichlorophenol	440 U	390 U	420 U	390 U	380 U	390 U
2,4-Dimethylphenol	440 U	390 U	420 U	390 U	380 U	390 U
2,4-Dinitrophenol	1100 UJ	980 U	1000 U	990 U	950 U	970 UJ
2,4-Dinitrotoluene	440 U	390 U	420 U	390 U	380 U	390 U
2,6-Dinitrotoluene	440 U	390 U	420 U	390 U	380 U	390 U
2-Chloronaphthalene	440 U	390 U	420 U	390 U	380 U	390 U
2-Chlorophenol	440 U	390 U	420 U	390 U	380 U	390 U
2-Methylnaphthalene	440 U	390 U	420 U	390 U	380 U	390 U
2-Methylphenol	440 U	390 U	420 U	390 U	380 U	390 U
2-Nitroaniline	1100 U	980 U	1000 U	990 U	950 U	970 U
2-Nitrophenol	440 U	390 U	420 U	390 U	380 U	390 U
3,3'-Dichlorobenzidine	440 UJ	390 UJ	420 UJ	390 U	380 UJ	390 UJ
3-Nitroaniline	1100 U	980 U	1000 U	990 U	950 U	970 U
4,6-Dinitro-2-Methyl-Phenol	1100 U	980 U	1000 U	990 U	950 U	970 U
4-Bromophenyl Phenyl Ether	440 U	390 U	420 U	390 U	380 U	390 U
4-Chloro-3-Methylphenol	440 U	390 U	420 U	390 U	380 U	390 U
4-Chloroaniline	440 U	390 U	420 U	390 U	380 U	390 U
4-Chlorophenyl [illegible] Ether	440 U	390 U	420 U	390 U	380 U	390 U

APPENDIX F

SUMMARY OF ANALYTICAL RESULTS
TEST TRENCHES - SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	SWMU46-TT01-01	SWMU46-TT02-01	SWMU46-TT02-02	SWMU46-TT03-01	SWMU46-TT03-02	SWMU46-TT04-01
Date	01-Apr-04	01-Apr-04	01-Apr-04	02-Apr-04	02-Apr-04	02-Apr-04
Depth Range	1-3	1-3	3-5	1-3	3-5	1-3
SEMIVOLATILES (ug/kg)						
4-Methylphenol	440 U	390 U	420 U	390 U	380 U	390 U
4-Nitroaniline	1100 UJ	980 UJ	1000 UJ	990 UJ	950 UJ	970 UJ
4-Nitrophenol	1100 U	980 U	1000 U	990 U	950 U	970 U
Acenaphthene	440 U	390 U	420 U	390 U	380 U	390 U
Acenaphthylene	440 U	390 U	420 U	390 U	380 U	390 U
Acetophenone	440 U	390 U	420 U	390 U	380 U	390 U
Anthracene	163 J	390 U	420 U	390 U	380 U	390 U
Atrazine	440 U	390 U	420 U	390 U	380 U	390 U
Benzaldehyde	440 U	390 U	420 U	390 U	380 U	390 U
Benzo(A)Anthracene	450	390 U	420 U	390 UJ	380 U	390 U
Benzo(A)Pyrene	440 U	390 U	420 U	390 U	380 U	390 U
Benzo(B)Fluoranthene	480	390 U	420 U	390 U	380 U	390 U
Benzo(K)Fluoranthene	240 J	390 U	420 U	390 U	380 U	390 U
Benzo[G,H,I]Perylene	440 U	390 U	420 U	390 U	380 U	390 U
Bis(2-Chloroethoxy) Methane	440 U	390 U	420 U	390 U	380 U	390 U
Bis(2-Chloroethyl) Ether	440 U	390 U	420 U	390 U	380 U	390 U
Bis(2-Ethylhexyl) Phthalate	440 U	390 U	420 U	390 U	380 U	390 U
Butyl Benzyl Phthalate	440 U	390 U	420 U	390 U	380 U	390 U
Caprolactam	440 U	390 U	420 U	390 U	380 U	390 U
Carbazole	440 U	390 U	420 U	390 U	380 U	390 U
Chrysene	830	390 U	420 U	390 U	380 U	390 U
Di-N-Butyl Phthalate	440 U	390 U	420 U	390 U	380 U	390 U
Di-N-Octylphthalate	440 U	390 U	420 U	390 U	380 U	390 U
Dibenzo(A,H)Anthracene	440 U	390 U	420 U	390 U	380 U	390 U
Dibenzofuran	440 U	390 U	420 U	390 U	380 U	390 U
Diethyl Phthalate	440 U	390 U	420 U	390 U	380 U	390 U
Dimethyl Phthalate	440 U	390 U	420 U	390 U	380 U	390 U
Fluoranthene	2200	390 U	420 U	390 U	380 U	390 U
Fluorene	440 U	390 U	420 U	390 U	380 U	390 U
Hexachlorobenzene	440 U	390 U	420 U	390 U	380 U	390 U
Hexachlorobutadiene	440 U	390 U	420 U	390 U	380 U	390 U
Hexachlorocyclopentadiene	440 U	390 U	420 U	390 U	380 U	390 U
Hexachloroethane	440 U	390 U	420 U	390 U	380 U	390 U
Indeno(1,2,3-Cd)Pyrene	440 U	390 U	420 U	390 U	380 U	390 U
Isophorone	440 U	390 U	420 U	390 U	380 U	390 U
N-Nitroso-Di-N-Propylamine	440 U	390 U	420 U	390 U	380 U	390 U
N-Nitrosodiphenylamine	440 U	390 U	420 U	390 U	380 U	390 U

APPENDIX F

SUMMARY OF ANALYTICAL RESULTS
TEST TRENCHES - SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	SWMU46-TT01-01	SWMU46-TT02-01	SWMU46-TT02-02	SWMU46-TT03-01	SWMU46-TT03-02	SWMU46-TT04-01
Date	01-Apr-04	01-Apr-04	01-Apr-04	02-Apr-04	02-Apr-04	02-Apr-04
Depth Range	1-3	1-3	3-5	1-3	3-5	1-3
SEMIVOLATILES (ug/kg)						
Naphthalene	440 U	390 U	420 U	390 U	380 U	390 U
Nitrobenzene	440 U	390 U	420 U	390 U	380 U	390 U
Pentachlorophenol	1100 U	980 U	1000 U	990 U	950 U	970 U
Phenanthrene	800	390 U	420 U	390 U	380 U	390 U
Phenol	440 U	390 U	420 U	390 U	380 U	390 U
Pyrene	2400	390 U	420 U	390 U	380 U	390 U
PESTICIDES / PCBs (ug/kg)						
4,4'-Ddd	620 D	3.9 U	35	3.9 U	110 DJ	1600
4,4'-Dde	180 D	3.9 U	38	3.9 U	170 DJ	4400 D
4,4'-Ddt	16	3.9 U	11	3.9 U	38 J	27000 D
Aldrin	2.5 J	2 U	2.1 U	2 U	1.9 U	99 U
Alpha Bhc	1.7	2 U	2.1 U	2 U	1.9 U	99 U
Alpha-Chlordane	4.5 U	2 U	2.1 U	2 U	1.6 J	99 U
Beta Bhc	4.5 U	2 U	2.1 U	2 U	1.9 U	99 U
Delta Bhc	4.5 U	2 U	2.1 U	2 U	1.9 U	99 U
Dieldrin	8.8 U	3.9 U	4.2 U	3.9 U	3.8 U	190 U
Endosulfan I	4.5 U	2 U	2.1 U	2 U	1.9 U	99 U
Endosulfan II	8.8 U	3.9 U	4.2 U	3.9 U	3.8 U	190 U
Endosulfan Sulfate	8.8 U	3.9 U	4.2 U	3.9 U	3.8 U	190 U
Endrin	8.8 U	3.9 U	4.2 U	3.9 U	3.8 U	190 U
Endrin Aldehyde	8.8 U	3.9 U	4.2 U	3.9 U	3.8 U	190 U
Endrin Ketone	8.8 U	3.9 U	4.2 U	3.9 U	3.8 U	190 U
Gamma Bhc	4.5 U	2 U	2.1 U	2 U	1.9 U	99 U
Gamma-Chlordane	4.5 U	2 U	2.1 U	2 U	1.9 U	99 U
Heptachlor	4.5 U	2 U	2.1 U	2 U	1.9 U	99 U
Heptachlor Epoxide	4.5 U	2 U	2.1 U	2 U	1.9 U	99 U
Methoxychlor	45 U	20 U	21 U	20 U	19 U	990 U
Toxaphene	450 U	200 U	210 U	200 U	190 U	9900 U
METALS (mg/kg)						
Arsenic	2.5 J	0.48 UJ	13.9 J	0.85 J	11.6 J	8 J
Barium	341	1.5 J	1410	1.2 J	266	110
Cadmium	1.8	0.06 J	8.4	0.07 J	4.5	3.7
Chromium	16.1	1.5 J	150	1.2 J	80.6	18
Lead	1080 J	1.8 J	2930 J	1.6 J	899 J	253 J
Mercury	0.1 J	0.01 U	0.15	0.01 U	0.14	0.25
Selenium	0.79 U	0.58 U	1.6 J	0.7 U	1.5 J	1.1
Silver	0.3 J	0.11 U	20.1	0.17 J	5.4	1.7 J

APPENDIX F

SUMMARY OF ANALYTICAL RESULTS
TEST TRENCHES - SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	SWMU46-TT01-01	SWMU46-TT02-01	SWMU46-TT02-02	SWMU46-TT03-01	SWMU46-TT03-02	SWMU46-TT04-01
Date	01-Apr-04	01-Apr-04	01-Apr-04	02-Apr-04	02-Apr-04	02-Apr-04
Depth Range	1-3	1-3	3-5	1-3	3-5	1-3
SOLIDS						
Total Solids	75	85	79	84	87	85

Notes:

U - Non Detected
J - Analyte detected. Reported value is estimated.
mg/kg - milligrams per kilogram

DNJ - Reported value froma dilution, tentatively identified analyte, estimated value.
D - Reported value from a dilution.
UUJ - Non-detected, estimated value.

APPENDIX F

SUMMARY OF ANALYTICAL RESULTS
TEST TRENCHES - SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	SWMU46-TT04-02	SWMU46-TT05-01	SWMU46-TT05-02	SWMU46-TT06-01	SWMU46-TT06-02	SWMU46-TT07-01
Date	02-Apr-04	05-Apr-04	05-Apr-04	05-Apr-04	05-Apr-04	05-Apr-04
Depth Range	3-5	1-3	3-5	1-3	3-5	1-3
VOLATILES (ug/kg)						
1,1,1-Trichloroethane	10 U	12 U	12 UJ	10 U	12 U	11 UJ
1,1,2,2-Tetrachloroethane	10 U	12 U	12 UJ	10 U	12 U	11 UJ
1,1,2-Trichloro-1,2,2-Trifluoroethane	10 U	12 U	12 UJ	10 U	12 U	11 UJ
1,1,2-Trichloroethane	10 U	12 U	12 UJ	10 U	12 U	11 UJ
1,1-Dichloroethane	10 U	12 U	12 UJ	10 U	12 U	11 UJ
1,1-Dichloroethene	10 U	12 U	12 UJ	10 U	12 U	11 UJ
1,2,4-Trichlorobenzene	10 U	12 U	12 UJ	10 U	12 U	11 UJ
1,2-Dibromo-3-Chloropropane	10 U	12 U	12 UJ	10 U	12 U	11 UJ
1,2-Dichlorobenzene	10 U	12 U	12 UJ	10 U	12 U	11 UJ
1,2-Dichloroethane	10 U	12 U	12 UJ	10 U	12 U	11 UJ
1,2-Dichloroethylene (Total)	10 U	12 U	12 UJ	10 U	12 U	11 UJ
1,2-Dichloropropane	10 U	12 U	12 UJ	10 U	12 U	11 UJ
1,3-Dichlorobenzene	10 U	12 U	12 UJ	10 U	12 U	11 UJ
1,4-Dichlorobenzene	10 U	12 U	12 UJ	10 U	12 U	11 UJ
2-Butanone	10 UJ	12 U	12 UJ	10 U	12 U	11 UJ
2-Hexanone	10 U	12 U	12 UJ	10 U	12 U	11 UJ
4-Methyl-2-Pentanone	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Acetone	10 UJ	12 U	12 UJ	10 U	12 U	11 UJ
Benzene	10 U	12 U	2 J	10 U	12 U	3 J
Bromodichloromethane	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Bromoform	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Bromomethane	10 UJ	12 U	12 UJ	10 U	12 U	11 UJ
Carbon Disulfide	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Carbon Tetrachloride	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Chlorobenzene	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Chloroethane	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Chloroform	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Chloromethane	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Cis-1,2-Dichloroethene	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Cis-1,3-Dichloropropene	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Cyclohexane	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Dibromochloromethane	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Dichlorodifluoromethane	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Ethylbenzene	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Ethylene Dibromide	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Isopropylbenzene	10 U	12 U	12 UJ	10 U	12 U	11 UJ
M-,P-Xylene	10 U	12 U	12 UJ	10 U	12 U	11 UJ

APPENDIX F

SUMMARY OF ANALYTICAL RESULTS
TEST TRENCHES - SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	SWMU46-TT04-02	SWMU46-TT05-01	SWMU46-TT05-02	SWMU46-TT06-01	SWMU46-TT06-02	SWMU46-TT07-01
Date	02-Apr-04	05-Apr-04	05-Apr-04	05-Apr-04	05-Apr-04	05-Apr-04
Depth Range	3-5	1-3	3-5	1-3	3-5	1-3
VOLATILES (ug/kg)						
Methyl Acetate	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Methyl Tert-Butyl Ether	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Methylcyclohexane	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Methylene Chloride	14 U	11 U	14 UJ	11 U	14 U	13 UJ
O-Xylene	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Styrene	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Tetrachloroethene	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Toluene	10 U	12 U	12 UJ	10 U	12 U	2 J
Trans-1,2-Dichloroethene	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Trans-1,3-Dichloropropene	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Trichloroethene	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Trichlorofluoromethane	2 J	1 J	2 J	1 J	2 J	3 J
Vinyl Chloride	10 U	12 U	12 UJ	10 U	12 U	11 UJ
Xylenes (Total)	10 U	12 U	12 UJ	10 U	12 U	11 UJ
SEMIVOLATILES (ug/kg)						
1,1-Biphenyl	370 U	360 U	410 U	390 U	390 U	390 U
2,2'-Oxybis (1-Chloropropane)	370 U	360 U	410 U	390 U	390 U	390 U
2,4,5-Trichlorophenol	930 U	910 U	1000 U	980 U	970 U	970 U
2,4,6-Trichlorophenol	370 U	360 U	410 U	390 U	390 U	390 U
2,4-Dichlorophenol	370 U	360 U	410 U	390 U	390 U	390 U
2,4-Dimethylphenol	370 U	360 U	410 U	390 U	390 U	390 U
2,4-Dinitrophenol	930 UJ	910 UJ	1000 UJ	980 UUJ	970 UJ	970 UJ
2,4-Dinitrotoluene	370 U	360 U	410 U	390 U	390 U	390 U
2,6-Dinitrotoluene	370 U	360 U	410 U	390 U	390 U	390 U
2-Chloronaphthalene	370 U	360 U	410 U	390 U	390 U	390 U
2-Chlorophenol	370 U	360 U	410 U	390 U	390 U	390 U
2-Methylnaphthalene	370 U	360 U	410 U	390 U	390 U	390 U
2-Methylphenol	370 U	360 U	410 U	390 U	390 U	390 U
2-Nitroaniline	930 U	910 U	1000 U	980 U	970 U	970 U
2-Nitrophenol	370 U	360 U	410 U	390 U	390 U	390 U
3,3'-Dichlorobenzidine	370 UJ	360 JU	410 UJ	390 UJ	390 UJ	390 UJ
3-Nitroaniline	930 U	910 U	1000 U	980 U	970 U	970 U
4,6-Dinitro-2-Methyl-Phenol	930 U	910 U	1000 U	980 U	970 U	970 U
4-Bromophenyl Phenyl Ether	370 U	360 U	410 U	390 U	390 U	390 U
4-Chloro-3-Methylphenol	370 U	360 U	410 U	390 U	390 U	390 U
4-Chloroaniline	370 U	360 U	410 U	390 U	390 U	390 U
4-Chlorophenyl Phenyl Ether	370 U	360 U	410 U	390 U	390 U	390 U

APPENDIX F

SUMMARY OF ANALYTICAL RESULTS
TEST TRENCHES - SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	SWMU46-TT04-02	SWMU46-TT05-01	SWMU46-TT05-02	SWMU46-TT06-01	SWMU46-TT06-02	SWMU46-TT07-01
Date	02-Apr-04	05-Apr-04	05-Apr-04	05-Apr-04	05-Apr-04	05-Apr-04
Depth Range	3-5	1-3	3-5	1-3	3-5	1-3
SEMIVOLATILES (ug/kg)						
4-Methylphenol	370 U	360 U	410 U	390 U	390 U	390 U
4-Nitroaniline	930 UJ	910 UJ	1000 UJ	980 UJ	970 UJ	970 UJ
4-Nitrophenol	930 U	910 U	1000 U	980 U	970 U	970 U
Acenaphthene	370 U	360 U	410 U	390 U	390 U	390 U
Acenaphthylene	370 U	360 U	410 U	390 U	390 U	390 U
Acetophenone	370 U	360 U	410 U	390 U	390 U	390 U
Anthracene	370 U	360 U	410 U	390 U	390 U	390 U
Atrazine	370 U	360 U	410 U	390 U	390 U	390 U
Benzaldehyde	370 U	360 U	410 U	390 U	390 U	390 U
Benzo(A)Anthracene	370 U	360 U	410 U	390 U	390 U	390 U
Benzo(A)Pyrene	370 U	360 U	410 U	390 U	390 U	390 U
Benzo(B)Fluoranthene	370 U	360 U	410 U	390 U	390 U	390 U
Benzo(K)Fluoranthene	370 U	360 U	410 U	390 U	390 U	390 U
Benzo[G,H,I]Perylene	370 U	360 U	410 U	390 U	390 U	390 U
Bis(2-Chloroethoxy) Methane	370 U	360 U	410 U	390 U	390 U	390 U
Bis(2-Chloroethyl) Ether	370 U	360 U	410 U	390 U	390 U	390 U
Bis(2-Ethylhexyl) Phthalate	370 U	360 U	410 U	390 U	390 U	390 U
Butyl Benzyl Phthalate	370 U	360 U	410 U	390 U	390 U	390 U
Caprolactam	370 U	360 U	410 U	390 U	390 U	390 U
Carbazole	370 U	360 U	410 U	390 U	390 U	390 U
Chrysene	370 U	360 U	410 U	390 U	390 U	390 U
Di-N-Butyl Phthalate	370 U	360 U	410 U	390 U	390 U	390 U
Di-N-Octylphthalate	370 U	360 U	410 U	390 U	390 U	390 U
Dibenzo(A,H)Anthracene	370 U	360 U	410 U	390 U	390 U	390 U
Dibenzofuran	370 U	360 U	410 U	390 U	390 U	390 U
Diethyl Phthalate	370 U	360 U	410 U	390 U	390 U	390 U
Dimethyl Phthalate	370 U	360 U	410 U	390 U	390 U	390 U
Fluoranthene	370 U	360 U	410 U	390 U	390 U	390 U
Fluorene	370 U	360 U	410 U	390 U	390 U	390 U
Hexachlorobenzene	370 U	360 U	410 U	390 U	390 U	390 U
Hexachlorobutadiene	370 U	360 U	410 U	390 U	390 U	390 U
Hexachlorocyclopentadiene	370 U	360 U	410 U	390 U	390 U	390 U
Hexachloroethane	370 U	360 U	410 U	390 U	390 U	390 U
Indeno(1,2,3-Cd)Pyrene	370 U	360 U	410 U	390 U	390 U	390 U
Isophorone	370 U	360 U	410 U	390 U	390 U	390 U
N-Nitroso-Di-N-Pro[illegible]mine	370 U	360 U	410 U	390 U	390 U	390 U
N-Nitrosodiphenyl[illegible]	370 U	360 U	410 U	390 U	390 U	390 U

APPENDIX F

SUMMARY OF ANALYTICAL RESULTS
TEST TRENCHES - SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	SWMU46-TT04-02	SWMU46-TT05-01	SWMU46-TT05-02	SWMU46-TT06-01	SWMU46-TT06-02	SWMU46-TT07-01
Date	02-Apr-04	05-Apr-04	05-Apr-04	05-Apr-04	05-Apr-04	05-Apr-04
Depth Range	3-5	1-3	3-5	1-3	3-5	1-3
SEMIVOLATILES (ug/kg)						
Naphthalene	370 U	360 U	410 U	390 U	390 U	390 U
Nitrobenzene	370 U	360 U	410 U	390 U	390 U	390 U
Pentachlorophenol	930 U	910 U	1000 U	980 U	970 U	970 U
Phenanthrene	370 U	360 U	410 U	390 U	390 U	390 U
Phenol	370 U	360 U	410 U	390 U	390 U	390 U
Pyrene	370 U	360 U	410 U	390 U	390 U	390 U
PESTICIDES / PCBs (ug/kg)						
4,4'-Ddd	110 NJ	15	2300 D	3.9 U	420 D	520 D
4,4'-Dde	400	4.7	970 D	3.6 J	970 D	240 D
4,4'-Ddt	3000 D	57 D	3100 D	4.5	160 D	120
Aldrin	19 U	1.9 U	11 U	2 U	5 U	4 U
Alpha Bhc	19 U	1.9 U	11 U	2 U	5 U	4 U
Alpha-Chlordane	180	6	400 D	2.4	140 D	2.8 JP
Beta Bhc	19 U	1.9 U	11 U	2 U	5 U	4 U
Delta Bhc	19 U	1.9 U	11 U	2 U	5 U	4 U
Dieldrin	37 U	3.6 U	20 U	3.9 U	9.7 U	7.7 U
Endosulfan I	19 U	1.9 U	9.5 NJ	2 U	5 U	2.5 JP
Endosulfan II	37 U	3.6 U	20 U	3.9 U	9.7 U	7.7 U
Endosulfan Sulfate	37 U	3.6 U	20 U	3.9 U	9.7 U	7.7 U
Endrin	37 U	3.6 U	20 U	3.9 U	9.7 U	7.7 U
Endrin Aldehyde	37 U	3.6 U	20 U	3.9 U	9.7 U	7.7 U
Endrin Ketone	37 U	3.6 U	20 U	3.9 U	9.7 U	7.7 U
Gamma Bhc	19 U	1.9 U	11 U	2 U	5 U	4 U
Gamma-Chlordane	200	5.6	430 D	1.7 J	180 DNJ	4 U
Heptachlor	19 U	1.9 U	11 U	2 U	5 U	4 U
Heptachlor Epoxide	19 U	1.9 U	11 U	2 U	5 U	4 U
Methoxychlor	190 U	19 U	110 U	20 U	50 U	40 U
Toxaphene	1900 U	190 U	1100 U	200 U	500 U	400 U
METALS (mg/kg)						
Arsenic	1.7 J	0.83 J	6.1 J	1.8 J	3.8 J	7 J
Barium	10.6 J	5.8 J	323	35.8 J	137	101
Cadmium	0.24 J	0.09 J	3.6 J	0.15 J	1.5	2.8
Chromium	4.9	1.4 J	42.4	8.6	9.5	19
Lead	8.5 J	1.8 J	819 J	5.7 J	141 J	1040 J
Mercury	0.05 J	0.02 J	0.05 J	0.03 J	0.04 J	0.19
Selenium	0.72 U	0.63 U	3.43 U	0.71 U	0.67 U	0.76 U
Silver	0.14 U	0.12 U	1.6 J	0.13 U	0.13 U	0.61 J

APPENDIX F

SUMMARY OF ANALYTICAL RESULTS
TEST TRENCHES - SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	SWMU46-TT04-02	SWMU46-TT05-01	SWMU46-TT05-02	SWMU46-TT06-01	SWMU46-TT06-02	SWMU46-TT07-01
Date	02-Apr-04	05-Apr-04	05-Apr-04	05-Apr-04	05-Apr-04	05-Apr-04
Depth Range	3-5	1-3	3-5	1-3	3-5	1-3
SOLIDS						
Total Solids	89	91	80	85	85	85

Notes:

U - Non Detected
J - Analyte detected. Reported value is estimated.
mg/kg - milligrams per kilogram

DNJ - Reported value froma dilution, tentatively identified analyte, estimated value.
D - Reported value from a dilution.
UUJ - Non-detected, estimated value.

APPENDIX F

SUMMARY OF ANALYTICAL RESULTS
TEST TRENCHES - SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	SWMU46-TT07-01D	SWMU46-TT07-02	SWMU46-TT08-01	SWMU46-TT08-02	SWMU46-DP01	SWMU46-DP01 D
Date	05-Apr-04	05-Apr-04	02-Apr-04	02-Apr-04	05-Apr-04	05-Apr-04
Depth Range	1-3	3-5	1-3	3-5	0-0	0-0
VOLATILES (ug/kg)						
1,1,1-Trichloroethane	11 UJ	12 UJ	10 U	11 U	12 UJ	
1,1,2,2-Tetrachloroethane	11 UJ	12 UJ	10 U	11 U	12 UJ	
1,1,2-Trichloro-1,2,2-Trifluoroethane	11 UJ	12 UJ	10 U	11 U	12 UJ	
1,1,2-Trichloroethane	11 UJ	12 UJ	10 U	11 U	12 UJ	
1,1-Dichloroethane	11 UJ	12 UJ	10 U	11 U	12 UJ	
1,1-Dichloroethene	11 UJ	12 UJ	10 U	11 U	12 UJ	
1,2,4-Trichlorobenzene	11 UJ	12 UJ	10 U	11 U	12 UJ	
1,2-Dibromo-3-Chloropropane	11 UJ	12 UJ	10 U	11 U	12 UJ	
1,2-Dichlorobenzene	11 UJ	12 UJ	10 U	11 U	12 UJ	
1,2-Dichloroethane	11 UJ	12 UJ	10 U	11 U	12 UJ	
1,2-Dichloroethylene (Total)	11 UJ	12 UJ	10 U	11 U	12 UJ	
1,2-Dichloropropane	11 UJ	12 UJ	10 U	11 U	12 UJ	
1,3-Dichlorobenzene	11 UJ	12 UJ	10 U	11 U	12 UJ	
1,4-Dichlorobenzene	11 UJ	12 UJ	10 U	11 U	12 UJ	
2-Butanone	11 UJ	12 UJ	10 U	11 U	12 UJ	
2-Hexanone	11 UJ	12 UJ	10 U	11 U	12 UJ	
4-Methyl-2-Pentanone	11 UJ	12 UJ	10 U	11 U	12 UJ	
Acetone	11 UJ	12 UJ	10 U	11 U	28 UJ	
Benzene	11 UJ	12 UJ	10 U	11 U	12 UJ	
Bromodichloromethane	11 UJ	12 UJ	10 U	11 U	12 UJ	
Bromoform	11 UJ	12 UJ	10 U	11 U	12 UJ	
Bromomethane	11 UJ	12 UJ	10 UJ	11 UJ	12 UJ	
Carbon Disulfide	11 UJ	12 UJ	10 U	11 U	12 UJ	
Carbon Tetrachloride	11 UJ	12 UJ	10 U	11 U	12 UJ	
Chlorobenzene	11 UJ	12 UJ	10 U	11 U	12 UJ	
Chloroethane	11 UJ	12 UJ	10 U	11 U	12 UJ	
Chloroform	11 UJ	12 UJ	10 U	11 U	12 UJ	
Chloromethane	11 UJ	12 UJ	10 U	11 U	12 UJ	
Cis-1,2-Dichloroethene	11 UJ	12 UJ	10 U	11 U	12 UJ	
Cis-1,3-Dichloropropene	11 UJ	12 UJ	10 U	11 U	12 UJ	
Cyclohexane	11 UJ	12 UJ	10 U	11 U	12 UJ	
Dibromochloromethane	11 UJ	12 UJ	10 U	11 U	12 UJ	
Dichlorodifluoromethane	11 UJ	12 UJ	10 U	11 U	12 UJ	
Ethylbenzene	11 UJ	12 UJ	10 U	11 U	12 UJ	
Ethylene Dibromide	11 UJ	12 UJ	10 U	11 U	12 UJ	
Isopropylbenzene	11 UJ	12 UJ	10 U	11 U	12 UJ	
M-,P-Xylene	11 UJ	12 UJ	10 U	11 U	12 UJ	

APPENDIX F

SUMMARY OF ANALYTICAL RESULTS
TEST TRENCHES - SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	SWMU46-TT07-01D	SWMU46-TT07-02	SWMU46-TT08-01	SWMU46-TT08-02	SWMU46-DP01	SWMU46-DP01 D
Date	05-Apr-04	05-Apr-04	02-Apr-04	02-Apr-04	05-Apr-04	05-Apr-04
Depth Range	1-3	3-5	1-3	3-5	0-0	0-0
VOLATILES (ug/kg)						
Methyl Acetate	11 UJ	12 UJ	10 U	11 U	12 UJ	
Methyl Tert-Butyl Ether	11 UJ	12 UJ	10 U	11 U	12 UJ	
Methylcyclohexane	11 UJ	12 UJ	10 U	11 U	12 UJ	
Methylene Chloride	16 UJ	12 UJ	11 U	11 U	13 UJ	
O-Xylene	11 UJ	12 UJ	10 U	11 U	12 UJ	
Styrene	11 UJ	12 UJ	10 U	11 U	12 UJ	
Tetrachloroethene	11 UJ	12 UJ	10 U	11 U	12 UJ	
Toluene	11 UJ	12 UJ	10 U	11 U	12 UJ	
Trans-1,2-Dichloroethene	11 UJ	12 UJ	10 U	11 U	12 UJ	
Trans-1,3-Dichloropropene	11 UJ	12 UJ	10 U	11 U	12 UJ	
Trichloroethene	11 UJ	12 UJ	10 U	11 U	12 UJ	
Trichlorofluoromethane	3 J	3 J	2 J	2 J	2 J	
Vinyl Chloride	11 UJ	12 UJ	10 U	11 U	12 UJ	
Xylenes (Total)	11 UJ	12 UJ	10 U	11 U	12 UJ	
SEMIVOLATILES (ug/kg)						
1,1-Biphenyl	400 U	360 U	380 U	390 U	390 U	380 U
2,2'-Oxybis (1-Chloropropane)	400 U	360 U	380 U	390 U	390 U	380 U
2,4,5-Trichlorophenol	1000 U	910 U	970 U	970 U	970 U	960 U
2,4,6-Trichlorophenol	400 U	360 U	380 U	390 U	390 U	380 U
2,4-Dichlorophenol	400 U	360 U	380 U	390 U	390 U	380 U
2,4-Dimethylphenol	400 U	360 U	380 U	390 U	390 U	380 U
2,4-Dinitrophenol	1000 U	910 U	970 U	970 U	970 UJ	960 UJ
2,4-Dinitrotoluene	400 U	360 U	380 U	390 U	390 U	380 U
2,6-Dinitrotoluene	400 U	360 U	380 U	390 U	390 U	380 U
2-Chloronaphthalene	400 U	360 U	380 U	390 U	390 U	380 U
2-Chlorophenol	400 U	360 U	380 U	390 U	390 U	380 U
2-Methylnaphthalene	400 U	360 U	380 U	390 U	390 U	380 U
2-Methylphenol	400 U	360 U	380 U	390 U	390 U	380 U
2-Nitroaniline	1000 U	910 U	970 U	970 U	970 U	960 U
2-Nitrophenol	400 U	360 U	380 U	390 U	390 U	380 U
3,3'-Dichlorobenzidine	400 UJ	360 UJ	380 UJ	390 UJ	390 UJ	380 UJ
3-Nitroaniline	1000 U	910 U	970 U	970 U	970 U	960 U
4,6-Dinitro-2-Methyl-Phenol	1000 U	910 U	970 U	970 U	970 U	960 U
4-Bromophenyl Phenyl Ether	400 U	360 U	380 U	390 U	390 U	380 U
4-Chloro-3-Methylphenol	400 U	360 U	380 U	390 U	390 U	380 U
4-Chloroaniline	400 U	360 U	380 U	390 U	390 U	380 U
4-Chlorophenyl [illegible]yl Ether	400 U	360 U	380 U	390 U	390 U	380 U

APPENDIX F

SUMMARY OF ANALYTICAL RESULTS
TEST TRENCHES - SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	SWMU46-TT07-01D	SWMU46-TT07-02	SWMU46-TT08-01	SWMU46-TT08-02	SWMU46-DP01	SWMU46-DP01 D
Date	05-Apr-04	05-Apr-04	02-Apr-04	02-Apr-04	05-Apr-04	05-Apr-04
Depth Range	1-3	3-5	1-3	3-5	0-0	0-0
SEMIVOLATILES (ug/kg)						
4-Methylphenol	400 U	360 U	380 U	390 U	390 U	380 U
4-Nitroaniline	1000 UJ	910 UJ	970 UJ	970 UJ	970 UJ	960 UJ
4-Nitrophenol	1000 U	910 U	970 U	970 U	970 U	960 U
Acenaphthene	400 U	360 U	380 U	390 U	390 U	380 U
Acenaphthylene	400 U	360 U	380 U	390 U	390 U	380 U
Acetophenone	400 U	360 U	380 U	390 U	390 U	380 U
Anthracene	400 U	360 U	380 U	390 U	390 U	380 U
Atrazine	400 U	360 U	380 U	390 U	390 U	380 U
Benzaldehyde	400 U	360 U	380 U	390 U	390 U	380 U
Benzo(A)Anthracene	400 U	360 U	380 U	390 U	390 U	380 U
Benzo(A)Pyrene	400 U	360 U	380 U	390 U	390 U	380 U
Benzo(B)Fluoranthene	400 U	360 U	380 U	390 U	390 U	380 U
Benzo(K)Fluoranthene	400 U	360 U	380 U	390 U	390 U	380 U
Benzo[G,H,I]Perylene	400 U	360 U	380 U	390 U	390 U	380 U
Bis(2-Chloroethoxy) Methane	400 U	360 U	380 U	390 U	390 U	380 U
Bis(2-Chloroethyl) Ether	400 U	360 U	380 U	390 U	390 U	380 U
Bis(2-Ethylhexyl) Phthalate	400 U	360 U	380 U	390 U	390 U	380 U
Butyl Benzyl Phthalate	400 U	360 U	380 U	390 U	390 U	380 U
Caprolactam	400 U	360 U	380 U	390 U	390 U	380 U
Carbazole	400 U	360 U	380 U	390 U	390 U	380 U
Chrysene	400 U	360 U	380 U	390 U	390 U	380 U
Di-N-Butyl Phthalate	400 U	360 U	380 U	390 U	390 U	380 U
Di-N-Octylphthalate	400 U	360 U	380 U	390 U	390 U	380 U
Dibenzo(A,H)Anthracene	400 U	360 U	380 U	390 U	390 U	380 U
Dibenzofuran	400 U	360 U	380 U	390 U	390 U	380 U
Diethyl Phthalate	400 U	360 U	380 U	390 U	390 U	380 U
Dimethyl Phthalate	400 U	360 U	380 U	390 U	390 U	380 U
Fluoranthene	400 U	360 U	380 U	390 U	390 U	380 U
Fluorene	400 U	360 U	380 U	390 U	390 U	380 U
Hexachlorobenzene	400 U	360 U	380 U	390 U	390 U	380 U
Hexachlorobutadiene	400 U	360 U	380 U	390 U	390 U	380 U
Hexachlorocyclopentadiene	400 U	360 U	380 U	390 U	390 U	380 U
Hexachloroethane	400 U	360 U	380 U	390 U	390 U	380 U
Indeno(1,2,3-Cd)Pyrene	400 U	360 U	380 U	390 U	390 U	380 U
Isophorone	400 U	360 U	380 U	390 U	390 U	380 U
N-Nitroso-Di-N-Propylamine	400 U	360 U	380 U	390 U	390 U	380 U
N-Nitrosodiphenylamine	400 U	360 U	380 U	390 U	390 U	380 U

APPENDIX F

SUMMARY OF ANALYTICAL RESULTS
TEST TRENCHES - SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	SWMU46-TT07-01D	SWMU46-TT07-02	SWMU46-TT08-01	SWMU46-TT08-02	SWMU46-DP01	SWMU46-DP01 D
Date	05-Apr-04	05-Apr-04	02-Apr-04	02-Apr-04	05-Apr-04	05-Apr-04
Depth Range	1-3	3-5	1-3	3-5	0-0	0-0
SEMIVOLATILES (ug/kg)						
Naphthalene	400 U	360 U	380 U	390 U	390 U	380 U
Nitrobenzene	400 U	360 U	380 U	390 U	390 U	380 U
Pentachlorophenol	1000 U	910 U	970 U	970 U	970 U	960 U
Phenanthrene	400 U	360 U	380 U	390 U	390 U	380 U
Phenol	400 U	360 U	380 U	390 U	390 U	380 U
Pyrene	400 U	360 U	380 U	390 U	390 U	380 U
PESTICIDES / PCBs (ug/kg)						
4,4'-Ddd	990 D	18	22	3.9 U	3.3 J	
4,4'-Dde	290 D	54	17	3.9 U	12	
4,4'-Ddt	73	11	6.8	3.9 U	14	
Aldrin	5.1 U	1.8 U	2 U	2 U	2 U	
Alpha Bhc	5.1 U	1.8 U	2 U	2 U	2 U	
Alpha-Chlordane	5.1 U	1.8 U	2 U	2 U	2 U	
Beta Bhc	5.1 U	1.8 U	2 U	2 U	2 U	
Delta Bhc	5.1 U	1.8 U	2 U	2 U	2 U	
Dieldrin	10 U	3.6 U	3.8 U	3.9 U	3.9 U	
Endosulfan I	5.1 U	1.8 U	2 U	2 U	2 U	
Endosulfan II	10 U	3.6 U	3.8 U	3.9 U	3.9 U	
Endosulfan Sulfate	10 U	3.6 U	3.8 U	3.9 U	3.9 U	
Endrin	10 U	3.6 U	3.8 U	3.9 U	3.9 U	
Endrin Aldehyde	10 U	3.6 U	3.8 U	3.9 U	3.9 U	
Endrin Ketone	10 U	3.6 U	3.8 U	3.9 U	3.9 U	
Gamma Bhc	5.1 U	1.8 U	2 U	2 U	2 U	
Gamma-Chlordane	5.1 U	1.8 U	2 U	2 U	2 U	
Heptachlor	5.1 U	1.8 U	2 U	2 U	2 U	
Heptachlor Epoxide	5.1 U	1.8 U	2 U	2 U	2 U	
Methoxychlor	51 U	18 U	20 U	20 U	20 U	
Toxaphene	510 U	180 U	200 U	200 U	200 U	
METALS (mg/kg)						
Arsenic	19 J	0.88 J	3.3 J	0.62 UJ	0.69 J	1.3 J
Barium	110	5.4 J	23.5 J	4.4 J	15.5 J	15.4 J
Cadmium	3	0.07 J	1 J	0.13 J	0.26 J	0.28 J
Chromium	40.8	3.7	5.1	2.6	3.5	3.4
Lead	456 J	8 J	122 J	2.2 J	35.2 J	41 J
Mercury	0.19	0.02 J	0.02 J	0.01 J	0.96	0.62
Selenium	1.7	0.71 U	0.77 U	0.76 U	0.72 U	0.76 J
Silver	0.73 J	0.13 U	0.14 U	0.14 U	0.14 U	0.14 U

APPENDIX F

SUMMARY OF ANALYTICAL RESULTS
TEST TRENCHES - SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	SWMU46-TT07-01D	SWMU46-TT07-02	SWMU46-TT08-01	SWMU46-TT08-02	SWMU46-DP01	SWMU46-DP01 D
Date	05-Apr-04	05-Apr-04	02-Apr-04	02-Apr-04	05-Apr-04	05-Apr-04
Depth Range	1-3	3-5	1-3	3-5	0-0	0-0
SOLIDS						
Total Solids	83	92	86	85	85	86

Notes:

U - Non Detected
J - Analyte detected. Reported value is estimated.
mg/kg - milligrams per kilogram

DNJ - Reported value froma dilution, tentatively identified analyte, estimated value.
D - Reported value from a dilution.
UUJ - Non-detected, estimated value.

APPENDIX F

SUMMARY OF ANALYTICAL RESULTS
GROUNDWATER - SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB, CAMP LEJEUNE, NORTH CAROLINA

Sample ID	SWMU46-MW01
Date	21-Mar-04
METALS (ug/L)	
Arsenic	2.13 U
Barium	64.7
Cadmium	0.25 U
Chromium	0.88 U
Lead	1.56 U
Mercury	0.01 U
Selenium	2.32 U
Silver	1.16 U

Notes:

U - Non detected

Baker

Baker Environmental, Inc.

APPENDIX G

Risk Assessment Data Sets

APPENDIX G

SURFACE SOIL ANALYTICAL RESULTS
SWMU 046
RCRA INVESTIGATION - CTO-0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU46-IS01-00	SWMU46-IS02-00	SWMU46-IS03-00	SWMU46-IS04-00	SWMU46-TW01-00	SWMU46-TW02-00	SWMU46-TW03-00	SWMU46-TW04-00
SAMPLE DATE	09-09-1997	09-09-1997	09-09-1997	09-09-1997	03-23-2002	03-23-2002	03-23-2002	03-23-2002
DEPTH	0'-2'	0'-2'	0'-2'	0'-2'	0'-1'	0'-1'	0'-1'	0'-1'
Semivolatiles (ug/kg)								
1,2,4-Trichlorobenzene	350 U	360 U	350 U	370 U	NA	NA	NA	NA
1,2-Dichlorobenzene (o-)	350 U	360 U	350 U	370 U	NA	NA	NA	NA
1,3-Dichlorobenzene (m-)	350 U	360 U	350 U	370 U	NA	NA	NA	NA
1,4-Dichlorobenzene (p-)	350 U	360 U	350 U	370 U	NA	NA	NA	NA
2,2'-Oxybis[1-chloropropane]	350 U	360 U	350 U	370 U	NA	NA	NA	NA
2,4,5-Trichlorophenol	350 U	360 U	350 U	370 U	NA	NA	NA	NA
2,4,6-Trichlorophenol	350 U	360 U	350 U	370 U	NA	NA	NA	NA
2,4-Dichlorophenol	350 U	360 U	350 U	370 U	NA	NA	NA	NA
2,4-Dimethylphenol	350 U	360 U	350 U	370 U	NA	NA	NA	NA
2,4-Dinitrophenol	1700 U	1800 U	1700 U	1800 U	NA	NA	NA	NA
2,4-Dinitrotoluene	350 U	360 U	350 U	370 U	NA	NA	NA	NA
2,6-Dinitrotoluene	350 U	360 U	350 U	370 U	NA	NA	NA	NA
2-Chloronaphthalene	350 U	360 U	350 U	370 U	NA	NA	NA	NA
2-Chlorophenol	350 U	360 U	350 U	370 U	NA	NA	NA	NA
2-Methylnaphthalene	350 U	360 U	350 U	370 U	NA	NA	NA	NA
2-Methylphenol (o-Cresol)	350 U	360 U	350 U	370 U	NA	NA	NA	NA
2-Nitroaniline	1700 U	1800 U	1700 U	1800 U	NA	NA	NA	NA
2-Nitrophenol	350 U	360 U	350 U	370 U	NA	NA	NA	NA
3,3'-Dichlorobenzidine	1700 U	1800 U	1700 U	1800 U	NA	NA	NA	NA
3-Nitroaniline	1700 U	1800 U	1700 U	1800 U	NA	NA	NA	NA
4,6-Dinitro-2-methylphenol	1700 U	1800 U	1700 U	1800 U	NA	NA	NA	NA
4-Bromophenyl-phenylether	350 U	360 U	350 U	370 U	NA	NA	NA	NA
4-Chloro-3-methylphenol	350 U	360 U	350 U	370 U	NA	NA	NA	NA
4-Chloroaniline	350 U	360 U	350 U	370 U	NA	NA	NA	NA
4-Chlorophenyl-phenylether	350 U	360 U	350 U	370 U	NA	NA	NA	NA
4-Methylphenol (p-Cresol)	350 U	360 U	350 U	370 U	NA	NA	NA	NA
4-Nitroaniline	1700 U	1800 U	1700 U	1800 U	NA	NA	NA	NA
4-Nitrophenol	1700 U	1800 U	1700 U	1800 U	NA	NA	NA	NA
Acenaphthene	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Acenaphthylene	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Anthracene	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Benzo(a)anthracene	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Benzo(a)pyrene	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Benzo(b)fluoranthene	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Benzo(g,h,i)perylene	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Benzo(k)fluoranthene	350 U	360 U	350 U	370 U	NA	NA	NA	NA

APPENDIX G (Continued)

SURFACE SOIL ANALYTICAL RESULTS
SWMU 046
RCRA INVESTIGATION - CTO-0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU46-IS01-00	SWMU46-IS02-00	SWMU46-IS03-00	SWMU46-IS04-00	SWMU46-TW01-00	SWMU46-TW02-00	SWMU46-TW03-00	SWMU46-TW04-00
SAMPLE DATE	09-09-1997	09-09-1997	09-09-1997	09-09-1997	03-23-2002	03-23-2002	03-23-2002	03-23-2002
DEPTH	0'-2'	0'-2'	0'-2'	0'-2'	0'-1'	0'-1'	0'-1'	0'-1'
Semivolatiles (ug/kg) (Cont)								
Bis(2-chloroethoxy)methane	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Bis(2-chloroethyl)ether	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Bis(2-ethylhexyl) Phthalate (BEHP)	350 U	360 U	42 J	370 U	NA	NA	NA	NA
Butyl Benzyl Phthalate	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Carbazole	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Chrysene	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Dibenz(a,h)anthracene	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Dibenzofuran	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Diethyl Phthalate (DEP)	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Dimethyl Phthalate	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Di-n-butyl Phthalate (DBP)	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Di-n-octyl Phthalate	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Fluoranthene	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Fluorene	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Hexachlorobenzene	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Hexachlorobutadiene	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Hexachlorocyclopentadiene	1700 U	1800 U	1700 U	1800 U	NA	NA	NA	NA
Hexachloroethane	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Isophorone	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Naphthalene	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Nitrobenzene	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Nitrosodi-n-propylamine, n-	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Nitrosodiphenylamine, n-	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Pentachlorophenol	1700 U	1800 U	1700 U	1800 U	NA	NA	NA	NA
Phenanthrene	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Phenol	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Pyrene	350 U	360 U	350 U	370 U	NA	NA	NA	NA
Metals (mg/kg)								
Arsenic	1.3	2	1.1 U	1.1	0.28 U	0.89 J	0.59 J	1.7
Barium	21 U	22 U	21.1 U	22.3 U	14.3	13.2	10.5	38.3
Cadmium	0.53 U	0.55 U	0.53 U	0.56 U	0.034 U	0.051 J	0.13 J	0.51 J
Chromium	9.3	7.1	3.5	4.1	4	4.6	4.2	60.6
Lead	38.6	8	28.9	5.7	4.7	16.5	11.4	1950
Mercury	0.048	0.036 U	0.053	0.037 U	0.5 J	0.061 J	0.04 J	0.075 J
Selenium	0.53 U	0.55 U	0.53 U	0.56 U	0.53 U	0.48 U	0.6	0.53 J
Silver	1.1 U	1.1 U	1.1 U	1.1 U	0.1 U	0.095 U	0.095 U	0.55

APPENDIX G (Continued)

SURFACE SOIL ANALYTICAL RESULTS
SWMU 046
RCRA INVESTIGATION - CTO-0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU46-TW05-00	SWMU46-TW06-00	SWMU46-SB01-00	SWMU46-SB02-00	SWMU46-SB03-00	SWMU46-SB04-00	SWMU46-SB05-00
SAMPLE DATE	03-23-2002	03-23-2002	3/22/2004	3/22/2004	3/22/2004	3/22/2004	3/22/2004
DEPTH	0'-1'	0'-1'	0-1	0-1	0-1	0-1	0-1
Semivolatiles (ug/kg)							
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene (o-)	NA	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene (m-)	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene (p-)	NA	NA	NA	NA	NA	NA	NA
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
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

APPENDIX G (Continued)

SURFACE SOIL ANALYTICAL RESULTS
SWMU 046
RCRA INVESTIGATION - CTO-0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU46-TW05-00	SWMU46-TW06-00	SWMU46-SB01-00	SWMU46-SB02-00	SWMU46-SB03-00	SWMU46-SB04-00	SWMU46-SB05-00
SAMPLE DATE	03-23-2002	03-23-2002	3/22/2004	3/22/2004	3/22/2004	3/22/2004	3/22/2004
DEPTH	0'-1'	0'-1'	0-1	0-1	0-1	0-1	0-1
Semivolatiles (ug/kg) (Cont)							
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 (BEHP)	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
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
Nitrosodi-n-propylamine, n-	NA	NA	NA	NA	NA	NA	NA
Nitrosodiphenylamine, n-	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	0.62 J	1.9	7.7	1.4 U	2.025	2.8	1.6 U
Barium	8.1	15.6	131 J	8 J	11.25 J	17 J	14.6 J
Cadmium	0.12 J	0.25 J	3.2	1.8 U	0.87 U	0.4 J	0.05 U
Chromium	4.9	8	36.5 J	4.6 J	6.5 J	7.2 J	5.3 J
Lead	34.9	242	528 J	48.4 J	34.6 J	55.9 J	5.4 J
Mercury	0.04 J	0.047 J	0.83	0.04 J	0.025 J	0.04 J	0.03 J
Selenium	0.47 U	0.68	0.48 U	0.42 U	1.05 U	0.42 U	0.42 U
Silver	0.093 U	0.099 U	3.9	0.21 U	0.2 U	0.21 U	0.21 U

APPENDIX G (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 046
RCRA INVESTIGATION - CTO-0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU46-IS01-04	SWMU46-IS02-04	SWMU46-IS03-04	SWMU46-IS04-04	SWMU46-TW01-05	SWMU46-TW02-04	SWMU46-TW03-04	SWMU46-TW04-04
SAMPLE DATE	09-09-1997	09-09-1997	09-09-1997	09-09-1997	03-23-2002	03-23-2002	03-23-2002	03-23-2002
DEPTH	8'-10'	8'-10'	8'-10'	8'-10'	9'-11'	7'-9'	7'-9'	7'-9'
VOLATILES (ug/kg)								
1,1,1-Trichloroethane (TCA)	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane (DBCP)	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane (EDB)	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene (o-)	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethane	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethene (cis)	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethene (total)	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethene (trans)	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene (m-)	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichloropropene (cis)	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichloropropene (trans)	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene (p-)	NA	NA	NA	NA	NA	NA	NA	NA
2-Butanone (MEK)	NA	NA	NA	NA	NA	NA	NA	NA
2-Hexanone (MBK)	NA	NA	NA	NA	NA	NA	NA	NA
4-Methyl-2-pentanone (MIBK)	NA	NA	NA	NA	NA	NA	NA	NA
Acetone	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	NA	NA	NA	NA	NA	NA	NA	NA
Bromodichloromethane	NA	NA	NA	NA	NA	NA	NA	NA
Bromoform	NA	NA	NA	NA	NA	NA	NA	NA
Bromomethane	NA	NA	NA	NA	NA	NA	NA	NA
Carbon Disulfide	NA	NA	NA	NA	NA	NA	NA	NA
Carbon Tetrachloride	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	NA	NA	NA	NA	NA	NA	NA	NA
Chloromethane	NA	NA	NA	NA	NA	NA	NA	NA
Cyclohexane	NA	NA	NA	NA	NA	NA	NA	NA
Dibromochloromethane	NA	NA	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	NA	NA	NA	NA	NA	NA	NA	NA
Isopropylbenzene (Cumene)	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Acetate	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Cyclohexane	NA	NA	NA	NA	NA	NA	NA	NA

APPENDIX G (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 046
RCRA INVESTIGATION - CTO-0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU46-IS01-04	SWMU46-IS02-04	SWMU46-IS03-04	SWMU46-IS04-04	SWMU46-TW01-05	SWMU46-TW02-04	SWMU46-TW03-04	SWMU46-TW04-04
SAMPLE DATE	09-09-1997	09-09-1997	09-09-1997	09-09-1997	03-23-2002	03-23-2002	03-23-2002	03-23-2002
DEPTH	8'-10'	8'-10'	8'-10'	8'-10'	9'-11'	7'-9'	7'-9'	7'-9'
Volatiles (ug/kg) (Cont)								
Methyl Tert-Butyl Ether (MTBE)	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	NA	NA	NA	NA	NA	NA	NA	NA
Styrene (Ethenylbenzene)	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene (PCE)	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene (TCE)	NA	NA	NA	NA	NA	NA	NA	NA
Trichlorofluoromethane	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA
Xylene, m/p-	NA	NA	NA	NA	NA	NA	NA	NA
Xylene, o-	NA	NA	NA	NA	NA	NA	NA	NA
Xylenes, total	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatiles (ug/kg)								
1,1'-Biphenyl	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	370 U	370 U	410 U	400 U	NA	NA	NA	NA
1,2-Dichlorobenzene (o-)	370 U	370 U	410 U	400 U	NA	NA	NA	NA
1,3-Dichlorobenzene (m-)	370 U	370 U	410 U	400 U	NA	NA	NA	NA
1,4-Dichlorobenzene (p-)	370 U	370 U	410 U	400 U	NA	NA	NA	NA
2,2'-Oxybis[1-chloropropane]	370 U	370 U	410 U	400 U	NA	NA	NA	NA
2,4,5-Trichlorophenol	370 U	370 U	410 U	400 U	NA	NA	NA	NA
2,4,6-Trichlorophenol	370 U	370 U	410 U	400 U	NA	NA	NA	NA
2,4-Dichlorophenol	370 U	370 U	410 U	400 U	NA	NA	NA	NA
2,4-Dimethylphenol	370 U	370 U	410 U	400 U	NA	NA	NA	NA
2,4-Dinitrophenol	1800 U	1800 U	2000 U	1900 U	NA	NA	NA	NA
2,4-Dinitrotoluene	370 U	370 U	410 U	400 U	NA	NA	NA	NA
2,6-Dinitrotoluene	370 U	370 U	410 U	400 U	NA	NA	NA	NA
2-Chloronaphthalene	370 U	370 U	410 U	400 U	NA	NA	NA	NA
2-Chlorophenol	370 U	370 U	410 U	400 U	NA	NA	NA	NA
2-Methylnaphthalene	370 U	370 U	410 U	400 U	NA	NA	NA	NA
2-Methylphenol (o-Cresol)	370 U	370 U	410 U	400 U	NA	NA	NA	NA
2-Nitroaniline	1800 U	1800 U	2000 U	1900 U	NA	NA	NA	NA
2-Nitrophenol	370 U	370 U	410 U	400 U	NA	NA	NA	NA
3,3'-Dichlorobenzidine	1800 U	1800 U	2000 U	1900 U	NA	NA	NA	NA
3-Nitroaniline	1800 U	1800 U	2000 U	1900 U	NA	NA	NA	NA
4,6-Dinitro-2-methylphenol	1800 U	1800 U	2000 U	1900 U	NA	NA	NA	NA
4-Bromophenyl-phenylether	370 U	370 U	410 U	400 U	NA	NA	NA	NA
4-Chloro-3-methylphenol	370 U	370 U	410 U	400 U	NA	NA	NA	NA
4-Chloroaniline	370 U	370 U	410 U	400 U	NA	NA	NA	NA
4-Chlorophenyl-phenylether	370 U	370 U	410 U	400 U	NA	NA	NA	NA
4-Methylphenol (p-Cresol)	370 U	370 U	410 U	400 U	NA	NA	NA	NA
4-Nitroaniline	1800 U	1800 U	2000 U	1900 U	NA	NA	NA	NA
4-Nitrophenol	1800 U	1800 U	2000 U	1900 U	NA	NA	NA	NA

APPENDIX G (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 046
RCRA INVESTIGATION - CTO-0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU46-IS01-04	SWMU46-IS02-04	SWMU46-IS03-04	SWMU46-IS04-04	SWMU46-TW01-05	SWMU46-TW02-04	SWMU46-TW03-04	SWMU46-TW04-04
SAMPLE DATE	09-09-1997	09-09-1997	09-09-1997	09-09-1997	03-23-2002	03-23-2002	03-23-2002	03-23-2002
DEPTH	8'-10'	8'-10'	8'-10'	8'-10'	9'-11'	7'-9'	7'-9'	7'-9'
Semivolatiles (ug/kg) (Cont)								
Acenaphthene	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Acenaphthylene	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Acetophenone	NA	NA	NA	NA	NA	NA	NA	NA
Anthracene	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Atrazine	NA	NA	NA	NA	NA	NA	NA	NA
Benzaldehyde	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Benzo(a)pyrene	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Benzo(b)fluoranthene	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Benzo(g,h,i)perylene	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Benzo(k)fluoranthene	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Bis(2-chloroethoxy)methane	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Bis(2-chloroethyl)ether	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Bis(2-ethylhexyl) Phthalate (BEHP)	370 U	77 J	410 U	400 U	NA	NA	NA	NA
Butyl Benzyl Phthalate	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Caprolactam	NA	NA	NA	NA	NA	NA	NA	NA
Carbazole	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Chrysene	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Dibenz(a,h)anthracene	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Dibenzofuran	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Diethyl Phthalate (DEP)	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Dimethyl Phthalate	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Di-n-butyl Phthalate (DBP)	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Di-n-octyl Phthalate	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Fluoranthene	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Fluorene	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Hexachlorobenzene	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Hexachlorobutadiene	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Hexachlorocyclopentadiene	1800 U	1800 U	2000 U	1900 U	NA	NA	NA	NA
Hexachloroethane	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Isophorone	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Naphthalene	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Nitrobenzene	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Nitrosodi-n-propylamine, n-	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Nitrosodiphenylamine, n-	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Pentachlorophenol	1800 U	1800 U	2000 U	1900 U	NA	NA	NA	NA
Phenanthrene	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Phenol	370 U	370 U	410 U	400 U	NA	NA	NA	NA
Pyrene	370 U	370 U	410 U	400 U	NA	NA	NA	NA

APPENDIX G (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 046
RCRA INVESTIGATION - CTO-0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU46-IS01-04	SWMU46-IS02-04	SWMU46-IS03-04	SWMU46-IS04-04	SWMU46-TW01-05	SWMU46-TW02-04	SWMU46-TW03-04	SWMU46-TW04-04
SAMPLE DATE	09-09-1997	09-09-1997	09-09-1997	09-09-1997	03-23-2002	03-23-2002	03-23-2002	03-23-2002
DEPTH	8'-10'	8'-10'	8'-10'	8'-10'	9'-11'	7'-9'	7'-9'	7'-9'
Pesticides / PCBs (ug/kg)								
4,4'-DDD	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	NA	NA	NA	NA	NA	NA	NA	NA
BHC, alpha-	NA	NA	NA	NA	NA	NA	NA	NA
BHC, beta-	NA	NA	NA	NA	NA	NA	NA	NA
BHC, delta-	NA	NA	NA	NA	NA	NA	NA	NA
BHC, gamma- (Lindane)	NA	NA	NA	NA	NA	NA	NA	NA
Chlordane, alpha-	NA	NA	NA	NA	NA	NA	NA	NA
Chlordane, gamma-	NA	NA	NA	NA	NA	NA	NA	NA
Aldrin	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan I	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan II	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan Sulfate	NA	NA	NA	NA	NA	NA	NA	NA
Endrin	NA	NA	NA	NA	NA	NA	NA	NA
Endrin Aldehyde	NA	NA	NA	NA	NA	NA	NA	NA
Endrin Ketone	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor Epoxide	NA	NA	NA	NA	NA	NA	NA	NA
Methoxychlor	NA	NA	NA	NA	NA	NA	NA	NA
Toxaphene	NA	NA	NA	NA	NA	NA	NA	NA
Metals (mg/kg)								
Arsenic	1.1 U	1.7	6.1	1.2 U	0.25 U	0.28 U	0.28 U	0.27 U
Barium	22.7 U	36.6	25.3	24.2 U	1.1	2.7	3.6	3.6
Cadmium	0.57 U	4.5	0.61 U	0.61 U	0.031 U	0.035 U	0.035 U	0.034 U
Chromium	3.5	7.4	21.5	3	0.72	2	2.6	3.2
Lead	1	12300	7.2	1.8	1.2	1.8	2.8	3.7
Mercury	0.037 U	0.037 U	0.041 U	0.04 U	0.018 J	0.025 J	0.026 J	0.025 J
Selenium	0.57 U	0.56 U	0.61 U	0.61 U	0.47 U	0.54 U	0.54 U	0.55 J
Silver	1.1 U	1.1 U	1.2 U	1.2 U	0.092 U	0.11 U	0.1 U	0.1 U

APPENDIX G (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 046
RCRA INVESTIGATION - CTO-0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU46-TW05-05	SWMU46-TW06-04	SWMU46-SB01-03	SWMU46-SB02-04	SWMU46-SB03-02	SWMU46-SB04-02	SWMU46-SB05-04	SWMU46-TT01-01
SAMPLE DATE	03-23-2002	03-23-2002	3/22/2004	3/22/2004	3/22/2004	3/22/2004	3/22/2004	01-Apr-04
DEPTH	9'-11'	7'-9'	5-7	7-9	3-5	3-5	7-9	1-3
VOLATILES (ug/kg)								
1,1,1-Trichloroethane (TCA)	NA	NA	NA	NA	NA	NA	NA	12 U
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA	NA	NA	12 U
1,1,2-Trichloro-1,2,2-trifluoroethane	NA	NA	NA	NA	NA	NA	NA	12 U
1,1,2-Trichloroethane	NA	NA	NA	NA	NA	NA	NA	12 U
1,1-Dichloroethane	NA	NA	NA	NA	NA	NA	NA	12 U
1,1-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	12 U
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA	NA	12 U
1,2-Dibromo-3-chloropropane (DBCP)	NA	NA	NA	NA	NA	NA	NA	12 U
1,2-Dibromoethane (EDB)	NA	NA	NA	NA	NA	NA	NA	12 U
1,2-Dichlorobenzene (o-)	NA	NA	NA	NA	NA	NA	NA	12 U
1,2-Dichloroethane	NA	NA	NA	NA	NA	NA	NA	12 U
1,2-Dichloroethene (cis)	NA	NA	NA	NA	NA	NA	NA	12 U
1,2-Dichloroethene (total)	NA	NA	NA	NA	NA	NA	NA	12 U
1,2-Dichloroethene (trans)	NA	NA	NA	NA	NA	NA	NA	12 U
1,2-Dichloropropane	NA	NA	NA	NA	NA	NA	NA	12 U
1,3-Dichlorobenzene (m-)	NA	NA	NA	NA	NA	NA	NA	12 U
1,3-Dichloropropene (cis)	NA	NA	NA	NA	NA	NA	NA	12 U
1,3-Dichloropropene (trans)	NA	NA	NA	NA	NA	NA	NA	12 U
1,4-Dichlorobenzene (p-)	NA	NA	NA	NA	NA	NA	NA	12 U
2-Butanone (MEK)	NA	NA	NA	NA	NA	NA	NA	12 U
2-Hexanone (MBK)	NA	NA	NA	NA	NA	NA	NA	12 U
4-Methyl-2-pentanone (MIBK)	NA	NA	NA	NA	NA	NA	NA	12 U
Acetone	NA	NA	NA	NA	NA	NA	NA	40 U
Benzene	NA	NA	NA	NA	NA	NA	NA	12 U
Bromodichloromethane	NA	NA	NA	NA	NA	NA	NA	12 U
Bromoform	NA	NA	NA	NA	NA	NA	NA	12 U
Bromomethane	NA	NA	NA	NA	NA	NA	NA	12 UJ
Carbon Disulfide	NA	NA	NA	NA	NA	NA	NA	12 U
Carbon Tetrachloride	NA	NA	NA	NA	NA	NA	NA	12 U
Chlorobenzene	NA	NA	NA	NA	NA	NA	NA	12 U
Chloroethane	NA	NA	NA	NA	NA	NA	NA	12 U
Chloroform	NA	NA	NA	NA	NA	NA	NA	12 U
Chloromethane	NA	NA	NA	NA	NA	NA	NA	12 U
Cyclohexane	NA	NA	NA	NA	NA	NA	NA	12 U
Dibromochloromethane	NA	NA	NA	NA	NA	NA	NA	12 U
Dichlorodifluoromethane	NA	NA	NA	NA	NA	NA	NA	12 U
Ethylbenzene	NA	NA	NA	NA	NA	NA	NA	12 U
Isopropylbenzene (Cumene)	NA	NA	NA	NA	NA	NA	NA	12 U
Methyl Acetate	NA	NA	NA	NA	NA	NA	NA	12 U
Methyl Cyclohexane	NA	NA	NA	NA	NA	NA	NA	12 U

APPENDIX G (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 046
RCRA INVESTIGATION - CTO-0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU46-TW05-05	SWMU46-TW06-04	SWMU46-SB01-03	SWMU46-SB02-04	SWMU46-SB03-02	SWMU46-SB04-02	SWMU46-SB05-04	SWMU46-TT01-01
SAMPLE DATE	03-23-2002	03-23-2002	3/22/2004	3/22/2004	3/22/2004	3/22/2004	3/22/2004	01-Apr-04
DEPTH	9'-11'	7'-9'	5-7	7-9	3-5	3-5	7-9	1-3
Volatiles (ug/kg) (Cont)								
Methyl Tert-Butyl Ether (MTBE)	NA	NA	NA	NA	NA	NA	NA	12 U
Methylene Chloride	NA	NA	NA	NA	NA	NA	NA	13 U
Styrene (Ethenylbenzene)	NA	NA	NA	NA	NA	NA	NA	12 U
Tetrachloroethene (PCE)	NA	NA	NA	NA	NA	NA	NA	12 U
Toluene	NA	NA	NA	NA	NA	NA	NA	12 U
Trichloroethene (TCE)	NA	NA	NA	NA	NA	NA	NA	12 U
Trichlorofluoromethane	NA	NA	NA	NA	NA	NA	NA	2 J
Vinyl Chloride	NA	NA	NA	NA	NA	NA	NA	12 U
Xylene, m/p-	NA	NA	NA	NA	NA	NA	NA	12 U
Xylene, o-	NA	NA	NA	NA	NA	NA	NA	12 U
Xylenes, total	NA	NA	NA	NA	NA	NA	NA	12 U
Semivolatiles (ug/kg)								
1,1'-Biphenyl	NA	NA	NA	NA	NA	NA	NA	440 U
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene (o-)	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene (m-)	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene (p-)	NA	NA	NA	NA	NA	NA	NA	NA
2,2'-Oxybis[1-chloropropane]	NA	NA	NA	NA	NA	NA	NA	440 U
2,4,5-Trichlorophenol	NA	NA	NA	NA	NA	NA	NA	1100 U
2,4,6-Trichlorophenol	NA	NA	NA	NA	NA	NA	NA	440 U
2,4-Dichlorophenol	NA	NA	NA	NA	NA	NA	NA	440 U
2,4-Dimethylphenol	NA	NA	NA	NA	NA	NA	NA	440 U
2,4-Dinitrophenol	NA	NA	NA	NA	NA	NA	NA	1100 UJ
2,4-Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	440 U
2,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	440 U
2-Chloronaphthalene	NA	NA	NA	NA	NA	NA	NA	440 U
2-Chlorophenol	NA	NA	NA	NA	NA	NA	NA	440 U
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA	440 U
2-Methylphenol (o-Cresol)	NA	NA	NA	NA	NA	NA	NA	440 U
2-Nitroaniline	NA	NA	NA	NA	NA	NA	NA	1100 U
2-Nitrophenol	NA	NA	NA	NA	NA	NA	NA	440 U
3,3'-Dichlorobenzidine	NA	NA	NA	NA	NA	NA	NA	440 UJ
3-Nitroaniline	NA	NA	NA	NA	NA	NA	NA	1100 U
4,6-Dinitro-2-methylphenol	NA	NA	NA	NA	NA	NA	NA	1100 U
4-Bromophenyl-phenylether	NA	NA	NA	NA	NA	NA	NA	440 U
4-Chloro-3-methylphenol	NA	NA	NA	NA	NA	NA	NA	440 U
4-Chloroaniline	NA	NA	NA	NA	NA	NA	NA	440 U
4-Chlorophenyl-phenylether	NA	NA	NA	NA	NA	NA	NA	440 U
4-Methylphenol (p-Cresol)	NA	NA	NA	NA	NA	NA	NA	440 U
4-Nitroaniline	NA	NA	NA	NA	NA	NA	NA	1100 UJ
4-Nitrophenol	NA	NA	NA	NA	NA	NA	NA	1100 U

APPENDIX G (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 046
RCRA INVESTIGATION - CTO-0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU46-TW05-05	SWMU46-TW06-04	SWMU46-SB01-03	SWMU46-SB02-04	SWMU46-SB03-02	SWMU46-SB04-02	SWMU46-SB05-04	SWMU46-TT01-01
SAMPLE DATE	03-23-2002	03-23-2002	3/22/2004	3/22/2004	3/22/2004	3/22/2004	3/22/2004	01-Apr-04
DEPTH	9'-11'	7'-9'	5-7	7-9	3-5	3-5	7-9	1-3
Semivolatiles (ug/kg) (Cont)								
Acenaphthene	NA	NA	NA	NA	NA	NA	NA	440 U
Acenaphthylene	NA	NA	NA	NA	NA	NA	NA	440 U
Acetophenone	NA	NA	NA	NA	NA	NA	NA	440 U
Anthracene	NA	NA	NA	NA	NA	NA	NA	163 J
Atrazine	NA	NA	NA	NA	NA	NA	NA	440 U
Benzaldehyde	NA	NA	NA	NA	NA	NA	NA	440 U
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA	450
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA	440 U
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA	480
Benzo(g,h,i)perylene	NA	NA	NA	NA	NA	NA	NA	440 U
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	NA	240 J
Bis(2-chloroethoxy)methane	NA	NA	NA	NA	NA	NA	NA	440 U
Bis(2-chloroethyl)ether	NA	NA	NA	NA	NA	NA	NA	440 U
Bis(2-ethylhexyl) Phthalate (BEHP)	NA	NA	NA	NA	NA	NA	NA	440 U
Butyl Benzyl Phthalate	NA	NA	NA	NA	NA	NA	NA	440 U
Caprolactam	NA	NA	NA	NA	NA	NA	NA	440 U
Carbazole	NA	NA	NA	NA	NA	NA	NA	440 U
Chrysene	NA	NA	NA	NA	NA	NA	NA	830
Dibenz(a,h)anthracene	NA	NA	NA	NA	NA	NA	NA	440 U
Dibenzofuran	NA	NA	NA	NA	NA	NA	NA	440 U
Diethyl Phthalate (DEP)	NA	NA	NA	NA	NA	NA	NA	440 U
Dimethyl Phthalate	NA	NA	NA	NA	NA	NA	NA	440 U
Di-n-butyl Phthalate (DBP)	NA	NA	NA	NA	NA	NA	NA	440 U
Di-n-octyl Phthalate	NA	NA	NA	NA	NA	NA	NA	440 U
Fluoranthene	NA	NA	NA	NA	NA	NA	NA	2200
Fluorene	NA	NA	NA	NA	NA	NA	NA	440 U
Hexachlorobenzene	NA	NA	NA	NA	NA	NA	NA	440 U
Hexachlorobutadiene	NA	NA	NA	NA	NA	NA	NA	440 U
Hexachlorocyclopentadiene	NA	NA	NA	NA	NA	NA	NA	440 U
Hexachloroethane	NA	NA	NA	NA	NA	NA	NA	440 U
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA	NA	NA	440 U
Isophorone	NA	NA	NA	NA	NA	NA	NA	440 U
Naphthalene	NA	NA	NA	NA	NA	NA	NA	440 U
Nitrobenzene	NA	NA	NA	NA	NA	NA	NA	440 U
Nitrosodi-n-propylamine, n-	NA	NA	NA	NA	NA	NA	NA	440 U
Nitrosodiphenylamine, n-	NA	NA	NA	NA	NA	NA	NA	440 U
Pentachlorophenol	NA	NA	NA	NA	NA	NA	NA	1100 U
Phenanthrene	NA	NA	NA	NA	NA	NA	NA	800
Phenol	NA	NA	NA	NA	NA	NA	NA	440 U
Pyrene	NA	NA	NA	NA	NA	NA	NA	2400

APPENDIX G (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 046
RCRA INVESTIGATION - CTO-0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU46-TW05-05	SWMU46-TW06-04	SWMU46-SB01-03	SWMU46-SB02-04	SWMU46-SB03-02	SWMU46-SB04-02	SWMU46-SB05-04	SWMU46-TT01-01
SAMPLE DATE	03-23-2002	03-23-2002	3/22/2004	3/22/2004	3/22/2004	3/22/2004	3/22/2004	01-Apr-04
DEPTH	9'-11'	7'-9'	5-7	7-9	3-5	3-5	7-9	1-3
Pesticides / PCBs (ug/kg)								
4,4'-DDD	NA	NA	NA	NA	NA	NA	NA	620 D
4,4'-DDE	NA	NA	NA	NA	NA	NA	NA	180 D
4,4'-DDT	NA	NA	NA	NA	NA	NA	NA	16
BHC, alpha-	NA	NA	NA	NA	NA	NA	NA	1.7
BHC, beta-	NA	NA	NA	NA	NA	NA	NA	4.5 U
BHC, delta-	NA	NA	NA	NA	NA	NA	NA	4.5 U
BHC, gamma- (Lindane)	NA	NA	NA	NA	NA	NA	NA	4.5 U
Chlordane, alpha-	NA	NA	NA	NA	NA	NA	NA	4.5 U
Chlordane, gamma-	NA	NA	NA	NA	NA	NA	NA	4.5 U
Aldrin	NA	NA	NA	NA	NA	NA	NA	2.5 J
Dieldrin	NA	NA	NA	NA	NA	NA	NA	8.8 U
Endosulfan I	NA	NA	NA	NA	NA	NA	NA	4.5 U
Endosulfan II	NA	NA	NA	NA	NA	NA	NA	8.8 U
Endosulfan Sulfate	NA	NA	NA	NA	NA	NA	NA	8.8 U
Endrin	NA	NA	NA	NA	NA	NA	NA	8.8 U
Endrin Aldehyde	NA	NA	NA	NA	NA	NA	NA	8.8 U
Endrin Ketone	NA	NA	NA	NA	NA	NA	NA	8.8 U
Heptachlor	NA	NA	NA	NA	NA	NA	NA	4.5 U
Heptachlor Epoxide	NA	NA	NA	NA	NA	NA	NA	4.5 U
Methoxychlor	NA	NA	NA	NA	NA	NA	NA	45 U
Toxaphene	NA	NA	NA	NA	NA	NA	NA	450 U
Metals (mg/kg)								
Arsenic	0.25 U	0.32 U	0.42 U	0.41 U	1.3 U	4.5	1.4 U	2.5 J
Barium	0.59 U	2.5	0.96 J	0.74 J	0.85 J	209 J	0.88 J	341
Cadmium	0.031 U	0.4 U	0.05 U	0.05 U	0.04 U	6	0.06 J	1.8
Chromium	0.69	3.1	2.9 UJ	2.9 UJ	2.4 UJ	39.4 J	1.8 J	16.1
Lead	1.1	2.1	1.4 J	2.2 J	1.5 J	3010 J	1.8 J	1080 J
Mercury	0.017 U	0.024 J	0.01 U	0.01 U	0.01 U	0.11 J	0.01 U	0.1 J
Selenium	0.48 U	0.62 U	0.46 U	0.44 U	0.38 U	2 UJ	0.39 U	0.79 U
Silver	0.094 U	0.12 U	0.23 U	0.22 U	0.19 U	9.5	0.2 U	0.3 J

APPENDIX G (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 046
RCRA INVESTIGATION - CTO-0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU46-TT02-01	SWMU46-TT02-02	SWMU46-TT03-01	SWMU46-TT03-02	SWMU46-TT04-01	SWMU46-TT04-02	SWMU46-TT05-01	SWMU46-TT05-02
SAMPLE DATE	01-Apr-04	01-Apr-04	02-Apr-04	02-Apr-04	02-Apr-04	02-Apr-04	05-Apr-04	05-Apr-04
DEPTH	1-3	3-5	1-3	3-5	1-3	3-5	1-3	3-5
VOLATILES (ug/kg)								
1,1,1-Trichloroethane (TCA)	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
1,1,2,2-Tetrachloroethane	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
1,1,2-Trichloro-1,2,2-trifluoroethane	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
1,1,2-Trichloroethane	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
1,1-Dichloroethane	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
1,1-Dichloroethene	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
1,2,4-Trichlorobenzene	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
1,2-Dibromo-3-chloropropane (DBCP)	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
1,2-Dibromoethane (EDB)	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
1,2-Dichlorobenzene (o-)	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
1,2-Dichloroethane	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
1,2-Dichloroethene (cis)	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
1,2-Dichloroethene (total)	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
1,2-Dichloroethene (trans)	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
1,2-Dichloropropane	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
1,3-Dichlorobenzene (m-)	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
1,3-Dichloropropene (cis)	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
1,3-Dichloropropene (trans)	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
1,4-Dichlorobenzene (p-)	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
2-Butanone (MEK)	12 U	14 UJ	13 U	11 UJ	11 UJ	10 UJ	12 U	12 UJ
2-Hexanone (MBK)	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
4-Methyl-2-pentanone (MIBK)	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
Acetone	10 U	19 UJ	13 U	11 UJ	11 UJ	10 UJ	12 U	12 UJ
Benzene	12 U	14 UJ	13 U	4 J	11 UJ	10 U	12 U	2 J
Bromodichloromethane	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
Bromoform	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
Bromomethane	12 UJ	14 UJ	13 UJ	11 UJ	11 UJ	10 UJ	12 U	12 UJ
Carbon Disulfide	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
Carbon Tetrachloride	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
Chlorobenzene	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
Chloroethane	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
Chloroform	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
Chloromethane	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
Cyclohexane	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
Dibromochloromethane	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
Dichlorodifluoromethane	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
Ethylbenzene	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
Isopropylbenzene (Cumene)	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
Methyl Acetate	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
Methyl Cyclohexane	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ

APPENDIX G (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 046
RCRA INVESTIGATION - CTO-0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU46-TT02-01	SWMU46-TT02-02	SWMU46-TT03-01	SWMU46-TT03-02	SWMU46-TT04-01	SWMU46-TT04-02	SWMU46-TT05-01	SWMU46-TT05-02
SAMPLE DATE	01-Apr-04	01-Apr-04	02-Apr-04	02-Apr-04	02-Apr-04	02-Apr-04	05-Apr-04	05-Apr-04
DEPTH	1-3	3-5	1-3	3-5	1-3	3-5	1-3	3-5
Volatiles (ug/kg) (Cont)								
Methyl Tert-Butyl Ether (MTBE)	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
Methylene Chloride	20 U	16 UJ	14 U	12 UJ	15 UJ	14 U	11 U	14 UJ
Styrene (Ethenylbenzene)	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
Tetrachloroethene (PCE)	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
Toluene	12 U	14 UJ	13 U	3 J	11 UJ	10 U	12 U	12 UJ
Trichloroethene (TCE)	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
Trichlorofluoromethane	9 J	4 J	2 J	2 J	5 J	2 J	1 J	2 J
Vinyl Chloride	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
Xylene, m/p-	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
Xylene, o-	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
Xylenes, total	12 U	14 UJ	13 U	11 UJ	11 UJ	10 U	12 U	12 UJ
Semivolatiles (ug/kg)								
1,1'-Biphenyl	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene (o-)	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene (m-)	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene (p-)	NA	NA	NA	NA	NA	NA	NA	NA
2,2'-Oxybis[1-chloropropane]	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
2,4,5-Trichlorophenol	980 U	1000 U	990 U	950 U	970 U	930 U	910 U	1000 U
2,4,6-Trichlorophenol	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
2,4-Dichlorophenol	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
2,4-Dimethylphenol	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
2,4-Dinitrophenol	980 U	1000 U	990 U	950 U	970 UJ	930 UJ	910 UJ	1000 UJ
2,4-Dinitrotoluene	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
2,6-Dinitrotoluene	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
2-Chloronaphthalene	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
2-Chlorophenol	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
2-Methylnaphthalene	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
2-Methylphenol (o-Cresol)	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
2-Nitroaniline	980 U	1000 U	990 U	950 U	970 U	930 U	910 U	1000 U
2-Nitrophenol	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
3,3'-Dichlorobenzidine	390 UJ	420 UJ	390 U	380 UJ	390 UJ	370 UJ	360 JU	410 UJ
3-Nitroaniline	980 U	1000 U	990 U	950 U	970 U	930 U	910 U	1000 U
4,6-Dinitro-2-methylphenol	980 U	1000 U	990 U	950 U	970 U	930 U	910 U	1000 U
4-Bromophenyl-phenylether	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
4-Chloro-3-methylphenol	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
4-Chloroaniline	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
4-Chlorophenyl-phenylether	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
4-Methylphenol (p-Cresol)	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
4-Nitroaniline	980 UJ	1000 UJ	990 UJ	950 UJ	970 UJ	930 UJ	910 UJ	1000 UJ
4-Nitrophenol	980 U	1000 U	990 U	950 U	970 U	930 U	910 U	1000 U

APPENDIX G (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 046
RCRA INVESTIGATION - CTO-0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU46-TT02-01	SWMU46-TT02-02	SWMU46-TT03-01	SWMU46-TT03-02	SWMU46-TT04-01	SWMU46-TT04-02	SWMU46-TT05-01	SWMU46-TT05-02
SAMPLE DATE	01-Apr-04	01-Apr-04	02-Apr-04	02-Apr-04	02-Apr-04	02-Apr-04	05-Apr-04	05-Apr-04
DEPTH	1-3	3-5	1-3	3-5	1-3	3-5	1-3	3-5
Semivolatiles (ug/kg) (Cont)								
Acenaphthene	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Acenaphthylene	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Acetophenone	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Anthracene	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Atrazine	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Benzaldehyde	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Benzo(a)anthracene	390 U	420 U	390 UJ	380 U	390 U	370 U	360 U	410 U
Benzo(a)pyrene	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Benzo(b)fluoranthene	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Benzo(g,h,i)perylene	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Benzo(k)fluoranthene	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Bis(2-chloroethoxy)methane	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Bis(2-chloroethyl)ether	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Bis(2-ethylhexyl) Phthalate (BEHP)	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Butyl Benzyl Phthalate	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Caprolactam	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Carbazole	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Chrysene	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Dibenz(a,h)anthracene	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Dibenzofuran	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Diethyl Phthalate (DEP)	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Dimethyl Phthalate	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Di-n-butyl Phthalate (DBP)	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Di-n-octyl Phthalate	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Fluoranthene	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Fluorene	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Hexachlorobenzene	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Hexachlorobutadiene	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Hexachlorocyclopentadiene	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Hexachloroethane	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Indeno(1,2,3-cd)pyrene	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Isophorone	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Naphthalene	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Nitrobenzene	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Nitrosodi-n-propylamine, n-	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Nitrosodiphenylamine, n-	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Pentachlorophenol	980 U	1000 U	990 U	950 U	970 U	930 U	910 U	1000 U
Phenanthrene	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Phenol	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U
Pyrene	390 U	420 U	390 U	380 U	390 U	370 U	360 U	410 U

APPENDIX G (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 046
RCRA INVESTIGATION - CTO-0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU46-TT02-01	SWMU46-TT02-02	SWMU46-TT03-01	SWMU46-TT03-02	SWMU46-TT04-01	SWMU46-TT04-02	SWMU46-TT05-01	SWMU46-TT05-02
SAMPLE DATE	01-Apr-04	01-Apr-04	02-Apr-04	02-Apr-04	02-Apr-04	02-Apr-04	05-Apr-04	05-Apr-04
DEPTH	1-3	3-5	1-3	3-5	1-3	3-5	1-3	3-5
Pesticides / PCBs (ug/kg)								
4,4'-DDD	3.9 U	35	3.9 U	110 DJ	1600	110 NJ	15	2300 D
4,4'-DDE	3.9 U	38	3.9 U	170 DJ	4400 D	400	4.7	970 D
4,4'-DDT	3.9 U	11	3.9 U	38 J	27000 D	3000 D	57 D	3100 D
BHC, alpha-	2 U	2.1 U	2 U	1.9 U	99 U	19 U	1.9 U	11 U
BHC, beta-	2 U	2.1 U	2 U	1.9 U	99 U	19 U	1.9 U	11 U
BHC, delta-	2 U	2.1 U	2 U	1.9 U	99 U	19 U	1.9 U	11 U
BHC, gamma- (Lindane)	2 U	2.1 U	2 U	1.9 U	99 U	19 U	1.9 U	11 U
Chlordane, alpha-	2 U	2.1 U	2 U	1.6 J	99 U	180	6	400 D
Chlordane, gamma-	2 U	2.1 U	2 U	1.9 U	99 U	200	5.6	430 D
Aldrin	2 U	2.1 U	2 U	1.9 U	99 U	19 U	1.9 U	11 U
Dieldrin	3.9 U	4.2 U	3.9 U	3.8 U	190 U	37 U	3.6 U	20 U
Endosulfan I	2 U	2.1 U	2 U	1.9 U	99 U	19 U	1.9 U	9.5 NJ
Endosulfan II	3.9 U	4.2 U	3.9 U	3.8 U	190 U	37 U	3.6 U	20 U
Endosulfan Sulfate	3.9 U	4.2 U	3.9 U	3.8 U	190 U	37 U	3.6 U	20 U
Endrin	3.9 U	4.2 U	3.9 U	3.8 U	190 U	37 U	3.6 U	20 U
Endrin Aldehyde	3.9 U	4.2 U	3.9 U	3.8 U	190 U	37 U	3.6 U	20 U
Endrin Ketone	3.9 U	4.2 U	3.9 U	3.8 U	190 U	37 U	3.6 U	20 U
Heptachlor	2 U	2.1 U	2 U	1.9 U	99 U	19 U	1.9 U	11 U
Heptachlor Epoxide	2 U	2.1 U	2 U	1.9 U	99 U	19 U	1.9 U	11 U
Methoxychlor	20 U	21 U	20 U	19 U	990 U	190 U	19 U	110 U
Toxaphene	200 U	210 U	200 U	190 U	9900 U	1900 U	190 U	1100 U
Metals (mg/kg)								
Arsenic	0.48 UJ	13.9 J	0.85 J	11.6 J	8 J	1.7 J	0.83 J	6.1 J
Barium	1.5 J	1410	1.2 J	266	110	10.6 J	5.8 J	323
Cadmium	0.06 J	8.4	0.07 J	4.5	3.7	0.24 J	0.09 J	3.6 J
Chromium	1.5 J	150	1.2 J	80.6	18	4.9	1.4 J	42.4
Lead	1.8 J	2930 J	1.6 J	899 J	253 J	8.5 J	1.8 J	819 J
Mercury	0.01 U	0.15	0.01 U	0.14	0.25	0.05 J	0.02 J	0.05 J
Selenium	0.58 U	1.6 J	0.7 U	1.5 J	1.1	0.72 U	0.63 U	3.43 U
Silver	0.11 U	20.1	0.17 J	5.4	1.7 J	0.14 U	0.12 U	1.6 J

APPENDIX G (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 046
RCRA INVESTIGATION - CTO-0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU46-TT06-01	SWMU46-TT06-02	SWMU46-TT07-01	SWMU46-TT07-02	SWMU46-TT08-01	SWMU46-TT08-02
SAMPLE DATE	05-Apr-04	05-Apr-04	05-Apr-04	05-Apr-04	02-Apr-04	02-Apr-04
DEPTH	1-3	3-5	1-3	3-5	1-3	3-5
VOLATILES (ug/kg)						
1,1,1-Trichloroethane (TCA)	10 U	12 U	11 UJ	12 UJ	10 U	11 U
1,1,2,2-Tetrachloroethane	10 U	12 U	11 UJ	12 UJ	10 U	11 U
1,1,2-Trichloro-1,2,2-trifluoroethane	10 U	12 U	11 UJ	12 UJ	10 U	11 U
1,1,2-Trichloroethane	10 U	12 U	11 UJ	12 UJ	10 U	11 U
1,1-Dichloroethane	10 U	12 U	11 UJ	12 UJ	10 U	11 U
1,1-Dichloroethene	10 U	12 U	11 UJ	12 UJ	10 U	11 U
1,2,4-Trichlorobenzene	10 U	12 U	11 UJ	12 UJ	10 U	11 U
1,2-Dibromo-3-chloropropane (DBCP)	10 U	12 U	11 UJ	12 UJ	10 U	11 U
1,2-Dibromoethane (EDB)	10 U	12 U	11 UJ	12 UJ	10 U	11 U
1,2-Dichlorobenzene (o-)	10 U	12 U	11 UJ	12 UJ	10 U	11 U
1,2-Dichloroethane	10 U	12 U	11 UJ	12 UJ	10 U	11 U
1,2-Dichloroethene (cis)	10 U	12 U	11 UJ	12 UJ	10 U	11 U
1,2-Dichloroethene (total)	10 U	12 U	11 UJ	12 UJ	10 U	11 U
1,2-Dichloroethene (trans)	10 U	12 U	11 UJ	12 UJ	10 U	11 U
1,2-Dichloropropane	10 U	12 U	11 UJ	12 UJ	10 U	11 U
1,3-Dichlorobenzene (m-)	10 U	12 U	11 UJ	12 UJ	10 U	11 U
1,3-Dichloropropene (cis)	10 U	12 U	11 UJ	12 UJ	10 U	11 U
1,3-Dichloropropene (trans)	10 U	12 U	11 UJ	12 UJ	10 U	11 U
1,4-Dichlorobenzene (p-)	10 U	12 U	11 UJ	12 UJ	10 U	11 U
2-Butanone (MEK)	10 U	12 U	11 UJ	12 UJ	10 U	11 U
2-Hexanone (MBK)	10 U	12 U	11 UJ	12 UJ	10 U	11 U
4-Methyl-2-pentanone (MIBK)	10 U	12 U	11 UJ	12 UJ	10 U	11 U
Acetone	10 U	12 U	11 UJ	12 UJ	10 U	11 U
Benzene	10 U	12 U	4.25 J	12 UJ	10 U	11 U
Bromodichloromethane	10 U	12 U	11 UJ	12 UJ	10 U	11 U
Bromoform	10 U	12 U	11 UJ	12 UJ	10 U	11 U
Bromomethane	10 U	12 U	11 UJ	12 UJ	10 UJ	11 UJ
Carbon Disulfide	10 U	12 U	11 UJ	12 UJ	10 U	11 U
Carbon Tetrachloride	10 U	12 U	11 UJ	12 UJ	10 U	11 U
Chlorobenzene	10 U	12 U	11 UJ	12 UJ	10 U	11 U
Chloroethane	10 U	12 U	11 UJ	12 UJ	10 U	11 U
Chloroform	10 U	12 U	11 UJ	12 UJ	10 U	11 U
Chloromethane	10 U	12 U	11 UJ	12 UJ	10 U	11 U
Cyclohexane	10 U	12 U	11 UJ	12 UJ	10 U	11 U
Dibromochloromethane	10 U	12 U	11 UJ	12 UJ	10 U	11 U
Dichlorodifluoromethane	10 U	12 U	11 UJ	12 UJ	10 U	11 U
Ethylbenzene	10 U	12 U	11 UJ	12 UJ	10 U	11 U
Isopropylbenzene (Cumene)	10 U	12 U	11 UJ	12 UJ	10 U	11 U
Methyl Acetate	10 U	12 U	11 UJ	12 UJ	10 U	11 U
Methyl Cyclohexane	10 U	12 U	11 UJ	12 UJ	10 U	11 U

APPENDIX G (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 046
RCRA INVESTIGATION - CTO-0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU46-TT06-01	SWMU46-TT06-02	SWMU46-TT07-01	SWMU46-TT07-02	SWMU46-TT08-01	SWMU46-TT08-02
SAMPLE DATE	05-Apr-04	05-Apr-04	05-Apr-04	05-Apr-04	02-Apr-04	02-Apr-04
DEPTH	1-3	3-5	1-3	3-5	1-3	3-5
Volatiles (ug/kg) (Cont)						
Methyl Tert-Butyl Ether (MTBE)	10 U	12 U	11 UJ	12 UJ	10 U	11 U
Methylene Chloride	11 U	14 U	14.5 UJ	12 UJ	11 U	11 U
Styrene (Ethenylbenzene)	10 U	12 U	11 UJ	12 UJ	10 U	11 U
Tetrachloroethene (PCE)	10 U	12 U	11 UJ	12 UJ	10 U	11 U
Toluene	10 U	12 U	3.75 J	12 UJ	10 U	11 U
Trichloroethene (TCE)	10 U	12 U	11 UJ	12 UJ	10 U	11 U
Trichlorofluoromethane	1 J	2 J	3 J	3 J	2 J	2 J
Vinyl Chloride	10 U	12 U	11 UJ	12 UJ	10 U	11 U
Xylene, m/p-	10 U	12 U	11 UJ	12 UJ	10 U	11 U
Xylene, o-	10 U	12 U	11 UJ	12 UJ	10 U	11 U
Xylenes, total	10 U	12 U	11 UJ	12 UJ	10 U	11 U
Semivolatiles (ug/kg)						
1,1'-Biphenyl	390 U	390 U	395 U	360 U	380 U	390 U
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene (o-)	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene (m-)	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene (p-)	NA	NA	NA	NA	NA	NA
2,2'-Oxybis[1-chloropropane]	390 U	390 U	395 U	360 U	380 U	390 U
2,4,5-Trichlorophenol	980 U	970 U	985 U	910 U	970 U	970 U
2,4,6-Trichlorophenol	390 U	390 U	395 U	360 U	380 U	390 U
2,4-Dichlorophenol	390 U	390 U	395 U	360 U	380 U	390 U
2,4-Dimethylphenol	390 U	390 U	395 U	360 U	380 U	390 U
2,4-Dinitrophenol	980 UUJ	970 UJ	985 U	910 U	970 U	970 U
2,4-Dinitrotoluene	390 U	390 U	395 U	360 U	380 U	390 U
2,6-Dinitrotoluene	390 U	390 U	395 U	360 U	380 U	390 U
2-Chloronaphthalene	390 U	390 U	395 U	360 U	380 U	390 U
2-Chlorophenol	390 U	390 U	395 U	360 U	380 U	390 U
2-Methylnaphthalene	390 U	390 U	395 U	360 U	380 U	390 U
2-Methylphenol (o-Cresol)	390 U	390 U	395 U	360 U	380 U	390 U
2-Nitroaniline	980 U	970 U	985 U	910 U	970 U	970 U
2-Nitrophenol	390 U	390 U	395 U	360 U	380 U	390 U
3,3'-Dichlorobenzidine	390 UJ	390 UJ	395 UJ	360 UJ	380 UJ	390 UJ
3-Nitroaniline	980 U	970 U	985 U	910 U	970 U	970 U
4,6-Dinitro-2-methylphenol	980 U	970 U	985 U	910 U	970 U	970 U
4-Bromophenyl-phenylether	390 U	390 U	395 U	360 U	380 U	390 U
4-Chloro-3-methylphenol	390 U	390 U	395 U	360 U	380 U	390 U
4-Chloroaniline	390 U	390 U	395 U	360 U	380 U	390 U
4-Chlorophenyl-phenylether	390 U	390 U	395 U	360 U	380 U	390 U
4-Methylphenol (p-Cresol)	390 U	390 U	395 U	360 U	380 U	390 U
4-Nitroaniline	980 UJ	970 UJ	985 UJ	910 UJ	970 UJ	970 UJ
4-Nitrophenol	980 U	970 U	985 U	910 U	970 U	970 U

APPENDIX G (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 046
RCRA INVESTIGATION - CTO-0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU46-TT06-01	SWMU46-TT06-02	SWMU46-TT07-01	SWMU46-TT07-02	SWMU46-TT08-01	SWMU46-TT08-02
SAMPLE DATE	05-Apr-04	05-Apr-04	05-Apr-04	05-Apr-04	02-Apr-04	02-Apr-04
DEPTH	1-3	3-5	1-3	3-5	1-3	3-5
Semivolatiles (ug/kg) (Cont)						
Acenaphthene	390 U	390 U	395 U	360 U	380 U	390 U
Acenaphthylene	390 U	390 U	395 U	360 U	380 U	390 U
Acetophenone	390 U	390 U	395 U	360 U	380 U	390 U
Anthracene	390 U	390 U	395 U	360 U	380 U	390 U
Atrazine	390 U	390 U	395 U	360 U	380 U	390 U
Benzaldehyde	390 U	390 U	395 U	360 U	380 U	390 U
Benzo(a)anthracene	390 U	390 U	395 U	360 U	380 U	390 U
Benzo(a)pyrene	390 U	390 U	395 U	360 U	380 U	390 U
Benzo(b)fluoranthene	390 U	390 U	395 U	360 U	380 U	390 U
Benzo(g,h,i)perylene	390 U	390 U	395 U	360 U	380 U	390 U
Benzo(k)fluoranthene	390 U	390 U	395 U	360 U	380 U	390 U
Bis(2-chloroethoxy)methane	390 U	390 U	395 U	360 U	380 U	390 U
Bis(2-chloroethyl)ether	390 U	390 U	395 U	360 U	380 U	390 U
Bis(2-ethylhexyl) Phthalate (BEHP)	390 U	390 U	395 U	360 U	380 U	390 U
Butyl Benzyl Phthalate	390 U	390 U	395 U	360 U	380 U	390 U
Caprolactam	390 U	390 U	395 U	360 U	380 U	390 U
Carbazole	390 U	390 U	395 U	360 U	380 U	390 U
Chrysene	390 U	390 U	395 U	360 U	380 U	390 U
Dibenz(a,h)anthracene	390 U	390 U	395 U	360 U	380 U	390 U
Dibenzofuran	390 U	390 U	395 U	360 U	380 U	390 U
Diethyl Phthalate (DEP)	390 U	390 U	395 U	360 U	380 U	390 U
Dimethyl Phthalate	390 U	390 U	395 U	360 U	380 U	390 U
Di-n-butyl Phthalate (DBP)	390 U	390 U	395 U	360 U	380 U	390 U
Di-n-octyl Phthalate	390 U	390 U	395 U	360 U	380 U	390 U
Fluoranthene	390 U	390 U	395 U	360 U	380 U	390 U
Fluorene	390 U	390 U	395 U	360 U	380 U	390 U
Hexachlorobenzene	390 U	390 U	395 U	360 U	380 U	390 U
Hexachlorobutadiene	390 U	390 U	395 U	360 U	380 U	390 U
Hexachlorocyclopentadiene	390 U	390 U	395 U	360 U	380 U	390 U
Hexachloroethane	390 U	390 U	395 U	360 U	380 U	390 U
Indeno(1,2,3-cd)pyrene	390 U	390 U	395 U	360 U	380 U	390 U
Isophorone	390 U	390 U	395 U	360 U	380 U	390 U
Naphthalene	390 U	390 U	395 U	360 U	380 U	390 U
Nitrobenzene	390 U	390 U	395 U	360 U	380 U	390 U
Nitrosodi-n-propylamine, n-	390 U	390 U	395 U	360 U	380 U	390 U
Nitrosodiphenylamine, n-	390 U	390 U	395 U	360 U	380 U	390 U
Pentachlorophenol	980 U	970 U	985 U	910 U	970 U	970 U
Phenanthrene	390 U	390 U	395 U	360 U	380 U	390 U
Phenol	390 U	390 U	395 U	360 U	380 U	390 U
Pyrene	390 U	390 U	395 U	360 U	380 U	390 U

APPENDIX G (Continued)

SUBSURFACE SOIL ANALYTICAL RESULTS
SWMU 046
RCRA INVESTIGATION - CTO-0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU46-TT06-01	SWMU46-TT06-02	SWMU46-TT07-01	SWMU46-TT07-02	SWMU46-TT08-01	SWMU46-TT08-02
SAMPLE DATE	05-Apr-04	05-Apr-04	05-Apr-04	05-Apr-04	02-Apr-04	02-Apr-04
DEPTH	1-3	3-5	1-3	3-5	1-3	3-5
Pesticides / PCBs (ug/kg)						
4,4'-DDD	3.9 U	420 D	755 D	18	22	3.9 U
4,4'-DDE	3.6 J	970 D	265 D	54	17	3.9 U
4,4'-DDT	4.5	160 D	96.5	11	6.8	3.9 U
BHC, alpha-	2 U	5 U	4.55 U	1.8 U	2 U	2 U
BHC, beta-	2 U	5 U	4.55 U	1.8 U	2 U	2 U
BHC, delta-	2 U	5 U	4.55 U	1.8 U	2 U	2 U
BHC, gamma- (Lindane)	2 U	5 U	4.55 U	1.8 U	2 U	2 U
Chlordane, alpha-	2.4	140 D	2.675 JP	1.8 U	2 U	2 U
Chlordane, gamma-	1.7 J	180 DNJ	4.55 U	1.8 U	2 U	2 U
Aldrin	2 U	5 U	4.55 U	1.8 U	2 U	2 U
Dieldrin	3.9 U	9.7 U	8.85 U	3.6 U	3.8 U	3.9 U
Endosulfan I	2 U	5 U	2.525 JP	1.8 U	2 U	2 U
Endosulfan II	3.9 U	9.7 U	8.85 U	3.6 U	3.8 U	3.9 U
Endosulfan Sulfate	3.9 U	9.7 U	8.85 U	3.6 U	3.8 U	3.9 U
Endrin	3.9 U	9.7 U	8.85 U	3.6 U	3.8 U	3.9 U
Endrin Aldehyde	3.9 U	9.7 U	8.85 U	3.6 U	3.8 U	3.9 U
Endrin Ketone	3.9 U	9.7 U	8.85 U	3.6 U	3.8 U	3.9 U
Heptachlor	2 U	5 U	4.55 U	1.8 U	2 U	2 U
Heptachlor Epoxide	2 U	5 U	4.55 U	1.8 U	2 U	2 U
Methoxychlor	20 U	50 U	45.5 U	18 U	20 U	20 U
Toxaphene	200 U	500 U	455 U	180 U	200 U	200 U
Metals (mg/kg)						
Arsenic	1.8 J	3.8 J	13 J	0.88 J	3.3 J	0.62 UJ
Barium	35.8 J	137	105.5	5.4 J	23.5 J	4.4 J
Cadmium	0.15 J	1.5	2.9	0.07 J	1 J	0.13 J
Chromium	8.6	9.5	29.9	3.7	5.1	2.6
Lead	5.7 J	141 J	748 J	8 J	122 J	2.2 J
Mercury	0.03 J	0.04 J	0.19	0.02 J	0.02 J	0.01 J
Selenium	0.71 U	0.67 U	1.04	0.71 U	0.77 U	0.76 U
Silver	0.13 U	0.13 U	0.67 J	0.13 U	0.14 U	0.14 U

APPENDIX G (Continued)

GROUNDWATER ANALYTICAL RESULTS
SWMU 046
RCRA INVESTIGATION - CTO-0041
MCB, CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU46-GW01	SWMU46-GW02	SWMU46-GW03	SWMU46-GW04	SWMU46-GW05	SWMU46-GW06	SWMU46-MW01
SAMPLE DATE	04-06-2002	04-06-2002	04-06-2002	04-06-2002	04-06-2002	04-06-2002	3/21/2004
Metals (ug/L)							
Arsenic	2.4 U	2.4 U	4.2 J	2.4 U	2.4 U	5.7 J	2.13 U
Barium	152	92.3	59.4	68.4	87.5	78.4	64.7
Cadmium	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.59 U	0.25 U
Chromium	4.7 J	0.83 J	2.1 J	1 J	3 J	31.4	0.88 U
Lead	4 J	4.6 J	1.8 UJ	4.4 J	2.2 J	21.9	1.56 U
Mercury	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.01 U
Selenium	4.6 U	4.6 U	4.6 U	4.6 U	4.6 U	4.6 U	2.32 U
Silver	0.9 U	0.9 U	0.9 U	0.9 U	0.9 U	0.9 U	1.16 U

APPENDIX H

RAGS D Tables

TABLE 1
SELECTION OF EXPOSURE PATHWAYS
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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
	Semivolatiles (ug/kg)															
117-81-7	Bis(2-ethylhexyl) Phthalate (BEHP)	42	J	42	J	µg/kg	SWMU46-IS03-00	1/4	350U - 370U	42	NA	3.47E+04 C	N/A	N/A	NO	BSL
	Metals (mg/kg)															
7440-38-2	Arsenic	0.59	J	7.7		mg/kg	SWMU46-SB01-00	11/15	0.28U - 1.6U	7.7	0.776	3.90E-01 C	N/A	N/A	YES	ASL
7440-39-3	Barium	8	J	131	J	mg/kg	SWMU46-SB01-00	11/15	21U - 22.3U	131	21.9	5.37E+02 N	N/A	N/A	NO	BSL
7440-43-9	Cadmium	0.051	J	3.2		mg/kg	SWMU46-SB01-00	7/15	0.034U - 1.8U	3.2	0.0272	3.70E+00 N	N/A	N/A	NO	BSL
7440-47-3	Chromium	3.5		60.6		mg/kg	SWMU46-TW04-00	15/15	(4)	60.6	6.37	3.01E+01 C (5)	N/A	N/A	YES	ASL
7439-92-1	Lead	4.7		1,950		mg/kg	SWMU46-TW04-00	15/15	(4)	1,950	12.4	4.00E+02 N	N/A	N/A	YES	ASL
7439-97-6	Mercury	0.025	J	0.83		mg/kg	SWMU46-SB01-00	13/15	0.036U - 0.037U	0.83	0.0554	2.30E+00 N	N/A	N/A	NO	BSL
7782-49-2	Selenium	0.53	J	0.68		mg/kg	SWMU46-TW06-00	3/15	0.42U - 1.05U	0.68	0.493	3.91E+01 N	N/A	N/A	NO	BSL
7440-22-4	Silver	0.55		3.9		mg/kg	SWMU46-SB01-00	2/15	0.093U - 1.1U	3.9	0.101	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) - AOC 3

(2) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals
USEPA Region IX Residential Soil COC Screening Value (derived from USEPA Region IX PRG Table - October, 2002)

(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 chromium VI used.

Definitions:
N/A = Not applicable
NA = Not Analyzed
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

C = Carcinogenic
N = Non-Carcinogenic

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

TABLE 2.2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (3) Contaminant Deletion or Selection
	Volatiles (ug/kg)															
71-43-2	Benzene	2	J	4.25	J	µg/kg	SWMU46-TT07-01	3/15	10U - 14UJ	4.25	NA	6.01E+02 C	N/A	N/A	NO	BSL
108-88-3	Toluene	3	J	3.75	J	µg/kg	SWMU46-TT07-01	2/15	10U - 14UJ	3.75	NA	6.60E+04 N	N/A	N/A	NO	BSL
75-69-4	Trichlorofluoromethane	1	J	9	J	µg/kg	SWMU46-TT02-01	15/15	(4)	9	NA	3.86E+04 N	N/A	N/A	NO	BSL
	Semivolatiles (ug/kg)															
120-12-7	Anthracene	163	J	163	J	µg/kg	SWMU46-TT01-01	1/19	360U - 420U	163	NA	2.19E+06 N	N/A	N/A	NO	BSL
56-55-3	Benzo(a)anthracene	450		450		µg/kg	SWMU46-TT01-01	1/19	360U - 420U	450	NA	6.21E+02 C	N/A	N/A	NO	BSL
205-99-2	Benzo(b)fluoranthene	480		480		µg/kg	SWMU46-TT01-01	1/19	360U - 420U	480	NA	6.21E+02 C	N/A	N/A	NO	BSL
207-08-9	Benzo(k)fluoranthene	240	J	240	J	µg/kg	SWMU46-TT01-01	1/19	360U - 420U	240	NA	6.21E+03 C	N/A	N/A	NO	BSL
117-81-7	Bis(2-ethylhexyl) Phthalate (BEHP)	77	J	77	J	µg/kg	SWMU46-IS02-04	1/19	360U - 440U	77	NA	3.47E+04 C	N/A	N/A	NO	BSL
218-01-9	Chrysene	830		830		µg/kg	SWMU46-TT01-01	1/19	360U - 420U	830	NA	6.21E+04 C	N/A	N/A	NO	BSL
206-44-0	Fluoranthene	2,200		2,200		µg/kg	SWMU46-TT01-01	1/19	360U - 420U	2,200	NA	2.29E+05 N	N/A	N/A	NO	BSL
85-01-8	Phenanthrene	800		800		µg/kg	SWMU46-TT01-01	1/19	360U - 420U	800	NA	2.32E+05 N (5)	N/A	N/A	NO	BSL
129-00-0	Pyrene	2,400		2,400		µg/kg	SWMU46-TT01-01	1/19	360U - 420U	2,400	NA	2.32E+05 N	N/A	N/A	NO	BSL
	Pesticides / PCBs (ug/kg)															
72-54-8	4,4'-DDD	15		2,300	D	µg/kg	SWMU46-TT05-02	11/15	3.9U - 3.9U	2,300	NA	2.44E+03 C	N/A	N/A	NO	BSL
72-55-9	4,4'-DDE	3.6	J	4,400	D	µg/kg	SWMU46-TT04-01	12/15	3.9U - 3.9U	4,400	NA	1.72E+03 C	N/A	N/A	YES	ASL
50-29-3	4,4'-DDT	4.5		27,000	D	µg/kg	SWMU46-TT04-01	12/15	3.9U - 3.9U	27,000	NA	1.72E+03 C	N/A	N/A	YES	ASL
319-84-6	BHC, alpha-	1.7		1.7		µg/kg	SWMU46-TT01-01	1/15	1.8U - 99U	1.7	NA	9.02E+01 C	N/A	N/A	NO	BSL
5103-71-9	Chlordane, alpha-	1.6	J	400	D	µg/kg	SWMU46-TT05-02	7/15	1.8U - 99U	400	NA	1.62E+03 C	N/A	N/A	NO	BSL
5103-74-2	Chlordane, gamma-	1.7	J	430	D	µg/kg	SWMU46-TT05-02	5/15	1.8U - 99U	430	NA	1.62E+03 C (6)	N/A	N/A	NO	BSL
309-00-2	Aldrin	2.5	J	2.5	J	µg/kg	SWMU46-TT01-01	1/15	1.8U - 99U	2.5	NA	2.86E+01 C	N/A	N/A	NO	BSL
959-98-8	Endosulfan I	2.525	JP	9.5	NJ	µg/kg	SWMU46-TT05-02	2/15	1.8U - 99U	9.5	NA	3.67E+04 N (7)	N/A	N/A	NO	BSL
	Metals (mg/kg)															
7440-38-2	Arsenic	0.83	J	13.9	J	mg/kg	SWMU46-TT02-02	16/30	0.25U - 1.4U	13.9	1.77	3.90E-01 C	N/A	N/A	YES	ASL
7440-39-3	Barium	0.74	J	1,410		mg/kg	SWMU46-TT02-02	27/30	0.59U - 24.2U	1,410	27.5	5.37E+02 N	N/A	N/A	YES	ASL
7440-43-9	Cadmium	0.06	J	8.4		mg/kg	SWMU46-TT02-02	18/30	0.031U - 0.61U	8.4	ND	3.70E+00 N	N/A	N/A	YES	ASL
7440-47-3	Chromium	0.69		150		mg/kg	SWMU46-TT02-02	27/30	2.4UJ - 2.9UJ	150	15.6	3.01E+01 C (8)	N/A	N/A	YES	ASL
7439-92-1	Lead	1		12,300		mg/kg	SWMU46-IS02-04	30/30	(4)	12,300	11.6	4.00E+02 N	N/A	N/A	YES	ASL
7439-97-6	Mercury	0.01	J	0.25		mg/kg	SWMU46-TT04-01	19/30	0.01U - 0.041U	0.25	0.0442	2.30E+00 N	N/A	N/A	NO	BSL
7782-49-2	Selenium	0.55	J	1.6	J	mg/kg	SWMU46-TT02-02	5/30	0.38U - 3.43U	1.6	0.546	3.91E+01 N	N/A	N/A	NO	BSL
7440-22-4	Silver	0.17	J	20.1		mg/kg	SWMU46-TT02-02	8/30	0.092U - 1.2U	20.1	0.169	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) - AOC 3

(2) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals
USEPA Region IX Residential Soil COC Screening Value (derived from USEPA Region IX PRG Table - October, 2002)

(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 chlordane used as a surrogate.
(7) Screening value for endosulfan used as a surrogate.
(8) Screening value for chromium VI used.

Definitions:
N/A = Not applicable
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
NJ - Presumptive evidence for the presence of the material at an estimated value
U - Not detected
UJ - Reported quantitation limit is qualified as estimated

C = Carcinogenic — mg/kg = milligrams per kilogram
N = Non-Carcinogenic — ug/kg = microgram per kilogram

TABLE 2.3
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (3) Contaminant Deletion or Selection
	Volatiles (ug/kg)															
71-43-2	Benzene	2	J	4.25	J	µg/kg	SWMU46-TT07-01	3/15	10U - 14UJ	4.25	NA	1.31E+03 C	N/A	N/A	NO	BSL
108-88-3	Toluene	3	J	3.75	J	µg/kg	SWMU46-TT07-01	2/15	10U - 14UJ	3.75	NA	2.20E+05 N	N/A	N/A	NO	BSL
75-69-4	Trichlorofluoromethane	1	J	9	J	µg/kg	SWMU46-TT02-01	15/15	(4)	9	NA	1.30E+05 N	N/A	N/A	NO	BSL
	Semivolatiles (ug/kg)															
120-12-7	Anthracene	163	J	163	J	µg/kg	SWMU46-TT01-01	1/19	360U - 420U	163	NA	2.40E+07 N	N/A	N/A	NO	BSL
56-55-3	Benzo(a)anthracene	450		450		µg/kg	SWMU46-TT01-01	1/19	360U - 420U	450	NA	2.11E+03 C	N/A	N/A	NO	BSL
205-99-2	Benzo(b)fluoranthene	480		480		µg/kg	SWMU46-TT01-01	1/19	360U - 420U	480	NA	2.11E+03 C	N/A	N/A	NO	BSL
207-08-9	Benzo(k)fluoranthene	240	J	240	J	µg/kg	SWMU46-TT01-01	1/19	360U - 420U	240	NA	2.11E+04 C	N/A	N/A	NO	BSL
117-81-7	Bis(2-ethylhexyl) Phthalate (BEHP)	77	J	77	J	µg/kg	SWMU46-IS02-04	1/19	360U - 440U	77	NA	1.23E+05 C	N/A	N/A	NO	BSL
218-01-9	Chrysene	830		830		µg/kg	SWMU46-TT01-01	1/19	360U - 420U	830	NA	2.11E+05 C	N/A	N/A	NO	BSL
206-44-0	Fluoranthene	2,200		2,200		µg/kg	SWMU46-TT01-01	1/19	360U - 420U	2,200	NA	2.20E+06 N	N/A	N/A	NO	BSL
85-01-8	Phenanthrene	800		800		µg/kg	SWMU46-TT01-01	1/19	360U - 420U	800	NA	2.91E+06 N (5)	N/A	N/A	NO	BSL
129-00-0	Pyrene	2,400		2,400		µg/kg	SWMU46-TT01-01	1/19	360U - 420U	2,400	NA	2.91E+06 N	N/A	N/A	NO	BSL
	Pesticides / PCBs (ug/kg)															
72-54-8	4,4'-DDD	15		2,300	D	µg/kg	SWMU46-TT05-02	11/15	3.9U - 3.9U	2,300	NA	9.95E+03 C	N/A	N/A	NO	BSL
72-55-9	4,4'-DDE	3.6	J	4,400	D	µg/kg	SWMU46-TT04-01	12/15	3.9U - 3.9U	4,400	NA	7.02E+03 C	N/A	N/A	NO	BSL
50-29-3	4,4'-DDT	4.5		27,000	D	µg/kg	SWMU46-TT04-01	12/15	3.9U - 3.9U	27,000	NA	7.02E+03 C	N/A	N/A	YES	ASL
319-84-6	BHC, alpha-	1.7		1.7		µg/kg	SWMU46-TT01-01	1/15	1.8U - 99U	1.7	NA	3.59E+02 C	N/A	N/A	NO	BSL
5103-71-9	Chlordane, alpha-	1.6	J	400	D	µg/kg	SWMU46-TT05-02	7/15	1.8U - 99U	400	NA	6.47E+03 C	N/A	N/A	NO	BSL
5103-74-2	Chlordane, gamma-	1.7	J	430	D	µg/kg	SWMU46-TT05-02	5/15	1.8U - 99U	430	NA	6.47E+03 C (6)	N/A	N/A	NO	BSL
309-00-2	Aldrin	2.5	J	2.5	J	µg/kg	SWMU46-TT01-01	1/15	1.8U - 99U	2.5	NA	1.01E+02 C	N/A	N/A	NO	BSL
959-98-8	Endosulfan I	2.525	JP	9.5	NJ	µg/kg	SWMU46-TT05-02	2/15	1.8U - 99U	9.5	NA	3.69E+05 N (7)	N/A	N/A	NO	BSL
	Metals (mg/kg)															
7440-38-2	Arsenic	0.83	J	13.9	J	mg/kg	SWMU46-TT02-02	16/30	0.25U - 1.4U	13.9	1.77	1.59E+00 C	N/A	N/A	YES	ASL
7440-39-3	Barium	0.74	J	1,410		mg/kg	SWMU46-TT02-02	27/30	0.59U - 24.2U	1,410	27.5	6.66E+03 N	N/A	N/A	NO	BSL
7440-43-9	Cadmium	0.06	J	8.4		mg/kg	SWMU46-TT02-02	18/30	0.031U - 0.61U	8.4	ND	4.51E+01 N	N/A	N/A	NO	BSL
7440-47-3	Chromium	0.69		150		mg/kg	SWMU46-TT02-02	27/30	2.4UJ - 2.9UJ	150	15.6	6.40E+01 C (8)	N/A	N/A	YES	ASL
7439-92-1	Lead	1		12,300		mg/kg	SWMU46-IS02-04	30/30	(4)	12,300	11.6	7.50E+01 N	N/A	N/A	YES	ASL
7439-97-6	Mercury	0.01	J	0.25		mg/kg	SWMU46-TT04-01	19/30	0.01U - 0.041U	0.25	0.0442	3.10E+01 N	N/A	N/A	NO	BSL
7782-49-2	Selenium	0.55	J	1.6	J	mg/kg	SWMU46-TT02-02	5/30	0.38U - 3.43U	1.6	0.546	5.11E+02 N	N/A	N/A	NO	BSL
7440-22-4	Silver	0.17	J	20.1		mg/kg	SWMU46-TT02-02	8/30	0.092U - 1.2U	20.1	0.169	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) - AOC 3

(2) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals
USEPA Region IX Industrial Soil COC Screening Value (derived from USEPA Region IX PRG Table - October, 2002)

(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 chlordane used as a surrogate.
(7) Screening value for endosulfan used as a surrogate.
(8) Screening value for chromium VI used.

Definitions:
N/A = Not applicable
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
NJ - Presumptive evidence for the presence of the material at an estimated value
U - Not detected
UJ - Reported quantitation limit is qualified as estimated

C = Carcinogenic
N = Non-Carcinogenic
mg/kg = milligrams per kilogram
ug/kg = microgram per kilogram

TABLE 2.4
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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 (1)	Screening (2) Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (3) Contaminant Deletion or Selection
	METALS (ug/L)															
7440-38-2	Arsenic	4.2	J	5.7	J	µg/L	SWMU46-GW06	2/7	2.13U - 2.4U	5.7	5.77	4.48E-02 C	10	MCL	NO	BKG
7440-39-3	Barium	59.4		152		µg/L	SWMU46-GW01	7/7	(4)	152	86.2	2.55E+02 N	2,000	MCL	NO	BSL
7440-47-3	Chromium	0.83	J	31.4		µg/L	SWMU46-GW06	6/7	0.88U - 0.88U	31.4	3.13	1.09E+01 N (5)	100	MCL	YES	ASL
7439-92-1	Lead	2.2	J	21.9		µg/L	SWMU46-GW06	5/7	1.56U - 1.8UJ	21.9	2.80	N/A	15	MCL (6)	YES	ASL-MCL

(1) MCB Camp Lejeune Base Background Study, Final (Baker, 2001): Base Groundwater

(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 - October, 2002)

(3) Rationale Codes Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Background Levels (BKG)
Below Screening Level (BSL)

(4) No detection limits given; analyte detected in every sample.
(5) Screening value for chromium VI used.
(6) Action level for copper and lead.

Definitions: N/A = Not Applicable
MCL = Maximum Contaminant Level
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
ug/L = microgram per liter
N = Non-Carcinogenic

TABLE 2.5
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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 (1)	Screening (2) Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (3) Contaminant Deletion or Selection
	METALS (ug/L)															
7440-38-2	Arsenic	4.2	J	5.7	J	µg/L	SWMU46-GW06	2/7	2.13U - 2.4U	5.7	5.77	1.00E+01	10	MCL	NO	BSL
7440-39-3	Barium	59.4		152		µg/L	SWMU46-GW01	7/7	(4)	152	86.2	2.00E+03	2,000	MCL	NO	BSL
7440-47-3	Chromium	0.83	J	31.4		µg/L	SWMU46-GW06	6/7	0.88U - 0.88U	31.4	3.13	5.00E+01	100	MCL	NO	BSL
7439-92-1	Lead	2.2	J	21.9		µg/L	SWMU46-GW06	5/7	1.56U - 1.8UJ	21.9	2.80	1.50E+01	15	MCL (5)	YES	ASL

(1) MCB Camp Lejeune Base Background Study, Final (Baker, 2001): Base Groundwater

(2) North Carolina Department of Environment and Natural Resources (NC DENR)
Target Groundwater Concentration

(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) Action level for copper and lead.

Definitions: COPC = Chemical of Potential C MCL = Maximum Contaminant Level
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered

J - Analyte present - Reported value is estimated ug/L = microgram per liter
U - Not detected
UJ - Reported quantitation limit is qualified as estimated

TABLE 3.1
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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
Arsenic	mg/kg	1.65	3.33	7.7		mg/kg	3.33	W-Lognormal	(1)	3.33	W-Lognormal	(1)
Chromium	mg/kg	11.4	17.7	60.6		mg/kg	17.7	W-Lognormal	(1)	17.7	W-Lognormal	(1)
Lead	mg/kg	201	1,087	1,950		mg/kg	1,087	W-Lognormal	(1)	1,087	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 3.2
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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
4,4'-DDE	mg/kg	0.499	135	4.4	D	mg/kg	4.4	Max	(2)	4.4	Max	(2)
4,4'-DDT	mg/kg	2.23	611	27	D	mg/kg	27	Max	(2)	27	Max	(2)
Arsenic	mg/kg	2.83	9.31	13.9	J	mg/kg	9.31	W-Lognormal	(1)	9.31	W-Lognormal	(1)
Barium	mg/kg	103	1,055	1,410		mg/kg	1,055	W-Lognormal	(1)	1,055	W-Lognormal	(1)
Cadmium	mg/kg	1.33	14.1	8.4		mg/kg	8.4	Max	(2)	8.4	Max	(2)
Chromium	mg/kg	15.6	32.2	150		mg/kg	32.2	W-Lognormal	(1)	32.2	W-Lognormal	(1)
Lead	mg/kg	745	52,530	12,300		mg/kg	12,300	Max	(2)	12,300	Max	(2)

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
(2) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.

TABLE 3.3
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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
4,4'-DDT	mg/kg	2.23	611	27	D	mg/kg	27	Max	(2)	27	Max	(2)
Arsenic	mg/kg	2.83	9.31	13.9	J	mg/kg	9.31	W-Lognormal	(1)	9.31	W-Lognormal	(1)
Chromium	mg/kg	15.6	32.2	150		mg/kg	32.2	W-Lognormal	(1)	32.2	W-Lognormal	(1)
Lead	mg/kg	745	52,530	12,300		mg/kg	12,300	Max	(2)	12,300	Max	(2)

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
(2) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.

TABLE 3.4
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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
Chromium	mg/L	0.00621	0.122	0.0314		mg/L	0.0314	Max	(1)	0.0314	Max	(1)
Lead	mg/L	0.00554	0.0457	0.0219		mg/L	0.0219	Max	(1)	0.0219	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 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Trespassers
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	52	Prof Judge	--	--	
	ED	Exposure Duration	years	24	USEPA, 1993	--	--	
	BW	Body Weight	kg	70	USEPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	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	5,700	USEPA, 2001	--	--	1/BW x1/AT
	AF	Soil to Skin Adherence Factor	mg/cm2	0.07	USEPA, 2001	--	--	
	ABS	Absorption Factor	NA	(1)	USEPA, 2001	--	--	
	EF	Exposure Frequency	days/year	52	Prof Judge	--	--	
	ED	Exposure Duration	years	24	USEPA, 1993	--	--	
	BW	Body Weight	kg	70	USEPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	USEPA, 1989	--	--	

Notes

(1) In the absense of USEPA RAGS Part E ABS values, USEPA Region IV default values of 0.01 organics and 0.001 for inorganics were used.

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 4.1.1a
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Trespassers
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	1.5	USEPA, 1997	--	--	1/BW x1/AT
	EF	Exposure Frequency	days/year	52	Prof Judge	--	--	
	ED	Exposure Duration	years	24	USEPA, 1993	--	--	
	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	8,760	USEPA, 1989	--	--	

Notes

(1) In the absense of USEPA RAGS Part E ABS values, USEPA Region IV default values of 0.01 organics and 0.001 for inorganics were used.

Prof Judge - Professional Judgment

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.

TABLE 4.2.1
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Trespassers
Receptor Age: Adolescent

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	52	Prof Judge	--	--	
	ED	Exposure Duration	years	10	USEPA, 2000	--	--	
	BW	Body Weight	kg	45	USEPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	3,650	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	5,300	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	52	Prof Judge	--	--	
	ED	Exposure Duration	years	10	USEPA, 2000	--	--	
	BW	Body Weight	kg	45	USEPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	3,650	USEPA, 1989	--	--	

Notes

(1) In the absense of USEPA RAGS Part E ABS values, USEPA Region IV default values of 0.01 organics and 0.001 for inorganics were used.

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, 2000: Supplemental Guidance to RAGS: Region 4 Bulletins: Human Health Risk Assessment.
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 CALCULATIONS
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Trespassers
Receptor Age: Adolescent

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	0.576	USEPA, 1997	--	--	C x IR x ET x EF x ED x 1/PEF x
	ET	Exposure Time	hours/day	4.04	USEPA, 1997	--	--	1/BW x1/AT
	EF	Exposure Frequency	days/year	52	Prof Judge	--	--	
	ED	Exposure Duration	years	10	USEPA, 2000	--	--	
	PEF	Particulate Emission Factor	m3/kg	1.32E+09	Cowherd, et al., 1995	--	--	
	BW	Body Weight	kg	45	USEPA, 1997	--	--	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, 1989	--	--	
	AT-N	Averaging Time (Non-Cancer)	days	3,650	USEPA, 1989	--	--	

Notes

(1) In the absense of USEPA RAGS Part E ABS values, USEPA Region IV default values of 0.01 organics and 0.001 for inorganics were used.

Prof Judge - Professional Judgment

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, 2000: Supplemental Guidance to RAGS: Region 4 Bulletins: Human Health Risk Assessment.

TABLE 4.3.1
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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) In the absense of USEPA RAGS Part E ABS values, USEPA Region IV default values of 0.01 organics and 0.001 for inorganics were used.

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 4.3.1a
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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

(1) In the absense of USEPA RAGS Part E ABS values, USEPA Region IV default values of 0.01 organics and 0.001 for inorganics were used.

Prof Judge - Professional Judgment
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 4.4.1
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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) In the absense of USEPA RAGS Part E ABS values, USEPA Region IV default values of 0.01 organics and 0.001 for inorganics were used.

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 CALCULATIONS
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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

(1) In the absense of USEPA RAGS Part E ABS values, USEPA Region IV default values of 0.01 organics and 0.001 for inorganics were used.

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 4.4.2
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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) In the absense of USEPA RAGS Part E ABS values, USEPA Region IV default values of 0.01 organics and 0.001 for inorganics were used.

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 CALCULATIONS
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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

(1) In the absense of USEPA RAGS Part E ABS values, USEPA Region IV default values of 0.01 organics and 0.001 for inorganics were used.

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 4.4.3
VALUES USED FOR DAILY INTAKE CALCULATION
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041
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, 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 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 Contac	cm2	18,000	USEPA, 2001	18,000	USEPA, 2001	1/BW x1/AT
	PC	Permeability Constant	cm/hour	Chemical Specific	USEPA, 2001	Chemical Specific	USEPA, 2001	
	ET	Exposure Time	hours/day	0.58	USEPA, 2001	0.25	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	

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/00
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 199
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002F

TABLE 4.4.3a
VALUES USED FOR DAILY INTAKE CALCULATION
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041
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, 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	

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/00
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 199
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002F

TABLE 4.5.1
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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, 1993	
	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, 1993	
	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) In the absense of USEPA RAGS Part E ABS values, USEPA Region IV default values of 0.01 organics and 0.001 for inorganics were used.

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 4.5.1a
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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, 1993	
	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

(1) In the absense of USEPA RAGS Part E ABS values, USEPA Region IV default values of 0.01 organics and 0.001 for inorganics were used.

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 4.5.2
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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, 1993	
	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, 1993	
	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) In the absense of USEPA RAGS Part E ABS values, USEPA Region IV default values of 0.01 organics and 0.001 for inorganics were used.

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 4.5.2a
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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, 1993	
	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

(1) In the absense of USEPA RAGS Part E ABS values, USEPA Region IV default values of 0.01 organics and 0.001 for inorganics were used.

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 4.5.3
VALUES USED FOR DAILY INTAKE CALCULATION:
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041
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, 1993	1	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	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 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 Contac	cm2	6,600	USEPA, 2001	6,600	USEPA, 2001	1/BW x1/AT
	PC	Permeability Constant	cm/hour	Chemical Specific	USEPA, 2001	Chemical Specific	USEPA, 2001	
	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, 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	

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/00
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 199
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002F

TABLE 4.6.1
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Chemical Specific	Chemical Specific	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	480	USEPA, 1993	240	Prof Judge	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	250	USEPA, 2001	219	USEPA, 2001	
	ED	Exposure Duration	years	1	Prof Judge	1	Prof Judge	
	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	365	USEPA, 1989	365	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	3,300	USEPA, 2001	3,300	USEPA, 2001	1/BW x1/AT
	AF	Soil to Skin Adherence Factor	mg/cm2	0.2	USEPA, 2001	0.02	USEPA, 2001	
	ABS	Absorption Factor	NA	(1)	USEPA, 2001	(1)	USEPA, 2001	
	EF	Exposure Frequency	days/year	250	USEPA, 2001	219	USEPA, 2001	
	ED	Exposure Duration	years	1	Prof Judge	1	Prof Judge	
	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	365	USEPA, 1989	365	USEPA, 1989	

Notes

(1) In the absense of USEPA RAGS Part E ABS values, USEPA Region IV default values of 0.01 organics and 0.001 for inorganics were used.

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 4.6.1a
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Chemical Specific	Chemical Specific	CDI (mg/kg-day) =
	RR	Respiration Rate	m3/hour	3.3	USEPA, 1997	1.3	USEPA, 1997	C x IR x ET x EF x ED x 1/PEF x
	ET	Exposure Time	hours/day	8	USEPA, 1991	8	USEPA, 1991	1/BW x1/AT
	EF	Exposure Frequency	days/year	250	USEPA, 2001	219	USEPA, 2001	
	ED	Exposure Duration	years	1	Prof Judge	1	Prof Judge	
	PEF	Particulate Emission Factor	m3/kg	2.46E+06	USEPA, 2001a	2.46E+06	USEPA, 2001a	
	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	365	USEPA, 1989	365	USEPA, 1989	

Notes

(1) In the absense of USEPA RAGS Part E ABS values, USEPA Region IV default values of 0.01 organics and 0.001 for inorganics were used.

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 4.6.2
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Chemical Specific	Chemical Specific	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR-S	Ingestion Rate of Soil	mg/day	480	USEPA, 1993	240	Prof Judge	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	250	USEPA, 2001	219	USEPA, 2001	
	ED	Exposure Duration	years	1	Prof Judge	1	Prof Judge	
	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	365	USEPA, 1989	365	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	3,300	USEPA, 2001	3,300	USEPA, 2001	1/BW x1/AT
	AF	Soil to Skin Adherence Factor	mg/cm2	0.2	USEPA, 2001	0.02	USEPA, 2001	
	ABS	Absorption Factor	NA	(1)	USEPA, 2001	(1)	USEPA, 2001	
	EF	Exposure Frequency	days/year	250	USEPA, 2001	219	USEPA, 2001	
	ED	Exposure Duration	years	1	Prof Judge	1	Prof Judge	
	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	365	USEPA, 1989	365	USEPA, 1989	

Notes

(1) In the absense of USEPA RAGS Part E ABS values, USEPA Region IV default values of 0.01 organics and 0.001 for inorganics were used.

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 4.6.2a
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Chemical Specific	Chemical Specific	CDI (mg/kg-day) =
	RR	Respiration Rate	m3/hour	3.3	USEPA, 1997	1.3	USEPA, 1997	C x IR x ET x EF x ED x 1/PEF x
	ET	Exposure Time	hours/day	8	USEPA, 1991	8	USEPA, 1991	1/BW x1/AT
	EF	Exposure Frequency	days/year	250	USEPA, 2001	219	USEPA, 2001	
	ED	Exposure Duration	years	1	Prof Judge	1	Prof Judge	
	PEF	Particulate Emission Factor	m3/kg	2.46E+06	USEPA, 2001a	2.46E+06	USEPA, 2001a	
	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	365	USEPA, 1989	365	USEPA, 1989	

Notes

(1) In the absense of USEPA RAGS Part E ABS values, USEPA Region IV default values of 0.01 organics and 0.001 for inorganics were used.

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 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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)
4,4'-DDE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	Chronic	5.00E-04	mg/kg/day	100%	5.00E-04	mg/kg/day	Liver	100/1	IRIS	1/7/2004
Arsenic	Chronic	3.00E-04	mg/kg/day	100%	3.00E-04	mg/kg/day	Skin / CVS	3/1	IRIS	7/21/2004
Barium	Chronic	7.00E-02	mg/kg/day	7.0%	4.90E-03	mg/kg/day	NOEL	3/1	IRIS	7/21/2004
Cadmium	Chronic	5.00E-04	mg/kg/day	5.0%	2.50E-05	mg/kg/day	Kidney	10/1	IRIS	7/21/2004
Chromium (4)	Chronic	3.00E-03	mg/kg/day	2.5%	7.50E-05	mg/kg/day	NOEL	300/3	IRIS	4/29/2004
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

(1) Refer to the risk calculation spreadsheets presented in Appendix J
(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.
(4) Values for Chromium VI

NA = Not Applicable

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

Sources:
IRIS = Integrated Risk Information System

TABLE 5.2
NON-CANCER TOXICITY DATA -- INHALATION
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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)
4,4'-DDE	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	NA	NA	NA	5.00E-04	mg/kg/day	NA	NA	RE	NA
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium	Chronic	4.9E-04	mg/m3	1.43E-04	mg/kg/day	Fetus	100/1	HEAST	7/1/1997
Cadmium	Chronic	NA	NA	NA	NA	Kidney	1/1	NA	3/4/1999
Chromium (3)	Chronic	1.1E-04	mg/m3	2.20E-06	mg/kg/day	RsS	90/1 (aerosols), 300/1 (particulates)	IRIS	4/29/2004
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.
(3) Values for Chromium VI

NA = Not Applicable

Target Organ Abbreviations:
RsS = Respiratory System

Sources:
IRIS = Integrated Risk Information System
HEAST= Health Effects Assessment Summary Tables
RE = Region 9 Route Extrapolation

TABLE 6.1
CANCER TOXICITY DATA -- ORAL/DERMAL
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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)
4,4'-DDE	3.40E-01	100%	3.40E-01	$(mg/kg/day)^{-1}$	B2	IRIS	6/2/2004
4,4'-DDT	3.40E-01	100%	3.40E-01	$(mg/kg/day)^{-1}$	B2	IRIS	6/2/2004
Arsenic	1.50E+00	100%	1.50E+00	$(mg/kg/day)^{-1}$	A	IRIS	7/21/2004
Barium	NA	NA	NA	NA	NA	NA	NA
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 the risk calculation spreadsheets presented in Appendix J
(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 availabl
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 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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)
4,4'-DDE	NA	NA	3,500	3.40E-01	mg/kg/day	B2	RE	6/2/2004
4,4'-DDT	9.7E-05	ug/m3	3,500	3.40E-01	mg/kg/day	B2	IRIS	6/2/2004
Arsenic	4.3E-03	ug/m3	3,500	1.51E+01	mg/kg/day	A	IRIS	7/21/2004
Barium	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	1.8E-03	ug/m3	3,500	6.30E+00	mg/kg/day	B1	IRIS	7/21/2004
Chromium (3)	1.2E-02	ug/m3	3,500	2.94E+02	mg/kg/day	A	IRIS	4/29/2004
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.
(3) Values for Chromium VI

EPA Group:
A - Human carcinogen
B1 - Probable human carcinogen - indicates that limited hum:
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
RE = Region 9 Route Extrapolation

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 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Trespassers
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	3.33	mg/kg	3.33	mg/kg	M	6.8E-07	mg/kg-day	3.0E-04	mg/kg-day	--	--	2.3E-03
	Chromium	17.7	mg/kg	17.7	mg/kg	M	3.6E-06	mg/kg-day	3.0E-03	mg/kg-day	--	--	1.2E-03
	Lead	1,087	mg/kg	1,087	mg/kg	M	2.2E-04	mg/kg-day	NA	--	--	--	--
	(Total)												3.5E-03
Dermal	Arsenic	3.33	mg/kg	3.33	mg/kg	M	8.1E-08	mg/kg-day	3.0E-04	mg/kg-day	--	--	2.7E-04
	Chromium	17.7	mg/kg	17.7	mg/kg	M	1.4E-08	mg/kg-day	7.5E-05	mg/kg-day	--	--	1.9E-04
	Lead	1,087	mg/kg	1,087	mg/kg	M	8.8E-07	mg/kg-day	NA	--	--	--	--
	(Total)												4.6E-04
												Total Hazard Index Across All Exposure Routes/Pathways	3.9E-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.

See Appendix J for risk calculation spreadsheets

TABLE 7.1.1a RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Trespassers
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	3.33	mg/kg	2.52E-09	mg/m^3	R	4.2E-12	mg/kg-day	NA	--	NA	--	--
	Chromium	17.7	mg/kg	1.34E-08	mg/m^3	R	2.3E-11	mg/kg-day	2.2E-06	mg/kg-day	1.1E-04	mg/m3	1.0E-05
	Lead	1,087	mg/kg	8.24E-07	mg/m^3	R	1.4E-09	mg/kg-day	NA	--	NA	--	--
	(Total)												1.0E-05
												Total Hazard Index Across All Exposure Routes/Pathways	1.0E-05

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.

See Appendix J for risk calculation spreadsheets

TABLE 7.2.1 RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Trespassers
Receptor Age: Adolescent

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	3.33	mg/kg	3.33	mg/kg	M	1.1E-06	mg/kg-day	3.0E-04	mg/kg-day	--	--	3.5E-03
	Chromium	17.7	mg/kg	17.7	mg/kg	M	5.6E-06	mg/kg-day	3.0E-03	mg/kg-day	--	--	1.9E-03
	Lead	1,087	mg/kg	1,087	mg/kg	M	3.4E-04	mg/kg-day	NA	--	--	--	--
	(Total)												5.4E-03
Dermal	Arsenic	3.33	mg/kg	3.33	mg/kg	M	3.4E-07	mg/kg-day	3.0E-04	mg/kg-day	--	--	1.1E-03
	Chromium	17.7	mg/kg	17.7	mg/kg	M	6.0E-08	mg/kg-day	7.5E-05	mg/kg-day	--	--	7.9E-04
	Lead	1,087	mg/kg	1,087	mg/kg	M	3.6E-06	mg/kg-day	NA	--	--	--	--
	(Total)												1.9E-03
												Total Hazard Index Across All Exposure Routes/Pathways	7.3E-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.

See Appendix J for risk calculation spreadsheets

TABLE 7.2.1a RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Trespassers
Receptor Age: Adolescent

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	3.33	mg/kg	2.52E-09	mg/m^3	R	1.9E-11	mg/kg-day	NA	--	NA	--	--
	Chromium	17.7	mg/kg	1.34E-08	mg/m^3	R	9.9E-11	mg/kg-day	2.2E-06	mg/kg-day	1.1E-04	mg/m3	4.5E-05
	Lead	1,087	mg/kg	8.24E-07	mg/m^3	R	6.1E-09	mg/kg-day	NA	--	NA	--	--
	(Total)												4.5E-05
							Total Hazard Index Across All Exposure Routes/Pathways						4.5E-05

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.

See Appendix J for risk calculation spreadsheets

TABLE 7.3.1 RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	3.33	mg/kg	M	3.3E-06	mg/kg-day	3.0E-04	mg/kg-day	--	--	1.1E-02
	Chromium	17.7	mg/kg	17.7	mg/kg	M	1.7E-05	mg/kg-day	3.0E-03	mg/kg-day	--	--	5.8E-03
	Lead	1,087	mg/kg	1,087	mg/kg	M	1.1E-03	mg/kg-day	NA	--	--	--	--
	(Total)												1.7E-02
Dermal	Arsenic	3.33	mg/kg	3.33	mg/kg	M	6.5E-07	mg/kg-day	3.0E-04	mg/kg-day	--	--	2.2E-03
	Chromium	17.7	mg/kg	17.7	mg/kg	M	1.1E-07	mg/kg-day	7.5E-05	mg/kg-day	--	--	1.5E-03
	Lead	1,087	mg/kg	1,087	mg/kg	M	7.0E-06	mg/kg-day	NA	--	--	--	--
	(Total)												3.7E-03
												Total Hazard Index Across All Exposure Routes/Pathways	2.0E-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.

See Appendix J for risk calculation spreadsheets

TABLE 7.3.1a RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	2.52E-09	mg/m^3	R	1.1E-10	mg/kg-day	NA	--	NA	--	--
	Chromium	17.7	mg/kg	1.34E-08	mg/m^3	R	5.8E-10	mg/kg-day	2.2E-06	mg/kg-day	1.1E-04	mg/m3	2.6E-04
	Lead	1,087	mg/kg	8.24E-07	mg/m^3	R	3.5E-08	mg/kg-day	NA	--	NA	--	--
	(Total)												2.6E-04
												Total Hazard Index Across All Exposure Routes/Pathways	2.6E-04

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.

See Appendix J for risk calculation spreadsheets

TABLE 7.4.1 RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	3.33	mg/kg	M	4.6E-06	mg/kg-day	3.0E-04	mg/kg-day	--	--	1.5E-02
	Chromium	17.7	mg/kg	17.7	mg/kg	M	2.4E-05	mg/kg-day	3.0E-03	mg/kg-day	--	--	8.1E-03
	Lead	1,087	mg/kg	1,087	mg/kg	M	1.5E-03	mg/kg-day	NA	--	--	--	--
	(Total)												2.3E-02
Dermal	Arsenic	3.33	mg/kg	3.33	mg/kg	M	5.5E-07	mg/kg-day	3.0E-04	mg/kg-day	--	--	1.8E-03
	Chromium	17.7	mg/kg	17.7	mg/kg	M	9.7E-08	mg/kg-day	7.5E-05	mg/kg-day	--	--	1.3E-03
	Lead	1,087	mg/kg	1,087	mg/kg	M	5.9E-06	mg/kg-day	NA	--	--	--	--
	(Total)												3.1E-03
										Total Hazard Index Across All Exposure Routes/Pathways			2.6E-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.

See Appendix J for risk calculation spreadsheets

TABLE 7.4.1a RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	2.52E-09	mg/m^3	R	2.9E-11	mg/kg-day	NA	--	NA	--	--
	Chromium	17.7	mg/kg	1.34E-08	mg/m^3	R	1.5E-10	mg/kg-day	2.2E-06	mg/kg-day	1.1E-04	mg/m3	6.9E-05
	Lead	1,087	mg/kg	8.24E-07	mg/m^3	R	9.3E-09	mg/kg-day	NA	--	NA	--	--
	(Total)												6.9E-05
												Total Hazard Index Across All Exposure Routes/Pathways	6.9E-05

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.

See Appendix J for risk calculation spreadsheets

TABLE 7.4.2 RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	4,4'-DDE	4.4	mg/kg	4.4	mg/kg	M	6.0E-06	mg/kg-day	NA	--	--	--	--
	4,4'-DDT	27	mg/kg	27	mg/kg	M	3.7E-05	mg/kg-day	5.0E-04	mg/kg-day	--	--	7.4E-02
	Arsenic	9.31	mg/kg	9.31	mg/kg	M	1.3E-05	mg/kg-day	3.0E-04	mg/kg-day	--	--	4.3E-02
	Barium	1,055	mg/kg	1,055	mg/kg	M	1.4E-03	mg/kg-day	7.0E-02	mg/kg-day	--	--	2.1E-02
	Cadmium	8.4	mg/kg	8.4	mg/kg	M	1.2E-05	mg/kg-day	5.0E-04	mg/kg-day	--	--	2.3E-02
	Chromium	32.2	mg/kg	32.2	mg/kg	M	4.4E-05	mg/kg-day	3.0E-03	mg/kg-day	--	--	1.5E-02
	Lead	12,300	mg/kg	12,300	mg/kg	M	1.7E-02	mg/kg-day	NA	--	--	--	--
	(Total)												1.7E-01
Dermal	4,4'-DDE	4.4	mg/kg	4.4	mg/kg	M	2.4E-07	mg/kg-day	NA	--	--	--	--
	4,4'-DDT	27	mg/kg	27	mg/kg	M	4.4E-06	mg/kg-day	5.0E-04	mg/kg-day	--	--	8.9E-03
	Arsenic	9.31	mg/kg	9.31	mg/kg	M	1.5E-06	mg/kg-day	3.0E-04	mg/kg-day	--	--	5.1E-03
	Barium	1,055	mg/kg	1,055	mg/kg	M	5.8E-06	mg/kg-day	4.9E-03	mg/kg-day	--	--	1.2E-03
	Cadmium	8.4	mg/kg	8.4	mg/kg	M	4.6E-08	mg/kg-day	2.5E-05	mg/kg-day	--	--	1.8E-03
	Chromium	32.2	mg/kg	32.2	mg/kg	M	1.8E-07	mg/kg-day	7.5E-05	mg/kg-day	--	--	2.3E-03
	Lead	12,300	mg/kg	12,300	mg/kg	M	6.7E-05	mg/kg-day	NA	--	--	--	--
	(Total)												1.9E-02
									Total Hazard Index Across All Exposure Routes/Pathways				1.9E-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.

See Appendix J for risk calculation spreadsheets

TABLE 7.4.2a RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	4,4'-DDE	4.4	mg/kg	3.33E-09	mg/m^3	R	3.8E-11	mg/kg-day	NA	--	NA	--	--
	4,4'-DDT	27	mg/kg	2.05E-08	mg/m^3	R	2.3E-10	mg/kg-day	5.0E-04	mg/kg-day	NA	--	4.6E-07
	Arsenic	9.31	mg/kg	7.05E-09	mg/m^3	R	8.0E-11	mg/kg-day	NA	--	NA	--	--
	Barium	1,055	mg/kg	7.99E-07	mg/m^3	R	9.0E-09	mg/kg-day	1.4E-04	mg/kg-day	4.9E-04	mg/m3	6.3E-05
	Cadmium	8.4	mg/kg	6.36E-09	mg/m^3	R	7.2E-11	mg/kg-day	NA	--	2.0E-04	mg/m3	--
	Chromium	32.2	mg/kg	2.44E-08	mg/m^3	R	2.8E-10	mg/kg-day	2.2E-06	mg/kg-day	1.1E-04	mg/m3	1.3E-04
	Lead	12,300	mg/kg	9.32E-06	mg/m^3	R	1.1E-07	mg/kg-day	NA	--	NA	--	--
	(Total)												1.9E-04
												Total Hazard Index Across All Exposure Routes/Pathways	1.9E-04

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.

See Appendix J for risk calculation spreadsheets

TABLE 7.4.3 RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Chromium	0.0314	mg/L	0.0314	mg/L	M	8.6E-04	mg/kg-day	3.0E-03	mg/kg-day	--	--	2.9E-01
	Lead	0.0219	mg/L	0.0219	mg/L	M	6.0E-04	mg/kg-day	NA	--	--	--	--
	(Total)												2.9E-01
Dermal	Chromium	0.0314	mg/L	0.0314	mg/L	M	3.6E-06	mg/kg-day	7.5E-05	mg/kg-day	--	--	4.9E-02
	Lead	0.0219	mg/L	0.0219	mg/L	M	3.4E-07	mg/kg-day	NA	--	--	--	--
	(Total)												4.9E-02
								Total Hazard Index Across All Exposure Routes/Pathways					3.4E-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.

See Appendix J for risk calculation spreadsheets

TABLE 7.4.1 CT
CALCULATION OF NON-CANCER HAZARDS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	3.33	mg/kg	M	1.5E-06	mg/kg-day	3.0E-04	mg/kg-day	--	--	5.1E-03
	Chromium	17.7	mg/kg	17.7	mg/kg	M	8.1E-06	mg/kg-day	3.0E-03	mg/kg-day	--	--	2.7E-03
	Lead	1,087	mg/kg	1,087	mg/kg	M	5.0E-04	mg/kg-day	NA	--	--	--	--
	(Total)												7.8E-03
Dermal	Arsenic	3.33	mg/kg	3.33	mg/kg	M	5.2E-08	mg/kg-day	3.0E-04	mg/kg-day	--	--	1.7E-04
	Chromium	17.7	mg/kg	17.7	mg/kg	M	9.3E-09	mg/kg-day	7.5E-05	mg/kg-day	--	--	1.2E-04
	Lead	1,087	mg/kg	1,087	mg/kg	M	5.7E-07	mg/kg-day	NA	--	--	--	--
	(Total)												3.0E-04
												Total Hazard Index Across All Exposure Routes/Pathways	8.1E-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.

See Appendix J for risk calculation spreadsheets

TABLE 7.4.1a CT
CALCULATION OF NON-CANCER HAZARDS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	2.52E-09	mg/m^3	R	1.9E-11	mg/kg-day	NA	--	NA	--	--
	Chromium	17.7	mg/kg	1.34E-08	mg/m^3	R	1.0E-10	mg/kg-day	2.2E-06	mg/kg-day	1.1E-04	mg/m3	4.6E-05
	Lead	1,087	mg/kg	8.24E-07	mg/m^3	R	6.2E-09	mg/kg-day	NA	--	NA	--	--
	(Total)												4.6E-05
												Total Hazard Index Across All Exposure Routes/Pathways	4.6E-05

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.

See Appendix J for risk calculation spreadsheets

TABLE 7.4.2 CT
CALCULATION OF NON-CANCER HAZARDS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	4,4'-DDE	4.4	mg/kg	4.4	mg/kg	M	2.0E-06	mg/kg-day	NA	--	--	--	--
	4,4'-DDT	27	mg/kg	27	mg/kg	M	1.2E-05	mg/kg-day	5.0E-04	mg/kg-day	--	--	2.5E-02
	Arsenic	9.31	mg/kg	9.31	mg/kg	M	4.3E-06	mg/kg-day	3.0E-04	mg/kg-day	--	--	1.4E-02
	Barium	1,055	mg/kg	1,055	mg/kg	M	4.8E-04	mg/kg-day	7.0E-02	mg/kg-day	--	--	6.9E-03
	Cadmium	8.4	mg/kg	8.4	mg/kg	M	3.8E-06	mg/kg-day	5.0E-04	mg/kg-day	--	--	7.7E-03
	Chromium	32.2	mg/kg	32.2	mg/kg	M	1.5E-05	mg/kg-day	3.0E-03	mg/kg-day	--	--	4.9E-03
	Lead	12,300	mg/kg	12,300	mg/kg	M	5.6E-03	mg/kg-day	NA	--	--	--	--
	(Total)												5.8E-02
Dermal	4,4'-DDE	4.4	mg/kg	4.4	mg/kg	M	2.3E-08	mg/kg-day	NA	--	--	--	--
	4,4'-DDT	27	mg/kg	27	mg/kg	M	4.2E-07	mg/kg-day	5.0E-04	mg/kg-day	--	--	8.5E-04
	Arsenic	9.31	mg/kg	9.31	mg/kg	M	1.5E-07	mg/kg-day	3.0E-04	mg/kg-day	--	--	4.9E-04
	Barium	1,055	mg/kg	1,055	mg/kg	M	5.5E-07	mg/kg-day	4.9E-03	mg/kg-day	--	--	1.1E-04
	Cadmium	8.4	mg/kg	8.4	mg/kg	M	4.4E-09	mg/kg-day	2.5E-05	mg/kg-day	--	--	1.8E-04
	Chromium	32.2	mg/kg	32.2	mg/kg	M	1.7E-08	mg/kg-day	7.5E-05	mg/kg-day	--	--	2.2E-04
	Lead	12,300	mg/kg	12,300	mg/kg	M	6.4E-06	mg/kg-day	NA	--	--	--	--
	(Total)												1.8E-03
												Total Hazard Index Across All Exposure Routes/Pathways	6.0E-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.

See Appendix J for risk calculation spreadsheets

TABLE 7.4.2a CT
CALCULATION OF NON-CANCER HAZARDS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	4,4'-DDE	4.4	mg/kg	3.33E-09	mg/m^3	R	2.5E-11	mg/kg-day	NA	--	NA	--	--
	4,4'-DDT	27	mg/kg	2.05E-08	mg/m^3	R	1.5E-10	mg/kg-day	5.0E-04	mg/kg-day	NA	--	3.1E-07
	Arsenic	9.31	mg/kg	7.05E-09	mg/m^3	R	5.3E-11	mg/kg-day	NA	--	NA	--	--
	Barium	1,055	mg/kg	7.99E-07	mg/m^3	R	6.0E-09	mg/kg-day	1.4E-04	mg/kg-day	4.9E-04	mg/m3	4.2E-05
	Cadmium	8.4	mg/kg	6.36E-09	mg/m^3	R	4.8E-11	mg/kg-day	NA	--	2.0E-04	mg/m3	--
	Chromium	32.2	mg/kg	2.44E-08	mg/m^3	R	1.8E-10	mg/kg-day	2.2E-06	mg/kg-day	1.1E-04	mg/m3	8.4E-05
	Lead	12,300	mg/kg	9.32E-06	mg/m^3	R	7.0E-08	mg/kg-day	NA	--	NA	--	--
	(Total)												1.3E-04
												Total Hazard Index Across All Exposure Routes/Pathways	1.3E-04

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.

See Appendix J for risk calculation spreadsheets

TABLE 7.4.3 CT
CALCULATION OF NON-CANCER HAZARDS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Chromium	0.0314	mg/L	0.0314	mg/L	M	4.0E-04	mg/kg-day	3.0E-03	mg/kg-day	--	--	1.3E-01
	Lead	0.0219	mg/L	0.0219	mg/L	M	2.8E-04	mg/kg-day	NA	--	--	--	--
	(Total)												1.3E-01
Dermal	Chromium	0.0314	mg/L	0.0314	mg/L	M	1.0E-06	mg/kg-day	7.5E-05	mg/kg-day	--	--	1.4E-02
	Lead	0.0219	mg/L	0.0219	mg/L	M	9.9E-08	mg/kg-day	NA	--	--	--	--
	(Total)												1.4E-02
												Total Hazard Index Across All Exposure Routes/Pathways	1.5E-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.

See Appendix J for risk calculation spreadsheets

TABLE 7.5.1 RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	3.33	mg/kg	M	4.3E-05	mg/kg-day	3.0E-04	mg/kg-day	--	--	1.4E-01
	Chromium	17.7	mg/kg	17.7	mg/kg	M	2.3E-04	mg/kg-day	3.0E-03	mg/kg-day	--	--	7.6E-02
	Lead	1,087	mg/kg	1,087	mg/kg	M	1.4E-02	mg/kg-day	NA	--	--	--	--
	(Total)												2.2E-01
Dermal	Arsenic	3.33	mg/kg	3.33	mg/kg	M	3.6E-06	mg/kg-day	3.0E-04	mg/kg-day	--	--	1.2E-02
	Chromium	17.7	mg/kg	17.7	mg/kg	M	6.3E-07	mg/kg-day	7.5E-05	mg/kg-day	--	--	8.5E-03
	Lead	1,087	mg/kg	1,087	mg/kg	M	3.9E-05	mg/kg-day	NA	--	--	--	--
	(Total)												2.0E-02
										Total Hazard Index Across All Exposure Routes/Pathways			2.4E-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.

See Appendix J for risk calculation spreadsheets

TABLE 7.5.1a RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	2.52E-09	mg/m^3	R	2.8E-10	mg/kg-day	NA	--	NA	--	--
	Chromium	17.7	mg/kg	1.34E-08	mg/m^3	R	1.5E-09	mg/kg-day	2.2E-06	mg/kg-day	1.1E-04	mg/m3	6.7E-04
	Lead	1,087	mg/kg	8.24E-07	mg/m^3	R	9.0E-08	mg/kg-day	NA	--	NA	--	--
	(Total)												6.7E-04
												Total Hazard Index Across All Exposure Routes/Pathways	6.7E-04

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.

See Appendix J for risk calculation spreadsheets

TABLE 7.5.2 RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	4,4'-DDE	4.4	mg/kg	4.4	mg/kg	M	5.6E-05	mg/kg-day	NA	--	--	--	--
	4,4'-DDT	27	mg/kg	27	mg/kg	M	3.5E-04	mg/kg-day	5.0E-04	mg/kg-day	--	--	6.9E-01
	Arsenic	9.31	mg/kg	9.31	mg/kg	M	1.2E-04	mg/kg-day	3.0E-04	mg/kg-day	--	--	4.0E-01
	Barium	1,055	mg/kg	1,055	mg/kg	M	1.3E-02	mg/kg-day	7.0E-02	mg/kg-day	--	--	1.9E-01
	Cadmium	8.4	mg/kg	8.4	mg/kg	M	1.1E-04	mg/kg-day	5.0E-04	mg/kg-day	--	--	2.1E-01
	Chromium	32.2	mg/kg	32.2	mg/kg	M	4.1E-04	mg/kg-day	3.0E-03	mg/kg-day	--	--	1.4E-01
	Lead	12,300	mg/kg	12,300	mg/kg	M	1.6E-01	mg/kg-day	NA	--	--	--	--
	(Total)												1.6E+00
Dermal	4,4'-DDE	4.4	mg/kg	4.4	mg/kg	M	1.6E-06	mg/kg-day	NA	--	--	--	--
	4,4'-DDT	27	mg/kg	27	mg/kg	M	2.9E-05	mg/kg-day	5.0E-04	mg/kg-day	--	--	5.8E-02
	Arsenic	9.31	mg/kg	9.31	mg/kg	M	1.0E-05	mg/kg-day	3.0E-04	mg/kg-day	--	--	3.3E-02
	Barium	1,055	mg/kg	1,055	mg/kg	M	3.8E-05	mg/kg-day	4.9E-03	mg/kg-day	--	--	7.7E-03
	Cadmium	8.4	mg/kg	8.4	mg/kg	M	3.0E-07	mg/kg-day	2.5E-05	mg/kg-day	--	--	1.2E-02
	Chromium	32.2	mg/kg	32.2	mg/kg	M	1.2E-06	mg/kg-day	7.5E-05	mg/kg-day	--	--	1.5E-02
	Lead	12,300	mg/kg	12,300	mg/kg	M	4.4E-04	mg/kg-day	NA	--	--	--	--
	(Total)												1.3E-01
									Total Hazard Index Across All Exposure Routes/Pathways				1.8E+00

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.

See Appendix J for risk calculation spreadsheets

TABLE 7.5.2a RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	4,4'-DDE	4.4	mg/kg	3.33E-09	mg/m^3	R	3.7E-10	mg/kg-day	NA	--	NA	--	--
	4,4'-DDT	27	mg/kg	2.05E-08	mg/m^3	R	2.2E-09	mg/kg-day	5.0E-04	mg/kg-day	NA	--	4.5E-06
	Arsenic	9.31	mg/kg	7.05E-09	mg/m^3	R	7.7E-10	mg/kg-day	NA	--	NA	--	--
	Barium	1,055	mg/kg	7.99E-07	mg/m^3	R	8.8E-08	mg/kg-day	1.4E-04	mg/kg-day	4.9E-04	mg/m3	6.1E-04
	Cadmium	8.4	mg/kg	6.36E-09	mg/m^3	R	7.0E-10	mg/kg-day	NA	--	2.0E-04	mg/m3	--
	Chromium	32.2	mg/kg	2.44E-08	mg/m^3	R	2.7E-09	mg/kg-day	2.2E-06	mg/kg-day	1.1E-04	mg/m3	1.2E-03
	Lead	12,300	mg/kg	9.32E-06	mg/m^3	R	1.0E-06	mg/kg-day	NA	--	NA	--	--
	(Total)												1.8E-03
												Total Hazard Index Across All Exposure Routes/Pathways	1.8E-03

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.

See Appendix J for risk calculation spreadsheets

TABLE 7.5.3 RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Chromium	0.0314	mg/L	0.0314	mg/L	M	2.0E-03	mg/kg-day	3.0E-03	mg/kg-day	--	--	6.7E-01
	Lead	0.0219	mg/L	0.0219	mg/L	M	1.4E-03	mg/kg-day	NA	--	--	--	--
	(Total)												6.7E-01
Dermal	Chromium	0.0314	mg/L	0.0314	mg/L	M	1.1E-05	mg/kg-day	7.5E-05	mg/kg-day	--	--	1.4E-01
	Lead	0.0219	mg/L	0.0219	mg/L	M	1.0E-06	mg/kg-day	NA	--	--	--	--
	(Total)												1.4E-01
												Total Hazard Index Across All Exposure Routes/Pathways	8.1E-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.

See Appendix J for risk calculation spreadsheets

TABLE 7.5.1 CT
CALCULATION OF NON-CANCER HAZARDS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	3.33	mg/kg	M	1.4E-05	mg/kg-day	3.0E-04	mg/kg-day	--	--	4.7E-02
	Chromium	17.7	mg/kg	17.7	mg/kg	M	7.6E-05	mg/kg-day	3.0E-03	mg/kg-day	--	--	2.5E-02
	Lead	1,087	mg/kg	1,087	mg/kg	M	4.6E-03	mg/kg-day	NA	--	--	--	--
	(Total)												7.3E-02
Dermal	Arsenic	3.33	mg/kg	3.33	mg/kg	M	4.8E-07	mg/kg-day	3.0E-04	mg/kg-day	--	--	1.6E-03
	Chromium	17.7	mg/kg	17.7	mg/kg	M	8.5E-08	mg/kg-day	7.5E-05	mg/kg-day	--	--	1.1E-03
	Lead	1,087	mg/kg	1,087	mg/kg	M	5.2E-06	mg/kg-day	NA	--	--	--	--
	(Total)												2.7E-03
												Total Hazard Index Across All Exposure Routes/Pathways	7.5E-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.

See Appendix J for risk calculation spreadsheets

TABLE 7.5.1a CT
CALCULATION OF NON-CANCER HAZARDS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	2.52E-09	mg/m^3	R	1.9E-10	mg/kg-day	NA	--	NA	--	--
	Chromium	17.7	mg/kg	1.34E-08	mg/m^3	R	9.8E-10	mg/kg-day	2.2E-06	mg/kg-day	1.1E-04	mg/m3	4.5E-04
	Lead	1,087	mg/kg	8.24E-07	mg/m^3	R	6.0E-08	mg/kg-day	NA	--	NA	--	--
	(Total)												4.5E-04
								Total Hazard Index Across All Exposure Routes/Pathways					4.5E-04

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.

See Appendix J for risk calculation spreadsheets

TABLE 7.5.2 CT
CALCULATION OF NON-CANCER HAZARDS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	4,4'-DDE	4.4	mg/kg	4.4	mg/kg	M	1.9E-05	mg/kg-day	NA	--	--	--	--
	4,4'-DDT	27	mg/kg	27	mg/kg	M	1.2E-04	mg/kg-day	5.0E-04	mg/kg-day	--	--	2.3E-01
	Arsenic	9.31	mg/kg	9.31	mg/kg	M	4.0E-05	mg/kg-day	3.0E-04	mg/kg-day	--	--	1.3E-01
	Barium	1,055	mg/kg	1,055	mg/kg	M	4.5E-03	mg/kg-day	7.0E-02	mg/kg-day	--	--	6.4E-02
	Cadmium	8.4	mg/kg	8.4	mg/kg	M	3.6E-05	mg/kg-day	5.0E-04	mg/kg-day	--	--	7.2E-02
	Chromium	32.2	mg/kg	32.2	mg/kg	M	1.4E-04	mg/kg-day	3.0E-03	mg/kg-day	--	--	4.6E-02
	Lead	12,300	mg/kg	12,300	mg/kg	M	5.3E-02	mg/kg-day	NA	--	--	--	--
	(Total)												5.5E-01
Dermal	4,4'-DDE	4.4	mg/kg	4.4	mg/kg	M	2.1E-07	mg/kg-day	NA	--	--	--	--
	4,4'-DDT	27	mg/kg	27	mg/kg	M	3.9E-06	mg/kg-day	5.0E-04	mg/kg-day	--	--	7.8E-03
	Arsenic	9.31	mg/kg	9.31	mg/kg	M	1.3E-06	mg/kg-day	3.0E-04	mg/kg-day	--	--	4.5E-03
	Barium	1,055	mg/kg	1,055	mg/kg	M	5.1E-06	mg/kg-day	4.9E-03	mg/kg-day	--	--	1.0E-03
	Cadmium	8.4	mg/kg	8.4	mg/kg	M	4.0E-08	mg/kg-day	2.5E-05	mg/kg-day	--	--	1.6E-03
	Chromium	32.2	mg/kg	32.2	mg/kg	M	1.5E-07	mg/kg-day	7.5E-05	mg/kg-day	--	--	2.1E-03
	Lead	12,300	mg/kg	12,300	mg/kg	M	5.9E-05	mg/kg-day	NA	--	--	--	--
	(Total)												1.7E-02
												Total Hazard Index Across All Exposure Routes/Pathways	5.6E-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.

See Appendix J for risk calculation spreadsheets

TABLE 7.5.2a CT
CALCULATION OF NON-CANCER HAZARDS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	4,4'-DDE	4.4	mg/kg	3.33E-09	mg/m^3	R	2.4E-10	mg/kg-day	NA	--	NA	--	--
	4,4'-DDT	27	mg/kg	2.05E-08	mg/m^3	R	1.5E-09	mg/kg-day	5.0E-04	mg/kg-day	NA	--	3.0E-06
	Arsenic	9.31	mg/kg	7.05E-09	mg/m^3	R	5.2E-10	mg/kg-day	NA	--	NA	--	--
	Barium	1,055	mg/kg	7.99E-07	mg/m^3	R	5.9E-08	mg/kg-day	1.4E-04	mg/kg-day	4.9E-04	mg/m3	4.1E-04
	Cadmium	8.4	mg/kg	6.36E-09	mg/m^3	R	4.7E-10	mg/kg-day	NA	--	2.0E-04	mg/m3	--
	Chromium	32.2	mg/kg	2.44E-08	mg/m^3	R	1.8E-09	mg/kg-day	2.2E-06	mg/kg-day	1.1E-04	mg/m3	8.1E-04
	Lead	12,300	mg/kg	9.32E-06	mg/m^3	R	6.8E-07	mg/kg-day	NA	--	NA	--	--
	(Total)												1.2E-03
												Total Hazard Index Across All Exposure Routes/Pathways	1.2E-03

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.

See Appendix J for risk calculation spreadsheets

TABLE 7.5.3 CT
CALCULATION OF NON-CANCER HAZARDS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Chromium	0.0314	mg/L	0.0314	mg/L	M	1.3E-03	mg/kg-day	3.0E-03	mg/kg-day	--	--	4.5E-01
	Lead	0.0219	mg/L	0.0219	mg/L	M	9.4E-04	mg/kg-day	NA	--	--	--	--
	(Total)												4.5E-01
Dermal	Chromium	0.0314	mg/L	0.0314	mg/L	M	2.4E-06	mg/kg-day	7.5E-05	mg/kg-day	--	--	3.2E-02
	Lead	0.0219	mg/L	0.0219	mg/L	M	2.2E-07	mg/kg-day	NA	--	--	--	--
	(Total)												3.2E-02
												Total Hazard Index Across All Exposure Routes/Pathways	4.8E-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.

See Appendix J for risk calculation spreadsheets

TABLE 7.6.1 RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	3.33	mg/kg	M	1.6E-05	mg/kg-day	3.0E-04	mg/kg-day	--	--	5.2E-02
	Chromium	17.7	mg/kg	17.7	mg/kg	M	8.3E-05	mg/kg-day	3.0E-03	mg/kg-day	--	--	2.8E-02
	Lead	1,087	mg/kg	1,087	mg/kg	M	5.1E-03	mg/kg-day	NA	--	--	--	--
	(Total)												8.0E-02
Dermal	Arsenic	3.33	mg/kg	3.33	mg/kg	M	6.5E-07	mg/kg-day	3.0E-04	mg/kg-day	--	--	2.2E-03
	Chromium	17.7	mg/kg	17.7	mg/kg	M	1.1E-07	mg/kg-day	7.5E-05	mg/kg-day	--	--	1.5E-03
	Lead	1,087	mg/kg	1,087	mg/kg	M	7.0E-06	mg/kg-day	NA	--	--	--	--
	(Total)												3.7E-03
									Total Hazard Index Across All Exposure Routes/Pathways				8.4E-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.

See Appendix J for risk calculation spreadsheets

TABLE 7.6.1a RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	2.52E-09	mg/m^3	R	3.5E-07	mg/kg-day	NA	--	NA	--	--
	Chromium	17.7	mg/kg	1.34E-08	mg/m^3	R	1.9E-06	mg/kg-day	2.2E-06	mg/kg-day	1.1E-04	mg/m3	8.5E-01
	Lead	1,087	mg/kg	8.24E-07	mg/m^3	R	1.1E-04	mg/kg-day	NA	--	NA	--	--
	(Total)												8.5E-01
							Total Hazard Index Across All Exposure Routes/Pathways						8.5E-01

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.

See Appendix J for risk calculation spreadsheets

TABLE 7.6.2 RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	4,4'-DDT	27	mg/kg	27	mg/kg	M	1.3E-04	mg/kg-day	5.0E-04	mg/kg-day	--	--	2.5E-01
	Arsenic	9.31	mg/kg	9.31	mg/kg	M	4.4E-05	mg/kg-day	3.0E-04	mg/kg-day	--	--	1.5E-01
	Chromium	32.2	mg/kg	32.2	mg/kg	M	1.5E-04	mg/kg-day	3.0E-03	mg/kg-day	--	--	5.0E-02
	Lead	12,300	mg/kg	12,300	mg/kg	M	5.8E-02	mg/kg-day	NA	--	--	--	--
	(Total)												4.5E-01
Dermal	4,4'-DDT	27	mg/kg	27	mg/kg	M	5.2E-06	mg/kg-day	5.0E-04	mg/kg-day	--	--	1.0E-02
	Arsenic	9.31	mg/kg	9.31	mg/kg	M	1.8E-06	mg/kg-day	3.0E-04	mg/kg-day	--	--	6.0E-03
	Chromium	32.2	mg/kg	32.2	mg/kg	M	2.1E-07	mg/kg-day	7.5E-05	mg/kg-day	--	--	2.8E-03
	Lead	12,300	mg/kg	12,300	mg/kg	M	7.9E-05	mg/kg-day	NA	--	--	--	--
	(Total)												1.9E-02
												Total Hazard Index Across All Exposure Routes/Pathways	4.7E-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.

See Appendix J for risk calculation spreadsheets

TABLE 7.6.2a RME
CALCULATION OF NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	4,4'-DDT	27	mg/kg	2.05E-08	mg/m^3	R	2.8E-06	mg/kg-day	5.0E-04	mg/kg-day	NA	--	5.7E-03
	Arsenic	9.31	mg/kg	7.05E-09	mg/m^3	R	9.8E-07	mg/kg-day	NA	--	NA	--	--
	Chromium	32.2	mg/kg	2.44E-08	mg/m^3	R	3.4E-06	mg/kg-day	2.2E-06	mg/kg-day	1.1E-04	mg/m3	1.5E+00
	Lead	12,300	mg/kg	9.32E-06	mg/m^3	R	1.3E-03	mg/kg-day	NA	--	NA	--	--
	(Total)												1.5E+00
												Total Hazard Index Across All Exposure Routes/Pathways	1.5E+00

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.

See Appendix J for risk calculation spreadsheets

TABLE 7.6.1 CT
CALCULATION OF NON-CANCER HAZARDS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	3.33	mg/kg	M	6.9E-06	mg/kg-day	3.0E-04	mg/kg-day	--	--	2.3E-02
	Chromium	17.7	mg/kg	17.7	mg/kg	M	3.6E-05	mg/kg-day	3.0E-03	mg/kg-day	--	--	1.2E-02
	Lead	1,087	mg/kg	1,087	mg/kg	M	2.2E-03	mg/kg-day	NA	--	--	--	--
	(Total)												3.5E-02
Dermal	Arsenic	3.33	mg/kg	3.33	mg/kg	M	5.7E-08	mg/kg-day	3.0E-04	mg/kg-day	--	--	1.9E-04
	Chromium	17.7	mg/kg	17.7	mg/kg	M	1.0E-08	mg/kg-day	7.5E-05	mg/kg-day	--	--	1.3E-04
	Lead	1,087	mg/kg	1,087	mg/kg	M	6.2E-07	mg/kg-day	NA	--	--	--	--
	(Total)												3.2E-04
										Total Hazard Index Across All Exposure Routes/Pathways			3.5E-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.

See Appendix J for risk calculation spreadsheets

TABLE 7.6.1a CT
CALCULATION OF NON-CANCER HAZARDS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	2.52E-09	mg/m^3	R	1.2E-07	mg/kg-day	NA	--	NA	--	--
	Chromium	17.7	mg/kg	1.34E-08	mg/m^3	R	6.4E-07	mg/kg-day	2.2E-06	mg/kg-day	1.1E-04	mg/m3	2.9E-01
	Lead	1,087	mg/kg	8.24E-07	mg/m^3	R	3.9E-05	mg/kg-day	NA	--	NA	--	--
	(Total)												2.9E-01
												Total Hazard Index Across All Exposure Routes/Pathways	2.9E-01

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.

See Appendix J for risk calculation spreadsheets

TABLE 7.6.2 CT
CALCULATION OF NON-CANCER HAZARDS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	4,4'-DDT	27	mg/kg	27	mg/kg	M	5.6E-05	mg/kg-day	5.0E-04	mg/kg-day	--	--	1.1E-01
	Arsenic	9.31	mg/kg	9.31	mg/kg	M	1.9E-05	mg/kg-day	3.0E-04	mg/kg-day	--	--	6.4E-02
	Chromium	32.2	mg/kg	32.2	mg/kg	M	6.6E-05	mg/kg-day	3.0E-03	mg/kg-day	--	--	2.2E-02
	Lead	12,300	mg/kg	12,300	mg/kg	M	2.5E-02	mg/kg-day	NA	--	--	--	--
	(Total)												2.0E-01
Dermal	4,4'-DDT	27	mg/kg	27	mg/kg	M	4.6E-07	mg/kg-day	5.0E-04	mg/kg-day	--	--	9.2E-04
	Arsenic	9.31	mg/kg	9.31	mg/kg	M	1.6E-07	mg/kg-day	3.0E-04	mg/kg-day	--	--	5.3E-04
	Chromium	32.2	mg/kg	32.2	mg/kg	M	1.8E-08	mg/kg-day	7.5E-05	mg/kg-day	--	--	2.4E-04
	Lead	12,300	mg/kg	12,300	mg/kg	M	7.0E-06	mg/kg-day	NA	--	--	--	--
	(Total)												1.7E-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/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.

See Appendix J for risk calculation spreadsheets

TABLE 7.6.2a CT
CALCULATION OF NON-CANCER HAZARDS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	4,4'-DDT	27	mg/kg	2.05E-08	mg/m^3	R	9.8E-07	mg/kg-day	5.0E-04	mg/kg-day	NA	--	2.0E-03
	Arsenic	9.31	mg/kg	7.05E-09	mg/m^3	R	3.4E-07	mg/kg-day	NA	--	NA	--	--
	Chromium	32.2	mg/kg	2.44E-08	mg/m^3	R	1.2E-06	mg/kg-day	2.2E-06	mg/kg-day	1.1E-04	mg/m3	5.3E-01
	Lead	12,300	mg/kg	9.32E-06	mg/m^3	R	4.5E-04	mg/kg-day	NA	--	NA	--	--
	(Total)												5.3E-01
							Total Hazard Index Across All Exposure Routes/Pathways						5.3E-01

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.

See Appendix J for risk calculation spreadsheets

TABLE 8.1.1 RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Trespassers
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	3.33	mg/kg	3.33	mg/kg	M	2.3E-07	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	3.5E-07
	Chromium	17.7	mg/kg	17.7	mg/kg	M	1.2E-06	mg/kg-day	NA	--	--
	Lead	1,087	mg/kg	1,087	mg/kg	M	7.6E-05	mg/kg-day	NA	--	--
	(Total)										3.5E-07
Dermal	Arsenic	3.33	mg/kg	3.33	mg/kg	M	2.8E-08	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	4.2E-08
	Chromium	17.7	mg/kg	17.7	mg/kg	M	4.9E-09	mg/kg-day	NA	--	--
	Lead	1,087	mg/kg	1,087	mg/kg	M	3.0E-07	mg/kg-day	NA	--	--
	(Total)										4.2E-08
										Total Risk Across All Exposure Routes/Pathways	3.9E-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.

See Appendix J for risk calculation spreadsheets

TABLE 8.1.1a RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Trespassers
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	3.33	mg/kg	2.52E-09	mg/m^3	R	1.5E-12	mg/kg-day	1.5E+01	$(mg/kg\text{-}day)^{-1}$	2.2E-11
	Chromium	17.7	mg/kg	1.34E-08	mg/m^3	R	7.7E-12	mg/kg-day	2.9E+02	$(mg/kg\text{-}day)^{-1}$	2.3E-09
	Lead	1,087	mg/kg	8.24E-07	mg/m^3	R	4.7E-10	mg/kg-day	NA	--	--
	(Total)										2.3E-09
										Total Risk Across All Exposure Routes/Pathways	2.3E-09

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.

See Appendix J for risk calculation spreadsheets

TABLE 8.2.1 RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil
Exposure Point: Surface Soil
Receptor Population: Trespassers
Receptor Age: Adolescent

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	3.33	mg/kg	3.33	mg/kg	M	1.5E-07	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	2.3E-07
	Chromium	17.7	mg/kg	17.7	mg/kg	M	8.0E-07	mg/kg-day	NA	--	--
	Lead	1,087	mg/kg	1,087	mg/kg	M	4.9E-05	mg/kg-day	NA	--	--
	(Total)										2.3E-07
Dermal	Arsenic	3.33	mg/kg	3.33	mg/kg	M	4.8E-08	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	7.2E-08
	Chromium	17.7	mg/kg	17.7	mg/kg	M	8.5E-09	mg/kg-day	NA	--	--
	Lead	1,087	mg/kg	1,087	mg/kg	M	5.2E-07	mg/kg-day	NA	--	--
	(Total)										7.2E-08
										Total Risk Across All Exposure Routes/Pathways	3.0E-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.

See Appendix J for risk calculation spreadsheets

TABLE 8.2.1a RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Fugative dust
Receptor Population: Trespassers
Receptor Age: Adolescent

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	3.33	mg/kg	2.52E-09	mg/m^3	R	2.7E-12	mg/kg-day	1.5E+01	$(mg/kg\text{-}day)^{-1}$	4.0E-11
	Chromium	17.7	mg/kg	1.34E-08	mg/m^3	R	1.4E-11	mg/kg-day	2.9E+02	$(mg/kg\text{-}day)^{-1}$	4.2E-09
	Lead	1,087	mg/kg	8.24E-07	mg/m^3	R	8.7E-10	mg/kg-day	NA	--	--
	(Total)										4.2E-09
										Total Risk Across All Exposure Routes/Pathways	4.2E-09

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.

See Appendix J for risk calculation spreadsheets

TABLE 8.3.1 RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	3.33	mg/kg	M	1.9E-07	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	2.8E-07
	Chromium	17.7	mg/kg	17.7	mg/kg	M	9.9E-07	mg/kg-day	NA	--	--
	Lead	1,087	mg/kg	1,087	mg/kg	M	6.1E-05	mg/kg-day	NA	--	--
	(Total)										2.8E-07
Dermal	Arsenic	3.33	mg/kg	3.33	mg/kg	M	3.7E-08	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	5.5E-08
	Chromium	17.7	mg/kg	17.7	mg/kg	M	6.5E-09	mg/kg-day	NA	--	--
	Lead	1,087	mg/kg	1,087	mg/kg	M	4.0E-07	mg/kg-day	NA	--	--
	(Total)										5.5E-08
										Total Risk Across All Exposure Routes/Pathways	3.3E-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.

See Appendix J for risk calculation spreadsheets

TABLE 8.3.1a RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	2.52E-09	mg/m^3	R	6.2E-12	mg/kg-day	1.5E+01	$(mg/kg\text{-}day)^{-1}$	9.3E-11
	Chromium	17.7	mg/kg	1.34E-08	mg/m^3	R	3.3E-11	mg/kg-day	2.9E+02	$(mg/kg\text{-}day)^{-1}$	9.7E-09
	Lead	1,087	mg/kg	8.24E-07	mg/m^3	R	2.0E-09	mg/kg-day	NA	--	--
	(Total)										9.8E-09
										Total Risk Across All Exposure Routes/Pathways	9.8E-09

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.

See Appendix J for risk calculation spreadsheets

TABLE 8.4.1 RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	3.33	mg/kg	M	1.6E-06	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	2.3E-06
	Chromium	17.7	mg/kg	17.7	mg/kg	M	8.3E-06	mg/kg-day	NA	--	--
	Lead	1,087	mg/kg	1,087	mg/kg	M	5.1E-04	mg/kg-day	NA	--	--
	(Total)										2.3E-06
Dermal	Arsenic	3.33	mg/kg	3.33	mg/kg	M	1.9E-07	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	2.8E-07
	Chromium	17.7	mg/kg	17.7	mg/kg	M	3.3E-08	mg/kg-day	NA	--	--
	Lead	1,087	mg/kg	1,087	mg/kg	M	2.0E-06	mg/kg-day	NA	--	--
	(Total)										2.8E-07
										Total Risk Across All Exposure Routes/Pathways	2.6E-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.

See Appendix J for risk calculation spreadsheets

TABLE 8.4.1a RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	2.52E-09	mg/m^3	R	9.8E-12	mg/kg-day	1.5E+01	$(mg/kg\text{-}day)^{-1}$	1.5E-10
	Chromium	17.7	mg/kg	1.34E-08	mg/m^3	R	5.2E-11	mg/kg-day	2.9E+02	$(mg/kg\text{-}day)^{-1}$	1.5E-08
	Lead	1,087	mg/kg	8.24E-07	mg/m^3	R	3.2E-09	mg/kg-day	NA	--	--
	(Total)										1.5E-08
										Total Risk Across All Exposure Routes/Pathways	1.5E-08

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.

See Appendix J for risk calculation spreadsheets

TABLE 8.4.2 RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	4,4'-DDE	4.4	mg/kg	4.4	mg/kg	M	2.1E-06	mg/kg-day	3.4E-01	(mg/kg-day) $^{-1}$	7.0E-07
	4,4'-DDT	27	mg/kg	27	mg/kg	M	1.3E-05	mg/kg-day	3.4E-01	(mg/kg-day) $^{-1}$	4.3E-06
	Arsenic	9.31	mg/kg	9.31	mg/kg	M	4.4E-06	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	6.6E-06
	Barium	1,055	mg/kg	1,055	mg/kg	M	5.0E-04	mg/kg-day	NA	--	--
	Cadmium	8.4	mg/kg	8.4	mg/kg	M	3.9E-06	mg/kg-day	NA	--	--
	Chromium	32.2	mg/kg	32.2	mg/kg	M	1.5E-05	mg/kg-day	NA	--	--
	Lead	12,300	mg/kg	12,300	mg/kg	M	5.8E-03	mg/kg-day	NA	--	--
	(Total)										1.2E-05
Dermal	4,4'-DDE	4.4	mg/kg	4.4	mg/kg	M	8.2E-08	mg/kg-day	3.4E-01	(mg/kg-day) $^{-1}$	2.8E-08
	4,4'-DDT	27	mg/kg	27	mg/kg	M	1.5E-06	mg/kg-day	3.4E-01	(mg/kg-day) $^{-1}$	5.2E-07
	Arsenic	9.31	mg/kg	9.31	mg/kg	M	5.2E-07	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	7.9E-07
	Barium	1,055	mg/kg	1,055	mg/kg	M	2.0E-06	mg/kg-day	NA	--	--
	Cadmium	8.4	mg/kg	8.4	mg/kg	M	1.6E-08	mg/kg-day	NA	--	--
	Chromium	32.2	mg/kg	32.2	mg/kg	M	6.0E-08	mg/kg-day	NA	--	--
	Lead	12,300	mg/kg	12,300	mg/kg	M	2.3E-05	mg/kg-day	NA	--	--
	(Total)										1.3E-06
										Total Risk Across All Exposure Routes/Pathways	1.3E-05

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.

See Appendix J for risk calculation spreadsheets

TABLE 8.4.2a RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	4,4'-DDE	4.4	mg/kg	3.33E-09	mg/m^3	R	1.3E-11	mg/kg-day	3.4E-01	$(mg/kg\text{-}day)^{-1}$	4.4E-12
	4,4'-DDT	27	mg/kg	2.05E-08	mg/m^3	R	7.9E-11	mg/kg-day	3.4E-01	$(mg/kg\text{-}day)^{-1}$	2.7E-11
	Arsenic	9.31	mg/kg	7.05E-09	mg/m^3	R	2.7E-11	mg/kg-day	1.5E+01	$(mg/kg\text{-}day)^{-1}$	4.1E-10
	Barium	1,055	mg/kg	7.99E-07	mg/m^3	R	3.1E-09	mg/kg-day	NA	--	--
	Cadmium	8.4	mg/kg	6.36E-09	mg/m^3	R	2.5E-11	mg/kg-day	6.3E+00	$(mg/kg\text{-}day)^{-1}$	1.6E-10
	Chromium	32.2	mg/kg	2.44E-08	mg/m^3	R	9.4E-11	mg/kg-day	2.9E+02	$(mg/kg\text{-}day)^{-1}$	2.8E-08
	Lead	12,300	mg/kg	9.32E-06	mg/m^3	R	3.6E-08	mg/kg-day	NA	--	--
	(Total)										2.8E-08
										Total Risk Across All Exposure Routes/Pathways	2.8E-08

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.

See Appendix J for risk calculation spreadsheets

TABLE 8.4.3 RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Chromium	0.0314	mg/L	0.0314	mg/L	M	2.9E-04	mg/kg-day	NA	--	--
	Lead	0.0219	mg/L	0.0219	mg/L	M	2.1E-04	mg/kg-day	NA	--	--
	(Total)										--
Dermal	Chromium	0.0314	mg/L	0.0314	mg/L	M	1.2E-06	mg/kg-day	NA	--	--
	Lead	0.0219	mg/L	0.0219	mg/L	M	1.2E-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/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.

See Appendix J for risk calculation spreadsheets

TABLE 8.4.1 CT
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	3.33	mg/kg	M	1.5E-07	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	2.3E-07
	Chromium	17.7	mg/kg	17.7	mg/kg	M	8.1E-07	mg/kg-day	NA	--	--
	Lead	1,087	mg/kg	1,087	mg/kg	M	5.0E-05	mg/kg-day	NA	--	--
	(Total)										2.3E-07
Dermal	Arsenic	3.33	mg/kg	3.33	mg/kg	M	5.2E-09	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	7.8E-09
	Chromium	17.7	mg/kg	17.7	mg/kg	M	9.3E-10	mg/kg-day	NA	--	--
	Lead	1,087	mg/kg	1,087	mg/kg	M	5.7E-08	mg/kg-day	NA	--	--
	(Total)										7.8E-09
										Total Risk Across All Exposure Routes/Pathways	2.4E-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.

See Appendix J for risk calculation spreadsheets

TABLE 8.4.1a CT
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	2.52E-09	mg/m^3	R	1.9E-12	mg/kg-day	1.5E+01	$(mg/kg\text{-}day)^{-1}$	2.9E-11
	Chromium	17.7	mg/kg	1.34E-08	mg/m^3	R	1.0E-11	mg/kg-day	2.9E+02	$(mg/kg\text{-}day)^{-1}$	3.0E-09
	Lead	1,087	mg/kg	8.24E-07	mg/m^3	R	6.2E-10	mg/kg-day	NA	--	--
	(Total)										3.0E-09
										Total Risk Across All Exposure Routes/Pathways	3.0E-09

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.

See Appendix J for risk calculation spreadsheets

TABLE 8.4.2 CT
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	4,4'-DDE	4.4	mg/kg	4.4	mg/kg	M	2.0E-07	mg/kg-day	3.4E-01	(mg/kg-day) $^{-1}$	6.9E-08
	4,4'-DDT	27	mg/kg	27	mg/kg	M	1.2E-06	mg/kg-day	3.4E-01	(mg/kg-day) $^{-1}$	4.2E-07
	Arsenic	9.31	mg/kg	9.31	mg/kg	M	4.3E-07	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	6.4E-07
	Barium	1,055	mg/kg	1,055	mg/kg	M	4.8E-05	mg/kg-day	NA	--	--
	Cadmium	8.4	mg/kg	8.4	mg/kg	M	3.8E-07	mg/kg-day	NA	--	--
	Chromium	32.2	mg/kg	32.2	mg/kg	M	1.5E-06	mg/kg-day	NA	--	--
	Lead	12,300	mg/kg	12,300	mg/kg	M	5.6E-04	mg/kg-day	NA	--	--
	(Total)										1.1E-06
Dermal	4,4'-DDE	4.4	mg/kg	4.4	mg/kg	M	2.3E-09	mg/kg-day	3.4E-01	(mg/kg-day) $^{-1}$	7.8E-10
	4,4'-DDT	27	mg/kg	27	mg/kg	M	4.2E-08	mg/kg-day	3.4E-01	(mg/kg-day) $^{-1}$	1.4E-08
	Arsenic	9.31	mg/kg	9.31	mg/kg	M	1.5E-08	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	2.2E-08
	Barium	1,055	mg/kg	1,055	mg/kg	M	5.5E-08	mg/kg-day	NA	--	--
	Cadmium	8.4	mg/kg	8.4	mg/kg	M	4.4E-10	mg/kg-day	NA	--	--
	Chromium	32.2	mg/kg	32.2	mg/kg	M	1.7E-09	mg/kg-day	NA	--	--
	Lead	12,300	mg/kg	12,300	mg/kg	M	6.4E-07	mg/kg-day	NA	--	--
	(Total)										3.7E-08
										Total Risk Across All Exposure Routes/Pathways	1.2E-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.

See Appendix J for risk calculation spreadsheets

TABLE 8.4.2a CT
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	4,4'-DDE	4.4	mg/kg	3.33E-09	mg/m^3	R	2.5E-12	mg/kg-day	3.4E-01	$(mg/kg\text{-}day)^{-1}$	8.6E-13
	4,4'-DDT	27	mg/kg	2.05E-08	mg/m^3	R	1.5E-11	mg/kg-day	3.4E-01	$(mg/kg\text{-}day)^{-1}$	5.2E-12
	Arsenic	9.31	mg/kg	7.05E-09	mg/m^3	R	5.3E-12	mg/kg-day	1.5E+01	$(mg/kg\text{-}day)^{-1}$	8.0E-11
	Barium	1,055	mg/kg	7.99E-07	mg/m^3	R	6.0E-10	mg/kg-day	NA	--	--
	Cadmium	8.4	mg/kg	6.36E-09	mg/m^3	R	4.8E-12	mg/kg-day	6.3E+00	$(mg/kg\text{-}day)^{-1}$	3.0E-11
	Chromium	32.2	mg/kg	2.44E-08	mg/m^3	R	1.8E-11	mg/kg-day	2.9E+02	$(mg/kg\text{-}day)^{-1}$	5.4E-09
	Lead	12,300	mg/kg	9.32E-06	mg/m^3	R	7.0E-09	mg/kg-day	NA	--	--
	(Total)										5.5E-09
										Total Risk Across All Exposure Routes/Pathways	5.5E-09

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.

See Appendix J for risk calculation spreadsheets

TABLE 8.4.3 CT
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Chromium	0.0314	mg/L	0.0314	mg/L	M	4.0E-05	mg/kg-day	NA	--	--
	Lead	0.0219	mg/L	0.0219	mg/L	M	2.8E-05	mg/kg-day	NA	--	--
	(Total)										--
Dermal	Chromium	0.0314	mg/L	0.0314	mg/L	M	1.0E-07	mg/kg-day	NA	--	--
	Lead	0.0219	mg/L	0.0219	mg/L	M	9.9E-09	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/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.

See Appendix J for risk calculation spreadsheets

TABLE 8.5.1 RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	3.33	mg/kg	M	3.7E-06	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	5.5E-06
	Chromium	17.7	mg/kg	17.7	mg/kg	M	1.9E-05	mg/kg-day	NA	--	--
	Lead	1,087	mg/kg	1,087	mg/kg	M	1.2E-03	mg/kg-day	NA	--	--
	(Total)										5.5E-06
Dermal	Arsenic	3.33	mg/kg	3.33	mg/kg	M	3.1E-07	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	4.6E-07
	Chromium	17.7	mg/kg	17.7	mg/kg	M	5.4E-08	mg/kg-day	NA	--	--
	Lead	1,087	mg/kg	1,087	mg/kg	M	3.3E-06	mg/kg-day	NA	--	--
	(Total)										4.6E-07
										Total Risk Across All Exposure Routes/Pathways	5.9E-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.

See Appendix J for risk calculation spreadsheets

TABLE 8.5.1a RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	2.52E-09	mg/m^3	R	2.4E-11	mg/kg-day	1.5E+01	$(mg/kg\text{-}day)^{-1}$	3.6E-10
	Chromium	17.7	mg/kg	1.34E-08	mg/m^3	R	1.3E-10	mg/kg-day	2.9E+02	$(mg/kg\text{-}day)^{-1}$	3.7E-08
	Lead	1,087	mg/kg	8.24E-07	mg/m^3	R	7.7E-09	mg/kg-day	NA	--	--
	(Total)										3.7E-08
										Total Risk Across All Exposure Routes/Pathways	3.7E-08

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.

See Appendix J for risk calculation spreadsheets

TABLE 8.5.2 RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	4,4'-DDE	4.4	mg/kg	4.4	mg/kg	M	4.8E-06	mg/kg-day	3.4E-01	(mg/kg-day) $^{-1}$	1.6E-06
	4,4'-DDT	27	mg/kg	27	mg/kg	M	3.0E-05	mg/kg-day	3.4E-01	(mg/kg-day) $^{-1}$	1.0E-05
	Arsenic	9.31	mg/kg	9.31	mg/kg	M	1.0E-05	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	1.5E-05
	Barium	1,055	mg/kg	1,055	mg/kg	M	1.2E-03	mg/kg-day	NA	--	--
	Cadmium	8.4	mg/kg	8.4	mg/kg	M	9.2E-06	mg/kg-day	NA	--	--
	Chromium	32.2	mg/kg	32.2	mg/kg	M	3.5E-05	mg/kg-day	NA	--	--
	Lead	12,300	mg/kg	12,300	mg/kg	M	1.3E-02	mg/kg-day	NA	--	--
	(Total)										2.7E-05
Dermal	4,4'-DDE	4.4	mg/kg	4.4	mg/kg	M	1.4E-07	mg/kg-day	3.4E-01	(mg/kg-day) $^{-1}$	4.6E-08
	4,4'-DDT	27	mg/kg	27	mg/kg	M	2.5E-06	mg/kg-day	3.4E-01	(mg/kg-day) $^{-1}$	8.5E-07
	Arsenic	9.31	mg/kg	9.31	mg/kg	M	8.6E-07	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	1.3E-06
	Barium	1,055	mg/kg	1,055	mg/kg	M	3.2E-06	mg/kg-day	NA	--	--
	Cadmium	8.4	mg/kg	8.4	mg/kg	M	2.6E-08	mg/kg-day	NA	--	--
	Chromium	32.2	mg/kg	32.2	mg/kg	M	9.9E-08	mg/kg-day	NA	--	--
	Lead	12,300	mg/kg	12,300	mg/kg	M	3.8E-05	mg/kg-day	NA	--	--
	(Total)										2.2E-06
										Total Risk Across All Exposure Routes/Pathways	2.9E-05

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.

See Appendix J for risk calculation spreadsheets

TABLE 8.5.2a RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	4,4'-DDE	4.4	mg/kg	3.33E-09	mg/m^3	R	3.1E-11	mg/kg-day	3.4E-01	$(mg/kg\text{-}day)^{-1}$	1.1E-11
	4,4'-DDT	27	mg/kg	2.05E-08	mg/m^3	R	1.9E-10	mg/kg-day	3.4E-01	$(mg/kg\text{-}day)^{-1}$	6.5E-11
	Arsenic	9.31	mg/kg	7.05E-09	mg/m^3	R	6.6E-11	mg/kg-day	1.5E+01	$(mg/kg\text{-}day)^{-1}$	1.0E-09
	Barium	1,055	mg/kg	7.99E-07	mg/m^3	R	7.5E-09	mg/kg-day	NA	--	--
	Cadmium	8.4	mg/kg	6.36E-09	mg/m^3	R	6.0E-11	mg/kg-day	6.3E+00	$(mg/kg\text{-}day)^{-1}$	3.8E-10
	Chromium	32.2	mg/kg	2.44E-08	mg/m^3	R	2.3E-10	mg/kg-day	2.9E+02	$(mg/kg\text{-}day)^{-1}$	6.7E-08
	Lead	12,300	mg/kg	9.32E-06	mg/m^3	R	8.8E-08	mg/kg-day	NA	--	--
	(Total)										6.9E-08
										Total Risk Across All Exposure Routes/Pathways	6.9E-08

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.

See Appendix J for risk calculation spreadsheets

TABLE 8.5.3 RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Chromium	0.0314	mg/L	0.0314	mg/L	M	1.7E-04	mg/kg-day	NA	--	--
	Lead	0.0219	mg/L	0.0219	mg/L	M	1.2E-04	mg/kg-day	NA	--	--
	(Total)										--
Dermal	Chromium	0.0314	mg/L	0.0314	mg/L	M	9.2E-07	mg/kg-day	NA	--	--
	Lead	0.0219	mg/L	0.0219	mg/L	M	8.7E-08	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/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.

See Appendix J for risk calculation spreadsheets

TABLE 8.5.1 CT
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	3.33	mg/kg	M	4.1E-07	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	6.1E-07
	Chromium	17.7	mg/kg	17.7	mg/kg	M	2.2E-06	mg/kg-day	NA	--	--
	Lead	1,087	mg/kg	1,087	mg/kg	M	1.3E-04	mg/kg-day	NA	--	--
	(Total)										6.1E-07
Dermal	Arsenic	3.33	mg/kg	3.33	mg/kg	M	1.4E-08	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	2.1E-08
	Chromium	17.7	mg/kg	17.7	mg/kg	M	2.4E-09	mg/kg-day	NA	--	--
	Lead	1,087	mg/kg	1,087	mg/kg	M	1.5E-07	mg/kg-day	NA	--	--
	(Total)										2.1E-08
										Total Risk Across All Exposure Routes/Pathways	6.3E-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.

See Appendix J for risk calculation spreadsheets

TABLE 8.5.1a CT
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	2.52E-09	mg/m^3	R	5.3E-12	mg/kg-day	1.5E+01	$(mg/kg\text{-}day)^{-1}$	8.0E-11
	Chromium	17.7	mg/kg	1.34E-08	mg/m^3	R	2.8E-11	mg/kg-day	2.9E+02	$(mg/kg\text{-}day)^{-1}$	8.3E-09
	Lead	1,087	mg/kg	8.24E-07	mg/m^3	R	1.7E-09	mg/kg-day	NA	--	--
	(Total)										8.4E-09
										Total Risk Across All Exposure Routes/Pathways	8.4E-09

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.

See Appendix J for risk calculation spreadsheets

TABLE 8.5.2 CT
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	4,4'-DDE	4.4	mg/kg	4.4	mg/kg	M	5.4E-07	mg/kg-day	3.4E-01	(mg/kg-day) $^{-1}$	1.8E-07
	4,4'-DDT	27	mg/kg	27	mg/kg	M	3.3E-06	mg/kg-day	3.4E-01	(mg/kg-day) $^{-1}$	1.1E-06
	Arsenic	9.31	mg/kg	9.31	mg/kg	M	1.1E-06	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	1.7E-06
	Barium	1,055	mg/kg	1,055	mg/kg	M	1.3E-04	mg/kg-day	NA	--	--
	Cadmium	8.4	mg/kg	8.4	mg/kg	M	1.0E-06	mg/kg-day	NA	--	--
	Chromium	32.2	mg/kg	32.2	mg/kg	M	3.9E-06	mg/kg-day	NA	--	--
	Lead	12,300	mg/kg	12,300	mg/kg	M	1.5E-03	mg/kg-day	NA	--	--
	(Total)										3.0E-06
Dermal	4,4'-DDE	4.4	mg/kg	4.4	mg/kg	M	6.0E-09	mg/kg-day	3.4E-01	(mg/kg-day) $^{-1}$	2.0E-09
	4,4'-DDT	27	mg/kg	27	mg/kg	M	1.1E-07	mg/kg-day	3.4E-01	(mg/kg-day) $^{-1}$	3.8E-08
	Arsenic	9.31	mg/kg	9.31	mg/kg	M	3.8E-08	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	5.7E-08
	Barium	1,055	mg/kg	1,055	mg/kg	M	1.4E-07	mg/kg-day	NA	--	--
	Cadmium	8.4	mg/kg	8.4	mg/kg	M	1.1E-09	mg/kg-day	NA	--	--
	Chromium	32.2	mg/kg	32.2	mg/kg	M	4.4E-09	mg/kg-day	NA	--	--
	Lead	12,300	mg/kg	12,300	mg/kg	M	1.7E-06	mg/kg-day	NA	--	--
	(Total)										9.7E-08
										Total Risk Across All Exposure Routes/Pathways	3.1E-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.

See Appendix J for risk calculation spreadsheets

TABLE 8.5.2a CT
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	4,4'-DDE	4.4	mg/kg	3.33E-09	mg/m^3	R	7.0E-12	mg/kg-day	3.4E-01	$(mg/kg\text{-}day)^{-1}$	2.4E-12
	4,4'-DDT	27	mg/kg	2.05E-08	mg/m^3	R	4.3E-11	mg/kg-day	3.4E-01	$(mg/kg\text{-}day)^{-1}$	1.5E-11
	Arsenic	9.31	mg/kg	7.05E-09	mg/m^3	R	1.5E-11	mg/kg-day	1.5E+01	$(mg/kg\text{-}day)^{-1}$	2.2E-10
	Barium	1,055	mg/kg	7.99E-07	mg/m^3	R	1.7E-09	mg/kg-day	NA	--	--
	Cadmium	8.4	mg/kg	6.36E-09	mg/m^3	R	1.3E-11	mg/kg-day	6.3E+00	$(mg/kg\text{-}day)^{-1}$	8.4E-11
	Chromium	32.2	mg/kg	2.44E-08	mg/m^3	R	5.1E-11	mg/kg-day	2.9E+02	$(mg/kg\text{-}day)^{-1}$	1.5E-08
	Lead	12,300	mg/kg	9.32E-06	mg/m^3	R	2.0E-08	mg/kg-day	NA	--	--
	(Total)										1.5E-08
										Total Risk Across All Exposure Routes/Pathways	1.5E-08

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.

See Appendix J for risk calculation spreadsheets

TABLE 8.5.3 CT
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Chromium	0.0314	mg/L	0.0314	mg/L	M	3.8E-05	mg/kg-day	NA	--	--
	Lead	0.0219	mg/L	0.0219	mg/L	M	2.7E-05	mg/kg-day	NA	--	--
	(Total)										--
Dermal	Chromium	0.0314	mg/L	0.0314	mg/L	M	6.8E-08	mg/kg-day	NA	--	--
	Lead	0.0219	mg/L	0.0219	mg/L	M	6.4E-09	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/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.

See Appendix J for risk calculation spreadsheets

TABLE 8.6.1 RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	3.33	mg/kg	M	2.2E-07	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	3.4E-07
	Chromium	17.7	mg/kg	17.7	mg/kg	M	1.2E-06	mg/kg-day	NA	--	--
	Lead	1,087	mg/kg	1,087	mg/kg	M	7.3E-05	mg/kg-day	NA	--	--
	(Total)										3.4E-07
Dermal	Arsenic	3.33	mg/kg	3.33	mg/kg	M	9.2E-09	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	1.4E-08
	Chromium	17.7	mg/kg	17.7	mg/kg	M	1.6E-09	mg/kg-day	NA	--	--
	Lead	1,087	mg/kg	1,087	mg/kg	M	1.0E-07	mg/kg-day	NA	--	--
	(Total)										1.4E-08
										Total Risk Across All Exposure Routes/Pathways	3.5E-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.

See Appendix J for risk calculation spreadsheets

TABLE 8.6.1a RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	2.52E-09	mg/m^3	R	5.0E-09	mg/kg-day	1.5E+01	$(mg/kg\text{-}day)^{-1}$	7.5E-08
	Chromium	17.7	mg/kg	1.34E-08	mg/m^3	R	2.7E-08	mg/kg-day	2.9E+02	$(mg/kg\text{-}day)^{-1}$	7.8E-06
	Lead	1,087	mg/kg	8.24E-07	mg/m^3	R	1.6E-06	mg/kg-day	NA	--	--
	(Total)										7.9E-06
										Total Risk Across All Exposure Routes/Pathways	7.9E-06

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.

See Appendix J for risk calculation spreadsheets

TABLE 8.6.2 RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	4,4'-DDT	27	mg/kg	27	mg/kg	M	1.8E-06	mg/kg-day	3.4E-01	(mg/kg-day) $^{-1}$	6.2E-07
	Arsenic	9.31	mg/kg	9.31	mg/kg	M	6.2E-07	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	9.4E-07
	Chromium	32.2	mg/kg	32.2	mg/kg	M	2.2E-06	mg/kg-day	NA	--	--
	Lead	12,300	mg/kg	12,300	mg/kg	M	8.3E-04	mg/kg-day	NA	--	--
	(Total)										1.6E-06
Dermal	4,4'-DDT	27	mg/kg	27	mg/kg	M	7.5E-08	mg/kg-day	3.4E-01	(mg/kg-day) $^{-1}$	2.5E-08
	Arsenic	9.31	mg/kg	9.31	mg/kg	M	2.6E-08	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	3.9E-08
	Chromium	32.2	mg/kg	32.2	mg/kg	M	3.0E-09	mg/kg-day	NA	--	--
	Lead	12,300	mg/kg	12,300	mg/kg	M	1.1E-06	mg/kg-day	NA	--	--
	(Total)										6.4E-08
										Total Risk Across All Exposure Routes/Pathways	1.6E-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.

See Appendix J for risk calculation spreadsheets

TABLE 8.6.2a RME
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	4,4'-DDT	27	mg/kg	2.05E-08	mg/m^3	R	4.1E-08	mg/kg-day	3.4E-01	$(mg/kg\text{-}day)^{-1}$	1.4E-08
	Arsenic	9.31	mg/kg	7.05E-09	mg/m^3	R	1.4E-08	mg/kg-day	1.5E+01	$(mg/kg\text{-}day)^{-1}$	2.1E-07
	Chromium	32.2	mg/kg	2.44E-08	mg/m^3	R	4.8E-08	mg/kg-day	2.9E+02	$(mg/kg\text{-}day)^{-1}$	1.4E-05
	Lead	12,300	mg/kg	9.32E-06	mg/m^3	R	1.8E-05	mg/kg-day	NA	--	--
	(Total)										1.4E-05
										Total Risk Across All Exposure Routes/Pathways	1.4E-05

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.

See Appendix J for risk calculation spreadsheets

TABLE 8.6.1 CT
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	3.33	mg/kg	M	9.8E-08	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	1.5E-07
	Chromium	17.7	mg/kg	17.7	mg/kg	M	5.2E-07	mg/kg-day	NA	--	--
	Lead	1,087	mg/kg	1,087	mg/kg	M	3.2E-05	mg/kg-day	NA	--	--
	(Total)										1.5E-07
Dermal	Arsenic	3.33	mg/kg	3.33	mg/kg	M	8.1E-10	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	1.2E-09
	Chromium	17.7	mg/kg	17.7	mg/kg	M	1.4E-10	mg/kg-day	NA	--	--
	Lead	1,087	mg/kg	1,087	mg/kg	M	8.8E-09	mg/kg-day	NA	--	--
	(Total)										1.2E-09
										Total Risk Across All Exposure Routes/Pathways	1.5E-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.

See Appendix J for risk calculation spreadsheets

TABLE 8.6.1a CT
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.33	mg/kg	2.52E-09	mg/m^3	R	1.7E-09	mg/kg-day	1.5E+01	$(mg/kg\text{-}day)^{-1}$	2.6E-08
	Chromium	17.7	mg/kg	1.34E-08	mg/m^3	R	9.2E-09	mg/kg-day	2.9E+02	$(mg/kg\text{-}day)^{-1}$	2.7E-06
	Lead	1,087	mg/kg	8.24E-07	mg/m^3	R	5.6E-07	mg/kg-day	NA	--	--
	(Total)										2.7E-06
										Total Risk Across All Exposure Routes/Pathways	2.7E-06

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.

See Appendix J for risk calculation spreadsheets

TABLE 8.6.2 CT
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	4,4'-DDT	27	mg/kg	27	mg/kg	M	7.9E-07	mg/kg-day	3.4E-01	(mg/kg-day) $^{-1}$	2.7E-07
	Arsenic	9.31	mg/kg	9.31	mg/kg	M	2.7E-07	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	4.1E-07
	Chromium	32.2	mg/kg	32.2	mg/kg	M	9.5E-07	mg/kg-day	NA	--	--
	Lead	12,300	mg/kg	12,300	mg/kg	M	3.6E-04	mg/kg-day	NA	--	--
	(Total)										6.8E-07
Dermal	4,4'-DDT	27	mg/kg	27	mg/kg	M	6.5E-09	mg/kg-day	3.4E-01	(mg/kg-day) $^{-1}$	2.2E-09
	Arsenic	9.31	mg/kg	9.31	mg/kg	M	2.3E-09	mg/kg-day	1.5E+00	(mg/kg-day) $^{-1}$	3.4E-09
	Chromium	32.2	mg/kg	32.2	mg/kg	M	2.6E-10	mg/kg-day	NA	--	--
	Lead	12,300	mg/kg	12,300	mg/kg	M	9.9E-08	mg/kg-day	NA	--	--
	(Total)										5.6E-09
										Total Risk Across All Exposure Routes/Pathways	6.9E-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.

See Appendix J for risk calculation spreadsheets

TABLE 8.6.2a CT
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	4,4'-DDT	27	mg/kg	2.05E-08	mg/m^3	R	1.4E-08	mg/kg-day	3.4E-01	$(mg/kg\text{-}day)^{-1}$	4.8E-09
	Arsenic	9.31	mg/kg	7.05E-09	mg/m^3	R	4.8E-09	mg/kg-day	1.5E+01	$(mg/kg\text{-}day)^{-1}$	7.3E-08
	Chromium	32.2	mg/kg	2.44E-08	mg/m^3	R	1.7E-08	mg/kg-day	2.9E+02	$(mg/kg\text{-}day)^{-1}$	4.9E-06
	Lead	12,300	mg/kg	9.32E-06	mg/m^3	R	6.4E-06	mg/kg-day	NA	--	--
	(Total)										5.0E-06
										Total Risk Across All Exposure Routes/Pathways	5.0E-06

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.

See Appendix J for risk calculation spreadsheets

TABLE 9.1.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Receptor Population: Trespassers
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	Arsenic	3.5E-07	2.2E-11	4.2E-08	3.9E-07	Arsenic	(o) Skin / CVS	2.3E-03	--	2.7E-04	2.5E-03
			Chromium	--	2.3E-09	--	2.3E-09	Chromium	(o) NOEL, (i) RsS	1.2E-03	1.0E-05	1.9E-04	1.4E-03
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	3.5E-07	2.3E-09	4.2E-08	3.9E-07	(Total)		3.5E-03	1.0E-05	4.6E-04	3.9E-03

Total Risk Across Surface Soil: 3.9E-07
Total Risk Across All Media and All Exposure Routes: 3.9E-07

Total Hazard Index Across Surface Soil: 0.00394
tal Hazard Index Across All Media and All Exposure Routes: 0.00394

Inhalation Exposure Routes:
Inhalation Respiratory System HI = 1.03E-05

Oral and Dermal Exposure Routes:
Oral / Dermal Cardiovascular System HI = 0.00253
Oral / Dermal Skin HI = 0.00253

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

(o) Oral exposure
(i) Inhalation exposure

TABLE 9.2.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA

Scenario Timeframe: Current
Receptor Population: Trespassers
Receptor Age: Adolescent

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	Arsenic	2.3E-07	4.0E-11	7.2E-08	3.0E-07	Arsenic	(o) Skin / CVS	3.5E-03	--	1.1E-03	4.6E-03
			Chromium	--	4.2E-09	--	4.2E-09	Chromium	(o) NOEL, (i) RsS	1.9E-03	4.5E-05	7.9E-04	2.7E-03
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	2.3E-07	4.2E-09	7.2E-08	3.0E-07	(Total)		5.4E-03	4.5E-05	1.9E-03	7.3E-03

Total Risk Across Surface Soil: 3.0E-07
Total Risk Across All Media and All Exposure Routes: 3.0E-07

Total Hazard Index Across Surface Soil: 0.00734
tal Hazard Index Across All Media and All Exposure Routes: 0.00734

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

(o) Oral exposure
(i) Inhalation exposure

Inhalation Exposure Routes:
Inhalation Respiratory System HI = 4.50E-05

Oral and Dermal Exposure Routes:
Oral / Dermal Cardiovascular System HI = 0.00463
Oral / Dermal Skin HI = 0.00463

TABLE 9.3.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	2.8E-07	9.3E-11	5.5E-08	3.3E-07	Arsenic	(o) Skin / CVS	1.1E-02	--	2.2E-03	1.3E-02
			Chromium	--	9.7E-09	--	9.7E-09	Chromium	(o) NOEL, (i) RsS	5.8E-03	2.6E-04	1.5E-03	7.6E-03
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	2.8E-07	9.8E-09	5.5E-08	3.4E-07	(Total)		1.7E-02	2.6E-04	3.7E-03	2.1E-02

Total Risk Across Surface Soil: 3.4E-07
Total Risk Across All Media and All Exposure Routes: 3.4E-07

Total Hazard Index Across Surface Soil: 0.02
Total Hazard Index Across All Media and All Exposure Routes: 0.02

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

(o) Oral exposure
(i) Inhalation exposure

Inhalation Exposure Routes:
Inhalation Respiratory System HI = 2.63E-04

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

TABLE 9.4.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	2.3E-06	1.5E-10	2.8E-07	2.6E-06	Arsenic	(o) Skin / CVS	1.5E-02	--	1.8E-03	1.7E-02
			Chromium	--	1.5E-08	--	1.5E-08	Chromium	(o) NOEL, (i) RsS	8.1E-03	6.9E-05	1.3E-03	9.5E-03
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	2.3E-06	1.5E-08	2.8E-07	2.6E-06	(Total)		2.3E-02	6.9E-05	3.1E-03	2.6E-02
Subsurface Soil	Subsurface Soil	Subsurface Soil	4,4'-DDE	7.0E-07	4.4E-12	2.8E-08	7.3E-07	4,4'-DDE	NA	--	--	--	--
			4,4'-DDT	4.3E-06	2.7E-11	5.2E-07	4.8E-06	4,4'-DDT	(o) Liver	7.4E-02	4.6E-07	8.9E-03	8.3E-02
			Arsenic	6.6E-06	4.1E-10	7.9E-07	7.3E-06	Arsenic	(o) Skin / CVS	4.3E-02	--	5.1E-03	4.8E-02
			Barium	--	--	--	--	Barium	(o) NOEL, (i) Fetus	2.1E-02	6.3E-05	1.2E-03	2.2E-02
			Cadmium	--	1.6E-10	--	1.6E-10	Cadmium	Kidney	2.3E-02	--	1.8E-03	2.5E-02
			Chromium	--	2.8E-08	--	2.8E-08	Chromium	(o) NOEL, (i) RsS	1.5E-02	1.3E-04	2.3E-03	1.7E-02
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	1.2E-05	2.8E-08	1.3E-06	1.3E-05	(Total)		1.7E-01	1.9E-04	1.9E-02	1.9E-01
Groundwater	Groundwater	Tap	Chromium	--	--	--	--	Chromium	(o) NOEL, (i) RsS	2.9E-01	--	4.9E-02	3.4E-01
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	--	--	--	--	(Total)		2.9E-01	--	4.9E-02	3.4E-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	2.6E-06
Total Risk Across Subsurface Soil	1.3E-05
Total Risk Across Groundwater	--
Total Risk Across All Media and All Exposure Routes	1.6E-05

Total Hazard Index Across Surface Soil	0.03
Total Hazard Index Across Subsurface Soil	0.19
Total Hazard Index Across Groundwater	0.34
Total Hazard Index Across All Media and All Exposure Routes	0.56

All Exposure Routes:

Total Kidney HI =	0.02

Inhalation Exposure Routes:

Inhalation Respiratory System HI =	1.94E-04
Inhalation Fetus HI =	6.32E-05

Oral and Dermal Exposure Routes:

Oral / Dermal Cardiovascular System HI =	0.06
Oral / Dermal Skin HI =	0.06
Oral / Dermal Liver HI =	0.08

TABLE 9.4.CT
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	2.3E-07	2.9E-11	7.8E-09	2.4E-07	Arsenic	(o) Skin / CVS	5.1E-03	--	1.7E-04	5.3E-03
			Chromium	--	3.0E-09	--	3.0E-09	Chromium	(o) NOEL, (i) RsS	2.7E-03	4.6E-05	1.2E-04	2.9E-03
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	2.3E-07	3.0E-09	7.8E-09	2.4E-07	(Total)		7.8E-03	4.6E-05	3.0E-04	8.1E-03
Subsurface Soil	Subsurface Soil	Subsurface Soil	4,4'-DDE	6.9E-08	8.6E-13	7.8E-10	6.9E-08	4,4'-DDE	NA	--	--	--	--
			4,4'-DDT	4.2E-07	5.2E-12	1.4E-08	4.3E-07	4,4'-DDT	(o) Liver	2.5E-02	3.1E-07	8.5E-04	2.6E-02
			Arsenic	6.4E-07	8.0E-11	2.2E-08	6.6E-07	Arsenic	(o) Skin / CVS	1.4E-02	--	4.9E-04	1.5E-02
			Barium	--	--	--	--	Barium	(o) NOEL, (i) Fetus	6.9E-03	4.2E-05	1.1E-04	7.1E-03
			Cadmium	--	3.0E-11	--	3.0E-11	Cadmium	Kidney	7.7E-03	--	1.8E-04	7.9E-03
			Chromium	--	5.4E-09	--	5.4E-09	Chromium	(o) NOEL, (i) RsS	4.9E-03	8.4E-05	2.2E-04	5.2E-03
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	1.1E-06	5.5E-09	3.7E-08	1.2E-06	(Total)		5.8E-02	1.3E-04	1.8E-03	6.0E-02
Groundwater	Groundwater	Tap	Chromium	--	--	--	--	Chromium	(o) NOEL, (i) RsS	1.3E-01	--	1.4E-02	1.5E-01
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	--	--	--	--	(Total)		1.3E-01	--	1.4E-02	1.5E-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	2.4E-07
Total Risk Across Subsurface Soil	1.2E-06
Total Risk Across Groundwater	--
Total Risk Across All Media and All Exposure Routes	1.4E-06

Total Hazard Index Across Surface Soil	0.01
Total Hazard Index Across Subsurface Soil	0.06
Total Hazard Index Across Groundwater	0.15
Total Hazard Index Across All Media and All Exposure Routes	0.2167

All Exposure Routes:
Total Kidney HI = 0.01

Inhalation Exposure Routes:
Inhalation Respiratory System HI = 1.30E-04
Inhalation Fetus HI = 4.23E-05

Oral and Dermal Exposure Routes:
Oral / Dermal Cardiovascular System HI = 0.02
Oral / Dermal Skin HI = 0.02
Oral / Dermal Liver HI = 0.03

TABLE 9.5.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	5.5E-06	3.6E-10	4.6E-07	5.9E-06	Arsenic	(o) Skin / CVS	1.4E-01	--	1.2E-02	1.5E-01
			Chromium	--	3.7E-08	--	3.7E-08	Chromium	(o) NOEL, (i) RsS	7.6E-02	6.7E-04	8.5E-03	8.5E-02
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	5.5E-06	3.7E-08	4.6E-07	6.0E-06	(Total)		2.2E-01	6.7E-04	2.0E-02	2.4E-01
Subsurface Soil	Subsurface Soil	Subsurface Soil	4,4'-DDE	1.6E-06	1.1E-11	4.6E-08	1.7E-06	4,4'-DDE	NA	--	--	--	--
			4,4'-DDT	1.0E-05	6.5E-11	8.5E-07	1.1E-05	4,4'-DDT	(o) Liver	6.9E-01	4.5E-06	5.8E-02	7.5E-01
			Arsenic	1.5E-05	1.0E-09	1.3E-06	1.7E-05	Arsenic	(o) Skin / CVS	4.0E-01	--	3.3E-02	4.3E-01
			Barium	--	--	--	--	Barium	(o) NOEL, (i) Fetus	1.9E-01	6.1E-04	7.7E-03	2.0E-01
			Cadmium	--	3.8E-10	--	3.8E-10	Cadmium	Kidney	2.1E-01	--	1.2E-02	2.3E-01
			Chromium	--	6.7E-08	--	6.7E-08	Chromium	(o) NOEL, (i) RsS	1.4E-01	1.2E-03	1.5E-02	1.5E-01
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	2.7E-05	6.9E-08	2.2E-06	2.9E-05	(Total)		1.6E+00	1.8E-03	1.3E-01	**1.8E+00**
Groundwater	Groundwater	Tap	Chromium	--	--	--	--	Chromium	(o) NOEL, (i) RsS	6.7E-01	--	1.4E-01	8.1E-01
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	--	--	--	--	(Total)		6.7E-01	--	1.4E-01	8.1E-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	6.0E-06
Total Risk Across Subsurface Soil	2.9E-05
Total Risk Across Groundwater	--
Total Risk Across All Media and All Exposure Routes	3.5E-05

Total Hazard Index Across Surface Soil	0.24
Total Hazard Index Across Subsurface Soil	1.76
Total Hazard Index Across Groundwater	0.81
Total Hazard Index Across All Media and All Exposure Routes	2.81

All Exposure Routes:
Total Kidney HI = 0.23

Inhalation Exposure Routes:
Inhalation Respiratory System HI = 1.89E-03
Inhalation Fetus HI = 6.14E-04

Oral and Dermal Exposure Routes:
Oral / Dermal Cardiovascular System HI = 0.58
Oral / Dermal Skin HI = 0.58
Oral / Dermal Liver HI = 0.75

TABLE 9.5.CT
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	6.1E-07	8.0E-11	2.1E-08	6.3E-07	Arsenic	(o) Skin / CVS	4.7E-02	--	1.6E-03	4.9E-02
			Chromium	--	8.3E-09	--	8.3E-09	Chromium	(o) NOEL, (i) RsS	2.5E-02	4.5E-04	1.1E-03	2.7E-02
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	6.1E-07	8.4E-09	2.1E-08	6.4E-07	(Total)		7.3E-02	4.5E-04	2.7E-03	7.6E-02
Subsurface Soil	Subsurface Soil	Subsurface Soil	4,4'-DDE	1.8E-07	2.4E-12	2.0E-09	1.8E-07	4,4'-DDE	NA	--	--	--	--
			4,4'-DDT	1.1E-06	1.5E-11	3.8E-08	1.2E-06	4,4'-DDT	(o) Liver	2.3E-01	3.0E-06	7.8E-03	2.4E-01
			Arsenic	1.7E-06	2.2E-10	5.7E-08	1.8E-06	Arsenic	(o) Skin / CVS	1.3E-01	--	4.5E-03	1.4E-01
			Barium	--	--	--	--	Barium	(o) NOEL, (i) Fetus	6.4E-02	4.1E-04	1.0E-03	6.6E-02
			Cadmium	--	8.4E-11	--	8.4E-11	Cadmium	Kidney	7.2E-02	--	1.6E-03	7.3E-02
			Chromium	--	1.5E-08	--	1.5E-08	Chromium	(o) NOEL, (i) RsS	4.6E-02	8.1E-04	2.1E-03	4.9E-02
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	3.0E-06	1.5E-08	9.7E-08	3.1E-06	(Total)		5.5E-01	1.2E-03	1.7E-02	5.6E-01
Groundwater	Groundwater	Tap	Chromium	--	--	--	--	Chromium	(o) NOEL, (i) RsS	4.5E-01	--	3.2E-02	4.8E-01
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	--	--	--	--	(Total)		4.5E-01	--	3.2E-02	4.8E-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	6.4E-07
Total Risk Across Subsurface Soil	3.1E-06
Total Risk Across Groundwater	--
Total Risk Across All Media and All Exposure Routes	3.8E-06

Total Hazard Index Across Surface Soil	0.08
Total Hazard Index Across Subsurface Soil	0.56
Total Hazard Index Across Groundwater	0.48
Total Hazard Index Across All Media and All Exposure Routes	1.12

All Exposure Routes:
Total Kidney HI = 0.07

Inhalation Exposure Routes:
Inhalation Respiratory System HI = 1.26E-03
Inhalation Fetus HI = 4.10E-04

Oral and Dermal Exposure Routes:
Oral / Dermal Cardiovascular System HI = 0.19
Oral / Dermal Skin HI = 0.19
Oral / Dermal Liver HI = 0.24

TABLE 9.6.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	3.4E-07	7.5E-08	1.4E-08	4.2E-07	Arsenic	(o) Skin / CVS	5.2E-02	--	2.2E-03	5.4E-02
			Chromium	--	7.8E-06	--	7.8E-06	Chromium	(o) NOEL, (i) RsS	2.8E-02	8.5E-01	1.5E-03	8.8E-01
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	3.4E-07	7.9E-06	1.4E-08	8.3E-06	(Total)		8.0E-02	8.5E-01	3.7E-03	9.3E-01
Subsurface Soil	Subsurface Soil	Subsurface Soil	4,4'-DDT	6.2E-07	1.4E-08	2.5E-08	6.6E-07	4,4'-DDT	(o) Liver	2.5E-01	5.7E-03	1.0E-02	2.7E-01
			Arsenic	9.4E-07	2.1E-07	3.9E-08	1.2E-06	Arsenic	(o) Skin / CVS	1.5E-01	--	6.0E-03	1.5E-01
			Chromium	--	1.4E-05	--	1.4E-05	Chromium	(o) NOEL, (i) RsS	5.0E-02	1.5E+00	2.8E-03	**1.6E+00**
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	1.6E-06	1.4E-05	6.4E-08	1.6E-05	(Total)		4.5E-01	1.5E+00	1.9E-02	**2.0E+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	8.3E-06
Total Risk Across Subsurface Soil	1.6E-05
Total Risk Across All Media and All Exposure Routes	2.4E-05

Inhalation Exposure Routes:

Inhalation Respiratory System HI =	2.39

Total Hazard Index Across Surface Soil	0.93
Total Hazard Index Across Subsurface Soil	2.01
tal Hazard Index Across All Media and All Exposure Routes	2.95

Oral and Dermal Exposure Routes:

Oral / Dermal Cardiovascular System HI =	0.21
Oral / Dermal Skin HI =	0.21
Oral / Dermal Liver HI =	0.26

TABLE 9.6.CT
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Arsenic	1.5E-07	2.6E-08	1.2E-09	1.7E-07	Arsenic	(o) Skin / CVS	2.3E-02	--	1.9E-04	2.3E-02
			Chromium	--	2.7E-06	--	2.7E-06	Chromium	(o) NOEL, (i) RsS	1.2E-02	2.9E-01	1.3E-04	3.0E-01
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	1.5E-07	2.7E-06	1.2E-09	2.9E-06	(Total)		3.5E-02	2.9E-01	3.2E-04	3.3E-01
Subsurface Soil	Subsurface Soil	Subsurface Soil	4,4'-DDT	2.7E-07	4.8E-09	2.2E-09	2.8E-07	4,4'-DDT	(o) Liver	1.1E-01	2.0E-03	9.2E-04	1.1E-01
			Arsenic	4.1E-07	7.3E-08	3.4E-09	4.9E-07	Arsenic	(o) Skin / CVS	6.4E-02	--	5.3E-04	6.4E-02
			Chromium	--	4.9E-06	--	4.9E-06	Chromium	(o) NOEL, (i) RsS	2.2E-02	5.3E-01	2.4E-04	5.5E-01
			Lead	--	--	--	--	Lead	NA	--	--	--	--
			(Total)	6.8E-07	5.0E-06	5.6E-09	5.7E-06	(Total)		2.0E-01	5.3E-01	1.7E-03	7.3E-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	2.9E-06
Total Risk Across Subsurface Soil	5.7E-06
Total Risk Across All Media and All Exposure Routes	8.5E-06

Total Hazard Index Across Surface Soil	0.33
Total Hazard Index Across Subsurface Soil	0.73
tal Hazard Index Across All Media and All Exposure Routes	1.06

Inhalation Exposure Routes:

Inhalation Respiratory System HI =	0.82

Oral and Dermal Exposure Routes:

Oral / Dermal Cardiovascular System HI =	0.09
Oral / Dermal Skin HI =	0.09
Oral / Dermal Liver HI =	0.11

TABLE 10.1.RME
RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Chromium	--	1.5E-08	--	1.5E-08	Chromium	(o) NOEL, (i) RsS	8.1E-03	6.9E-05	1.3E-03	9.5E-03
			(Total)	--	1.5E-08	--	1.5E-08	(Total)		8.1E-03	6.9E-05	1.3E-03	9.5E-03
Subsurface Soil	Subsurface Soil	Subsurface Soil						Barium	(o) NOEL, (i) Fetus	2.1E-02	6.3E-05	1.2E-03	2.2E-02
			Chromium	--	2.8E-08	--	2.8E-08	Chromium	(o) NOEL, (i) RsS	1.5E-02	1.3E-04	2.3E-03	1.7E-02
			(Total)	--	2.8E-08	--	2.8E-08	(Total)		3.5E-02	1.9E-04	3.5E-03	3.9E-02
Groundwater	Groundwater	Tap						Chromium	(o) NOEL, (i) RsS	2.9E-01	--	4.9E-02	3.4E-01
			(Total)	--	--	--	--	(Total)		2.9E-01	--	4.9E-02	3.4E-01

Total Risk Across Surface Soil	1.5E-08
Total Risk Across Subsurface Soil	2.8E-08
Total Risk Across Groundwater	--
Total Risk Across All Media and All Exposure Routes	4.3E-08

Total Hazard Index Across Surface Soil	0.01
Total Hazard Index Across Subsurface Soil	0.04
Total Hazard Index Across Groundwater	0.34
Total Hazard Index Across All Media and All Exposure Routes	0.38

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

(o) Oral exposure
(i) Inhalation exposure

Inhalation Exposure Routes:

Inhalation Respiratory System HI =	1.94E-04
Inhalation Fetus HI =	6.32E-05

TABLE 10.1.CT
RISK ASSESSMENT SUMMARY
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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	Chromium	--	3.0E-09	--	3.0E-09	Chromium	(o) NOEL, (i) RsS	2.7E-03	4.6E-05	1.2E-04	2.9E-03
			(Total)	--	3.0E-09	--	3.0E-09	(Total)		2.7E-03	4.6E-05	1.2E-04	2.9E-03
Subsurface Soil	Subsurface Soil	Subsurface Soil						Barium	(o) NOEL, (i) Fetus	6.9E-03	4.2E-05	1.1E-04	7.1E-03
			Chromium	--	5.4E-09	--	5.4E-09	Chromium	(o) NOEL, (i) RsS	4.9E-03	8.4E-05	2.2E-04	5.2E-03
			(Total)	--	5.4E-09	--	5.4E-09	(Total)		1.2E-02	1.3E-04	3.4E-04	1.2E-02
Groundwater	Groundwater	Tap						Chromium	(o) NOEL, (i) RsS	1.3E-01	--	1.4E-02	1.5E-01
			(Total)	--	--	--	--	(Total)		1.3E-01	--	1.4E-02	1.5E-01

Total Risk Across Surface Soil	3.0E-09
Total Risk Across Subsurface Soil	5.4E-09
Total Risk Across Groundwater	--
Total Risk Across All Media and All Exposure Routes	8.4E-09

Total Hazard Index Across Surface Soil	0.00
Total Hazard Index Across Subsurface Soil	0.01
Total Hazard Index Across Groundwater	0.15
Total Hazard Index Across All Media and All Exposure Routes	0.16

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

(o) Oral exposure
(i) Inhalation exposure

Inhalation Exposure Routes:

Inhalation Respiratory System HI =	1.30E-04
Inhalation Fetus HI =	4.23E-05

TABLE 10.2.RME
RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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						Arsenic	(o) Skin / CVS	1.4E-01	--	1.2E-02	1.5E-01
			Chromium	--	3.7E-08	--	3.7E-08	Chromium	(o) NOEL, (i) RsS	7.6E-02	6.7E-04	8.5E-03	8.5E-02
			(Total)	--	3.7E-08	--	3.7E-08	(Total)		2.2E-01	6.7E-04	2.0E-02	2.4E-01
Subsurface Soil	Subsurface Soil	Subsurface Soil											
			4,4'-DDT	1.0E-05	6.5E-11	8.5E-07	1.1E-05	4,4'-DDT	(o) Liver	6.9E-01	4.5E-06	5.8E-02	7.5E-01
			Arsenic	1.5E-05	1.0E-09	1.3E-06	1.7E-05	Arsenic	(o) Skin / CVS	4.0E-01	--	3.3E-02	4.3E-01
								Barium	(o) NOEL, (i) Fetus	1.9E-01	6.1E-04	7.7E-03	2.0E-01
								Cadmium	Kidney	2.1E-01	--	1.2E-02	2.3E-01
			Chromium	--	6.7E-08	--	6.7E-08	Chromium	(o) NOEL, (i) RsS	1.4E-01	1.2E-03	1.5E-02	1.5E-01
			(Total)	2.5E-05	6.8E-08	2.1E-06	2.8E-05	(Total)		1.6E+00	1.8E-03	1.3E-01	**1.8E+00**
Groundwater	Groundwater	Tap											
								Chromium	(o) NOEL, (i) RsS	6.7E-01	--	1.4E-01	8.1E-01
			(Total)	--	--	--	--	(Total)		6.7E-01	--	1.4E-01	8.1E-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	3.7E-08
Total Risk Across Subsurface Soil	2.8E-05
Total Risk Across All Media and All Exposure Routes	2.8E-05

Total Hazard Index Across Surface Soil	0.24
Total Hazard Index Across Subsurface Soil	1.76
Total Hazard Index Across Groundwater	0.81
Total Hazard Index Across All Media and All Exposure Routes	2.81

All Exposure Routes:

Total Kidney HI =	0.23

Inhalation Exposure Routes:

Inhalation Respiratory System HI =	1.89E-03
Inhalation Fetus HI =	6.14E-04

Oral and Dermal Exposure Routes:

Oral / Dermal Cardiovascular System HI =	0.58
Oral / Dermal Skin HI =	0.58
Oral / Dermal Liver HI =	0.75

TABLE 10.2.CT
RISK ASSESSMENT SUMMARY
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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						Arsenic	(o) Skin / CVS	4.7E-02	--	1.6E-03	4.9E-02
			Chromium	--	8.3E-09	--	8.3E-09	Chromium	(o) NOEL, (i) RsS	2.5E-02	4.5E-04	1.1E-03	2.7E-02
			(Total)	--	8.3E-09	--	8.3E-09	(Total)		7.3E-02	4.5E-04	2.7E-03	7.6E-02
Subsurface Soil	Subsurface Soil	Subsurface Soil											
			4,4'-DDT	1.1E-06	1.5E-11	3.8E-08	1.2E-06	4,4'-DDT	(o) Liver	2.3E-01	3.0E-06	7.8E-03	2.4E-01
			Arsenic	1.7E-06	2.2E-10	5.7E-08	1.8E-06	Arsenic	(o) Skin / CVS	1.3E-01	--	4.5E-03	1.4E-01
								Barium	(o) NOEL, (i) Fetus	6.4E-02	4.1E-04	1.0E-03	6.6E-02
								Cadmium	Kidney	7.2E-02	--	1.6E-03	7.3E-02
			Chromium	--	1.5E-08	--	1.5E-08	Chromium	(o) NOEL, (i) RsS	4.6E-02	8.1E-04	2.1E-03	4.9E-02
			(Total)	2.8E-06	1.5E-08	9.5E-08	2.9E-06	(Total)		5.5E-01	1.2E-03	1.7E-02	5.6E-01
Groundwater	Groundwater	Tap											
								Chromium	(o) NOEL, (i) RsS	4.5E-01	--	3.2E-02	4.8E-01
			(Total)	--	--	--	--	(Total)		4.5E-01	--	3.2E-02	4.8E-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	8.3E-09
Total Risk Across Subsurface Soil	2.9E-06
Total Risk Across All Media and All Exposure Routes	2.9E-06

Total Hazard Index Across Surface Soil	0.08
Total Hazard Index Across Subsurface Soil	0.56
Total Hazard Index Across Groundwater	0.48
Total Hazard Index Across All Media and All Exposure Routes	1.12

All Exposure Routes:

Total Kidney HI =	0.07

Inhalation Exposure Routes:

Inhalation Respiratory System HI =	1.26E-03
Inhalation Fetus HI =	4.10E-04

Oral and Dermal Exposure Routes:

Oral / Dermal Cardiovascular System HI =	0.19
Oral / Dermal Skin HI =	0.19
Oral / Dermal Liver HI =	0.24

TABLE 10.3.RME
RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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						Chromium	(o) NOEL, (i) RsS	2.8E-02	8.5E-01	1.5E-03	8.8E-01
								(Total)		2.8E-02	8.5E-01	1.5E-03	8.8E-01
Subsurface Soil	Subsurface Soil	Subsurface Soil						4,4'-DDT	(o) Liver	2.5E-01	5.7E-03	1.0E-02	2.7E-01
								Arsenic	(o) Skin / CVS	1.5E-01	--	6.0E-03	1.5E-01
								Chromium	(o) NOEL, (i) RsS	5.0E-02	1.5E+00	2.8E-03	**1.6E+00**
								(Total)		4.5E-01	1.5E+00	1.9E-02	**2.0E+00**

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

(o) Oral exposure
(i) Inhalation exposure

Total Hazard Index Across Surface Soil	0.88
Total Hazard Index Across Subsurface Soil	2.01
tal Hazard Index Across All Media and All Exposure Routes	2.89

Inhalation Exposure Routes:
Inhalation Respiratory System HI = 2.39

Oral and Dermal Exposure Routes:

Oral / Dermal Cardiovascular System HI =	0.15
Oral / Dermal Skin HI =	0.15
Oral / Dermal Liver HI =	0.26

TABLE 10.3.CT
RISK ASSESSMENT SUMMARY
CENTRAL TENDENCY
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041)
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						Chromium	(o) NOEL, (i) RsS	1.2E-02	2.9E-01	1.3E-04	3.0E-01
								(Total)		1.2E-02	2.9E-01	1.3E-04	3.0E-01
Subsurface Soil	Subsurface Soil	Subsurface Soil						4,4'-DDT	(o) Liver	1.1E-01	2.0E-03	9.2E-04	1.1E-01
								Arsenic	(o) Skin / CVS	6.4E-02	--	5.3E-04	6.4E-02
								Chromium	(o) NOEL, (i) RsS	2.2E-02	5.3E-01	2.4E-04	5.5E-01
								(Total)		2.0E-01	5.3E-01	1.7E-03	7.3E-01

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

(o) Oral exposure
(i) Inhalation exposure

Inhalation Exposure Routes:
Inhalation Respiratory System HI = 0.82

Total Hazard Index Across Surface Soil 0.30
Total Hazard Index Across Subsurface Soil 0.73
tal Hazard Index Across All Media and All Exposure Routes 1.04

Oral and Dermal Exposure Routes:
Oral / Dermal Cardiovascular System HI = 0.06
Oral / Dermal Skin HI = 0.06
Oral / Dermal Liver HI = 0.11

APPENDIX I

Statistical Summaries

APPENDIX I

SURFACE SOIL STATISTICAL SUMMARY
SWMU 046
RCRA INVESTIGATION - CTO-0041
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
Semivolatiles (ug/kg)							
Bis(2-ethylhexyl) Phthalate (BEHP)	42 J	42 J	SWMU46-IS03-00	1/4	227	1,586	LOGNORMAL
METALS (mg/kg)							
Arsenic	0.59 J	7.7	SWMU46-SB01-00	11/15	2.48	3.33	LOGNORMAL
Barium	8 J	131 J	SWMU46-SB01-00	11/15	35.8	30.3	LOGNORMAL
Cadmium	0.051 J	3.2	SWMU46-SB01-00	7/15	0.833	1.92	LOGNORMAL
Chromium	3.5	60.6	SWMU46-TW04-00	15/15	18.6	17.7	LOGNORMAL
Lead	4.7	1950	SWMU46-TW04-00	15/15	430	1,087	LOGNORMAL
Mercury	0.025 J	0.83	SWMU46-SB01-00	13/15	0.228	0.246	LOGNORMAL
Selenium	0.53 J	0.68	SWMU46-TW06-00	3/15	0.408	0.420	LOGNORMAL
Silver	0.55	3.9	SWMU46-SB01-00	2/15	0.9	1.6	LOGNORMAL

APPENDIX I (Continued)

SUBSURFACE SOIL STATISTICAL SUMMARY
SWMU 046
RCRA INVESTIGATION - CTO-0041
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)							
Benzene	2 J	4.25 J	SWMU46-TT07-01	3/15	5.87	6.30	LOGNORMAL
Toluene	3 J	3.75 J	SWMU46-TT07-01	2/15	5.95	6.14	LOGNORMAL
Trichlorofluoromethane	1 J	9 J	SWMU46-TT02-01	15/15	3.71	3.86	LOGNORMAL
Semivolatiles (ug/kg)							
Anthracene	163 J	163 J	SWMU46-TT01-01	1/19	196	196	LOGNORMAL
Benzo(a)anthracene	450	450	SWMU46-TT01-01	1/19	231	224	LOGNORMAL
Benzo(b)fluoranthene	480	480	SWMU46-TT01-01	1/19	235	228	LOGNORMAL
Benzo(k)fluoranthene	240 J	240 J	SWMU46-TT01-01	1/19	201	201	LOGNORMAL
Bis(2-ethylhexyl) Phthalate (BEHP)	77 J	77 J	SWMU46-IS02-04	1/19	201	209	LOGNORMAL
Chrysene	830	830	SWMU46-TT01-01	1/19	285	257	LOGNORMAL
Fluoranthene	2200	2200	SWMU46-TT01-01	1/19	482	339	LOGNORMAL
Phenanthrene	800	800	SWMU46-TT01-01	1/19	281	255	LOGNORMAL
Pyrene	2400	2400	SWMU46-TT01-01	1/19	511	348	LOGNORMAL
PESTICIDES / PCBs (ug/kg)							
4,4'-DDD	15	2300 D	SWMU46-TT05-02	11/15	713	116,019	LOGNORMAL
4,4'-DDE	3.6 J	4400 D	SWMU46-TT04-01	12/15	1,011	135,091	LOGNORMAL
4,4'-DDT	4.5	27000 D	SWMU46-TT04-01	12/15	5,386	611,145	LOGNORMAL
BHC, alpha-	1.7	1.7	SWMU46-TT01-01	1/15	11.0	9.88	LOGNORMAL
Chlordane, alpha-	1.6 J	400 D	SWMU46-TT05-02	7/15	103	1,483	LOGNORMAL
Chlordane, gamma-	1.7 J	430 D	SWMU46-TT05-02	5/15	114	1,965	LOGNORMAL
Aldrin	2.5 J	2.5 J	SWMU46-TT01-01	1/15	11.0	10.2	LOGNORMAL
Endosulfan I	2.525 JP	9.5 NJ	SWMU46-TT05-02	2/15	11.3	11.5	LOGNORMAL
METALS (mg/kg)							
Arsenic	0.83 J	13.9 J	SWMU46-TT02-02	16/30	4.06	9.31	LOGNORMAL
Barium	0.74 J	1410	SWMU46-TT02-02	27/30	186	1,055	LOGNORMAL
Cadmium	0.06 J	8.4	SWMU46-TT02-02	18/30	2.00	14.1	LOGNORMAL
Chromium	0.69	150	SWMU46-TT02-02	27/30	25.1	32.2	LOGNORMAL
Lead	1	12300	SWMU46-IS02-04	30/30	1,464	52,530	LOGNORMAL
Mercury	0.01 J	0.25	SWMU46-TT04-01	19/30	0.0661	0.0863	LOGNORMAL
Selenium	0.55 J	1.6 J	SWMU46-TT02-02	5/30	0.648	0.636	LOGNORMAL
Silver	0.17 J	20.1	SWMU46-TT02-02	8/30	2.68	2.81	LOGNORMAL

APPENDIX I (Continued)

GROUNDWATER STATISTICAL SUMMARY
SWMU 046
RCRA INVESTIGATION - CTO-0041
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
METALS (ug/L)							
Arsenic	4.2 J	5.7 J	SWMU46-GW06	2/7	4	6	LOGNORMAL
Barium	59.4	152	SWMU46-GW01	7/7	109	116	LOGNORMAL
Chromium	0.83 J	31.4	SWMU46-GW06	6/7	14	122	LOGNORMAL
Lead	2.2 J	21.9	SWMU46-GW06	5/7	11	46	LOGNORMAL

Baker

Baker Environmental, Inc.

APPENDIX J

HHRA Calculation Spreadsheets

ADULT AND ADOLESCENT TRESPASSERS - CURRENT SCENARIO
ACCIDENTAL INGESTION OF SURFACE SOIL - SWMU 046
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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	Adolescent	
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	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	52	52	
ED	years	Exposure duration	24	10	
BW	kg	Body weight	70	45	
AT-C	days	Averaging time, carcinogens	25,550	25,550	
AT-N	days	Averaging time, noncarcinogens	8,760	3,650	

				Adult						Adolescent					
				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	3.33	1.5E+00	3.0E-04	2.3E-07	3.5E-07	100.0%	6.8E-07	2.3E-03	65.3%	1.5E-07	2.3E-07	100.0%	1.1E-06	3.5E-03	65.3%
Chromium	17.7	NA	3.0E-03 (1)	1.2E-06	--	--	3.6E-06	1.2E-03	34.7%	8.0E-07	--	--	5.6E-06	1.9E-03	34.7%
Lead	1,087	NA	NA	7.6E-05	--	--	2.2E-04	--	--	4.9E-05	--	--	3.4E-04	--	--
				Total ILCR:	3.5E-07	100.0%	Total HI:	3.5E-03	100.0%	Total ILCR:	2.3E-07	100.0%	Total HI:	5.4E-03	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT AND ADOLESCENT TRESPASSERS - CURRENT SCENARIO
DERMAL CONTACT WITH SURFACE SOIL - SWMU 046
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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	Adult	Adolescent	
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	5,300	
EF	days/year	Exposure frequency	52	52	
ED	years	Exposure duration	24	10	
BW	kg	Body weight	70	45	
AT-C	days	Averaging time, carcinogens	25,550	25,550	
AT-N	days	Averaging time, noncarcinogens	8,760	3,650	

					Adult						Adolescent					
					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	3.33	0.03	1.5E+00	3.0E-04	2.8E-08	4.2E-08	100.0%	8.1E-08	2.7E-04	58.5%	4.8E-08	7.2E-08	100.0%	3.4E-07	1.1E-03	58.5%
Chromium	17.7	0.001	NA	7.5E-05 (1)	4.9E-09	--	--	1.4E-08	1.9E-04	41.5%	8.5E-09	--	--	6.0E-08	7.9E-04	41.5%
Lead	1,087	0.001	NA	NA	3.0E-07	--	--	8.8E-07	--	--	5.2E-07	--	--	3.6E-06	--	--
					Total ILCR:	4.2E-08	100.0%	Total HI:	4.6E-04	100.0%	Total ILCR:	7.2E-08	100.0%	Total HI:	1.9E-03	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT AND ADOLESCENT TRESPASSERS - CURRENT SCENARIO
INHALATION OF FUGITIVE DUSTS EMANATING FROM SURFACE SOIL - SWMU 046
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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	Adult	Adolescent	
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	0.58	
ET	hours/day	Exposure time	1.5	4.0	
EF	days/year	Exposure frequency	52	52	
ED	years	Exposure duration	24	10	
BW	kg	Body weight	70	45	
AT-C	days	Averaging time, carcinogens	25,550	25,550	
AT-N	days	Averaging time, noncarcinogens	8,760	3,650	

					Adult						Adolescent					
					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	3.33	2.52E-09	1.5E+01	NA	1.5E-12	2.2E-11	1.0%	4.2E-12	--	--	2.7E-12	4.0E-11	1.0%	1.9E-11	--	--
Chromium	17.7	1.34E-08	2.9E+02 (1)	2.2E-06 (1)	7.7E-12	2.3E-09	99.0%	2.3E-11	1.0E-05	100.0%	1.4E-11	4.2E-09	99.0%	9.9E-11	4.5E-05	100.0%
Lead	1,087	8.24E-07	NA	NA	4.7E-10	--	--	1.4E-09	--	--	8.7E-10	--	--	6.1E-09	--	--
					Total ILCR:	2.3E-09	100.0%	Total HI:	1.0E-05	100.0%	Total ILCR:	4.2E-09	100.0%	Total HI:	4.5E-05	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT MILITARY BASE PERSONNEL - CURRENT SCENARIO
ACCIDENTAL INGESTION OF SURFACE SOIL - SWMU 046
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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
Arsenic	3.33	1.5E+00	3.0E-04	1.9E-07	2.8E-07	100.0%	3.3E-06	1.1E-02	65.3%
Chromium	17.7	NA	3.0E-03 (1)	9.9E-07	--	--	1.7E-05	5.8E-03	34.7%
Lead	1,087	NA	NA	6.1E-05	--	--	1.1E-03	--	--
				Total ILCR:	2.8E-07	100.0%	Total HI:	1.7E-02	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT MILITARY BASE PERSONNEL - CURRENT SCENARIO
DERMAL CONTACT WITH SURFACE SOIL - SWMU 046
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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
Arsenic	3.33	0.03	1.5E+00	3.0E-04	3.7E-08	5.5E-08	100.0%	6.5E-07	2.2E-03	58.5%
Chromium	17.7	0.001	NA	7.5E-05 (1)	6.5E-09	--	--	1.1E-07	1.5E-03	41.5%
Lead	1,087	0.001	NA	NA	4.0E-07	--	--	7.0E-06	--	--
					Total ILCR:	5.5E-08	100.0%	Total HI:	3.7E-03	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT MILITARY BASE PERSONNEL - CURRENT SCENARIO
INHALATION OF FUGITIVE DUSTS EMANATING FROM SURFACE SOIL - SWMU 046
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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
Arsenic	3.33	2.52E-09	1.5E+01	NA	6.2E-12	9.3E-11	1.0%	1.1E-10	--	--
Chromium	17.7	1.34E-08	2.9E+02 (1)	2.2E-06 (1)	3.3E-11	9.7E-09	99.0%	5.8E-10	2.6E-04	100.0%
Lead	1,087	8.24E-07	NA	NA	2.0E-09	--	--	3.5E-08	--	--
					Total ILCR:	9.8E-09	100.0%	Total HI:	2.6E-04	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
ACCIDENTAL INGESTION OF SURFACE SOIL - SWMU 046
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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	3.33	1.5E+00	3.0E-04	1.6E-06	2.3E-06	100.0%	4.6E-06	1.5E-02	65.3%	3.7E-06	5.5E-06	100.0%	4.3E-05	1.4E-01	65.3%
Chromium	17.7	NA	3.0E-03 (1)	8.3E-06	--	--	2.4E-05	8.1E-03	34.7%	1.9E-05	--	--	2.3E-04	7.6E-02	34.7%
Lead	1,087	NA	NA	5.1E-04	--	--	1.5E-03	--	--	1.2E-03	--	--	1.4E-02	--	--
				Total ILCR:	2.3E-06	100.0%	Total HI:	2.3E-02	100.0%	Total ILCR:	5.5E-06	100.0%	Total HI:	2.2E-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 SURFACE SOIL - SWMU 046
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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	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	3.33	0.03	1.5E+00	3.0E-04	1.9E-07	2.8E-07	100.0%	5.5E-07	1.8E-03	58.5%	3.1E-07	4.6E-07	100.0%	3.6E-06	1.2E-02	58.5%
Chromium	17.7	0.001	NA	7.5E-05 (1)	3.3E-08	--	--	9.7E-08	1.3E-03	41.5%	5.4E-08	--	--	6.3E-07	8.5E-03	41.5%
Lead	1,087	0.001	NA	NA	2.0E-06	--	--	5.9E-06	--	--	3.3E-06	--	--	3.9E-05	--	--
					Total ILCR:	2.8E-07	100.0%	Total HI:	3.1E-03	100.0%	Total ILCR:	4.6E-07	100.0%	Total HI:	2.0E-02	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
INHALATION OF FUGITIVE DUSTS EMANATING FROM SURFACE SOIL - SWMU 046
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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	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	3.33	2.52E-09	1.5E+01	NA	9.8E-12	1.5E-10	1.0%	2.9E-11	--	--	2.4E-11	3.6E-10	1.0%	2.8E-10	--	--
Chromium	17.7	1.34E-08	2.9E+02 (1)	2.2E-06 (1)	5.2E-11	1.5E-08	99.0%	1.5E-10	6.9E-05	100.0%	1.3E-10	3.7E-08	99.0%	1.5E-09	6.7E-04	100.0%
Lead	1,087	8.24E-07	NA	NA	3.2E-09	--	--	9.3E-09	--	--	7.7E-09	--	--	9.0E-08	--	--
					Total ILCR:	1.5E-08	100.0%	Total HI:	6.9E-05	100.0%	Total ILCR:	3.7E-08	100.0%	Total HI:	6.7E-04	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
ACCIDENTAL INGESTION OF SUBSURFACE SOIL - SWMU 046
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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
4,4'-DDE	4.4	3.4E-01	NA	2.1E-06	7.0E-07	6.1%	6.0E-06	--	--	4.8E-06	1.6E-06	6.1%	5.6E-05	--	--
4,4'-DDT	27	3.4E-01	5.0E-04	1.3E-05	4.3E-06	37.3%	3.7E-05	7.4E-02	42.3%	3.0E-05	1.0E-05	37.3%	3.5E-04	6.9E-01	42.3%
Arsenic	9.31	1.5E+00	3.0E-04	4.4E-06	6.6E-06	56.7%	1.3E-05	4.3E-02	24.3%	1.0E-05	1.5E-05	56.7%	1.2E-04	4.0E-01	24.3%
Barium	1,055	NA	7.0E-02	5.0E-04	--	--	1.4E-03	2.1E-02	11.8%	1.2E-03	--	--	1.3E-02	1.9E-01	11.8%
Cadmium	8.4	NA	5.0E-04	3.9E-06	--	--	1.2E-05	2.3E-02	13.2%	9.2E-06	--	--	1.1E-04	2.1E-01	13.2%
Chromium	32.2	NA	3.0E-03 (1)	1.5E-05	--	--	4.4E-05	1.5E-02	8.4%	3.5E-05	--	--	4.1E-04	1.4E-01	8.4%
Lead	12,300	NA	NA	5.8E-03	--	--	1.7E-02	--	--	1.3E-02	--	--	1.6E-01	--	--
				Total ILCR:	1.2E-05	100.0%	Total HI:	1.7E-01	100.0%	Total ILCR:	2.7E-05	100.0%	Total HI:	1.6E+00	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 SUBSURFACE SOIL - SWMU 046
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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	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
4,4'-DDE	4.4	0.01	3.4E-01	NA	8.2E-08	2.8E-08	2.1%	2.4E-07	--	--	1.4E-07	4.6E-08	2.1%	1.6E-06	--	--
4,4'-DDT	27	0.03	3.4E-01	5.0E-04	1.5E-06	5.2E-07	38.8%	4.4E-06	8.9E-03	45.9%	2.5E-06	8.5E-07	38.8%	2.9E-05	5.8E-02	45.9%
Arsenic	9.31	0.03	1.5E+00	3.0E-04	5.2E-07	7.9E-07	59.1%	1.5E-06	5.1E-03	26.4%	8.6E-07	1.3E-06	59.1%	1.0E-05	3.3E-02	26.4%
Barium	1,055	0.001	NA	4.9E-03	2.0E-06	--	--	5.8E-06	1.2E-03	6.1%	3.2E-06	--	--	3.8E-05	7.7E-03	6.1%
Cadmium	8.4	0.001	NA	2.5E-05	1.6E-08	--	--	4.6E-08	1.8E-03	9.5%	2.6E-08	--	--	3.0E-07	1.2E-02	9.5%
Chromium	32.2	0.001	NA	7.5E-05 (1)	6.0E-08	--	--	1.8E-07	2.3E-03	12.2%	9.9E-08	--	--	1.2E-06	1.5E-02	12.2%
Lead	12,300	0.001	NA	NA	2.3E-05	--	--	6.7E-05	--	--	3.8E-05	--	--	4.4E-04	--	--
					Total ILCR:	1.3E-06	100.0%	Total HI:	1.9E-02	100.0%	Total ILCR:	2.2E-06	100.0%	Total HI:	1.3E-01	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
INHALATION OF FUGITIVE DUSTS EMANATING FROM SUBSURFACE SOIL - SWMU 046
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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	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
4,4'-DDE	4.4	3.33E-09	3.4E-01	NA	1.3E-11	4.4E-12	0.0%	3.8E-11	--	--	3.1E-11	1.1E-11	0.0%	3.7E-10	--	--
4,4'-DDT	27	2.05E-08	3.4E-01	5.0E-04	7.9E-11	2.7E-11	0.1%	2.3E-10	4.6E-07	0.2%	1.9E-10	6.5E-11	0.1%	2.2E-09	4.5E-06	0.2%
Arsenic	9.31	7.05E-09	1.5E+01	NA	2.7E-11	4.1E-10	1.4%	8.0E-11	--	--	6.6E-11	1.0E-09	1.4%	7.7E-10	--	--
Barium	1,055	7.99E-07	NA	1.4E-04	3.1E-09	--	--	9.0E-09	6.3E-05	33.5%	7.5E-09	--	--	8.8E-08	6.1E-04	33.5%
Cadmium	8.4	6.36E-09	6.3E+00	NA	2.5E-11	1.6E-10	0.5%	7.2E-11	--	--	6.0E-11	3.8E-10	0.5%	7.0E-10	--	--
Chromium	32.2	2.44E-08	2.9E+02 (1)	2.2E-06 (1)	9.4E-11	2.8E-08	97.9%	2.8E-10	1.3E-04	66.3%	2.3E-10	6.7E-08	97.9%	2.7E-09	1.2E-03	66.3%
Lead	12,300	9.32E-06	NA	NA	3.6E-08	--	--	1.1E-07	--	--	8.8E-08	--	--	1.0E-06	--	--
					Total ILCR:	2.8E-08	100.0%	Total HI:	1.9E-04	100.0%	Total ILCR:	6.9E-08	100.0%	Total HI:	1.8E-03	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
INGESTION OF GROUNDWATER AS DRINKING WATER - SWMU 046
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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
Chromium	0.0314	NA	3.0E-03 (1)	2.9E-04	--	--	8.6E-04	2.9E-01	100.0%	1.7E-04	--	--	2.0E-03	6.7E-01	100.0%
Lead	0.0219	NA	NA	2.1E-04	--	--	6.0E-04	--	--	1.2E-04	--	--	1.4E-03	--	--
				Total ILCR:	--	--	Total HI:	2.9E-01	100.0%	Total ILCR:	--	--	Total HI:	6.7E-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 046
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - MCB CAMP LEJEUNE, NORTH CAROLINA

DAD (mg/kg/d) = (C*CF*Kp*SA*EF*ED*ET)/(BW*AT) Inorganics
DAD (mg/kg/d) = (C*CF*(2*Kp*SQRT(6*tau*ET/pi))*SA*EF*ED)/(BW*AT) ET <= t* (Organics)
DAD (mg/kg/d) = (C*CF*(Kp*(ET/(1+B)+2*tau*((1+3*B)/(1+B)))*SA*EF*ED)/(BW*AT) ET > t* (Benzene & Vinyl Chloride)

ILCR = CDI*CSFo Adj
HQ = CDI/RfDo Adj

CSF Adj = CSF/AD
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)	tau (hours)	t* (hours)	B	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
Chromium	0.0314	0.0008106	NA	NA	NA	NA	7.5E-05 (1)	1.2E-06	--	--	3.6E-06	4.9E-02	100.0%	9.2E-07	--	--	1.1E-05	1.4E-01	100.0%
Lead	0.0219	0.0001096	NA	NA	NA	NA	NA	1.2E-07	--	--	3.4E-07	--	--	8.7E-08	--	--	1.0E-06	--	--
								Total ILCR:	--	--	Total HI:	4.9E-02	100.0%	Total ILCR:	--	--	Total HI:	1.4E-01	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

Kp, tau, t*, and B values are derived from the USEPA RAGS E Guidance unless otherwise noted

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
ACCIDENTAL INGESTION OF SURFACE SOIL - SWMU 046
CENTRAL TENDENCY
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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	3.33	1.5E+00	3.0E-04	1.5E-07	2.3E-07	100.0%	1.5E-06	5.1E-03	65.3%	4.1E-07	6.1E-07	100.0%	1.4E-05	4.7E-02	65.3%
Chromium	17.7	NA	3.0E-03 (1)	8.1E-07	--	--	8.1E-06	2.7E-03	34.7%	2.2E-06	--	--	7.6E-05	2.5E-02	34.7%
Lead	1,087	NA	NA	5.0E-05	--	--	5.0E-04	--	--	1.3E-04	--	--	4.6E-03	--	--
				Total ILCR:	2.3E-07	100.0%	Total HI:	7.8E-03	100.0%	Total ILCR:	6.1E-07	100.0%	Total HI:	7.3E-02	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 SURFACE SOIL - SWMU 046
CENTRAL TENDENCY
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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	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	3.33	0.03	1.5E+00	3.0E-04	5.2E-09	7.8E-09	100.0%	5.2E-08	1.7E-04	58.5%	1.4E-08	2.1E-08	100.0%	4.8E-07	1.6E-03	58.5%
Chromium	17.7	0.001	NA	7.5E-05 (1)	9.3E-10	--	--	9.3E-09	1.2E-04	41.5%	2.4E-09	--	--	8.5E-08	1.1E-03	41.5%
Lead	1,087	0.001	NA	NA	5.7E-08	--	--	5.7E-07	--	--	1.5E-07	--	--	5.2E-06	--	--
					Total ILCR:	7.8E-09	100.0%	Total HI:	3.0E-04	100.0%	Total ILCR:	2.1E-08	100.0%	Total HI:	2.7E-03	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
INHALATION OF FUGITIVE DUSTS EMANATING FROM SURFACE SOIL - SWMU 046
CENTRAL TENDENCY
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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	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
Arsenic	3.33	2.52E-09	1.5E+01	NA	1.9E-12	2.9E-11	1.0%	1.9E-11	--	--	5.3E-12	8.0E-11	1.0%	1.9E-10	--	--
Chromium	17.7	1.34E-08	2.9E+02 (1)	2.2E-06 (1)	1.0E-11	3.0E-09	99.0%	1.0E-10	4.6E-05	100.0%	2.8E-11	8.3E-09	99.0%	9.8E-10	4.5E-04	100.0%
Lead	1,087	8.24E-07	NA	NA	6.2E-10	--	--	6.2E-09	--	--	1.7E-09	--	--	6.0E-08	--	--
					Total ILCR:	3.0E-09	100.0%	Total HI:	4.6E-05	100.0%	Total ILCR:	8.4E-09	100.0%	Total HI:	4.5E-04	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
ACCIDENTAL INGESTION OF SUBSURFACE SOIL - SWMU 046
CENTRAL TENDENCY
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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
4,4'-DDE	4.4	3.4E-01	NA	2.0E-07	6.9E-08	6.1%	2.0E-06	--	--	5.4E-07	1.8E-07	6.1%	1.9E-05	--	--
4,4'-DDT	27	3.4E-01	5.0E-04	1.2E-06	4.2E-07	37.3%	1.2E-05	2.5E-02	42.3%	3.3E-06	1.1E-06	37.3%	1.2E-04	2.3E-01	42.3%
Arsenic	9.31	1.5E+00	3.0E-04	4.3E-07	6.4E-07	56.7%	4.3E-06	1.4E-02	24.3%	1.1E-06	1.7E-06	56.7%	4.0E-05	1.3E-01	24.3%
Barium	1,055	NA	7.0E-02	4.8E-05	--	--	4.8E-04	6.9E-03	11.8%	1.3E-04	--	--	4.5E-03	6.4E-02	11.8%
Cadmium	8.4	NA	5.0E-04	3.8E-07	--	--	3.8E-06	7.7E-03	13.2%	1.0E-06	--	--	3.6E-05	7.2E-02	13.2%
Chromium	32.2	NA	3.0E-03 (1)	1.5E-06	--	--	1.5E-05	4.9E-03	8.4%	3.9E-06	--	--	1.4E-04	4.6E-02	8.4%
Lead	12,300	NA	NA	5.6E-04	--	--	5.6E-03	--	--	1.5E-03	--	--	5.3E-02	--	--
				Total ILCR:	1.1E-06	100.0%	Total HI:	5.8E-02	100.0%	Total ILCR:	3.0E-06	100.0%	Total HI:	5.5E-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 SUBSURFACE SOIL - SWMU 046
CENTRAL TENDENCY
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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	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
4,4'-DDE	4.4	0.01	3.4E-01	NA	2.3E-09	7.8E-10	2.1%	2.3E-08	--	--	6.0E-09	2.0E-09	2.1%	2.1E-07	--	--
4,4'-DDT	27	0.03	3.4E-01	5.0E-04	4.2E-08	1.4E-08	38.8%	4.2E-07	8.5E-04	45.9%	1.1E-07	3.8E-08	38.8%	3.9E-06	7.8E-03	45.9%
Arsenic	9.31	0.03	1.5E+00	3.0E-04	1.5E-08	2.2E-08	59.1%	1.5E-07	4.9E-04	26.4%	3.8E-08	5.7E-08	59.1%	1.3E-06	4.5E-03	26.4%
Barium	1,055	0.001	NA	4.9E-03	5.5E-08	--	--	5.5E-07	1.1E-04	6.1%	1.4E-07	--	--	5.1E-06	1.0E-03	6.1%
Cadmium	8.4	0.001	NA	2.5E-05	4.4E-10	--	--	4.4E-09	1.8E-04	9.5%	1.1E-09	--	--	4.0E-08	1.6E-03	9.5%
Chromium	32.2	0.001	NA	7.5E-05 (1)	1.7E-09	--	--	1.7E-08	2.2E-04	12.2%	4.4E-09	--	--	1.5E-07	2.1E-03	12.2%
Lead	12,300	0.001	NA	NA	6.4E-07	--	--	6.4E-06	--	--	1.7E-06	--	--	5.9E-05	--	--
					Total ILCR:	3.7E-08	100.0%	Total HI:	1.8E-03	100.0%	Total ILCR:	9.7E-08	100.0%	Total HI:	1.7E-02	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
INHALATION OF FUGITIVE DUSTS EMANATING FROM SUBSURFACE SOIL - SWMU 046
CENTRAL TENDENCY
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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	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
4,4'-DDE	4.4	3.33E-09	3.4E-01	NA	2.5E-12	8.6E-13	0.0%	2.5E-11	--	--	7.0E-12	2.4E-12	0.0%	2.4E-10	--	--
4,4'-DDT	27	2.05E-08	3.4E-01	5.0E-04	1.5E-11	5.2E-12	0.1%	1.5E-10	3.1E-07	0.2%	4.3E-11	1.5E-11	0.1%	1.5E-09	3.0E-06	0.2%
Arsenic	9.31	7.05E-09	1.5E+01	NA	5.3E-12	8.0E-11	1.4%	5.3E-11	--	--	1.5E-11	2.2E-10	1.4%	5.2E-10	--	--
Barium	1,055	7.99E-07	NA	1.4E-04	6.0E-10	--	--	6.0E-09	4.2E-05	33.5%	1.7E-09	--	--	5.9E-08	4.1E-04	33.5%
Cadmium	8.4	6.36E-09	6.3E+00	NA	4.8E-12	3.0E-11	0.5%	4.8E-11	--	--	1.3E-11	8.4E-11	0.5%	4.7E-10	--	--
Chromium	32.2	2.44E-08	2.9E+02 (1)	2.2E-06 (1)	1.8E-11	5.4E-09	97.9%	1.8E-10	8.4E-05	66.3%	5.1E-11	1.5E-08	97.9%	1.8E-09	8.1E-04	66.3%
Lead	12,300	9.32E-06	NA	NA	7.0E-09	--	--	7.0E-08	--	--	2.0E-08	--	--	6.8E-07	--	--
					Total ILCR:	5.5E-09	100.0%	Total HI:	1.3E-04	100.0%	Total ILCR:	1.5E-08	100.0%	Total HI:	1.2E-03	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
INGESTION OF GROUNDWATER AS DRINKING WATER - SWMU 046
CENTRAL TENDENCY
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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
Chromium	0.0314	NA	3.0E-03 (1)	4.0E-05	--	--	4.0E-04	1.3E-01	100.0%	3.8E-05	--	--	1.3E-03	4.5E-01	100.0%
Lead	0.0219	NA	NA	2.8E-05	--	--	2.8E-04	--	--	2.7E-05	--	--	9.4E-04	--	--
				Total ILCR:	--	--	Total HI:	1.3E-01	100.0%	Total ILCR:	--	--	Total HI:	4.5E-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 046
CENTRAL TENDENCY
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - MCB CAMP LEJEUNE, NORTH CAROLINA

DAD (mg/kg/d) = (C*CF*Kp*SA*EF*ED*ET)/(BW*AT) Inorganics
DAD (mg/kg/d) = (C*CF*(2*Kp*SQRT(6*tau*ET/pi))*SA*EF*ED)/(BW*AT) ET <= t* (Organics)
DAD (mg/kg/d) = (C*CF*(Kp*(ET/(1+B)+2*tau*((1+3*B)/(1+B)))*SA*EF*ED)/(BW*AT) ET > t* (Benzene & Vinyl Chloride)

ILCR = CDI*CSFo Adj
HQ = CDI/RfDo Adj

CSF Adj = CSF/AD
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)	tau (hours)	t* (hours)	B	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
Chromium	0.0314	0.0008106	NA	NA	NA	NA	7.5E-05 (1)	1.0E-07	--	--	1.0E-06	1.4E-02	100.0%	6.8E-08	--	--	2.4E-06	3.2E-02	100.0%
Lead	0.0219	0.0001096	NA	NA	NA	NA	NA	9.9E-09	--	--	9.9E-08	--	--	6.4E-09	--	--	2.2E-07	--	--
								Total ILCR:	--	--	Total HI:	1.4E-02	100.0%	Total ILCR:	--	--	Total HI:	3.2E-02	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

Kp, tau, t*, and B values are derived from the USEPA RAGS E Guidance unless otherwise noted

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
ACCIDENTAL INGESTION OF SURFACE SOIL - SWMU 046
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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	3.33	1.5E+00	3.0E-04	2.2E-07	3.4E-07	100.0%	1.6E-05	5.2E-02	65.3%
Chromium	17.7	NA	3.0E-03 (1)	1.2E-06	--	--	8.3E-05	2.8E-02	34.7%
Lead	1,087	NA	NA	7.3E-05	--	--	5.1E-03	--	--
				Total ILCR:	3.4E-07	100.0%	Total HI:	8.0E-02	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
DERMAL CONTACT WITH SURFACE SOIL - SWMU 046
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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	3.33	0.03	1.5E+00	3.0E-04	9.2E-09	1.4E-08	100.0%	6.5E-07	2.2E-03	58.5%
Chromium	17.7	0.001	NA	7.5E-05 (1)	1.6E-09	--	--	1.1E-07	1.5E-03	41.5%
Lead	1,087	0.001	NA	NA	1.0E-07	--	--	7.0E-06	--	--
					Total ILCR:	1.4E-08	100.0%	Total HI:	3.7E-03	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
INHALATION OF FUGITIVE DUSTS EMANATING FROM SURFACE SOIL - SWMU 046
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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	2.46E+06	
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	3.33	1.36E-06	1.5E+01	NA	5.0E-09	7.5E-08	1.0%	3.5E-07	--	--
Chromium	17.7	7.22E-06	2.9E+02 (1)	2.2E-06 (1)	2.7E-08	7.8E-06	99.0%	1.9E-06	8.5E-01	100.0%
Lead	1,087	4.43E-04	NA	NA	1.6E-06	--	--	1.1E-04	--	--
					Total ILCR:	7.9E-06	100.0%	Total HI:	8.5E-01	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
ACCIDENTAL INGESTION OF SUBSURFACE SOIL - SWMU 046
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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
4,4'-DDT	27	3.4E-01	5.0E-04	1.8E-06	6.2E-07	39.7%	1.3E-04	2.5E-01	56.4%
Arsenic	9.3092	1.5E+00	3.0E-04	6.2E-07	9.4E-07	60.3%	4.4E-05	1.5E-01	32.4%
Chromium	32.1868	NA	3.0E-03 (1)	2.2E-06	--	--	1.5E-04	5.0E-02	11.2%
Lead	12300	NA	NA	8.3E-04	--	--	5.8E-02	--	--
				Total ILCR:	1.6E-06	100.0%	Total HI:	4.5E-01	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
DERMAL CONTACT WITH SUBSURFACE SOIL - SWMU 046
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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
4,4'-DDT	27	0.03	3.4E-01	5.0E-04	7.5E-08	2.5E-08	39.7%	5.2E-06	1.0E-02	54.4%
Arsenic	9.3092	0.03	1.5E+00	3.0E-04	2.6E-08	3.9E-08	60.3%	1.8E-06	6.0E-03	31.2%
Chromium	32.1868	0.001	NA	7.5E-05 (1)	3.0E-09	--	--	2.1E-07	2.8E-03	14.4%
Lead	12300	0.001	NA	NA	1.1E-06	--	--	7.9E-05	--	--
					Total ILCR:	6.4E-08	100.0%	Total HI:	1.9E-02	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
INHALATION OF FUGITIVE DUSTS EMANATING FROM EXCAVATED SUBSURFACE SOIL - SWMU 046
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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	2.46E+06	
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
4,4'-DDT	27	1.10E-05	3.4E-01	5.0E-04	4.1E-08	1.4E-08	0.1%	2.8E-06	5.7E-03	0.4%
Arsenic	9.3092	3.79E-06	1.5E+01	NA	1.4E-08	2.1E-07	1.5%	9.8E-07	--	--
Chromium	32.1868	1.31E-05	2.9E+02 (1)	2.2E-06 (1)	4.8E-08	1.4E-05	98.4%	3.4E-06	1.5E+00	99.6%
Lead	12300	5.01E-03	NA	NA	1.8E-05	--	--	1.3E-03	--	--
					Total ILCR:	1.4E-05	100.0%	Total HI:	1.5E+00	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
ACCIDENTAL INGESTION OF SURFACE SOIL - SWMU 046
CENTRAL TENDENCY
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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	240	
CF	kg/mg	Conversion factor	1.00E-06	
FI	NA	Fraction of soil ingested from site	1	
EF	days/year	Exposure frequency	219	
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	3.33	1.5E+00	3.0E-04	9.8E-08	1.5E-07	100.0%	6.9E-06	2.3E-02	65.3%
Chromium	17.7	NA	3.0E-03 (1)	5.2E-07	--	--	3.6E-05	1.2E-02	34.7%
Lead	1,087	NA	NA	3.2E-05	--	--	2.2E-03	--	--
				Total ILCR:	1.5E-07	100.0%	Total HI:	3.5E-02	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
DERMAL CONTACT WITH SURFACE SOIL - SWMU 046
CENTRAL TENDENCY
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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	0.02	
ABS	NA	Absorption fraction	CS	
SA	cm2/day	Skin surface area available for contact	3,300	
EF	days/year	Exposure frequency	219	
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	3.33	0.03	1.5E+00	3.0E-04	8.1E-10	1.2E-09	100.0%	5.7E-08	1.9E-04	58.5%
Chromium	17.7	0.001	NA	7.5E-05 (1)	1.4E-10	--	--	1.0E-08	1.3E-04	41.5%
Lead	1,087	0.001	NA	NA	8.8E-09	--	--	6.2E-07	--	--
					Total ILCR:	1.2E-09	100.0%	Total HI:	3.2E-04	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
INHALATION OF FUGITIVE DUSTS EMANATING FROM SURFACE SOIL - SWMU 046
CENTRAL TENDENCY
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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	2.46E+06	
RR	m3/hour	Respiration rate	1.30	
ET	hours/day	Exposure time	8.0	
EF	days/year	Exposure frequency	219	
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	3.33	1.36E-06	1.5E+01	NA	1.7E-09	2.6E-08	1.0%	1.2E-07	--	--
Chromium	17.7	7.22E-06	2.9E+02 (1)	2.2E-06 (1)	9.2E-09	2.7E-06	99.0%	6.4E-07	2.9E-01	100.0%
Lead	1,087	4.43E-04	NA	NA	5.6E-07	--	--	3.9E-05	--	--
					Total ILCR:	2.7E-06	100.0%	Total HI:	2.9E-01	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
ACCIDENTAL INGESTION OF SUBSURFACE SOIL - SWMU 046
CENTRAL TENDENCY
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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	240	
CF	kg/mg	Conversion factor	1.00E-06	
FI	NA	Fraction of soil ingested from site	1	
EF	days/year	Exposure frequency	219	
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
4,4'-DDT	27	3.4E-01	5.0E-04	7.9E-07	2.7E-07	39.7%	5.6E-05	1.1E-01	56.4%
Arsenic	9.3092	1.5E+00	3.0E-04	2.7E-07	4.1E-07	60.3%	1.9E-05	6.4E-02	32.4%
Chromium	32.1868	NA	3.0E-03 (1)	9.5E-07	--	--	6.6E-05	2.2E-02	11.2%
Lead	12300	NA	NA	3.6E-04	--	--	2.5E-02	--	--
				Total ILCR:	6.8E-07	100.0%	Total HI:	2.0E-01	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
DERMAL CONTACT WITH SUBSURFACE SOIL - SWMU 046
CENTRAL TENDENCY
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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	0.02	
ABS	NA	Absorption fraction	CS	
SA	cm2/day	Skin surface area available for contact	3,300	
EF	days/year	Exposure frequency	219	
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
4,4'-DDT	27	0.03	3.4E-01	5.0E-04	6.5E-09	2.2E-09	39.7%	4.6E-07	9.2E-04	54.4%
Arsenic	9.3092	0.03	1.5E+00	3.0E-04	2.3E-09	3.4E-09	60.3%	1.6E-07	5.3E-04	31.2%
Chromium	32.1868	0.001	NA	7.5E-05 (1)	2.6E-10	--	--	1.8E-08	2.4E-04	14.4%
Lead	12300	0.001	NA	NA	9.9E-08	--	--	7.0E-06	--	--
					Total ILCR:	5.6E-09	100.0%	Total HI:	1.7E-03	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
INHALATION OF FUGITIVE DUSTS EMANATING FROM EXCAVATED SUBSURFACE SOIL - SWMU 046
CENTRAL TENDENCY
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
RCRA FACILITY INVESTIGATION (CTO-0041) - 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	2.46E+06	
RR	m3/hour	Respiration rate	1.30	
ET	hours/day	Exposure time	8.0	
EF	days/year	Exposure frequency	219	
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
4,4'-DDT	27	1.10E-05	3.4E-01	5.0E-04	1.4E-08	4.8E-09	0.1%	9.8E-07	2.0E-03	0.4%
Arsenic	9.3092	3.79E-06	1.5E+01	NA	4.8E-09	7.3E-08	1.5%	3.4E-07	--	--
Chromium	32.1868	1.31E-05	2.9E+02 (1)	2.2E-06 (1)	1.7E-08	4.9E-06	98.4%	1.2E-06	5.3E-01	99.6%
Lead	12300	5.01E-03	NA	NA	6.4E-06	--	--	4.5E-04	--	--
					Total ILCR:	5.0E-06	100.0%	Total HI:	5.3E-01	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
(1) Value for chromium VI

PARTICULATE EMISSION FACTOR - CONSTRUCTION WORKERS
SWMU 046
RCRA FACILITY INVESTIGATION (CTO-0041) - MCB CAMP LEJEUNE, NORTH CAROLINA

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

$$Q/C_{sr} = A \times \exp\left((\ln A_S - B)^2/C\right)$$

Symbol	Definition (units)	Default	Reference
Q/C_{sr}	Inverse of a 1-h avg. air concentration along a straight road bisecting a 3.44 acre square site (g/m2 -s/kg/m3)	17.2	USEPA 2001
A	Constant (unitless)	12.9351	USEPA 2001
A_S	Arial extent of site surface soil contamination (acres)	3.44	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)	7.20E+06	USEPA 2001
A_R	Surface area of contaminated road segment (m^2)	1,798	Site-specific
W	Mean vehicle weight (tons)	8	USEPA 2001
p	Number of days with at least 0.01 inches of precipitation (days/year)	120	USEPA 2001
Sum(VKT)	Sum of fleet vehicle kilometers traveled during the exposure duration (km)	885	USEPA 2001
PEF	Particulate Emission Factor (m^3/kg)	2.46E+06	Site-specific

Q/C_{sr} Calculation

$\ln A_S$	1.235	
$(\ln A_S - B)^2$	20.3	
$(\ln A_S - B)^2/C$	0.283	
$e^{(\ln AS - B)2/C}$	1.33	
$A \times e^{(\ln AS - B)2/C}$	17.2	Q/C_{sr}

PEF Calculation

$Q/C_{sr} \times 1/F_D$	93	
$T \times A_R$	12,946,545,347	
$(W/3)^{0.4}$	1.48	
(365-p)/365	0.671	
$556 \times (W/3)^{0.4} \times (365-p)/365 \times Sum(VKT)$	488,966	
$T \times A_R/556 \times (W/3)^{0.4} \times (365-p)/365 \times Sum(VKT)$	26,477	
PEF	2,455,626	
3.44 acres / 0.000247 acres / m2 =	13,927	m^2
sqrt (13927) / 1000 =	0.118	km

Assumptions

W assumptions: 20 - 2-ton cars and 10 - 20-ton trucks = 30 vehicles

Sum(VKT) assumptions:

Assume that the site is 3.44 acres configured as a square with the unpaved road segment dividing the square evenly. The road length equals the square root of the 3.44 acres (0.118 km). Assume that each vehicle travels the length of the road 1 time per day, 5 days per week, for a total of 12 months (1 year) = 30 vehicles x 0.118 km/day x 50 weeks/yr x 5 days/week = 885 km

A_R assumptions:

Based on VKT, the road length is 118 m and assume the road width is 50 ft. (15.24).

Reference

USEPA 2001. Draft Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

Baker

Baker Environmental, Inc.

APPENDIX K

Checklist for Ecological Assessment

CHECKLIST FOR ECOLOGICAL ASSESSMENTS/SAMPLING

I. SITE LOCATION

1. Site Name *SWMU 46- Montford Point Dump Site*
   US EPA ID Number *NA*
   Location *Marine Corps Base Camp Lejeune*
   County *Onslow* City *Jacksonville* State *NC*

2. Latitude *34°45' N* Longitude *77°25' W*

3. Attach site maps, including a topographical map, a diagram that illustrates the layout of the facility (e.g., site boundaries, structures, etc.), and maps showing all habitat areas identified in Section III of the checklist. Also, include maps that illustrate known and suspected release areas, sampling locations and any other important features, if available.

   Site maps are included within the main text of this report (RFI Report).

II. SITE CHARACTERIZATION

1. Indicate the approximate area of the site (i.e., acres or sq. ft.)

   50' X 50' approximate area of former mounded area

2. Is this the first site visit? ☐ *X* Yes ☐ No *(first visit by ecologist)*
   If no, attach trip report of previous site visit(s), if available.

   Dates(s) of previous site visit(s) *NA*

3. Are aerial or other site photographs available? ☐ *X* Yes ☐ No
   If yes, please attach any available photo(s) to the site map to the report.

   An aerial photo is presented as Figure 7-1 of this report. Additional site photos follow this checklist.

4. Provide an approximate breakdown of the land uses on the site:

____% Heavy Industrial	____% Light Industrial	____% Urban
____% Residential	____% Rural	____% Agricultural[b]
____% Recreational[a]	____% Undisturbed	*100* % Other[c]

[a]For recreational areas, please describe the use of the area (e.g., park, playing field, etc).

[b]For agricultural areas, please list the crops and/or livestock which are present.

[c]For areas designated as "other," please describe the use of the area.
Military installation. SWMU is open field formerly used for disposal. Surrounded by woodland laced with gravel roads. This area is classified as an industrial area of the base.

5. Provide an approximate breakdown of the land uses in the area surrounding the site. Indicate the radius (in miles) of the area described: *½ mile*

____% Heavy Industrial	__*50*__% Light Industrial	____% Urban
____% Residential	____% Rural	____% Agricultural[b]
____% Recreational[a]	__*50*__% Undisturbed	____% Other [c]

[a]For recreational areas, please describe the use of the area (e.g., park, playing field, golf course, etc).

[b]For agricultural areas, please list the crops and/or livestock which are present.

[c]For areas designated as "other," please describe the use of the area.

6. Has any movement of soil taken place at the site? ☐ *X* Yes ☐ No
If yes, indicate the likely source of the disturbance, (e.g., erosion, agricultural, mining, industrial activities, removals, etc.) degree of disturbance, and estimate when these events occurred.

Mounded material present during 1996 site visit by Baker – most of this material had been removed during the Phase I and Phase II CSIs. Tracks of heavy equipment were observed at the site.

7. Do any sensitive environmental areas exist adjacent to or in proximity to the site, (e.g. Federal and State parks, National and State monuments, wetlands)?
Remember, flood plains and wetlands are not always obvious; do not answer "no" without confirming information. See Table 1 for a list of contacts.

No.

Please provide the source(s) of 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 the Camp Lejeune Marine Corps Base, North Carolina (LeBlond, Fussell, and Braswell 1994) to determine if sensitive areas were present in the vicinity of the site.

8. What type of facility is located at the site?

☐ Chemical ☐ Manufacturing ☐ Mixing

☐ X Waste Disposal ☐ Other (specify)

_____

_____

9. Identify the contaminants of potential concern (COPCs) at the site. If known, include the maximum contaminant levels. Please indicate the source of data cited (e.g., RFI, confirmatory sampling, etc).

Prior studies indicate metals in excess of background concentrations, NCDENR soil to groundwater criteria, and/or EPA Region 9 Industrial Preliminary Remediation Goals (Hg, As, Pb, Cd, Ag).

10. Check any potential routes of off-site migration of contaminants observed at the site:

☐ Swales ☐ Depressions ☐ Drainage Ditches

☐ Runoff ☐ *X* Windblown Particulates ☐ *X* Vehicular Traffic

☐ Other (specify):

11. Indicate the approximate depth to groundwater (in feet below ground surface [(bgs)].

Per Phase II CSI, depth to groundwater is approx. 10.3 to 11.6 feet bgs.

12. Indicate the direction of groundwater flow (e.g., north, southeast, etc.)

Per Phase II CSI, groundwater flow direction is southeast.

13. Is the direction of surface runoff apparent from site observations? ☐ Yes ☐ *X* No
If yes, to which of the following does the surface runoff discharge? Indicate all that apply.

☐ Surface water ☐ Groundwater ☐ Sewer

☐ Collection Impoundment

Assume direct infiltration to groundwater due to flat topography and lack of drainage ways.

14. Is there a navigable water body or tributary to a navigable water body?
☐ Yes ☐*X* No
(not on the site. The New River is off-site to the southeast)

15. Is there a water body anywhere on or in the vicinity of the site? If yes, also complete Section III.B.1: Aquatic Habitat Checklist -- Non-Flowing Systems and/or Section III.B.2: Aquatic Habitat Checklist -- Flowing Systems.

☐ *X* Yes (approx. distance) ☐ No
2500 feet southeast (downgradient of GW flow) is Northeast Creek, trib to New River, which is 1550 feet southwest of SWMU

16. Is there evidence of flooding? ☐ Yes ☐*X* No
Wetlands and flood plains are not always obvious. Do not answer "no" without confirming information. If yes, complete Section III.C: Wetland Habitat Checklist.

17. 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.)
NA

18. Are any threatened and/or endangered species (plant or animal) known to inhabit the area of the site? ☐ Yes ☐ *X* No
If yes, you are required to verify this information with the U.S. Fish and Wildlife Service or other appropriate agencies (see Table 1 for a list of contacts). If species' identities are known, please list them next.

19. Record weather conditions at the site at the time of the site visit when information for completion of this checklist was prepared:

DATE *31 March 2004*

60s Temperature (°C/°F)

Wind (direction/speed): *light breeze*

Cloud Cover: *cumulous*

Normal daily high temperature (°C/°F): *approx. 67 °F*
(source: http://www.city-data.com/city/Jacksonville-North-Carolina.html)

Precipitation (rain, snow): *dry afternoon after heavy night and morning rains*

20. Describe reasonable and likely future land and/or water use(s) at the site.

Site area will remain an industrial area for the foreseeable future.

21. Describe the historical uses of the site. Include information on chemical releases that may have occurred as a result of previous land uses. For each chemical release, provide information on the form of the chemical released (i.e., solid, liquid, vapor) and the known or suspected causes or mechanism of the release (i.e., spills, leaks, material disposal, dumping, explosion, etc.).

Waste disposal of sewage treatment sludge and other materials including litter, asphalt, and sand.

22. Identify the media (e.g., soil [surface or subsurface], surface water, air, groundwater) which are known or suspected to contain COCs.

Surface and subsurface soils and groundwater were identified as media of concern in the Phase II CSI.

II.A. SUMMARY OF OBSERVATIONS AND SITE SETTING

Include information on significant source areas and migration pathways that are likely to constitute complete exposure pathways.

SWMU 46 is located at the edge of an open field surrounded by upland forest. The field is a mix of many herbaceous species and grasses with some areas of bare dirt/tire tracks. Some bullet casings in field closer to gravel access road.

Terrestrial wooded habitat surrounds the site. The forest is predominantly pine with some deciduous species (e.g., holly, oak, gum). Litter is thick pine needles. Site is suitable terrestrial habitat. Check direct contamination of soils in open field and extent of contamination into wooded habitat. Migration to groundwater possible. Due to limited topography and no evidence or erosion/ drainage ways overland migration of soils with surface runoff is anticipated to be minimal. Potential migration with vehicular traffic or fugitive dusts. Within the wooded habitat there were signs of small mammals (piles of nut husks here and there) and birdsong. There were also various areas of mounding within the woods – piles of dirt (apparently) up to approximately 3' tall, covered with pine needles. On one pile there was a gum tree growing – estimated age 25 to 35 years old, suggesting that the mounding had been present in this area for at least that long. Note years of site operation 1948 to 1958.

The surficial aquifer is close to the ground surface at the SWMU (less than 15 feet bgs). The site is also relatively close to Northeast Creek (tributary of the New River located southeast of site 2500 feet [in direction of groundwater flow]) and the New River (1500 feet to the southwest). Potential migration of contaminated groundwater to off-site aquatic habitat is a concern. Groundwater sample SWMU46-TW03 was collected upgradient from the SWMU. Had considered using this sample as site background. However, based on the fact that the soil in this area was disturbed and due to the shallow depth of groundwater, will include this sample with main site samples.

Checklist Completed by	*Heather G. Wojdak*
Affiliation	*Michael Baker Jr., Inc.*
Author Assisted by	*NA*
Date	*31 March 2003*

III. HABITAT EVALUATION

III.A Terrestrial Habitat Checklist

III.A.1 Wooded

Are any wooded areas on or adjacent to the site? ☐X Yes ☐ No

If yes, indicate the wooded area on the attached site map and answer the following questions. If more than one wooded area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual wooded area. Distinguish between wooded areas by using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.A.2: Shrub/Scrub

Wooded Area Questions

☐ On-site ☐ *X* Off-site

Name or Designation: *Woods (adjacent to site)*

1. Estimate the approximate size of the wooded area (_____% _>5___acres)
   Please identify what information was used to determine the wooded area of the site (e.g., direct observation, photos, etc). *aerial photograph(Figure 7-1)*

2. Indicate the dominant type of vegetation in the wooded area. Provide photographs, if available.

   - ☐ *X* Evergreen
   - ☐ Deciduous
   - ☐ Mixed

   Dominant plant species, if known: *Loblolly pine (Pinus taeda)(?)*

3. Estimate the vegetation density of the wooded area.

   - ☐ Dense (i.e., greater than 75% vegetation)
   - ☐ *X* Moderate (i.e., 25% to 75% vegetation)
   - ☐ Sparse (i.e., less than 25% vegetation)

4. Indicate the predominant size of the trees at the site. Use diameter at breast height.

   - ☐ 0-6 inches
   - ☐ *X* 6-12 inches
   - ☐ >12 inches
   - ☐ No single size range is predominant

5. Specify type of understory present, if known. Provide a photograph, if available.

   Photographs attached to this checklist.

III.A.2 Shrub/Scrub

Are any shrub/scrub areas on or adjacent to the site? ☐ Yes ☐ X No

If yes, indicate the shrub/scrub area on the attached site map and answer the following questions. If more than one shrub/scrub area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual shrub/scrub area. Distinguish between shrub/scrub areas, using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.A.3: Open Field

III.A.3 Open Field

Are any open field areas on or adjacent to the site? ☐ X Yes ☐ No

If yes, indicate the open field area on the attached site map and answer the following questions. If more than one open field area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual open field area. Distinguish between open field areas, using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.A.4: Miscellaneous

Open Field Area Questions

☐ *X* On-site ☐ Off-site
and adjacent to site

Name or Designation: *open field*

1. Estimate the approximate size of the open field area (_____% *1.5* acres). Please identify what information was used to determine the open field area of the site. *Aerial photograph*

2. Indicate the dominant type of vegetation present, if known.
   ??

3. Estimate the vegetation density of the shrub/scrub area.

   - ☐ Dense (i.e., greater than 75% vegetation)
   - ☐ *X* Moderate (i.e., 25% to 75% vegetation)
   - ☐ Sparse (i.e., less than 25% vegetation)

4. Indicate the approximate average height of the dominant plant:

   Less than 4 inches – low lying herbaceous species

III.A.4 Miscellaneous

Are other types of terrestrial habitats present at the site, other than woods, scrub/shrub and open field? ☐ Yes ☐ X No

If yes, indicate the area on the attached site map and answer the following questions. If more than one of these areas are present on or adjacent to the site, make additional copies of the following questions and fill out for each individual area. Distinguish between areas by using names or other designations. Clearly identify each area on the site map.

If no, proceed to Section III.B: Aquatic Habitats.

III.B Aquatic Habitats

Note: Aquatic systems are often associated with wetland habitats. Please refer to Section III.C, Wetland Habitat Checklist.

III.B.1 Non-Flowing Systems

Are any non-flowing aquatic features (such as ponds or lakes) located at or adjacent to the site?

☐ Yes ☐ X No *(Intermittent wet spot observed. See summary of site observations.)*

If yes, indicate the aquatic feature on the attached site map and answer the following questions regarding the non-flowing aquatic features. If more than one non-flowing aquatic feature is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual aquatic feature. Distinguish between aquatic features by using names or other designations. Clearly identify each area on the site map.

If no, proceed to Section III.B.2: Flowing Systems

III.B.2 Flowing Systems

Note: Aquatic systems are often associated with wetland habitats. Please refer to Section III.C, Wetland Habitat Checklist.

Are any flowing aquatic features (such as streams or rivers) located at or adjacent to the site?

☐ X Yes ☐ No

New River 1500 feet southwest. Northeast Creek 2500 feet southeast. Neither observed.

If yes, indicate the system on the attached site map and answer the following questions regarding the flowing system. If more than one flowing system is present on or adjacent to the site, make additional copies of the following questions and complete one set for each individual aquatic feature. Distinguish between flowing systems by using names or other designation. Clearly identify each area on the site map

If no, proceed to Section III.C: Wetlands Habitats.

III.C Wetland Habitats

Are any wetland[1] areas such as marshes or swamps on or adjacent to the site?

☐ Yes ☐ *X* No

If yes, indicate the wetland area on the attached site map and answer the following questions regarding the wetland area. If more than one wetland area is present on or adjacent to the site, make additional copies of the following questions and fill out one for each individual wetland area. Distinguish between wetland areas by using names or other designations (such as location). Clearly identify each area on the site map. Also, obtain and attach a National Wetlands Inventory Map (or maps) to illustrate each wetland area.

Identify the sources of the observations and information (e.g., National Wetland Inventory, Federal or State Agency, USGS topographic maps) used to make the determination whether or not wetland areas are present.

National Wetland Inventory mapping on Camp Lejeune GIS website.

If no wetland areas are present, proceed to Section III.D: Sensitive Environments and Receptors.

[1]Wetlands are defined in 40 CFR §232.2 as " Areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Examples of typical wetlands plants include: cattails, cordgrass, willows and cypress trees. National wetland inventory maps may be available at http:\\nwi.fws.gov. Additional information on wetland delineation criteria is also available from the Army Corps of Engineers.

III.D Sensitive Environments and Receptors

1. Do any other potentially sensitive environmental areas[2] exist adjacent to or within one-half mile of the site? If yes, list these areas and provide the source(s) of information used to identify sensitive areas. *Do not answer "no" without confirmation from the U.S. Fish and Wildlife Service and other appropriate agencies. See Table 1 for a list of contacts.*

   No (consulted Inventory of the Rare Species, Natural Communities, and Critical Areas of the Camp Lejeune Marine Corps Base, North Carolina [LeBlond et al., 1994])

2. Are any areas on or near (i.e., within one-half mile) the site owned or used by local tribes? If yes, describe.

   No

3. Does the site serve or potentially serve as a habitat, foraging area or refuge by rare, threatened, endangered, candidate and/or proposed species (plants or animals), or any otherwise protected species? If yes, identify species. *This information should be obtained from the U.S. Fish and Wildlife Service and other appropriate agencies. See Table 1 for a list of contacts.*

   No(consulted Inventory of the Rare Species, Natural Communities, and Critical Areas of the Camp Lejeune Marine Corps Base, North Carolina [LeBlond et al., 1994])

4. Is the site potentially used as a breeding, roosting or feeding area by migratory bird species? If yes, identify which species.

   Wooded habitat adjacent to the site could potentially be used by migratory species, but this area was not noted as a significant area in the Inventory of the Rare Species, Natural Communities, and Critical Areas of the Camp Lejeune Marine Corps Base, North Carolina (LeBlond et al., 1994)

5. Is the site used by any ecologically[3], recreationally or commercially important species? If yes, explain.

   No

---

[3] Areas that provide unique and often protected habitat for wildlife species. These areas are typically used during critical life stages such as breeding, hatching, rearing of young and overwintering. Refer to Table 2 at the end of this document for examples of sensitive environments.

[3] Ecologically important species include populations of species which provide a critical (i.e., not replaceable) food resource for higher organisms. These species' functions would not be replaced by more tolerant species or perform a critical ecological function (such as organic matter decomposition) and will not be replaced by other species. Ecologically important species include pest and opportunistic species that populate an area if they serve as a food source for other species, but do not include domesticated animals (e.g., pets and livestock) or plants/animals whose existence is maintained by continuous human interventions (e.g., fish hatcheries, agricultural crops, etc).

IV. EXPOSURE PATHWAY EVALUATION

(this section completed following review of RFI data set)

1. Do existing data provide sufficient information on the nature, rate and extent of contamination at the site?

   - ❑ *X* Yes
   - ❑ No
   - ❑ Uncertain

   Please provide an explanation for your answer._____

2. Do existing data provide sufficient information on the nature, rate and extent of contamination in offsite affected areas?

   - ❑ *X* Yes
   - ❑ No
   - ❑ Uncertain
   - ❑ No offsite contamination

   Please provide an explanation for your answer._____

3. Do existing data address potential migration pathways of contaminants at the site?

   - ❑ *X* Yes
   - ❑ No
   - ❑ Uncertain

   Please provide an explanation for your answer._____

4. Do existing data address potential migration pathways of contaminants in offsite affected areas?

- ❑ Yes
- ❑ No
- ❑ Uncertain
- ❑ *X* No offsite contamination

Please provide an explanation for your answer.

5. Are there visible indications of stressed habitats or receptors on or near (i.e., within one-half mile) the site that may be the result of a chemical release? If yes, explain. Attach photographs if available.

No

6. Is the location of the contamination such that receptors might be reasonably expected to come into contact with it? For soil, this means contamination in the soil 0 to 1 foot below ground surface (bgs). If yes, explain.

Yes, contamination in surface soils

7. Are receptors located in or using habitats where chemicals exist in air, soil, sediment or surface water? If yes, explain.

Yes, in terrestrial habitat at site

8. Could chemicals reach receptors via groundwater? Can chemicals leach or dissolve to groundwater? Are chemicals mobile in groundwater? Does groundwater discharge into receptor habitats? If yes, explain.

Groundwater pathway was evaluated, see text Section 7.0

9. Could chemicals reach receptors through runoff or erosion? Answer the following questions.

What is the approximate distance from the contaminated area to the nearest watercourse?

- ❑ 0 feet (i.e., contamination has reached a watercourse)
- ❑ 1-10 feet
- ❑ 11-20 feet
- ❑ 21-50 feet
- ❑ 51-100 feet
- ❑ 101-200 feet
- ❑ > 200 feet
- ❑ > 500 feet
- ❑ *X* > 1000 feet

What is the slope of the ground in the contaminated area?

- ❑ *X* 0-10%
- ❑ 10-30%
- ❑ > 30%

What is the approximate amount of ground and canopy vegetative cover in the contaminated area?

- ❑ < 25%
- ❑ *X* 25-75%
- ❑ > 75%

Is there visible evidence of erosion (e.g., a rill or gully) in or near the contaminated area?

- ❑ Yes
- ❑ *X* No
- ❑ Do not know

Do any structures, pavement or natural drainage features direct run-on flow (i.e., surface flows originating upstream or uphill from the area of concern) into the contaminated area?

- ❑ Yes
- ❑ *X* No
- ❑ Do not know

10. Could chemicals reach receptors through the dispersion of contaminants in air (e.g., volatilization, vapors, fugitive dust)? If yes, explain.

Air exposure pathway discussed in text Section 7.0

11. Could chemicals reach receptors through migration of non-aqueous phase liquids (NAPLs)? Is a NAPL present at the site that might be migrating towards receptors or habitats? Could NAPL discharge contact receptors or their habitat?

No NAPL at the site.

TABLE 1
SENSITIVE ENVIRONMENT CONTACTS

CONTACT	TELEPHONE #	SENSITIVE ENVIRONMENT
NC Division of Parks and Recreation – National Heritage Program	(919) 733-4181 Fax: (919) 715-3085	State Parks Areas Important to Maintenance of Unique Natural Communities Sensitive Areas Identified Under The National Estuary Program Designated State Natural Areas State Seashore, Lakeshore, and River Recreational Areas Rare species (state and federal Threatened and Endangered) Sensitive Aquatic Habitat
NC Planning and Natural Resources	(919) 846-9991	State Wild & Scenic Rivers
National Park Service Public Affairs Office	(404) 562-3103	National Seashore, Lakeshore and River Recreational Areas National Parks or Monuments
Internet	www.nps.gov/rivers	Federal Designated Wild & Scenic Rivers
US Forest Service	(828) 257-4253	Designated and Proposed Federal Wilderness and Natural Areas
	(828) 257-4864	National Preserves and Forests
	(828) 257-4810	Federal Land Designated for the protection of natural ecosystems.

CONTACT	TELEPHONE #	SENSITIVE ENVIRONMENT
NC Division of Water Quality	(919) 733-6510	Critical Areas Identified Under the Clean Lakes Program
	(919) 733-5083 *Ask for Clean Water Act 305b report*	State-Designated Areas for Protection or Maintenance of Aquatic Life
NC Division of Forest Resources	(919) 733-2162 x 234	State Preserves and Forests
US Fish & Wildlife Service	(919) 856-4520 x 11	Terrestrial Areas Utilized for Breeding by Large or Dense Aggregations of Animals
NC Wildlife Resources Commission	(252) 451-2534	National or State Wildlife Refuges
NOAA	(301) 713-3145 x 173	Marine Sanctuaries
NC Department of Cultural Resources	(919) 733-4763	National and State Historical Sites
NC Division of Coastal Management	(919) 733-2293	Areas Identified Under Coastal Protection Legislation
Internet	http://dcm2.enr.state.nc.us	Coastal Barriers or Units of a Coastal Barrier Resources System
NC Wildlife Resources Commission	(919) 733-3633	Spawning Areas Critical for the Maintenance of Fish/Shellfish Species within River, Lake or Coastal Tidal Waters. Migratory Pathways and Feeding Areas Critical for Maintenance of Anadromous Fish Species within River Reaches or Areas in Lakes or Coastal Tidal Waters in Which such Fish Spend Extended Periods of Time State Lands Designated for Wildlife or Game Management
US Army Corps of Engineers	(919) 876-8441, ext. 28	Wetlands

TABLE 2
EXAMPLES OF SENSITIVE ENVIRONMENTS

National Parks and National Monuments

Designated or Administratively Proposed Federal Wilderness Areas

National Preserves

National or State Wildlife Refuges

National Lakeshore Recreational Areas

Federal land designated for protection of natural ecosystems

State land designated for wildlife or game management

State designated Natural Areas

Federal or state designated Scenic or Wild River

All areas that provide or could potentially provide critical habitat[1] for state and federally listed Threatened or Endangered Species, those species that are currently petitioned for listing, and species designated by other agencies as sensitive or species of concern.

Marine Sanctuary

Areas identified under the Coastal Zone Management Act

Sensitive areas identified under the National Estuary Program or Near Coastal Waters Program

Critical areas identified under the Clean Lakes Program

National Seashore Recreational Area

Habitat known to be used by Federal designated or proposed endangered or threatened species

---

1 Critical habitats are defined by the Endangered Species Act (50 CFR §424.02(d)) as:

1) Specific areas within the geographical area currently occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features (i) essential to the conservation of the species and (ii) that may require special management considerations or protection, and 2) Specific areas outside the geographical area occupied by a species at the time it is listed upon a determination by the Secretary [of Interior] that such areas are essential for the conservation of the species.

Unit of Coastal Barrier Resources System

Coastal Barrier (undeveloped)

Spawning areas critical for the maintenance of fish/shellfish species within river, lake, or coastal tidal waters

Migratory pathways and feeding areas critical for maintenance of andromous fish species within river reaches or areas in lakes or coastal tidal waters in which the fish spend extended periods of time

Terrestrial areas utilized for breeding by large or dense aggregations of animals

National river reach designated as Recreational

Habitat known to be used by state designated endangered or threatened species

Habitat known to be used by species under review as to its Federal endangered or threatened status

Coastal Barrier (partially developed)

Particular areas, relatively small in size, important to maintenance of unique biotic communities

State-designated areas for protection or maintenance of aquatic life

Wetlands

Photos of SWMU 46 taken 31 March 2004

Photo 1. SWMU 46, a formerly mounded area near orange flagging in center of image.

Photo 2. Open field between gravel access road and SWMU 46. Viewed from midway between road and SWMU, facing southeast.

Photos of SWMU 46 taken 31 March 2004

Photo 3. Abandoned helicopter.

Photo 4. View from abandoned helicopter south toward SWMU 46.

Photos of SWMU 46 taken 31 March 2004

Photo 5. View from abandoned helicopter facing southwest.

Photo 6. View from SWMU 46 facing north.

Photos of SWMU 46 taken 31 March 2004

Photo 7. Wet spot resulting from excavation of former mounded area.

Photo 8. Telephone poles adjacent to wet spot.

Photos of SWMU 46 taken 31 March 2004

Photo 9. Wooded habitat south of SWMU 46.

Photo 10. Example of mounded area within wooded habitat south of SWMU 46.

APPENDIX L

Groundwater Data Used in the Ecological Risk Assessment

APPENDIX L
GROUNDWATER DATA USED IN THE ECOLOGICAL RISK ASSESSMENT
SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	SWMU46-GW01	SWMU46-GW02	SWMU46-GW03	SWMU46-GW04	SWMU46-GW05	SWMU46-GW06	SWMU46-MW01
SAMPLE DATE	04-06-2002	04-06-2002	04-06-2002	04-06-2002	04-06-2002	04-06-2002	3/21/2004
METALS (ug/L)							
Arsenic	2.4 U	2.4 U	4.2 J	2.4 U	2.4 U	5.7 J	2.13 U
Barium	152	92.3	59.4	68.4	87.5	78.4	64.7
Cadmium	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.59 U	0.25 U
Chromium	4.7 J	0.83 J	2.1 J	1 J	3 J	31.4	0.88 U
Lead	4 J	4.6 J	1.8 UJ	4.4 J	2.2 J	21.9	1.56 U
Mercury	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.01 U
Selenium	4.6 U	4.6 U	4.6 U	4.6 U	4.6 U	4.6 U	2.32 U
Silver	0.9 U	0.9 U	0.9 U	0.9 U	0.9 U	0.9 U	1.16 U

APPENDIX L
GROUNDWATER DATA USED IN THE ECOLOGICAL RISK ASSESSMENT
SWMU 46
RCRA FACILITY INVESTIGATION (CTO-0041)
MCB CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID SAMPLE DATE	Minimum Non-Detect	Maximum Non-Detect	Minimum Detected	Maximum Detected	Frequency of Detection	Arithmatic Mean Half Non-Detects	Standard Deviation	Upper 95% Confidence Level	Log Arithmatic Mean Half Non-Detects	Log Standard Deviation	Log Upper 95% Confidence Level	Location of Maximum Detect
METALS (ug/L)												
Arsenic	2.13 U	2.4 U	4.2 J	5.7 J	2/7	2.2521	1.8938	3.643	0.57	0.7	5.5956	SWMU46-GW06
Barium	0	0	59.4	152	7/7	86.1	31.4289	109.1831	4.41	0.31	115.7578	SWMU46-GW01
Cadmium	0.25 U	0.59 U	0	0	0/7	0.1671	0.0571	0.209	-1.83	0.28	0.2124	
Chromium	0.88 U	0.88 U	0.83 J	31.4	6/7	6.21	11.2056	14.44	0.83	1.41	121.8156	SWMU46-GW06
Lead	1.56 U	1.8 UJ	2.2 J	21.9	5/7	5.54	7.3886	10.9666	1.13	1.13	45.7414	SWMU46-GW06
Mercury	0.01 U	0.1 U	0	0	0/7	0.0436	0.017	0.0561	-3.32	0.87	0.1771	
Selenium	2.32 U	4.6 U	0	0	0/7	2.1371	0.4309	2.4536	0.74	0.26	2.6993	
Silver	0.9 U	1.16 U	0	0	0/7	0.4686	0.0491	0.5047	-0.76	0.1	0.5047	