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FINAL EXPANDED SITE INVESTIGATION REPORT MILITARY MUNITIONS RESPONSE
PROGRAM SITE UXO-14 FORMER INDOOR PISTOL RANGE (ASR 2.199) AND FORMER
GAS CHAMBER (ASR 2.200) MCB CAMP LEJEUNE NC
2/1/2012
CH2M HILL

Final

**Expanded Site Investigation Report
Military Munitions Response Program Site UXO-14 - Former Indoor
Pistol Range (ASR #2.199) and Former Gas Chamber (ASR #2.200)**

**Marine Corps Base Camp Lejeune
Jacksonville, North Carolina**

Contract Task Order WE41

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Executive Summary

This report documents the findings of the Expanded Site Investigation (SI) at United States Marine Corps Military Munitions Response Program (MMRP) Site Unexploded Ordnance (UXO)-14 – Former Indoor Pistol Range (ASR #2.199) and Former Gas Chamber (ASR #2.200). The Expanded SI was conducted by CH2M HILL under the Naval Facilities Engineering Command Comprehensive Long-Term Environmental Action—Navy (CLEAN) Contract N62470-08-D-1000, Contract Task Order (CTO) WE41.

Site UXO-14 is located west of Powder Lane in the Stones Bay area of Marine Corps Base Camp Lejeune (MCB CamLej) and includes a former Indoor Pistol Range in the eastern portion of the site and a former Gas Chamber in the western portion. The former Indoor Pistol Range is approximately 0.09 acre in size and the former Gas Chamber is approximately 0.04 acre in size.

The purpose of the Expanded SI was to address the recommendations of a Preliminary Assessment/Site Inspection (PA/SI) conducted in 2009. The following Expanded SI objectives were accomplished in 2011:

- Evaluated the distribution of and potential for human health and ecological risks associated with antimony, lead, and mercury in soil at the former Indoor Pistol range.
- Assessed the nature of geophysical anomalies identified as representing potential munitions and explosives of concern (MEC) in the former Gas Chamber area.

Environmental Investigation

Fourteen surface soil samples and seven subsurface soil samples were collected during the Expanded SI at locations in and around the former Indoor Pistol Range area. The samples were analyzed for antimony, lead, and mercury. Lead and antimony are generally higher in the western portion of the site. Elevated concentrations of lead and antimony are generally co-located and decrease significantly with distance from the site and with depth. The additional data were sufficient to fully delineate the horizontal and vertical extents of antimony and mercury concentrations greater than the United States Environmental Protection Agency (USEPA) residential and industrial Regional Screening Levels (RSLs). All mercury concentrations were less than the USEPA RSLs.

The Expanded SI results were combined with the PA/SI results and evaluated for potential risks to human health and the environment from exposure to site media. The conclusions of the risk evaluations are as follows:

- The Human Health Risk Screening (HHRS) concluded that there are potential unacceptable risks associated with exposure to lead and antimony in surface soil within the western portion of the former Indoor Pistol Range. However, there is no unacceptable risk associated with exposure to subsurface soil.
- Antimony and lead in surface and subsurface soil at the Indoor Pistol Range were identified as potentially posing unacceptable risks to lower trophic level receptors. Lead in surface soil was the only constituent identified as posing unacceptable risk to upper trophic level receptors based on food chain modeling, including the white-footed mouse, red fox, American robin, and the mourning dove.

MEC Intrusive Investigation

During the PA/SI, digital geophysical mapping (DGM) was conducted over 348 square feet of the 1742 square feet (20 percent) portion of the Gas Chamber area at Site UXO-14. This DGM survey identified 17 geophysical anomalies representing potential subsurface MEC. During the Expanded SI, an intrusive investigation of these 17 geophysical anomalies was conducted, and no MEC was found. Two geophysical anomalies were determined to be material potentially presenting an explosive hazard (MPPEH), and these were determined to be small arms cartridge casings. These results indicate that the potential for encountering subsurface MEC throughout the Gas Chamber portion of Site UXO-14 is likely to be low.

Recommendations

Based on these presented conclusions, the following recommendations are made:

- At the former Indoor Pistol Range, an interim removal action or a Remedial Investigation/Feasibility Study, or both, is recommended to reduce or mitigate potential human and ecological exposure to antimony and lead in surface and subsurface soil.
- No further action is recommended at the former Gas Chamber area.

Contents

Executive Summary	iii
Acronyms and Abbreviations.....	vii
1 Introduction.....	1-1
1.1 Purpose.....	1-1
1.2 Objectives and Approach.....	1-1
1.3 Report Organization	1-1
2 Site Background	2-1
2.1 MCB CamLej Location and Description.....	2-1
2.2 Site Setting.....	2-1
2.3 Site History.....	2-1
2.4 Previous Investigations.....	2-1
2.4.1 MEC Investigation	2-2
2.4.2 Environmental Sampling and Results	2-2
2.5 Regional Climate	2-6
2.6 Regional Geology and Hydrogeology.....	2-7
2.7 Site Geology and Hydrogeology	2-7
2.8 Conceptual Site Model	2-7
2.8.1 Source.....	2-7
2.8.2 Fate and Transport Mechanisms	2-7
2.8.3 Exposure Pathways and Receptors.....	2-7
3 Field Investigation Activities	3-1
3.1 Site Preparation and Support	3-1
3.1.1 MEC Avoidance.....	3-1
3.1.2 Buried Utility Location	3-1
3.2 Environmental Investigation Activities.....	3-1
3.2.1 Surface Soil Sampling.....	3-1
3.2.2 Subsurface Soil Sampling.....	3-1
3.2.3 Decontamination of Sampling Equipment	3-1
3.2.4 Investigation-Derived Waste Management	3-2
3.2.5 Data Validation	3-2
3.3 MEC Intrusive Investigation Activities	3-2
4 Investigation Results.....	4-1
4.1 Environmental Investigation Results	4-1
4.1.1 Surface Soil	4-1
4.1.2 Subsurface Soil.....	4-2
4.2 MEC Intrusive Investigation Results	4-3
5 Human Health Risk Screening.....	5-1
5.1 Previous Human Health Risk Evaluations	5-1
5.2 Human Health Risk Screening Overview	5-1
5.2.1 Step 1	5-1
5.2.2 Step 2	5-2
5.2.3 Step 3	5-2
5.3 Human Health Risk Screening Results	5-2
5.3.1 Surface Soil Risk Screening	5-2
5.3.2 Subsurface Soil Risk Screening.....	5-3

5.3.3 Comparison of Detection Limits for Non-detected Analytes to Screening Levels 5-3

5.4 Human Health Risk Screening Conclusion 5-3

6 Ecological Risk Assessment 6-1

6.1 Ecological Risk Assessment Overview 6-1

6.2 Ecological Risk Assessment Summary 6-1

7 Conclusions and Recommendations 7-1

7.1 Conclusions 7-1

7.1.1 Environmental Investigation..... 7-1

7.1.2 MEC Intrusive Investigation..... 7-1

7.2 Recommendations..... 7-1

8 References..... 8-1

Appendixes

- A PA/SI Analytical Data Screening Tables
- B Data Validation Summary Reports
- C Munitions Debris Disposal Documents
- D MEC Intrusive Investigation Documents
- E Human Health Risk Screening Tables
- F Ecological Risk Assessment

Tables (tables are located at the end of each section)

- 2-1 PA/SI Surface Soil Analytical Results
- 2-2 PA/SI Subsurface Soil Analytical Results
- 2-3 PA/SI Analytical Results for Metals in Groundwater beneath the Former Indoor Pistol Range Area
- 2-4 PA/SI Analytical Results for SVOCs in Groundwater beneath the Former Gas Chamber Area
- 2-5 PA/SI Human Health Risk Screening Summary
- 2-6 PA/SI Ecological Risk Screening Summary
- 4-1 Summary of Surface Soil Exceedances
- 4-2 Surface Soil Analytical Results
- 4-3 Summary of Subsurface Soil Exceedances
- 4-4 Subsurface Soil Analytical Results

Figures (figures are located at the end of each section)

- 1-1 Base Location Map
- 2-1 Site Location
- 2-2 Digital Geophysical Mapping Results
- 2-3 PA/SI Surface Soil Exceedances
- 2-4 PA/SI Subsurface Soil Exceedances
- 2-5 PA/SI Groundwater Exceedances
- 2-6 Conceptual Site Model
- 3-1 Sampling Locations
- 3-2 Locations of Geophysical Anomaly Targets
- 4-1 Surface Soil Exceedances
- 4-2 Antimony Concentrations in Surface Soil Greater than USEPA RSLs
- 4-3 Lead Concentrations in Surface Soil Greater than USEPA RSLs
- 4-4 Subsurface Soil Exceedances

Acronyms and Abbreviations

µg/L	microgram(s) per liter
ASR	Archive Search Report
Baker	Baker Environmental, Inc.
BBG	Base background
bgs	below ground surface
CamLej	Camp Lejeune
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-Term Environmental Action—Navy
COPC	chemical of potential concern
CSM	Conceptual Site Model
CTO	Contract Task Order
DGM	digital geophysical mapping
DoD	Department of Defense
DPT	direct-push technology
EcoSSL	Ecological Soil Screening Levels
EM61	EM61-MK2 electromagnetic system
EPC	exposure point concentration
ERA	Ecological Risk Assessment
ERS	Ecological Risk Screening
ESS	Explosives Safety Submission
ESV	ecological screening value
°F	degrees Fahrenheit
HHRS	Human Health Risk Screening
HI	hazard index
HQ	hazard quotient
IDW	investigation-derived waste
MCB	Marine Corps Base
MD	munitions debris
MDAS	material documented as safe
MEC	munitions and explosives of concern
mg/kg	milligrams per kilogram
MMRP	Military Munitions Response Program
MPPEH	material potentially presenting an explosive hazard
MRP	Munitions Response Program
Navy	Department of the Navy
NCGWQS	North Carolina Groundwater Quality Standards
NCDENR	North Carolina Department of Environment and Natural Resources
NC SSL	North Carolina Soil Screening Level
PA/SI	Preliminary Assessment/Site Inspection
PPE	personal protective equipment
QA	quality assurance
QC	quality control

RSL	Regional Screening Level
SI	Site Investigation
SSL	Soil Screening Level
SVOC	semivolatile organic compound
TAL	Target Analyte List
UCL	upper confidence limit
USACE	United States Army Corps of Engineers
USAE	USA Environmental, Inc.
USEPA	United States Environmental Protection Agency
UXO	unexploded ordnance
UXOQCS	UXO Quality Control Specialist

SECTION 1

Introduction

This report documents the findings of the Expanded Site Investigation (SI) conducted at United States Marine Corps Military Munitions Response Program (MMRP) Site Unexploded Ordnance (UXO)-14 – former Indoor Pistol Range (Archive Search Report [ASR] Area #2.199) and former Gas Chamber (ASR #2.200), collectively referred to as Site UXO-14, at Marine Corps Base Camp Lejeune (MCB CamLej) in Jacksonville, North Carolina.

The Site UXO-14 Expanded SI was conducted by CH2M HILL under the Naval Facilities Engineering Command Comprehensive Long-Term Environmental Action—Navy (CLEAN) Contract N62470-08-D-1000, Contract Task Order (CTO) WE41. The location of the investigation area is shown on **Figure 1-1**.

1.1 Purpose

The purpose of the Expanded SI was to address the recommendations of a Preliminary Assessment/Site Inspection (PA/SI) conducted in 2009 as part of the MCB CamLej investigation of closed ranges following the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) investigation process. The PA/SI recommended that an intrusive investigation be performed to assess the nature of the geophysical anomalies representing potential subsurface munitions and explosives of concern (MEC) at the former gas chamber area. Additional investigation was also recommended for delineation of the extent of the identified impacts to surface and subsurface soil at the former Indoor Pistol Range area.

1.2 Objectives and Approach

The objectives of the UXO-14 Expanded SI are as follows:

- Assess the nature of 17 geophysical anomalies identified as representing potential subsurface MEC at the former Gas Chamber through intrusive investigation.
- Evaluate the distribution of and potential for human health and ecological risks associated with antimony, lead, and mercury in soil at the former Indoor Pistol Range by collecting and evaluating additional surface and subsurface soil samples.

The Expanded SI was conducted in accordance with the Expanded SI Work Plan (CH2M HILL, 2011b) and the Munitions Response Program (MRP) Master Project Plan (CH2M HILL, 2008).

1.3 Report Organization

This Expanded SI report is organized as follows:

- Section 1 – Introduction - provides the objectives of the Expanded SI and the tasks performed during the associated field effort
- Section 2 – Site Background - presents a brief summary of the site description, history, and physical setting
- Section 3 – Field Investigation Activities - provides a summary of the field activities conducted during the Expanded SI
- Section 4 – Investigation Results - presents the Expanded SI results
- Section 5 – Human Health Risk Screening - provides a summary of the risk screening process and findings
- Section 6 – Ecological Risk Assessment - provides a summary of the risk assessment process and findings
- Section 7 – Conclusions and Recommendations - presents the conclusions and recommendations for Site UXO-14, based upon the results of the PA/SI and Expanded SI environmental sampling and MEC intrusive investigation.

- Section 8 – References - presents the documents cited in this report

Field documentation, laboratory data and processing documentation, intrusive investigation results, munitions debris (MD) disposal documentation, and information supporting the risk evaluations are contained in the appendixes.



- Legend**
- Munitions Response Site Boundaries
 - Highways
 - Installation Boundary

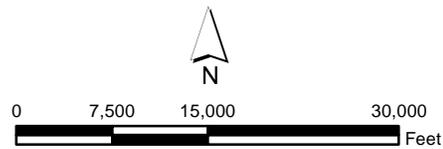


Figure 1-1
Base Location Map
Site UXO-14 Expanded SI Report
MCB CamLej
North Carolina

Site Background

This section summarizes regional and site-specific information, including location, site setting, physical characteristics, and history.

2.1 MCB CamLej Location and Description

MCB CamLej covers approximately 236 square miles in Onslow County, North Carolina, and is bisected by the New River, which flows in a southeasterly direction toward the Atlantic Ocean. Construction of MCB CamLej began in 1941 with the objective of developing the world's most complete amphibious training base. The mission of MCB CamLej is to maintain combat-ready units for expeditionary deployment. MCB CamLej provides housing, training facilities, logistical support, and administrative supplies for Fleet Marine Force units and other assigned units. The Base and surrounding community is home to an active-duty, dependent, retiree, and civilian population of approximately 180,000 people. Land use surrounding MCB CamLej is varied, with mainly commercial properties along the Northern Boundary. A mix of agricultural lands and residential areas are located along the eastern and western boundaries of the Base. The southern boundary of MCB CamLej extends to the New River and Atlantic Ocean.

2.2 Site Setting

Site UXO-14 includes two separate areas located west of Powder Lane in the Stone Bay area of MCB CamLej (**Figure 2-1**). The eastern area of Site UXO-14, the former Indoor Pistol Range area, includes approximately 3,920 square feet of level terrain consisting of maintained grass and a loose sandy area representing the former building footprint.

The western area of Site UXO-14, the former Gas Chamber area, is approximately 1,742 square feet in size and is heavily wooded with thick underbrush. The land surface within the former Gas Chamber area slopes toward the south and west, toward an unnamed tributary of the New River. No surface water bodies were observed within Site UXO-14 during the July 2009 site visit.

2.3 Site History

CH2M HILL completed an Archive Search Report (ASR) for this site as part of the PA/SI (CH2M HILL, 2011a). The Indoor Pistol Range first appears on existing conditions maps in 1950 as Building RR-53 according to the *Final Range Identification and Preliminary Range Assessment* and was present on Base maps until 1996 (USACE, 2001). The Indoor Pistol Range appears in the 1962 and 1989 historical aerial photographs. According to Base Range Safety Officer, Duane Richardson, the Indoor Pistol Range was only used for small arms training (Richardson, 2008).

The Gas Chamber first appeared on the 1950 existing conditions maps as Building RR-63; it was labeled as a Gas Chamber until 1954. After 1954, Building RR-63 was used for storage and was present on maps until 1965. However, on the 1962 historical aerial photograph, the area is completely overgrown and Building RR-63 is not visible. The 1989 aerial photograph also shows the area as being heavily wooded. According to the *Final Range Identification and Preliminary Range Assessment*, tear gas was used at this facility (USACE, 2001).

2.4 Previous Investigations

A PA/SI for Site UXO-14 was conducted in 2009 to evaluate the potential presence and nature of impacts to environmental media resulting from tear gas training at the former Gas Chamber and small arms training at the former Indoor Pistol Range. In addition, the former Gas Chamber Area was assessed for the presence of anomalies that represent potential subsurface MEC.

2.4.1 MEC Investigation

The May 2009 digital geophysical mapping (DGM) survey at the former Gas Chamber covered approximately 20 percent (approximately 348 square feet of the area). The DGM survey, which utilized a single-coil EM61-MK2 electromagnetic system (EM61), yielded a total of 17 geophysical anomalies representing potential subsurface MEC. **Figure 2-2** illustrates the DGM area and the distribution of anomalies identified as representing potential subsurface MEC. Based on the DGM results, the PA/SI report recommended that an intrusive investigation be performed to identify the sources of the geophysical anomalies representing potential subsurface MEC at the former Gas Chamber area.

2.4.2 Environmental Sampling and Results

Environmental sampling at the former Indoor Pistol Range and the former Gas Chamber consisted of:

- A total of 20 surface soil samples collected using the TR-02-1 approach (as described in the Work Plan) at a depth interval of 0 to 2 inches below ground surface (bgs). Soil samples were collected by compositing a minimum of 30 sample aliquots from random locations within each 1-meter by 1-meter sampling location, in accordance with the United States Army Corps of Engineers (USACE) Technical Report ERDC/CRREL TR-02-1, *Guide for Characterization of Sites Contaminated with Energetic Materials* (Thiboutot, Ampleman, and Hewitt, 2002).
- A total of four subsurface soil samples from soil cores collected using a direct-push technology (DPT) rig. The subsurface soil samples were collected from an unsaturated portion of the soil core located immediately above the estimated water table. Samples depths ranged from 2 to 5 feet bgs.
- A total of four groundwater samples collected from temporary groundwater monitoring wells screened within the surficial aquifer.

Soil

Twelve surface soil samples and three subsurface soil samples were collected at the former Indoor Pistol Range and analyzed for Target Analyte List (TAL) metals (SW-846 United States Environmental Protection Agency [USEPA] Methods 6010B and 7471A).

Eight surface soil samples and one subsurface soil sample were collected at the former Gas Chamber and analyzed for semivolatile organic compounds (SVOCs) (SW-846 USEPA Method 8270C).

Following the third-party validation of the laboratory analytical data, surface and subsurface soil samples were screened against the North Carolina Soil Screening Levels (NC SSLs) (NCDENR, 2010a), the Adjusted USEPA Regional Screening Levels (RSLs) for Chemical Contaminant Tables (USEPA, 2010a), and MCB CamLej background surface and subsurface soil concentrations (2 times the mean base background [BBG] surface soil concentration), which were available for inorganic analytes only (Baker, 2001).

The RSLs for non-carcinogenic compounds were adjusted by dividing by 10 to conservatively account for exposure to multiple analytes. The NC SSLs are back-calculated from acceptable groundwater concentrations and take fate and transport parameters into consideration (NCDENR, 2010a).

Summary information for surface soil samples collected at the former Indoor Pistol Range and former Gas Chamber with analyte concentrations greater than the screening criteria is shown in **Table 2-1**. **Figure 2-3** shows the locations of the exceedances. The analyte exceedances for each sample are provided in Appendix A. At the former Indoor Pistol Range, antimony, arsenic, lead, and mercury concentrations were greater than at least one of the regulatory screening criteria and two times the mean BBG in surface soil samples collected. Chromium concentrations in all former Indoor Pistol Range samples were greater than the residential RSL but less than two times the mean BBG. Iron concentrations in all samples were greater than the NC SSL but less than two times the mean BBG. The concentration of pentachlorophenol was greater than the NC SSL in one of the eight surface soil samples collected at the former Gas Chamber.

Summary information for subsurface soil results at the former Indoor Pistol Range with analyte concentrations greater than regulatory screening criteria is shown in **Table 2-2**. **Figure 2-4** shows the locations of the exceedances. The analyte exceedances for each sample are provided in Appendix A. Chromium concentrations in all samples were greater than the residential RSL but less than two times the mean BBG. Iron concentrations in all samples were greater than the NC SSL but less than two times the mean BBG. Lead concentrations were greater than the NC SSL and two times the mean BBG in one out of three samples. None of the analytes in subsurface soil samples collected at the former Gas Chamber had concentrations greater than NC SSLs or Adjusted RSLs.

TABLE 2-1
PA/SI Surface Soil Analytical Results

Analyte	Frequency of Detection (# detected / # analyzed)	Maximum Concentration (mg/kg)	Minimum Detected Concentration (mg/kg)	Screening Criteria (mg/kg)	Frequency of Exceedances
Former Indoor Pistol Range Exceedances					
Antimony	9/13	387	0.347 J	2X Mean BBG	8
				Residential RSL	6
				Industrial RSL	2
Arsenic	12/13	2.7	0.204 J	2X Mean BBG	5
				Residential RSL	7
				Industrial RSL	1
Chromium	13/13	3.76	0.882	Residential RSL	13
Iron	13/13	1,470	243	NC SSL	13
Lead	13/13	35,500	132	2X Mean BBG	13
				Residential RSL	7
				Industrial RSL	7
				NC SSL	10
Mercury	9/13	1.08	0.017	2X Mean BBG	1
				NC SSL	1
Former Gas Chamber Exceedances					
Pentachlorophenol	1/8	630 J	630 J	NC SSL	1

Notes:

BBG – Base Background

J – Analyte present, value may or may not be accurate or precise

mg/kg - milligrams per kilogram

NC SSL - North Carolina Soil Screening Level

RSL – Adjusted United States Environmental Protection Agency Regional Screening Level

TABLE 2-2

PA/SI Subsurface Soil Analytical Results

Analyte	Frequency of Detection (# detected / # analyzed)	Maximum Concentration (mg/kg)	Minimum Detected Concentration (mg/kg)	Screening Criteria (mg/kg)	Frequency of Exceedances
Former Indoor Pistol Range Exceedances					
Chromium	3/3	1.06	0.74 J	Residential RSL	0.29 3
Iron	3/3	370	183	NC SSL	150 3
Lead	3/3	290	1.34	2X Mean BBG	8.49 1
				NC SSL	270 1
Former Gas Chamber – No Exceedance					

Notes:

BBG – Base Background

J – Analyte present, value may or may not be accurate or precise

mg/kg - milligrams per kilogram

NC SSL - North Carolina Soil Screening Level

RSL – Adjusted United States Environmental Protection Agency Regional Screening Level

Groundwater

Groundwater samples at the former Indoor Pistol Range were analyzed for total and dissolved metals (SW-846 USEPA Methods 6010B and 7470), and groundwater samples at the former Gas Chamber were analyzed for SVOCs (SW-846 USEPA Method 8270C).

Groundwater results were screened against the North Carolina Groundwater Quality Standards (NCGWQS) (NCDENR, 2010b), Adjusted USEPA Tap Water RSLs (USEPA, 2010a), and 2 times the mean BBG groundwater concentration (Baker, 2002). The NCGWQS are the maximum allowable concentrations resulting from any discharge of contaminants to the land or waters of the state that may be tolerated without creating a threat to human health or otherwise rendering the groundwater unsuitable for its intended purpose. The Tap Water RSLs for non-carcinogenic compounds were adjusted by dividing by 10 to conservatively account for exposure to multiple analytes.

The detections and exceedances of groundwater screening criteria at the former Indoor Pistol Range and the former Gas Chamber are shown in **Table 2-3** and **Table 2-4**, respectively. The analyte exceedances for each sample are provided in **Appendix A**. **Figure 2-5** depicts the locations of groundwater exceedances for both areas.

TABLE 2-3

PA/SI Analytical Results for Metals in Groundwater beneath the Former Indoor Pistol Range Area

Analyte	Frequency of Detection (# detected / # sampled)	Maximum Concentration (µg/L)	Minimum Concentration (µg/L)	Screening Criteria (µg/L)	Frequency of Exceedances
Total Metals					
Arsenic	2/3	4.09	1.03 J	USEPA Adjusted Tap Water RSL	0.045 2
Chromium	3/3	2	1.14 J	USEPA Adjusted Tap Water RSL	0.043 3
Iron	3/3	2910	518	NCGWQS	300 3
				USEPA Adjusted Tap Water RSL	2600 1
Copper	2/3	103	1.49 J	2X Mean BBG	2.76 1

TABLE 2-3
PA/SI Analytical Results for Metals in Groundwater beneath the Former Indoor Pistol Range Area

Analyte	Frequency of Detection (# detected / # sampled)	Maximum Concentration (µg/L)	Minimum Concentration (µg/L)	Screening Criteria (µg/L)	Frequency of Exceedances	
Dissolved Metals						
Arsenic	1/3	3.29	3.29	USEPA Adjusted Tap Water RSL	0.045	1
Chromium	3/3	1.51	0.86 J	USEPA Adjusted Tap Water RSL	0.043	3
Iron	3/3	2670	398	NCGWQS	300	3
				USEPA Adjusted Tap Water RSL	2600	1

Notes:

µg/L – micrograms per liter

J – Analyte present, value may or may not be accurate or precise

NCGWQS – North Carolina Groundwater Quality Standards

RSL – Adjusted United States Environmental Protection Agency Regional Screening Level

TABLE 2-4
PA/SI Analytical Results for SVOCs in Groundwater beneath the Former Gas Chamber Area

Analyte	Frequency of Detection (# detected / # sampled)	Maximum Concentration (µg/L)	Minimum Concentration (µg/L)	Screening Criteria (µg/L)	Frequency of Exceedances	
Benzo(a)pyrene	1/1	0.07	0.07	USEPA Adjusted Tap Water RSL	0.003	1
				NCGWQS	0.005	1
Dibenz(a,h)anthracene	1/1	0.078 J	0.078 J	USEPA Adjusted Tap Water RSL	0.003	1
				NCGWQS	0.005	1
Indo (1,2,3-cd) pyrene	1/1	0.069 J	0.069 J	USEPA Adjusted Tap Water RSL	0.003	1
				NCGWQS	0.005	1

Notes:

µg/L - micrograms per liter

J – Analyte present, value may or may not be accurate or precise

NCGWQS – North Carolina Groundwater Quality Standards

RSL – Adjusted United States Environmental Protection Agency Regional Screening Level

At the former Indoor Pistol Range, arsenic (in two of three samples) and chromium concentrations (in three of three samples) exceeded the Adjusted Tap Water RSL. The concentration of iron was greater than the NCGWQS in three of three samples and greater than the Adjusted Tap Water RSL in one sample. The concentration of copper was greater than 2 times the mean BBG in one of three samples. At the former Gas Chamber, the concentrations of benzo(a)pyrene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene were greater than the NCGWQS.

A conservative preliminary Human Health Risk Screening (HHRS) and an Ecological Risk Screening (ERS) were conducted for Site UXO-14 based upon the PA/SI data. The results are summarized in **Tables 2-5** and **2-6**, respectively. The concentrations of SVOCs in groundwater beneath the former Gas Chamber Area did not present an unacceptable risk to human health or ecological receptors. At the former Indoor Pistol Range, antimony, mercury (from the ERS only), and lead were identified as chemicals of potential concern (COPCs) in surface soil. Antimony and lead were identified as COPCs in subsurface soil. The PA/SI HHRS and ERS indicated that further

investigation was necessary to delineate the extent of metals concentrations greater than screening values in surface and subsurface soil at the former Indoor Pistol Range.

TABLE 2-5
PA/SI Human Health Risk Screening Summary

Media	Step 1 COPCs		Step 2 COPCs		Step 3 COPCs		Conclusion
	Indoor Pistol Range	Gas Chamber Area	Indoor Pistol Range	Gas Chamber Area	Indoor Pistol Range	Gas Chamber Area	
Surface Soil	Antimony	None	Antimony	NC	Antimony	NC	Further evaluation of surface soil at the Former Indoor Pistol Range is necessary.
	Arsenic		Lead*		Lead*		
	Lead*						
*Average lead concentration of 4,603 mg/kg exceeds lead screening level of 400 mg/kg; therefore, lead is considered a COPC							
Sub-surface Soil	Antimony	None	Antimony	NC	Antimony	NC	Further evaluation of subsurface soil at the Former Indoor Pistol Range is necessary.
	Arsenic		Lead*		Lead*		
	Lead*						
*Average lead concentration of 3,702 mg/kg exceeds lead screening level of 400 mg/kg; therefore, lead is considered a COPC							
Ground-water	None	Benzo(a)pyrene	NC	None	NC	NC	No unacceptable risk expected from exposure to groundwater.
		Dibenz(a,h)anthracene					
		Indeno(1,2,3-cd)pyrene					

Notes:
 COPC = chemical of potential concern
 mg/kg = milligram(s) per kilogram
 NC = not calculated; no COPCs were identified in the preceding step

TABLE 2-6
PA/SI Ecological Risk Screening Summary

Media	COPCs	Conclusions
Surface Soil	Antimony, Lead, Mercury	These metals in surface soil at the former Indoor Pistol Range pose unacceptable potential risk to ecological receptors
Subsurface Soil	Antimony, Lead	These metals in subsurface soil at the former Indoor Pistol Range pose unacceptable potential risk to ecological receptors
Groundwater	None	No unacceptable potential risk from groundwater beneath UXO-14 to ecological receptors

Notes:
 UXO – unexploded ordnance

2.5 Regional Climate

The climate in the Onslow County area is characterized by short, mild winters and long, hot, and humid summers. Average annual net precipitation is approximately 50 inches. Ambient air temperatures generally range from 33 to 53 degrees Fahrenheit (°F) in the winter months and from 71 to 98°F during the summer months. Winds are generally south-southwesterly in the summer and north-northwesterly in the winter (Water and Air Research, 1983). The hurricane season begins on June 1 and continues through November 30. Storms of non-tropical origin, such as frontal passages, local thunderstorms, and tornadoes, are more frequent and can occur at any time during the year.

2.6 Regional Geology and Hydrogeology

Regional geology at MCB CamLej is discussed in the *Munitions Response Program Master Project Plans, Marine Corps Base Camp Lejeune, North Carolina* (CH2M HILL, 2008), referred to hereinafter as the Munitions Response Program (MRP) Master Project Plans.

2.7 Site Geology and Hydrogeology

Site-specific geologic information was obtained from soil cores collected from depths of up to 15 feet bgs during the PA/SI. Soil boring logs of the sediments indicated that the soils range from clay to fine grained sand in laterally discontinuous layers (CH2M HILL, 2011a). These shallow soils are consistent with those described as the undifferentiated formation (Cardinell et al., 1993).

The water table of the surficial aquifer occurs in the undifferentiated formation at this site. Site-specific hydrogeologic information was derived from the installation of four temporary monitoring wells during the PA/SI. The temporary wells were screened in the surficial aquifer, with screen bottom depths ranging from 15 to 18 feet bgs. In December 2009, groundwater flow in the surficial aquifer generally flowed toward the southwest with a horizontal hydraulic gradient of approximately 0.02 foot per foot in the vicinity of the former Indoor Pistol Range area (CH2M HILL, 2011a).

2.8 Conceptual Site Model

The Conceptual Site Model (CSM) for the former Indoor Pistol Range, shown on **Figure 2-6**, is an essential element of a results-based environmental investigation and corrective action program. A CSM integrates the information needed to understand how COPCs move through the environment and potentially come in contact with human and ecological receptors. The CSM is also an effective tool for identifying additional data needs and supporting management decisions regarding sampling strategies, project constraints, and regulatory compliance. Key elements of the CSM are grouped into major categories identifying potential sources, extent of contaminant migration, fate and transport, and potential exposure pathways and receptors.

2.8.1 Source

No source of contamination from training activities currently exists at the former Gas Chamber, and no COPCs were identified during the HHRS and ERS. At the former Indoor Pistol Range, antimony and lead were identified as surface soil HHRS and ERS COPCs and mercury was also identified as an ERS COPC. Antimony and lead were identified as subsurface soil HHRS and ERS COPCs. The primary sources at the former Indoor Pistol Range are believed to be the bullets, bullet fragments, casings, and residual propellant released when cartridges were fired during small arms training activities. The secondary sources are metals released during corrosion of the bullets, fragments, and casings that are now sorbed to the soil. The highest concentrations of antimony, lead, and mercury were located in the western portion of the former Indoor Pistol Range.

2.8.2 Fate and Transport Mechanisms

Lead and antimony generally tend to adhere to soil grains and organic material and remain fixed in shallow soil (Fabian and Watts, 2005). Given the low volatility and mobility of antimony and lead, the primary mode of transport is anticipated to be movement of contaminated soil by wind or surface run-off. The fate and transport of mercury is highly dependent upon soil pH and redox potential. Adsorption of mercury decreases with decreasing pH and volatile forms of mercury may be formed by biotic and abiotic processes (USEPA, 1992). Antimony and mercury were not detected in groundwater beneath the former Indoor Pistol Range. Lead was detected in one of three groundwater samples and the concentration was less than 2 times the mean BBG concentration. These results indicate that these metals have not yet migrated to groundwater, although they may do so given enough time.

2.8.3 Exposure Pathways and Receptors

The PA/SI HHRS evaluated potential risks to human health through exposure to Site UXO-14 surface soil, subsurface soil, and groundwater via ingestion, dermal contact, and inhalation. The potential receptors were

current and future workers, trespassers or visitors, and future residents and construction workers. The ERS evaluated potential risk to terrestrial flora through root contact and foliar uptake and terrestrial invertebrates, birds, and mammals through direct contact and ingestion of soil. In addition, terrestrial birds and mammals may be exposed through inhalation of dust and vapor.



Legend

- Site UXO-14 – Former Indoor Pistol Range (ASR #2.199) boundary
- Site UXO-14 – Former Gas Chamber (ASR #2.200) boundary
- Installation Boundary

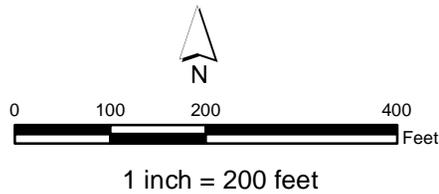


Figure 2-1
Site Location
Site UXO-14 Expanded SI Report
MCB CamLej
North Carolina



Legend

- Geophysical Anomaly (greater than 3 mV)(EM61-MK2)
- DGM Transect
- Site UXO-14 Boundary (Former Indoor Pistol Range Area)
- Site UXO-14 Boundary (Former Gas Chamber Area)

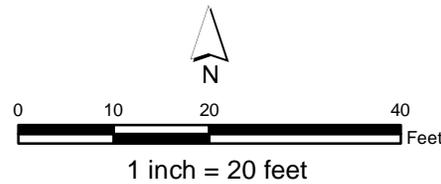
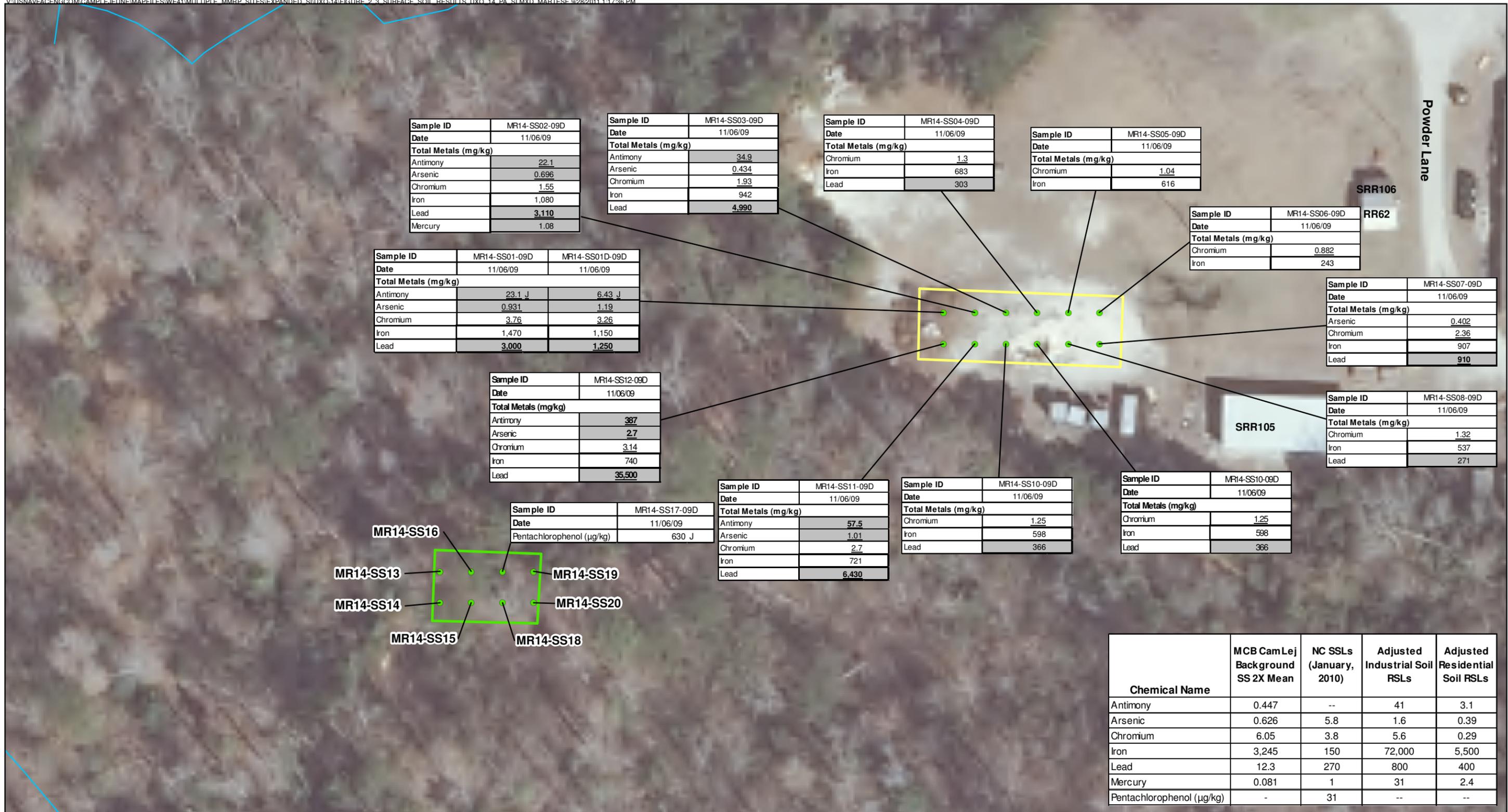


Figure 2-2
Digital Geophysical Mapping Results
Site UXO-14 Expanded SI Report
MCB CamLej
North Carolina



- Legend**
- Surface Soil Sampling Location
 - Surface Water
 - Site UXO-14 Boundary (Former Indoor Pistol Range Area)
 - Site UXO-14 Boundary (Former Gas Chamber Area)

- Notes:**
- Analytical exceedances from the PA/SI
 - Shading indicates exceedance of two times the mean base background concentration for surface soil
 - **Bold box** indicates exceedance of NC SSLs
 - **Bold text** indicates exceedance of Adjusted Industrial Soil RSLs
 - Underline indicates exceedance of Adjusted Residential Soil RSLs
 - RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents
 - mg/kg - Milligrams per kilogram
 - µg/kg - Micrograms per kilogram
 - J - Analyte present, value may or may not be accurate or precise

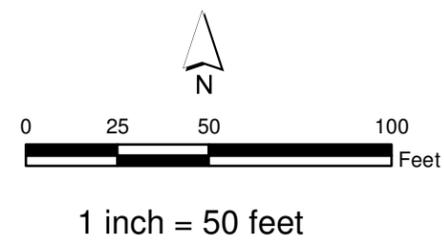


Figure 2-3
PA/SI Surface Soil Exceedances
Site UXO-14 Expanded SI Report
MCB CamLej
North Carolina





Sample ID	MR14-IS01-2-3-09D
Date	12/04/09
Total Metals (mg/kg)	
Chromium	<u>1.06</u>
Iron	370
Lead	290

Sample ID	MR14-IS03-2-3-09D
Date	12/04/09
Total Metals (mg/kg)	
Chromium	<u>0.748</u>
Iron	183

Sample ID	MR14-IS02-2-3-09D
Date	12/04/09
Total Metals (mg/kg)	
Chromium	<u>0.74</u>
Iron	322

MR14-TW04/IS04

Chemical Name	MCB CamLej Background SB 2X Mean	NC SSLs (January, 2010)	Adjusted Industrial Soil RSLs	Adjusted Residential Soil RSLs
Total Metals (mg/kg)				
Chromium	14.5	3.8	5.6	0.29
Iron	5,439	150	72,000	5,500
Lead	12.3	270	800	400

- Legend**
- Subsurface Soil Sampling Location
 - Surface Water
 - Site UXO-14 Boundary (Former Indoor Pistol Range Area)
 - Site UXO-14 Boundary (Former Gas Chamber Area)

Notes:

- Analytical exceedances from the PA/SI
- Shading indicates exceedance of two times the mean base background concentration for subsurface soil
- **Bold box indicates exceedance of NC SSLs**
- **Bold text indicates exceedance of Adjusted Industrial Soil RSLs**
- Underline indicates exceedance of Adjusted Residential Soil RSLs
- RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents
- mg/kg - Milligrams per kilogram

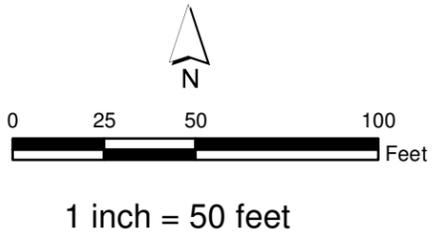


Figure 2-4
PA/SI Subsurface Soil Exceedances
Site UXO-14 Expanded SI Report
MCB CamLej
North Carolina



Sample ID	MR14-TW01-09D
Date	12/09/09
Total Metals (µg/l)	
Arsenic	1.03 J
Chromium	2
Iron	518
Dissolved Metals (µg/l)	
Chromium, Dissolved	1.51
Iron, Dissolved	398

Sample ID	MR14-TW03-09D
Date	12/08/09
Total Metals (µg/l)	
Chromium	1.36
Iron	1230
Dissolved Metals (µg/l)	
Chromium, Dissolved	0.98 J
Iron, Dissolved	1,160

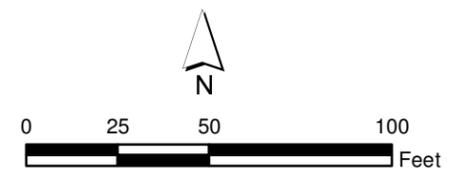
Sample ID	MR14-TW04-09D	MR14-TW04D-09D
Date	12/09/09	12/09/09
Semivolatile Organic Compounds (µg/l)		
Benzo(a)pyrene	0.07 J	0.07 J
Dibenz(a,h)anthracene	0.078 J	0.074 J
Indeno(1,2,3-cd)pyrene	0.069 J	0.071 J

Sample ID	MR14-TW02-09D
Date	12/08/09
Total Metals (µg/l)	
Arsenic	4.09
Chromium	1.14 J
Copper	103
Iron	2910
Dissolved Metals (µg/l)	
Arsenic, Dissolved	3.29
Chromium, Dissolved	0.86 J
Iron, Dissolved	2,670

Chemical Name	MCB CamLej Background GW 2X Mean	NCGWQS (January 2010) *	Adjusted Tap Water RSLs
Semivolatile Organic Compounds (µg/l)			
Benzo(a)pyrene	--	0.005	0.003
Dibenz(a,h)anthracene	--	0.005	0.003
Indeno(1,2,3-cd)pyrene	--	0.05	0.03
Total Metals (µg/l)			
Arsenic	5.77	10	0.045
Chromium	3.13	10	0.043
Copper	2.76	1,000	150
Iron	5,999	300	2,600

- Legend**
- Temporary Well Location
 - Streams
 - Site UXO-14 Boundary (Former Indoor Pistol Range Area)
 - Site UXO-14 Boundary (Former Gas Chamber Area)

- Notes:**
- Shading indicates exceedance of two times the mean base background concentration for surface soil
 - **Shaded box indicates exceedance of NCGWQS or the more conservative MCL**
 - **Bold text indicates exceedance of Adjusted Tap Water RSLs**
 - RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents
 - * - The MCL-Groundwater value is reported in place of the NC2LGW where the MCL value is more conservative.
 - µg/L - Micrograms per liter
 - J - Analyte present, value may or may not be accurate or precise



1 inch = 50 feet

Figure 2-5
PA/SI Groundwater Exceedances
Site UXO-14 Expanded SI Report
MCB CamLej
North Carolina



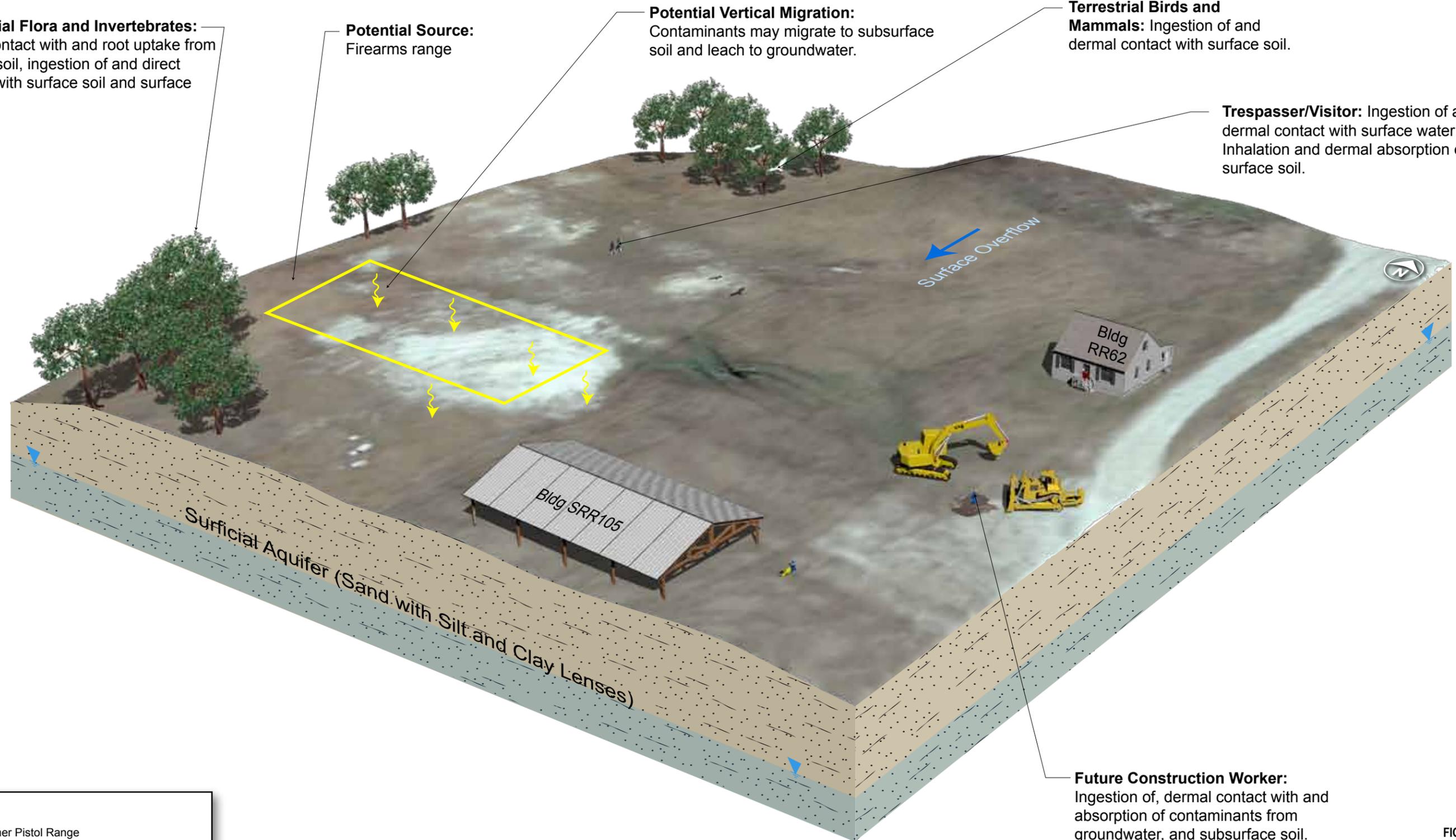
Terrestrial Flora and Invertebrates:
Direct contact with and root uptake from surface soil, ingestion of and direct contact with surface soil and surface water.

Potential Source:
Firearms range

Potential Vertical Migration:
Contaminants may migrate to subsurface soil and leach to groundwater.

Terrestrial Birds and Mammals: Ingestion of and dermal contact with surface soil.

Trespasser/Visitor: Ingestion of and dermal contact with surface water; Inhalation and dermal absorption of surface soil.



Future Construction Worker:
Ingestion of, dermal contact with and absorption of contaminants from groundwater, and subsurface soil.

LEGEND

- ▬ Former Pistol Range
- ▼ Groundwater Table
- Surface Water Flow Direction
- Surficial Aquifer
- Sand with Silt And Clay Lenes

FIGURE 2-6
Conceptual Site Model
UXO-14 Expanded SI Report
MCB CamLej
North Carolina

Field Investigation Activities

The Expanded SI field investigation activities at Site UXO-14 were conducted during July and August 2011 in accordance with the Expanded SI Work Plan and the approved Explosives Safety Submission (ESS) determination request (CH2M HILL, 2011c). The technical approach was developed by the MCB CamLej Tier I Partnering Team, which consists of representatives from the Department of the Navy (Navy), MCB CamLej, USEPA Region 4, and North Carolina Department of Environment and Natural Resources (NCDENR).

3.1 Site Preparation and Support

3.1.1 MEC Avoidance

Because of the potential presence of MEC, avoidance measures were implemented at the former Indoor Pistol Range and the former Gas Chamber in accordance with the approved ESS determination request (CH2M HILL, 2011c). UXO technicians qualified in accordance with Department of Defense (DoD) Explosives Safety Board Technical Paper 18 (2004) provided MEC escort and avoidance services to site visitors, the sampling team, and the utility location subcontractor.

3.1.2 Buried Utility Location

The North Carolina One-Call Center was contacted regarding the proposed subsurface sampling activities. ECLS, Inc., of Erwin, North Carolina, was subcontracted by CH2M HILL to locate and mark underground utilities at the former Indoor Pistol Range.

3.2 Environmental Investigation Activities

The Expanded SI sampling locations were selected to supplement environmental characterization data collected at the former Indoor Pistol Range during the 2009 PA/SI effort. Antimony, lead, and mercury were the only contaminants identified as COPCs in soil at the former Indoor Pistol Range. The number and spatial distribution of Expanded SI sampling locations were selected to assess the extent of the identified impacts to surface and subsurface soil.

3.2.1 Surface Soil Sampling

On July 13 and 14, 2011, surface soil samples were collected from locations shown on **Figure 3-1**. Fourteen composite surface soil samples (designated MR14-SS21 through MR14-SS34) were collected from a depth of 0 to 2 inches using the previously described TR-02-01 method and placed in a 4-ounce glass jar. The samples were packed into coolers with ice and shipped under chain-of-custody control to ENCO Lab, of Jacksonville, Florida, for the analysis of antimony, lead, and mercury by SW-846 USEPA Methods 6010C and 7471B.

3.2.2 Subsurface Soil Sampling

Seven soil borings were advanced to depths of up to 8 feet bgs at the locations shown on **Figure 3-1** using a hand auger, and the soil cuttings were placed in disposable plastic bags labeled with the collection depth. Following the completion of each soil boring, a discrete soil sample from unsaturated soil collected immediately above the estimated water table was transferred directly into a 4-ounce glass jar and packed into coolers with ice. A total of seven subsurface soil samples, MR14-IS05 through MR14-IS11, were collected and shipped under chain-of-custody control to the laboratory for the same analyses as the surface soil samples.

3.2.3 Decontamination of Sampling Equipment

Sampling equipment was decontaminated by physically removing residual soil with a brush, washing thoroughly with Alconox, rinsing with distilled water, then isopropyl alcohol, and again with distilled water. The equipment was then wrapped in aluminum foil unless used immediately. The hand augers were cleaned between boreholes using the same procedure.

3.2.4 Investigation-Derived Waste Management

Investigation-derived waste (IDW) was disposed of in accordance with the Base Waste Management Plan (CH2M HILL, 2011d). IDW consisted of soil cuttings, decontamination fluids, disposable equipment, and personal protective equipment (PPE). Soil from the borings was replaced in and spread around the borehole. The decontamination fluids were placed in labeled 55-gallon drums and staged at the storage facility on Parachute Tower Road. Disposable equipment, including PPE, poly sheeting, paper towels, and aluminum foil, was placed in black contractors' trash bags and disposed of in an on-Base trash receptacle.

3.2.5 Data Validation

The analytical data were validated by Environmental Data Services, Inc., of Williamsburg, Virginia. Data validation reports are provided in **Appendix B**.

3.3 MEC Intrusive Investigation Activities

The MEC intrusive investigation was conducted at the former Gas Chamber. The 2009 DGM survey (CH2M HILL, 2011a) covered 348 square feet, approximately 20 percent, of the 1,742 square feet former Gas Chamber area and identified 17 geophysical anomalies that represented potential subsurface MEC (**Figure 3-2**).

The following MEC intrusive investigation field activities were conducted in August 2011 in accordance with the approved ESS determination request (CH2M HILL, 2011c) and the Expanded SI Work Plan:

- Reacquisition of the geophysical anomalies representing potential subsurface MEC that were identified during the 2009 DGM survey (CH2M HILL, 2011a)
- Manual digging and identification of the sources of anomalies representing potential subsurface MEC
- Removal verification and excavation backfilling
- Disposal of material documented as safe (MDAS)

CH2M HILL provided project and site management, quality control (QC), and safety supervision during the intrusive investigation. USA Environmental, Inc., (USAE) was subcontracted to conduct the reacquisition and intrusive investigation of the geophysical anomalies and the disposition of material potentially presenting an explosive hazard (MPPEH) items found during the investigation.

At Site UXO-14, USAE identified all 17 subsurface geophysical anomalies for excavation using a Whites XLT metal detector or a Schonstedt GA-52Cx magnetometer, or both, and placed a flag approximately 1 foot north of each anomaly.

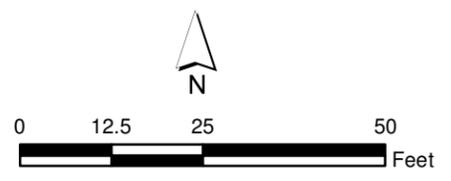
Excavation of all anomalies selected as representing potential subsurface MEC was performed by USAE. The UXO teams were composed of at least one UXO Technician III, one UXO Technician II, and additional UXO technicians. Small hand tools, such as shovels, spades, trowels, and pry bars, were used to access the source anomaly. If the item did not appear to be ordnance related, it was moved to the non-MPPEH (such as scrap metal) collection point. Once the item was removed, the excavation area was rechecked with the EM61 to ensure all anomaly source material had been removed. No MEC was found during the intrusive investigation.

QC inspections were performed by the UXO Quality Control Specialist (UXOQCS) during fieldwork. They consisted of checking 10 percent of the intrusively investigated anomaly locations using an EM61 to determine if all detectable metallic items had been removed. Additional quality assurance (QA)/QC removal verification requirements and analysis were followed as described the Expanded SI Work Plan. The one QC seed buried onsite during the 2009 DGM activities was recovered.

Following the 100 percent inspection and 100 percent re-inspection of MPPEH and its designation as MDAS, the MDAS was placed in a 55-gallon drum. The resulting 1 pound of MDAS will be disposed of at a qualified smelter/recycler upon completion of all the MMRP sites under this contract. A copy of the DD Form 1348-1A for this material can be found in **Appendix C**.



- Legend**
- Surface Soil
 - Subsurface Soil
 - Surface and Subsurface Soil
 - Site UXO-14 Boundary (Former Indoor Pistol Range Area)



1 inch = 25 feet

Figure 3-1
 Sampling Locations
 Site UXO-14 Expanded SI Report
 MCB CamLej
 North Carolina





Legend

- Geophysical Anomaly (greater than 3 mV)(EM61-MK2)
- DGM Transect
- Site UXO-14 Boundary (Former Indoor Pistol Range Area)
- Site UXO-14 Boundary (Former Gas Chamber Area)

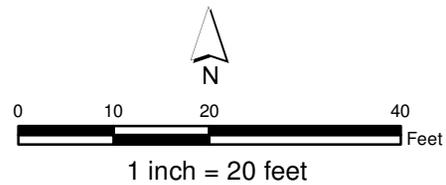


Figure 3-2
Locations of Geophysical Anomaly Targets
Site UXO-14 Expanded SI Report
MCB CamLej
North Carolina

Investigation Results

This section presents the findings of the investigative activities conducted at Site UXO-14 between July and August 2011.

4.1 Environmental Investigation Results

This subsection presents and summarizes the laboratory data from analysis of soil samples collected at the former Indoor Pistol Range. **Sections 5** and **6** evaluate these analytical data from human health and ecological viewpoints.

Following data validation of the laboratory analytical data, surface and subsurface soil analytical results were screened against the following criteria:

- Adjusted* USEPA RSLs for industrial and residential soil (USEPA, 2011)
- NCDENR Soil Screening Levels (SSLs) (NCDENR, 2011)
- Two times the mean BBG concentrations in surface and subsurface soil (Baker, 2001)

*The RSLs based on non-carcinogenic effects were adjusted through dividing by 10 to account for exposure to multiple constituents; the RSLs based on carcinogenic effects will be used as presented in the USEPA RSL table.

4.1.1 Surface Soil

Figure 4-1 illustrates the locations of the surface soil samples that exceeded 2 times the BBG levels *and* at least one of the screening levels (the NC SSLs or the USEPA Adjusted RSLs for soil). The antimony, lead, and mercury concentration ranges, frequencies of detection, and frequencies of screening criteria exceedance in surface soil are summarized in **Table 4-1**. The concentrations of detected analytes are compared to individual screening criteria in **Table 4-2**.

Antimony was detected in 4 of 14 of the surface soil samples. The detected concentrations were greater than 2 times the mean BBG and NC SSL but less than the Adjusted USEPA residential and industrial RSLs.

Lead was detected in all surface soil samples, and the concentrations were reported to exceed both 2 times the mean BBG and the NC SSL. The lead concentrations were greater than the Adjusted USEPA residential RSL in 3 of 14 samples, and only one sample had a concentration greater than the industrial RSL.

Mercury was detected in 4 of 14 surface soil samples, and the concentration was greater than the BBG in only one sample. All detected concentrations were less than the NC SSL and Adjusted USEPA residential and industrial RSLs.

Based upon the combined PA/SI and Expanded SI results, the horizontal extents of antimony, lead, and mercury concentrations greater than screening criteria have been delineated. The approximate extents of antimony and lead concentrations greater than the Adjusted USEPA residential and industrial RSLs are delineated as shown on **Figure 4-2** and **Figure 4-3**, respectively.

TABLE 4-1

Summary of Surface Soil Exceedances

Chemical Name	Frequency of Detection (# detected / # analyzed)	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	Location of Maximum Concentration	Screening Criteria (mg/kg)	Frequency of Exceedance
Antimony	4/14	0.656 J	2.5 J	MR14-SS23	2X Mean BBG 0.447	4
					NC SSL 0.27	4
Lead	14/14	16.8	886 J	MR14-SS31	2X Mean BBG 12.3	14
					NC SSL 14	14
					Residential RSL 400	3
					Industrial RSL 800	1
Mercury	4/14	0.0224 J	0.089	MR14-SS24	2X Mean BBG 0.081	1

Notes:

BBG – Base Background

J – Analyte present, value may or may not be accurate or precise

mg/kg - milligrams per kilogram

NC SSL - North Carolina Soil Screening Level

RSL – Adjusted United States Environmental Protection Agency Regional Screening Level

4.1.2 Subsurface Soil

Figure 4-4 depicts the locations of subsurface soil samples that contained COPCs at concentrations greater than twice the mean BBG levels *and* at least one of the screening levels (the NC SSLs or the USEPA Adjusted Soil RSLs).

Table 4-3 summarizes the antimony and lead concentration ranges, frequencies of detection, and frequencies of screening criteria exceedance in subsurface soil. Mercury was not detected in any subsurface soil sample. The concentrations of detected analytes are compared to individual screening criteria in **Table 4-4**.

Antimony was detected in one of seven subsurface samples. The concentration exceeded 2 times the mean BBG and the NC SSL but was less than the Adjusted USEPA residential and industrial RSLs.

Lead was detected in all subsurface soil samples. The concentrations were greater than 2 times the mean BBG in five of seven samples and greater than the NC SSL in three of seven samples. The lead concentrations were less than the USEPA residential and industrial RSLs in all cases.

TABLE 4-3

Summary of Subsurface Soil Exceedances

Chemical Name	Frequency of Detection (# detected / # analyzed)	Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	Location of Maximum Concentration	Screening Criteria (mg/kg)	Frequency of Exceedances
Antimony	1/7	0.842 J	0.842 J	MR14-IS07	2X Mean BBG 0.36	1
					NC SSL 0.27	1
Lead	7/7	1.72 J	71.5	MR14-IS07	2X Mean BBG 8.49	5
					NC SSL 14	3

Notes:

BBG – Base Background

J – Analyte present, value may or may not be accurate or precise

mg/kg - milligrams per kilogram

NC SSL - North Carolina Soil Screening Level

RSL – Adjusted United States Environmental Protection Agency Regional Screening Level

4.2 MEC Intrusive Investigation Results

The data collected during the investigation of each anomaly are documented in **Appendix D**. Approximately 45 pounds of non-MPPEH metallic debris (such as scrap metal and/or cultural debris) were collected during the intrusive investigation. No MEC was found at Site UXO-14 during the August 2011 intrusive investigation. Two of the anomalies investigated were determined to be MPPEH (small arms cartridge casings).

TABLE 4-2
Surface Soil Analytical Results
Site UXO-14 Expanded SI Report
MCB CamLej, North Carolina

Station ID	MCB CamLej Background 2X Mean	CLEAN NC SSLs (June, 2011)	Adjusted Industrial Soil RSLs (June, 2011)	Adjusted Residential Soil RSLs (June, 2011)	MR14-SS21	MR14-SS22/IS05	MR14-SS23/IS06	MR14-SS24/IS07	MR14-SS25/IS08		MR14-SS26/IS09	MR14-SS27	MR14-SS28	MR14-SS29	MR14-SS30	MR14-SS31		MR14-SS32	MR14-SS33	MR14-SS34
Sample ID					MR14-SS21-11C	MR14-SS22-11C	MR14-SS23-11C	MR14-SS24-11C	MR14-SS25-11C	MR14-SS25D-11C	MR14-SS26-11C	MR14-SS27-11C	MR14-SS28-11C	MR14-SS29-11C	MR14-SS30-11C	MR14-SS31-11C	MR14-SS31D-11C	MR14-SS32-11C	MR14-SS33-11C	MR14-SS34-11C
Sample Date					07/11/11	07/11/11	07/11/11	07/11/11	07/11/11	07/11/11	07/11/11	07/11/11	07/11/11	07/11/11	07/11/11	07/11/11	07/11/11	07/11/11	07/11/11	07/11/11
Chemical Name																				
Total Metals (mg/kg)																				
Antimony	0.447	0.27	41	3.1	2.02 <u>U</u>	1.03 J	2.5 J	1.45 <u>UJ</u>	1.75 <u>U</u>	1.98 <u>U</u>	1.54 <u>UJ</u>	1.57 <u>UJ</u>	1.74 <u>UJ</u>	1.9 <u>UJ</u>	1.48 <u>UJ</u>	1.65 J	1.56 J	1.7 <u>UJ</u>	0.656 J	1.48 <u>UJ</u>
Lead	12.3	14	800	400	19.4	342 J	764 J	509 J	267 J	244 J	73.5	31.1	114 J	141 J	112 J	886 J	432 J	25	341 J	16.8
Mercury	0.081	0.1	31	2.3	0.0299 <u>U</u>	0.0286 <u>U</u>	0.056 J	0.089	0.0278 <u>U</u>	0.0291 <u>U</u>	0.0251 <u>U</u>	0.024 <u>U</u>	0.0224 J	0.0394 J	0.0249 <u>U</u>	0.0245 <u>U</u>	0.0257 <u>U</u>	0.0272 <u>U</u>	0.0291 <u>U</u>	0.0279 <u>U</u>

Notes:

ID = identification

mg/kg - milligrams per kilogram

NC SSL = North Carolina Soil Screening Level

RSL = Regional Screening Level

SS = surface soil

Shading indicates exceedance of two times the mean base background concentration for surface soil

Bold box indicates exceedance of NC SSL

Bold text indicates exceedance of Adjusted Industrial Soil RSLs

Underline indicates exceedance of Adjusted Residential Soil RSLs

RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents

J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

TABLE 4-4
Subsurface Soil Analytical Results
Site UXO-14 Expanded SI Report
MCB CamLej, North Carolina

Station ID	MCB CamLej Background 2X Mean	CLEAN NC SSLs (June, 2011)	Adjusted Industrial Soil RSLs	Adjusted Residential Soil RSLs	MR14-IS10	MR14-IS11	MR14-SS22/IS05	MR14-SS23/IS06		MR14-SS24/IS07	MR14- SS25/IS08	MR14- SS26/IS09
Sample ID					MR14-IS10-6_5-7_5-11C	MR14-IS11-5-6-11C	MR14-IS05-7-8-11C	MR14-IS06-6-7-11C	MR14-IS06D-6-7-11C	MR14-IS07-5-6- 11C	MR14-IS08-4- 5-11C	MR14-IS09-6- 7-11C
Sample Date					07/12/11	07/12/11	07/11/11	07/11/11	07/11/11	07/12/11	07/12/11	07/12/11
Chemical Name												
Total Metals (mg/kg)												
Antimony	0.36	0.27	41	3.1	1.9 UJ	1.55 UJ	1.32 UJ	1.47 UJ	1.77 UJ	0.842 J	1.61 UJ	1.26 UJ
Lead	8.49	14	800	400	17.5	13.5	13.8	35.8 J	69.4 J	71.5	1.72 J	3.67 J
Mercury	0.071	0.1	31	2.3	0.0321 U	0.0292 U	0.0287 U	0.0303 U	0.0267 U	0.0302 U	0.0292 U	0.0303 U

Notes:

ID = Identification

NC SSL = North Carolina Soil Screening Level

RSL = Regional Screening Level

SB = subsurface

Shading indicates exceedance of two times the mean base background concentration for subsurface soil

Bold box indicates exceedance of NC SSL

Bold text indicates exceedance of Adjusted Industrial Soil RSLs

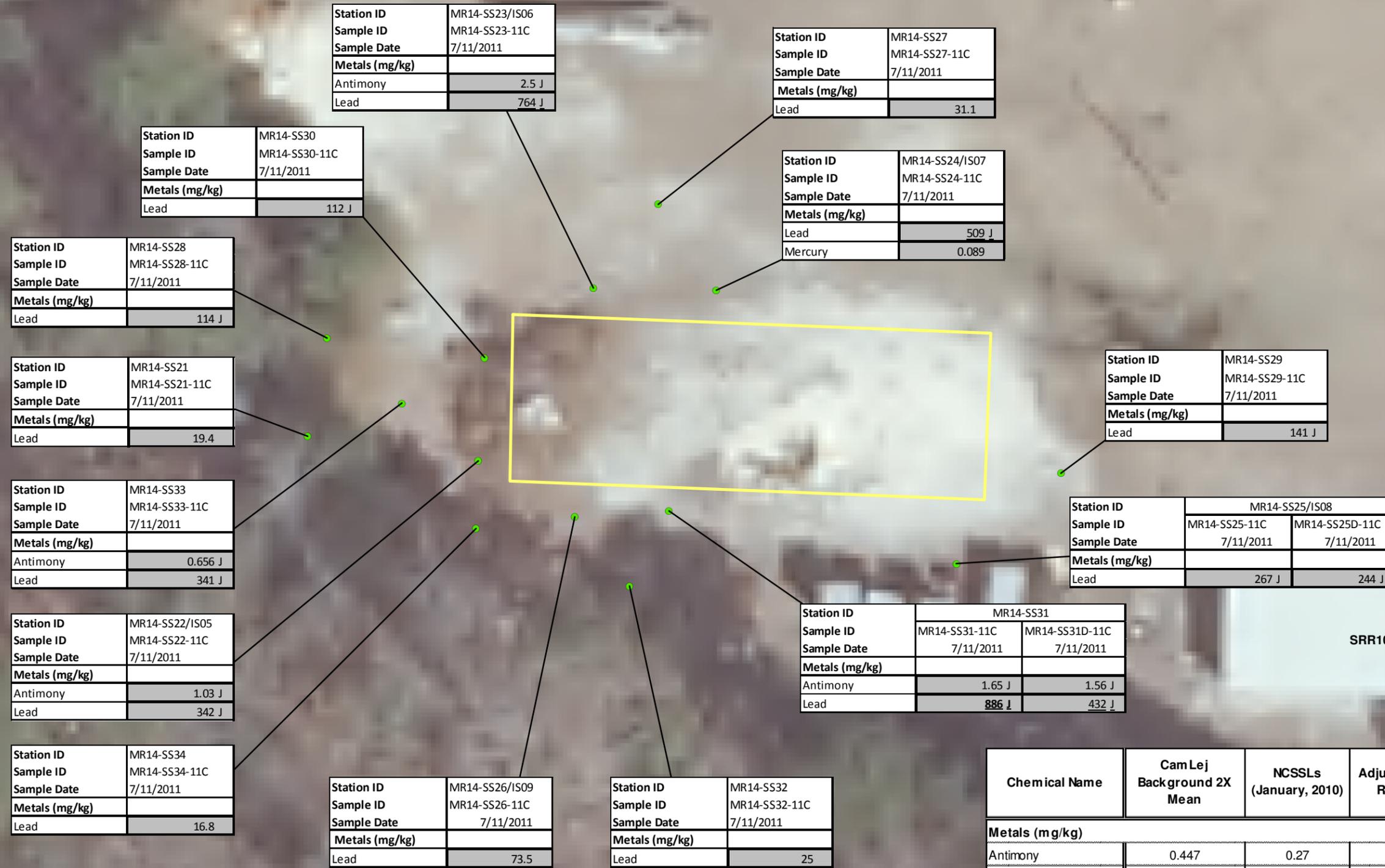
Underline indicates exceedance of Adjusted Residential Soil RSLs

RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents

J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate



Chemical Name	Cam Lej Background 2X Mean	NCSSLs (January, 2010)	Adjusted Industrial Soil RSLs (June, 2011)	Adjusted Residential Soil RSLs (June, 2011)
Metals (mg/kg)				
Antimony	0.447	0.27	41	3.1
Lead	12.3	14	800	400
Mercury	0.081	0.1	31	2.3

Legend
 ● Surface Soil
 □ Site UXO-14 Boundary (Former Indoor Pistol Range Area)

Notes:
 -Shading indicates exceedance of two times the mean base background concentration
 -**Bold box** indicates exceedance of NC SSL
 -**Bold text** indicates exceedance of Adjusted Industrial Soil RSLs
 -Underline indicates exceedance of Adjusted Residential Soil RSLs
 -RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents
 -J - Analyte present, value may or may not be accurate or precise
 -mg/kg - Milligrams per kilogram

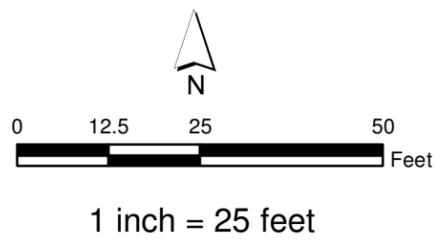
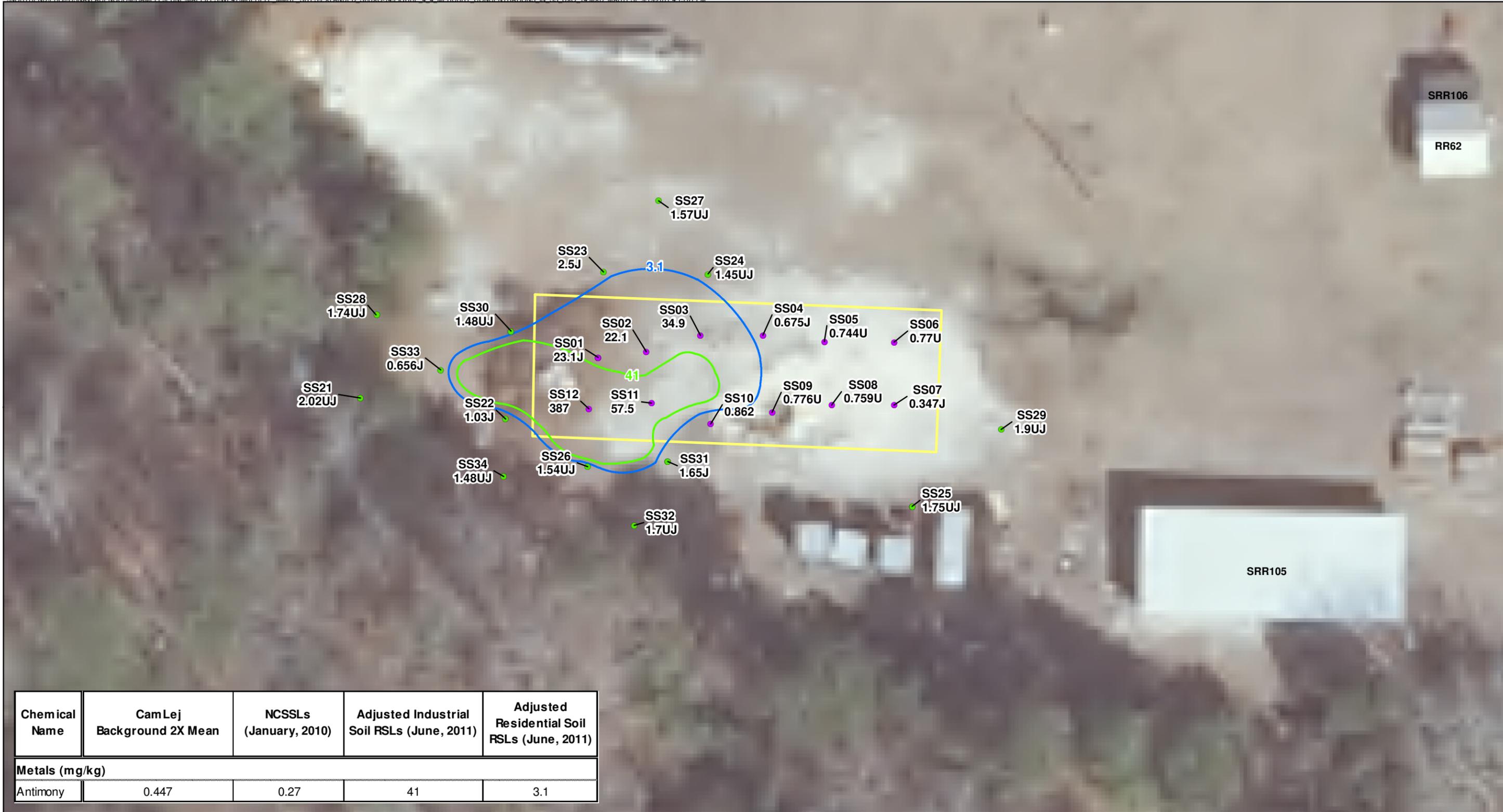


Figure 4-1
 Surface Soil Exceedances
 Site UXO-14 Expanded SI Report
 MCB CamLej
 North Carolina



Chemical Name	CamLej Background 2X Mean	NCSSLs (January, 2010)	Adjusted Industrial Soil RSLs (June, 2011)	Adjusted Residential Soil RSLs (June, 2011)
Metals (mg/kg)				
Antimony	0.447	0.27	41	3.1

- Legend**
- 2011 Surface Soil
 - 2009 Surface Soil
 - USEPA Residential RSL for Antimony (3.1 mg/kg)
 - USEPA Industrial RSL for Antimony (41 mg/kg)
 - Site UXO-14 Boundary (Former Indoor Pistol Range Area)

Notes:
 J - Analyte present, value may or may not be accurate or precise
 U - The material was analyzed for, but not detected
 UJ - Analyte not detected, quantitation limit may be inaccurate
 mg/kg - Milligrams per kilogram
 Concentration contours have been inferred between sampling locations.
 Actual conditions may differ from those shown here.
 The prefix "MR14-" has been deleted from the sampling location identifiers on this figure.

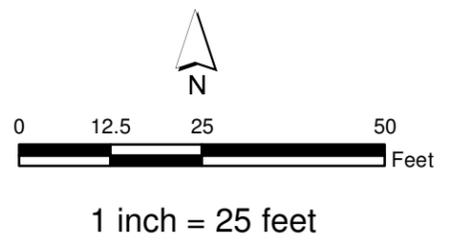
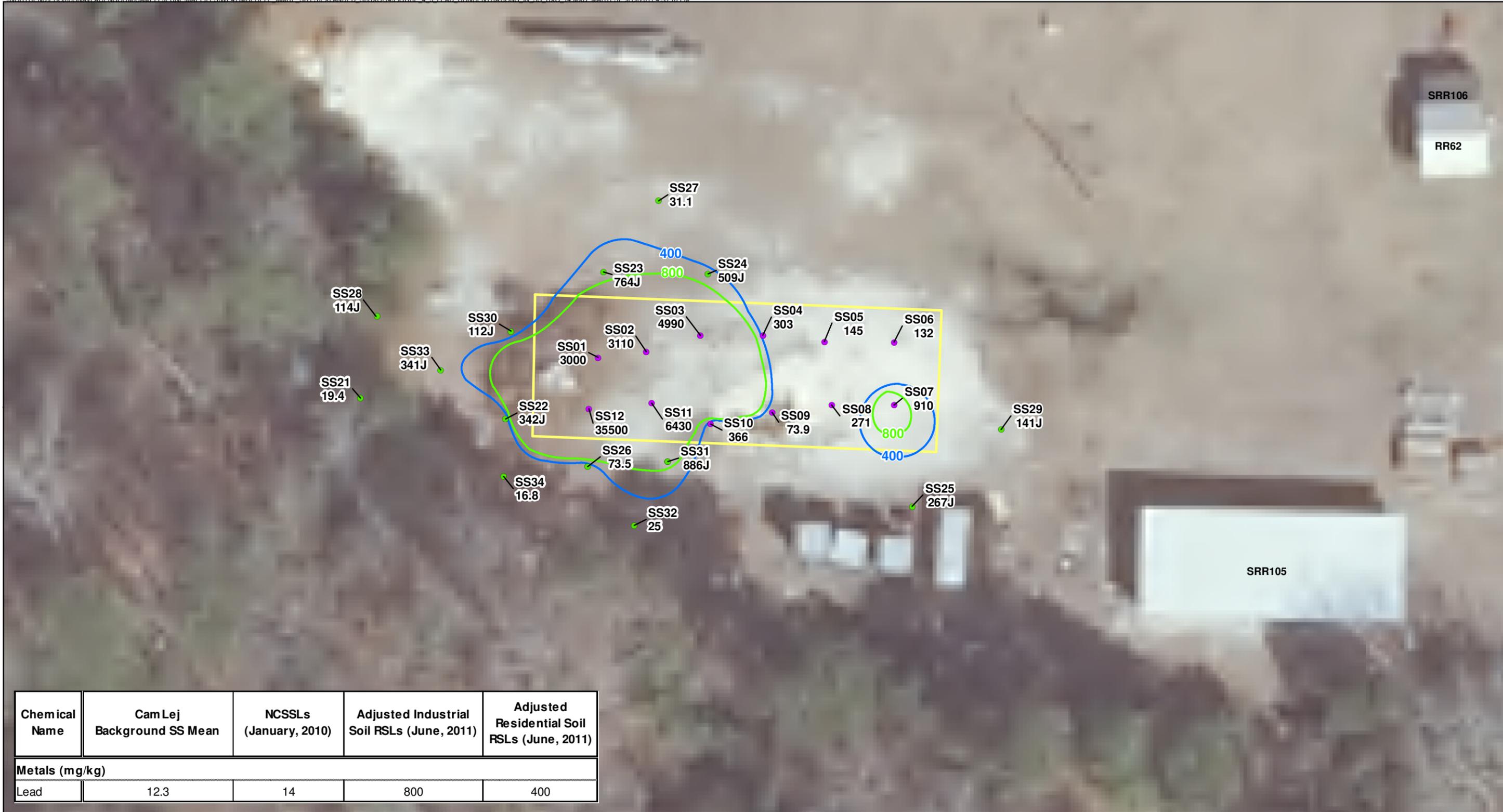


Figure 4-2
 Antimony in Surface Soil
 Greater than USEPA RSLs
 Site UXO-14 Expanded SI Report
 MCB CamLej
 North Carolina





Chemical Name	Cam Lej Background SS Mean	NCSSLs (January, 2010)	Adjusted Industrial Soil RSLs (June, 2011)	Adjusted Residential Soil RSLs (June, 2011)
Metals (mg/kg)				
Lead	12.3	14	800	400

- Legend**
- 2011 Surface Soil
 - 2009 Surface Soil
 - USEPA Residential RSL for Lead (400 mg/kg)
 - USEPA Industrial RSL for Lead (800 mg/kg)
 - Site UXO-14 Boundary (Former Indoor Pistol Range Area)

Notes:
 J - Analyte present, value may or may not be accurate or precise
 U - The material was analyzed for, but not detected
 UJ - Analyte not detected, quantitation limit may be inaccurate
 mg/kg - Milligrams per kilogram
 Concentration contours have been inferred between sampling locations.
 Actual conditions may differ from those shown here.
 The prefix "MR14-" has been deleted from the sampling location identifiers on this figure.

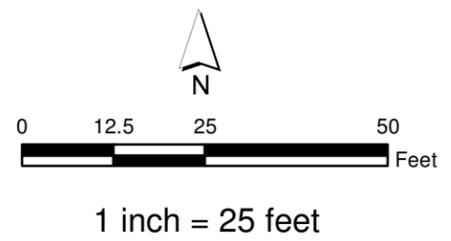
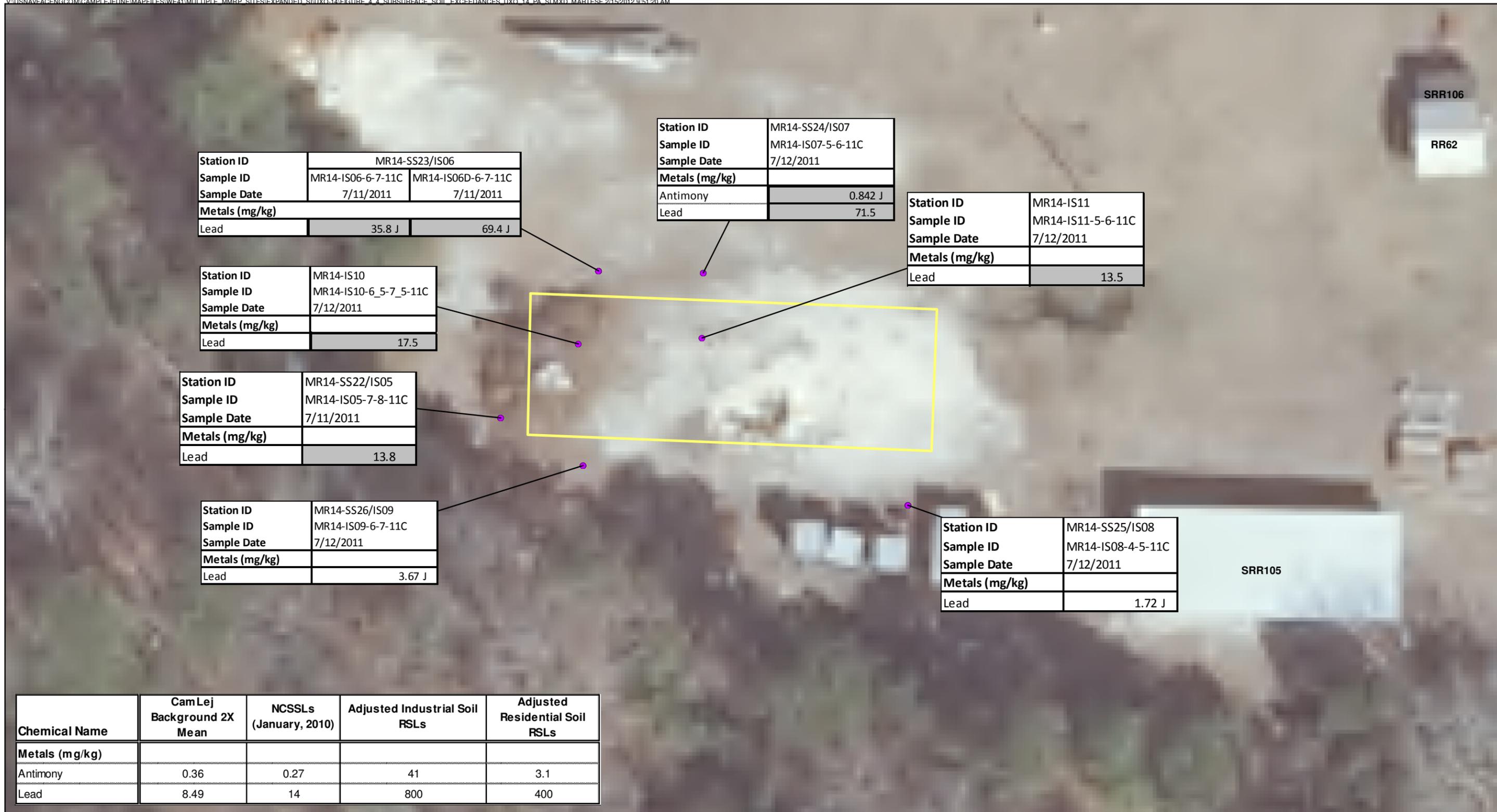


Figure 4-3
 Lead Concentrations in Surface Soil
 Greater than USEPA RSLs
 Site UXO-14 Expanded SI Report
 MCB CamLej
 North Carolina



Station ID	MR14-SS23/IS06	
Sample ID	MR14-IS06-6-7-11C	MR14-IS06D-6-7-11C
Sample Date	7/11/2011	7/11/2011
Metals (mg/kg)		
Lead	35.8 J	69.4 J

Station ID	MR14-SS24/IS07
Sample ID	MR14-IS07-5-6-11C
Sample Date	7/12/2011
Metals (mg/kg)	
Antimony	0.842 J
Lead	71.5

Station ID	MR14-IS11
Sample ID	MR14-IS11-5-6-11C
Sample Date	7/12/2011
Metals (mg/kg)	
Lead	13.5

Station ID	MR14-IS10
Sample ID	MR14-IS10-6_5-7_5-11C
Sample Date	7/12/2011
Metals (mg/kg)	
Lead	17.5

Station ID	MR14-SS22/IS05
Sample ID	MR14-IS05-7-8-11C
Sample Date	7/11/2011
Metals (mg/kg)	
Lead	13.8

Station ID	MR14-SS26/IS09
Sample ID	MR14-IS09-6-7-11C
Sample Date	7/12/2011
Metals (mg/kg)	
Lead	3.67 J

Station ID	MR14-SS25/IS08
Sample ID	MR14-IS08-4-5-11C
Sample Date	7/12/2011
Metals (mg/kg)	
Lead	1.72 J

Chemical Name	CamLej Background 2X Mean	NCSLs (January, 2010)	Adjusted Industrial Soil RSLs	Adjusted Residential Soil RSLs
Metals (mg/kg)				
Antimony	0.36	0.27	41	3.1
Lead	8.49	14	800	400

- Legend**
- Subsurface Soil
 - Site UXO-14 Boundary (Former Indoor Pistol Range Area)

- Notes:**
- Shading indicates exceedance of two times the mean base background concentration
 - **Bold text indicates exceedance of Adjusted Industrial Soil RSLs**
 - Underline indicates exceedance of Adjusted Residential Soil RSLs
 - RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents
 - J - Analyte present, value may or may not be accurate or precise
 - mg/kg - Milligrams per kilogram

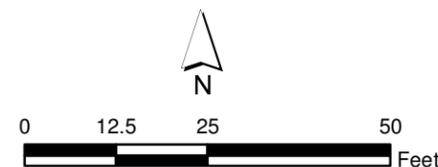


Figure 4-4
Subsurface Soil Exceedances
Site UXO-14 Expanded SI Report
MCB CamLej
North Carolina

Human Health Risk Screening

5.1 Previous Human Health Risk Evaluations

Human health risks associated with UXO-14 were evaluated in the *Final Preliminary Assessment/Site Inspection Report, MMRP Site UXO-14, Former Indoor Pistol Range (ASR #2.199) and Gas Chamber (ASR #2.200) (Rifle Range Area), Marine Corps Base Camp Lejeune, Jacksonville, North Carolina (CH2M HILL, 2011a) (PA/SI)*. The potential for human health risks was evaluated in a screening level evaluation consisting of three steps using a risk ratio technique (Navy, 2000) as discussed in the PA/SI.

The HHRS indicated that exposure to groundwater from Site UXO-14 would not result in any unacceptable risks to human health. The HHRS also demonstrated that exposure to soil within the former Gas Chamber area would not result in any unacceptable risks to human health. However, the HHRS indicated that potential contact with surface soil and combined surface and subsurface soil at the former Indoor Pistol Range could result in potential unacceptable non-carcinogenic hazards (primarily associated with antimony). Additionally, exposure to lead in surface and combined surface and subsurface soil at the former Indoor Pistol Range could result in unacceptable health risks.

The HHRS and ERS indicated that further investigation of Site UXO-14 was necessary to delineate the extent of elevated metals concentrations within the surface and subsurface soils at the former Indoor Pistol Range area. Antimony, mercury (ERS only), and lead were identified as COPCs in surface soils within the former Indoor Pistol Range area during the ERS and HHRS process. Antimony and lead were identified as COPCs in subsurface soils within the former Indoor Pistol Range area. The PA/SI recommended that additional investigation be conducted to delineate the extent of the identified impacts to surface and subsurface soil. Therefore, surface and subsurface soil samples were collected as part of this supplemental SI and analyzed for antimony, lead, and mercury.

5.2 Human Health Risk Screening Overview

A conservative HHRS was performed to assess the potential for human health risks associated with exposure to surface soil and combined surface and subsurface soil at the former Indoor Pistol Range using the samples collected for this supplemental SI and the samples included in the PA/SI. The PA/SI included evaluations of surface soil and combined surface and subsurface soil. This supplemental SI included evaluation of surface soil and subsurface soil separately. The evaluation was performed separately to get a better understanding of the potential contamination and risks associated with surface soil and subsurface soil separately. The results of the HHRS provided a preliminary indication of potential risks from COPCs and can be used to evaluate whether future residential use of the site is acceptable based on human health risks or if the site requires further evaluation (such as a baseline risk assessment or additional data collection).

The HHRS was conducted in three steps using a risk ratio technique (Navy, 2000) described as follows.

5.2.1 Step 1

The maximum detected analyte concentrations for each medium were compared to human health RSLs (USEPA, 2011) and 2 times the mean BBG concentration (for inorganics in soil) (Baker, 2001). Additionally, the maximum detection limit for analytes not detected in a medium was compared to the screening levels. RSLs based on non-carcinogenic effects were divided by 10 to account for exposure to multiple analytes (that is, were adjusted to a hazard quotient [HQ] of 0.1 from the HQ of 1.0 used on the RSL table). RSLs based on carcinogenic endpoints were used as presented in the RSL table and are based on a carcinogenic risk of 1×10^{-6} .

The soil data were compared to USEPA Residential Soil RSLs, which are more conservative (lower) than USEPA Industrial Soil RSLs, and are therefore protective of all potential receptors (residents, industrial workers, construction workers, and so forth)

If the maximum detected concentration exceeded the appropriate RSL and background concentration (for inorganics only), the screening level risk evaluation proceeded to Step 2. Additionally, the maximum detection limit for analytes not detected in a medium was compared to the screening levels. However, if the detection limit exceeded the screening levels, the constituent was not retained for evaluation in Step 2 but is discussed qualitatively in Section 5.2.

5.2.2 Step 2

For analytes identified as COPCs in Step 1, a corresponding risk level was calculated using the following equation:

$$\text{corresponding risk level} = \frac{\text{concentration} \times \text{acceptable risk level}}{\text{RSL}}$$

The concentration is the maximum detected concentration (the same concentration that was used in Step 1), and the acceptable risk level is 1 for non-carcinogens and 10^{-6} for carcinogens. RSLs for non-carcinogenic effects were not adjusted by 10 as was done in Step 1; they were used as presented in the RSL table. The corresponding risk level was calculated using the previously presented equation. All of the corresponding risk levels for each analyte within a media were summed to calculate the cumulative corresponding hazard index (HI) (for non-carcinogens) and cumulative corresponding carcinogenic risk (for carcinogens). A cumulative corresponding HI was also calculated for each target organ/effect. If the cumulative corresponding HI for a target organ/effect was greater than 0.5, or the cumulative corresponding carcinogenic risk was greater than 5×10^{-5} , the analytes contributing to these values were retained as COPCs and carried forward to Step 3.

5.2.3 Step 3

A corresponding risk level was calculated as previously discussed for Step 2 if more than five samples were available for a given media; however, the 95 percent upper confidence limit (UCL) was used in place of the maximum detected concentration in order to obtain a more site-specific risk ratio. If the cumulative corresponding HI by target organ/effect was greater than 0.5, or the cumulative corresponding carcinogenic risk was greater than 5×10^{-5} , then analytes contributing to these values were considered COPCs.

The most current version of the ProUCL software program (USEPA, 2010b) was used to test the data distribution and calculate 95 percent UCL exposure point concentrations used for the Step 3 risk ratio calculations. In cases where there were fewer than five samples in the data set, or the recommended UCL exceeded the maximum detected concentration, the maximum concentration was used as the exposure point concentration.

5.3 Human Health Risk Screening Results

Results of the HHRS are summarized in Tables E-1 through E-4 in **Appendix E**.

5.3.1 Surface Soil Risk Screening

Tables E-1 through E-3 of **Appendix E** present the risk-based screening and risk ratio evaluation for surface soil. As shown in Table E-1, three metals (antimony, arsenic, and lead) were identified as COPCs. Based on Step 2 of the screening process (Table E-2), antimony was identified as a COPC. In Step 3 (Table E-3), the HI of antimony was 5.6, which is greater than 0.5. Therefore, antimony was retained as a COPC.

The average lead concentration in the surface soil was 2,264 mg/kg, which is higher than the Adjusted USEPA residential RSL of 400 mg/kg in soil. Therefore, lead is considered to be present at a concentration of potential concern, and lead was identified as a COPC in the HHRS.

The majority of the samples where lead exceeds the screening level are in the western half of the former Indoor Pistol Range, within the range boundary. There were two sample locations north of the boundary that also exceeded the lead screening level. The antimony concentrations were also higher in the western half of the former Indoor Pistol Range; however, all exceedances of the screening level were within the range boundary.

5.3.2 Subsurface Soil Risk Screening

Table E-4 of Appendix E presents the risk-based screening and risk ratio evaluation for subsurface soil. As shown in Table E-4, no COPCs were identified for subsurface soil. All of the concentrations detected in the subsurface soil were either below the RSL or the BBG concentrations.

5.3.3 Comparison of Detection Limits for Non-detected Analytes to Screening Levels

Thallium was the only constituent not detected in any of the soil samples with a detection limit above the screening level. The maximum detection limit for thallium in the soil was 0.8 mg/kg, while the screening level for thallium (the residential soil RSL adjusted by dividing by 10) is 0.078 mg/kg, and the BBG concentration is 0.38 mg/kg. The maximum detection limit only slightly exceeds the residential soil RSL (unadjusted, 0.78 mg/kg); therefore, even if thallium is present at the site at a concentration below the detection limit, it is unlikely it would contribute significantly to the total risk from exposure to soil at the site.

5.4 Human Health Risk Screening Conclusion

Based on the evaluation of available data, the results of the HHRS indicate there is a potential unacceptable risk associated with exposure to surface soil at the former Indoor Pistol Range; however, there is no unacceptable risk associated with exposure to subsurface soil. The potential unacceptable health risks are associated with lead and antimony in surface soil.

Ecological Risk Assessment

An Ecological Risk Assessment (ERA) consisting of Steps 1 through 3a of the ERA process was conducted for UXO 14, as presented in **Appendix F**. UXO 14 includes the former Gas Chamber and the former Indoor Pistol Range. Both areas were previously evaluated for ecological risk as part of the ERS presented in the PA/SI (CH2M HILL, 2011a). No risk was identified at the former Gas Chamber; however, risk from metals to ecological receptors exposed to surface and subsurface soils was identified at the former Indoor Pistol Range. This ERA evaluates the soil and subsurface soil data that were collected at the former Indoor Pistol Range at UXO 14 in 2009 and 2011.

6.1 Ecological Risk Assessment Overview

The potential for effects from exposure to soil was evaluated by comparing ecological screening values (ESVs) to maximum concentrations (Step 2) of constituents detected at the site. The USEPA Ecological Soil Screening Levels (EcoSSL) (USEPA, 2009) were preferentially selected over Region 4 values (USEPA, 2001). When no EcoSSL was available for a constituent, the Region 4 value was selected. Based on the results, antimony, lead, and mercury in surface soil and antimony and lead in subsurface soil were carried forward to Step 3.

Using the same CSM, Step 3a involves re-evaluation of the conservative assumptions used in Steps 1 and 2, resulting in a refinement of the COPC list. Step 3a includes a reassessment of the risks to lower trophic level receptors (direct exposure) and an evaluation, for the subset of contaminants that are bioaccumulative, of the potential for risks to upper trophic level receptors (food chain transfer). The risk to lower trophic level receptors was recalculated using a conservative estimate of the mean chemical concentration as the exposure point concentration (EPC). If a conservative estimate of the mean EPC could not be calculated, the arithmetic mean concentration was used as the EPC. Food chain modeling was initially conducted for the terrestrial receptors using maximum concentrations of analytes in surface soils. If analytes posed a risk based on maximum concentrations, modeling was refined using a conservative estimate of the mean or an arithmetic mean when a conservative estimate of the mean could not be calculated.

6.2 Ecological Risk Assessment Summary

Based on the Step 3a screening, antimony and lead in surface and subsurface soil were identified as potentially posing unacceptable risk to lower trophic level receptors. Lead in surface soil was the only analyte identified as posing unacceptable risk to upper trophic level receptors based on food chain modeling, including the white-footed mouse, red fox, American robin, and the mourning dove.

Concentrations of lead and antimony are generally higher in the western portion of the former Indoor Pistol Range, with the maximum detected concentrations in surface samples MR14-SS11 and MR14-SS12. Elevated concentrations of lead and antimony are generally co-located and decrease significantly with distance from the site and depth.

Conclusions and Recommendations

This section presents conclusions and provides recommendations based upon the PA/SI and Expanded SI findings.

7.1 Conclusions

7.1.1 Environmental Investigation

The Expanded SI results were combined with the PA/SI results and evaluated for potential risks to human health and the environment from exposure to site media. The conclusions of the risk evaluations are as follows:

7.1.1.1. Human Health Risk Screening Conclusions

The HHRS concluded that there is a potential unacceptable risk associated with exposure to lead and antimony in surface soil within the western portion of the former Indoor Pistol Range. However, there is no unacceptable risk associated with exposure to subsurface soil or groundwater. No unacceptable risks to human health are associated with exposure to surface soil, subsurface soil, or groundwater at the former Gas Chamber.

7.1.1.2. Ecological Risk Assessment Conclusions

Antimony and lead in surface and subsurface soil at the former Indoor Pistol Range were identified as potentially posing unacceptable risk to lower trophic level receptors. Lead in surface soil was the only constituent identified as posing unacceptable risk to upper trophic level receptors based on food chain modeling, including the white-footed mouse, red fox, American robin, and the mourning dove. No unacceptable risks are associated with exposure of ecological receptors to surface soil, subsurface soil, or groundwater at the former Gas Chamber.

7.1.2 MEC Intrusive Investigation

No MEC was found during the intrusive investigation. Two small arms cartridge casings were found. These results indicate that the potential for encountering subsurface MEC within the Gas Chamber portion of Site UXO-14 is likely to be low.

7.2 Recommendations

Based on the conclusions previously presented, no further action is recommended at the former Gas Chamber area. At the former Indoor Pistol Range, an interim removal action or a Remedial Investigation/Feasibility Study, or both, is recommended to reduce or mitigate potential human health and ecological exposure to antimony and lead in surface and subsurface soil.

SECTION 8

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Appendix A
PA/SI Analytical Data Screening Tables

TABLE 4-1
 Surface Soil Analytical Results
 Site UXO-14 Former Indoor Pistol Range and Gas Chamber (Rifle Range Area)
 PA/SI Report
 MCB CamLej, North Carolina

Station ID	Camp Lejeune Background SS 2X Mean	NCPSRGs (January, 2010)	Adjusted Industrial Soil RSLs	Adjusted Residential Soil RSLs	MR14-SS01		MR14-SS02	MR14-SS03	MR14-SS04	MR14-SS05	MR14-SS06	MR14-SS07	MR14-SS08	MR14-SS09	MR14-SS10	MR14-SS11
					MR14-SS01-09D	MR14-SS01D-09D	MR14-SS02-09D	MR14-SS03-09D	MR14-SS04-09D	MR14-SS05-09D	MR14-SS06-09D	MR14-SS07-09D	MR14-SS08-09D	MR14-SS09-09D	MR14-SS10-09D	MR14-SS11-09D
Sample ID					11/06/09	11/06/09	11/06/09	11/06/09	11/06/09	11/06/09	11/06/09	11/06/09	11/06/09	11/06/09	11/06/09	11/06/09
Sample Date																
Chemical Name																
Semivolatile Organic Compounds (µg/kg)																
2-Methylnaphthalene	--	1,600	370,000	31,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzaldehyde	--	--	1,200,000	780,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	--	180	2,100	150	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	--	600	2,100	150	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	--	360,000	1,700,000	170,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	--	5,900	21,000	1,500	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	--	7,200	120,000	35,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	--	330,000	2,200,000	230,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluorene	--	56,000	2,200,000	230,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene	--	8.7	22,000	6,100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	--	210	18,000	3,600	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	--	31	9,000	3,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	--	57,000	17,000,000	1,700,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	--	220,000	1,700,000	170,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Metals (mg/kg)																
Aluminum	5,487	--	99,000	7,700	1,590	1,760	869	856	662	744	551	821	963	1,380	1,060	1,080
Antimony	0.447	--	41	3.1	<u>23.1 J</u>	<u>6.43 J</u>	<u>22.1</u>	<u>34.9</u>	0.675 J	0.744 U	0.77 U	0.347 J	0.759 U	0.776 U	0.862	<u>57.5</u>
Arsenic	0.626	5.8	1.6	0.39	<u>0.931</u>	<u>1.19</u>	<u>0.696</u>	<u>0.434</u>	0.246 J	0.204 J	0.257 U	<u>0.402</u>	0.337	0.33	0.335	<u>1.01</u>
Barium	14.5	580	19,000	1,500	13.2	10.4	6.57	6.09	3.15	2.21	2.17	6.32	2.44	2.96	2.83	5.57
Beryllium	0.103	--	200	16	0.256 U	0.266 U	0.251 U	0.247 U	0.254 U	0.248 U	0.257 U	0.302 U	0.253 U	0.259 U	0.249 U	0.269 U
Calcium	6,360	--	--	--	390	550	1,350	474	127 J	53 J	200 J	203 J	253 U	1,080	200 J	97.7 J
Chromium	6.05	3.8	5.6	0.29	<u>3.76</u>	<u>3.26</u>	<u>1.55</u>	<u>1.93</u>	<u>1.3</u>	<u>1.04</u>	<u>0.882</u>	<u>2.36</u>	<u>1.32</u>	<u>1.48</u>	<u>1.25</u>	<u>2.7</u>
Cobalt	0.294	--	30	2.3	0.267 J	0.665 U	0.627 U	<u>0.592 J</u>	0.634 U	0.62 U	0.641 U	0.754 U	0.632 U	0.646 U	0.622 U	<u>0.375 J</u>
Copper	4.83	700	4,100	310	4.57	<u>12.8</u>	2.68	2.78	1.39	0.962	1.08	<u>8.47</u>	1.43	1.2	1.3	4.43
Iron	3,245	150	72,000	5,500	1,470	1,150	1,080	942	683	616	243	907	537	639	598	721
Lead	12.3	270	800	400	<u>3.000</u>	<u>1.250</u>	<u>3.110</u>	<u>4.990</u>	303	145	132	<u>910</u>	271	73.9	366	<u>6.430</u>
Magnesium	238	--	--	--	77.3 J	93.6 J	251 U	68.7 J	254 U	248 U	257 U	62.2	253 U	58.8 J	249 U	141 J
Manganese	13.7	65	2,300	180	21.2	18	13.1	8.78	5.09	4.89	3.69	13.5	9.04	6.92	8.51	18
Mercury	0.081	1	31	2.4	0.0486	0.052	<u>1.08</u>	0.0399	0.017	0.033 U	0.033 U	0.0301 J	0.0135 J	0.033 U	0.033 U	0.0688
Nickel	1.21	130	2,000	160	1.83	1.78	1.42	1.91	1.01	0.592	0.404 J	1.43	0.912	0.961	0.936	1.73
Potassium	116	--	--	--	74.9 J	82.4 J	251 U	247 U	254 U	248 U	257 U	302 U	253 U	259 U	249 U	82.9 J
Silver	0.14	3.4	510	39	0.0563 J	0.266 U	0.11 J	0.0506 J	0.254 U	0.248 U	0.257 U	0.302 U	0.253 U	0.259 U	0.249 U	0.195 J
Sodium	80.9	--	--	--	256 U	266 U	251 U	247 U	254 U	248 U	257 U	302 U	253 U	259 U	249 U	225 J
Vanadium	8.9	--	520	39	7.66	7.17	7.1	8.74	3.45	1.63	1.09	6.02	3.63	2.52	3.55	5.39
Zinc	10.8	1,200	31,000	2,400	65.3	57.7	43.8	62.1	19.6	15	16.6 J	61.4 J	24.2 J	12.9 J	18.8 J	47.2 J

Notes:

Shading indicates exceedance of two times the mean base background concentration for surface soil

Bold box indicates exceedance of NC SSL

Bold text indicates exceedance of Adjusted Industrial Soil RSLs

Underline indicates exceedance of Adjusted Residential Soil RSLs

RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents

NA - Not analyzed

J - Analyte present, value may or may not be accurate or precise

R - Unreliable Result

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

TABLE 4-1

Surface Soil Analytical Results

Site UXO-14 Former Indoor Pistol Range and Gas Chamber (Rifle Range Area)

PA/SI Report

MCB CamLej, North Carolina

Station ID	Camp Lejeune Background SS 2X Mean	NCPSSRGs (January, 2010)	Adjusted Industrial Soil RSLs	Adjusted Residential Soil RSLs	MR14-SS12	MR14-SS13		MR14-SS14	MR14-SS15	MR14-SS16	MR14-SS17	MR14-SS18	MR14-SS19	MR14-SS20
Sample ID					MR14-SS12-09D	MR14-SS13-09D	MR14-SS13D-09D	MR14-SS14-09D	MR14-SS15-09D	MR14-SS16-09D	MR14-SS17-09D	MR14-SS18-09D	MR14-SS19-09D	MR14-SS20-09D
Sample Date					11/06/09	11/06/09	11/06/09	11/06/09	11/06/09	11/06/09	11/06/09	11/06/09	11/06/09	11/06/09
Chemical Name														
Semivolatile Organic Compounds (µg/kg)														
2-Methylnaphthalene	--	1,600	370,000	31,000	NA	11 U	11 U	11 U	12 U	12 U	12	1.6 J	3.3 J	11 J
Benzaldehyde	--	--	1,200,000	780,000	NA	260 R	270 R	250 R	270 R	280 R	94 J	92 J	270 R	110 J
Benzo(a)anthracene	--	180	2,100	150	NA	11 UJ	11 U	11 U	12 UJ	12 UJ	12 UJ	12 UJ	2.8 J	3.2 J
Benzo(b)fluoranthene	--	600	2,100	150	NA	11 U	11 U	11 U	12 U	12 U	18	4.7	7.3 J	13 U
Benzo(g,h,i)perylene	--	360,000	1,700,000	170,000	NA	11 U	11 U	11 U	12 U	12 U	7.2 J	12 U	2.6 J	13 U
Benzo(k)fluoranthene	--	5,900	21,000	1,500	NA	11 U	11 U	11 U	12 U	12 U	4.4 J	2.3	2.8 J	13 U
bis(2-Ethylhexyl)phthalate	--	7,200	120,000	35,000	NA	260 UJ	270 U	250 UJ	270 UJ	280 UJ	60 J	280 U	270 U	310 U
Fluoranthene	--	330,000	2,200,000	230,000	NA	1.8 J	2.5 J	1.5 J	4 J	6 J	11 J	4.7 J	5 J	7.2 J
Fluorene	--	56,000	2,200,000	230,000	NA	11 U	11 U	11 U	12 U	4 J				
Hexachlorobutadiene	--	8.7	22,000	6,100	NA	11 U	11 U	11 U	12 U	4.3 J				
Naphthalene	--	210	18,000	3,600	NA	11 U	11 U	11 U	12 U	12 U	10 J	12 U	12 U	11 J
Pentachlorophenol	--	31	9,000	3,000	NA	760 U	760 U	720 U	780 U	800 U	630 J	800 U	780 U	900 U
Phenanthrene	--	57,000	17,000,000	1,700,000	NA	11 U	11 U	11 U	12 U	12 U	20	3.3	5.3 J	9.4 J
Pyrene	--	220,000	1,700,000	170,000	NA	2 J	3 J	11 U	12 U	6.3 J	12 J	4.6 J	6.2 J	6.8 J
Total Metals (mg/kg)														
Aluminum	5,487	--	99,000	7,700	807	NA	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	0.447	--	41	3.1	387	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	0.626	5.8	1.6	0.39	2.7	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium	14.5	580	19,000	1,500	7.79	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	0.103	--	200	16	0.0503 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Calcium	6,360	--	--	--	405	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	6.05	3.8	5.6	0.29	3.14	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt	0.294	--	30	2.3	0.314 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper	4.83	700	4,100	310	11.3	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3,245	150	72,000	5,500	740	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	12.3	270	800	400	35,500	NA	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	238	--	--	--	248 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	13.7	65	2,300	180	13	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	0.081	1	31	2.4	0.0293 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	1.21	130	2,000	160	2.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Potassium	116	--	--	--	248 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	0.14	3.4	510	39	0.634	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sodium	80.9	--	--	--	248 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	8.9	--	520	39	5.4	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	10.8	1,200	31,000	2,400	47.3 J	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Shading indicates exceedance of two times the mean base background concentration for surface soil

Bold box indicates exceedance of NC SSL

Bold text indicates exceedance of Adjusted Industrial Soil RSLs

Underline indicates exceedance of Adjusted Residential Soil RSLs

RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents

NA - Not analyzed

J - Analyte present, value may or may not be accurate or precise

R - Unreliable Result

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

TABLE 4-2

Subsurface Soil Analytical Results
 Site UXO-14 Former Indoor Pistol Range and Gas Chamber (Rifle Range Area)
 PA/SI Report
 MCB CamLej, North Carolina

Station ID	Camp Lejeune Background SB 2X Mean	NCPSRGs (January, 2010)	Adjusted Industrial Soil RSLs	Adjusted Residential Soil RSLs	MR14-IS01	MR14-IS02	MR14-IS03	MR14-IS04	
Sample ID					MR14-IS01-2-3-09D	MR14-IS02-2-3-09D	MR14-IS03-2-3-09D	MR14-IS04-4-5-09D	MR14-IS04D-4-5-09D
Sample Date					12/04/09	12/04/09	12/04/09	12/04/09	12/04/09
Chemical Name									
Semivolatile Organic Compounds (µg/kg)									
Benzaldehyde	--	--	1,200,000	780,000	280 U	280 U	290 U	540 J	520 J
Naphthalene	--	210	18,000	3,600	12 U	12 U	12 U	1.8 J	13 U
Total Metals (mg/kg)									
Aluminum	10,369	--	99,000	7,700	1,530	881 J	793	NA	NA
Antimony	0.36	--	41	3.1	2.62	0.889 U	0.913 U	NA	NA
Arsenic	2.12	5.8	1.6	0.39	0.208 J	0.195 J	0.304 U	NA	NA
Barium	16.6	580	19,000	1,500	2.49	1.78 J	1.44 J	NA	NA
Chromium	14.5	3.8	5.6	0.29	1.06	0.74	0.748	NA	NA
Copper	2.56	700	4,100	310	1.28	0.592 U	0.609 U	NA	NA
Iron	5,439	150	72,000	5,500	370	322	183	NA	NA
Lead	8.49	270	800	400	290	1.34	1.8	NA	NA
Manganese	9.25	65	2,300	180	3.29	2.81 J	1.54	NA	NA
Mercury	0.071	1	31	2.4	0.0342 J	0.0333 U	0.041 U	NA	NA
Nickel	2.27	130	2,000	160	0.43 J	0.368 J	0.357 J	NA	NA
Vanadium	17.2	--	520	39	1.28	1.2	0.799	NA	NA
Zinc	6.59	1,200	31,000	2,400	9.98	1.18 U	3.3	NA	NA

Notes:

Shading indicates exceedance of two times the mean base background concentration for subsurface soil

Bold box indicates exceedance of NC SSL

Bold text indicates exceedance of Adjusted

Industrial Soil RSLs

Underline indicates exceedance of Adjusted

Residential Soil RSLs

RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents

NA - Not analyzed

J - Analyte present, value may or may not be accurate or precise

R - Unreliable Result

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

TABLE 4-3

Groundwater Analytical Results
 Site UXO-14 Former Indoor Pistol Range and Gas Chamber (Rifle Range Area)
 PA/SI Report
 MCB CamLej, North Carolina

Station ID Sample ID Sample Date	Camp Lejeune Background GW 2X Mean	NCGWQS (January 2010) *	Adjusted Tap Water RSLs	MR14-IS01	MR14-IS02	MR14-IS03	MR14-IS04	
				MR14-TW01-09D 12/08/09	MR14-TW02-09D 12/08/09	MR14-TW03-09D 12/08/09	MR14-TW04-09D 12/09/09	MR14-TW04D-09D 12/09/09
Chemical Name								
Semivolatile Organic Compounds (µg/l)								
4-Methylphenol	--	40	18	NA	NA	NA	1.7 J	1.6 J
Benzo(a)pyrene	--	0.005	0.003	NA	NA	NA	0.07 J	0.07 J
Benzo(g,h,i)perylene	--	200	110	NA	NA	NA	0.08 J	0.073 J
Dibenz(a,h)anthracene	--	0.005	0.003	NA	NA	NA	0.078 J	0.074 J
Indeno(1,2,3-cd)pyrene	--	0.05	0.03	NA	NA	NA	0.069 J	0.071 J
Total Metals (µg/l)								
Aluminum	1,886	--	3,700	246 J	175 J	293 J	NA	NA
Arsenic	5.77	10	0.045	1.03 J	4.09	1.25 U	NA	NA
Barium	86.2	700	730	8.48 J	63.6	46.9	NA	NA
Beryllium	0.308	--	7.3	1.25 U	0.254 J	1.25 U	NA	NA
Calcium	69,078	--	--	7,480	5,870	31,600	NA	NA
Chromium	3.13	10	0.043	2	1.14 J	1.36	NA	NA
Copper	2.76	1,000	150	1.49 J	103	2.5 U	NA	NA
Iron	5,999	300	2,600	518	2,910	1,230	NA	NA
Lead	2.8	15	--	0.975	0.75 U	0.75 U	NA	NA
Magnesium	6,363	--	--	437 J	1,170 J	1,500	NA	NA
Manganese	214	50	88	5.01 J	23.4 J	13.7 J	NA	NA
Nickel	7.97	100	73	0.851 J	1.23 J	2.5 U	NA	NA
Potassium	3,277	--	--	1,070 J	1,250 J	1,710 J	NA	NA
Sodium	22,508	--	--	13,600	8,000	12,100	NA	NA
Vanadium	4.72	--	18	3.12 U	1.88 J	2.2 J	NA	NA
Zinc	42.1	1,000	1,100	3.16 J	3.16 J	5 U	NA	NA
Dissolved Metals (µg/l)								
Aluminum, Dissolved	1,886	--	3,700	100 J	118 J	149 J	NA	NA
Arsenic, Dissolved	5.77	10	0.045	1.25 U	3.29	1.25 U	NA	NA
Barium, Dissolved	86.2	700	730	8.1 J	61.5	47.5	NA	NA
Calcium, Dissolved	69,078	--	--	7,220	5,550	32,600	NA	NA
Chromium, Dissolved	3.13	10	0.043	1.51	0.86 J	0.98 J	NA	NA
Copper, Dissolved	2.76	1,000	150	1.32 J	2.5 U	2.5 U	NA	NA
Iron, Dissolved	5,999	300	2,600	398	2,670	1,160	NA	NA
Lead, Dissolved	2.8	15	--	0.83	0.75 U	0.75 U	NA	NA
Magnesium, Dissolved	6,363	--	--	422 J	1,140 J	1,530	NA	NA
Manganese, Dissolved	214	50	88	5.53 J	22.8 J	13.4 J	NA	NA
Nickel, Dissolved	7.97	100	73	0.78 J	1.35 J	2.5 U	NA	NA
Potassium, Dissolved	3,277	--	--	1,060 J	1,260 J	1,750 J	NA	NA
Sodium, Dissolved	22,508	--	--	13,400	9,510	12,500	NA	NA
Vanadium, Dissolved	4.72	--	18	3.12 U	2.33 J	1.94 J	NA	NA

Notes:

- Shading indicates exceedance of two times the mean base background concentration for Groundwater
- Bold box indicates exceedance of NCGWQS or the more conservative MCL**
- Bold text indicates exceedance of Adjusted Tap Water RSLs**
- RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents
- * - The MCL-Groundwater value is reported in place of the NC2LGW where the MCL value is more conservative.
- NA - Not analyzed
- J - Analyte present, value may or may not be accurate or precise
- U - The material was analyzed for, but not detected
- UJ - Analyte not detected, quantitation limit may be inaccurate
- µg/l - Micrograms per liter

Appendix B
Data Validation Summary Reports

DataQual

Environmental Services, LLC

CH2M HILL
 5700 Cleveland Street
 Suite 101
 Virginia Beach, VA 23462

August 4, 2011

SDG# CH025-005
 ENCO Labs (A103583)
 MCB Camp Lejeune, CTO-WE41

Dear Mr. Horn,

The following Data Validation report is provided as requested for the parameters noted in the table below for SDG # CH025-005 (ENCO Lab WO # A103583). The data validation was performed in accordance with the SW846 methods 6010C for antimony and lead and 7470A/7471B for mercury. Also used in the validation of these samples were the National Functional Guidelines for Inorganic Data Review (October, 2004), as applicable, and good professional judgment. The laboratory used the requirements presented in the DOD Quality Systems Manual for Environmental Laboratories Version 4.2, so this manual was consulted as well. All areas of concern are discussed in the body of the report and a summary of data qualifications is provided.

Sample ID	Lab ID	Matrix	Metals
MR14-IS07-5-6-11C	A103583-01	soil	X
MR14-IS11-5-6-11C	A103583-02	soil	X
MR14-IS10-6.5-7.5-11C	A103583-03	soil	X
MR14-SS25-11C	A103583-04	soil	X
MR14-SS31D-11C	A103583-05	soil	X
MR14-SS31-11C	A103583-06	soil	X
MR14-SS27-11C	A103583-07	soil	X
MR14-SS22-11C	A103583-08	soil	X
MR14-SS21-11C	A103583-09	soil	X
MR14-SS33-11C	A103583-10	soil	X
MR14-SS29-11C	A103583-11	soil	X
MR14-SS23-11C	A103583-12	soil	X
MR14-IS06-6-7-11C	A103583-13	soil	X
MR14-SS26-11C	A103583-14	soil	X
MR14-SS25D-11C	A103583-15	soil	X
MR14-IS05-7-8-11C	A103583-16	soil	X
MR14-SS28-11C	A103583-17	soil	X
MR14-IS06D-6-7-11C	A103583-18	soil	X
MR14-IS08-4-5-11C	A103583-19	soil	X
MR14-SS24-11C	A103583-20	soil	X
MR14-SS34-11C	A103583-21	soil	X
MR14-SS32-11C	A103583-22	soil	X

Sample ID	Lab ID	Matrix	Metals
MR14-IS09-6-7-11C	A103583-23	soil	X
MR14-SS30-11C	A103583-24	soil	X
MR14-EB071111-IS	A103583-25	water	X
MR14-EB071111-SS	A103583-26	water	X
MR14-EB071211-IS	A103583-27	water	X
MR14-IS10-6.5-7.5-11C MS	A103583-03MS	soil	X
MR14-IS10-6.5-7.5-11C MSD	A103583-03MSD	soil	X
MR14-SS22-11C MS	A103583-08MS	soil	X
MR14-SS22-11C MSD	A103583-08MSD	soil	X
MR14-EB071111-IS MS	A103583-25MS	water	X
MR14-EB071111-IS MSD	A103583-25MSD	water	X

The following quality control samples were provided with this SDG: samples MR14-EB071111-IS, MR14-EB071111-SS, and MR14-EB071211-IS-equipment blanks; sample MR14-SS31D-11C-field duplicate of sample MR14-SS31-11C, sample MR14-SS25D-11C -field duplicate of sample MR14-SS25-11C, and sample MR14-IS06D-6-7-11C-field duplicate of sample MR14-IS06-6-7-11C.

The samples were evaluated based on the following criteria:

- Data Completeness *
- Technical Holding Times *
- ICP Tuning NA
- Instrument Performance *
- Initial/Continuing Calibrations *
- 2nd Source Standards *
- Low Range Standards *
- Interference Check Sample *
- Blanks
- ICP-MS Internal Standards NA
- Laboratory Control Samples *
- Matrix Spike Recoveries
- Matrix Duplicate RPDs *
- Post Digestion Spike Recoveries *
- Serial Dilutions NA
- Field Duplicates
- Identification/Quantitation
- Reporting Limits *

* - indicates that no qualifications were required based on this criteria

Overall Evaluation of Data/Potential Usability Issues

A summary of qualifications applied to the sample results are noted below for the fractions validated. Specific details regarding qualification of the data are addressed in the Specific Evaluation section of this narrative. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte the validator has chosen the qualifier that best indicates possible bias in the results and flagged the data accordingly. However, information regarding all quality control issues is provided in the body of the report and on the qualification summary page. Please note that when a compound or analyte is flagged due to blank contamination the BL qualifier code takes precedence over all other qualifier codes except a code that explains rejected data.

Select Metals & Mercury

Blank qualifications were required in two samples due to rinse blank qualification above the LOD.

The associated matrix spike recoveries were low for one analyte. Qualifications were applied to the data.

Two of the submitted field duplicate pairs exhibited non-compliant RPDs for the analyte lead. Qualifications were required.

Results for lead were flagged E by the laboratory in several samples. This indicates that the results were above the calibration curve. These E flagged results were qualified as estimated J.

Mercury

Both of the submitted field duplicate pairs exhibited non-compliant RPDs for the analyte mercury. Qualifications were required.

Specific Evaluation of Data

Data Completeness

Clarification questions were asked of the laboratory regarding reported E flagged results. Additional calibration curve information was requested from the laboratory for both the 7470A and 7471B methods. All requested information was provided by the laboratories. Copies of the e-mail correspondence are included in the validation worksheets section of this narrative.

Technical Holding Times

According to chain of custody records, sampling was performed on July 11, 2011 and July 12, 2011 and samples were received ENCO Labs on July 13, 2011. All sample preparation and analysis was performed within holding time requirements.

Blanks

Select Metals & Mercury

Contamination was noted in associated blanks and qualification was required in the associated samples. Required action is noted in the following tables. The concentration of lead in the rinse blank noted below was above the LOD. Therefore, positive results above the blank level up to 10X the blank level were qualified as estimated J in accordance with guidance from the Functional Guidelines. These J flagged results should be considered potentially biased high. All differences in sample matrix (sample size, moisture content, etc.) was taken into consideration when assessing the action level and applying the qualifiers.

Blank ID	Analyte	Concentration	Action Level	Q Flag
MR14-EB-071211-IS	lead	10.7 ug/L	10X blank level	J

Associated samples and required qualifications are noted in the following table.

Sample ID	Analyte	Q Flag	Q Code
MR14-IS08-4-5-11C, MR14-IS09-6-7-11C	lead	J	EBL

Matrix Spikes

Select Metals & Mercury

The matrix spike analysis exhibited non-compliant %Rs that resulted in qualification of analytical data. Specific action is noted in the following table.

MS/MSD	Analyte	Samples Affected	%R	Q Flag	Q Code
MR14-IS10-6.5-7.5-11C	antimony	all soil samples	49/50	J/UJ	MSL

Field Duplicates

Select Metals & Mercury

The field duplicate pair of samples MR14-SS31-11C/MW14-SS31D-11C exhibited a non-compliant RPD for lead (69%). This analyte was flagged as estimated J in both samples with a qualifier code of FD.

The field duplicate pair of samples MR14-IS06-6-7-11C/MW14-IS06D-6-7-11C exhibited a non-compliant RPD for lead (69%). This analyte was flagged as estimated J in both samples with a qualifier code of FD.

Identification/Quantitation

Select Metals & Mercury

Several results reported for lead in the field samples were E-flagged by the laboratory to indicate results that were above the calibration curve. The laboratory did analyze a high calibration check standard at the end of the sequence and this standard met criteria. However, since the results were above the calibration range they must be considered estimated values. Therefore, all of the E-flagged lead results were qualified as estimated J, with a qualifier code of LR.

A summary of qualifications required is provided on the following page. Please do not hesitate to contact DataQual ES with any questions regarding this validation report.

Sincerely,



Laura Maschhoff
President

Summary of Data Qualifications

Select Metals & Mercury

Sample ID	Analyte	Results	Q-Flag	Q Code
MR14-IS08-4-5-11C, MR14-IS09-6-7-11C	lead	+	J	EBL
all soil samples	antimony	+/-	J/UJ	MSL
MR14-SS31-11C, MW14-SS31D-11C	lead	+	J	FD*
MR14-IS06-6-7-11C, MW14-IS06D-6-7-11C	lead	+	J	FD
all field samples with E-flagged lead results	lead	+E	J	LR

*Final qualifier code for lead in these samples will be LR because the result is above the range of the calibration curve.

Glossary of Qualification Flags and Abbreviations

Qualification Flags (Q-Flags)

U	not detected above the reported sample quantitation limit
J	estimated value
UJ	reported quantitation limit is qualified as estimated
R	result is rejected; the presence or absence of the analyte cannot be verified
D	result value is based on dilution analysis result
NJ	analyte has been tentatively identified, estimated value
L	analyte present, biased low
UL	not detected, quantitation limit is probably higher
K	analyte present, biased high

Inorganic Field/Lab Blank Qualification Flags (Q-Flags)

NA	The sample result for the blank contaminant is greater than the sample LOD and is greater than 5X the blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.
LOD-U	The sample result for the blank contaminant is less than the sample LOD and the result is raised to the LOD and flagged U.
R or J+	The blank contaminant concentration was greater than the LOD and the sample result is greater than the LOD but less than 10X the blank contaminant concentration. The reported results are flagged either as rejected R or biased high J+ based on the professional judgment of the validator. (see NFG, Rev. date 10/04, p. 17 for extracted blanks (PB))

Organic Field/Lab Blank Qualification Flags (Q-Flags)

NA	The sample result for the blank contaminant is greater than the sample LOD and is greater than 5X (10X for common laboratory contaminants) the blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.
LOD-U	The sample result for the blank contaminant is less than the sample LOD but is less than 5X (10X for common laboratory contaminants) the blank value, so the result is raised to the LOD and flagged U.
U	The sample result for the blank contaminant is greater than the sample LOD but is less than 5X (10X for common laboratory contaminants) the blank value, so the result is flagged U at the reported value.

General Abbreviations

LOQ	level of quantitation
LOD	level of detection
MDL	method detection limit
CRQL/CRDL	contract required quantitation/detection limit
Q Code	qualifier code
+ /-	positive result/non-detect result

QUALIFIER CODE REFERENCE

Qualifier	Description
TN	Tune
BSL	Blank Spike/LCS - High Recovery
BSH	Blank Spike/LCS - Low Recovery
BD	Blank Spike/Blank Spike Duplicate (LCS/LCSD) Precision
BRL	Below Reporting Limit
ISL	Internal Standard - Low Recovery
ISH	Internal Standard - High Recovery
MSL	Matrix Spike and/or Matrix Spike Duplicate - Low Recovery
MSH	Matrix Spike and/or Matrix Spike Duplicate - High Recovery
MI	Matrix interference obscuring the raw data
MDP	Matrix Spike/Matrix Spike Duplicate Precision
2S	Second Source - Bad reproducibility between tandem detectors
SSL	Spiked Surrogate - Low Recovery
SSH	Spiked Surrogate - High Recovery
SD	Serial Dilution Reproducibility
ICL	Initial Calibration - Low Relative Response Factors (RRF)
ICH	Initial Calibration - High Relative Response Factors (RRF)
ICB	Initial Calibration - Bad Linearity or Curve Function
CCL	Continuing Calibration - Low Recovery or %Difference
CCH	Continuing Calibration - High Recovery or %Difference
LD	Lab Duplicate Reproducibility
HT	Holding Time
PD	Pesticide Degradation
2C	Second Column - Poor Dual Column Reproducibility
LR	Concentration Exceeds Linear Range
BL	Blank Contamination (MBL, TBL, EBL, FBL)
RE	Redundant Result - due to Re-analysis or Re-extraction
DL	Redundant Result - due to Dilution
FD	Field Duplicate
OT	Other - explained in data validation report
%SOL	High moisture content

INORGANIC ANALYSIS DATA SHEET

MR14-IS07-5-6-11C

EPA 6010C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-01/A103583-01

File ID: 071511a-024

Sampled: 07/12/11 10:00

Prepared: 07/14/11 09:38

Analyzed: 07/15/11 11:01

Solids: 79.58

Preparation: EPA 3050B

Initial/Final: 0.753 g / 50 mL

Batch: 1G14007

Sequence:

BA09747

Calibration: 1107018

Instrument: JMICP2

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7440-36-0	Antimony	0.842	1	<i>0.871</i>	0.818	1.67	3.34	EPA 6010C
7439-92-1	Lead	71.5	1		0.401	0.834	1.67	EPA 6010C

1 Correction
ML 08/2/11

JC
8/1/11

INORGANIC ANALYSIS DATA SHEET

MR14-IS11-5-6-11C

EPA 6010C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-02/A103583-02

File ID: 071511a-025

Sampled: 07/12/11 10:30

Prepared: 07/14/11 09:38

Analyzed: 07/15/11 11:02

Solids: 82.24

Preparation: EPA 3050B

Initial/Final: 0.787 g / 50 mL

Batch: 1G14007

Sequence:

BA09747

Calibration: 1107018

Instrument: JM1CP2

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7440-36-0	Antimony	<1.55	1	<i>U</i>	0.757	1.55	3.09	EPA 6010C
7439-92-1	Lead	13.5	1		0.371	0.773	1.55	EPA 6010C

JHC
8/11/11

UINORGANIC ANALYSIS DATA SHEET
EPA 6010C

MR14-SS25-11C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-04/B103410-04

File ID: 071511a-027

Sampled: 07/11/11 12:30

Prepared: 07/14/11 09:38

Analyzed: 07/15/11 11:06

Solids: 86.36

Preparation: EPA 3050B

Initial/Final: 0.662 g / 50 mL

Batch: 1G14007

Sequence:

BA09747

Calibration: 1107018

Instrument: JM1CP2

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7440-36-0	Antimony	<1.75	1	<i>NT/MB</i>	0.857	1.75	3.50	EPA 6010C
7439-92-1	Lead	267	1	<i>JER</i>	0.420	0.875	1.75	EPA 6010C

JAC
8/11

INORGANIC ANALYSIS DATA SHEET

MR14-SS31D-11C

EPA 6010C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-05/B103410-05

File ID: 071511a-028

Sampled: 07/11/11 12:40

Prepared: 07/14/11 09:38

Analyzed: 07/15/11 11:08

Solids: 93.29

Preparation: EPA 3050B

Initial/Final: 0.649 g / 50 mL

Batch: 1G14007

Sequence:

BA09747

Calibration: 1107018

Instrument: JM1CP2

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7440-36-0	Antimony	1.56	1	<i>3/1/11</i>	0.809	1.65	3.30	EPA 6010C
7439-92-1	Lead	432	1	<i>1/1/11</i>	0.396	0.826	1.65	EPA 6010C

*JAC
8/11*

INORGANIC ANALYSIS DATA SHEET

EPA 6010C

MR14-SS31-11C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLei Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-06/B103410-06

File ID: 071511a-029

Sampled: 07/11/11 12:35

Prepared: 07/14/11 09:38

Analyzed: 07/15/11 11:10

Solids: 97.89

Preparation: EPA 3050B

Initial/Final: 0.616 g / 50 mL

Batch: IG14007

Sequence:

BA09747

Calibration: 1107018

Instrument: JMICP2

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7440-36-0	Antimony	1.65	1	<i>J/mt</i>	0.813	1.66	3.32	EPA 6010C
7439-92-1	Lead	886	1	<i>J/ER</i>	0.398	0.829	1.66	EPA 6010C

*JAC
8/11/11*

INORGANIC ANALYSIS DATA SHEET
EPA 6010C

MR14-SS22-11C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-08/B103410-08

File ID: 071511a-052

Sampled: 07/11/11 13:30

Prepared: 07/14/11 09:39

Analyzed: 07/15/11 11:54

Solids: 83.84

Preparation: EPA 3050B

Initial/Final: 0.676 g / 50 mL

Batch: 1G14008

Sequence:

BA09747

Calibration: 1107018

Instrument: JMICP2

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7440-36-0	Antimony	1.03	1	<i>JAC</i>	0.865	1.76	3.53	EPA 6010C
7439-92-1	Lead	342	1	<i>EQ</i>	0.423	0.882	1.76	EPA 6010C

JAC
8/11

INORGANIC ANALYSIS DATA SHEET
EPA 6010C

MR14-SS21-11C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE4I

Matrix: Soil

Laboratory ID: A103583-09/B103410-09

File ID: 071511a-031

Sampled: 07/11/11 13:35

Prepared: 07/14/11 09:38

Analyzed: 07/15/11 11:14

Solids: 80.18

Preparation: EPA 3050B

Initial/Final: 0.617 g / 50 mL

Batch: 1G14007

Sequence:

BA09747

Calibration: 1107018

Instrument: JM1CP2

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7440-36-0	Antimony	<2.02	1	<i>WJH</i>	0.991	2.02	4.04	EPA 6010C
7439-92-1	Lead	19.4	1		0.485	1.01	2.02	EPA 6010C

WJH
8/11

INORGANIC ANALYSIS DATA SHEET

MR14-SS33-11C

EPA 6010C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-10/B103410-10

File ID: 071511a-032

Sampled: 07/11/11 13:15

Prepared: 07/14/11 09:38

Analyzed: 07/15/11 11:16

Solids: 82.54

Preparation: EPA 3050B

Initial/Final: 1.044 g / 50 mL

Batch: 1G14007

Sequence:

BA09747

Calibration: 1107018

Instrument: JM1CP2

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7440-36-0	Antimony	0.656	1	<i>JAC</i>	0.594	1.21	2.42	EPA 6010C
7439-92-1	Lead	341	1	<i>JAC</i>	0.291	0.606	1.21	EPA 6010C

*JAC
8/11*

INORGANIC ANALYSIS DATA SHEET

MR14-SS29-11C

EPA 6010C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-11/B103410-11

File ID: 071511a-035

Sampled: 07/11/11 12:20

Prepared: 07/14/11 09:38

Analyzed: 07/15/11 11:22

Solids: 95.59

Preparation: EPA 3050B

Initial/Final: 0.552 g / 50 mL

Batch: 1G14007

Sequence:

BA09747

Calibration: 1107018

Instrument: JMICP2

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7440-36-0	Antimony	<1.90	1	<i>U</i>	0.929	1.90	3.79	EPA 6010C
7439-92-1	Lead	141	1	<i>J E L</i>	0.455	0.948	1.90	EPA 6010C

*QAC
8/11*

INORGANIC ANALYSIS DATA SHEET

MR14-SS23-11C

EPA 6010C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-12/B103410-12

File ID: 071511a-036

Sampled: 07/11/11 14:05

Prepared: 07/14/11 09:38

Analyzed: 07/15/11 11:24

Solids: 85.05

Preparation: EPA 3050B

Initial/Final: 0.638 g / 50 mL

Batch: 1G14007

Sequence:

BA09747

Calibration: 1107018

Instrument: JMICP2

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7440-36-0	Antimony	2.50	1	<i>J J</i>	0.903	1.84	3.69	EPA 6010C
7439-92-1	Lead	764	1	<i>J E R</i>	0.442	0.921	1.84	EPA 6010C

*JAC
8/11*

INORGANIC ANALYSIS DATA SHEET

MR14-IS06-6-7-11C

EPA 6010C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-13/B103410-13

File ID: 071511a-037

Sampled: 07/11/11 16:35

Prepared: 07/14/11 09:38

Analyzed: 07/15/11 11:25

Solids: 79.27

Preparation: EPA 3050B

Initial/Final: 0.857 g / 50 mL

Batch: 1G14007

Sequence:

BA09747

Calibration: 1107018

Instrument: JMICP2

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7440-36-0	Antimony	<1.47	1	U <i>(Handwritten)</i>	0.721	1.47	2.94	EPA 6010C
7439-92-1	Lead	35.8	1	JAB <i>(Handwritten)</i>	0.353	-0.736	1.47	EPA 6010C

JAC
8/11

INORGANIC ANALYSIS DATA SHEET

MR14-SS26-11C

EPA 6010C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-14/B103410-14

File ID: 071511a-038

Sampled: 07/11/11 12:50

Prepared: 07/14/11 09:38

Analyzed: 07/15/11 11:27

Solids: 86.36

Preparation: EPA 3050B

Initial/Final: 0.753 g / 50 mL

Batch: 1G14007

Sequence:

BA09747

Calibration: 1107018

Instrument: JMICP2

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7440-36-0	Antimony	<1.54	1	<i>U</i>	0.754	1.54	3.08	EPA 6010C
7439-92-1	Lead	73.5	1		0.369	0.769	1.54	EPA 6010C

U
8/11

INORGANIC ANALYSIS DATA SHEET

MR14-SS25D-11C

EPA 6010C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-15/B103410-15

File ID: 071511a-039

Sampled: 07/11/11 12:35

Prepared: 07/14/11 09:38

Analyzed: 07/15/11 11:29

Solids: 82.42

Preparation: EPA 3050B

Initial/Final: 0.613 g / 50 mL

Batch: 1G14007

Sequence:

BA09747

Calibration: 1107018

Instrument: JM1CP2

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7440-36-0	Antimony	<1.98	1	U <i>U</i>	0.970	1.98	3.96	EPA 6010C
7439-92-1	Lead	244	1	E <i>JER</i>	0.475	0.990	1.98	EPA 6010C

JWC
8/11

INORGANIC ANALYSIS DATA SHEET
EPA 6010C

MR14-SS28-11C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-17/B103410-17

File ID: 071511a-041

Sampled: 07/11/11 13:40

Prepared: 07/14/11 09:38

Analyzed: 07/15/11 11:33

Solids: 82.46

Preparation: EPA 3050B

Initial/Final: 0.695 g / 50 mL

Batch: 1G14007

Sequence:

BA09747

Calibration: 1107018

Instrument: JMICP2

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7440-36-0	Antimony	<1.74	1	U 10 mL	0.855	1.74	3.49	EPA 6010C
7439-92-1	Lead	114	1	IE 10 mL	0.419	0.872	1.74	EPA 6010C

JAC
8/11

INORGANIC ANALYSIS DATA SHEET
EPA 6010C

MR14-IS06D-6-7-11C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-18/B103410-18

File ID: 071511a-042

Sampled: 07/11/11 16:40

Prepared: 07/14/11 09:38

Analyzed: 07/15/11 11:35

Solids: 79.04

Preparation: EPA 3050B

Initial/Final: 0.713 g / 50 mL

Batch: 1G14007

Sequence: BA09747

Calibration: 1107018

Instrument: JMICP2

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7440-36-0	Antimony	<1.77	1	U	0.870	1.77	3.55	EPA 6010C
7439-92-1	Lead	69.4	1	573	0.426	0.887	1.77	EPA 6010C

JAC
8/11/11

INORGANIC ANALYSIS DATA SHEET

MR14-IS08-4-5-11C

EPA 6010C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-19/B103410-19

File ID: 071511a-043

Sampled: 07/12/11 12:00

Prepared: 07/14/11 09:38

Analyzed: 07/15/11 11:37

Solids: 82.16

Preparation: EPA 3050B

Initial/Final: 0.757 g / 50 mL

Batch: IG14007

Sequence:

BA09747

Calibration: 1107018

Instrument: JMICP2

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7440-36-0	Antimony	<1.61	1	U	0.788	1.61	3.22	EPA 6010C
7439-92-1	Lead	1.72	1	JEBL	0.386	0.804	1.61	EPA 6010C

JEBL
07/11

INORGANIC ANALYSIS DATA SHEET

MR14-SS24-11C

EPA 6010C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-20/B103410-20

File ID: 071511a-044

Sampled: 07/11/11 13:10

Prepared: 07/14/11 09:38

Analyzed: 07/15/11 11:38

Solids: 88.15

Preparation: EPA 3050B

Initial/Final: 0.784 g / 50 mL

Batch: 1G14007

Sequence: BA09747

Calibration: 1107018

Instrument: JMICP2

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7440-36-0	Antimony	<1.45	1	U	0.709	1.45	2.89	EPA 6010C
7439-92-1	Lead	509	1	JEUR	0.347	0.724	1.45	EPA 6010C

JMC
8/11

INORGANIC ANALYSIS DATA SHEET

MR14-SS34-11C

EPA 6010C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-21/B103410-21

File ID: 071511a-047

Sampled: 07/11/11 12:55

Prepared: 07/14/11 09:38

Analyzed: 07/15/11 11:44

Solids: 85.98

Preparation: EPA 3050B

Initial/Final: 0.784 g / 50 mL

Batch: 1G14007

Sequence:

BA09747

Calibration: 1107018

Instrument: JM1CP2

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7440-36-0	Antimony	<1.48	1	<i>NET/ML</i>	0.727	1.48	2.97	EPA 6010C
7439-92-1	Lead	16.8	1		0.356	0.742	1.48	EPA 6010C

*SPC
8/11*

INORGANIC ANALYSIS DATA SHEET

MR14-IS09-6-7-11C

EPA 6010C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-23/B103410-23

File ID: 071511a-054

Sampled: 07/12/11 11:30

Prepared: 07/14/11 09:39

Analyzed: 07/15/11 11:58

Solids: 79.32

Preparation: EPA 3050B

Initial/Final: 0.958 g / 50 mL

Batch: 1G14008

Sequence:

BA09747

Calibration: 1107018

Instrument: JM1CP2

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7440-36-0	Antimony	<1.26	1	<i>WU</i>	0.618	1.26	2.52	EPA 6010C
7439-92-1	Lead	3.67	1	<i>JEBL</i>	0.303	0.630	1.26	EPA 6010C

*SDG
8/11*

INORGANIC ANALYSIS DATA SHEET
EPA 6010C

MR14-SS30-11C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-24/B103410-24

File ID: 071511a-055

Sampled: 07/11/11 13:55

Prepared: 07/14/11 09:39

Analyzed: 07/15/11 11:59

Solids: 96.40

Preparation: EPA 3050B

Initial/Final: 0.702 g / 50 mL

Batch: 1G14008

Sequence:

BA09747

Calibration: 1107018

Instrument: JM1CP2

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7440-36-0	Antimony	<1.48	1	<i>U</i>	0.724	1.48	2.96	EPA 6010C
7439-92-1	Lead	112	1	<i>JER</i>	0.355	0.739	1.48	EPA 6010C

*OK
8/11*

INORGANIC ANALYSIS DATA SHEET

MR14-EB071111-IS

EPA 6010C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Water

Laboratory ID: A103583-25/B103410-25

File ID: 071511a-015

Sampled: 07/11/11 17:30

Prepared: 07/14/11 09:40

Analyzed: 07/15/11 10:43

Solids: 0.00

Preparation: EPA 3005A

Initial/Final: 50 mL / 50 mL

Batch: 1G14009

Sequence:

BA09747

Calibration: 1107018

Instrument: JMICP2

CAS NO.	Analyte	Concentration (ug/L)	Dilution Factor	Q	DL	LOD	LOQ	Method
7440-36-0	Antimony	<20.0	1	U	13.0	20.0	40.0	EPA 6010C
7439-92-1	Lead	22.0	1		2.90	10.0	20.0	EPA 6010C

JAC
8/11

INORGANIC ANALYSIS DATA SHEET

MR14-EB071111-SS

EPA 6010C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Water

Laboratory ID: A103583-26/B103410-26

File ID: 071511a-016

Sampled: 07/11/11 17:25

Prepared: 07/14/11 09:40

Analyzed: 07/15/11 10:45

Solids: 0.00

Preparation: EPA 3005A

Initial/Final: 50 mL / 50 mL

Batch: 1G14009

Sequence:

BA09747

Calibration: 1107018

Instrument: JMICP2

CAS NO.	Analyte	Concentration (ug/L)	Dilution Factor	Q	DL	LOD	LOQ	Method
7440-36-0	Antimony	<20.0	1	U	13.0	20.0	40.0	EPA 6010C
7439-92-1	Lead	<10.0	1	U	2.90	10.0	20.0	EPA 6010C

JOC
8/11

INORGANIC ANALYSIS DATA SHEET

MR14-EB071211-IS

EPA 6010C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLei Site UXO-14 CTO-WE41

Matrix: Water

Laboratory ID: A103583-27/B103410-27

File ID: 071511a-017

Sampled: 07/12/11 14:00

Prepared: 07/14/11 09:40

Analyzed: 07/15/11 10:47

Solids: 0.00

Preparation: EPA 3005A

Initial/Final: 50 mL / 50 mL

Batch: IG14009

Sequence:

BA09747

Calibration: 1107018

Instrument: JMICP2

CAS NO.	Analyte	Concentration (ug/L)	Dilution Factor	Q	DL	LOD	LOQ	Method
7440-36-0	Antimony	<20.0	1	U	13.0	20.0	40.0	EPA 6010C
7439-92-1	Lead	10.7	1	J	2.90	10.0	20.0	EPA 6010C

CHC
07/11

INORGANIC ANALYSIS DATA SHEET

MR14-EB071111-SS

EPA 7470A

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Water

Laboratory ID: A103583-26/B103410-26

File ID: 071811W-015

Sampled: 07/11/11 17:25

Prepared: 07/15/11 13:16

Analyzed: 07/18/11 11:28

Solids: 0.00

Preparation: EPA 7470A

Initial/Final: 30 mL / 30 mL

Batch: 1G15017

Sequence:

BA09754

Calibration: 1107019

Instrument: JMHG1

CAS NO.	Analyte	Concentration (ug/L)	Dilution Factor	Q	DL	LOD	LOQ	Method
7439-97-6	Mercury	<0.200	1	U	0.0720	0.200	0.400	EPA 7470A

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 JAC
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037

INORGANIC ANALYSIS DATA SHEET
EPA 7471B

MR14-IS07-5-6-11C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-01/B103410-01

File ID: 071511S-014

Sampled: 07/12/11 10:00

Prepared: 07/14/11 13:54

Analyzed: 07/15/11 10:57

Solids: 79.58

Preparation: EPA 7471B

Initial/Final: 0.316 g / 36 mL

Batch: IG14020

Sequence:

BA09746

Calibration: 1107016

Instrument: JMHG1

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7439-97-6	Mercury	<0.0302	1	U	0.0201	0.0302	0.0603	EPA 7471B

JAC
8/11

INORGANIC ANALYSIS DATA SHEET

EPA 7471B

MR14-IS10-6.5-7.5-11C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-03/B103410-03

File ID: 071511S-016

Sampled: 07/12/11 11:10

Prepared: 07/14/11 13:54

Analyzed: 07/15/11 11:01

Solids: 74.69

Preparation: EPA 7471B

Initial/Final: 0.292 g / 36 mL

Batch: 1G14020

Sequence: BA09746

Calibration: 1107016

Instrument: JMHG1

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7439-97-6	Mercury	<0.0321	1	U	0.0214	0.0321	0.0643	EPA 7471B

JAC
8/1/11

INORGANIC ANALYSIS DATA SHEET

MR14-SS31D-11C

EPA 7471B

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-05/B103410-05

File ID: 071511S-018

Sampled: 07/11/11 12:40

Prepared: 07/14/11 13:54

Analyzed: 07/15/11 11:06

Solids: 93.29

Preparation: EPA 7471B

Initial/Final: 0.298 g / 36 mL

Batch: 1G14020

Sequence:

BA09746

Calibration: 1107016

Instrument: JMHG1

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7439-97-6	Mercury	<0.0257	1	U	0.0172	0.0257	0.0515	EPA 7471B

Handwritten: JMC 7/15/11

INORGANIC ANALYSIS DATA SHEET

MRI4-SS27-11C

EPA 7471B

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-07/B103410-07

File ID: 071511S-022

Sampled: 07/11/11 14:00

Prepared: 07/14/11 13:54

Analyzed: 07/15/11 11:15

Solids: 89.94

Preparation: EPA 7471B

Initial/Final: 0.333 g / 36 mL

Batch: 1G14020

Sequence: BA09746

Calibration: 1107016

Instrument: JMHG1

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7439-97-6	Mercury	<0.0240	1	U	0.0160	0.0240	0.0481	EPA 7471B

Handwritten signature/initials

INORGANIC ANALYSIS DATA SHEET

EPA 7471B

MR14-SS22-11C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-08/B103410-08

File ID: 071511S-042

Sampled: 07/11/11 13:30

Prepared: 07/14/11 13:55

Analyzed: 07/15/11 12:01

Solids: 83.84

Preparation: EPA 7471B

Initial/Final: 0.31 g / 36 mL

Batch: 1G14021

Sequence:

BA09746

Calibration: 1107016

Instrument: JMHG1

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7439-97-6	Mercury	<0.0286	1	U	0.0191	0.0286	0.0573	EPA 7471B

SLC
8/11

INORGANIC ANALYSIS DATA SHEET

EPA 7471B

MRI4-SS21-11C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLei Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-09/B103410-09

File ID: 071511S-023

Sampled: 07/11/11 13:35

Prepared: 07/14/11 13:54

Analyzed: 07/15/11 11:17

Solids: 80.18

Preparation: EPA 7471B

Initial/Final: 0.314 g / 36 mL

Batch: 1G14020

Sequence: BA09746

Calibration: 1107016

Instrument: JMHG1

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7439-97-6	Mercury	<0.0299	1	U	0.0200	0.0299	0.0599	EPA 7471B

JAC
8/11

INORGANIC ANALYSIS DATA SHEET

MR14-SS29-11C

EPA 7471B

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-11/B103410-11

File ID: 071511S-025

Sampled: 07/11/11 12:20

Prepared: 07/14/11 13:54

Analyzed: 07/15/11 11:22

Solids: 95.59

Preparation: EPA 7471B

Initial/Final: 0.302 g / 36 mL

Batch: 1G14020

Sequence: BA09746

Calibration: 1107016

Instrument: JMHG1

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7439-97-6	Mercury	0.0394	1	J	0.0167	0.0251	0.0502	EPA 7471B

JC
8/11

INORGANIC ANALYSIS DATA SHEET

MR14-SS23-11C

EPA 7471B

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-12/B103410-12

File ID: 071511S-026

Sampled: 07/11/11 14:05

Prepared: 07/14/11 13:54

Analyzed: 07/15/11 11:24

Solids: 85.05

Preparation: EPA 7471B

Initial/Final: 0.307 g / 36 mL

Batch: 1G14020

Sequence: BA09746

Calibration: 1107016

Instrument: JMHG1

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7439-97-6	Mercury	0.0560	1	J	0.0188	0.0282	0.0564	EPA 7471B

JAC
8/11

INORGANIC ANALYSIS DATA SHEET

MR14-IS06-6-7-11C

EPA 7471B

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-13/B103410-13

File ID: 071511S-027

Sampled: 07/11/11 16:35

Prepared: 07/14/11 13:54

Analyzed: 07/15/11 11:27

Solids: 79.27

Preparation: EPA 7471B

Initial/Final: 0.312 g / 36 mL

Batch: 1G14020

Sequence: BA09746

Calibration: 1107016

Instrument: JMHG1

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7439-97-6	Mercury	<0.0303	1	U	0.0202	0.0303	0.0606	EPA 7471B

JKC
8/11

INORGANIC ANALYSIS DATA SHEET

EPA 7471B

MR14-SS26-11C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-14/B103410-14

File ID: 071511S-028

Sampled: 07/11/11 12:50

Prepared: 07/14/11 13:54

Analyzed: 07/15/11 11:29

Solids: 86.36

Preparation: EPA 7471B

Initial/Final: 0.332 g / 36 mL

Batch: 1G14020

Sequence: BA09746

Calibration: 1107016

Instrument: JMHG1

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7439-97-6	Mercury	<0.0251	1	U	0.0167	0.0251	0.0502	EPA 7471B

JMC
8/11

INORGANIC ANALYSIS DATA SHEET

MR14-SS25D-11C

EPA 7471B

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-15/B103410-15

File ID: 071511S-029

Sampled: 07/11/11 12:35

Prepared: 07/14/11 13:54

Analyzed: 07/15/11 11:31

Solids: 82.42

Preparation: EPA 7471B

Initial/Final: 0.312 g / 36 mL

Batch: 1G14020

Sequence: BA09746

Calibration: 1107016

Instrument: JMHG1

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7439-97-6	Mercury	<0.0291	1	U	0.0194	0.0291	0.0582	EPA 7471B

*SAC
8/11*

INORGANIC ANALYSIS DATA SHEET

EPA 7471B

MR14-SS28-11C

Laboratory: <u>ENCO Jacksonville</u>	SDG: <u>CH025-005</u>	
Client: <u>CH2M Hill, Inc. (CH025)</u>	Project: <u>MCB CamLej Site UXO-14 CTO-WE41</u>	
Matrix: <u>Soil</u>	Laboratory ID: <u>A103583-17/B103410-17</u>	File ID: <u>071511S-031</u>
Sampled: <u>07/11/11 13:40</u>	Prepared: <u>07/14/11 13:54</u>	Analyzed: <u>07/15/11 11:36</u>
Solids: <u>82.46</u>	Preparation: <u>EPA 7471B</u>	Initial/Final: <u>0.318 g / 36 mL</u>
Batch: <u>1G14020</u>	Sequence: <u>BA09746</u>	Calibration: <u>1107016</u>
		Instrument: <u>JMHG1</u>

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7439-97-6	Mercury	0.0224	1	J	0.0194	0.0291	0.0582	EPA 7471B

JAC
8/11

INORGANIC ANALYSIS DATA SHEET

MR14-IS06D-6-7-11C

EPA 7471B

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-18/B103410-18

File ID: 071511S-034

Sampled: 07/11/11 16:40

Prepared: 07/14/11 13:54

Analyzed: 07/15/11 11:43

Solids: 79.04

Preparation: EPA 7471B

Initial/Final: 0.341 g / 36 mL

Batch: 1G14020

Sequence: BA09746

Calibration: 1107016

Instrument: JMHG1

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7439-97-6	Mercury	<0.0267	1	U	0.0178	0.0267	0.0534	EPA 7471B

JAC
8/1/11

INORGANIC ANALYSIS DATA SHEET

MR14-IS08-4-5-11C

EPA 7471B

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-19/B103410-19

File ID: 071511S-035

Sampled: 07/12/11 12:00

Prepared: 07/14/11 13:54

Analyzed: 07/15/11 11:45

Solids: 82.16

Preparation: EPA 7471B

Initial/Final: 0.303 g / 36 mL

Batch: 1G14020

Sequence: BA09746

Calibration: 1107016

Instrument: JMHG1

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7439-97-6	Mercury	<0.0292	1	U	0.0195	0.0292	0.0584	EPA 7471B

JAC
8/11

INORGANIC ANALYSIS DATA SHEET

MR14-SS24-11C

EPA 7471B

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-20/B103410-20

File ID: 071511S-036

Sampled: 07/11/11 13:10

Prepared: 07/14/11 13:54

Analyzed: 07/15/11 11:47

Solids: 88.15

Preparation: EPA 7471B

Initial/Final: 0.338 g / 36 mL

Batch: 1G14020

Sequence:

BA09746

Calibration: 1107016

Instrument: JMHG1

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7439-97-6	Mercury	0.0890	1		0.0161	0.0242	0.0483	EPA 7471B

JAC
8/11

INORGANIC ANALYSIS DATA SHEET

MR14-SS34-11C

EPA 7471B

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-21/B103410-21

File ID: 071511S-037

Sampled: 07/11/11 12:55

Prepared: 07/14/11 13:54

Analyzed: 07/15/11 11:50

Solids: 85.98

Preparation: EPA 7471B

Initial/Final: 0.32 g / 36 mL

Batch: 1G14020

Sequence: BA09746

Calibration: 1107016

Instrument: JMHG1

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7439-97-6	Mercury	<0.0279	1	U	0.0186	0.0279	0.0558	EPA 7471B

JAC
8/11/11

INORGANIC ANALYSIS DATA SHEET

MR14-SS32-11C

EPA 7471B

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLei Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-22/B103410-22

File ID: 071511S-043

Sampled: 07/11/11 12:40

Prepared: 07/14/11 13:55

Analyzed: 07/15/11 12:04

Solids: 88.35

Preparation: EPA 7471B

Initial/Final: 0.314 g / 36 mL

Batch: 1G14021

Sequence:

BA09746

Calibration: 1107016

Instrument: JMHG1

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7439-97-6	Mercury	<0.0272	1	U	0.0181	0.0272	0.0543	EPA 7471B

JAC
8/11

INORGANIC ANALYSIS DATA SHEET

EPA 7471B

MR14-SS30-11C

Laboratory: ENCO Jacksonville

SDG: CH025-005

Client: CH2M Hill, Inc. (CH025)

Project: MCB CamLej Site UXO-14 CTO-WE41

Matrix: Soil

Laboratory ID: A103583-24/B103410-24

File ID: 071511S-047

Sampled: 07/11/11 13:55

Prepared: 07/14/11 13:55

Analyzed: 07/15/11 12:13

Solids: 96.40

Preparation: EPA 7471B

Initial/Final: 0.313 g / 36 mL

Batch: 1G14021

Sequence:

BA09746

Calibration: 1107016

Instrument: JMHG1

CAS NO.	Analyte	Concentration (mg/kg dry)	Dilution Factor	Q	DL	LOD	LOQ	Method
7439-97-6	Mercury	<0.0249	1	U	0.0166	0.0249	0.0498	EPA 7471B

JAC
8/11

PROJECT NARRATIVE

Client: CH2M Hill, Inc.
 Project: MCB CamLej Site UXO-14 CTO-WE41
 Project Number: 418824
 ENCO Project ID: A103583/B103410
 SDG: CH025-005

Overview

All samples submitted were analyzed by Environmental Conservation Laboratories, Inc. in accordance with the methods referenced in the laboratory report. Any particular difficulties encountered during sample handling and processing will be discussed in the Remarks section below.

Remarks

List of instruments used:

Analytical and Preparation Method	SOP Reference Instrument
SW-846 6010C	JMICP2
SW-846 7470A	JMHG1
SW-846 7471B	JMHG1

Analysis: EPA 6010C

Affected Samples: MR14-SS22-11C[B103410-08], 1G14008-MS1, 1G14008-MSD1

Nonconformance: The sample selected for matrix spiking had high levels of the target analyte for Lead, rendering the spike used invalid. This may be reflected in matrix spike and matrix spike duplicate recoveries outside of acceptance limits for lead, but is not a reflection of laboratory performance; the laboratory control sample (LCS) passed acceptance criteria, and therefore the analytical system is considered to be in control.

Analysis: EPA 6010C

Affected Samples: MR14-IS10-6.5-7.5-11C[B103410-03], 1G14007-MS1, 1G14007-MSD1

Nonconformance: The matrix spike and matrix spike duplicate had recoveries that were outside acceptance limits for Antimony, but by virtue of a laboratory control sample being in control, the laboratory has demonstrated to be in control of its internal process.

Analysis: EPA 6010C

Affected Samples: MR14-SS25-11C [A103583-04], MR14-SS31D-11C [A103583-05], MR14-SS31-11C [A103583-06], MR14-SS22-11C [A103583-08], MR14-SS33-11C [A103583-10], MR14-SS29-11C [A103583-11], MR14-SS23-11C [A103583-12], MR14-SS25D-11C [A103583-15], MR14-SS28-11C [A103583-17], MR14-SS24-11C [A103583-20], MR14-SS30-11C [A103583-24]

Nonconformance: Estimated result for Lead. The lead results are above calibration. In accordance with DOD QSM a CCV-High for Lead at 11 ug/L was analyzed, the result was within 10% of the true value.

Marcia Colon
 Project Manager

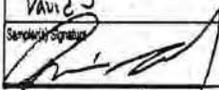


ENVIRONMENTAL CONSERVATION LABORATORIES CHAIN-OF-CUSTODY RECORD

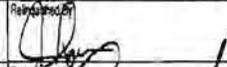
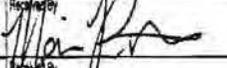
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10775 Central Park Dr. Orlando, FL 32824 (407) 826-5314 Fax (407) 860-6945
 4810 Ecolab Park Court, Suite 211 Jacksonville, FL 32219-9388 (904) 296-3007 Fax (904) 298-8210
 1024 Woodlands Industrial Ct. Cary, NC 27511 (919) 497-3090 Fax (919) 497-3615

Page 2 of 3

Client Name CH2M Hill, Inc. (CH025)		Project Number [none]		Requested Analysis			Requested Turnaround Time			
Address 5700 Cleveland Street, Suite 101		Project Name/Desc MOB CamLug Site UX03-14 CTO-ME11 (JACKSONVILLE)		%Solids, Hg, Pb, Sb	Hg	Pb, Sb	Note: Rush requests subject to acceptance by the facility			
City/State Virginia Beach, VA 23462		PO # / Billing Info					<input checked="" type="checkbox"/> Standard		<input type="checkbox"/> Per Se Sol	
Tel 757-871-8288		Fax					<input type="checkbox"/> Expedited		Due <u> </u> / <u> </u> / <u> </u>	
Reporting Contact Troy Horn		Billing Contact Troy Horn					Lab Workorder A103583			
Sampler(s) Name, Affiliation (Print) David S		Billing Contact Troy Horn		Site Location / Time Zone						
Sampler(s) Signature 										

Item #	Sample ID (Field Identification)	Collection Date	Collection Time	Corp / Grab	Matrix (see codes)	Total # of Containers	Requested Analysis			Sample Comments
	"-3507-5-6-11C	7/12/11	1000	Grp	SD	1	X	X	X	
	"-3511-5-6-11C	7/12/11	1030		SD					
	"-3510-6.5-25-11C	7/12/11	1110							
	"-3510-6.5-25-11C-MS									
	"-3510-6.5-25-11C-SD									
	"-5525-11C	7/11/11	1230							
	"-5533D-11C	7/11/11	1240							
	"-5531-11C	7/11/11	1235							
	"-5527-11C	7/11/11	1400							
	"-5522-11C	7/11/11	1350							
	"-5522-11C-MS									
	"-5522-11C-SD									

Sample(s) Prepared By 	Date/Time 7/12/11 16:40	Received By 	Date/Time 7/12/11 16:40
Completed Special Reporting Requirements MR14	Requested By 	Received By 	Date/Time 7/12/11 17:00
Cooler #s & Temps on Receipt 250 @ 18°C		Condition Upon Receipt <input type="checkbox"/> Acceptable <input type="checkbox"/> Unacceptable	

Matrix: GWF-Groundwater BQ-Sal DW-Drinking Water SS-Sediment SW-Surface Water WW-Wastewater A-M Other (detail in comments) Preservation: H-HCl H-HNO3 S-H2SO4 MO-H2O2 O-Other (detail in comments)
 Note: All samples submitted to ENCO Labs are in accordance with the terms and conditions listed on the reverse of this form, unless prior written agreements exist.

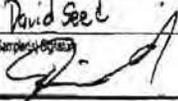


ENVIRONMENTAL CONSERVATION LABORATORIES CHAIN-OF-CUSTODY RECORD

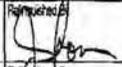
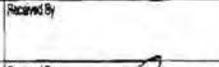
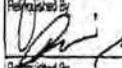
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 Orlando, FL 32824 Jacksonville, FL 32216-6058 Cary, NC 27511
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Page 3 of 3

Client Name CH2M Hill, Inc. (CH025)		Project Number [none]	Requested Analytes				Requested Turnaround Times
Address 5700 Cleveland Street, Suite 101		Project Name/Desc MCB Cantilever Site Ux0-14 (TOWHEM) (JACKSONVILLE)	%Solids, Hg, Pb, Sb Hg Pb, Sb				Note: Rush requests subject to acceptance by the facility. <input checked="" type="checkbox"/> Standard <input type="checkbox"/> Per SOW <input type="checkbox"/> Expedited
City/State Virginia Beach, VA 23462		PO # / Billing Info					
Tel 757-871-6288	Fax	Reporting Contact Troy Horn					
Sampler(s) Name, Affiliation (Print) David Seel		Refing Contact Troy Horn					
Sampler(s) Signature 		Site Location / Time Zone Site Ux0-14 (WE-41)					
Preservation (See Codes) (Combine as necessary)							Due <u> </u> / <u> </u> / <u> </u>
							Lab Workorder A103583

Item #	Sample ID (Field Identification)	Collection Date	Collection Time	Comp / Grab	Matrix (see codes)	Total # of Containers				Sample Comments
	"-SS28-11C	7/11/11	1340	Comp	SO	2	X	X	X	
	"-IS060-6-7-11C	7/11/11	1640	C		1				
	"-IS08-4-5-11C	7/12/11	1200	C						
	"-SS24-11C	7/11/11	1310	C						
	"-SS34-11C	7/11/11	1255	C						
	"-SS32-11C	7/11/11	1240	C						
	"-IS01-6-7-11C	7/12/11	1130	C						
	"-SS30-11C	7/11/11	1355	C	↓					
	"-EB-071111-35	7/11/11	1730		0					
	"-EB-071111-35	7/11/11	1725		0					
	"-EB-071211-35	7/12/11	1400	↓	0		↓	↓	↓	
							← Total # of Containers			

Sample Kit Prepared By 	Date/Time 7/11/11 16:50	Requisitioned By 	Date/Time 7/11/11 16:50	Received By 	Date/Time 7/11/11 16:50
Comments/Special Reporting Requirements "-11- MR14 D= Blank		Requisitioned By 	Date/Time 7/12/11 1700	Received By 	Date/Time 7/13/11 9:00
Cooler #s & Temps on Receipt 25 @ 18°C			Condition Upon Receipt <input type="checkbox"/> Acceptable <input type="checkbox"/> Unacceptable		

Matrix: GW-Groundwater; SO-Soil; DW-Drinking Water; SE-Sediment; SW-Surface Water; WW-Wastewater; A-Air; O-Other (detail in comments) Preservation: I-Ice; H-HCl; N-HNO3; S-H2SO4; NG-NaOH; O-Other (detail in comments)
 Note: All samples submitted to ENCO Labs are in accordance with the terms and conditions listed on the reverse of this form, unless prior written agreements exist.

This SDG contains metals analysis using SW-846 methods 6020A, 7470A, and 7471B. It also contains hexavalent chromium analysis using SM18 3500-Cr D. ENCO Lab WO # A103583.

HOLDING TIMES

Sampling Date: 1/25-26/11
 Received Date: 1/27/11 Cooler temps: acceptable
 Prep. Dates: 1/31 ICP MS; 2/10 Hg;
 Analysis Dates: 2/2-2/3 ICP MS; 2/11 Hg;

All holding time requirements were met. (6 mos for ICP, 28 days for Hg.)

CALIBRATIONS

All initial calibration criteria were met. Single point calibration was analyzed for ICP. Multiple point calibration was analyzed for the mercury fraction. All verification criteria were met for all ICV, CCV, 2nd source, and low range standards for both the ICP-AES and the CVAA analyses. Interference check standards were analyzed and met criteria. Raw data was verified. Calibration curve specifics were requested and received from the laboratory for the mercury fraction as this information was not provided in the original submission of the data package.

BLANK SUMMARY

Blank qualification guidelines:

- No action is taken if an analyte is found in the blank but not in the sample.
- Sample weight, volume or dilution factor must be taken into consideration when applying the criteria.
- Apply the same data validation guidelines to any associated calibration, preparation, and field QC blanks and all associated samples.
- Qualification/Action codes:
 - No Action - The sample result is greater than the LOD.
 - U - The sample result is greater than or equal to the MDL but less than or equal to the LOD, result is reported as non-detect at the LOD.
 - R or J, The blank contaminant concentration was greater than the LOD and the sample result is greater than the LOD but less than 10X the blank contaminant concentration. The reported results are flagged either as rejected R or biased high J+ based on the professional judgment of the validator.

Blank Contamination and Qualification Summaries

Blank ID	Analyte	Concentration	Action Level	Q Flag
MR14-EB-071211-IS	lead	10.7 ug/L	10X blank level	J

The concentration noted for the CCBs is the highest concentration in all the CCBs. However, when qualifying samples for CCB contamination, associated samples are those just prior to or just following a CCB. Therefore, not all analytes in all samples are flagged for noted CCB contamination. See worksheets for associations. Samples are qualified for field QC blank contamination based on QC tracking provided by CH2M HILL. Negative contamination in a prep blank or CCB, if less than the analyte LOD, is qualified based on professional judgment.

Associated samples and required qualifications are noted in the following table.

Sample ID	Analyte	Q Flag	Q Code
MR14-IS08-4-5-11C, MR14-IS09-6-7-11C	lead	J	EBL

MATRIX SPIKE/DUPLICATE SUMMARY

The spike pair analyzed in this SDG exhibited low recoveries for antimony in one spike pair, high recoveries for lead in a second spike pair and acceptable recoveries in the third spike pair. All positive and non-detect results for antimony in the field samples were qualified as estimated J/UJ. Lead was high in the second spike pair due to the abundance of the target analyte in the native sample so flagging criteria do not apply. The PDS results were within criteria for all analytes. LCS recoveries and RPDs were acceptable.

The mercury spike pairs were acceptable for recoveries and RPDs. LCS recoveries were acceptable also.

SERIAL DILUTIONS

Serial dilution analyses were not performed for the samples in this SDG.

FIELD DUPLICATE SAMPLE SUMMARY

Note: Field duplicate results are assessed only if both results are above the LOD.

Sample ID: MR14-SS31-11C Duplicate Sample ID: MR14-SS31D-11C

Analyte	Sample Conc.	Duplicate Conc.	RPD
antimony	1.65	1.56	6%
lead	886	432	69%
mercury			#DIV/0!

Comments: Flag lead as estimated J in both samples.

Sample ID: MR14-SS25-11C Duplicate Sample ID: MR14-SS25D-11C

Analyte	Sample Conc.	Duplicate Conc.	RPD
antimony			#DIV/0!
lead	267	244	9%
mercury			#DIV/0!

Comments: No qualifications were required.

Sample ID: MR14-IS06-6-7-11C Duplicate Sample ID: MR14-IS06D6-7-11C

Analyte	Sample Conc.	Duplicate Conc.	RPD
antimony			#DIV/0!
lead	35.8	69.4	64%
mercury			#DIV/0!

Comments: Flag lead as estimated J in both samples.

SAMPLE RESULT VERIFICATION**Specific Comments:**

All sample results were reported within the calibration/linear range of the instruments. Detection limits were acceptable. Raw data was verified. Calculation verification was performed. Bench sheets were provided. All positive results reported at concentrations between the DL and the LOQ were qualified as estimated, J by the laboratory.

Reviewer

JACleveland

Date:

8-3-11

SDG# CH025-001
MCB Camp Lejeune, CTO-WE41
Metals & Mercury
Page 2

CH2M HILL LEJEUNE CTO-WE-41

METALS CALCULATIONS

SDG CH025-005

ICP - AES	
SAMPLE ID	MR14-SS31-11C
ANALYTE	lead
Lab Value CONCENTRATION (mg/Kg)	886E
AMOUNT FROM RAW DATA (ug/ml)	10.69
SAMPLE SIZE (g)	0.616
FINAL VOLUME (ml)	50
DILUTION FACTOR	1
DRYNESS FACTOR	0.9789
CONVERSION FACTOR (ug/g TO mg/Kg)	1
CALCULATED CONCENTRATION (mg/Kg)	886.398

Hg, CVAA	
SAMPLE ID	MR14-SS24-11C
ANALYTE	mercury
Lab Value CONCENTRATION (mg/Kg)	0.089
AMOUNT FROM RAW DATA (ug/L)	0.737
SAMPLE SIZE (g)	0.338
FINAL VOLUME (L)	0.036
DILUTION FACTOR	1
DRYNESS FACTOR	0.8815
CONVERSION FACTOR (ug/g to mg/Kg)	1
CALCULATED CONCENTRATION (ug/Kg)	0.089

MATRIX SPIKE / MATRIX SPIKE DUPLICATE RECOVERY

MR14-SS22-11C

EPA 6010C

Laboratory: ENCO Jacksonville SDG: CH025-005
 Client: CH2M Hill, Inc. (CH025) Project: MCB CamLei Site UXO-14 CTO-WE41
 Matrix: Soil
 Batch: 1G14008 Laboratory ID: 1G14008-MS1
 Preparation: EPA 3050B Initial/Final: 0.636 g / 50 mL
 Source Sample Name: MR14-SS22-11C

COMPOUND	SPIKE ADDED (mg/kg dry)	SAMPLE CONCENTRATION (mg/kg dry)	MS CONCENTRATION (mg/kg dry)	MS % REC. #	QC LIMITS REC.
Antimony	46.9	1.03	40.0	83	75 - 125
Lead	46.9	342	446	221 *	75 - 125

NR

COMPOUND	SPIKE ADDED (mg/kg dry)	MSD CONCENTRATION (mg/kg dry)	MSD % REC. #	% RPD #	QC LIMITS	
					RPD	REC.
Antimony	44.4	37.0	81	8	20	75 - 125
Lead	44.4	421	178 *	6	20	75 - 125

NR

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

non-compliance is due to the abundance of Pb in the native sample. (SA is ~ 4X conc)

Jacqueline Cleveland

From: Marcia Colon [mcolon@encolabs.com]
Sent: Tuesday, August 02, 2011 2:11 PM
To: 'Jacqueline Cleveland'
Cc: Bianca.Kleist@CH2M.com; Troy.Horn@ch2m.com; 'DataQual Environmental Services, LLC'
Subject: [SPAM]RE: CH2M HILL Lejeune CTO-WE41
Attachments: A103583 ICAL Form0001.pdf

Hi Jackie-

I have responses to your questions. See below, I've added my comments in RED.
If you need anything else just let me know.

Thanks,
Marcia

Marcia Colon
Project Manager

Environmental Conservation Laboratories, Inc.
10775 Central Port Drive
Orlando, FL 32824
(407)826-5314 ph
(407)850-6945 fax
mcolon@encolabs.com

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From: Jacqueline Cleveland [mailto:cleve137@charter.net]
Sent: Tuesday, August 02, 2011 10:46 AM
To: 'Marcia Colon'
Cc: Bianca.Kleist@CH2M.com; Troy.Horn@ch2m.com; 'DataQual Environmental Services, LLC'
Subject: CH2M HILL Lejeune CTO-WE41
Importance: High

Good Morning Marcia,

I am validating the data for Lejeune CTO-WE41 for CH2M HILL and I have two questions regarding the metals data. These questions are regarding SDG CH025-005.

1. There were several results for lead that were reported with E flags. Why were these samples not diluted and reported at concentrations within the curve range?

The DOD QSM allows sample results to be reported above the calibration range for single point calibrations provided we pass a CCV above the sample concentrations and below the LDR. See gray box 33 for more information.

2. May I have calibration curve information for the mercury curves analyzed for the 7470 & 7471 methods? The raw data standards are present but the correlation coefficients, etc. are not present in the package that I can find. If I have missed them somehow – please tell me where I can find this info. I have attached the ICAL Reports for EPA 7470 & EPA 7471.

This validation is on a 7-day TAT. It would be very helpful if you would respond today if at all possible! I appreciate your help!

Jackie

Jacqueline Cleveland
Vice-President
DataQual, ES, LLC
636-352-9391
cleve137@charter.net

Jacqueline Cleveland

From: Marcia Colon [mcolon@encolabs.com]
Sent: Wednesday, August 03, 2011 12:52 PM
To: 'Jacqueline Cleveland'
Cc: Bianca.Kleist@CH2M.com; Troy.Horn@ch2m.com; 'DataQual Environmental Services, LLC'
Subject: RE: [SPAM]RE: CH2M HILL Lejeune CTO-WE41
Attachments: Metals Calibration0001.pdf; Mercury Calibration Data0001.pdf

Hi Jackie-

Enclosed is the curve for Mercury. I'm also enclosing the metals curve, in case you need that as well.

Thanks!!

Marcia

*Marcia Colon
Project Manager*

Environmental Conservation Laboratories, Inc.
10775 Central Port Drive
Orlando, FL 32824
(407)826-5314 ph
(407)850-6945 fax
mcolon@encolabs.com

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From: Jacqueline Cleveland [mailto:cleve137@charter.net]
Sent: Tuesday, August 02, 2011 3:28 PM
To: 'Marcia Colon'
Cc: Bianca.Kleist@CH2M.com; Troy.Horn@ch2m.com; 'DataQual Environmental Services, LLC'
Subject: RE: [SPAM]RE: CH2M HILL Lejeune CTO-WE41

Marcia,

On the mercury curves, I was asking for the curves themselves – for example the correlation coefficients, slopes and y-intercepts for each curve. Is this information available? The pages that you sent do not contain these items. Thank you!

Jackie

From: Marcia Colon [mailto:mcolon@encolabs.com]
Sent: Tuesday, August 02, 2011 2:11 PM
To: 'Jacqueline Cleveland'

INITIAL CALIBRATION CURVE

Laboratory: ENCO Jacksonville

Calibration ID: 1107016

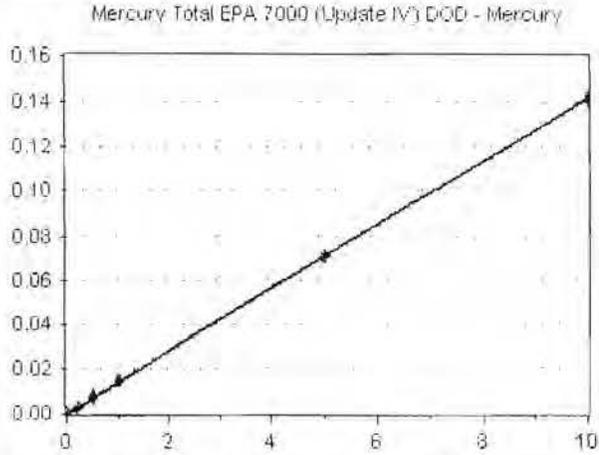
Instrument: JMHG1

Created By: LTS

Calibration Date: 15-Jul-2011 11:22

Mercury Total EPA 7000 (Update IV) DOD

Mercury



Curve Type: Linear regression
 Avg RF/Slope: 1.417937E-02
 Intercept: 5.70941E-05
 RF RSD/COD: 0.9999883

Lab Number	Standard ID	Concentration (ug/mL)	Response	ISTD Conc (ug/mL)	ISTD Resp	Response Factor
BA09746-CAL1	B1E0018	0	0			0
BA09746-CAL2	B1E0019	0.2	2.661842E-03			1.330921E-02
BA09746-CAL3	B1E0020	0.5	7.407322E-03			1.481464E-02
BA09746-CAL4	B1E0021	1	1.438341E-02			1.438341E-02
BA09746-CAL5	B1E0022	5	7.076164E-02			1.415233E-02
BA09746-CAL6	B1E0023	10	0.1419239			1.419239E-02

ICAL VERIFICATION

Calibration: 1107016

LRI

8/2/2011

1:15:42PM

ENCO policy QA-008 requires that regression curves be validated to ensure that curve intercepts will not result in mathematically-derived false positive or false negative results. This report facilitates this check, but requires that the curve in Element and in the source data system (Chemstation, Turbochrom, ELAN, etc) be an exact match. The slope and Y-intercept must match exactly to at least three decimal places. Please verify this before using the information on this report

Mercury Total EPA 7000 (Update)

Sample ID	Type	analyte	MRL	initialunits	calresult	truevalue	%Rec	Limits
BA09746-CAL2	LRI	Mercury		ug/L	0.183700	0.200	92	75-125
BA09746-CAL3	LRI	Mercury		ug/L	0.518375	0.500	104	75-125
BA09746-CAL4	LRI	Mercury		ug/L	1.010360	1.00	101	75-125
BA09746-CAL5	LRI	Mercury		ug/L	4.986440	5.00	100	75-125
BA09746-CAL6	LRI	Mercury		ug/L	10.005200	10.0	100	75-125

INITIAL CALIBRATION CURVE

Laboratory: ENCO Jacksonville

Calibration ID: 1107019

Instrument: JMHG1

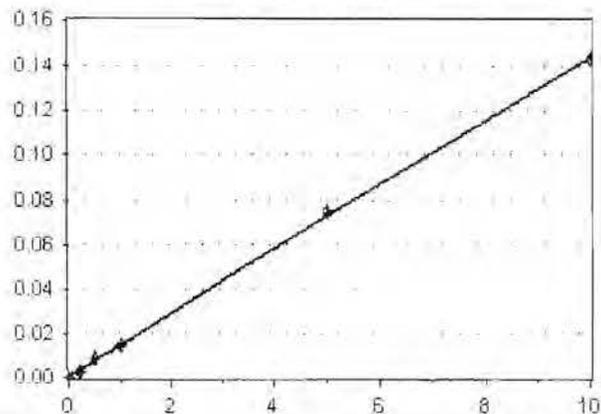
Created By: LTS

Calibration Date: 18-Jul-2011 11:22

Mercury Total EPA 7000 (Update IV) DOD

Mercury

Mercury Total EPA 7000 (Update IV) DOD - Mercury



Curve Type: Linear regression

Avg RF/Slope: 1.435798E-02

Intercept: 7.368004E-04

RF RSD/COD: 0.9996009

Lab Number	Standard ID	Concentration (ug/mL)	Response	ISTD Conc (ug/mL)	ISTD Resp	Response Factor
BA09754-CAL1	B1G0211	0	0			0
BA09754-CAL2	B1G0212	0.2	2.445578E-03			1.222789E-02
BA09754-CAL3	B1G0213	0.5	9.075863E-03			1.815173E-02
BA09754-CAL4	B1G0214	1	1.505584E-02			1.505584E-02
BA09754-CAL5	B1G0215	5	7.414537E-02			1.482907E-02
BA09754-CAL6	B1G0216	10	0.1434764			1.434764E-02

ICAL VERIFICATION

Calibration: 1107019

LRI

8/2/2011

1:16:38PM

ENCO policy QA-008 requires that regression curves be validated to ensure that curve intercepts will not result in mathematically-derived false positive or false negative results. This report facilitates this check, but requires that the curve in Element and in the source data system (Chemstation, Turbochrom, ELAN, etc) be an exact match. The slope and Y-intercept must match exactly to at least three decimal places. Please verify this before using the information on this report.

Mercury Total EPA 7000 (Update)

Sample ID	Type	analyte	MRL	initialunits	calresult	truevalue	%Rec	Limits
BA09754-CAL2	LRI	Mercury		ug/L	0.119012	0.200	61	75-125
BA09754-CAL3	LRI	Mercury		ug/L	0.580796	0.500	116	75-125
BA09754-CAL4	LRI	Mercury		ug/L	0.997288	1.00	100	75-125
BA09754-CAL5	LRI	Mercury		ug/L	5.112740	5.00	102	75-125
BA09754-CAL6	LRI	Mercury		ug/L	9.941480	10.0	99	75-125

Appendix C
Munitions Debris Disposal Documents

Appendix D
MEC Intrusive Investigation Documents

Table D-1
 MEC Intrusive Investigation Results
 Site UXO-14 Gas Chamber (ASR#2.200)
 MCB CamLej, North Carolina

Anomaly Identification	Grid	Amplitude (millivolts)	Dig Date	Easting (UTM)	Northing (UTM)	Item Group	Item Class	Category	Filler	Fuze	Quantity	Depth (inch)	Weight (pound)	Action Taken	Demolition Required?	Item Comment
UXO14_T01-00001	UXO14_T01	79.13	8/18/2011	275028.91	3830510.58	Cultural Debris	Scrap	N/A	N/A	N/A	5	4	0.5	Scrap Bin	None	5 nails
UXO14_T01-00002	UXO14_T01	78.17	8/18/2011	275039.59	3830510.19	Cultural Debris	Scrap	N/A	N/A	N/A	1	4	0.25	Scrap Bin	None	Screen 4x8 inches
UXO14_T01-00003	UXO14_T01	76.76	8/18/2011	275044.45	3830510.01	Cultural Debris	Scrap	N/A	N/A	N/A	1	12	0.5	Scrap Bin	None	Wire mesh
UXO14_T01-00004	UXO14_T01	76.04	8/18/2011	275041.76	3830510.11	MPPEH	Small Arms	Expended Cartridge Cases (Various Calibers)	Empty	N/A	1	12	0.015	Consolidation Point	Demilitarization	Small arms ctg case
UXO14_T01-00005	UXO14_T01	42.6	8/18/2011	275038.8	3830510.21	Cultural Debris	Scrap	N/A	N/A	N/A	5	4	0.5	Scrap Bin	None	
UXO14_T01-00006	UXO14_T01	39.9	8/18/2011	275045.32	3830509.98	Cultural Debris	Scrap	N/A	N/A	N/A	1	4	0.25	Scrap Bin	None	
UXO14_T01-00007	UXO14_T01	25	8/18/2011	275033.1	3830510.42	Cultural Debris	Scrap	N/A	N/A	N/A	11	10	3	Scrap Bin	None	Nails/bolts
UXO14_T01-00008	UXO14_T01	7.62	8/18/2011	275040.45	3830510.15	Cultural Debris	Scrap	N/A	N/A	N/A	2	8	0.15	Scrap Bin	None	Nails
UXO14_T02-00001	UXO14_T02	799.59	8/18/2011	275044.15	3830514.37	Cultural Debris	Scrap	N/A	N/A	N/A	2	5	0.1	Scrap Bin	None	
UXO14_T02-00002	UXO14_T02	182.14	8/18/2011	275043.12	3830514.41	Cultural Debris	Scrap	N/A	N/A	N/A	5	4	25	Scrap Bin	None	
UXO14_T02-00003	UXO14_T02	77.15	8/18/2011	275038.36	3830514.58	TBD	TBD	Greater than 2 feet	N/A	N/A	0	0	0	Left in Place	None	Dug to depth
UXO14_T02-00004	UXO14_T02	70.68	8/18/2011	275045.55	3830514.33	Cultural Debris	Scrap	N/A	N/A	N/A	4	6	4	Scrap Bin	None	
UXO14_T02-00005	UXO14_T02	70.67	8/18/2011	275029.31	3830514.89	Cultural Debris	Scrap	N/A	N/A	N/A	2	4	0.5	Scrap Bin	None	
UXO14_T02-00006	UXO14_T02	42.69	8/18/2011	275041.9	3830514.45	MPPEH	Small arms	Expended Cartridge Cases (Various Calibers)	Empty	N/A	1	12	0.015	Consolidation Point	Demilitarization	
UXO14_T02-00007	UXO14_T02	33.28	8/18/2011	275039.94	3830514.52	QC	QC Seed	QC Seed	N/A	N/A	1	14	0.5	Consolidation Point	None	Seed label destroyed
UXO14_T02-00008	UXO14_T02	20.93	8/18/2011	275040.79	3830514.49	Cultural Debris	Scrap	N/A	N/A	N/A	2	5	0.1	Scrap Bin	None	
UXO14_T02-00009	UXO14_T02	16.99	8/18/2011	275032	3830514.8	Cultural Debris	Scrap	N/A	N/A	N/A	5	6	10	Scrap Bin	None	

QC - quality control
 MPPEH - Materially potentially presenting an explosive hazard
 TBD - to be determined
 N/A - not applicable
 UXO - unexploded ordnance
 UTM - Universal Transverse Mercator, Zone 18

Appendix E
Human Health Risk Screening Tables

TABLE E-1

Occurrence, Distribution, and Selection of Chemicals of Potential Concern
 Site UXO-14 Former Indoor Pistol Range
 MCB Camp Lejeune, North Carolina

Scenario Timeframe: Current/Future Medium: Surface Soil Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening [2]	Background Value [3]	Screening Toxicity Value [4]	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection [5]
UXO-14	7429-90-5	Aluminum	5.5E+02	1.8E+03	MG/KG	MR14-SS01D-09D	12/12	9.88 - 12.1	1.8E+03	5.5E+03	7.7E+03 N	N/A		NO	BSL
	7440-36-0	Antimony	3.5E-01 J	3.9E+02	MG/KG	MR14-SS12-09D	12/26	0.741 - 0.905	3.9E+02	4.5E-01	3.1E+00 N	N/A		YES	ASL
	7440-38-2	Arsenic	2.0E-01 J	2.7E+00	MG/KG	MR14-SS12-09D	11/12	0.247 - 0.302	2.7E+00	6.3E-01	3.9E-01 C*	5.8E+00	NCSSL	YES	ASL
	7440-39-3	Barium	2.2E+00	1.3E+01	MG/KG	MR14-SS01-09D	12/12	1.98 - 2.41	1.3E+01	1.5E+01	1.5E+03 N	5.8E+02	NCSSL	NO	BSL
	7440-41-7	Beryllium	5.0E-02 J	5.0E-02 J	MG/KG	MR14-SS12-09D	1/12	0.247 - 0.302	5.0E-02	1.0E-01	1.6E+01 N	N/A		NO	BSL
	7440-43-9	Cadmium	ND	ND	MG/KG		0/12	0.247 - 0.302	3.0E-01	3.3E-02	7.0E+00 N	3.0E+00	NCSSL	NO	DLBSL
	7440-70-2	Calcium	5.3E+01 J	5.0E+03	MG/KG	MR14-SS11-09D	11/12	247 - 302	5.0E+03	6.4E+03	N/A	N/A		NO	NUT, BBK
	7440-47-3	Chromium	8.8E-01	3.8E+00	MG/KG	MR14-SS01-09D	12/12	0.247 - 0.302	3.8E+00	6.1E+00	2.9E-01 C	3.8E+00	NCSSL	NO	BBK
	7440-48-4	Cobalt	2.7E-01 J	5.9E-01 J	MG/KG	MR14-SS03-09D	4/12	0.617 - 0.754	5.9E-01	2.9E-01	2.3E+00 N	N/A		NO	BSL
	7440-50-8	Copper	9.6E-01	1.3E+01	MG/KG	MR14-SS01D-09D	12/12	0.494 - 0.603	1.3E+01	4.8E+00	3.1E+02 N	7.0E+02	NCSSL	NO	BSL
	57-12-5	Cyanide	ND	ND	MG/KG		0/12	0.256 - 0.3	3.0E-01	N/A	1.6E+02 N	2.8E-01	NCSSL	NO	DLBSL
	7439-89-6	Iron	2.4E+02	1.5E+03	MG/KG	MR14-SS01-09D	12/12	4.94 - 6.03	1.5E+03	3.2E+03	5.5E+03 N	1.5E+02	NCSSL	NO	BSL
	7439-92-1	Lead	7.4E+01	3.6E+04	MG/KG	MR14-SS12-09D	26/26	0.149 - 37.3	3.6E+04	1.2E+01	4.0E+02 NL	2.7E+02	NCSSL	YES	ASL
	7439-95-4	Magnesium	5.9E+01 J	1.4E+02 J	MG/KG	MR14-SS11-09D	5/12	247 - 302	1.4E+02	2.4E+02	N/A	N/A		NO	NUT, BBK
	7439-96-5	Manganese	3.7E+00	2.1E+01	MG/KG	MR14-SS01-09D	12/12	0.741 - 0.905	2.1E+01	1.4E+01	1.8E+02 N	6.5E+01	NCSSL	NO	BSL
	7439-97-6	Mercury	1.4E-02 J	1.1E+00	MG/KG	MR14-SS02-09D	12/26	0.033 - 0.0394	1.1E+00	8.1E-02	2.3E+00 N	1.0E+00	NCSSL	NO	BSL
	7440-02-0	Nickel	4.0E-01 J	2.0E+00	MG/KG	MR14-SS12-09D	12/12	0.494 - 0.603	2.0E+00	1.2E+00	1.5E+02 N	1.3E+02	NCSSL	NO	BSL
	7440-09-7	Potassium	8.2E+01 J	8.3E+01 J	MG/KG	MR14-SS11-09D	2/12	247 - 302	8.3E+01	1.2E+02	N/A	N/A		NO	NUT
	7782-49-2	Selenium	ND	ND	MG/KG		0/12	0.247 - 0.302	3.0E-01	5.6E-01	3.9E+01 N	2.1E+00	NCSSL	NO	DLBSL
	7440-22-4	Silver	5.1E-02 J	6.3E-01	MG/KG	MR14-SS12-09D	5/12	0.247 - 0.302	6.3E-01	1.4E-01	3.9E+01 N	3.4E+00	NCSSL	NO	BSL
	7440-23-5	Sodium	2.3E+02 J	2.3E+02 J	MG/KG	MR14-SS11-09D	1/12	247 - 302	2.3E+02	8.1E+01	N/A	N/A		NO	NUT
	7440-28-0	Thallium	ND	ND	MG/KG		0/12	0.395 - 0.795	8.0E-01	3.6E-01	7.8E-02	N/A		YES	DLASL
	7440-62-2	Vanadium	1.1E+00	8.7E+00	MG/KG	MR14-SS03-09D	12/12	0.617 - 0.754	8.7E+00	8.9E+00	3.9E+01 N	N/A		NO	BSL
	7440-66-6	Zinc	1.3E+01 J	6.5E+01	MG/KG	MR14-SS01-09D	12/12	0.988 - 1.21	6.5E+01	1.1E+01	2.4E+03 N	1.2E+03	NCSSL	NO	BSL

TABLE E-1

Occurrence, Distribution, and Selection of Chemicals of Potential Concern
 Site UXO-14 Former Indoor Pistol Range
 MCB Camp Lejeune, North Carolina

Scenario Timeframe: Current/Future
 Medium: Surface Soil
 Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening [2]	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
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<p>[1] Minimum/Maximum detected concentrations. Samples collected from former indoor pistol range analyzed for metals, samples collected from former gas chamber area analyzed for SVOCs.</p> <p>[2] Maximum concentration is used for screening. If chemical was not detected, the maximum detection limit is used for screening.</p> <p>[3] Background values are two times the arithmetic mean basewide background surface soil concentrations. Background values are from <i>Final Base Background Soil Study Report, Marine Corps Base Camp Lejeune, North Carolina</i>, Baker Environmental, April 25, 2001.</p> <p>[4] Oak Ridge National Laboratory (ORNL). June 2011. Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites. http://epa-prgs.ornl.gov/chemicals/index.shtml. Adjusted (noncarcinogenic RSLs adjusted by dividing by 10) residential soil RSLs. RSL value for chromium VI used for total chromium.</p> <p>[5] Rationale Codes</p>	<p>Selection Reason: Above Screening Levels (ASL) Detection Limit Above Screening Level (DLASL), not quantitatively evaluated in HHRA</p> <p>Deletion Reason: No Toxicity Information (NTX) Essential Nutrient (NUT) Below Screening Level (BSL) Below Background (BBK) Detection Limit Below Screening Level (DLBSL)</p>	<p>COPC = Chemical of Potential Concern ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered NCSL = North Carolina Soil Screening Levels (NCDENR, 2010) J = Estimated Value C = Carcinogenic C* = N screening level < 100x C screening level, therefore N screening value/10 used as screening level C** = N screening level < 10x C screening level, therefore N screening value/10 used as screening level N = Noncarcinogenic N/A = Not available ND = Non-detect NL = Noncarcinogenic lead residential soil RSL not adjusted by dividing by 10.</p>
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TABLE E-2

Risk Ratio Screening for Surface Soil, Maximum Detected Concentration

Site UXO-14 Former Indoor Pistol Range

MCB Camp Lejeune, North Carolina

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier)	Sample Location of Maximum Detected Concentration	Residential Soil RSL	Acceptable Risk Level	Corresponding Hazard Index ^a	Corresponding Cancer Risk ^b	Target Organ
Metals^c (mg/kg)								
Antimony	12 / 26	3.9E+02	MR14-SS12-09D	3.1E+01	1	12.5	NA	Blood
Arsenic	11 / 12	2.7E+00	MR14-SS12-09D	3.9E-01	1E-06	NA	7E-06	NA
Lead	26 / 26	3.6E+04	MR14-SS12-09D	NA	NA	NA	NA	NA
Cumulative Corresponding Hazard Index^d						12.5		
Cumulative Corresponding Cancer Risk^e							7E-06	
Total Blood HI =								12.5

Notes:

a Corresponding Hazard Index equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

b Corresponding Cancer Risk equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

c Cumulative Corresponding Hazard Index equals sum of Corresponding Hazard Indices for each constituent.

d Cumulative Corresponding Cancer Risk equals sum of Corresponding Cancer Risks for each constituent.

e Samples analyzed for metals collected from the former indoor pistol range, samples collected from former gas chamber were not analyzed for metals.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Corresponding Cancer Risk greater than 5E-05, otherwise, constituent not selected as COPC.

Constituents selected as COPCs are indicated by shading.

COPC = Constituent of Potential Concern

HI = Hazard Index

mg/kg = micrograms per kilogram

NA = Not available/not applicable.

TABLE E-3

Risk Ratio Screening for Surface Soil, 95% UCL Concentration
 Site UXO-14 Former Indoor Pistol Range
 MCB Camp Lejeune, North Carolina

Analyte	Detection Frequency	95% UCL	95% UCL Rationale	Residential Soil RSL	Acceptable Risk Level	Corresponding Hazard Index ^a	Corresponding Cancer Risk ^b	Target Organ
Metals ^e (mg/kg)								
Antimony	12 / 26	1.7E+02 99% KM	2	3.1E+01	1	5.6	NA	Blood
Lead	26 / 26	2.3E+03 Mean	6	NA	NA	NA	NA	NA
Cumulative Corresponding Hazard Index ^c						5.6		
Cumulative Corresponding Cancer Risk ^d							0E+00	
							Total Blood HI =	5.6

Notes:

- ^a Corresponding Hazard Index equals 95% UCL concentration divided by the RSL divided by the acceptable risk level
- ^b Corresponding Cancer Risk equals 95% UCL concentration divided by the RSL divided by the acceptable risk level
- ^c Cumulative Corresponding Hazard Index equals sum of Corresponding Hazard Indices for each constituent
- ^d Cumulative Corresponding Cancer Risk equals sum of Corresponding Cancer Risks for each constituent
- ^e Samples analyzed for metals collected from the former indoor pistol range, samples collected from former gas chamber were not analyzed for metals

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Corresponding Cancer Risk greater than 5E-05, otherwise, constituent not selected as COPC.

Constituents selected as COPCs are indicated by shading.

COPC = Constituent of Potential Concern
 mg/kg = micrograms per kilogram
 HI = Hazard Index
 NA = Not available/not applicable

ProUCL, Version 4.1 used to determine distribution of data and calculate 95% UCL, following recommendations in users guide (USEPA, May 2010, ProUCL, Version 4.1, Prepared by Lockheed Martin Environmental Services).
 Options: 99% Kaplan-Meier (Chebyshev) UCL (99% KM); Arithmetic Mean Concentration (Mean)

Upper Confidence Limit (UCL) Rationale:

- (1) Shapiro-Wilk W Test/Lilliefors test indicates data are log-normally distributed.
- (2) Shapiro-Wilk W Test/Lilliefors indicates data are normally distributed.
- (3) Test indicates data are gamma distributed.
- (4) Distribution tests are inconclusive
- (5) Max value used because 95% UCL greater than max.
- (6) Lead evaluated using arithmetic mean concentration in lead models, therefore, arithmetic mean concentration presented here.

TABLE E-4

Occurrence, Distribution, and Selection of Chemicals of Potential Concern
 Site UXO-14 Former Indoor Pistol Range
 MCB Camp Lejeune, North Carolina

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

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
UXO-14	7429-90-5	Aluminum	7.9E+02	1.5E+03	MG/KG	MR14-IS01-2-3-09D	3/3	11.8 - 12.3	1.5E+03	1.0E+04	7.7E+03 N	N/A		NO	BSL
	7440-36-0	Antimony	8.4E-01 J	2.6E+00	MG/KG	MR14-IS01-2-3-09D	2/11	0.889 - 3.8	2.6E+00	3.6E-01	3.1E+00 N	N/A		NO	BSL
	7440-38-2	Arsenic	2.0E-01 J	2.1E-01 J	MG/KG	MR14-IS01-2-3-09D	2/3	0.296 - 0.307	2.1E-01	2.1E+00	3.9E-01 C*	5.8E+00	NCSSL	NO	BSL
	7440-39-3	Barium	1.4E+00 J	2.5E+00	MG/KG	MR14-IS01-2-3-09D	3/3	2.37 - 2.45	2.5E+00	1.7E+01	1.5E+03 N	5.8E+02	NCSSL	NO	BSL
	7440-41-7	Beryllium	ND	ND	MG/KG		0/3	0.296 - 0.307	3.1E-01	1.7E-01	1.6E+01 N	N/A		NO	DLBSL
	7440-43-9	Cadmium	ND	ND	MG/KG		0/3	0.296 - 0.307	3.1E-01	2.3E-02	7.0E+00 N	3.0E+00	NCSSL	NO	DLBSL
	7440-70-2	Calcium	ND	ND	MG/KG		0/3	296 - 307	3.1E+02	4.4E+02	N/A	N/A		NO	NUT, BBK
	7440-47-3	Chromium	7.4E-01	1.1E+00	MG/KG	MR14-IS01-2-3-09D	3/3	0.296 - 0.307	1.1E+00	1.5E+01	2.9E-01 C	3.8E+00	NCSSL	NO	BBK
	7440-48-4	Cobalt	ND	ND	MG/KG		0/3	0.741 - 0.766	7.7E-01	8.2E-01	2.3E+00 N	N/A		NO	DLBSL
	7440-50-8	Copper	1.3E+00	1.3E+00	MG/KG	MR14-SS01D-09D	1/3	0.592 - 0.613	1.3E+00	2.6E+00	3.1E+02 N	7.0E+02	NCSSL	NO	BSL
	57-12-5	Cyanide	ND	ND	MG/KG		0/3	0.295 - 0.31	3.1E-01	N/A	1.6E+02 N	2.8E-01	NCSSL	NO	DLBSL
	7439-89-6	Iron	1.8E+02	3.7E+02	MG/KG	MR14-IS01-2-3-09D	3/3	5.92 - 6.13	3.7E+02	5.4E+03	5.5E+03 N	1.5E+02	NCSSL	NO	BSL
	7439-92-1	Lead	1.3E+00	2.9E+02	MG/KG	MR14-IS01-2-3-09D	11/11	0.178 - 1.9	2.9E+02	8.5E+00	4.0E+02 NL	2.7E+02	NCSSL	NO	BSL
	7439-95-4	Magnesium	ND	ND	MG/KG		0/3	296 - 307	3.1E+02	3.6E+02	N/A	N/A		NO	NUT, BBK
	7439-96-5	Manganese	1.5E+00	3.3E+00	MG/KG	MR14-IS01-2-3-09D	3/3	0.889 - 0.92	3.3E+00	9.3E+00	1.8E+02 N	6.5E+01	NCSSL	NO	BSL
	7439-97-6	Mercury	3.4E-02 J	3.4E-02 J	MG/KG	MR14-IS01-2-3-09D	1/11	0.0333 - 0.0643	3.4E-02	7.1E-02	2.3E+00 N	1.0E+00	NCSSL	NO	BSL
	7440-02-0	Nickel	3.6E-01 J	4.3E-01 J	MG/KG	MR14-IS01-2-3-09D	3/3	0.592 - 0.613	4.3E-01	2.3E+00	1.5E+02 N	1.3E+02	NCSSL	NO	BSL
	7440-09-7	Potassium	ND	ND	MG/KG		0/3	296 - 307	3.1E+02	3.6E+02	N/A	N/A		NO	NUT
	7782-49-2	Selenium	ND	ND	MG/KG		0/3	0.296 - 0.307	3.1E-01	5.1E-01	3.9E+01 N	2.1E+00	NCSSL	NO	DLBSL
	7440-22-4	Silver	ND	ND	MG/KG		0/3	0.296 - 0.307	3.1E-01	1.3E-01	3.9E+01 N	3.4E+00	NCSSL	NO	DLBSL
	7440-23-5	Sodium	ND	ND	MG/KG		0/3	296 - 307	3.1E+02	6.8E+01	N/A	N/A		NO	NUT
	7440-28-0	Thallium	ND	ND	MG/KG		0/3	0.474 - 0.491	4.9E-01	3.8E-01	7.8E-02	N/A		YES	DLASL
	7440-62-2	Vanadium	8.0E-01	1.3E+00	MG/KG	MR14-IS01-2-3-09D	3/3	0.741 - 0.766	1.3E+00	1.7E+01	3.9E+01 N	N/A		NO	BSL
	7440-66-6	Zinc	3.3E+00	1.0E+01	MG/KG	MR14-IS01-2-3-09D	2/3	1.18 - 1.23	1.0E+01	6.6E+00	2.4E+03 N	1.2E+03	NCSSL	NO	BSL

TABLE E-4

Occurrence, Distribution, and Selection of Chemicals of Potential Concern
 Site UXO-14 Former Indoor Pistol Range
 MCB Camp Lejeune, North Carolina

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

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
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[1] Minimum/Maximum detected concentrations. Samples collected from former indoor pistol range analyzed for metals, samples collected from former gas chamber area analyzed for SVOCs.

[2] Maximum concentration is used for screening. If chemical was not detected, the maximum detection limit is used for screening.

[3] Background values are 1 two times the arithmetic mean basewide background subsurface soil concentrations. Background values are from *Final Base Background Soil Study Report, Marine Corps Base Camp Lejeune, North Carolina*, Baker Environmental, April 25, 2001.

[4] Oak Ridge National Laboratory (ORNL), June 2011. Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites. <http://epa-prgs.ornl.gov/chemicals/index.shtml>. Adjusted (noncarcinogenic RSLs adjusted by dividing by 10) residential soil RSLs. RSL value for chromium VI used for total chromium.

[5] Rationale Codes

Selection Reason:	Above Screening Levels (ASL) Detection Limit Above Screening Level (DLASL), not quantitatively evaluated in HHRA
Deletion Reason:	No Toxicity Information (NTX) Essential Nutrient (NUT) Below Screening Level (BSL) Below Background (BBK) Detection Limit Below Screening Level (DLBSL)

COPC = Chemical of Potential Concern
 ARAR/TBC = Applicable or Relevant and Appropriate Requirement/
 To Be Considered
 NCSSL = North Carolina Soil Screening Levels (NCDENR, 2010)
 J = Estimated Value
 C = Carcinogenic
 C* = N screening level < 100x C screening level, therefore
 N screening value/10 used as screening level
 C** = N screening level < 10x C screening level, therefore
 N screening value/10 used as screening level
 N = Noncarcinogenic
 N/A = Not available
 ND = Non-detect
 NL = Noncarcinogenic lead residential soil RSL not adjusted by dividing by 10.

Appendix F
Ecological Risk Assessment

Ecological Risk Assessment

F.1 Introduction

The following ecological risk assessment (ERA) completes Steps 1 through 3a of the ERA process for UXO 14, Marine Corps Base Camp Lejeune. The ERA was performed in accordance with the following guidance:

- *Ecological Risk Assessment Guidance for Superfund (RAGS): Process for Designing and Conducting Ecological Risk Assessments* (USEPA, 1997)
- *Region 4 Ecological Risk Assessment Bulletins – Supplement to RAGS* (USEPA, 2001)
- *Navy Guidance for Conducting Ecological Risk Assessments* (Navy, 2003)
- *NCDENR Guidelines for Performing Screening Level Ecological Risk Assessments within the North Carolina Division of Waste Management* (NCDENR, 2003).

F.2 Step 1—Preliminary Problem Formulation and Ecological Effects Evaluation

F.2.1 Problem Formulation

The problem formulation covers the physical layout of the site, its history and ecology, available analytical data, fate and transport mechanisms, complete exposure pathways, and receptors of concern.

Site Description

UXO 14 includes both the former indoor pistol range (FIPR) area and the former gas chamber (FGC) area (Figure 2-1 of the main text). The FGC area is located approximately 200 feet southwest of the FIPR area. A detailed description of the history of site use is included in Section 2 of the main text.

An ecological risk screening was previously conducted at UXO 14 as part of the PA/SI (CH2M HILL, 2011a) to evaluate impacts to ecological receptors from contaminants in soil and groundwater near the FIPR and the FGC. No risk was predicted based on data collected at the FGC. Potential risk to ecological receptors from metals in soils at the FIPR was predicted and additional soil investigation was recommended. Additional soil data were collected at FIPR in 2011 as proposed in the Site-Specific Work Plan Addendum (CH2M HILL, 2011b). This ERA evaluates the soil and subsurface soil data that were collected at UXO 14 in 2009 and in 2011 near the FIPR.

Ecological Setting

The New River is a coastal blackwater river. The New River watershed sits within Onslow County and includes the Base and the City of Jacksonville to the north.

The watershed upgradient of Jacksonville is characterized by gum-cypress swamps, with upland areas used primarily for forestry and agriculture. At Jacksonville, the river widens into a broad, slow-moving tidal embayment. About 16 miles south of Jacksonville, it discharges into the Atlantic Ocean through a narrow opening called New River Inlet. Jacksonville and the Base comprise the majority of land in the lower watershed (the area downstream of the U.S. 17 Bypass). There are 223 stream miles, 22,810 estuarine acres, and 15 miles of Atlantic coastline in this subbasin.

This portion of the North Carolina coast consists of sandy beaches. The adjacent upland area transitions to a region of pines (*Pinus* sp.), scrub oaks (*Quercus* sp.), sweet gum (*Liquidambar styraciflua*), and dogwood (*Cornus* sp.). Wire grass (*Cynodon dactylon*) is the primary undergrowth species. The area is interspersed with bottomland hardwood forests which are dominated by bald cypress (*Taxodium distichum*), swamp tupelo (*Nyssa sylvatica* var. *biflora*), and white cedar (*Chamaecyparis thyoides*). Croplands are common in this area, and consist of mostly corn, cotton, peanuts, and tobacco.

The climate in Jacksonville is characterized by short, mild winters and long, hot, humid summers. Average annual net precipitation is approximately 50 inches. Ambient air temperatures generally range from 33 to 53°F in the winter months, and 71°F to 88°F during the summer months.

The FIPR includes approximately 0.09 acres of level terrain consisting of maintained grass and a loose sandy area in the vicinity of the former building footprint. Forested areas surround FIPR to the south and west.

The ecological checklist identifies the terrestrial and aquatic habitats on-site and nearby and was presented in the ERS as part of the PA/SI (CH2M HILL, 2011a). Threatened or endangered species located in Onslow County are not expected to occur at the site or in the adjacent areas (Table F-1).

Summary of Available Analytical Data

Soil data used for this assessment were collected from the FIPR in 2009 and 2011 (Table 2-1). The following samples were used for the assessment:

- 26 surface soil samples (plus three field duplicate) from 0 to 1 feet below ground surface (bgs).
- 4 subsurface soil samples (plus one field duplicate) from 1 to 5 feet bgs

Samples are listed in Table F-2. The 2011 samples were analyzed for antimony, lead, and mercury. While historical samples were analyzed for SVOCs and the full suite of metals, only those analytes identified as potentially posing risk (antimony, lead, and mercury) in the PA/SI were evaluated as part of this ERA.

Fate and Transport Mechanisms

Release and transport mechanisms at the site, as they relate to ecological exposures, are briefly discussed below.

Leaching to Groundwater Groundwater data were collected and evaluated as part of the ERS. Antimony and mercury were not detected in groundwater samples and lead was consistent with background. Consequently, this pathway is not considered significant.

Surface Water Runoff and Erosion UXO 14 consists of open field with maintained grasses. It is bordered to the south and west by forested areas. A drainage is located approximately 200 feet north of UXO 14. Stormwater run off likely flows west, eventually discharging to a wetland located west of the site. In general, high rates of infiltration are expected across most of site and erosion at the site is expected to be minimal due to the grassy cover and relatively flat terrain.

Dust Soil dust at the site is not expected to be significant because the majority of the site is covered by grass.

Conceptual Site Model

Information regarding the general habitat features of UXO 14 and the fate and transport of the chemicals associated with site media was used to build an ecological conceptual site model (CSM). Key components of the CSM include chemical sources, release and transport mechanisms, exposure media, receptors, and exposure routes (Figure F-1).

Potentially complete and significant exposure pathways to terrestrial ecological receptors include the following:

- Direct exposure to plants (root uptake) and soil invertebrates (dermal and direct ingestion)
- Incidental ingestion and dermal exposure for wildlife
- Food chain (prey consumption) exposures for wildlife

Terrestrial bird and mammal species that are representative of UXO 14 include the white-footed mouse (mammalian omnivore), red fox (mammalian omnivore), white-tailed deer (mammalian herbivore), American robin (avian omnivore), mourning dove (avian herbivore), and red-tailed hawk (avian carnivore).

F.2.2 Ecological Effects Evaluation

The potential for effects from exposure to soil was evaluated by comparing ecological screening values (ESVs) to maximum concentrations (Step 2) of constituents detected at the site. The EPA Ecological Soil Screening Levels (EcoSSL) (USEPA, 2009) were preferentially selected over Region 4 values (USEPA, 2001). When no EcoSSL was available for a constituent, the Region 4 value was selected.

F.3 Step 2—Preliminary Exposure Estimate and Risk Calculation

In Step 2, risk to ecological receptors was evaluated by calculating Hazard Quotients (HQs). HQs are calculated by dividing the maximum concentration detected within a medium by the corresponding medium-specific ESV. Maximum concentrations for detected analytes and maximum detection limits for undetected analytes were used to conservatively estimate

potential chemical exposures to ecological receptors. Risk estimates were calculated for surface soil and subsurface soil (Tables F-3 and Table F-4).

North Carolina SLERA guidance (NCDENR, 2003) requires that constituents falling into one of the following categories be identified as a Step 2 Contaminant of Potential Concern (COPC):

- Category 1 – Contaminants with a maximum detection exceeding the ESV
- Category 2– Undetected contaminants with a laboratory sample quantitation limit (SQL) exceeding the ESV
- Category 3 – Detected contaminants with no ESV
- Category 4 – Undetected contaminants with no ESV

Based on the results, antimony, lead, and mercury in surface soil and antimony and lead in subsurface soil were carried forward to Step 3.

F.4 Step 3a —Refinement of Conservative Exposure Assumptions

Using the same conceptual site model, Step 3a involves re-evaluation of the conservative assumptions used in Steps 1 and 2, resulting in a refinement of the COPC list. Step 3a includes a re-assessment of the risks to lower trophic levels receptors (direct exposure) and an evaluation, for the subset of contaminants that are bioaccumulative, of the potential for risks to upper trophic level receptors (food chain transfer).

Maximum concentrations of antimony, lead, and mercury were also compared to the range of base background (Baker, 2001) in surface and subsurface soils. When maximum concentrations exceeded the associated background range, the analyte was retained for further evaluation.

F.4.1 Direct Exposure Screening

The risk to lower trophic level receptors was recalculated using a conservative estimate of the mean chemical concentration as the exposure point concentration (EPC). Conservative estimate of the mean EPCs were calculated using ProUCL Version 4.0.0.5 (USEPA, 2010). If a conservative estimate of the mean EPC could not be calculated, the arithmetic mean concentration was used as the EPC. The maximum detected concentration was retained as the EPC if the arithmetic mean was higher than the maximum.

Risks are further evaluated using a weight-of-evidence (WOE) approach not utilized in Step 2. The WOE approach considers the magnitude of the recalculated risks, toxicity information not used in the Step 2 screening, frequency of detection, magnitude of exceedance, and the distribution of detected concentrations.

Tables F-5 and F-6 present the results of the direct exposure assessment for surface soil and subsurface soil. A summary of the screening results is presented below.

Surface Soil

Based on refined screening, antimony, lead, and mercury all had HQs greater than one (Table F-5). Antimony exceeded the ESV in 12 of 26 samples and was greater than the background range in 10 of 26 samples. Lead exceeded the ESV in all 26 samples and was greater than the maximum background concentration in 23 of 26 samples. Both antimony and lead have high magnitudes and frequencies of exceedance and are present at concentrations that may impact lower trophic level receptors. Mercury had a low magnitude of exceedance (HQ of 1.6) and a low frequency of exceedance (1/26) and was not considered to pose significant risk to lower trophic level receptors.

Subsurface Soil

Based on the refined screening, antimony and lead were both found to have HQs greater than one (Table F-6). Lead and antimony in subsurface soils exceeded the maximum background concentrations in 1 of 4 samples (MR14-IS01). Because the magnitude of exceedance was high for both analytes, antimony (HQ=9.7) and lead (HQ= 26) in subsurface soils are predicted to pose potential risk to lower trophic level receptors.

F.4.2 Food Chain Transfer Screening

Food chain modeling is conducted for detected constituents carried to Step 3 and identified as bioaccumulative in [USEPA \(2000\)](#) (i.e., lead and mercury). Food chain modeling was initially conducted for the terrestrial receptors using maximum concentrations of analytes in surface soils. If analytes posed a risk based on maximum concentrations, modeling was refined using a conservative estimate of the mean, or an arithmetic mean when a conservative estimate of the mean could not be calculated.

Receptors selected for the terrestrial evaluation include the white-footed mouse, red fox, white-tailed deer, American robin, mourning dove, and red-tailed hawk. The basis for modeling for terrestrial receptors was surface soil.

Risks to upper trophic level receptors were evaluated by modeling exposure to lead and mercury via the ingestion of constituents which have accumulated in prey. Incidental ingestion of soil was also included when calculating exposure. Dietary items for which tissue concentrations were modeled included terrestrial plants, terrestrial invertebrates, and mammals. The uptake of chemicals from the abiotic media into these food items was modeled based upon conservative assumptions.

For the maximum exposure case, two HQs were developed. Each exposure estimate was calculated and compared to two types of toxicity reference values (TRVs), no observed adverse effect levels (NOAELs) and lowest observed adverse effects levels (LOAELs). If the LOAEL-based HQ was over 1, the exposure estimate based on a conservative estimate of the mean (i.e., also referred to as the EPC) was calculated. When HQs based on the NOAEL are below 1, there is high confidence of no significant risk. When HQs based on the LOAEL are above 1, risk may be present.

Exposure Assessment

Exposure Point Concentrations EPCs are the environmental media concentrations of COPCs that receptors are assumed to encounter in an exposure area. Risk calculations were initially developed using the maximum concentration. If the LOAEL-based HQ was greater than

one, risk was reevaluated using a conservative estimate of the mean and/or an arithmetic mean. Conservative estimates of the mean were calculated using ProUCL Version 4.1 (USEPA, 2010). To be conservative, the maximum detected value or the maximum detection limit between the field duplicate and native sample was used when calculating upper confidence limits. When a conservative estimate of the mean could not be calculated or was higher than the maximum concentration, an arithmetic mean was used.

Exposure Parameters Receptor-specific inputs are presented in **Table F2-1 of Appendix F-2**. Central tendency estimates (e.g., mean, median, or midpoint) for body weight and ingestion rates from the scientific literature were used for each receptor. It was assumed that chemicals were 100 percent bioavailable to the receptor and that each receptor spent 100 percent of its time on the site (i.e., an area use factor [AUF] of 1.0 was assumed).

Concentrations in Food Items The concentrations of COPCs in food items were estimated rather than measured. For the purposes of exposure estimation, partitioning of constituents from environmental media to prey was estimated from literature values. The conservative model assumptions included bioaccumulation factors (BAFs) from the literature. The BAFs and other uptake or biotransfer factors used to estimate constituent concentrations in food items are provided in **Appendix F-2, Table F2-2**. In all cases, it was assumed that tissue uptake occurs under steady-state conditions.

Calculation of Chemical Intakes Dietary exposure includes multiple pathways and requires modeling. The end product or exposure estimate resulting from exposure modeling for wildlife is a dosage (amount of chemical per kilogram receptor body weight per day [mg/kg/d]). Dietary exposure from food and incidental ingestion of soil was estimated using a generalized exposure model modified from **Suter et al. (2000)**:

$$E_j = \left[(Med_{jk} * P_k * FIR) + \left(\sum_{i=1}^N B_{ij} * P_i * FIR \right) \right] * AUF$$

where:

E_j	= total dietary exposure (mg/kg/d)
Med_{jk}	= concentration of chemical (j) in medium (k) (mg/kg dry weight)
P_k	= ingestion rate of medium (k) as proportion of diet
FIR	= species-specific food ingestion rate (kg food/kg body weight/d)
B_{ij}	= concentration of chemical (j) in biota type (i) (mg/kg dry weight)
P_i	= proportion of biota type (i) in diet
AUF	= area use factor (unitless)

Effects Assessment

Compilation of Toxicity Data Currently available toxicological data were evaluated and a range of potential effects was determined by using procedures recommended by **USEPA (1997)**. Data were extracted from original literature sources (when available) to verify levels of effects, quality of study design, magnitude of dose, and other study parameters. Sources for toxicity data included the following:

- Toxicological Benchmarks for Wildlife, produced for the Department of Energy at Oak Ridge National Laboratories (ORNL) (**Sample et al., 1996**)

- Ecological Soil Screening Values (Eco SSLs) (USEPA, 2009)
- Peer-reviewed scientific literature

Ingestion toxicity reference values (TRVs) were selected for both chronic NOAEL and chronic LOAEL endpoints (see **Appendix F-2, Tables F2-3 and F2-4**). Because the risk assessment is based upon population- or community-level effects, no intraspecies uncertainty factors were applied. Taxonomic class-type uncertainty factors were also not applied because the TRVs selected were typically derived based upon data from a broad range of taxonomic groups.

Food chain COPCs were identified based upon a comparison of exposure doses from site-specific food chain modeling with the NOAEL- and LOAEL-based ingestion TRVs.

Risk Results and Characterization

The results of the food chain modeling for terrestrial wildlife exposed to maximum concentrations in surface soil are presented in **Table F-7**. All receptors had NOAEL- and LOAEL-based HQs less than one for mercury suggesting that risk from mercury is negligible. For lead, the white-footed mouse, red fox, America robin, and the mourning dove all had both NOAEL- and LOAEL-based HQs greater than one. While the NOAEL-based HQ for the red-tailed hawk was greater than 1 (HQ = 1.38), the LOAEL-based HQ was less than one. All HQs were less than one for the white tailed deer exposed to lead.

Based on these results, predicted risk for the white-footed mouse, red fox, America robin, and the mourning dove exposed to lead were re-evaluated using the EPC (8,220 mg/kg) as presented in **Table F-8**. All receptors still had LOAEL-based HQs above one and risk from lead to ecological receptors is considered probable.

F.5 Uncertainty

Uncertainties are inherent in all risk assessments. In general, risks are over-estimated in this evaluation through the use of conservative exposure, effects, and risk characterization assumptions described in the previous sections. A qualitative evaluation of the major general uncertainties associated with this assessment is presented below.

Effects Assessment Uncertainties

Literature-derived toxicity data based on laboratory studies were the only available toxicity data used to evaluate risk to all receptor groups. It was assumed that effects observed in laboratory species were indicative of effects that would occur in wild species. The suitability of this assumption is unknown.

The use of uncertainty factors in the development of TRVs is designed to ensure that the TRV is a conservative estimate of a toxicological effect level or endpoint. However, there is some additional uncertainty associated with extrapolating TRVs between toxicological endpoints, species, duration, and study conditions to site conditions.

The TRVs developed from literature studies are usually based on a highly soluble and bioavailable form of the chemical. It is generally accepted that forms present in environmental media are not likely to be in a highly soluble form and, due to physical and chemical processes in the environment, are likely to be far less than 100 percent bioavailable.

This difference between literature studies and site conditions may contribute to an over-estimation of potential exposure and risks from the COPCs.

Standard industry laboratory methods of analysis were used for the development of detection limits. In some instances, the methods produced detection limits that were higher than the ESVs. This is considered an acceptable uncertainty. Because these chemicals were not detected, they are not known to be present onsite, but the potential for risks cannot be totally discounted because the reporting limits for at least some samples are higher than the screening values.

Exposure Assessment Uncertainties

Exposure Media and Pathways Wildlife doses were estimated based on the ingestion pathway only. This is due to limitations in the field of ecological risk assessment with regard to adequately evaluating the volatilization (inhalation) and dermal absorption pathways. Although these pathways would not be expected to contribute significantly to the overall dose that receptors might receive from COPCs at this site, this is nonetheless an uncertainty inherent in the assessment.

Bioavailability The exposure dose estimates in this assessment assume that 100 percent of the chemical concentrations to which receptors are exposed are in the bioavailable form. However, most chemicals will not be 100 percent bioavailable. In cases where bioavailability is less than 100 percent, risk is over-estimated.

The exposure concentrations used in the evaluation of trophic transfer were assumed to remain constant for the duration of exposure. Physical, chemical, and biological processes that could reduce chemical concentrations and their bioavailability over time were not factored into the calculation of the exposure concentrations. Use of this additional conservative assumption is also likely to over-estimate exposure to the COPCs.

Analytical chemistry data collected within the exposure area at UXO 14 were assumed to adequately represent the exposure to wildlife and exposure concentrations were assumed to represent the distribution of constituents present. These assumptions could either under- or over-estimate risk.

Receptor Life History Data No avian or mammalian life history data specific to the site were available; therefore, exposure parameters were either modeled based on allometric relationships (e.g., food ingestion rates) or were based on data from these same species in other portions of their range. Because diet composition as well as food, water, and soil ingestion rates can differ among individuals and locations, published parameter values may not accurately reflect conditions at the site. Consequently, risk may be either over- or under-estimated.

Dietary Composition Dietary compositions were simplified for the site receptors to estimate concentrations in food items using bioaccumulation models. It was assumed that concentrations were similar in comparable food types. The suitability of this assumption is unknown. Consequently, risk may be either over- or under-estimated.

Estimating Prey Tissue Concentration There is uncertainty associated with the estimated chemical concentrations in tissue of prey. Prey tissue concentrations were estimated using

literature-based values for all dietary items. Potential risks based on these tissue concentration estimates, therefore, could either be over- or under-estimated.

F.6 Conclusions

Antimony and lead in surface and subsurface soil were identified as potentially posing risk to lower trophic level receptors. Lead in surface soil was the only analyte identified as posing risk to upper trophic level receptors including the white-footed mouse, red fox, America robin, and the mourning dove.

Lead and antimony are generally higher in the western portion of the site with the maximum detected concentrations in surface samples MR14-SS11 and MR14-SS12. Elevated concentrations of lead and antimony are generally co-located and decrease significantly with distance from the site and depth. Contamination is relatively well defined and additional investigation for the purposes of defining extent is not recommended.

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TABLE F-1

Threatened and Endangered Species List for Onslow County, North Carolina
 Remedial Investigation Report UXO 14
 MCB CamLej, Jacksonville, North Carolina

Scientific Name	Common Name	Federal Status
Vertebrates		
<i>Chelonia mydas</i>	Green sea turtle	T
<i>Caretta caretta</i>	Loggerhead sea turtle	T
<i>Dermochelys coriacea</i>	Leatherback sea turtle	E
<i>Trichechus manatus</i>	West Indian manatee	E
<i>Charadrius melodus</i>	Piping plover	T
<i>Acipenser brevirostrum</i>	Shortnose sturgeon	E
<i>Picoides borealis</i>	Red-cockaded woodpecker	E
Vascular Plants		
<i>Thalictrum cooleyi</i>	Cooley's meadowrue	E
<i>Carex lutea</i>	Golden sedge	E
<i>Lindera melissifolia</i>	Pondberry	E
<i>Lysimachia asperulaefolia</i>	Rough-leaved loosestrife	E
<i>Amaranthus pumilus</i>	Seabeach amaranth	T

Notes:

E - Endangered - A taxon in danger of extinction throughout all or a significant portion of its range.

T - Threatened - A taxon likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

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TABLE F-2

Samples Used in the Ecological Risk Assessment (ERA) for UXO 14

*Remedial Investigation Report UXO 14**MCB CamLej, Jacksonville, North Carolina*

Sample ID	Sample Depth (ft bgs)	Date
Surface Soils		
MR14-SS01	0-0	11/6/2009
MR14-SS02	0-0	11/6/2009
MR14-SS03	0-0	11/6/2009
MR14-SS04	0-0	11/6/2009
MR14-SS05	0-0	11/6/2009
MR14-SS06	0-0	11/6/2009
MR14-SS07	0-0	11/6/2009
MR14-SS08	0-0	11/6/2009
MR14-SS09	0-0	11/6/2009
MR14-SS10	0-0	11/6/2009
MR14-SS11	0-0	11/6/2009
MR14-SS12	0-0	11/6/2009
MR14-SS21	0-0.16	7/11/2011
MR14-SS22	0-0.16	7/11/2011
MR14-SS23	0-0.16	7/11/2011
MR14-SS24	0-0.16	7/11/2011
MR14-SS25	0-0.16	7/11/2011
MR14-SS26	0-0.16	7/11/2011
MR14-SS27	0-0.16	7/11/2011
MR14-SS28	0-0.16	7/11/2011
MR14-SS29	0-0.16	7/11/2011
MR14-SS30	0-0.16	7/11/2011
MR14-SS31	0-0.16	7/11/2011
MR14-SS32	0-0.16	7/11/2011
MR14-SS33	0-0.16	7/11/2011
MR14-SS34	0-0.16	7/11/2011
Subsurface Soils		
MR14-IS01	2-3	12/4/2009
MR14-IS02	2-3	12/4/2009
MR14-IS03	2-3	12/4/2009
MR14-IS08	4-5	7/11/2011

Notes:

ft bgs - feet below ground surface

NA - not applicable

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TABLE F-3

UXO 14 Surface Soil Screen - Step 2

Remedial Investigation Report UXO 14

MCB CamLej, Jacksonville, North Carolina

Chemical	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Ecological Screening Value (ESV)	Frequency of Exceedance ¹	Maximum Hazard Quotient (HQ)	Step 2 COPC? ²	
Inorganics (MG/KG)									
Antimony	0.74 - 2.02	12 / 26	387	MR14-SS12-09D	0.27	12 / 26	1,433	YES	(1) HQ above one, detected
Lead	-- - --	26 / 26	35,500	MR14-SS12-09D	11.0	26 / 26	3,227	YES	(1) HQ above one, detected
Mercury	0.024 - 0.033	12 / 26	1.08	MR14-SS02-09D	0.10	1 / 26	10.8	YES	(1) HQ above one, detected

1 - Count of detected samples exceeding or equaling Screening Value

2 - Categories are assigned to analytes retained as Step 2 COPCs as follows:

Category 1 – Contaminants with a maximum detection exceeding the ESV

COPC - Contaminant of Potential Concern

ESV - Ecological Screening Value

HQ - Hazard Quotient

NSV - No Screening Value

mg/kg - milligram per kilogram

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TABLE F-4

UXO 14 Subsurface Soil Screen - Step 2

Remedial Investigation Report UXO 14

MCB CamLej, Jacksonville, North Carolina

Chemical	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Ecological Screening Value (ESV)	Frequency of Exceedance ¹	Maximum Hazard Quotient (HQ)	Step 2 COPC? ²	
Inorganics (MG/KG)									
Antimony	0.89 - 1.61	1 / 4	2.62	MR14-IS01-2-3-09D	0.27	1 / 4	9.70	YES	(1) HQ above one, detected
Lead	-- - --	4 / 4	290	MR14-IS01-2-3-09D	11.0	1 / 4	26.4	YES	(1) HQ above one, detected
Mercury	0.029 - 0.041	1 / 4	0.034	MR14-IS01-2-3-09D	0.10	0 / 4	0.34	NO	HQ less than one

NOTES

1 - Count of detected samples exceeding or equaling Screening Value

2 - Categories are assigned to analytes retained as Step 2 COPCs as follows:

Category 1 – Contaminants with a maximum detection exceeding the ESV

COPC - Contaminant of Potential Concern

ESV - Ecological Screening Value

HQ - Hazard Quotient

NSV - No Screening Value

mg/kg - milligrams per kilogram

Generated By: Kelly Taylor/DFW

Checked by: Sara Kent/ATL

TABLE F-5

UXO 14 Surface Soil Screen - Step 3

Remedial Investigation Report UXO 14

MCB CamLej, Jacksonville, North Carolina

Chemical	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Exposure Point Concentration (EPC)	EPC Basis	Ecological Screening Value (ESV)	Frequency of Exceedance ¹	Background Range	Maximum Exceeds Background Range?	EPC Hazard Quotient (HQ)	Step 3 COPC?	Rationale
Inorganics (MG/KG)													
Antimony	0.74 - 2.02	12 / 26	387	MR14-SS12-09D	173	99% KM (Chebyshev) UCL	0.27	12 / 26	ND - 0.9	Yes	641	YES	HQ greater than one, food chain effects
Lead	-- - --	26 / 26	35,500	MR14-SS12-09D	8220	95% Chebyshev (Mean, Sd) UCL	11.0	26 / 26	0.45 - 38.5	Yes	747	YES	HQ greater than one, food chain effects
Mercury	0.024 - 0.033	12 / 26	1.08	MR14-SS02-09D	0.158	95% KM (BCA) UCL	0.10	1 / 26	ND - 0.12	Yes	1.6	No	Low frequency of exceedance

1 - Count of detected samples exceeding or equaling Screening Value

COPC - Contaminant of Potential Concern

EPC - Exposure Point Concentration

ESV - Ecological Screening Value

HQ - Hazard Quotient

ND - nondetect

UCL - Upper Confidence Limit

mg/kg - milligrams per kilogram

TABLE F-6

UXO 14 Subsurface Soil Screen - Step 3

Remedial Investigation Report UXO 14

MCB CamLej, Jacksonville, North Carolina

Chemical	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Exposure Point Concentration (EPC)	EPC Basis	Ecological Screening Value (ESV)	Frequency of Exceedance ¹	Background Range	Maximum Exceeds Background Range?	EPC Hazard Quotient (HQ)	Step 3 COPC?	Rationale
Inorganics (MG/KG)													
Antimony	0.89 - 1.61	1 / 4	2.62	MR14-IS01-2-3-09D	1.08	Arithmetic Mean	0.27	1 / 4	ND - 0.5	Yes	9.7	YES	HQ greater than one
Lead	-- --	4 / 4	290	MR14-IS01-2-3-09D	73.7	Arithmetic Mean	11.0	1 / 4	1 - 12.2	Yes	26	YES	HQ greater than one

NOTES

1 - Count of detected samples exceeding or equaling Screening Value

COPC - Contaminant of Potential Concern

EPC - Exposure Point Concentration

ESV - Ecological Screening Value

HQ - Hazard Quotient

ND - nondetect

mg/kg - milligrams per kilogram

Generated By: Kelly Taylor/DFW

Checked by: Sara Kent/ATL

TABLE F-7

UXO 14 Food Chain Transfer Screening Hazard Quotients Using Maximums - Step 3

Remedial Investigation Report UXO 14

MCB CamLej, Jacksonville, North Carolina

Chemical	Hazard Quotients											
	White-footed mouse		Red fox		White-tailed deer		American robin		Mourning dove		Red-tailed hawk	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Lead	1.29E+01	6.83E+00	8.08E+00	4.27E+00	8.43E-01	4.45E-01	6.17E+01	1.23E+01	1.59E+02	7.95E+01	1.38E+00	2.76E-01
Mercury	6.15E-01	1.23E-01	3.08E-02	1.87E-02	6.15E-02	1.23E-02	1.18E-01	4.81E-02	1.30E-01	6.48E-02	4.43E-03	1.81E-03

NOTES

Hazard quotients in **bold** and shaded grey exceed one

NOAEL - no observed adverse effect level

LOAEL - lowest observed adverse effect level

TABLE F-8

UXO 14 Food Chain Transfer Screening Hazard Quotients Using EPCs - Step 3

Remedial Investigation Report UXO 14

MCB CamLej, Jacksonville, North Carolina

Chemical	Hazard Quotients											
	White-footed mouse		Red fox		White-tailed deer		American robin		Mourning dove		Red-tailed hawk	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Lead	3.73E+00	1.97E+00	2.18E+00	1.15E+00	2.15E-01	1.14E-01	1.68E+01	3.36E+00	3.84E+01	1.92E+01	6.81E-01	1.36E-01

NOTES

Hazard quotients in **bold** and shaded grey exceed one

NOAEL - no observed adverse effect level

LOAEL - lowest observed adverse effect level

TABLE F2-1

Exposure Parameters for Upper Trophic Level Ecological Receptors
 Remedial Investigation Report UXO 14
 MCB CamLej, Jacksonville, North Carolina

Receptor	Body Weight (kg)		Food Ingestion Rate (kg/day - dry)		Dietary Composition (percent)						Soil/ Sediment Ingestion (percent)	
	Value	Reference	Value	Reference	Terrestrial Plants	Terrestrial Invertebrates	Mouse	Vole	Shrew	Reference	Value	Reference
Mammals												
White-footed mouse	0.0208	Silva and Downing 1995	0.00050	Sample and Suter 1994	51.0	47.0	0.0	0.0	0.0	Martin et al. 1951; Sample and Suter 1994	2.0	Beyer et al. 1994
Red fox	4.0600	Silva and Downing 1995	0.12308	Sample and Suter 1994	7.0	2.8	29.2	29.1	29.1	USEPA 1993	2.8	Beyer et al. 1994
White-tailed deer	52.9	Silva and Downing 1995	0.26100	Sample and Suter 1994	98.0	0.0	0.0	0.0	0.0	Sample and Suter 1994	2.0	Beyer et al. 1994
Birds												
American robin	0.0773	USEPA 1993	0.00552	Levey and Karasov 1989	51.9	43.5	0.0	0.0	0.0	Martin et al. 1951	4.6	Sample and Suter 1994
Mourning dove	0.1265	Tomlinson et al. 1994	0.01757	allometric equation (Nagy 2001)	95.0	0.0	0.0	0.0	0.0	Tomlinson et al. 1994	5.0	Assumed based on diet
Red-tailed hawk	1.1260	Sample and Suter 1994	0.03603	Sample and Suter 1994	0.0	0.0	34.0	33.0	33.0	USEPA 1993; Sample and Suter 1994	0.0	Sample and Suter 1994

Notes

kg - kilogram
 kg/day-dry - kilogram per day - dry weight
 USEPA - United States environmental protection agency

TABLE F2-2

Bioaccumulation Factors for Terrestrial Plants, Soil Invertebrates, and Small Mammals

Remedial Investigation Report UXO 14

MCB CamLej, Jacksonville, North Carolina

Analyte	Soil BAF (dry weight)			Regression		
	Value	Basis	Reference	B0	B1	Reference
Terrestrial Plants						
Lead	--	--	--	-1.328	0.561	Bechtel Jacobs 1998
Mercury	--	--	--	-0.996	0.544	Bechtel Jacobs 1998
Soil Invertebrates						
Lead	--	--	--	-0.218	0.807	Sample et al. 1998a
Mercury	1.186	Geometric mean	Sample et al. 1998a	--	--	--
Small Mammal (omnivore)						
Lead	--	--	--	0.0761	0.4422	Sample et al. 1998b
Mercury	0.462	90th percentile	Sample et al. 1998b	--	--	--

Notes

BAF - bioaccumulation factor

TABLE F2-3

Toxicity Reference Values for Mammals
Remedial Investigation Report UXO 14
MCB CamLej, Jacksonville, North Carolina

Chemical	Chemical Form	Test Organism	Duration	Critical Life Stage?	Exposure Route	Effect/Endpoint	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	Reference
Lead	--	rat	chronic	--	oral	--	4.70	8.90	USEPA 2005
Mercury	Methyl mercury chloride	rat	3 generations	Yes	oral in diet	reproduction	0.032	0.160	Sample et al. 1996
Mercury*	Methyl mercury chloride	mink	93 days	No	oral in diet	survival/weight loss/ataxia	0.150	0.247	Sample et al. 1996

Notes

* Used for red fox only.

LOAEL - Lowest observable adverse effect level

mg/kg/d - milligrams per kilogram body weight per day

NOAEL - No observable adverse effect level

USEPA - United States environmental protection agency

TABLE F2-4

Toxicity Reference

Remedial Investigation Report UXO 14

MCB CamLej, Jacksonville, North Carolina

Chemical	Chemical Form	Test Organism	Duration	Critical Life Stage?	Exposure Route	Effect/Endpoint	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	Reference
Lead	Metallic	American kestrel	7 months	Yes	oral in diet	reproduction	3.85	19.3	Sample et al. 1996
Lead *	--	chicken	chronic	--	oral	--	1.63	3.26	USEPA 2005
Mercury	--	red-tailed hawk	12 weeks	Yes	oral in diet	survival/neurological	0.49	1.20	USEPA 1995
Mercury *	Mercuric chloride	Japanese quail	1 year	Yes	oral in diet	reproduction	0.45	0.90	Sample et al. 1996

Notes

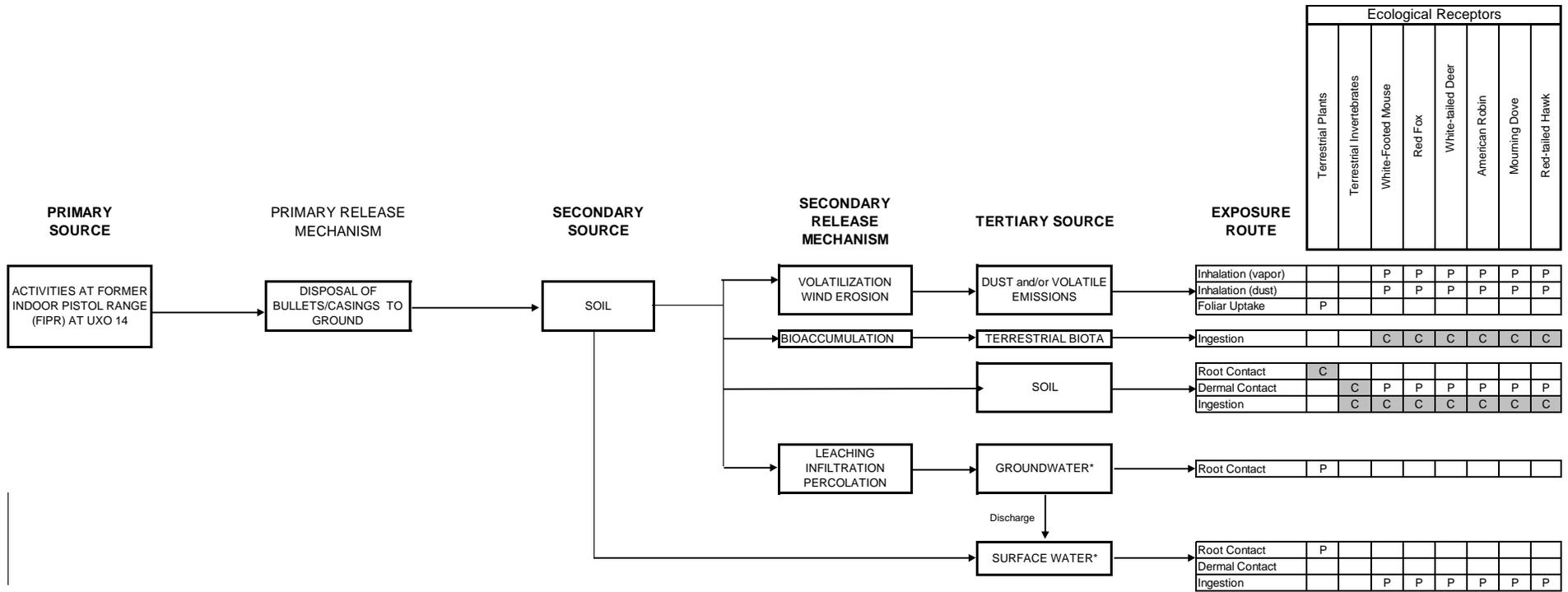
* Used for mourning dove only.

LOAEL - Lowest observable adverse effect level

mg/kg/d - milligrams per kilogram body weight per day

NOAEL - No observable adverse effect level

USEPA - United States environmental protection agency



C - Pathway considered complete for purposes of ecological risk assessment

P - Pathway considered potentially complete, but insignificant

Pathways evaluated quantitatively in ecological risk assessment

* Groundwater and surface water exposures assessed in previous ERS.

Exposure to surface water represented by comparing groundwater concentrations to ESVs.

FIGURE F-1

Conceptual Site Model of Ecological Exposures at UXO 14

Remedial Investigation Report UXO 14

MCB CamLej, Jacksonville, North Carolina