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FINAL PRELIMINARY ASSESSMENT/SITE INSPECTION REPORT MMRP SITE UXO-11 FORMER B-5 PRACTICE HAND GRENADE COURSE MCB CAMP LEJEUNE NC

06/01/2011

CH2M HILL

Final

Preliminary Assessment/Site Inspection Report MMRP Site UXO-11, Former B-5 Practice Hand Grenade Course (ASR #2.81)

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

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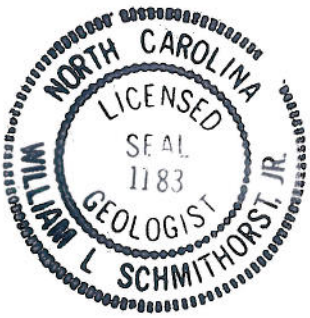

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Acronyms and Abbreviations

ºF	degrees Fahrenheit
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
ASR	Archive Search Report
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-term Environmental Action—Navy
COPC	constituent of potential concern
CSM	conceptual site model
CTO	contract task order
DDESB	Department of Defense Explosives Safety Board
DGM	digital geophysical mapping
DO	dissolved oxygen
DPT	direct push technology
DQO	data quality objective
DU	decision unit
EcoSSL	Ecological Soil Screening Level
EM	electromagnetic
EM61	EM61-MK2
ERS	Ecological Risk Screening
ESS	Explosives Safety Submission
ESV	ecological screening value
ft	feet, foot
ft/ft	feet per foot
GIS	geographic information system
gpm	gallons per minute
GPO	Geophysical Proveout
GPS	Global Positioning System
HHRS	Human Health Risk Screening
HI	hazard index
HQ	hazard quotient
IDW	investigation-derived waste
IS	Incremental Sampling
MC	munitions constituents
MCB CamLej	Marine Corps Base Camp Lejeune

MEC	munitions and explosives of concern
mg/kg	milligrams per kilogram
MMRP	Military Munitions Response Program
MR	munitions response
MRP	Munitions Response Program
MRSPP	Munitions Response Site Prioritization Protocol
MS/MSD	matrix spike/matrix spike duplicate
mV	millivolt
NAD83	North American Datum of 1983
NAVD 88	North American Vertical Datum of 1988
NAVFAC	Naval Facilities Engineering Command
NCAC	North Carolina Administrative Code
NCDENR	North Carolina Department of Environment and Natural Resources
NCGWQS	North Carolina Groundwater Quality Standards
NC SSL	North Carolina Soil Screening Levels
NRCC	National Research Council Canada
ORP	oxidation-reduction potential
PA/SI	Preliminary Assessment/Site Inspection
PETN	pentaerythritol tetranitrate
PID	photoionization detector
PPE	personal protective equipment
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RSL	regional screening level
RTK	real time kinematic
SOP	standard operating procedure
TAL	Target Analyte List
TOC	top of casing
TP	technical paper
UCL	upper confidence limit
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UTM	universal transverse mercator
UXO	unexploded ordnance
VOC	volatile organic compound

SECTION 1

Introduction

This report documents the findings of a Preliminary Assessment/Site Inspection (PA/SI) conducted at United States Marine Corps Military Munitions Response Program (MMRP) site Unexploded Ordnance (UXO)-11 – Former B-5 Practice Hand Grenade Course (Archive Search Report [ASR] #2.81) located at Marine Corps Base Camp Lejeune (MCB CamLej) in Jacksonville, North Carolina **(Figure 1-1)**.

This PA/SI was conducted by CH2M HILL under the Naval Facilities Engineering Command (NAVFAC) Comprehensive Long-term Environmental Action—Navy (CLEAN) Contract N62470-08-D-1000, Contract Task Order (CTO) 0014. **Appendix A** presents the Munitions Response Site Prioritization Protocol (MRSPP) Site Summary for Site UXO-11.

1.1 Objectives and Approach

MCB CamLej is in the process of investigating closed ranges at the Base following the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) investigation process. Reported historical range activities at Site UXO-11 have prompted this PA/SI, the first phase of the CERCLA cleanup process.

The primary objective of this environmental investigation was to evaluate the potential presence and nature of impacts to environmental media resulting from historical munitions use at the subject site, and to evaluate whether additional investigation and/or remediation activities are necessary. Accordingly, this investigation focused on identifying impacts to surface and subsurface soil, sediment, surface water, and groundwater from munitions constituents (MC). A secondary objective was to access the site for the presence of geophysical anomalies that represent potential subsurface munitions and explosives of concern (MEC).

This PA/SI was conducted in accordance with the *Site-specific Work Plan Addendum for Preliminary Assessment/Site Inspection, Site UXO-11, B-5 Practice Hand Grenade Course (ASR #2.81), Marine Corps Base Camp Lejeune, Jacksonville, North Carolina* (PA/SI Work Plan Addendum) (CH2M HILL, 2009) and *the Munitions Response Program Master Project Plan, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina* (MRP Master Project Plan) (CH2M HILL, 2008a).

The general approach adopted during this PA/SI was as follows:

- Conduct research to identify historical activities that may have resulted in MEC or MC contamination at the site, including review of archival records and interviews with current and former installation personnel.
- Evaluate the potential presence and nature of MC contamination by conducting an investigation of surface and subsurface soil, sediment, surface water, and groundwater.

- Conduct ecological and human health risk screening using analytical data collected at the site.
- Perform a geophysical survey of 10 percent of Site UXO-11 to evaluate the number and density of geophysical anomalies representing potential subsurface MEC.

1.2 Report Organization

This PA/SI report is organized as follows:

- Section 1, Introduction
- Section 2, Site Background
- Section 3, Field Investigation Activities
- Section 4, Investigation Results
- Section 5, Human Health Risk Screening
- Section 6, Ecological Risk Screening
- Section 7, Conclusions and Recommendations
- Section 8, References

\\NORTHEND\PROJ\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\SITE_UXO_11\PA_SI\FIGURE_1_1_SITE_UXO-11_BASE_LOCATION_MAP.MXD

Legend

- Cities
- Highways
- Installation Boundary
- Site UXO-11 Boundary

N

0 7,500 15,000 30,000 Feet

1 inch = 15,000 feet

Figure 1-1
Base Location Map
Site UXO-11, Former B-5 Practice Hand Grenade Course (ASR #2.81)
PA/SI Report
MCB CamLej
North Carolina

CH2MHILL

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SECTION 2

Site Background

This section presents a brief summary of 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 (**Figure 1-1**). 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. MCB CamLej is home to an active duty, dependent, retiree, and civilian population of approximately 150,000, of whom approximately 47,000 are military personnel. Land use surrounding MCB CamLej is varied, with mainly commercial properties along the northern boundary. The eastern and western boundaries of the Base are a mix of agricultural and residential land. The southern boundary of MCB CamLej extends to the New River and Atlantic Ocean.

2.2 Site Setting

Approximately 2 acres in size, Site UXO-11 is located north of Sixth Street and east of Seventh Street and the Marine Corps Air Station New River (**Figure 2-1**). The site is undeveloped and covered with landscaped grass which gently slopes southwest towards Sixth and Seventh Streets. There is little topographic relief at the site. There is a small drainage swale on the southeast corner of the site and several other drainage swales surround the site. The drainage swale on the southeast corner of the site drains southwest towards the traffic circle. According to the Preliminary Range Assessment (USACE, 2001), no historical structures or remnants of a practice hand grenade course are present. Current use of Site UXO-11 includes weekly athletic training exercises and occasional graduation ceremonies.

A water supply well, PSWTC-600, is located approximately 800 feet (ft) from Site UXO-11. This well is currently designated by MCB CamLej as an "active backup well" and is not being used for distribution. In addition, the well has been recommended and is planned for abandonment. The well is screened from 48-70 ft below ground surface (ft bgs) and runs at a rate of 100 gallons- per-minute (gpm) (AHEC, 2002). The MCB CamLej Wellhead Protection Plan (AHEC, 2002) cites that the cone of influence created from this well can extend under Site UXO-11.

2.3 Site History

CH2M HILL conducted a detailed investigative review of existing information related to historical activities at Site UXO-11 in August 2008 that could have resulted in the release of hazardous substances within the area of investigation. The review also included interviews with current and former site personnel. Information obtained from this effort is presented in the Archival Records Search Report included in **Appendix B** and is summarized below.

Historical range overlay maps show Site UXO-11 first appearing as a practice hand grenade course in 1954 (USACE, 2001). This document also references a map from September 1, 1953 and states that while the range appeared on the 1954 range overlay map, Site UXO-11 was in use only during 1953. To date, no other historical reference to this area being used as a practice hand grenade course has been identified. Existing conditions maps from 1947 and 1953 include the area designated as Site UXO-11. These maps show a mockup structure (Building 507), presumably used for training exercises, within the site boundaries (Figure 2-2 of **Appendix B**). This building is also seen on aerial photographs from 1946, 1948, and 1951. Building 507 does not appear on maps after 1953. All aerial photographs from 1946, 1948, 1951, 1962, and 1989 (Figures 2-3 and 2-4 and Attachment 2 of **Appendix B**), show that the area designated as Site UXO-11 was clear of all vegetation except grass.

2.4 Regional Climate

The climate in the Onslow County area is characterized by typically short, mild winters and long, hot and humid summers. Average annual net precipitation is approximately 50 inches. Ambient air temperatures generally range from 33 degrees Fahrenheit (°F) to 53 °F in the winter months, and from 71°F to 88°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 year-round.

2.5 Regional Geology and Hydrogeology

Regional geology at MCB CamLej is discussed in the MRP Master Project Plan (CH2M HILL, 2008a).

2.6 Site Geology and Hydrogeology

Inspection of the soil cores recovered from Site UXO-11 indicates that the underlying sediments consist of laterally discontinuous fine grained sediments consistent with those of the Undifferentiated formation (Cardinell et al., 1993). Particle sizes noted from soil boring indicate sediments ranging from clay and silt to very fine to fine grained sand. Soil borings for Site UXO-11 ranged from 10 to 15 ft bgs.

Surface water from Site UXO-11 flows to an unnamed tributary of Edwards Creek and then into the New River. The New River flows into the Atlantic Ocean via New River inlet (MCB CamLej, 2002).

Site-specific hydrogeologic information was derived from the installation of five shallow temporary monitoring wells screened above the Castle Hayne confining unit in the undifferentiated surficial aquifer, as detailed in Section 3.3.4. The temporary well depths for Site UXO-11 ranged from 12 to 15 ft bgs during the December 2009 investigation. **Figure 2-2** depicts the potentiometric surface of the water table on December 3 and 4, 2009 and indicates that groundwater flow was toward the center of the site, with a general northwest trend. Groundwater in the temporary well ranged from 0.21 to 1.82 ft bgs. Horizontal hydraulic gradients calculated from **Table 2-1** range from 0.0041 feet per foot (ft/ft) (between wells TW01 and TW02) to 0.0099 ft/ft (between wells TW03 and TW02).

TABLE 2-1
Groundwater Elevation and Well Construction Information
Site UXO-11, Former B-5 Practice Hand Grenade Course (ASR #2.81)
MCB CamLej, North Carolina

Well ID	**Date Installed** (mm/dd/yy)	**Screened Interval** (ft bgs)	**Bottom of Well** (ft bTOC)	**Surveyed Top of Casing Elevation** (ft msl)	**Surveyed Ground Surface of Well** (ft msl)	**Depth to Water December 3-4, 2009** (ft bTOC)	**Groundwater Elevation December 3-4, 2009** (ft msl)
MR11-TW01	12/3/09	4-14	14	19.73	18.17	1.76	17.97
MR11-TW02	12/3/09	2-12	12	20.26	19.25	1.42	18.84
MR11-TW03	12/3/09	5-15	15	19.30	18.98	1.43	17.87
MR11-TW04	12/3/09	2-12	12	19.57	19.21	1.65	17.92
MR11-TW05	12/3/09	5-15	15	19.89	19.56	1.55	18.34

Notes:

ft bgs = feet below ground surface
ft bTOC = feet below top of casing
ft msl = feet above mean sea level

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Checked by: Simon Kline

\\NORTHEND\PROJ\USNAV...\CL\MAPFILES\SITE_UXO_11\PA_SI\FIGURE_2_1_SITE_UXO-11_SITE_LOCATION_MAP.MXD

Legend

Site UXO-11 Boundary

Installation Boundary

N

0 100 200 400 Feet

1 inch = 200 feet

Figure 2-1
Site Location Map
Site UXO-11, Former B-5 Practice Hand Grenade Course (ASR #2.81)
PA/SI Report
MCB CamLej
North Carolina

CH2MHILL

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\\NORTHEND\PROJ\USNAV...\CL\MAPFILES\SITE_UXO_11\PA_SI\FIGURE_2_2_SITE_UXO-11_POT_SURFACE_MAP.MXD

Legend

- Temporary Well Location
- Potentiomentric Contour (inferred)
- Potentiometric Contour
- Groundwater Flow Direction
- Site UXO-11 Boundary

Note: Potentiometric surface contours have been inferred beween temporary well locations. Actual conditions may differ from those shown here.

N

0 40 80 160 Feet

1 inch = 80 feet

Figure 2-2
Water Table Potentiometic Surface Map (December 2009)
Site UXO-11, Former B-5 Practice Hand Grenade Course (ASR #2.81)
PA/SI Report
MCB CamLej
North Carolina

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SECTION 3

Field Investigation Activities

The initial site reconnaissance, surveying, and DGM field activities at Site UXO-11 were completed in May 2009. The environmental sampling field activities were conducted in November and December 2009.

Field activities were conducted in accordance with the PA/SI Work Plan Addendum (CH2M HILL, 2009) and the MR Work Plan (CH2M HILL, 2008a).

The technical approach included in the PA/SI Work Plan Addendum was developed by the MCB CamLej Tier I Partnering Team, which includes representatives from the United States Navy, MCB CamLej, United States Environmental Protection Agency (USEPA) Region 4, and North Carolina Department of Environment and Natural Resources (NCDENR).

3.1 Site Preparation and Support

3.1.1 MEC Avoidance

Due to the potential presence of MEC, avoidance measures were implemented in accordance with the Explosives Safety Submission (ESS) Determination (MARCORSYSCOM, 2009). UXO technicians qualified in accordance with Department of Defense Explosives Safety Board (DDESB) Technical Paper (TP) 18 (DDESB, 2004) provided MEC escort and avoidance services to the surveying and geophysical surveying subcontractors. The UXO technicians also conducted subsurface MEC avoidance at all utility locating, soil boring, and temporary well installation locations. MEC items were not encountered during this project.

3.1.2 Site Survey

Land surveying services were conducted in accordance with the MRP Master Project Plan (CH2M HILL, 2008a). SEPI Engineering, a North Carolina-licensed surveyor from Raleigh, North Carolina, conducted the site surveying activities in two phases as described below.

Phase 1 consisted of delineating the site boundary, DGM area layout, and Decision Unit (DU) layout. The DU layout was surveyed for the systematic random Incremental Sampling (IS) of surface soil. The surveyor prominently marked the boundaries of the project area using flagging tape and wooden stakes and provided all survey results to CH2M HILL. The site boundary was provided by MCB CamLej; the site boundary supplied by the Base is consistent with the site boundary shown in the 1954 Range Overlay Map (Plate 8; USACE, 2001). The surveyor also facilitated the preparation of the site for DGM by establishing transect centerlines. Finally, the surveyor marked the corners of each DU and provided the survey results for incorporation into the geographic information system (GIS).

Phase 2 consisted of surveying the locations and elevations of temporary monitoring wells after the completion of environmental sampling activities.

3.2 Digital Geophysical Mapping

DGM was performed at Site UXO-11 to evaluate the frequency and distribution of geophysical anomalies that represent potential subsurface MEC. The DGM was subcontracted to and performed by NAEVA Geophysics, Inc. of Charlottesville, Virginia, with quality control (QC) performed by both NAEVA and CH2M HILL's Munitions Response (MR) QC Geophysicist. A summary of the work performed is provided below; the Geophysical Investigation Report is provided in **Appendix C**.

3.2.1 Digital Geophysical Mapping Survey

Prior to conducting the DGM survey at Site UXO-11, Sepi Engineering installed survey stakes along eight DGM transects that were incorporated into the DGM data collected during the DGM survey. Plastic pin flags were paced at 10-meter intervals to provide line of sight to the geophysicist recording DGM data along each transect.

The DGM data were collected using a Geonics EM61-MK2 (EM61) electromagnetic (EM) system operated in wheel mode configuration, with data positioning provided by a Real Time Kinematic (RTK) Global Positioning System (GPS). The EM61-MK2 was chosen based on its ability to detect small, near-surface ferrous and non-ferrous munitions and its high data resolution. The locations and actual spacing of the DGM transects were based on specific site conditions (e.g., accessibility). The DGM survey area covered approximately 11.5 percent (0.23 acre) of the total Site UXO-11 area.

3.2.2 Geophysical Proveout

Prior to the start of DGM at Site UXO-11, a geophysical proveout (GPO) was completed for the testing and evaluation of the selected geophysical equipment, and determination that the equipment met existing project data quality objectives (DQOs). This GPO was conducted at the existing GPO plot set up and seeded by CH2MHILL at the former Knox Trailer Park (Site UXO-04). A threshold of 3 millivolts (mV) in Channel 2 was chosen for the selection of geophysical anomalies because this value represents the threshold where a metallic item can be positively distinguished from signal noise. The GPO was conducted in accordance with Appendix B of the PA/SI Work Plan Addendum (CH2M HILL, 2009). The GPO results are presented **Appendix C** of this report.

3.2.3 Data Quality Objectives

All DQOs outlined in the PA/SI Work Plan Addendum (CH2M HILL, 2009) were met during the DGM survey.

3.2.4 Quality Control

An extensive QC program was applied to the DGM operations at the site. **Figure 3-1** shows an overall chart of the QC steps.

The geophysical system was field-tested as specified in the PA/SI Work Plan Addendum (CH2M HILL, 2009). A summary of the tests performed is presented in **Table 3-1**. Both NAEVA and CH2M HILL performed QC of geophysical data and data deliverables at each step of the process.

All tests outlined in the PA/SI Work Plan Addendum (CH2M HILL, 2009) were performed on the DGM instruments at the appropriate intervals (e.g., daily, weekly, at start of project). Results were checked by NAEVA's QC geophysicist prior to delivery to CH2M HILL and subsequently checked by the CH2M HILL QC geophysicist. Corrective actions were taken as necessary to ensure that all instruments functioned as required.

3.3 Environmental Investigation Activities

During the development of the PA/SI Work Plan Addendum (CH2M HILL, 2009), historical records were reviewed to identify potential areas of concern. However, historical records did not depict the former layout of the site; therefore, in the absence of evidence to bias the sampling, sample locations were distributed evenly across accessible areas of the site. **Figures 3-2 through 3-4** show the environmental sampling locations used during the PA/SI.

Environmental samples were collected in accordance with the PA/SI Work Plan Addendum (CH2M HILL, 2009). MEC avoidance procedures were observed and a UXO technician was present at all times during sampling.

3.3.1 Surface Soil Sampling

Surface soil sampling locations are shown on **Figure 3-2**. Surface soil sampling was conducted on November 5, 2009.

Three incremental surface soil samples were collected from each of four DUs for a total of 12 samples (designated as MR11-DU01-SS[01,02,03]-09D through MR11-DU04-SS[01,02,03]-09D). The dimensions of the DUs were 190 ft by 120 ft and surveyed by SEPI prior to sampling **(Figure 3-2**). The surface soil aliquots were collected from a depth of 0 to 2 inches with a minimum of 6.5 pounds of soil from 30 aliquots from heterogeneous locations within each DU using the IS procedure; this approach is described in the Standard Operating Procedure (SOP) entitled *Systematic Random Incremental Sampling* in Appendix C of the (MRP Master Project Plan (CH2M HILL, 2008a).

In accordance with the PA/SI Work Plan Addendum (CH2M HILL, 2009), all surface soil samples were placed in iced coolers, prepared for shipment under chain–of-custody control, submitted to Empirical Laboratories in Nashville, Tennessee, and analyzed for the following:

- Explosives residues, including pentaerythritol tetranitrate (PETN) and nitroglycerine (SW-846 USEPA Method 8330)
- Perchlorate (USEPA Method 6850)
- Target Analyte List (TAL) metals (SW-846 USEPA Method 6010B)

The analytical data were validated by Environmental Data Services, Inc. of Williamsburg, Virginia under subcontract to CH2M HILL. Data validation reports are provided in **Appendix D.**

3.3.2 Sediment and Surface Water Sampling

On November 12, 2009, two sediment and two surface water samples were collected at co-located sites (designated as MR11-SD01/02 and MR11-SW01/02) from the unnamed drainage swale in the southeastern portion of the site (**Figure 3-3**). A handheld GPS unit was used to record the locations of these samples. Prior to collection, a UXO technician screened each sediment sample location with a Schonstedt GA-52Cx magnetometer to avoid MEC anomalies.

The unnamed drainage swale contained ponded surface water approximately 5 ft wide and 1 ft deep with no discernable flow direction observed. At each location, the surface water samples were collected before the sediment samples. Sediment samples were collected by advancing a trowel approximately 6–12 inches into the sediment.

Sediment samples were placed in iced coolers and prepared for shipment under chain-of-custody control. The samples were then submitted to Empirical Laboratories and analyzed for the following:

- Explosives residues, including PETN and nitroglycerine (SW-846 USEPA Method 8330)
- Perchlorate (USEPA Method 6850)
- TAL metals (SW-846 USEPA Method 6010B)

Surface water samples were placed in iced coolers and prepared for shipment under chain-of-custody control. The samples were then submitted to Empirical Laboratories and analyzed for the following:

- Explosives residues, including PETN and nitroglycerine (SW-846 USEPA Method 8330)
- Perchlorate (USEPA Method 6850)
- TAL total metals and dissolved metals (SW-846 USEPA Method 6010B)

The analytical data were validated by Environmental Data Services, Inc. under subcontract to CH2M HILL. Data validation reports are provided in **Appendix D**.

3.3.3 Subsurface Soil Sampling

On December 3, 2009, five soil borings were advanced to depths of up to 15 ft bgs at the locations shown on **Figure 3-4**, using a direct push technology (DPT) drill rig operated by Probe Technology, Inc. of Concord, North Carolina. MEC anomaly avoidance was conducted during subsurface soil sampling activities in accordance with the PA/SI Work Plan Addendum (CH2M HILL, 2009). At the start of each borehole, a UXO technician hand augered to a depth of 5 ft bgs, checking the borehole with a downhole magnetometer at 1-ft increments.

The DPT sampling method included the use of an open core barrel sampling device along with disposable acetate liners. Down-hole sampling equipment was decontaminated between borings and new liners were used to retrieve each successive soil core. The continuous soil cores retrieved from these borings were examined and logged by the CH2M HILL geologist in accordance with the PA/SI Work Plan Addendum (CH2M HILL, 2009) and field screened for the presence of volatile organic compounds (VOCs) using a flame-ionization detector (FID). Soil boring logs are provided in **Appendix E**.

Following completion of each soil boring, a discrete soil sample was collected above the estimated water table. Due to rain events preceding soil sampling, the subsurface was saturated and the depth to the water table could not be determined during sample collection. Sample depths ranged from 2 to 5 feet bgs. Five subsurface soil samples, MR11-IS01-09D through MR11-IS05-09D, were collected from the locations shown on **Figure 3-4**.

Subsurface soil samples were placed in iced coolers and prepared for shipment under chain–of-custody control. The samples were submitted to Empirical Laboratories and analyzed for the following analytes:

- Explosives residues, including PETN) and nitroglycerine (SW-846 USEPA Method 8330)
- Perchlorate (USEPA Method 6850)
- TAL metals (SW-846 USEPA Method 6010B)

The analytical data were validated by Environmental Data Services, Inc. under subcontract to CH2M HILL. Data validation reports are provided in **Appendix D**.

3.3.4 Temporary Well Installation

During DPT investigation activities, five temporary groundwater monitoring wells were installed at the site (designated as MR11-TW01 through MR11-TW05) to depths ranging from 12 to 15 ft bgs. **Figure 3-4** shows the professionally surveyed temporary well locations, and **Table 2-1** summarizes the well construction details. The five temporary monitoring wells were installed by Probe Technology, Inc. under the observation of a CH2M HILL geologist.

Each temporary well was constructed with 1-inch inside diameter Schedule 40 polyvinyl screen (PVC) screen and riser. The well screens consisted of a 10-ft length of 0.010-inch machine slotted Schedule 40 PVC and were placed to bracket the water table. Each well was also equipped with a pre-packed sand filter (120 mesh) attached to the screened interval, to reduce turbidity. Additional silica filter sand was placed in the remaining annular space between the pre-packed sand filter and the borehole wall extending roughly 2 ft above the top of the screen. A layer of bentonite granules was placed above the top of the sand pack extending to the ground surface. A locking watertight cap was placed on the PVC pipe and the wells were clearly labeled using a permanent marker. Well completion diagrams are provided in **Appendix E**.

The temporary wells were developed using a peristaltic pump and disposable bailers. Development continued until the water was visually clear and water quality parameters had stabilized. Following well development, the wells were allowed to equilibrate for at least 24 hours before sampling.

3.3.5 Groundwater Sampling

Groundwater sampling was conducted at Site UXO-11 between December 4, and December 9, 2009. Prior to well purging and sampling, water level measurements from each temporary well were recorded (**Table 2-1**). Water level measurements were converted to water level elevations using the TOC elevation survey data, and were used to construct a potentiometric surface map of the water table (**Figure 2-2**).

All groundwater samples were collected using a peristaltic pump with disposable polyethylene tubing and low-flow purging and sampling techniques in accordance with the PA/SI Work Plan Addendum (CH2M HILL, 2009). Water quality parameters (specific conductance, pH, turbidity, temperature, dissolved oxygen [DO], and oxidation-reduction potential [ORP]) were measured during the purging phase using a YSI® 556 multi-probe water quality meter and Hanna® 98703 turbidimeter. Field parameters are summarized in **Table 3-2**. Groundwater sampling data sheets are provided in **Appendix F**. Groundwater samples were collected only after all field parameters had become stable over three successive readings and at least one well volume had been purged, or at least three well volumes had been purged from the well. Parameters were considered stabilized over three successive readings when successive measurements agreed as follows:

- pH within 0.1 pH units
- Temperature measurements within 10 percent
- Conductivity within 3 percent
- ORP within 10 mV
- DO within 10 percent
- Turbidity within 10 percent or as low as practicable given sampling conditions
- Prior to sample collection, the water quality meter flow-through cell was disconnected from the peristaltic pump so that the pump discharge flowed directly into the laboratory-supplied sample bottles.

Water level elevation, measuring point elevation, depth to water, sampling depth, and total well depth measurements were recorded in the field log book and/or on groundwater sampling data sheets.

Once sample collection was complete, the sample bottles were placed in iced coolers and prepared for shipment under chain-of-custody control to Empirical Laboratories and analyzed for the following:

- Explosives residues , including PETN and nitroglycerine (SW-846 USEPA Method 8330)
- Perchlorate (USEPA Method 6850)
- TAL Total metals (SW-846 USEPA Method 6010B)
- Dissolved metals (SW-846 USEPA Method 6010B) at TW01 only

The analytical data were validated by Environmental Data Services, Inc. under subcontract to CH2M HILL. Data validation reports are provided in **Appendix D**.

On December 11, 2009, following sampling and surveying, all temporary wells were abandoned by the drilling subcontractor in accordance with North Carolina well construction standards, 15A North Carolina Administrative Code (NCAC) 2C (NCDENR, 2010a).

3.3.6 Quality Assurance/Quality Control Sampling

Appropriate quality assurance (QA)/QC sampling was performed in accordance with Navy CLEAN and CH2M HILL protocols, including trip blanks, field blanks, equipment blanks, duplicates, and matrix spike/matrix spike duplicates (MS/MSDs). Required QA/QC samples and the frequency of collection are shown in **Table 3-3.**

3.4 Investigation-derived Waste Management

Investigation-derived waste (IDW) was disposed of onsite in accordance with the Base Waste Management Plan (CH2M HILL, 2008b). IDW generated during field events consisted of soil cuttings from DPT soil borings and installation of temporary monitoring wells, well development water, purge water, decontamination fluids, disposable equipment, and personal protective equipment (PPE). Soil from the borings was spread around the borehole. The purge water and decontamination fluids were placed in labeled 55-gallon drums and staged at the 90-day storage facility on Parachute Tower Road. Disposable equipment, including PPE, poly sheeting, paper towels, and aluminum foil, was placed in trash bags and disposed of in an on-Base trash receptacle.

3.5 Site Survey

Following completion of sampling activities, SEPI Engineering surveyed horizontal coordinates for all subsurface soil sampling locations, and horizontal coordinates and casing and ground elevations for the five temporary wells. Elevations were accurate to the nearest 0.01 ft (0.1 ft for unpaved ground surface), and tied to the nearest North American Datum of 1988 (NAVD 88) datum benchmark. Horizontal controls were based on the metric system and referenced to the North American Datum of 1983 (NAD83) and the Universal Transverse Mercator (UTM) grid system, and were accurate to the nearest 0.01 inch.

TABLE 3-1
DGM Instruments Standardization Tests and Acceptance Criteria
Site UXO-11 , Former B-5 Practice Hand Grenade Course (ASR #2.81)
MCB CamLej, North Carolina

Test	Test Description	Acceptance Criteria	Power On	Beginning of Day	Beginning and End of Day	First Time Instr. Used	2% of Total Area Surveyed
1	GPS QC	+/- 10 cm Positional Accuracy		X			
2	Personnel Test	Based on instrument used. Personnel, clothing, etc. should have no effect on instrument response. <2 mV		X			
3	Vibration Test (Cable Shake)	Data profile does not exhibit data spikes. <2 mV		X			
4	Static Background & Static Spike	+/- 20% of standard item response, after background correction			X		
5	Latency Test	Repeatability of response amplitude +/-20%, Positional Accuracy +/- 20 cm		X			
6	Repeat Data	Repeatability of response amplitude					X

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TABLE 3-2
Groundwater Field Parameters
Site UXO-11, Former B-5 Practice Hand Grenade Course (ASR #2.81)
MCB CamLej, North Carolina

Station ID	MR11-TW01	MR11-TW02	MR11-TW03	MR11-TW04	MR11-TW05
Sample Date	12/7/2009	12/4/2009	12/7/2009	12/7/2009	12/7/2009
Field Parameters					
Dissolved Oxygen (mg/L)	0.36	1.12	0.14	1.02	0.47
Oxidation Reduction Potential (mV)	198.9	-127	-104.9	108.4	116.3
pH	4.35	7.04	7	5.31	6.68
Specific Conductance (mS/cm)	0.066	0.413	0.355	0.062	0.254
Temperature (C)	16.18	18.86	19.07	17.23	19.34
Turbidity (NTU)	5.48	10	25	10	12

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TABLE 3-3
QA/QC Samples
Site UXO-11, Former B-5Practice Hand Grenade Course (ASR #2.81)
MCB CamLej, North Carolina

Analysis	Sample Matrix	Field Samples	Field Duplicates	Equipment Blanks	Field Blanks	MS/MSDs
Surface Soil Samples						
Explosives Residues including PETN and Nitroglycerine	Solid	12	2	3	1	1
Perchlorate		12	2	3	1	1
Total Metals		12	2	3	1	1
DPT Subsurface Soil Samples						
Explosives Residues including PETN and Nitroglycerine	Solid	5	1	1	1	1
Perchlorate		5	1	1	1	1
Total Metals		5	1	1	1	1
Sediment Samples						
Explosives Residues including PETN and Nitroglycerine	Solid	2	1	1	1	1
Perchlorate		2	1	1	1	1
Total Metals		2	1	1	1	1
Temporary Well Groundwater Samples						
Explosives Residues including PETN and Nitroglycerine	Aqueous	5	1	1	1	1
Perchlorate		5	1	1	1	1
Total Metals		5	1	1	1	1
Dissolved Metals		1	1	1	1	1
Surface Water Samples						
Explosives Residues including PETN and Nitroglycerine	Aqueous	2	1	1	1	1
Perchlorate		2	1	1	1	1
Total Metals		2	1	1	1	1
Dissolved Metals		2	1	1	1	1

Notes:
MS/MSD = Matrix Spike and Matrix Spike Duplicate pair
Field duplicates are collected at the rate of 1 for every 10 environmental samples
Equipment rinsate blanks are typically collected at the rate of 1 per day per medium
Field blanks are typically collected at the rate of 1 per week of sampling
MS/MSDs are collected at the rate of 1 for every 20 samples

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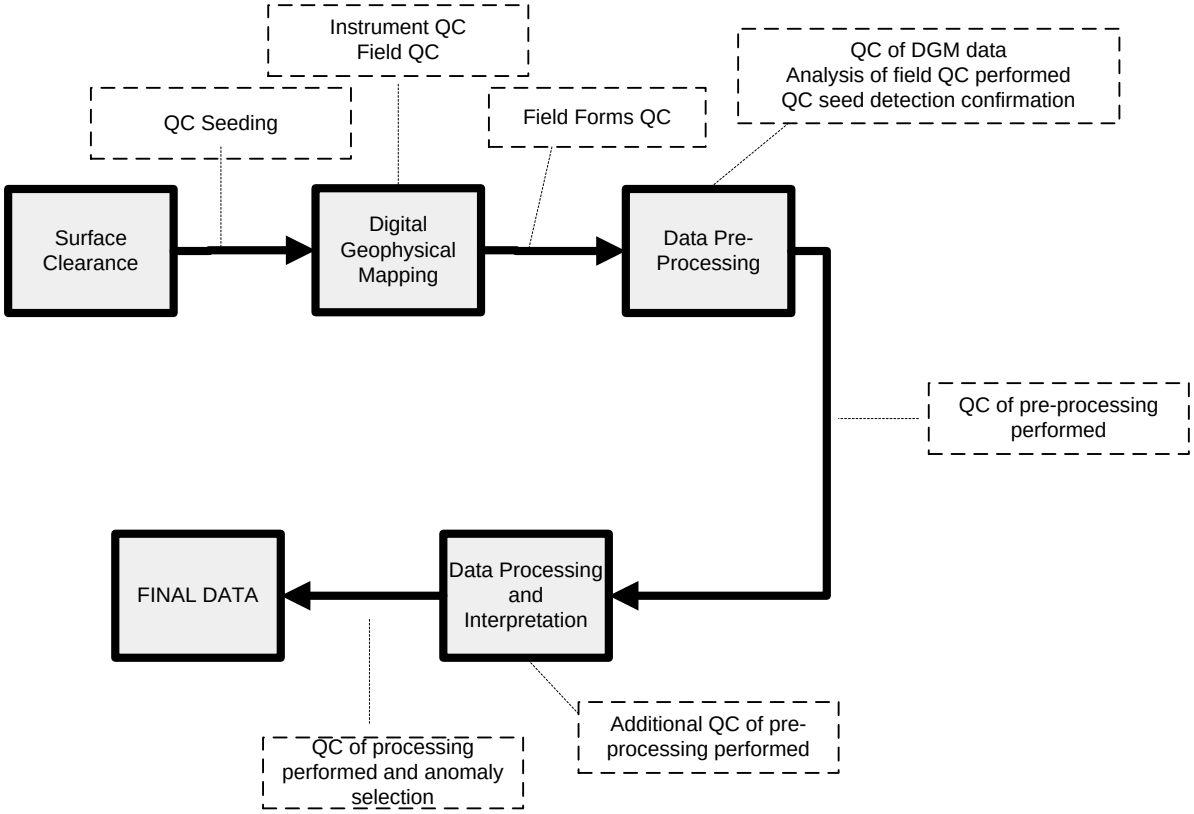

FIGURE 3-1
Overview of DGM Process QC
Site UXO-11 , Former B-5 Practice Hand Grenade Course (ASR #2.81)
PA/SI Report
MCB CamLej
North Carolina
Generated by: Lael Feist Checked by:Simon Kline

\\NORTHEND\PROJ\USNAV...\CL\MAPFILES\SITE_UXO_11\PA_SI\FIGURE_3-2_MRP_SITE_UXO_11_SURFACE_SOIL_SAMPLES.MXD

Legend
- Site UXO-11 Boundary
- Decision Unit (120 ft x190 ft)
- Wetlands
- Streams

N

0 40 80 160 Feet

1 inch = 80 feet

Figure 3-2
Surface Soil Sampling Locations
Site UXO-11, Former B-5 Practice Hand Grenade Course (ASR #2.81)
PA/SI Report
MCB CamLej
North Carolina

CH2MHILL

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\\NORTHEND\PROJ\USNAV...\CL\MAPFILES\SITE_UXO_11\PA_SI\FIGURE_3-3_SITE_UXO_11_SW_SD_LOCS.MXD

Legend

- Surface Water Sampling Location
- Sediment Sampling Location
- Site UXO-11 Boundary
- Wetlands
- Streams

N

0 100 200 Feet

1 inch = 80 feet

Figure 3-3
Sediment and Surface Water Sampling Locations
Site UXO-11, Former B-5 Practice Hand Grenade Course (ASR #2.81)
PA/SI Report
MCB CamLej
North Carolina

CH2MHILL

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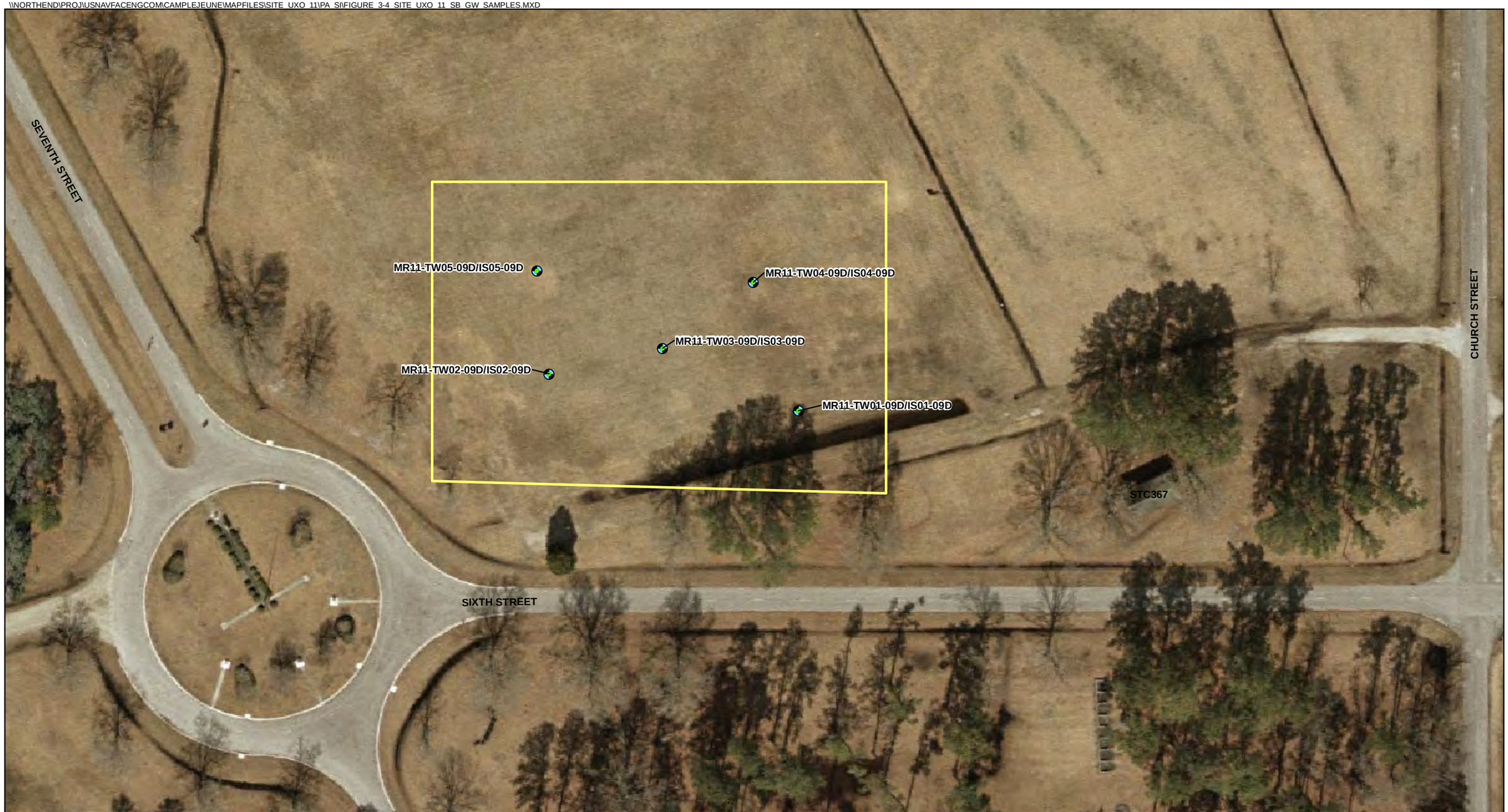

Legend

- Subsurface Soil/Groundwater Sampling Location
- Site UXO-11 Boundary
- Wetlands
- Streams

N

0 40 80 160 Feet

1 inch = 80 feet

Figure 3-4
Subsurface Soil and Groundwater Sampling Locations
Site UXO-11, Former B-5 Practice Hand Grenade Course (ASR #2.81)
PA/SI Report
MCB CamLej
North Carolina

CH2MHILL

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SECTION 4

Investigation Results

This section presents the findings of the investigative activities conducted at Site UXO-11 during May, November, and December 2009.

4.1 Digital Geophysical Mapping Results

The DGM survey was conducted in accordance with the approved PA/SI Work Plan Addendum (CH2M HILL, 2009) and covered approximately 11.5 percent (approximately 0.23 acre) of Site UXO-11. The DGM survey yielded a total of 86 geophysical anomalies with a signal greater than 3 mV in Channel 2. From this total, 16 anomalies were associated with surveyor nails marking the ends of transect lines, resulting in the selection of 70 anomalies representing potential subsurface MEC.

The highest densities of anomalies were located toward the center and northwest portions of the Site. **Figure 4-1** illustrates the DGM area and the distribution of anomalies observed with a signal greater than 3 mV representing potential subsurface MEC. **Appendix C** contains the Geophysical Investigation Report**.**

4.2 Environmental Investigation Results

The following subsections present and summarize the laboratory data from analysis of soil, sediment, surface water, and groundwater samples collected at Site UXO-11. Laboratory analytical data are presented in **Appendix G**.

4.2.1 Soil

Following the third-party data validation of the laboratory analytical data, surface and subsurface soil samples were screened against the NCDENR Federal Remediation Branch Target Soil Screening Levels (NC SSLs) (NCDENR, 2010b), the Adjusted[1] USEPA Regional Screening Levels (RSLs) for Chemical Contaminant Tables (USEPA, 2010), and MCB CamLej background soil concentrations (two times the mean MCB CamLej background soil concentrations), which were available for metals only (Baker, 2001).

The January 2010 USEPA RSLs replaced the 2008 RSLs that were the proposed screening criteria from the PA/SI Work Plan Addendum (CH2M HILL, 2009). The RSLs for non-carcinogenic compounds were adjusted by dividing by 10 to conservatively account for exposure to multiple analytes. The methodology for calculating NC SSLs for contaminant migration from soil to groundwater was developed to identify chemical concentrations in soil that have the potential to impact groundwater. The NC SSLs are back-calculated from acceptable groundwater concentrations and take into consideration fate and transport parameters (NCDENR, 2010b).

[1] Based on noncarcinogenic effects to conservatively account for exposure to multiple constituents

Figure 4-2 illustrates the locations of the IS surface soil samples that exceeded two times the mean MCB CamLej background concentration and at least one of the screening levels (NC SSLs or the Adjusted USEPA RSLs). **Figure 4-3** depicts the locations of subsurface soil samples that exceeded two times the mean MCB CamLej background concentration and at least one of the screening levels (NC SSLs or the Adjusted USEPA RSLs). The detected concentrations of specific target analytes are listed in **Tables 4-1** and **4-2.** Laboratory analytical data is presented in **Appendix G**.

IS Surface Soil Samples from Decision Units

- **Explosives Residues -** Four explosive residues constituents were detected in decision unit samples from UXO-11. The following table summarizes regulatory exceedances for explosives residues.

Analyte	Frequency of Detection (# detected/# sampled)	Maximum Concentration (ug/kg)	Minimum Concentration (ug/kg)	Screening Criteria (ug/kg)		Frequency of Exceedances
Nitroglycerine	1/10	920	920	Residential RSL	610	1
				Industrial RSL	6,200	

- **Perchlorate –** Perchlorate was not detected in any surface soil samples.
- **Metals -** The following table summarizes regulatory exceedances for metals analysis.

Analyte	Frequency of Detection (# detected/# sampled)	Maximum Concentration (mg/kg)	Minimum Concentration (mg/kg)	Screening Criteria (mg/kg)		Frequency of Exceedances
Arsenic	**14/14**	1.19	0.83	2x mean BBG	0.626	**14**
				Residential RSL	0.39	**14**
Chromium	14/14	9.9	4.86	2x mean BBG	6.05	8
				Residential RSL	0.29	14
				Industrial RSL	5.6	9
				NC SSL	3.8	14
Cyanide	5/14	0.645	0.19	NC SSL	0.28	1
Iron	14/14	2,280	1,460	NC SSL	150	14

- In addition, mercury was detected in all DU surface soil samples, with concentrations ranging from 0.023 J mg/kg to 0.0436 mg/kg. Mercury concentrations did not exceed screening criteria at any sample locations.
- Vanadium was detected in all DU surface soil samples collected from Site UXO-11, and concentrations ranged from 4.49 mg/kg to 8.48 mg/kg. Vanadium concentrations for all detections did not exceed the Adjusted USEPA Residential or Industrial Soil RSLs or two times the mean MCB CamLej background concentration. No NC SSL was available for vanadium.
- Fourteen additional metals (aluminum, barium, beryllium, cadmium, calcium, cobalt, copper, lead, magnesium, manganese, nickel, potassium, sodium, and zinc) were

detected at concentrations greater than two times the mean MCB CamLej background concentration in at least one IS surface soil sample from Site UXO-11, but did not exceed their respective Adjusted USEPA Soil RSLs or NC SSLs.

Subsurface Soil Samples

- **Explosives Residues** - One explosives residue, RDX, was detected in subsurface soil samples, but did not exceed screening criteria.
- **Perchlorate –** Perchlorate was detected in subsurface soil samples but did not exceed screening criteria.
- **Metals -** The following table summarizes regulatory exceedances for metals analysis.

Analyte	Frequency of Detection (# detected/# sampled)	Maximum Concentration (mg/kg)	Minimum Concentration (mg/kg)	Screening Criteria (mg/kg)		Frequency of Exceedances
Aluminum	6/6	13,600	5,870	2x mean BBG	5,487	4
				Residential RSL	7,700	5
Arsenic	6/6	1.4	0.462	Residential RSL	0.39	6
Chromium	6/6	16.0	6.72	2x mean BBG	6.05	1
				Residential RSL	0.29	6
				Industrial RSL	5.6	6
				NC SSL	3.8	6
Iron	6/6	6,920	1,100	2x mean BBG	3,245	1
				Residential RSL	5,500	1
				NC SSL	150	6

- Four metals (barium, beryllium, calcium, and magnesium) were detected at concentrations greater than two times the mean MCB CamLej background concentration in at least one subsurface soil sample from Site UXO-11, but did not exceed their respective Adjusted USEPA Soil RSLs or NC SSLs (if available).
- Ten additional metals (cobalt, copper, lead, manganese, mercury, nickel, potassium, selenium, vanadium, and zinc) were detected in at least one subsurface soil sample from Site UXO-11, but they did not exceed two times the mean MCB CamLej concentrations, Adjusted USEPA Soil RSLs, or NC SSLs.

4.2.2 Sediment

Sediment samples were screened against the Adjusted USEPA Soil RSLs for Chemical Contaminant Tables (USEPA, 2010). No North Carolina Sediment Screening Levels or MCB CamLej background values for sediment were available for comparison. The detected concentrations of specific target analytes are summarized in **Table 4-3.** Laboratory analytical data is presented in **Appendix G**. **Figure 4-4** depicts the locations of sediment samples that exceeded at least one of the Adjusted USEPA Soil RSLs**.**

- **Explosives Residues -** No explosives residues were detected in Site UXO-11 sediment samples.
- **Perchlorate –** Perchlorate was not detected in any sediment samples.
- **Metals -** The following table summarizes regulatory exceedances for metals analysis.

Analyte	Frequency of Detection (# detected/# sampled)	Maximum Concentration (mg/kg)	Minimum Concentration (mg/kg)	Screening Criteria (mg/kg)		Frequency of Exceedances
Aluminum	2/2	10,300	9,030	Residential RSL	7,700	2
Arsenic	2/2	1.55	1.09	Residential RSL	0.39	2
Chromium	2/2	17.8	16.60	Residential RSL	0.29	2
				Industrial RSL	5.6	2

- Fourteen additional metals (barium, beryllium, calcium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, vanadium, and zinc) were detected in sediment collected from Site UXO-11, but did not exceed their respective Adjusted USEPA Industrial or Residential Soil RSLs.

4.2.3 Surface Water

Surface water samples were screened against the North Carolina 15A NCAC 2B standards Surface Water Human Health and Water Supply, National Recommended Water Quality Criteria (NRWQC)-Human Health- Water and Organisms, and NRWQC-Human Health-Organisms. No Adjusted USEPA Tap Water RSLs were available for comparison. The detected concentrations of specific target analytes are listed in **Table 4-4.** Laboratory analytical data is presented in **Appendix G**.

- **Explosives Residues–**Explosives residues were detected in Site UXO-11 surface water samples. HMX was detected in MR11-SW01-09D at a concentration of 0.08 J micrograms per liter (µg/L). Nitrobenzene and tetryl were detected in all surface water samples at ranges of 0.094 J - 0.16 µg/L and 0.14 J - 0.34 J µg/L, respectively.
- **Perchlorate –** Perchlorate was not detected in any surface water samples.
- **Metals –** Ten total metals (aluminum, barium, cadmium, calcium, iron, magnesium, manganese, potassium, sodium, and zinc) and nine dissolved metals (aluminum, barium, cadmium, calcium, copper, magnesium, potassium, sodium, and zinc) were detected in Site UXO-11 surface water samples.
- Results from surface water sampling indicated no exceedances of screening criteria. Due to the lack of screening criteria exceedances, surface water sampling results are not presented on a figure.

4.2.4 Groundwater

Groundwater results were screened against the North Carolina Groundwater Quality Standards (NCGWQS) (NCDENR, 2010a), USEPA Tap Water RSLs, and MCB CamLej background groundwater concentrations (two times the mean MCB CamLej background groundwater concentration), which were available for inorganic analytes only (Baker, 2001). The NCGWQS are the maximum allowable concentrations resulting from any discharge of contaminants to the land or waters of the state, which may be tolerated without creating a threat to human health or otherwise rendering the groundwater unsuitable for its intended purpose.

The detections and exceedances of NCGWQS, USEPA RSLs, and/or two times the MCB CamLej background levels are shown in **Table 4-5.** Laboratory analytical data is presented in **Appendix G**. **Figure 4-5** depicts the locations of groundwater samples that exceed two times the mean MCB CamLej background concentration or at least one of the screening levels (NCGWQS or USEPA Tap Water RSLs)**.**

- **Explosives Residues -** The following table summarizes regulatory exceedances for explosives residues analysis.

Analyte	Frequency of Detection (# detected/# sampled)	Maximum Concentration (µg/L)	Minimum Concentration (µg/L)	Screening Criteria (µg/L)		Frequency of Exceedances
Nitrobenzene	4/6	0.48	0.064	Tap Water RSL	0.12	2

- The explosives residues 1,3,5-trinitrobenzene, 1-3-dinitrobenzene, 2,4,6-trinitrotoluene, 2-nitrotoluene, 3-nitrotoluene, 4-nitrotoluene, nitroglycerin, and RDX were detected in at least one of the five groundwater samples, but at concentrations below the screening criteria.
- **Perchlorate –** Perchlorate was detected in three groundwater samples, but at concentrations below the screening criteria.
- **Metals -**The following table summarizes regulatory exceedances for metals analysis.

Analyte	Frequency of Detection (# detected/# sampled)	Maximum Concentration (µg/L)	Minimum Concentration (µg/L)	Screening Criteria (µg/L)		Frequency of Exceedances
Total Arsenic	4/6	2.36	1.37	Tap Water RSL	0.045	4
Total Chromium	6/6	2.39	0.653	Tap Water RSL	0.043	6
Total Cobalt	2/6	4.3	1.48	2x Mean BBG	3.4	1
				Tap Water RSL	1.1	2

- The total metals (beryllium, cadmium, calcium, and vanadium) and one dissolved metal (beryllium) were detected at concentrations above two times the mean MCB CamLej

background concentration in at least one groundwater sample from Site UXO-11, but did not exceed Adjusted USEPA Tap Water RSLs or NCGWQS.

- Ten additional total metals (aluminum, barium, iron, magnesium, manganese, nickel, potassium, selenium, sodium, and zinc) and nine dissolved metals (aluminum, barium, calcium, iron, magnesium, manganese, nickel, sodium, and zinc) were detected but did not exceed concentrations above two times the mean MCB CamLej background concentration, Adjusted USEPA Tap Water RSLs, or NCGWQS.

TABLE 4-1
Surface Soil Analytical Results
Site UXO-11, Former B-5 Practice Hand Grenade Course (ASR #2.81)
MCB CamLej, North Carolina

Station ID	**Camp Lejeune Background SS 2X Mean**	**CLEAN NCSSLs (January, 2010)**	**Adjusted Industrial Soil RSLs (Nov, 2010)**	**Adjusted Residential Soil RSLs (Nov, 2010)**	MR11-DU01			
Sample ID					MR11-DU01-SS01-09D	MR11-DU01-SS01D-09D	MR11-DU01-SS02-09D	MR11-DU01-SS03-09D
Sample Date					11/05/09	11/05/09	11/05/09	11/05/09
Chemical Name								
Explosives (µg/kg)								
2-Amino-4,6-dinitrotoluene	--	--	200,000	15,000	260 J	190 U	190 U	190 U
Nitroglycerin	--	--	6,200	610	640 U	640 U	640 U	640 U
RDX	--	--	24,000	5,500	190 U	190 U	190 U	190 U
Tetryl	--	--	250,000	24,000	190 UJ	190 UJ	190 UJ	190 UJ
Total Metals (mg/kg)								
Aluminum	5,487	--	99,000	7,700	4,390	3,750	4,370	4,990
Arsenic	0.626	5.8	1.6	0.39	1.12	0.833	0.954	1.07
Barium	14.5	580	19,000	1,500	17.8 J	15.8 J	15.1 J	17 J
Beryllium	0.103	--	200	16	0.455 U	0.448 U	0.327 U	0.0942 J
Cadmium	0.033	3	80	7	0.455 U	0.448 U	0.327 U	0.33 U
Calcium	6,360	--	--	--	7,110 J	7,820 J	5,810 J	35,700 J
Chromium	6.05	3.8	5.6	0.29	5.43	4.86	4.91	**6.49**
Cobalt	0.294	--	30	2.3	1.14 U	1.12 U	0.818 U	0.824 U
Copper	4.83	700	4,100	310	3.84 J	3.78 J	3.03 J	5.78 J
Cyanide	--	0.28	2,000	160	0.465 U	0.461 U	0.33 U	0.336 U
Iron	3,245	150	72,000	5,500	1,460	1,470	1,510	1,840
Lead	12.3	270	800	400	18.5	13.2	11.1	11.4
Magnesium	238	--	--	--	685 J	663 J	629 J	959 J
Manganese	13.7	65	2,300	180	18.3	18.7	13.8	18.3
Mercury	0.081	1	31	2.3	0.0281 J	0.0237 J	0.0244 J	0.0273 J
Nickel	1.21	130	2,000	150	1.1 J	0.959 J	0.967 J	1.09 J
Potassium	116	--	--	--	225 J	227 J	194 J	231 J
Sodium	80.9	--	--	--	455 U	448 U	327 U	330 U
Vanadium	8.9	--	520	39	5.22	4.49	5.5	6.19
Zinc	10.8	1,200	31,000	2,300	22 J	18.9 J	14.3 J	17.6 J

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Notes:

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

Bold box indicates exceedance of NC HWS 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

mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

TABLE 4-1
Surface Soil Analytical Results
Site UXO-11, Former B-5 Practice Hand Grenade Course (ASR #2.81)
MCB CamLej, North Carolina

Station ID	**Camp Lejeune Background SS 2X Mean**	**CLEAN NCSSLs (January, 2010)**	**Adjusted Industrial Soil RSLs (Nov, 2010)**	**Adjusted Residential Soil RSLs (Nov, 2010)**	MR11-DU02		
Sample ID					MR11-DU02-SS01-09D	MR11-DU02-SS02-09D	MR11-DU02-SS03-09D
Sample Date					11/05/09	11/05/09	11/05/09
Chemical Name							
Explosives (µg/kg)							
2-Amino-4,6-dinitrotoluene	--	--	200,000	15,000	100 J	430	190 U
Nitroglycerin	--	--	6,200	610	640 U	640 U	640 U
RDX	--	--	24,000	5,500	190 U	190 U	190 U
Tetryl	--	--	250,000	24,000	180 J	190 UJ	190 UJ
Total Metals (mg/kg)							
Aluminum	5,487	--	99,000	7,700	4,610	4,940	5,170
Arsenic	0.626	5.8	1.6	0.39	1.03	1.04	1.13
Barium	14.5	580	19,000	1,500	16.6 J	14.7 J	17.7 J
Beryllium	0.103	--	200	16	0.0794 J	0.339 U	0.0805 J
Cadmium	0.033	3	80	7	0.322 U	0.339 U	0.373 U
Calcium	6,360	--	--	--	12,000 J	18,400 J	13,700 J
Chromium	6.05	3.8	5.6	0.29	5.6	5.42	**5.95**
Cobalt	0.294	--	30	2.3	0.806 U	0.846 U	0.932 U
Copper	4.83	700	4,100	310	2.83 J	3.05 J	3.5 J
Cyanide	--	0.28	2,000	160	0.337 U	0.645	0.375 U
Iron	3,245	150	72,000	5,500	1,750	1,740	1,870
Lead	12.3	270	800	400	12.5	10.3	12.3
Magnesium	238	--	--	--	487 J	703 J	697 J
Manganese	13.7	65	2,300	180	14.6	17.1	18.7
Mercury	0.081	1	31	2.3	0.0231 J	0.0347 J	0.0318 J
Nickel	1.21	130	2,000	150	1.26 J	1.11 J	1.28 J
Potassium	116	--	--	--	180 J	240 J	251 J
Sodium	80.9	--	--	--	322 U	339 U	373 U
Vanadium	8.9	--	520	39	5.81	5.79	5.9
Zinc	10.8	1,200	31,000	2,300	12.7 J	15.6 J	16.4 J

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Notes:

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

Bold box indicates exceedance of NC HWS 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

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mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

TABLE 4-1
Surface Soil Analytical Results
Site UXO-11, Former B-5 Practice Hand Grenade Course (ASR #2.81)
MCB CamLej, North Carolina

Station ID	**Camp Lejeune Background SS 2X Mean**	**CLEAN NCSSLs (January, 2010)**	**Adjusted Industrial Soil RSLs (Nov, 2010)**	**Adjusted Residential Soil RSLs (Nov, 2010)**	MR11-DU03		
Sample ID					MR11-DU03-SS01-09D	MR11-DU03-SS02-09D	MR11-DU03-SS03-09D
Sample Date					11/05/09	11/05/09	11/05/09
Chemical Name							
Explosives (µg/kg)							
2-Amino-4,6-dinitrotoluene	--	--	200,000	15,000	190 U	190 U	190 U
Nitroglycerin	--	--	6,200	610	640 U	920	640 U
RDX	--	--	24,000	5,500	190 U	290 J	190 U
Tetryl	--	--	250,000	24,000	190 UJ	190 UJ	190 UJ
Total Metals (mg/kg)							
Aluminum	5,487	--	99,000	7,700	4,460	4,680	5,190
Arsenic	0.626	5.8	1.6	0.39	0.846	0.971	1.11
Barium	14.5	580	19,000	1,500	15.9 J	15.5 J	16.2 J
Beryllium	0.103	--	200	16	0.0887 J	0.0881 J	0.0949 J
Cadmium	0.033	3	80	7	0.356 U	0.348 U	0.364 U
Calcium	6,360	--	--	--	17,900 J	21,400 J	15,200 J
Chromium	6.05	3.8	5.6	0.29	**6.29**	**6.4**	**7.25**
Cobalt	0.294	--	30	2.3	0.89 U	0.87 U	0.91 U
Copper	4.83	700	4,100	310	3.93 J	3.81 J	4.19 J
Cyanide	--	0.28	2,000	160	0.262 J	0.202 J	0.19 J
Iron	3,245	150	72,000	5,500	1,750	1,950	2,180
Lead	12.3	270	800	400	15.7	15.6	17.5
Magnesium	238	--	--	--	714 J	730 J	568 J
Manganese	13.7	65	2,300	180	20.9	22.9	23.6
Mercury	0.081	1	31	2.3	0.0286 J	0.023 J	0.0297 J
Nickel	1.21	130	2,000	150	1.29 J	1.37 J	1.57 J
Potassium	116	--	--	--	229 J	239 J	266 J
Sodium	80.9	--	--	--	356 U	348 U	364 U
Vanadium	8.9	--	520	39	6.05	6.58	7.41
Zinc	10.8	1,200	31,000	2,300	23.9 J	24.5 J	41.4 J

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Notes:

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

Bold box indicates exceedance of NC HWS SSL

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Underline indicates exceedance of Adjusted Residential Soil RSLs

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mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

TABLE 4-1
Surface Soil Analytical Results
Site UXO-11, Former B-5 Practice Hand Grenade Course (ASR #2.81)
MCB CamLej, North Carolina

Station ID	**Camp Lejeune Background SS 2X Mean**	**CLEAN NCSSLs (January, 2010)**	**Adjusted Industrial Soil RSLs (Nov, 2010)**	**Adjusted Residential Soil RSLs (Nov, 2010)**	MR11-DU04			
Sample ID					MR11-DU04-SS01-09D	MR11-DU04-SS02-09D	MR11-DU04-SS02D-09D	MR11-DU04-SS03-09D
Sample Date					11/05/09	11/05/09	11/05/09	11/05/09
Chemical Name								
Explosives (µg/kg)								
2-Amino-4,6-dinitrotoluene	--	--	200,000	15,000	190 U	190 U	190 U	190 U
Nitroglycerin	--	--	6,200	610	640 U	640 U	640 U	640 U
RDX	--	--	24,000	5,500	190 U	190 U	190 U	190 U
Tetryl	--	--	250,000	24,000	190 UJ	200 J	190 UJ	190 UJ
Total Metals (mg/kg)								
Aluminum	5,487	--	99,000	7,700	4,870	6,750	5,560	4,790
Arsenic	0.626	5.8	1.6	0.39	1.02	1.05	1.19	1.1
Barium	14.5	580	19,000	1,500	15.4 J	19.4 J	17 J	14.4 J
Beryllium	0.103	--	200	16	0.0946 J	0.133 J	0.113 J	0.0985 J
Cadmium	0.033	3	80	7	0.399	0.352 U	0.364 U	0.403
Calcium	6,360	--	--	--	56,500 J	21,700 J	38,200 J	56,100 J
Chromium	6.05	3.8	5.6	0.29	**6.8**	**9.9**	**8.3**	**7.56**
Cobalt	0.294	--	30	2.3	0.87 U	0.401 J	0.364 J	0.357 J
Copper	4.83	700	4,100	310	3.27 J	4.92 J	4.36 J	4.1 J
Cyanide	--	0.28	2,000	160	0.221 J	0.349 U	0.356 U	0.358 U
Iron	3,245	150	72,000	5,500	1,850	2,280	1,880	2,090
Lead	12.3	270	800	400	14.4	25.4	20.8	18.6
Magnesium	238	--	--	--	1,160 J	656 J	685 J	1,010 J
Manganese	13.7	65	2,300	180	19	18	19.1	23.3
Mercury	0.081	1	31	2.3	0.0283 J	0.0353 J	0.0436	0.0416 J
Nickel	1.21	130	2,000	150	1.26 J	1.94 J	1.57 J	1.57 J
Potassium	116	--	--	--	232 J	284 J	243 J	253 J
Sodium	80.9	--	--	--	115 J	349 U	84.9 J	104 J
Vanadium	8.9	--	520	39	7.26	8.48	7.21	7.38
Zinc	10.8	1,200	31,000	2,300	20.7 J	41.2 J	36.6 J	29.6 J

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Notes:

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

Bold box indicates exceedance of NC HWS SSL

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Underline indicates exceedance of Adjusted Residential Soil RSLs

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mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

TABLE 4-2
Subsurface Soil Analytical Results
Site UXO-11, Former B-5 Practice Hand Grenade Course (ASR #2.81)
MCB CamLej, North Carolina

Station ID	**CLEAN MCB CamLej Background SB 2X Mean**	**CLEAN NCSSLs (January, 2010)**	**Adjusted Industrial Soil RSLs (Nov, 2010)**	**Adjusted Residential Soil RSLs (Nov, 2010)**	MR11-IS01		MR11-IS02	MR11-IS03	MR11-IS04	MR11-IS05
Sample ID					MR11-IS01-2-3-09D	MR11-IS01D-2-3-09D	MR11-IS02-4-5-09D	MR11-IS03-2-3-09D	MR11-IS04-2-3-09D	MR11-IS05-2-3-09D
Sample Date					12/03/09	12/03/09	12/03/09	12/03/09	12/03/09	12/03/09
Chemical Name										
Explosives (µg/kg)										
Perchlorate	--	--	72,000	5,500	2.31 U	2.29 U	2.41	5.05	2.39 U	2.35 U
RDX	--	--	24,000	5,500	170 J	440	300	400 J	103 J	370 J
Total Metals (mg/kg)										
Aluminum	10,369	--	99,000	7,700	11,100 J	10,800 J	5,870 J	13,600 J	12,000 J	7,880 J
Arsenic	2.12	5.8	1.6	0.39	0.827	0.772	0.462	1.4	0.847	0.83
Barium	16.6	580	19,000	1,500	19.7	19.6	11.8	33.4	13.8	13.5
Beryllium	0.165	--	200	16	0.136 J	0.132 J	0.0916 J	0.209 J	0.0656 J	0.152 J
Calcium	441	--	--	--	106 J	106 J	215 J	2,180	201 J	114 J
Chromium	14.5	3.8	5.6	0.29	**10.2 J**	**9.93 J**	**6.72 J**	**16 J**	**9.12 J**	**8.12 J**
Cobalt	0.822	--	30	2.3	0.524 J	0.53 J	0.729 U	0.625 J	0.34 J	0.369 J
Copper	2.56	700	4,100	310	0.529 J	0.513 J	0.5 J	0.397 J	0.579 U	0.388 J
Iron	5,439	150	72,000	5,500	3,190	2,190	1,100	5,290	6,920	1,770
Lead	8.49	270	800	400	6.08	6.04	3.29	6.74	5.95	4.18
Magnesium	363	--	--	--	450 J	448 J	242 J	666 J	329 J	355 J
Manganese	9.25	65	2,300	180	5.07 J	5 J	2.74 J	5.97 J	3.95 J	4.05 J
Mercury	0.071	1	31	2.3	0.0368 U	0.0405 U	0.0166 J	0.0236 J	0.033 U	0.0352 U
Nickel	2.27	130	2,000	150	1.37	1.31	0.918	1.99	1.39	1.23
Potassium	361	--	--	--	210 J	212 J	140 J	282 J	135 J	157 J
Selenium	0.505	2.1	510	39	0.241 J	0.274 U	0.292 U	0.354	0.258 J	0.227 J
Vanadium	17.2	--	520	39	14.7	11.9	5.68	16.2	12.1	8.64
Zinc	6.59	1,200	31,000	2,300	3.66	3.75	2.33	5.26	2.31	2.73

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Notes:

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

Bold box indicates exceedance of NC HWS 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

mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

µg/kg - Micrograms per kilogram

TABLE 4-3
Sediment Analytical Results
Site UXO-11 Former Practice Hand Grenade Course
MCB CamLej, North Carolina

Station ID	**Adjusted Industrial Soil RSLs (Nov, 2010)**	**Adjusted Residential Soil RSLs (Nov, 2010)**	MR11-SW/SD01	MR11-SW/SD02
Sample ID			MR11-SD01-09D	MR11-SD02-09D
Sample Date			11/12/09	11/12/09
Chemical Name				
Explosives (µg/kg)				
No Detections				
Total Metals (mg/kg)				
Aluminum	99,000	7,700	10,300	9,030
Arsenic	1.6	0.39	1.55	1.09
Barium	19,000	1,500	42.7	23.4
Beryllium	200	16	0.221 J	0.181 J
Calcium	--	--	20,200	36,800
Chromium	5.6	0.29	**17.8**	**16.6**
Cobalt	30	2.3	0.688 J	0.717 J
Copper	4,100	310	5.42	15.2
Iron	72,000	5,500	3,230	3,340
Lead	800	400	87.8	53.1
Magnesium	--	--	820	1,080
Manganese	2,300	180	17.2	18.5
Mercury	31	2.3	0.0492	0.0532
Nickel	2,000	150	2.46	3.29
Potassium	--	--	320 J	418 J
Vanadium	520	39	13.7	11.8
Zinc	31,000	2,300	36.5	183

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Notes:

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
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram

TABLE 4-4
Surface Water Analytical Results
Site UXO-11, Former B-5 Practice Hand Grenade Course (ASR #2.81)
MCB CamLej, North Carolina

Station ID	**NC2B-SW-Human Health & Water Supply 1**	**NRWQC-Human Health - Organisms & Water + Organisms 2**	**Adjusted Tap Water RSLs**	MR11-SW/SD01		MR11-SW/SD02
Sample ID				MR11-SW01-09D	MR11-SW01D-09D	MR11-SW02-09D
Sample Date				11/12/09	11/12/09	11/12/09
Chemical Name						
Explosives (µg/l)						
HMX	--	--	--	0.14 UJ	0.08 J	0.14 UJ
Nitrobenzene	--	17	--	0.16	0.16 J	0.094 J
Tetryl	--	--	--	0.29 J	0.34 J	0.14 J
Total Metals (µg/l)						
Aluminum	--	--	--	55.2	57	52.9
Barium	1,000	1,000	--	3.64 J	3.69 J	3.14 J
Cadmium	--	5	--	0.344 J	0.33 J	0.325 J
Calcium	--	--	--	10,700	11,000	9,470
Iron	--	300	--	22.4 J	22.7 J	24.9 J
Magnesium	--	--	--	2,000	2,030	1,710
Manganese	200	50	--	3.75 U	0.918 J	3.75 U
Potassium	--	--	--	2,210	2,270	1,890
Sodium	--	--	--	1,200 J	1,220 J	1,010 J
Zinc	--	7,400	--	2.39 J	2.44 J	2.02 J
Dissolved Metals (µg/l)						
Aluminum, Dissolved	--	--	--	38.3 J	36.1 J	36 J
Barium, Dissolved	1,000	1,000	--	4.02 J	3.81 J	3.26 J
Cadmium, Dissolved	--	5	--	0.362 J	0.333 J	0.327 J
Calcium, Dissolved	--	--	--	11,600	11,500	10,000
Copper, Dissolved	--	1,300	--	2.5 U	4.11	2.5 U
Magnesium, Dissolved	--	--	--	2,090	2,100	1,750
Potassium, Dissolved	--	--	--	2,310	2,340	1,930
Sodium, Dissolved	--	--	--	1,480	1,460	1,150 J
Zinc, Dissolved	--	7,400	--	5.19	4.06 J	2.52 J

Notes:

Bold box indicates exceedance of NC2B-SW-Human Health + Water Supply

Bold text indicates exceedance of NRWQC-Human Health - Water+ Organisms

Underline indicates exceedance of Adjusted Tap Water RSLs

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

1 - NC2B-SW-Human Health and NC2B-SW-Water Supply were combined to show the most conservative criteria

2 - NRWQC-Human Health - Water+ Organisms and NRWQC-Human Health Organisms were combined to show the most conservative criteria

NA - Not analyzed

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

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be

µg/l - Micrograms per liter

TABLE 4-5
Groundwater Analytical Results
Site UXO-11, Former B-5 Practice Hand Grenade Course (ASR #2.81)
MCB CamLej, North Carolina

Station ID	**Camp Lejeune Background GW 2X Mean**	**NCGWQS (January 2010) ***	**Adjusted Tap Water RSLs**	MR11-IS01				MR11-IS02	MR11-IS03	MR11-IS04	MR11-IS05
Sample ID				MR11-TW01-09D	MR11-TW01D-09D	MR11-TW01-09D-2	MR11-TW01D-09D-2	MR11-TW02-09D	MR11-TW03-09D	MR11-TW04-09D	MR11-TW05-09D
Sample Date				12/07/09	12/07/09	12/09/09	12/09/09	12/04/09	12/07/09	12/07/09	12/07/09
Chemical Name											
Explosives (µg/l)											
1,3,5-Trinitrobenzene	--	--	110	0.15 U	0.076 J	NA	NA	0.15 U	0.15 U	0.086 J	0.15 U
1,3-Dinitrobenzene	--	--	0.37	0.15 U	0.15 U	NA	NA	0.12 J	0.062 J	0.058 J	0.15 U
2,4,6-Trinitrotoluene	--	--	1.8	0.15 U	0.15 U	NA	NA	0.15 U	0.053 J	0.15 U	0.15 U
2-Nitrotoluene	--	--	0.31	0.15 U	0.15 U	NA	NA	0.15 U	0.064 J	0.15 U	0.15 U
3-Nitrotoluene	--	--	0.37	0.15 U	0.15 U	NA	NA	0.15 U	0.12 J	0.15	0.15 U
4-Nitrotoluene	--	--	4.2	0.094 J	0.069 J	NA	NA	0.15 U	0.41 J	0.18	0.086 J
Nitrobenzene	--	--	0.12	0.1 J	0.15 U	NA	NA	**0.48 J**	**0.2 J**	0.064 J	0.15 U
Nitroglycerin	--	--	0.37	0.51 U	0.51 U	NA	NA	0.51 U	0.22 J	0.5 U	0.5 U
Perchlorate	--	--	2.6	0.2 U	0.2 U	NA	NA	0.383	0.202	0.2 U	0.0793 J
RDX	--	--	0.61	0.15 U	0.15 U	NA	NA	0.15 U	0.1 J	0.15 U	0.15 U
Total Metals (µg/l)											
Aluminum	1,886	--	3,700	398 J	366 J	NA	NA	255 J	443 J	531 J	473 J
Arsenic	5.77	10	0.045	1.25 U	1.25 U	NA	NA	**1.46**	**1.69**	**2.36**	**1.37**
Barium	86.2	700	730	49.2	46.6	NA	NA	13.5	18.8	49.4	10.3
Beryllium	0.308	--	7.3	0.66 J	0.632 J	NA	NA	1.25 U	1.25 U	0.54 J	1.25 U
Cadmium	0.358	2	1.8	1.25 U	1.25 U	NA	NA	0.643 J	0.264 J	1.25 U	0.311 J
Calcium	69,078	--	--	3,680	3,600	NA	NA	65,900	97,800	6,030	67,200
Chromium	3.13	10	0.043	**0.653 J**	**0.657 J**	NA	NA	**1.63**	**2.39**	**1.3**	**1.5**
Cobalt	3.4	--	1.1	3.12 U	3.12 U	NA	NA	3.12 U	3.12 U	**4.3**	**1.48 J**
Iron	5,999	300	2,600	234	233	NA	NA	331	2,340	1,510	220
Magnesium	6,363	--	--	919 J	878 J	NA	NA	1,310	2,030	686 J	1,270
Manganese	214	50	88	6.26 J	6.34 J	NA	NA	16.6 J	22 J	17.2 J	11.4 J
Nickel	7.97	100	73	2.64	2.48 J	NA	NA	2.82	2.5 U	6.14	3.33
Potassium	3,277	--	--	1,250 U	1,250 U	NA	NA	466 J	442 J	729 J	1,250 U
Selenium	3.14	20	18	1.25 U	1.25 U	NA	NA	2.88	1.25 U	1.25 U	1.16 J
Sodium	22,508	--	--	3,180	3,060	NA	NA	2,980	3,370	4,980	3,100
Vanadium	4.72	--	18	3.12 U	3.12 U	NA	NA	4.97	2.5 J	1.49 J	4.21
Zinc	42.1	1,000	1,100	8.11	7.93	NA	NA	42.1	2.76 J	6.95	3.85 J
Dissolved Metals (µg/l)											
Aluminum, Dissolved	1,886	--	3,700	NA	NA	325 J	322 J	NA	NA	NA	NA
Barium, Dissolved	86.2	700	730	NA	NA	48.2	46.2	NA	NA	NA	NA
Beryllium, Dissolved	0.308	--	7.3	NA	NA	0.664 J	0.642 J	NA	NA	NA	NA
Calcium, Dissolved	69,078	--	--	NA	NA	3,750	3,600	NA	NA	NA	NA
Iron, Dissolved	5,999	300	2,600	NA	NA	229	209	NA	NA	NA	NA
Magnesium, Dissolved	6,363	--	--	NA	NA	895 J	867 J	NA	NA	NA	NA
Manganese, Dissolved	214	50	88	NA	NA	5.51 J	5.22 J	NA	NA	NA	NA
Nickel, Dissolved	7.97	100	73	NA	NA	2.61	2.45 J	NA	NA	NA	NA
Sodium, Dissolved	22,508	--	--	NA	NA	3,160	3,070	NA	NA	NA	NA
Zinc, Dissolved	42.1	1,000	1,100	NA	NA	8.07	8.11	NA	NA	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

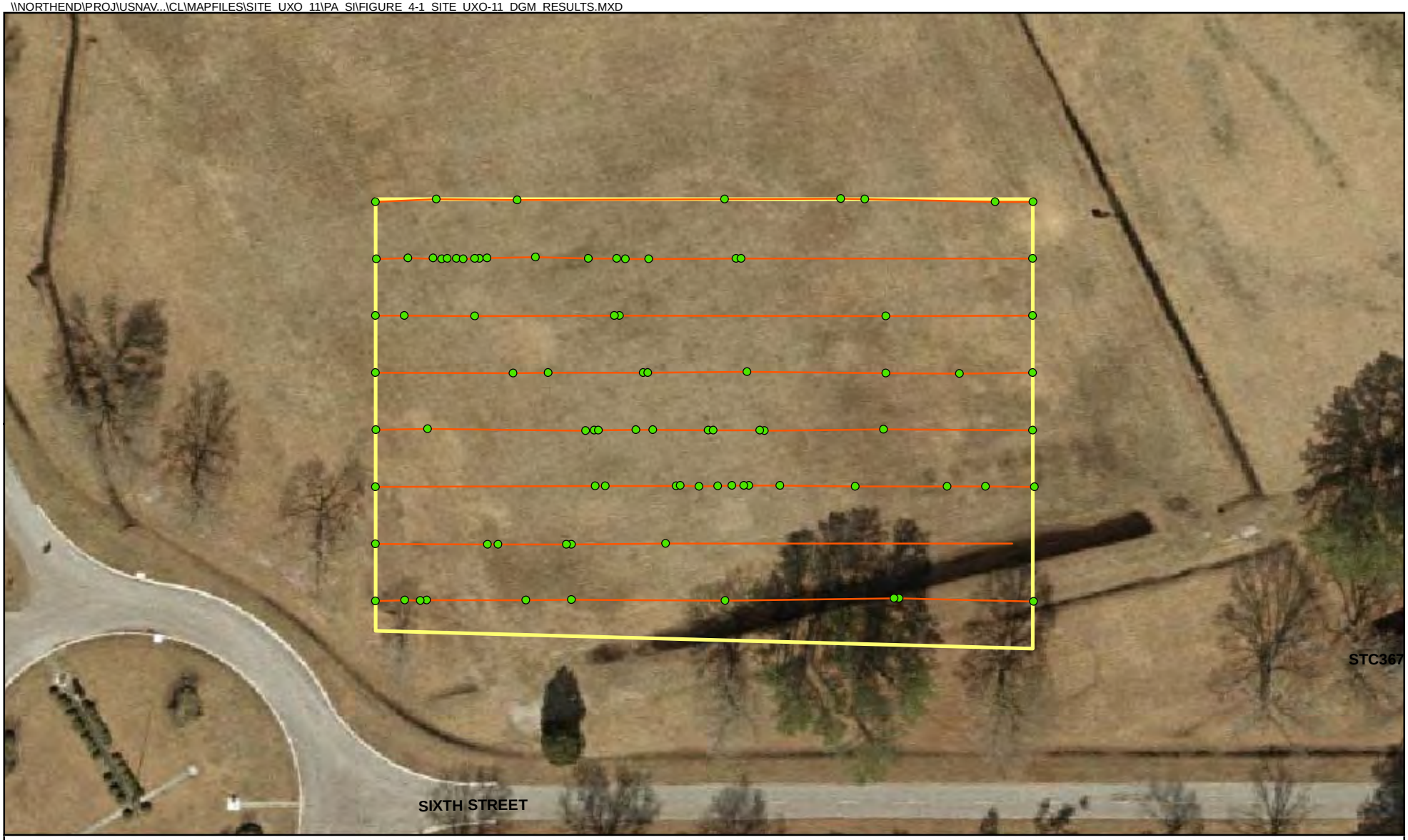
J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

µg/l - Micrograms per liter

\\NORTHEND\PROJ\USNAV...\CL\MAPFILES\SITE_UXO_11\PA_SI\FIGURE_4-1_SITE_UXO-11_DGM_RESULTS.MXD



Legend

- Geophysical Anomaly (greater than 3.0 mV)
- DGM Transects
- Site UXO-11 Boundary

N

0 40 80 160 Feet

1 inch = 80 feet

Figure 4-1
Digital Geophysical Mapping Results
Site UXO-11, Former B-5 Practice Hand Grenade Course (ASR #2.81)
PA/SI Report
MCB CamLej
North Carolina

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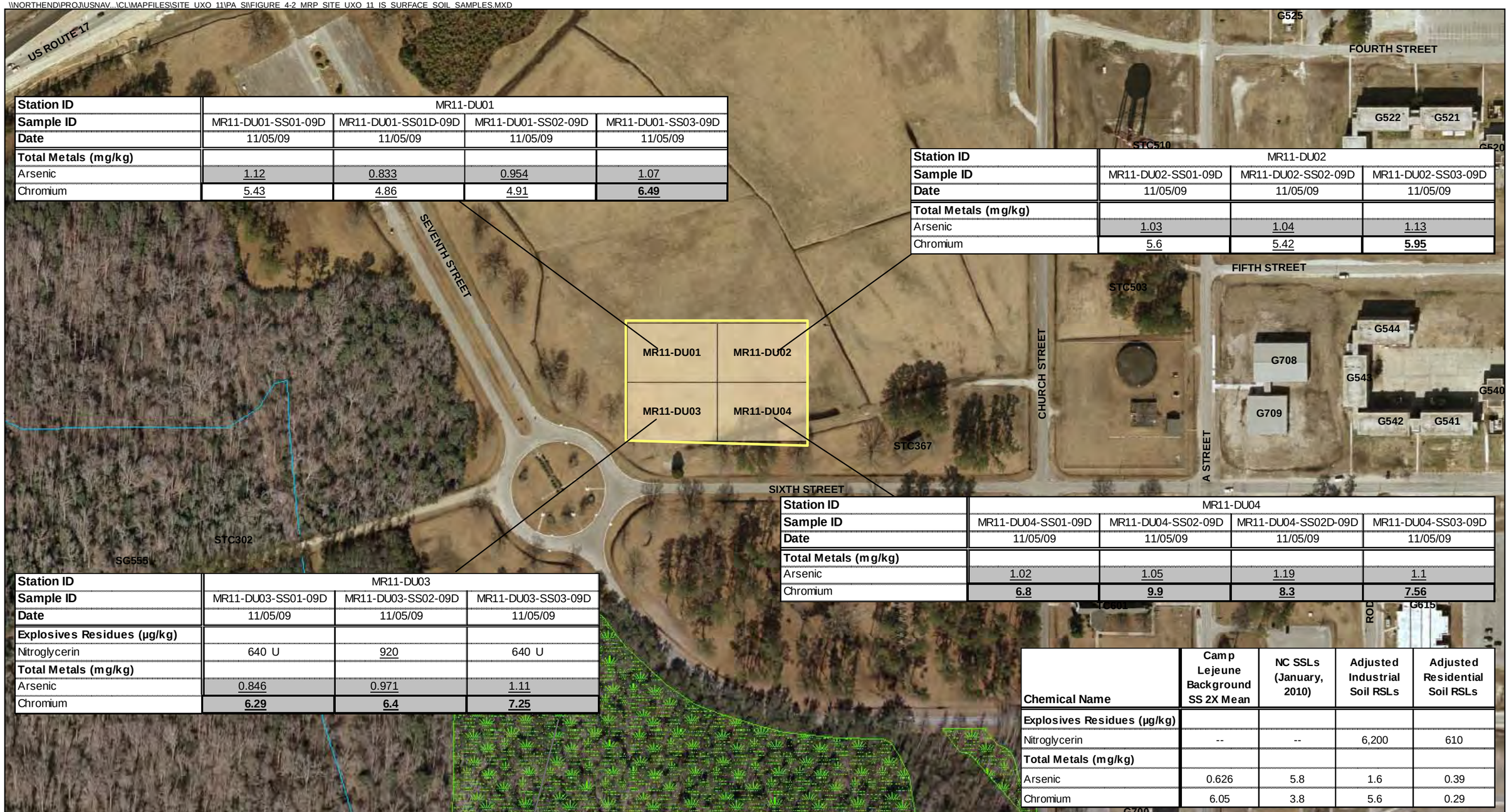
\\NORTHEND\PROJ\USNAV...\CL\MAPFILES\SITE_UXO_11\PA_SI\FIGURE_4-2_MRP_SITE_UXO_11_IS_SURFACE_SOIL_SAMPLES.MXD



Station ID	MR11-DU01			
Sample ID	MR11-DU01-SS01-09D	MR11-DU01-SS01D-09D	MR11-DU01-SS02-09D	MR11-DU01-SS03-09D
Date	11/05/09	11/05/09	11/05/09	11/05/09
Total Metals (mg/kg)				
Arsenic	1.12	0.833	0.954	1.07
Chromium	5.43	4.86	4.91	**6.49**

Station ID	MR11-DU02		
Sample ID	MR11-DU02-SS01-09D	MR11-DU02-SS02-09D	MR11-DU02-SS03-09D
Date	11/05/09	11/05/09	11/05/09
Total Metals (mg/kg)			
Arsenic	1.03	1.04	1.13
Chromium	5.6	5.42	**5.95**

Station ID	MR11-DU03		
Sample ID	MR11-DU03-SS01-09D	MR11-DU03-SS02-09D	MR11-DU03-SS03-09D
Date	11/05/09	11/05/09	11/05/09
Explosives Residues (µg/kg)			
Nitroglycerin	640 U	920	640 U
Total Metals (mg/kg)			
Arsenic	0.846	0.971	1.11
Chromium	**6.29**	**6.4**	**7.25**

Station ID	MR11-DU04			
Sample ID	MR11-DU04-SS01-09D	MR11-DU04-SS02-09D	MR11-DU04-SS02D-09D	MR11-DU04-SS03-09D
Date	11/05/09	11/05/09	11/05/09	11/05/09
Total Metals (mg/kg)				
Arsenic	1.02	1.05	1.19	1.1
Chromium	**6.8**	**9.9**	**8.3**	**7.56**

Chemical Name	Camp Lejeune Background SS 2X Mean	NC SSLs (January, 2010)	Adjusted Industrial Soil RSLs	Adjusted Residential Soil RSLs
Explosives Residues (µg/kg)				
Nitroglycerin	--	--	6,200	610
Total Metals (mg/kg)				
Arsenic	0.626	5.8	1.6	0.39
Chromium	6.05	3.8	5.6	0.29

Legend
- Site UXO-11 Boundary
- Proposed Decision Unit (120 ft x190 ft)
- Wetlands
- Streams

Notes:
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
U - The material was analyzed for, but not detected
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram

N

0 100 200 400 Feet

1 inch = 200 feet

Figure 4-2
Surface Soil Exceedances
Site UXO-11, Former B-5 Practice Hand Grenade Course (ASR #2.81)
PA/SI Report
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North Carolina

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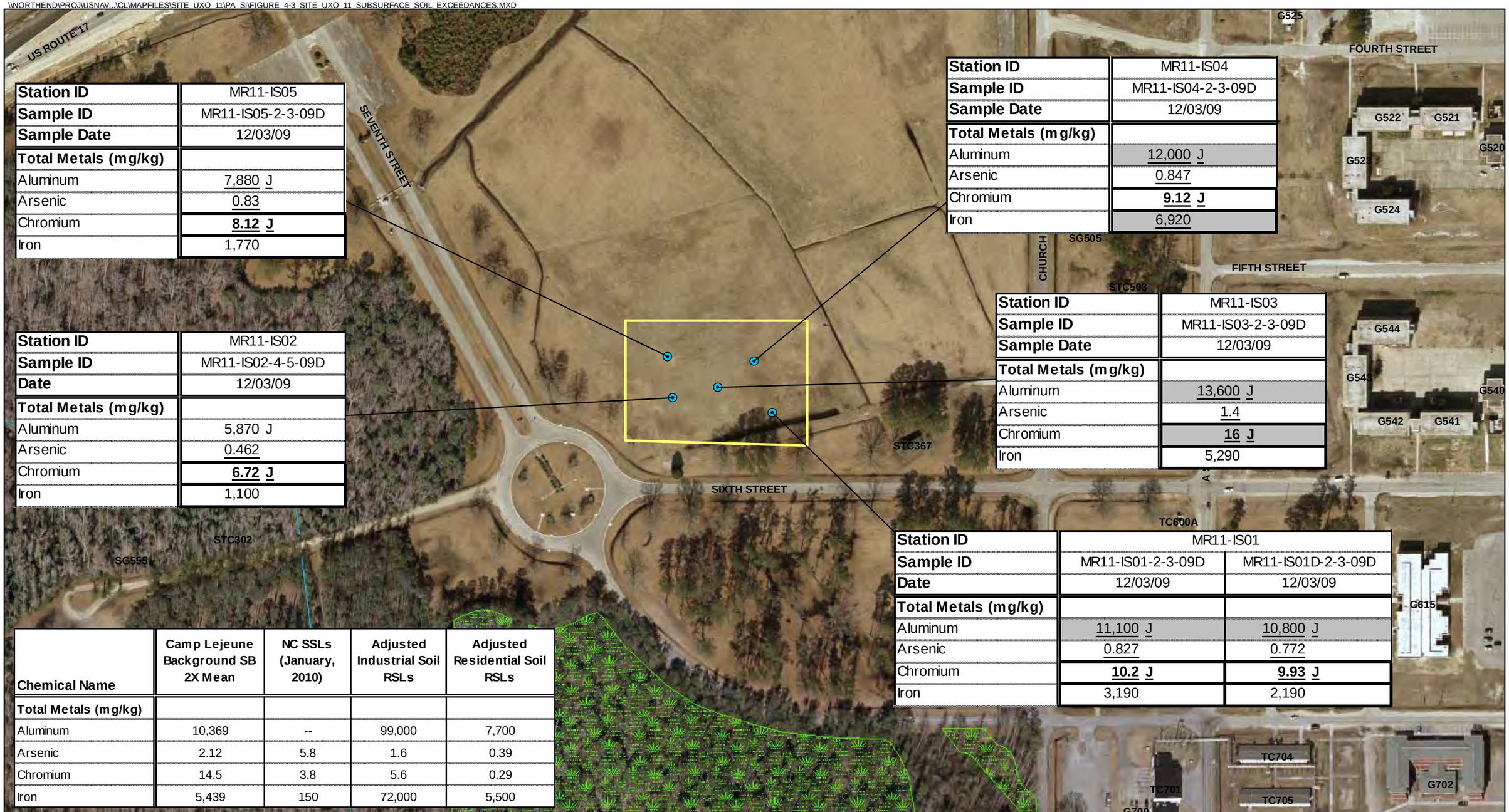
\\NORTHEND\PROJ\USNAV...\CL\MAPFILES\SITE_UXO_11\PA_SI\FIGURE_4-3_SITE_UXO_11_SUBSURFACE_SOIL_EXCEEDANCES.MXD



Station ID	MR11-IS05
Sample ID	MR11-IS05-2-3-09D
Sample Date	12/03/09
Total Metals (mg/kg)	
Aluminum	7,880 J
Arsenic	0.83
Chromium	**8.12 J**
Iron	1,770

Station ID	MR11-IS04
Sample ID	MR11-IS04-2-3-09D
Sample Date	12/03/09
Total Metals (mg/kg)	
Aluminum	12,000 J
Arsenic	0.847
Chromium	**9.12 J**
Iron	6,920

Station ID	MR11-IS02
Sample ID	MR11-IS02-4-5-09D
Date	12/03/09
Total Metals (mg/kg)	
Aluminum	5,870 J
Arsenic	0.462
Chromium	**6.72 J**
Iron	1,100

Station ID	MR11-IS03
Sample ID	MR11-IS03-2-3-09D
Sample Date	12/03/09
Total Metals (mg/kg)	
Aluminum	13,600 J
Arsenic	1.4
Chromium	**16 J**
Iron	5,290

Station ID	MR11-IS01	
Sample ID	MR11-IS01-2-3-09D	MR11-IS01D-2-3-09D
Date	12/03/09	12/03/09
Total Metals (mg/kg)		
Aluminum	11,100 J	10,800 J
Arsenic	0.827	0.772
Chromium	**10.2 J**	**9.93 J**
Iron	3,190	2,190

Chemical Name	Camp Lejeune Background SB 2X Mean	NC SSLs (January, 2010)	Adjusted Industrial Soil RSLs	Adjusted Residential Soil RSLs
Total Metals (mg/kg)				
Aluminum	10,369	--	99,000	7,700
Arsenic	2.12	5.8	1.6	0.39
Chromium	14.5	3.8	5.6	0.29
Iron	5,439	150	72,000	5,500

Legend
- Subsurface Soil Sampling Locations
- Site UXO-11 Boundary
- Wetlands
- Streams

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
J - Analyte present, value may or may not be accurate or precise
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram

N

0 100 200 400 Feet

1 inch = 200 feet

Figure 4-3
Subsurface Soil Exceedances
Site UXO-11, Former B-5 Practice Hand Grenade Course (ASR #2.81)
PA/SI Report
MCB CamLej
North Carolina

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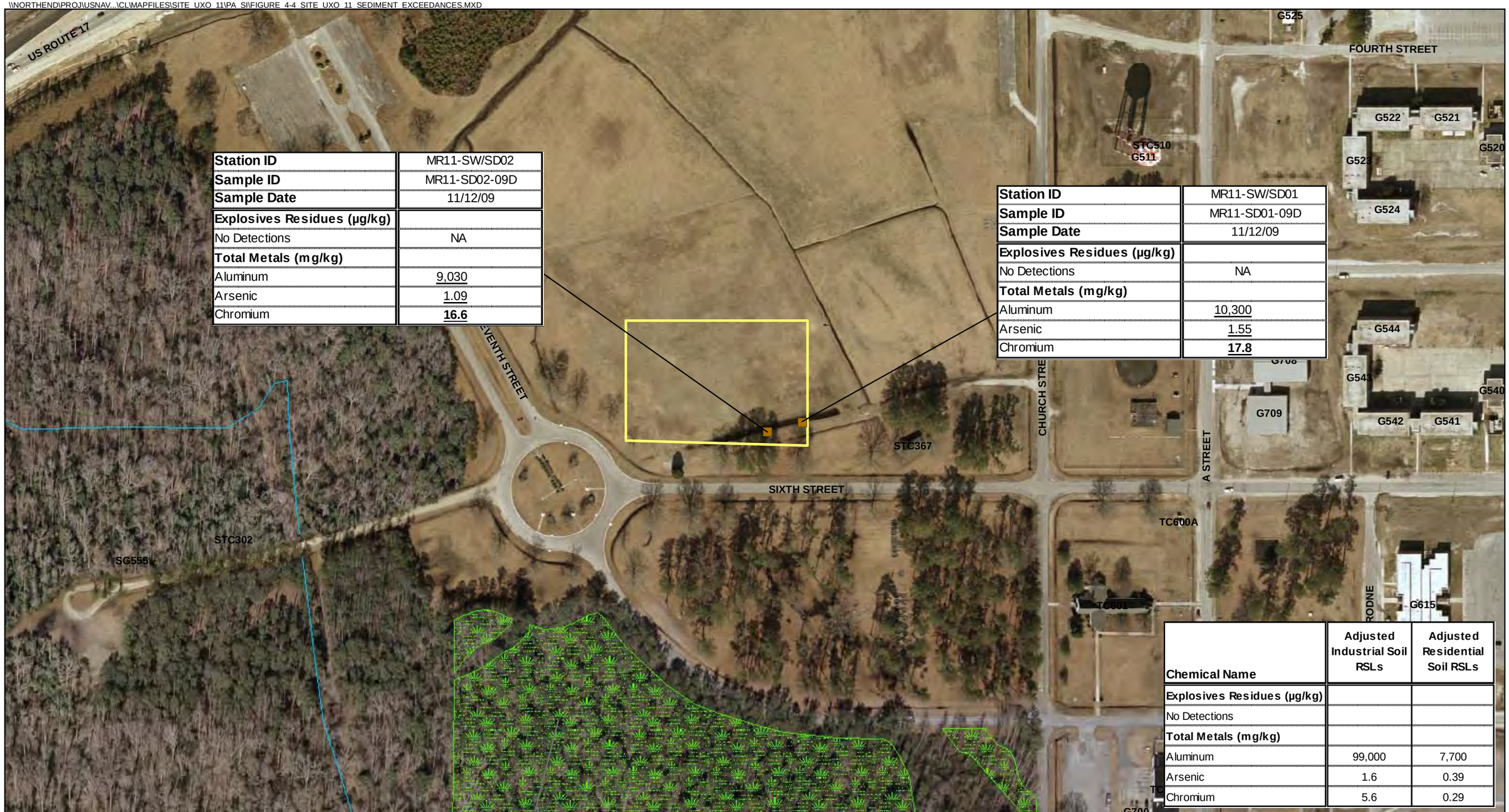
\\NORTHEND\PROJ\USNAV...\CL\MAPFILES\SITE_UXO_11\PA_SI\FIGURE_4-4_SITE_UXO_11_SEDIMENT_EXCEEDANCES.MXD



Station ID	MR11-SW/SD02
Sample ID	MR11-SD02-09D
Sample Date	11/12/09
Explosives Residues (µg/kg)	
No Detections	NA
Total Metals (mg/kg)	
Aluminum	9,030
Arsenic	1.09
Chromium	**16.6**

Station ID	MR11-SW/SD01
Sample ID	MR11-SD01-09D
Sample Date	11/12/09
Explosives Residues (µg/kg)	
No Detections	NA
Total Metals (mg/kg)	
Aluminum	10,300
Arsenic	1.55
Chromium	**17.8**

Chemical Name	Adjusted Industrial Soil RSLs	Adjusted Residential Soil RSLs
Explosives Residues (µg/kg)		
No Detections		
Total Metals (mg/kg)		
Aluminum	99,000	7,700
Arsenic	1.6	0.39
Chromium	5.6	0.29

Legend
- Sediment Sampling Location
- Site UXO-11 Boundary
- Wetlands
- Streams

Notes:
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
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram

N

0 100 200 400 Feet

1 inch = 200 feet

Figure 4-4
Sediment Exceedances
Site UXO-11, Former B-5 Practice Hand Grenade Course (ASR #2.81)
PA/SI Report
MCB CamLej
North Carolina

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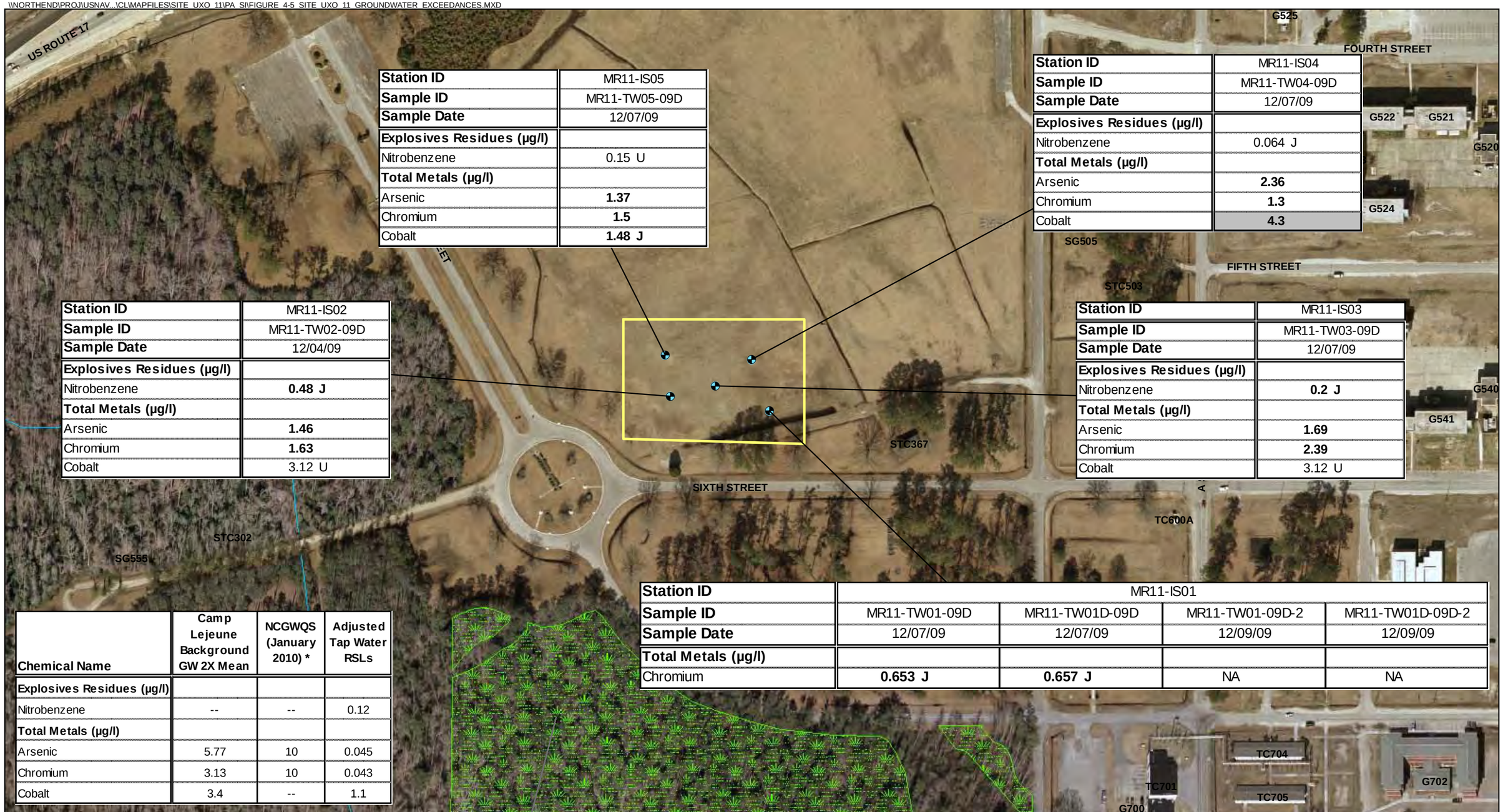
\\NORTHEND\PROJ\USNAV...\CL\MAPFILES\SITE_UXO_11\PA_SI\FIGURE_4-5_SITE_UXO_11_GROUNDWATER_EXCEEDANCES.MXD



Station ID	MR11-IS05
Sample ID	MR11-TW05-09D
Sample Date	12/07/09
Explosives Residues (µg/l)	
Nitrobenzene	0.15 U
Total Metals (µg/l)	
Arsenic	**1.37**
Chromium	**1.5**
Cobalt	**1.48 J**

Station ID	MR11-IS04
Sample ID	MR11-TW04-09D
Sample Date	12/07/09
Explosives Residues (µg/l)	
Nitrobenzene	0.064 J
Total Metals (µg/l)	
Arsenic	**2.36**
Chromium	**1.3**
Cobalt	**4.3**

Station ID	MR11-IS02
Sample ID	MR11-TW02-09D
Sample Date	12/04/09
Explosives Residues (µg/l)	
Nitrobenzene	**0.48 J**
Total Metals (µg/l)	
Arsenic	**1.46**
Chromium	**1.63**
Cobalt	3.12 U

Station ID	MR11-IS03
Sample ID	MR11-TW03-09D
Sample Date	12/07/09
Explosives Residues (µg/l)	
Nitrobenzene	**0.2 J**
Total Metals (µg/l)	
Arsenic	**1.69**
Chromium	**2.39**
Cobalt	3.12 U

Station ID	MR11-IS01			
Sample ID	MR11-TW01-09D	MR11-TW01D-09D	MR11-TW01-09D-2	MR11-TW01D-09D-2
Sample Date	12/07/09	12/07/09	12/09/09	12/09/09
Total Metals (µg/l)				
Chromium	**0.653 J**	**0.657 J**	NA	NA

Chemical Name	Camp Lejeune Background GW 2X Mean	NCGWQS (January 2010) *	Adjusted Tap Water RSLs
Explosives Residues (µg/l)			
Nitrobenzene	--	--	0.12
Total Metals (µg/l)			
Arsenic	5.77	10	0.045
Chromium	3.13	10	0.043
Cobalt	3.4	--	1.1

Legend
- Groundwater Sample Locations
- Site UXO-11 Boundary
- Wetlands
- Streams

Notes:
Shading indicates exceedance of two times the mean base background concentration for Groundwater
Bold box indicates exceedance of NCGWOS 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.
J - Analyte present, value may or may not be accurate or precise
U - The material was analyzed for, but not detected
µg/kg - Micrograms per kilogram

N

0 100 200 400 Feet

1 inch = 200 feet

Figure 4-5
Groundwater Exceedances
Site UXO-11, Former B-5 Practice Hand Grenade Course (ASR #2.81)
PA/SI Report
MCB CamLej
North Carolina

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SECTION 5

Human Health Risk Screening

A conservative preliminary human health risk screening (HHRS) was performed to assess the potential for human health risks associated with exposure to site media (soil, sediment, surface water, and groundwater). The results of the human health risk screening provide a preliminary indication of potential risks from constituents of potential concern (COPCs), and are used to help evaluate whether future residential use of the site is acceptable based on human health risks or if the site requires further evaluation (e.g., a baseline risk assessment, or additional data collection).

All of the data included in the risk screening were validated to determine the reliability of the data for use in the HHRS. The following criteria were used in determining data usability:

- Estimated values flagged with a J qualifier were treated as detected concentrations.
- For duplicate samples, the maximum concentration between the two samples was used as the sample concentration.
- Unfiltered groundwater samples were analyzed in the risk screening following USEPA Region IV guidance (USEPA, 2001a).

5.1 Human Health Conceptual Site Model

The human health conceptual site model (CSM) presents an overview of site conditions, potential contaminant migration pathways, and exposure pathways to potential receptors. The human health CSM for soil, sediment, surface water, and groundwater is presented on **Figure 5-1**. Section 5.2 presents the site history and setting, which is briefly summarized below.

Site UXO-11 is an approximately 2-acre area located north of Sixth Street and east of Seventh Street and the Marine Corps Air Station New River (**Figure 2-1**). The site is an open grassy area with no structures. There is a small drainage swale on the southeast corner of the Site, and several other drainage swales surround the Site. The drainage swale on the southeast corner of the site drains southwest towards the traffic circle.

Potential current receptors include visitors, trespassers, Base/industrial workers, and maintenance workers. The current receptors may come in contact with surface soil, surface water, and sediment. Exposure routes may include incidental ingestion of and dermal contact with the surface soil, surface water, and sediment, and inhalation of particulate emissions from the surface soil. Based on the site history, volatile organic compounds (VOCs) were not used at Site UXO-11; therefore, inhalation of VOC emissions from site media is not a potentially complete exposure route.

Future site use is not expected to change significantly from current site use; therefore, potential future receptors include current receptors and construction workers who perform

any future construction projects at the Site. Additionally, although unlikely to be present at the Site, future residents are included as a worst-case scenario to evaluate unrestricted future site use. Future receptors could be exposed to surface and subsurface soil if future construction at the Site results in re-working the soil and exposing the subsurface soil. Exposure routes for future exposure to the surface and subsurface soil are the same as those for current surface soil: incidental ingestion of and dermal contact with the soil, and inhalation of particulate emissions from the soil. The future receptors could also be exposed to the surface water and sediment, through incidental ingestion and dermal contact.

There is a water supply well within 1,500 feet of the site screened from 48-70 ft below ground surface. However, this well is screened in the Castle Hayne aquifer, not the surficial aquifer. In addition, MCB CamLej identified this well as an "active backup well" that is not being used for distribution, and is being recommended and is planned for abandonment. The groundwater use patterns are already established for the Base and area around Site UXO-11, so use of shallow groundwater from Site UXO-11 for industrial or residential purposes is unlikely. Additionally, the surficial aquifer at MCB CamLej is not suitable for potable water use due to high dissolved solids and hardness levels and fluctuating water levels that negatively affect water yields. However, state and federal governing policies assume that underground freshwater resources are potable and should be maintained as such; therefore, a potable use scenario was evaluated in this HHRS. It was conservatively assumed that if future residential development of the Site occurs, the residents could potentially use the groundwater as a potable water supply. The residents would be exposed through ingestion, as well as dermal contact while bathing. As VOCs are not associated with the site use, inhalation of VOCs while bathing is not a complete pathway. Additionally, due to the shallow groundwater depth (from 0.21 to 1.82 feet bgs), construction workers could be exposed to the groundwater through dermal contact during construction activities.

As previously noted, VOCs are not associated with historical use of the Site; therefore, vapor intrusion from groundwater (or soil) to indoor air is not a complete pathway for Site UXO-11.

5.2 Human Health Risk-Based Screening and Risk Ratio Evaluation Methodology

The HHRS was conducted in three steps using a risk ratio technique (Department of the Navy, 2000). If COPCs were identified after Step 1, they were evaluated in Step 2. If COPCs were identified after Step 2, they were evaluated in Step 3. The three-step screening process is described below.

5.2.1 Step 1

The maximum detected analyte concentrations for each medium were compared to USEPA risk-based screening levels (RSLs; USEPA, 2010), other HHRS screening levels (if appropriate), and two times the mean MCB CamLej background concentration (for inorganic constituents in soil and groundwater). RSLs based on noncarcinogenic effects were divided by 10 to account for exposure to multiple analytes (i.e., 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 and sediment data were compared to USEPA Residential Soil RSLs. Residential Soil RSLs are more conservative (i.e., lower) than industrial soil RSLs and are therefore protective of all potential receptors (e.g., residents, industrial workers, and construction workers).

The groundwater data were compared to USEPA Tap Water RSLs. Groundwater data were also compared to maximum contaminant levels (MCLs) and the NCGWQS (15A NCAC 2L); however, these comparisons were not used to identify the groundwater COPCs to carry forward to Step 2.

The surface water data were compared to 15A NCAC 2B water quality standards for human health and water supply (if available), or the NRWQC for Human Health (water and organisms criteria). If neither of these were available, the USEPA Tap Water RSL was used for comparison.

If the maximum detected concentration in soil, groundwater, surface water, or sediment exceeded the appropriate screening value and background concentration, the HHRS proceeded to Step 2.

In addition to comparing the detected concentrations to the screening levels, the detection limits for non-detected analytes were compared to the screening levels. Non-detected analytes with detection limits exceeding the screening level were not identified as COPCs to carry forward to Step 2, but are discussed below to evaluate the potential for underestimating the total risks.

5.2.2 Step 2

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

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

The concentration is the maximum detected concentration (the same concentration that was used in Step 1). The acceptable risk level is 1 for noncarcinogens and 10^{-6} for carcinogens. RSLs for noncarcinogenic effects were not adjusted by 10 as was done in Step 1; rather, they were used as presented in the RSL table.

All of the corresponding risk levels for each analyte within a medium were summed to calculate the cumulative corresponding hazard index (HI) (for noncarcinogens) 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 anayltes 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 discussed above for Step 2; however, the 95 percent upper confidence limit (UCL) was used in place of the maximum detected

concentration, if more than five samples were available for that medium, 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.

ProUCL Version 4.00.04 (USEPA, 2009b) was used to test the data distribution and calculate the 95 percent UCL used for the Step 3 risk ratio calculations (**Appendix H**).

5.3 Human Health Risk Screening Results

The HHRS (comparison to risk-based criteria and background levels, Step 1) and risk ratio evaluation (Steps 2 and 3) were performed for surface soil, subsurface soil, sediment, surface water, and groundwater.

5.3.1 Surface Soil Risk Screening

Tables H-1 and H-2**, Appendix H,** present the risk-based screening and risk ratio evaluation for surface soil. As shown in Table H-1 in **Appendix H**, three analytes (nitroglycerin, arsenic, and chromium) were identified as COPCs. Based on Step 2 of the screening process (Table H-2, **Appendix H**), these three analytes were eliminated as COPCs; therefore, exposure to surface soil would not pose any unacceptable risks, and further evluation of surface soil based on human health risks is not necessary.

5.3.2 Subsurface Soil Risk Screening

Tables H-3 through H-5**, Appendix H,** present the risk-based screening and risk ratio evaluation for the subsurface soil. As shown in Table H-3 in **Appendix H**, four metals (aluminum, arsenic, chromium, and iron) were identified as COPCs. Based on Step 2 of the screening process (Table H-4, **Appendix H**), two of the metals, arsenic and chromium, were retained as COPCs. After Step 3 (Table H-5, **Appendix H**) both arsenic and chromium were eliminated as COPCs. Based on this evaluation, exposure to subsurface soil would not pose any unacceptable risks, and further evluation of subsurface soil based on human health risks is not necessary.

5.3.3 Sediment Risk Screening

Tables H-6 and H-7, **Appendix H**, present the risk-based screening and risk ratio evaluation for sediment. As shown in Table H-6**, Appendix H**, three metals (aluminum, arsenic, and chromium) were identified as COPCs for evaluation in Step 2. Based on Step 2 (risk ratio using maximum detected concentrations, Table H-7**, Appendix H**), aluminum was eliminated as a COPC, but arsenic and chromium could not be eliminated as COPCs. Due to the small sample size (less than 5 samples), Step 3 screening was not performed. Exposure to sediment could potentially result in risks above acceptable levels associated with arsenic and chromium. Chromium was the greatest contributor to risks; the risk associated with arsenic alone falls within acceptable risk levels. However, per USEPA and Navy guidance, the risk calculations for chromium are based on hexavalent chromium toxicity criteria. The use of hexavalent chromium toxicity information results in an overestimate of risks because hexavalent chromium is the more toxic form of chromium for human receptors and it likely

is not the form that is predominant in the local environment. Additionally, it should be noted that residential soil screening levels were conservatively used to screen the sediment data, and exposure to sediment would be much less than the exposure assumed for soil. Therefore, it is assumed there would not be unacceptable risks associated with exposure to the sediment by potential human receptors.

5.3.4 Surface Water Risk Screening

Table H-8**, Appendix H** presents the risk-based screening for surface water. As shown on Table H-8, **Appendix H**, there were no analytes detected in surface water at concentrations exceeding the screening levels. Therefore, exposure to surface water would not result in unacceptable human health risks, and no further evaluation of surface water is required.

5.3.5 Groundwater Risk Screening

The risk-based screening and risk ratio evaluation for groundwater data are presented in Tables H-9 through H-11 of **Appendix H**. As shown on Table H-9 **Appendix H**, one explosives residue (nitrobenzene) and three metals (arsenic, chromium, and cobalt) exceeded screening levels in the first step of the screening and were identified as COPCs for evaluation in Step 2. Based on Step 2 (Table H-10**, Appendix H)**, the one explosives residue and two of the metals (arsenic and chromium) were identified as COPCs. Step 3 (Table H-11, **Appendix H**) did not eliminate any of the Step 2 COPCs.

Chromium and arsenic are the main contributors to carcinogenic risk, and the only COPCs that contribute a carcinogenic risk equal to the target level of $5x10^{-5}$. In the absence of chromium speciation information, the USEPA Tap Water RSL for hexavalent chromium, the more toxic (and carcinogenic) form of chromium for human receptors, was used as the screening value for total chromium. The use of hexavalent chromium for comparison to total chromium is extremely conservative since the presence of trivalent chromium is strongly favored in natural waters because the concentrations of analytes known to reduce hexavalent chromium to trivalent chromium generally far outweigh the concentrations of the few analytes known to oxidize trivalent chromium to hexavalent chromium. Furthermore, once reduced, trivalent chromium is very stable in aquatic environments and highly unlikely to oxidize to hexavalent chromium. Thus, chromium in groundwater is more likely to be in its trivalent form than its hexavalent form (Fendorf and Zasoski, 1992; Milacic and Stupar, 1995; Weaver and Hochella, 2003).

The maximum detected concentration of total chromium in the groundwater is below the USEPA Tap Water RSL for trivalent chromium. Additionally, prior to including the New Jersey EPA oral cancer slope factor for hexavalent chromium in the table, the USEPA Tap Water RSL for hexavalent chromium was more than three orders of magnitude higher than the value in the current RSL table. In addition, there is some uncertainty associated with the hexavalent chromium oral cancer slope factor, and RSL, as the value is from New Jersey EPA and has not been included in EPA's Integrated Risk Information System (IRIS) database. Elimination of chromium as a COPC would result in the elimination of the other carcinogenic COPCs (nitrobenzene and arsenic) because the cumulative calculated risks associated with these two COPCs meet the target level of $5x10^{-5}$. The screening was performed assuming the groundwater is used as a potable water supply, and as discussed in the CSM in Section 5.1, it is unlikely that the shallow groundwater will be used as a

potable water supply. It is more likely that a construction worker would be exposed to the shallow groundwater in an open excavation during future construction activities. As a result, due to the overestimation of risk, there would be no unacceptable risks associated with exposure to the groundwater by a construction worker.

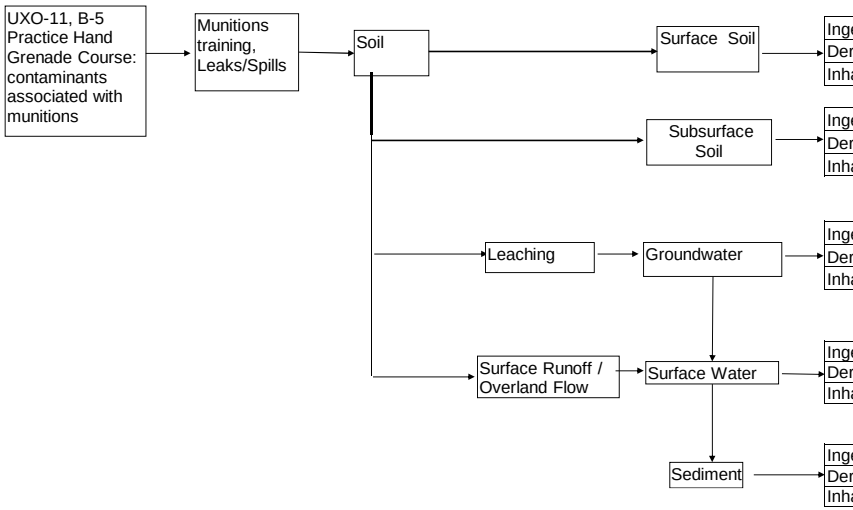
5.3.6 Non-detected Analytes

There were no non-detected analytes in surface soil with detection limits above the screening values. For subsurface soil and sediment, one of the non-detected analytes, nitroglycerin, had detection limits above the screening value; however, the detection limits were within an order of magnitude of the screening value, and below the unadjusted USEPA Residential Soil RSL. In surface water, there were two explosives residues and two metals with detection limits just slightly above the screening values. For groundwater, one metal had a detection limit above the screening value. Based on this evaluation, there are not expected to be any non-detected analytes present at the site that would result in unacceptable risks, or changes to the results of the HHRS evaluation.

5.4 Human Health Risk Screening Conclusion

The preliminary HHRS indicates that exposure to soil and surface water from Site UXO-11 would not result in any unacceptable risks to human health. The HHRS results also indicate that potential contact with sediment and potable use of groundwater by current and future receptors could result in carcinogenic risks above the target level (primarily associated with chromium). Sediment and groundwater were both evaluated using screening values for hexavalent chromium, the more toxic (and carcinogenic) form of chromium for human receptors, and assuming residential type exposures to both media. The sediment evaluation was limited to two samples and the Step 3 screening (risk ratio using 95% UCL exposure concentrations) was not performed. Additionally, the use of hexavalent chromium toxicity information and residential soil screening values representative of more intensive exposures results in a significant overestimate of risks for potential exposure to sediment. Therefore, it is concluded that no unacceptable risks would be associated with exposure to the sediment by potential current and future receptors.

If the shallow groundwater for the area were used as a residential potable water supply, there could be unacceptable risks associated with the chromium detected in groundwater. However, this is primarily associated with the assumption that all of the chromium detected in the groundwater is in the hexavalent form, which is unlikely, as discussed above. It should also be noted that the shallow groundwater is not currently used as a potable water supply at Site UXO-11 or MCB CamLej, and it is unlikely that it would be in the future. The more likely exposure scenario, exposure to the shallow groundwater by construction workers during excavation activities, is unlikely to result in any unacceptable risks. Because the exposure to groundwater for a construction worker is much lower than that for residential potable use, the risk to the construction worker would be within acceptable risk levels. Therefore, no further assessment of soil, sediment, surface water, or groundwater, based on human health risks, is necessary.



	Potential Human Receptors						
	Current/Future				Future		
Exposure Route	Industrial Worker	Maintenance Worker	Trespasser/Visitor Adult	Trespasser/Visitor Youth	Residential Adult	Residential Child	Construction Worker
Ingestion	X	X	X	X	X	X	X
Dermal Contact	X	X	X	X	X	X	X
Inhalation	X	X	X	X	X	X	X
Ingestion	X[1]	X[1]	X[1]	X[1]	X	X	X
Dermal Contact	X[1]	X[1]	X[1]	X[1]	X	X	X
Inhalation	X[1]	X[1]	X[1]	X[1]	X	X	X
Ingestion	NA	NA	NA	NA	X	X	NA
Dermal Contact	NA	NA	NA	NA	X	X	X
Inhalation	NA	NA	NA	NA	NA	NA	NA
Ingestion	NA	X	X	X	X	X	X
Dermal Contact	NA	X	X	X	X	X	X
Inhalation	NA	NA	NA	NA	NA	NA	NA
Ingestion	NA	X	X	X	X	X	X
Dermal Contact	NA	X	X	X	X	X	X
Inhalation	NA	NA	NA	NA	NA	NA	NA

[1]Current receptor populations may be exposed to surface soil. Future receptor populations may be exposed to surface and subsurface soil.
NA - Not Applicable or pathway is incomplete
X - Potentially complete exposure pathways

FIGURE 5-1
Conceptual Site Model for HHRS
Site UXO 11, Former B-5 Practice Hand Grenade Course
MCB Camp Lej, North Carolina

Generated by: Geanine Howard-Peebles Checked by: Roni Warren

SECTION 6

Ecological Risk Screening

6.1 Introduction

An ecological risk screening (ERS) was conducted for Site UXO-11. Results for analytes in surface soil, subsurface soil, sediment, surface water, and groundwater were screened against benchmarks intended to be protective of ecological receptors. All data considered in the screening process were collected in 2009.

6.2 Site Ecological Setting and Available Data

Site UXO-11 is predominantly mowed grasses with a small swale located along the southern border. Soil, sediment, surface water, and groundwater samples were collected at various locations throughout the Site.

A total of 12 surface soil samples were collected (plus 1 duplicate) from 0 to 2 inches bgs. Surface soil samples were analyzed for explosives residues and metals.

For subsurface soil, samples collected from 0 to 5 feet bgs were used for the ERS. A total of 5 samples (plus 1 duplicate) were analyzed for explosives residues and metals.

Co-located surface water and sediment samples were collected within the swale located in the southern area of the Site. Two surface water and sediment samples (plus one duplicate) were collected and analyzed for explosives residues and metals. Surface water samples were also analyzed for dissolved metals.

Data from five groundwater wells were available for screening (5 samples plus 1 duplicate). Groundwater samples were analyzed for explosives residues and metals. Dissolved metals data were available only from the well closest to surface water, TW01. Dissolved metals analysis for groundwater was only performed for samples from this well, since dissolved metals data in groundwater is used when performing an ecological risk assessment to determine the potential mobility of detected compounds through soil.

6.3 Screening Methodology

For each medium (surface soil, subsurface soil, sediment, surface water, and groundwater), the maximum and average concentrations are presented along with representative Ecological Screening Values (ESVs) intended to be protective of ecological receptors. HQs were calculated by dividing these statistics by the ESVs. It should be noted that ESVs for inorganic constituents in water are generally based on dissolved concentrations and comparing them to total metals concentrations is conservative and may over-represent risk.

For locations with multiple data points (i.e., a parent and duplicate sample were available), data were reduced to the value of the highest detected concentration or highest detection limit if there was no detection. Where average concentrations are reported, one-half of the

detection limit was used for nondetects as the representative concentration when determining the average.

For soil, the USEPA Ecological Soil Screening Levels (EcoSSL) (USEPA, 2009c) were preferentially selected over Region IV values (USEPA, 2001b). When no EcoSSL was available for a constituent, the Region 4 value was selected.

A selection hierarchy was also applied to surface water. The NRWQC was preferentially selected over the Region IV value (USEPA, 2009d). When no NRWQC was available for a constituent, the Region 4 value was selected as the ESV for that constituent. For surface water, freshwater screening values were selected for the analysis. For groundwater, it is uncertain if the receiving water body is marine or freshwater, so the lowest of freshwater and marine ESVs were selected.

For sediment, USEPA Region IV values (USEPA, 2001b) were used.

A base background study was conducted at MCB CamLej in June and July 2000 (Baker, 2001). As part of the ERS, two times the mean background concentrations in surface soil, subsurface soil, and groundwater were compared to site-specific media concentrations. Additional lines of evidence in the evaluation included the frequency of detection, frequency of exceedance, magnitude of exceedance, and identification of potential laboratory contaminants.

Calcium, magnesium, potassium, and sodium were evaluated but not considered as COPCs in the ERS. Each is considered a macronutrient (Whitehead, 2000).

6.4 Ecological Risk Screening Results

This section addresses analytes that were detected and had ESVs based on the selection hierarchy discussed in the previous section. Analytes not detected are not expected to pose a risk to ecological receptors.

6.4.1 Surface Soil

Five detected analytes had concentrations in excess of ESVs (aluminum, cadmium, iron, lead, and vanadium) (Table I-1, **Appendix I**). Iron and vanadium were consistent with MCB CamLej background concentrations. The maximum concentrations of aluminum and lead exceeded two times the mean background concentration but were within the background range for surface soils at MCB CamLej and are considered to be representative of background. Cadmium was detected and exceeded the ESV in 2 of the 12 samples. The two samples had low magnitudes of exceedance, and the mean HQ was less than 1.0. Therefore, cadmium is not expected to pose an unacceptable risk to ecological receptors because of the low magnitude of exceedance.

6.4.2 Subsurface Soil

Of the detected analytes, only aluminum, iron, and vanadium had concentrations in excess of the ESVs (Table I-2, **Appendix I**). However, the maximum concentrations for all three analytes did not exceed two times the mean base subsurface soil background values. Therefore, these analytes are not likely to pose an unacceptable risk to ecological receptors.

6.4.3 Sediment

Lead and zinc were the only detected analytes with concentrations in excess of the ESV (Table I-3, **Appendix I**). Zinc had a low magnitude of exceedance and a mean HQ of less than 1.0. The area where the surface water samples were collected is classified as a drainage swale and would not be considered aquatic habitat. The samples would be more appropriately classified as surface soil samples and compared to surface soil ESVs. Overall, lead concentrations in the surface soil onsite did not exceed the ESV. Lead concentrations are expected to be slightly higher in the drainage swale from runoff accumulation over time. Consequently, these concentrations are not expected to pose an unacceptable ecological risk.

6.4.4 Surface Water

For both total and dissolved inorganic constituents, cadmium was the only detected constituent with concentrations in excess of the ESV (Table I-4, **Appendix I**). For both results, cadmium had a low magnitude of exceedance, with HQs just barely above 1.0. As discussed in Section 6.4.3, the drainage swale where the samples were collected is not considered aquatic habitat. Concentrations of inorganic constituents in the drainage swale are not expected to pose an unacceptable risk to aquatic ecological receptors. Nitrobenzene was also detected, but at concentrations that did not exceed the ESV.

6.4.5 Groundwater

Of the total inorganic analytes detected, only aluminum, beryllium, cadmium, and iron had concentrations in excess of the freshwater ESVs (Table I-5, **Appendix I**). The maximum concentrations of aluminum and iron did not exceed two times the mean base background level. Beryllium had a low magnitude of exceedance, with an HQ just slightly greater than 1.0. Cadmium was not detected in the filtered sample, suggesting that cadmium is sorbed to sediments/suspended solids and not dissolved in surface water. Consequently, none of these analytes are expected to pose an unacceptable risk.

Of the dissolved metals detected, only aluminum and beryllium had concentrations exceeding the ESVs. As discussed for total metals, aluminum concentrations were within the background range and beryllium had a low magnitude of exceedance. Neither of these analytes is expected to pose an unacceptable risk to ecological receptors.

Nitrobenzene was also detected at concentrations that did not exceed the ESV.

6.5 Supplemental Evaluation

This section addresses analytes that were detected but did not have ESVs based on the selection hierarchy discussed above. Supplemental values were selected as available from the following reports: (1) Update to Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas (Texas Commission on Environmental Quality, 2006), (2) Validation of Environmental Military Threshold Values for Explosives in Soil (National Research Council Canada [NRCC], 2008), (3) Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota (Suter and Tsao, 1996), and other publications, as needed (see **Tables 6-1 through 6-3).** These comparisons are discussed along with other lines of evidence such as frequency of detection and relationship to the range of background concentrations.

6.5.1 Surface Soil

In surface soil, four explosives residues were detected that lack ESVs, including 2-amino-4,6-dinitrotoluene, nitroglycerin, RDX, and tetryl. Supplemental ESVs were identified for these analytes (Table I-1, **Appendix I**). The maximum concentrations of the five analytes were all below the supplemental screening values, and risk to ecological receptors is considered negligible.

6.5.2 Subsurface Soil

In subsurface soil, two explosives residues that lacked ESVs, RDX and perchlorate, were detected. Supplemental ESVs were identified for both analytes (Table I-2, **Appendix I**). A Callahan and Sprenger (1998) study identified an acute value for perchlorate. The acute value was divided by 100 to calculate the chronic value, which was used as the supplemental screening value in the analysis. The maximum concentrations of both analytes were less than the designated supplemental screening values, and risk to ecological receptors is considered negligible.

6.5.3 Sediment

In sediment, seven inorganic analytes that lacked ESVs were detected, including aluminum, barium, beryllium, cobalt, iron, manganese, and vanadium. Supplemental ESVs for aluminum, cobalt, iron, and manganese were identified. There were no exceedances of the supplemental values (Table I-3, **Appendix I**).

As previously discussed, the sediment samples were collected from a drainage swale that would not be considered aquatic habitat. Therefore, samples are more appropriately compared to surface soil background concentrations and ESVs. Barium concentrations in the sediment samples exceeded the MCB CamLej surface soil background data. However, the maximum concentration was less than the surface soil ESV for barium (330 mg/kg). The maximum concentrations of beryllium and vanadium in the sediment samples are within the range of MCB CamLej surface soil background data.

6.5.4 Surface Water

In surface water, two explosive and two inorganic analytes that lacked ESVs were detected: HMX, tetryl, barium, and manganese. Supplemental screening values were identified for these analytes (Table I-4, **Appendix I**). None of the maximum concentrations of the four analytes exceeded the supplemental ESVs.

6.5.5 Groundwater

In groundwater, nine explosive and four inorganic analytes that lacked ESVs were detected. Supplemental ESVs were identified for all the analytes (Table I-5, **Appendix I**). The maximum concentrations of all nine explosive and four inorganic analytes were below the designated supplemental ESVs and risk to ecological receptors is considered negligible.

6.6 Summary

Analytes detected at Site UXO 11 are not expected to pose an unacceptable risk to ecological receptors.

SECTION 7

Conclusions and Recommendations

This section provides the conclusions and recommendations based on the findings of this PA/SI.

7.1 Conclusions

7.1.1 Digital Geophysical Mapping

Following DGM protocol at MCB CamLej, approximately 11.5 percent of Site UXO-11 was surveyed yielding a total of 70 geophysical anomalies representing potential subsurface MEC. Intrusive investigation of the anomalies was not conducted during this phase of investigation and therefore the nature of the anomalies was not determined.

7.1.2 Environmental Investigation

The PA/SI involved collection of environmental media samples (i.e., surface soil, subsurface soil, sediment, surface water, and groundwater) from several locations within Site UXO-11. A summary of the detected target analytes is provided below.

Surface Soil

Four explosives residues (2-amino-4,6-dinitrotoluene, nitroglycerin, RDX, and tetryl) and 20 metals were detected in surface soil. Nitroglycerin, arsenic, and chromium were the only target analytes detected in surface soil that exceeded one or more of the regulatory screening criteria.

Subsurface Soil

Two explosives residues, perchlorate and RDX, and 18 metals were detected in subsurface soil. Four metals (aluminum, arsenic, chromium, and iron) were the only target analytes detected in subsurface soil that exceeded one or more of the regulatory screening criteria.

Sediment

Seventeen metals were detected in sediment. Three metals (aluminum, arsenic, and chromium) were the only target analytes that exceeded one or more of the regulatory screening criteria.

Surface Water

Three explosives residues (HMX, nitrobenzene, and tetryl), ten total metals, and nine dissolved metals were detected in surface water samples. None of the target analytes exceeded the regulatory screening criteria.

Groundwater

Ten explosives residues, 17 total metals, and ten dissolved metals were detected in groundwater samples. The explosives residue, nitrobenzene, and the three metals (arsenic, chromium, and cobalt) were the only target analtyes that exceeded one or more of the regulatory screening criteria.

7.1.3 Human Health and Ecological Risk Screening

Target analytes detected in sampled site media are not anticipated to pose unacceptable risks to human or ecological receptors.

7.2 Recommendations

Based on the DGM results, it is recommended that an intrusive investigation be performed to assess the nature of the identified geophysical anomalies. The need for additional sampling of MC will be re-evaluated based on the results of the intrusive anomaly investigation. Additional sampling is recommended to further evaluate the detections of MC and chromium in environmental media at the site.

SECTION 8

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Appendix A
MRSPP Site Summary Submittal to QA Panel

QA Panel Report

9/22/2010

Site Name:	UXO 000011 - NEW RIVER HAND GRENADE	**Site POC:**	CLELAND DAVID
Site Location:	CAMP LEJEUNE NC MCB	**Stakeholder Participation:**	No
Cognizant FEC:	MIDLANT	**Regulatory Participation:**	No
Last QA Date:		**Last QA MRS Priority:**	

Site Description:

MRP Site UXO-11—B-5, Practice Hand Grenade Course (ASR# 2.281). The 2 acre range located in Camp Geiger was reportedly used in 1953. The types of munitions employed at the site are unknown; however, it is assumed that practice hand grenades were used. The Draft PA/SI is complete and no MC contamination identified, geophysical anomalies are present and will be investigated.

Factors Affecting the Change in MRS Priority:

New data obtained through further study resulting in a revision to one or more subordinate MRSPP ratings that had previously been completed

Reason for Addressing the MRSP Site out of Sequence:

Not Out of Sequence

Summary

Overall MRS Priority:	5			**MRS Priority Source:**	EHE
EHE Priority:	5	**EHE Rating:**	D	**EHE Score:**	68
CHE Priority:	NH	**CHE Rating:**		**CHE Score:**	
HHE Priority:	EP	**HHE Rating:**		**HHE Priority Source:**	

EHE Priority:5 EHE Score: 68 EHE Rating: D

Explosive Hazard Factor Data Elements

Table 1
EHE Module: Munitions Type Data Element Table

Classification	Score
Sensitive;	30
Practice;	5
Munitions Type	**30**

Description:

Only practice hand grenades likely used. Assumed that hand grenades may have been used based on limited site history.

Table 2
EHE Module: Source of Hazard Data Element Table

Classification	Score
Former range;	10
Source of Hazard	**10**

Description:

N/A

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Accessibility Factor Data Elements

Table 3
EHE Module: Location of Munitions Data Element Table

Classification	Score
Suspected (historical evidence);	5
Location of Munitions	**5**

Description:

DGM conducted and 86 geophysical anomalies were identified.

Table 4
EHE Module: Ease of Access Data Element Table

Classification	Score
Barrier to MRS access is incomplete;	8
Ease of Access	**8**

Description:

Base is fenced but site is accessible within the Base boundary.

Table 5
EHE Module: Status of Property Data Element Table

Classification	Score
DoD control;	0
Status of Property	**0**

Description:

Base is fenced but site is accessible within the Base boundary.

Receptor Factor Data Elements

Table 6
EHE Module: Population Density Data Element Table

Classification	Score
> 500 persons per squire mile;	5
Population Density	**5**

Description:

The Base has an active duty, dependent, retiree, and civilian employee population of approximately 150,000 people. The density of the surrounding population is 196 persons per square mile within a 2-mile radius of the MRS boundary. Based on the 2008 census, the population of the City of Jacksonville is over 65,000 and Onslow County is over 165,000.

Table 7
EHE Module: Population Near Hazard Data Element Table

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Classification	Score
26 or more inhabited structures;	5
Population Near Hazard	**5**

Description:

No inhabited structures located within the MRS boundary. Approximately 2,500 structures are located within a 2 mile radius of the MRS boundary and at least 1,600 buildings oappear to be inhabited structures.

Table 8
EHE Module: Types of Activities/Structures Data Element Table

Classification	Score
Residental, educational, commercial, or subsistence;	5
Parks and recreational areas;	4
Agricultural, forestry;	3
Industrial or warehousing;	2
Types of Activities/Structures	**5**

Description:

N/A

Table 9
EHE Module: Ecological and/or Cultural Resources Data Element Table

Classification	Score
No known or recurring activities;	0
Ecological and/or Cultural Resources	**0**

Description:

N/A

CHE Priority: NH CHE Score: CHE Rating:

CWM Hazard Factor Data Elements

Table 11
CHE Module: CWM Configuration Data Element Table

Classification	Score
Evidence of no CWM;	0
CWM Configuration	**0**

Description:

No evidence of CWM.

Table 12
CHE Module: Sources of CWM Data Element Table

Classification	Score

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Evidence of no CWM;	0
CWM Configuration	**0**

Description:

No evidence of CWM.

Accessibility Factor Data Elements

Table 13
CHE Module: Location of CWM Data Element Table

Classification	Score
Evidence of no CWM;	0
Location of CWM	**0**

Description:

No evidence of CWM.

Table 14
CHE Module: Ease of Access Data Element Table

Classification	Score
Barrier to MRS access is incomplete;	8
Ease of Access	**8**

Description:

Base is fenced but site is accessible within the Base boundary.

Table 15
CHE Module: Status of Property Data Element Table

Classification	Score
DoD control;	0
Status of Property	**0**

Description:

Base is fenced but site is accessible within the Base boundary.

Receptor Factor Data Elements

Table 16
CHE Module: Population Density Data Element Table

Classification	Score
> 500 persons per squire mile;	5
Population Density	**5**

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Description:

The Base has an active duty, dependent, retiree, and civilian employee population of approximately 150,000 people. The density of the surrounding population is 196 persons per square mile within a 2-mile radius of the MRS boundary. Based on the 2008 census, the population of the City of Jacksonville is over 65,000 and Onslow County is over 165,000.

Table 17
CHE Module: Population Near Hazard Data Element Table

Classification	Score
26 or more inhabited structures;	5
Population Near Hazard	**5**

Description:

No inhabited structures located within the MRS boundary. Approximately 2,500 structures are located within a 2 mile radius of the MRS boundary and at least 1,600 buildings oappear to be inhabited structures.

Table 18
CHE Module: Types of Activities/Structures Data Element Table

Classification	Score
Residental, educational, commercial, or subsistence;	5
Parks and recreational areas;	4
Agricultural, forestry;	3
Industrial or warehousing;	2
Types of Activities/Structure	**5**

Description:

N/A

Table 19
CHE Module: Ecological and/or Cultural Resources Data Element Table

Classification	Score
No known or recurring activities;	0
Ecological and/or Cultural Resources	**0**

Description:

N/A

HHE Priority: EP HHE Rating: HHE Source:

Health Hazard Priority: EP

Receptor Description: Evaluation pending. Environmental media sampling and risk screenings were conducted during PA/SI and no unacceptable risks identified. Data will be loaded to the model in November 2010.

Pathway Description: Evaluation pending. Environmental media sampling and risk screenings were conducted during PA/SI and no unacceptable risks identified. Data will be loaded to the model in November 2010.

Groundwater

ActiveReports Evaluation. Copyright 2002-2003 (c) Data Dynamics, Ltd. All Rights Reserved.

CHF: 0 **MPF:** **RF:**

Rating: N/A **Priority:** EP

Migration Pathway Factor Desc:

N/A

Receptor Factor Desc:

N/A

Surface Water Human

CHF: 0 **MPF:** **RF:**

Rating: N/A **Priority:** EP

Migration Pathway Factor Desc:

N/A

Receptor Factor Desc:

N/A

Sediment Human

CHF: 0 **MPF:** **RF:**

Rating: N/A **Priority:** EP

Migration Pathway Factor Desc:

N/A

Receptor Factor Desc:

N/A

Surface Water Eco

CHF: 0 **MPF:** **RF:**

Rating: N/A **Priority:** EP

Migration Pathway Factor Desc:

N/A

Receptor Factor Desc:

N/A

Sediment Eco

CHF: 0 **MPF:** **RF:**

ActiveReports Evaluation. Copyright 2002-2003 (c) Data Dynamics, Ltd. All Rights Reserved.

Rating: N/A **Priority:** EP

Migration Pathway Factor Desc:

N/A

Receptor Factor Desc:

N/A

Soil

CHF: 0 **MPF:** **RF:**

Rating: N/A **Priority:** EP

Migration Pathway Factor Desc:

N/A

Receptor Factor Desc:

N/A

ActiveReports Evaluation. Copyright 2002-2003 (c) Data Dynamics, Ltd. All Rights Reserved.

Appendix B
Archival Records Search Report

Final

Archival Records Search Report for the Preliminary Assessment/Site Inspection of Site UXO-11, B-5 Practice Hand Grenade Course (ASR #2.81)

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Contract Task Order 0014

September 2010

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Under the

NAVFAC CLEAN 1000 Program
Contract N62470-08-D-1000

Prepared by

CH2MHILL

Raleigh, North Carolina

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2-1 Site UXO-11 Range Overlay Map – 1954

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2-3 Site UXO-11 Historical Aerial – 1962

2-4 Site UXO-11 Historical Aerial – 1984

Attachments

1 Resource Review Summary

2 Historical Aerial Photographs

Acronyms and Abbreviations

ASR	Archive Search Report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CTO	Contract Task Order
°F	degrees Fahrenheit
DGM	digital geophysical mapping
ft	feet/foot
HTW	hazardous and toxic waste
MC	munitions constituents
MCB	Marine Corps Base
MEC	munitions and explosives of concern
MRP	Munitions Response Program
NARA	National Archives and Records Administration
NAVFAC	Naval Facilities Engineering Command
PA/SI	Preliminary Assessment/Site Inspection
U.S.	United States
UXO	unexploded ordnance
WW II	World War II

SECTION 1

Introduction, Purpose, and Scope

The United States Marine Corps and Naval Facilities Engineering Command (NAVFAC) are in the process of investigating closed ranges at Marine Corps Base (MCB) Camp Lejeune following the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) investigation process. A munitions response program (MRP) Preliminary Assessment/Site Inspection (PA/SI) included under Contract Task Order (CTO)-0014 will be conducted at Site Unexploded Ordnance (UXO)-11, B-5 Practice Hand Grenade Course Archive Search Report (ASR) #2.81 in order to accomplish the following objectives:

- Identify historical activities at Site UXO-11 that may have resulted in environmental contamination with munitions and explosives of concern (MEC) or munitions constituents (MC).
- Evaluate the presence and nature of any MC contamination and/or hazardous and toxic waste (HTW) that may exist at Site UXO-11.
- Conduct ecological and human health risk screenings on analytical data collected at Site UXO-11.
- Estimate the number and density of geophysical anomalies that may represent subsurface MEC by conducting digital geophysical mapping (DGM) within representative portions of the site.

The results of the environmental investigation will determine if any impacts to soil and groundwater have occurred at Site UXO-11 due to past range activities. To support site investigation effort, this Archival Records Search Report has been prepared to provide a narrative of the historical activities at Site UXO-11 that may have resulted in environmental contamination with MEC.

Figure 1-1 shows the site in relation to the entire base.

The Archival Records Search Report is an investigative review of existing information about the site and its surrounding area, with an emphasis on obtaining information from personnel and historical resources that might indicate a potentially hazardous release to the environment. The scope of the report includes:

- A review of existing information about the site (including MCB Camp Lejeune maps, drawings, reports, and interviews with MCB Camp Lejeune personnel)
- Collection of additional information about the site

A complete listing of resources identified and investigated for this report is provided in **Attachment 1**. **Attachment 1** also includes details concerning the reviews of the historical information from the Alfred M. Gray Research Center at MCB Quantico, National Archives and Records Administration (NARA) map and text files, and MCB Camp Lejeune base files. **Attachment 2** contains photographs obtained during the research activities.

\\aphrodite\proj\USNavFacEngCom\CampLejeune\MapFiles\UXO_WP_Addendum\Figure_1_1_MRP_Site_UXO-11_Site_Map.mxd

Legend

Site UXO-11 Boundary

Installation Boundary

N

0 100 200 400 Feet

1 inch equals 200 feet

Figure 1-1
Site UXO-11
Site Location Map
MCB Camp Lejeune
North Carolina

CH2MHILL

SECTION 2

Site Information

2.1 Facility Information

MCB Camp Lejeune is located on the Atlantic coast in Jacksonville, North Carolina. The city of Jacksonville in Onslow County is the principal support community for the base. MCB Camp Lejeune occupies 153,000 acres including more than 450 miles of roads, approximately 6,800 buildings and facilities, and 14 miles of beach on the Atlantic Ocean for amphibious training. Approximately 14,000 acres of land have been developed for administrative, maintenance, logistics and personnel support facilities. Originally established in 1941, the base is home to several tenant commands including II Marine Expeditionary Force, 2nd Marine Division, and 2nd Marine Logistics Group, two Navy commands, one Coast Guard command, and several Marine Corps formal schools. MCB Camp Lejeune supports a total population of approximately 150,000 people, including active duty military and dependants, retirees, and civilian employees (Global Security, 2008).

2.2 Ownership and Operational History

2.2.1 Camp Lejeune Ownership History

The history of the land now occupied by MCB Camp Lejeune is documented primarily through land records and maps. Following the start of World War II (WW II), the War Department began purchasing tracts of land in 1941 from local residents to meet the need for an East Coast amphibious training facility. Prior to occupation by the Marine Corps, the land had been occupied by white and African-American communities and farms since the Colonial era. The land contained plantation houses, cabins, farm buildings, tobacco barns, stores, and various cemeteries (Global Security, 2008).

The initial land transferred to the government was acquired in 14 different transactions between April and October 1941 and totaled 173.8 square miles or 111,155 acres, of which there were 85,155 land acres and about 26,000 acres under water (Loftfield, 1981; Louis Berger Group, 2002). The individual tracts of land were grouped into various ”areas” for consolidation.

2.2.2 Site UXO-11 Practice Hand Grenade Course ASR #2.81

Site UXO-11 is approximately two acres in size and is identified in the *Range Identification and Preliminary Range Assessment* as ASR #2.81. The site is located just north of 6th Street and east of 7th Street at the New River Air Station. Presently, Site UXO-11 is primarily free of dense vegetation (**Figure 1-1**).

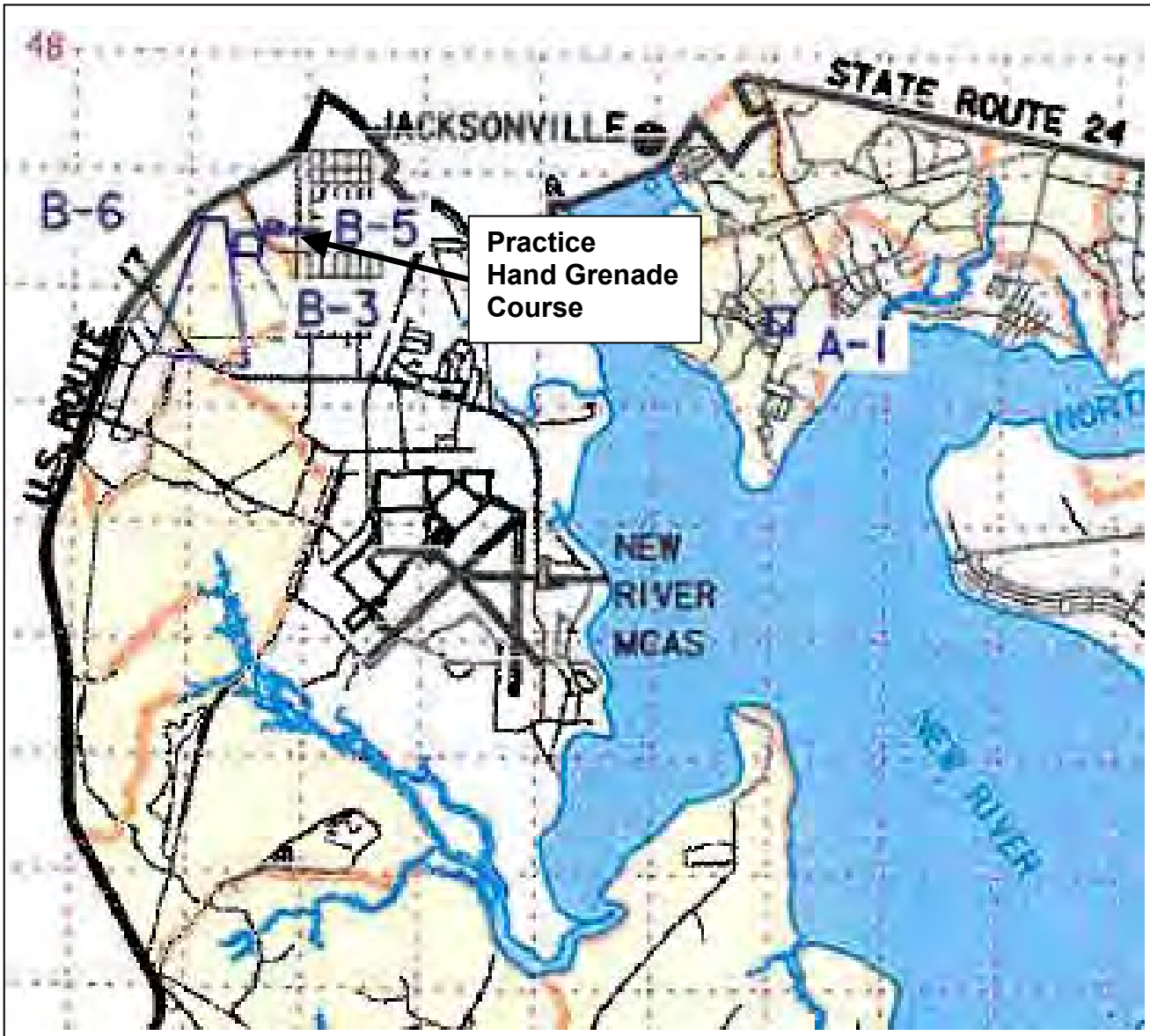
The B-5 Practice Hand Grenade Course appears on the June 30, 1954 range overlay map, Plate 8 in the *Range Identification and Preliminary Range Assessment* (USACE, 2000; **Figure 2-1**) and is located at 34°44′08″ N and 77°27′38″ W or military grid 7472 4653. This document

also references a map from September 1, 1953, and states that while the range appeared on the 1954 range overlay map, its actual time frame of use was 1953 only. The general types of munitions used in this area are unknown, although it is assumed that they were practice hand grenades based on the name of the range.

Existing conditions maps indicate that there was a mockup (Building 507), presumably used for training exercises, in the area of Site UXO-11 from 1947 until 1953, when 6th Street and 7th Street were extended to a traffic circle and connected to U.S. Route 17. Building 505 is a school building that is outside of the boundaries of Site UXO-11. **Figure 2-2** shows the 1947 and 1953 existing conditions maps for the Site UXO-11 area. Building 507 does not appear on any maps after 1953.

Aerial photographs from 1946, 1948, and 1951 indicate that the area for Site UXO-11 is a cleared field with the mock-up (Building 507) clearly visible in the location shown on the existing conditions maps. See **Attachment 2** for historic aerial photos.

Additional aerials of the site from 1962 (**Figure 2-3**) and 1989 (**Figure 2-4**) indicate that Site UXO-11 is cleared of heavy vegetation and trees and resembles its present-day condition. In the 1962 aerial a possible dirt road leads to the site and are present in the immediate area of Site UXO-11.



0 1500 3000

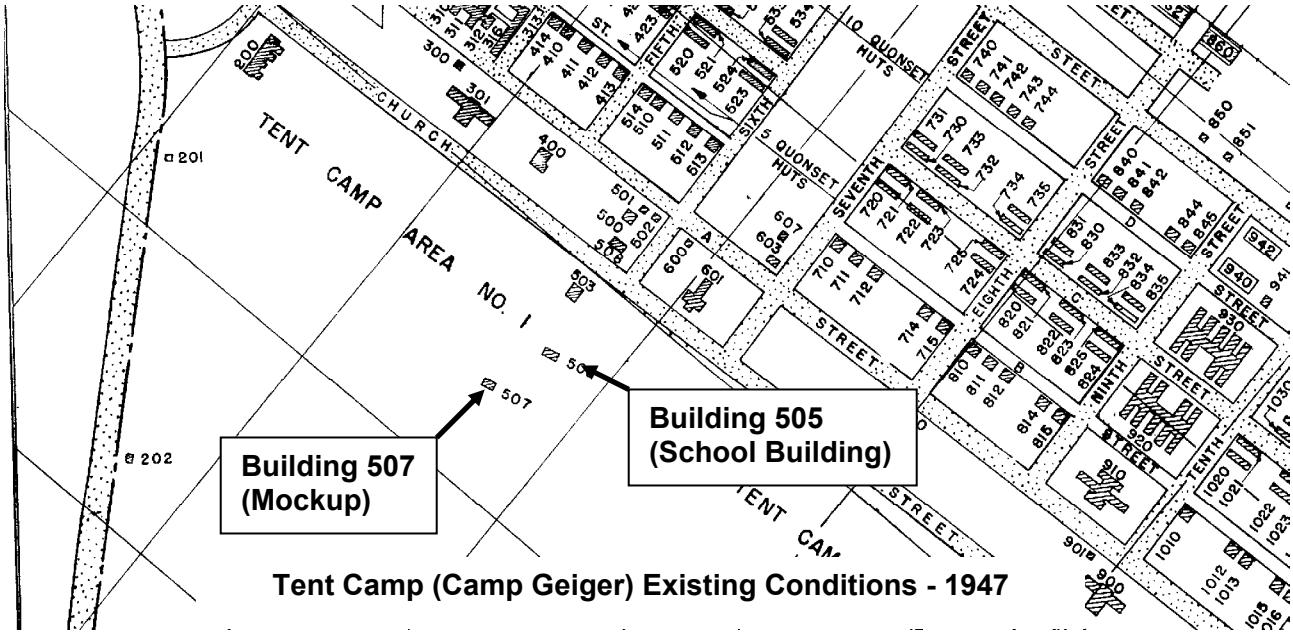
Approximate scale in Meters

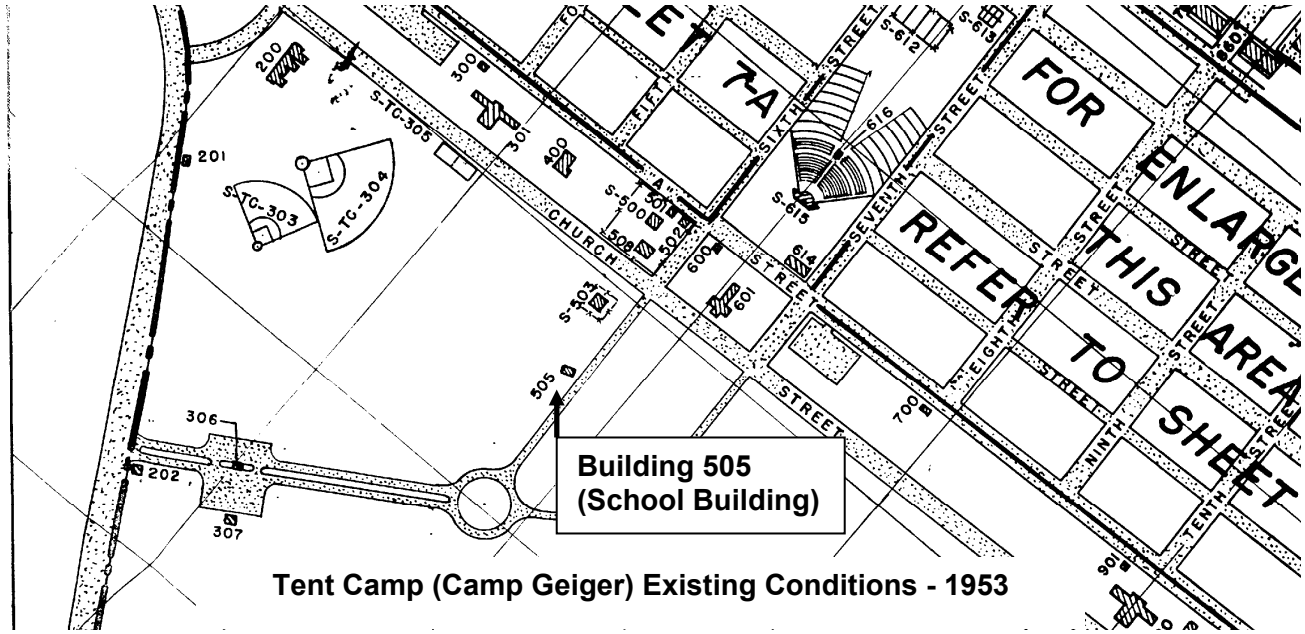
N

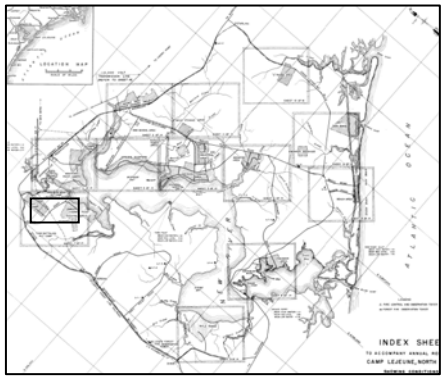
Figure 2-1
Sites UXO-11
Range Overlay Map - 1954
MCB Camp Lejeune
North Carolina

CH2MHILL

Source: USACE, 2000







0 1000 2000

Approximate Scale in Feet

N

Figure 2-2
Site UXO-11
Existing Conditions – 1947, 1953
MCB Camp Lejeune
North Carolina

CH2MHILL

Sources:
MCB Camp Lejeune, 1947
MCB Camp Lejeune, 1953

\\aphrodite\projects\USNavFaceNGCom\CampLejeune\Mapfiles\CTO-0014\ASR\Figure 2-18 Site UXO-11 and 12 1962.mxd

Legend
- Sites UXO-11 and UXO-12
- Installation Boundary

N

0 100 200 400 Feet

1 inch equals 200 feet

Figure 2-3
Site UXO-11 and UXO-12
Historical Aerial – 1962
MCB Camp Lejeune
North Carolina

CH2MHILL

\\aphrodite\projects\USNavFaceNGCom\CampLejeune\Mapfiles\CTO-0014\ASR\Figure 2-19 Site_UXO_11_and_12_1989.mxd

Legend
Sites UXO-11 and UXO-12
Installation Boundary

N

0 100 200 400 Feet

1 inch equals 200 feet

Figure 2-4
Site UXO-11 and UXO-12
Historical Aerial – 1989
MCB Camp Lejeune
North Carolina

CH2MHILL

SECTION 3

References

Cardinell, A.P, S. A Berg, and O. B. Lloyd, Jr. 1993. *Hydrogeologic Framework of U.S. Marine Corps Base at Camp Lejeune, North Carolina*. U.S. Geological Survey: Water Resources Investigations Report 93-4049.

Global Security. 2008. *Camp Lejeune.* Available online: http://www.globalsecurity.org/military/facility/camp-lejeune.htm. Accessed August 27.

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Harned, D. A., O. B. Lloyd, Jr., and M. W. Treece, Jr. 1989. *Assessment of Hydrologic and Hydrogeologic Data at Camp Lejeune Marine Corps Base, North Carolina*. U.S. Geological Survey Water-Resources Investigation Report 89-4096, 64p.

Loftfield, Thomas C., Principal Investigator. 1981. *Archeological and Historical Survey of USMC Base, Camp Lejeune*. Naval Facilities Engineering Command Norfolk, Coastal Zone Resource Corp, Vol. II. Contract # N62470-79-C-4273. University of North Carolina, Wilmington. August.

Louis Berger Group, Inc. 2002. *Semper Fidelis: A Brief History of Onslow County, North Carolina and MCB, Camp Lejeune, 2002, U.S.M.C.* LtCol Lynn J. Kimball (USMC Retired) USACE Wilmington District Contract DACWS4-99-C-0004.

United States Army Corps of Engineers (USACE). 2000. *Final Range Identification and Preliminary Range Assessment, Marine Corps Base Camp Lejeune, Onslow, North Carolina.* St. Louis District. February.

Water and Air Research. 1983. Water and Air Research, Inc. *Initial Assessment Study of Marine Corps Base, Camp Lejeune. North Carolina*. Prepared for Naval Energy and Environmental Support Activity.

Winner, M. and R. Coble. 1989. *Hydrogeologic Framework of the North Carolina Coastal Plain Aquifer System*. U.S. Geological Survey Open File Report 87-690.

Attachment 1
Resource Review Summary

Resource Review Summary

The following table provides a summary of the specific references identified for review, interview, or contact for the archival report.

Resource	Actions Completed
Quantico, Virginia, Marine Corp History Division, Historical Research Branch (Kara Newcomer and Lena Kaljot)	Reviewed all available file folders related to Camp Lejeune and copied relevant reports and figures/maps (August 19, 2008)
Quantico, Virginia, Marine Corp Library Gray Research Center (Greg Cina)	Reviewed all maps related to Camp Lejeune and copied relevant maps (August 19, 2008)
US National Archives (NARA II) Historical Files	Reviewed text and drawing files from Text and Cartographic Divisions (August 20-22, 2008)
Camp Lejeune Personnel	
Andrew Smith, Environmental Management Division	Contacted and interviewed (August 21, 2008)
Dennis Dunham and Jerry Jordan (intern), Public Works Technical Records	Contacted and interviewed (August 15 and August 21, 2008)
Julie Rowe, MCB Camp Lejeune Archivist	Contacted and phone interviewed (August 21, 2008)
Duane Richardson, Base Range Safety Officer	Contacted and interviewed (August 15, August 21 and September 12, 2008)

A.1 Marine Corp Library Review

History Division: Text

Contact: Kara Newcomer
Historian, Historical Reference Branch
Quantico, Virginia
(703) 432-4872 DSN 378
kara.newcomer@usmc.mil
Site Visit: August 19, 2008

File review at Marine Corps Base, Quantico, VA, Historical Reference Branch.

Files found under **Posts and Stations: N.C., Camp Lejeune** included Activities, Guides and Base Litter, History, Maps, Administrative Papers, Linage and Honors, Acquisition and Jurisdiction and Health Survey 2000.

Copied:

1. Training Areas and Facilities. February 16, 1953. Relevant site information and maps of ranges.

2. Camp Lejeune, North Carolina. February 10, 1942. Map of area.
3. Camp Lejeune: Early History. June 1942. Discusses "Miscellaneous Marine Corps Training."
4. Brief History of Camp Lejeune, North Carolina. August 15, 1954
5. Commandant Letter dated August 25, 1951 – Subject – "Twelve quartermaster warehouses for Camp Lejeune, North Carolina; further justification for."
6. Camp Lejeune General Map. Date unknown. Map of area.

History Division: Photographic Division

Contact: Lena Kaljot
Photo Historian, Historical Reference Branch
Quantico, Virginia
(703) 432-4873 DSN 378
Lena.kaljot@usmc.mil
Site Visit: August 19, 2008

Photo review at Marine Corps Base, Quantico, VA, Historical Reference Branch.

Photo files found under **Lejeune** included Administrative Buildings, Aerial Views:1940s, Aerial Views: 1950-1960, Aerial Views: undated, Aerial Views:1948, Chapels, Ice Cream Plant, Lumber, Medical, Misc., Mess Hall; Housing, Recreation, Public Works, Storage, Training and Utilities.

Copied:

1. Aerial Photos: Camp Lejeune, NC. Various angles. May 6, 1948.
2. Aerial Photos: Tent Camp, Camp Lejeune. Various angles. June 1946.
3. Aerial Photos: Tent Camp, Camp Lejeune. Various angles. September and December 1948.
4. Aerial Photo: Tent Camp, Camp Lejeune. September 1951.
5. Aerial Photos: Division Training Area, Camp Lejeune. Looking West. September 1948.
6. Aerial Photo: Division Training Area, Camp Lejeune. Looking East. December 23, 1948.
7. Aerial Photo: Magazine Area, Camp Lejeune, NC. Looking South. September 17, 1948.
8. Aerial Photo: Officers Quarters, Camp Lejeune. October 13, 1948.
9. Aerial Photo: Officers Housing Area, Camp Lejeune, NC. September 14, 1951.
10. Aerial Photo: Montford Point, Camp Lejeune, NC. September 22, 1948.
11. Aerial Photo: Camp Knox Area, Camp Lejeune. Looking North. September 22, 1948.
12. Aerial Photo: Rifle Range Area, Camp Lejeune. Various angles. September 17, 1948.
13. Aerial Photo: Rifle Range Area, Camp Lejeune, NC. September 14, 1951.
14. Aerial Photo: Airfield, Camp Lejeune, NC. September 16, 1948.
15. Aerial Photo: New River Administration Building and Circle, Camp Lejeune. August 22, 1944.
16. Aerial Photo: MCAAF Camp Lejeune, NC. October 30, 1947.
17. Aerial Photo: USMCAF, Camp Lejeune, NC. November 5, 1951.
18. Aerial Photo: Peter Point Field, MCAAF, Camp Lejeune, NC. April, 13, 1948.
19. Aerial Photo: Peter Point Field, Camp Lejeune, NC: Building No. PP-106.
20. Seven Aerial Photos of "Unknown dates and locations".

Achieve and Special Collections: Maps

Contact: Greg Cina
Archivist, Achieves and Special Collections
Quantico, Virginia
(703) 784-4685
cinagl@grc.usmc.edu
Site Visit: August 19, 2008

Map review at Marine Corps Base, Quantico, VA, Achieves and Special Collections in Gray Research Center.

Maps were the only items in the collection pertaining to Camp Lejeune. Reviewed 12-15 maps all pertaining to Camp Lejeune through time.

Copied:

1. Topographical Map: Sneads Ferry, N.C. 1971.
2. Topographical Map: New River Inlet, N.C. 1971
3. Topographical Map: New River N.C. 1972
4. Topographical Map: Approaches to the New River. 1956

A.2 National Archives and Records Administration Review

Text Division

Site visit: August 20-22, 2008

Below are the topics and boxes of files reviewed in association with the Marine Corps.

Record Group 127 (USMC), Records of the USMC, Offices of the Commandant, General Correspondence, January 1939-1950. USMC Excercises, 1960-1983. 170A/54/07, Boxes 1-2.

Record Group 127 (USMC), Records of the USMC, Offices of the Commandant, General Correspondence, January 1939-1950. Record of Training Exercise and Maneuvers, 1941-1950. 370/23/22 Boxes 5-15.

Record Ground 127 (USMC), Records of the USMC, Offices of the Commandant, General Correspondence, January 1939-1950. Division of Public Information, General Correspondence, 1942-1950. 370/23/18 Box 1.

Record Group 127 (USMC), Records of the USMC, Offices of the Commandant, General Correspondence, January 1939-1950. Command Chronologies, 2nd Marine Regiment, 1965-1979.

Record Group 127 (USMC), Records of the USMC, Offices of the Commandant, General Correspondence, January 1939-1950. Command Chronologies, 2nd Marine Regiment, 1st Marine Battalion, 2nd Marine Battalion, 3rd Marine Battalion, 1965-1972.

Record Group 127 (USMC), Records of the USMC, Offices of the Commandant, General Correspondence, January 1939-1950. Record of Field Organizations: 2nd Marine Division Regimental Orders and Other Issuance, 1951-1953. Boxes 1-11.

Record Group 127 (USMC), Records of the USMC, Offices of the Commandant, General Correspondence, January 1939-1950. Record of Field Organizations: 2nd Marine Division, 10th Marine Regiment, 6th Marine Regiment and 8th Marine Regiment, 1960-1983. Boxes 1-11.

Record Group 127 (USMC), Records of the USMC, Offices of the Commandant, General Correspondence, January 1939-1950. Ordnance, 1939-1950, Box 501.

Record Group 127 (USMC), Records of the USMC, Offices of the Commandant, General Correspondence, January 1939-1950. Infantry Weapons, 1945, Box 508.

Record Group 127 (USMC), Records of the USMC, Offices of the Commandant, General Correspondence, January 1939-1950. Geography, Boxes 885-886.

Record Group 127 (USMC), Records of the USMC, Offices of the Commandant, General Correspondence, January 1939-1950. Experiments, Grenades, and Explosives, Box 1206.

Record Group 127 (USMC), Records of the USMC, Offices of the Commandant, General Correspondence, January 1939-1950. SOPs, Boxes 1158-1159.

Record Group 127 (USMC), Records of the USMC, Offices of the Commandant, General Correspondence, January 1939-1950. Pistols, Box 1237.

Record Group 127 (USMC), Records of the USMC, Offices of the Commandant, General Correspondence, January 1939-1950. Training Bullitins-1943, Box 1437.

Record Group 127 (USMC), Records of the USMC, Offices of the Commandant, General Correspondence, January 1939-1950. Reports. Boxes 1470-1476.

Record Group 127 (USMC), Records of the USMC, Offices of the Commandant, General Correspondence, January 1939-1950. Ranges. Box 1990.

Record Group 127 (USMC), Records of the USMC, Offices of the Commandant, General Correspondence, January 1939-1950. Practice/Teams Pistols. Boxes 1994-1995.

Record Group 127 (USMC), Records of the USMC, Offices of the Commandant, General Correspondence, January 1939-1950. Marine Corps Communications. Boxes 1059-1064.

Record Group 127 (USMC), Records of the USMC, Offices of the Commandant, General Correspondence, January 1939-1950. Co. Drills and Instructions. Boxes 1076-1082.

The boxes contained information primarily related to weapons test results, weapons cost distribution, weapons training classes, weapon specifications, and cleaning and maintenance. The material was not specific to Camp Lejeune and included information for several MC bases.

Record Group 127 (USMC), Camp Lejeune, Command Chronologies, 1965-1979, Boxes 690-698.

List of Documents Obtained from National Archives

1. "Memorandum for the Personnel Division." June 6, 1942.
2. "Modification No. 2 to General Order Number 163: Training Facilities and Regulations Governing the Use of." October 11, 1942.
3. "Memorandum to the Quartermaster: Fuel Thickener (Napalm) for Flame Thrower H1A1." January 5, 1944.
4. "Marine Corps Training Bulletin: Use of Chlorine in Training" January 19, 1944.
5. Commandant Letter dated May 13, 1944 – Subject – "Chemical Warfare Class"
6. Commandant Letter dated May 19, 1944 – Subject – "Chemical Warfare Instruction"
7. Commandant Letter dated May 30, 1944 – Subject – "Chemical Warfare Class"
8. Commandant Letter dated July 7, 1944 – Subject – "Requirement Factors for Flame Thrower Fuels"
9. "Administrative Command Training Memorandum Number 5-44: Chemical Warfare." July 14, 1944.
10. Commandant Letter dated August 12, 1944 – Subject – "Chemical Warfare Training"
11. Commandant Letter dated September 6, 1944 – Subject – "Chemical Warfare Training"
12. Commandant Letter dated September 19, 1944 – Subject – "Distribution of Chemical Warfare Letter"
13. Commandant Letter dated December 2, 1944 – Subject – "Compressed Gases"
14. Commandant Letter dated December 15, 1944 – Subject – "Flame Thrower Expendable Supplies, requirement factors for."
15. "Marine Barracks Camp Lejeune Annual Report, North Carolina, Naval District Five." October 1, 1946.
16. "Camp General Order Number 163: Training Facilities and Regulations Governing the Use of." August 17, 1949.
17. "Lesson Plans for Training of the Organized Reserves" June –September 1950.
18. "Regimental General Order Number 39: Defense against Chemical and Radiological Warfare." August 28, 1951.
19. "Regimental Training Order Number 157-52: Training Schedule 4.2 Mortar Co, 16-21 June 1952." June 10, 1952.
20. "Regimental Training Order Number 180-52: Training Program 1 July to 30 September. 1952." June 30, 1952.
21. "Regimental Training Order Number 241-52: Training Program 1 October to 31 December 1952." September 29, 1952.

22. "Regimental Training Order Number 259-52: Preliminary Marksmanship Training Schedule for 6th Marines and attached Division Units from 4 to 11 October 1952." October 3, 1952.

23. "Regimental Training Order Number 9-53: Training Program 6 July-3 October 53" June 24, 1953.

24. "Change No.2 to Regimental Training Order Number 8-53: Training Facilities, Maneuver Areas and Firing Ranges" August 20, 1953.

25. "Regimental General Order 92: Interior Guard" October 20, 1953.

Cartographic Division

Site visit: August 22, 2008

Information for Camp Lejeune is located under Record Group (RG) 71-Bureau of Yards and Docks. The index for locating cartographic materials is then grouped by subject codes. The only available drawing for Camp Lejeune was for Subject Area 19- Water Systems, which contained no relevant materials. Subject Areas 44 is Rifle ranges, machine gun ranges, sighting ranges, bombing targets; however, no materials were located under this Subject Area.

A.3 MCB Camp Lejeune Base Records Review

Contact: Andrew Smith
Environmental Engineer, Environmental Management Division
Marine Corps Base, Camp Lejeune
(910) 451-9017
stephen.a.smith2@usmc.mil

Andrew provided electronic color copies of the RI/PRA Range Overlay Maps. Also suggested looking in documents that CH2M HILL has access to, including:

- US Army Corps of Engineers (USACE), St. Louis District. 2000. *Final Range Identification and Preliminary Range Assessment,* Marine Corps Base Camp Lejeune, Onslow, North Carolina, February.
- US Army Corps of Engineers (USACE), St. Louis District. 2001. *Archives Search Report for the Final Range Identification and Preliminary Range Assessment,* Marine Corps Base Camp Lejeune, Onslow, North Carolina, December.
- Water and Air Research. 1983. Water and Air Research, Inc. *Initial Assessment Study of Marine Corps Base, Camp Lejeune. North Carolina*. Prepared for Naval Energy and Environmental Support Activity.

Contact: Duane Richardson
Base Range Safety Officer
Marine Corps Base, Camp Lejeune
(910)451-1240
Duane.richardson@usmc.mil

Per email and phone conversations Duane described the areas as follows:

"Site UXO 11 ASR Area 2.81: same comments as above ASR 2.77. It was very common to have a practice hand grenade ranges close to where the Marines lived to make it easy to conduct training. Should not be any live ordanance/UXO in this area, it is in the present built up area of main side so I am sure the dirt berms, surrounding areas have been leveled out. Practice hand grenades had a small fuze (noise maker) and the steel body that was re-useable."

Contact: Dennis Dunham
Technical Records, Public Works Office
Marine Corps Base, Camp Lejeune
(910) 451-2818 ext 273

Per phone and e-mail conversations provided existing conditions maps. All maps and plans have been converted to electronic files and Dennis is happy to look up any information needed on builds and any civil work, sewage, electrical, etc.

Existing conditions for the all available areas of the base were provided for the following years:

1943, 1946 through 1960, 1963, 1966, 1985 and 2005.

Contact: Julie Rowe
Archivist, Combat Camera
Marine Corps Base, Camp Lejeune
(910) 451-1238

The archivist position at Camp Lejeune was create about a year ago and is still in development. Currently the office holds photos and oral histories of the main area of Camp Lejeune and the collection is growing. Julie did not have any information related to historical use of range areas.

Documents Reviewed at the Base Library

Site Visit: August 20 and 21, 2008

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   5 Pages from "Doc. No: CLEJ-00648-01.02-02/20/81" (Related to site 69)

   5 Pages from "Doc. No: CLEJ-00226-1.02-01/01/01" (Related to site 69)

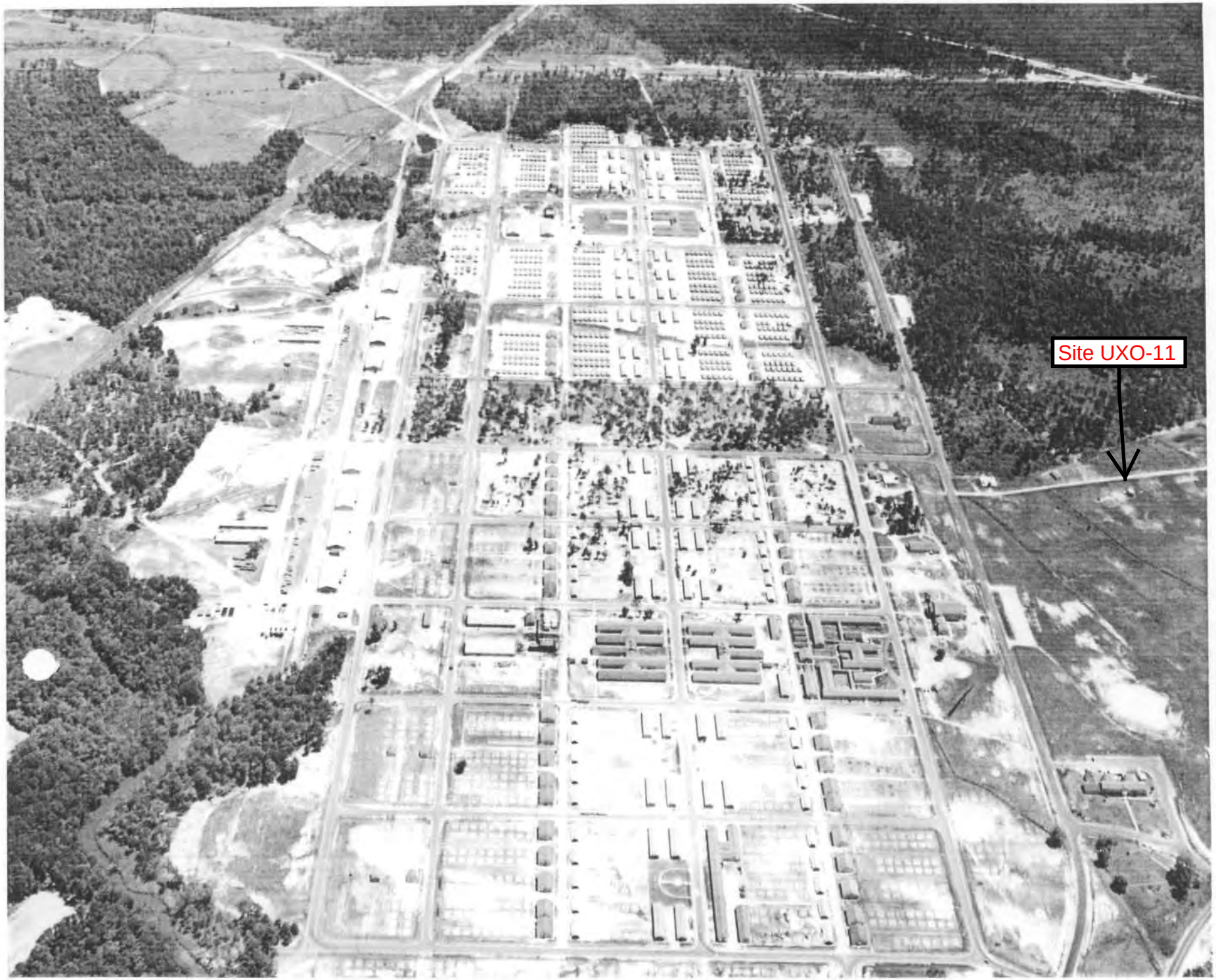
   1 Page from "Doc. No: CLEJ-00208-1.01- (unable to read date at the top of page, the date of the memo is 11/22/82)

   1 Page from "Doc. No: CLEJ-0090(?)-1.01-9/11/83"

   13 Pages from "Doc. No: CLEJ-00247-1.02-10/25/85"

   8 Pages from "Doc. No: CLEJ-00253-1.02-10/31/80"

Attachment 2
Historical Aerial Photographs

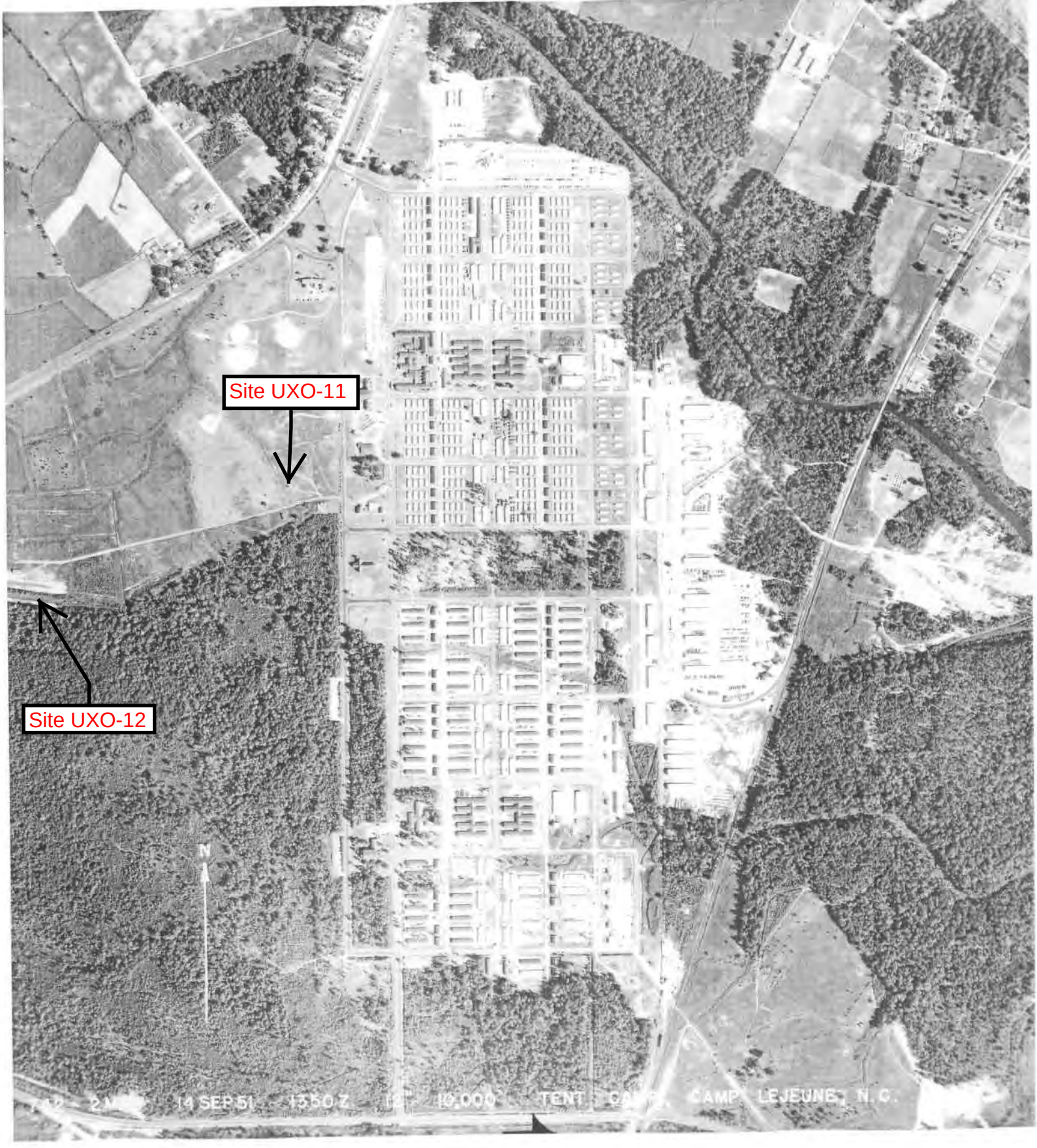


TENT CAMP 6/10/46 TENT camp 1 & 2

TENT CAMP May 30, 1948

Site UXO-11
Site UXO-12
CAMP AREA, CAMP LEJEUNE, N.C. F.L. 6" ELE. 3300 17 SEPT 48, LOOKING EAST

TENT


Site UXO-11
Site UXO-12
N
14 SEP 51
1350 Z
10,000
TENT
CAMP LEJEUNE, N.C.

Appendix C
Geophysical Investigation Report

NAeVA GEOPHYSICS INC.

THE LEADER IN SUBSURFACE DETECTION

Subsurface Geophysical Surveys

GPR
MAGNETICS
ELECTROMAGNETICS
SEISMICS
RESISTIVITY
UTILITY LOCATION
UXO DETECTION
BOREHOLE CAMERA
STAFF SUPPORT

GEOPHYSICAL INVESTIGATION REPORT

Focused Preliminary Assessment/Site Inspection
Sites UXO-07 and UXO-11
Former Practice Hand Grenade Ranges,
Site UXO-10
Former Flame Tank and Flame Thrower Range
&
Site UXO-14
Former Indoor Pistol Range and Gas Chamber
Marine Corps Base (MCB) Camp Lejeune, North Carolina

Task Order 0014

Dates of Investigation:

May 19th – May 22nd, 2009

FINAL SUBMITTAL
January 21, 2010

PREPARED FOR

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APPENDICES & CD

Appendix A: GPO color contour maps
Appendix B: Example QC test results
Contents of CD: Project deliverables

ACRONYMS AND ABBREVIATIONS

AHA	Activity Hazard Analysis
ASR	Archive Search Report
DGM	Digital Geophysical Mapping
DQO	Data Quality Objectives
GGA	Global Positioning System Fix Data Format
GLONASS	Global Navigation Satellite System (Russian)
GPO	Geophysical Prove-Out
GPS	Global Positioning System
MCB	Marine Corps Base
MEC	Munitions and Explosives of Concern
MR	Munitions Response
MRP	Munitions Response Program
mV	Millivolts
NAD83	North American Datum of 1983
QA	Quality Assurance
QC	Quality Control
RTK	Real Time Kinematic
SI	Site Inspection
SOP	Standard Operating Procedures
SOW	Statement of Work
TO	Task Order
UTM	Universal Transverse Mercator

1.0 INTRODUCTION

NAEVA Geophysics, Inc. (NAEVA) was contracted by CH2M HILL to conduct Digital Geophysical Mapping (DGM) at the following Munitions Response Sites in various locations at Marine Corps Base (MCB) Camp Lejeune, North Carolina: UXO-07, D-6 Practice Hand Grenade Course; UXO-10, D-11A Flame Tank and Flame Thrower Range; UXO-11, B-5 Practice Hand Grenade Course; and UXO-14 Former Indoor Pistol Range and Gas Chamber. Field operations were conducted from May 19th to May 21st, 2009.

1.1 BACKGROUND AND OBJECTIVES

The purpose of this geophysical investigation was to detect and map subsurface metal potentially representing munitions and explosives of concern (MEC) in four locations. The investigation involved DGM of transects totaling to 2.12 acres and covered approximately 10 percent of each of the targeted areas of sites UXO-07, UXO-10, and UXO-11. Due to site conditions, a smaller area of coverage was attained at Site UXO-14. Prior to the commencement of mapping, a Geophysical Prove-Out (GPO) was completed for the purpose of establishing an appropriate anomaly targeting threshold and to test the effectiveness of the geophysical instrument.

1.2 SCOPE OF WORK

NAEVA Geophysics provided all personnel and geophysical survey equipment to perform the DGM surveys at Camp Lejeune. A total of four separate locations were identified for DGM surveying and were completed according to the scope of work and work plan addendums. Geophysical data were collected in transect lines to provide 10% coverage of each of the targeted areas. Prior to starting the production geophysical surveying, a GPO was performed to demonstrate the capabilities of the personnel and equipment to meet the data quality objectives (DQOs) defined in the CH2M HILL project work plan. All production data were to be processed, interpreted and delivered to the CH2M HILL Project Geophysicist on the schedule and in the formats specified in the Statement of Work.

1.3 SITE LOCATION AND DESCRIPTION

The four sites selected for mapping under Task Order 14 (TO-14) are Site UXO-07, D-6 Practice Hand Grenade Course (ASR Site 2.77); Site UXO-10, D11A Flame Tank and Flame Thrower Range (ASR Site 2.136); Site UXO-11, B-5 Practice Hand Grenade Course (ASR Site 2.81); and Site UXO-14 Former Indoor Pistol Range (ASR Site 2.199) and Gas Chamber (ASR Site 2.200).

Site UXO-07, D-6 Practice Hand Grenade Course

The Site UXO-07, D-6 Practice Hand Grenade Course investigation area is composed of two separate areas located south of Main Service Road off of O Street on the Main Side of Camp Lejeune and is approximately seven acres in size. The northern area of the site, UXO-07_1 contains 91 transects spaced at 10 meter intervals with the exception of the northeast transects, which are spaced at five meter intervals; the southern portion of the site, UXO-07_2 consists of 35 transects evenly spaced at 10 meter intervals. Both portions of the site are composed primarily of cleared and developed land with active parking lots and buildings, including an Armory in the southern portion, which bound transects within each area. The topography is generally flat in both areas, with an isolated trench running southeast in the northern transects. The presence of underground and overhead utilities is confirmed on this site, and active roads run parallel to the westernmost and easternmost transects.

Site UXO-10, D-11A Flame Tank and Flame Thrower Range

The Site UXO-10, D-11A Flame Tank and Flame Thrower Range investigation area is bisected by Gonzalez Boulevard and Main Service Road located just west of Sneads Ferry Road on the Main Side of Camp Lejeune and is approximately 10 acres in size. The site is predominantly developed with parking lots and paved roads and may contain underground utilities. The 43 transects spaced at 10 meter intervals north of Main Service Road are relatively flat, with some hummocky terrain and are bounded by active parking lots and Gonzalez Boulevard to the west. The area bounded to the north by Main Service Road is relatively flat, and is scattered with large sewer piping, lumber, vegetation with some larger trees and a container from a 16-wheel truck. The area south of Main Service Road was not laid out with pre-planned transects due to the conditions of the area. NAEVA, under the guidance of CH2M HILL, conducted a meandering path transect using Real Time Kinematic (RTK) Global Positioning System (GPS), attempting to cover as much area as feasible to reach the 10 percent coverage goal, while avoiding existing surface metal.

Site UXO-11, B-5 Practice Grenade Course

The Site UXO-11, B-5 Practice Grenade Course investigation area is located north of Sixth Street and east of Seventh Street at the New River Air Station and is approximately one to two acres in size. The area contains 8 transects at 10 meter intervals on undeveloped, flat terrain that is primarily free of vegetation. The site is bound by the investigation boundary on all sides and is bisected by a water-filled trench on the southeast edge.

Site UXO-14 Former Indoor Pistol Range and Gas Chamber

The Site UXO-14 Former Indoor Pistol Range and Gas Chamber investigation area is located west of Powder Lane in the Stones Bay Area of Camp Lejeune and is approximately one acre in size. DGM

activities were only conducted at the former Gas Chamber site, which included only two transects spaced approximately 5 meters apart. The presence of dense vegetation and minimal brush clearance prevented the use of global positioning systems (GPS) for data positioning. Data collection is bounded on all sides by the edge of cleared vegetation.

2.0 EQUIPMENT

2.1 GEONICS EM61-MK2

The geophysical instrument used for the investigation at MCB Camp Lejeune is the Geonics EM61-MK2 metal detector. The EM61-MK2 is a high resolution time-domain electromagnetic instrument designed to detect, with high spatial resolution, shallow ferrous and non-ferrous metallic objects. In comparison with other metal detectors, especially magnetometers, it is much better suited for work in close proximity to man-made structures and in areas of dense subsurface metallic debris (i.e., impact ranges). This instrument was chosen based on multiple previous investigations successfully using the EM61-MK2 at MCB Camp Lejeune.

The EM61-MK2 system consists of two 1 meter by 0.5 meter air-cored coils, a digital data recorder, batteries and processing electronics. The EM61-MK2's transmitter generates a pulsed primary magnetic field, which then induces eddy currents in nearby metallic objects. The receivers either measure the eddy currents at three distinct time intervals in the bottom coil and one time interval in the top coil or four intervals in the bottom coil if no top coil measurements are recorded. Four time gates from the bottom coil were recorded for the DGM surveys at MCB Camp Lejeune. Earlier time gates provide enhanced detection of smaller metallic objects. Secondary voltages induced in both coils are measured in millivolts (mV). The arrangement of coils is such that there is a vertical separation of 40 cm from the ground to the bottom coil. Assuming accurate data positioning, target resolution of approximately 0.5 meters can be expected. The data are collected using Geomar's NAV61MK2 program and temporarily stored in a Juniper Allegro CX data logger prior to downloading to a laptop computer.

2.2 TRIMBLE 5700/R7/R8 REAL TIME KINEMATIC GLOBAL POSITIONING SYSTEM

Trimble's 5700/R7/R8 RTK GPS is a 24-channel dual frequency RTK receiver that uses both L1 and L2 satellites. This system operates with a base and a rover unit; the base sends corrections to the rover via radio link, thus maintaining a 3-cm horizontal accuracy and a 5-cm vertical accuracy. For configuration with the EM61-MK2, the rover is set to output a GGA NMEA (National Marine Electronics Association) string at 1 Hz, which is captured into the NAV61MK2 program and temporarily stored on the Juniper Allegro CX. The base station utilized for this survey was a Trimble R8 GNSS. The R8 GNSS is a

multichannel, multi-frequency receiver, antenna, and data-link radio combined into one device. It uses Trimble R-Track technology to support all GPS signals, including the new L2C signal and the planned L5 signal of GPS Modernization, and also supports GLONASS (Global Navigation Satellite System).

3.0 METHODOLOGY

3.1 DGM SURVEY ACTIVITIES

DGM surveying at MCB Camp Lejeune was accomplished using the EM61-MK2 in wheel mode configuration, with data positioning provided by RTK GPS. Wheel mode was tested in a GPO (see Section 5.1) and the generally flat terrain without many mounds or ruts allowed for its use on the two sites. In wheel mode, the EM61-MK2 bottom coil is mounted on two 40-cm wheels, and has four fiberglass spacers used to support the top coil. A tripod attached to the top coil holds the GPS antenna over the center of the EM coils. All data collected at MCB Camp Lejeune were recorded at a sample rate of 10 readings per second.

A survey transect spacing of 0.75-m was used for the GPO survey area. This spacing results in coil overlap on successive lines, reducing the likelihood of data gaps and improving the chance of detecting small MEC items. Low stretch polypropylene ropes painted with alternating bands of fluorescent orange and blue paint were placed across the GPO at 10-m intervals, perpendicular to the direction of travel. These ropes provided guidance to the geophysicist maneuvering the EM61-MK2 across the grid, to maintain parallel lines spaced 0.75-m apart.

Prior to DGM activities, licensed surveyors contracted by CH2M HILL placed color-coded stakes to mark the start and end of each transect in each of the four sites. For transects, which require only a single pass in one direction with no overlap, measuring tapes were pulled and secured as tightly and straight as possible; plastic pin flags were then placed at 10-m intervals to provide a line of sight to the geophysicist maneuvering the EM61-MK2 along the transect.

When in fiducial mode, in order to maximize control over positioning, tapes running along the transect line direction were made as straight as possible. Using the measuring tapes, fiducial points/markers and start and stop stations for each line were recorded. Using known UTM (Universal Transverse Mercator) coordinates for each stake, local coordinates recorded for each transect setup can be converted to meter coordinates in the data processing phase.

3.2 DATA PROCESSING AND INTERPRETATION

3.2.1 Data Storage and Initial Editing

EM61-MK2 data are temporarily stored in an Allegro CX data logger using Geomar's NAV61MK2 software and then downloaded into a laptop computer for further on-site processing using Geomar's Trackmaker and Geosoft Oasis Montaj software version 7.0.1.

Daily logs, field notes and survey report forms were input digitally into a handheld PDA while in the field each day. Initial data processing was performed by the field team, which included reviewing the data for integrity, repeatability, and data density issues, positioning the data based on the field notes and creating XYZ files for each grid and QC test for use in further processing the geophysical data. If an issue with a file was noted, such as a missing line or bad readings, the cause was investigated and corrected as necessary.

3.2.2 Preprocessing

Data were transferred to NAEVA's data processor in the Charlottesville, Virginia office where converted raw data files were imported into Geosoft's Oasis Montaj to perform the following:

- Review and finalize all QC tests (cable shake, personnel, static and latency) prior to processing of the DGM data for that day
- Set projection of NAD83 UTM Zone 18 North
- Evaluate data density and RTK GPS quality
- Apply auto leveling and instrument drift corrections
- Apply default lag correction
- Generate preliminary contour map(s) from submitted data
- Generate preliminary original vs. repeat profiles by transect
- Generate formatted ASCII files containing preprocessed data by transect

3.2.3 Final Processing

After completion of preprocessing, the data were further evaluated and processed to generate final processed data files. Final processing steps included:

- Evaluation and refinement of auto leveling and instrument drift corrections in the channel selected for target analysis (Channel 2)
- Evaluation and refinement of lag correction in the channel selected for target analysis (Channel 2)
- Additional digital filtering and enhancement, as necessary, in the channel selected for target analysis (Channel 2)

- Targeting of data, as described in Section 3.2.4
- Generation of formatted ASCII files containing processed data by transect
- Generation of final maps for each transect showing contoured data, target locations, and culture
- Generation of final original vs. repeat profiles by transect

3.2.4 Analysis and Target Selection

The UX-Detect module within Oasis Montaj identifies peak amplitude responses associated with, but not limited to, MEC items. Data was gridded using the Kriging method, and initial targets were selected along the profiles that were produced. The data profiles corresponding to the anomalies selected by Geosoft were then analyzed by trained geophysicists, with the targets evaluated as to their validity and position, as single-source anomalies may generate multiple target designations depending on shape and orientation. Targets found to be invalid or incorrectly located were removed or adjusted. Additionally, anomalies that were not selected by the UX-Detect module, yet deemed to represent a potential MEC target, were manually selected. All target selection was performed on final processed data from Channel 2 of the bottom coil of the EM61-MK2.

Final processed XYZ (ASCII) files were created for each transect and individual geophysical maps and target lists were created for each transect. When all data at a particular site had been collected mosaic maps were created by combining color contour maps from all the transects at that site. All anomalies occurring at or above the targeting threshold of 3 mV Channel 2 were identified using a unique ID number.

Each target list provides a Target ID, Transect ID, Easting (x) and Northing (y) UTM coordinate location for each target, the recorded peak response in millivolts, and any processor comments. The target IDs were prioritized by designating the highest amplitude response as the number one target in each transect.

All raw, preprocessed, and processed data have been submitted to CH2M HILL's project geophysicist and can be found on the enclosed CD (see Contents of CD).

4.0 RESULTS

4.1 SUMMARY OF WORK PERFORMED

The digital geophysical mapping of selected areas of MCB Camp Lejeune took place from May 19th to May 21st. After the majority of May 19th was spent surveying the GPO, Site UXO-14 Former Indoor Pistol Range and Gas Chamber was completed. The former gas chamber consists of two transects measuring 17 and 17.5-meters in length, respectively and is densely wooded, preventing the use of RTK GPS.

DGM was conducted in UXO-10, D-11A Flame Tank and Flame Thrower Range and UXO-11, B-5 Practice Hand Grenade Course on May 20th. UXO-10 is an area approximately 10 acres in size surrounding a developed parking lot and an adjacent field to the southwest. UXO-10 was collected in two portions: UXO-10 and UXO-10A. UXO-10 includes 43 transects and has minimal natural and cultural obstacles hindering data production and quality. UXO-10A is the area located to the southwest of Main Service Road. Although relatively flat, the area is scattered with dense vegetation and construction materials, which prevented the placement of transects prior to NAEVA's arrival. Consequently, UXO-10A was run as a continuous meandering path using RTK GPS.

Following the completion of UXO-10, collection of UXO-11, B-5 Practice Hand Grenade Course commenced. UXO-11 included eight transects and was on level ground; deep standing water in the southeast corner of the site created the only obstacle.

DGM took place at UXO-07, D-6 Practice Hand Grenade Course on May 21st. Site UXO-07 includes two separate areas – UXO-07_1 and UXO-07_2 – that combine for 126 transects. There are a large number of cultural items, including power lines, buildings, chain-link fence, active parking lots and roads, and vegetation that hindered production slightly.

Table 1 (at the end of the text) provides a full breakdown of acreage and targets by transect block. Plates 1 – 6 display the EM61-MK2 bottom coil mosaic maps for UXO-07_1 and UXO-07_2, UXO-10 and UXO-10A, UXO-11 and UXO-14, respectively.

4.2 MOBILIZATION AND SITE SETUP

Prior to mobilization an Activity Hazard Analysis (AHA) and Standard Operating Procedures (SOPs) were provided to CH2M HILL, and all personnel had current 8-hour and/or 40-hour OSHA HAZWOPER training.

NAEVA mobilized one field crew to Jacksonville, North Carolina on May 18th. Color-coded survey control stakes had been installed prior to arrival on site. Work was initiated on May 19th and all specified collection activities were completed by May 21st. Site-specific health and safety briefs were given each morning by the CH2M HILL site manager. No equipment was staged on site.

4.3 DGM SURVEY ACTIVITIES

4.3.1 Site UXO-07, D-6 Practice Hand Grenade Course

The Former Practice Hand Grenade Course designated as UXO-07 and subdivided into UXO-07_1 and UXO-07_2 (Figures 1 and 2) is a former practice hand grenade range used to train troops how to use hand grenades. Since it was not an actual hand grenade range, the level of MEC present is expected to be very low. The site has since been developed into a living facility with a surrounding parking lot with an Armory

in the south west portion. The ground was generally flat which aided the data quality, however a number of cultural objects are present; buildings, parking lots, chain-link fences, moving cars and vegetation acted as obstacles and in some cases caused GPS dropout and created gaps in the transect paths.

On the seven acre site, 126 total transects were collected in two separated areas. UXO-07_1, the larger of the two areas, consisted of 91 transects totaling .635 acres. 1105 targets were selected above the targeting threshold of 3 mV in Channel 2 in this area, giving an estimated target density of approximately 1740 targets per acre. The greatest anomaly distribution is generally located next to the buildings and roadways, possibly due to the presence of underground structures such as reinforced concrete. 196 of the 1105 selected targets – approximately 17 percent – have been designated as culture. The eastern-most area, farthest from the building and roads, were generally clear.

UXO-07_2, located to the southwest of the first area, was considerably smaller. 35 transects, totaling 0.18 acres were collected in this region. Transects were collected on a smooth but slight hill and were bounded by a parking lot and fences. Roads, utilities, and concrete pads were observed and avoided as much as possible. Dense concentrations of short trees also caused breaks in transect paths. 328 targets were selected in this area, resulting in an estimated target density of approximately 1822 targets per acre. The general concentration of these targets located near the Armory and roads in the southwest corner. A total of 113, or approximately 34 percent, of the selected targets have been deemed as culture-related.

4.3.2 Site UXO-10, D-11A Flame Tank and Flame Thrower Range

The Flame Tank and Flame Thrower Range, also composed of two separate areas, UXO-10 and UXO-10A (Figures 3 and 4), was only used as a flame thrower range, and as such no actual munitions are expected, however hand grenades and C-4 may have been used.

The area is currently a parking lot (UXO-10) to the north and an undeveloped field (UXO-10A) to the south, transected by a service road used primarily for tank traffic. UXO-10 was generally smooth with a small ravine located parallel to Main Service Road and another parallel to Gonzalez Boulevard. Cultural items in the area included a paved parking lot with cars, active roads, culverts and light posts and overhead power lines along Gonzalez Boulevard. No MEC surface debris was noted.

43 transects were collected over 0.35 acres; with 434 targets selected, the estimated target density is approximately 1251 targets per acre. Target distribution was generally uniform increasing slightly in proximity to the roads and power lines. Culture-related items were the source of 115 targets, or 26 percent of all selected targets for the area.

UXO-10A is located across Main Service Road from the northern area and is predominately level ground. Due to a large number of closely spaced obstructions, including lumber, sewer piping, dense vegetation and a container truck, stakes were not placed by surveyors prior to NAEVA's arrival. Under the guidance of

CH2M HILL, one meandering transect was used as an alternative method of collection. The path of collection was done in sweeps generally parallel to the main service road in order to reduce the amount of data overlap, and therefore ensuring the goal of 10 percent coverage would be met.

794 targets were selected along a path that totaled 0.72 acres, giving an estimated target density of approximately 1097 targets per acre. The main concentration of targets is located along the western boundary near the overhead power lines and utility markers and along the southern portions where the construction materials were present. A small percentage (less than 10 percent) of the selected targets was considered culture-sourced.

4.3.3 Site UXO-11, B-5 Practice Hand Grenade Course

The Practice Hand Grenade Course, UXO-11 (Figure 5), was used to train troops how to use hand grenades. Since it was not an actual hand grenade range, the level of MEC present is expected to be very low. The area is now a parade/training ground used sporadically for non-munitions related work.

Work at UXO-11 was begun immediately following the completion of UXO-10. Eight transect lines, each approximately 120 meters in length, were collected over smooth ground with no cultural influences for a total of 0.23 acres. A ditch containing deep standing water created a gap in the southernmost transect and tall trees were noted on the southern boundary but caused no GPS dropouts.

In the area collected, 86 targets were selected with slightly higher concentrations of targets were in the center of the area. The approximate estimated target density observed for UXO-11 is 379 targets per acre. Approximately 18 percent of all selected targets were considered culture related; however, these 16 targets represent the surveyor nails placed at the end of each transect. No MEC-related surface debris was observed in this area.

4.3.4 Site UXO-14, Former Indoor Pistol Range and Gas Chamber

Site UXO-14 (Figure 6), Former Indoor Pistol Range and Gas Chamber, was used for small arms practice and gas training, thus no actual munitions are expected. Due to dense forest with thick underbrush and minimal vegetation clearance, steep terrain, and scrap metal, only a small portion of the Former Gas Chamber was collected. The dense vegetation of Site UXO-14 also prevented the use of RTK GPS; in lieu of GPS, wheel mode with fiducial positioning was used with the EM61-MK2.

Two transects were collected on this site for a total of 33.9 meters and .01 acres, which was a reduced area compared to the original .96 acres that were expected to be surveyed. The area designated for collection is steep on the western edge and levels out to the east. Abundant scrap metal was observed at the surface; large pieces of sheet metal were removed from the survey area prior to collection. No MEC-related surface debris was observed.

The transects were 17 and 17.5 meters long, respectively, and yielded a total of 17 targets. A more concentrated area of high-response targets is present on the east side of the surveyed transects. Only two targets were designated as culture-related for the two transects, which represent the surveyor nails placed at stake locations 10138 and 10137 (Plate 6). The target density for UXO-14, based on the number of targets detected in comparison to the area collected, is approximately 2125 targets per acre; however, since such a small area was surveyed and in an area where surface metal was abundant, this number is not statistically accurate.

4.4 DATA PROCESSING AND INTERPRETATION

All data were processed as described in-depth in Section 3.2. Part of the process included analyzing channel decay in order to identify possible noise or other false positive responses. Any anomalies suspected as originating from noise (e.g., channel readings out of phase) and not metallic objects are noted in the processing reports included on the CD. These reports list down-line data density statistics, leveling, lag, and parameters used in processing each transect. Processors examined all data prior to NAEVA demobilizing from the site.

5.0 QUALITY CONTROL

To establish confidence in the data reliability, QC tests were conducted throughout the project. Tests were conducted prior to, during, and after all data collection sessions. All QC tests for the EM61-MK2 were conducted after a minimum 15 minute warm-up period for the electronics. Sample graphical displays of QC data are included in Appendix B.

5.1 SYSTEM VALIDATION - GEOPHYSICAL PROVE-OUT (GPO)

Prior to mapping the four sites, a survey of a pre-existing GPO area was completed. The purpose of surveying the GPO is to demonstrate the effectiveness of all instrumentation, methods, and personnel prior to the initiation of fieldwork and document the site-specific capabilities of a DGM system. Serial number identifications were recorded for all instrumentation (i.e. data logger, coils, EM61-MK2 electronics), and the GPO was mapped using the same personnel, equipment, and methodologies employed for the DGM survey.

The existing GPO location in Knox Park used by NAEVA for all prior work at MCB Camp Lejeune was used for this project as well. A background survey was not conducted, as the GPO has been in place for several years and many collected datasets exist for comparison. Inert seed items were emplaced by CH2M HILL at various depths and orientations in order to test the detection capabilities of the instrument and establish a targeting threshold for geophysical anomalies. The GPO was originally established using the

North Carolina State Plane coordinate system under the NAD83 (1986) datum. Both corner stakes and corner flags were present in the ground, and noted on the contour maps (Appendix A), displaying the shift in coordinates that has occurred with the new datum.

The EM61-MK2 was used to survey the GPO twice in wheel mode, using RTK GPS and fiducial positioning. The EM61-MK2 was chosen based on its ability to detect small, near-surface ferrous and non-ferrous munitions and its high data resolution. The unconsolidated sands at MCB Camp Lejeune should not adversely affect the instrument response, however the EM61-MK2 is susceptible to interference from power lines or other objects that create an electromagnetic field (e.g., junction boxes, radios in transmit mode).

It was determined that a threshold of 3 mV in Channel 2 (the same threshold used in prior work) would detect the MEC items of interest. See Appendix A for color contour maps of the RTS- and fiducial-collected GPO.

5.2 QC Test Descriptions and Acceptance Criteria

The following QC procedures were performed and documented during the data collection process and reviewed by a qualified geophysicist on a daily basis:

GPS QC: Positioning accuracy of the geophysical data was demonstrated by testing the GPS equipment over one or more known points. The accuracy of the data positioning was evaluated by comparing NAEVA's point coordinates provided by the professional land surveying team. The project DQO's called for the positions to be within 10-cm of the known points. The sensor position test was conducted prior to starting DGM surveying each workday. Errors noted in the positioning were less than 10-cm each day with typical errors on the order of 3-4 centimeters.

Static Background and Static Spike: Static tests were performed by positioning the survey equipment within or near the survey boundaries in an area free of metallic response and collecting data for a 3-minute period. During this time, the instrument was held in a fixed position through the use of a PVC pipe stand. The static tests consisted of one minute without a spike (known standard), one minute with a spike (a wood board fitted to the bottom coil with a bolt secured through the center), and then one minute without a spike. The purpose of the static test is to determine whether unusual levels of instrument or ambient noise exist, and to ensure consistent response to the spike item. The static background and static spike test were conducted at the beginning of each day and the end of each site investigation.

Cable Shake Test: Each morning, prior to production surveying, data were collected while the EM coil was held in a stationary position, and each of the cables were shaken, one at a time. The response was monitored in the field for immediate corrective action, transmitted back to a processor, analyzed, and checked for spikes in the data that can possibly create false anomalies. Any data spike greater than 2 mV

from the mean would constitute a QC failure. The cable shake test was conducted at the beginning of the survey operation for each workday and cables were not disconnected during the day.

Personnel Test: This test checks the response of instruments to personnel and their clothing/proximity to the system. Each morning, prior to survey operation, the instrument was checked for its response to the personnel operating the system. The response was observed in the field for immediate corrective action and transmitted back to a processor, and analyzed and checked for spikes in the data that can possibly create false anomalies. Any data spike greater than 2 mV from the mean would constitute a QC failure.

Latency Test: A 20-meter long single survey line was established near the first transect of the day with the static item placed at the center point (10-m). A line of data was collected in each direction along the test line prior to daily collection operations to demonstrate consistency in instrument performance (both response and positioning) throughout the course of the survey, with acceptance criteria of ± 20% response amplitude and ± 20 cm positional accuracy.

Repeat Data: This test is performed to verify repeatability of the data and was performed at the end of each of the four UXO sites. At least 2% of the survey lines were repeated and evaluated for consistency. Since small deviations in line path can affect the instrument response the profiles were evaluated qualitatively. The spike test is used to assess quantitative repeatability.

5.3 QC TEST RESULTS

QC data were evaluated using Geosoft's QA/QC software. Static, cable shake, and personnel test profiles were plotted with an acceptance criterion of ± 2 mV from the mean. Any readings outside this range were flagged on the profiles and an associated failure percentage was reported. The following provides a summary of the QC results:

GPS QC: All daily checks of GPS accuracy were within 10-cm of the recorded positions.

Static Background / Spike Test: All static and spike tests were within acceptance criteria; stable, repeatable, and without spikes.

Cable Shake Test: No spikes were observed in any of the tests.

Personnel Test: No deviation from background response was observed.

Latency Test: Latency tests were plotted showing the line path and gridded response. A comparison of tests shows that response amplitudes are consistent and test item positions are accurate.

Repeat Data: Repeat lines generally showed good repeatability. Discrepancies in repeat lines were often a result of line path deviation or noise in the data.

All QC tests were well within acceptance criteria. As QC tests were conducted in the vicinity of the

associated grids, variations in noise levels are apparent. Especially noisy tests are noted on the data plots as containing influence from power lines. Most static spike tests show an initial drop in response at the beginning of the collection period, likely due to software behavior, as readings were completely stable in monitoring mode, yet when data collection was started the recorded values dropped. This behavior was observed on multiple occasions but the effect was reduced during data leveling and did not result in any QC failures.

6.0 CONCLUSIONS

Work under TO-14 was completed after one working day for the GPO and Site UXO-14 Former Indoor Pistol Range and Gas Chamber, one day for Site UXO-10, D-11A Flame Tank and Flame Thrower Range and Site UXO-11, B-5 Practice Hand Grenade Course, and one day at UXO-07, D-6 Practice Hand Grenade Course. Mapping activities were slightly slower at site UXO-07 due to its large size and increased number of obstacles including buildings, roadways/parking lots, fences and vegetation that fragmented transects. This survey serves as the initial focused SI of all aforementioned areas in which NAEVA has conducted 10 percent transect surveys.

A qualitative analysis highlights the effectiveness of the transect survey in identifying areas of higher metallic concentrations. In particular, the higher densities of targets were generally located near cultural objects such as buildings and fences. The anomaly density observed for UXO-07_1 is more concentrated near the buildings in the southern portion of the site and near the road to the west; these areas composed more than half the targets selected. The surveyed area at Site UXO-07_1 is currently an in-use housing complex and therefore contains many cultural structures that may have affected target detection and densities. UXO-07_2 is similar with regards to target density array; the targets are even distributed throughout the area, but where there was a building, fence, or other structure present, anomaly density increased. Underground utilities associated with the housing complex may have been, in conjunction with aboveground influences, responsible for the increase in target density. However, since the area was not a full coverage survey, it is not possible to accurately identify the presence of underground utility lines.

MRP Site UXO-10, similar to UXO-07, shows high concentrations of targets near man-made objects. UXO-10 had a number of overhead power lines and light posts, near which target densities tended to increase. Approximately one-third of the targets were located below the overhead power lines on the western side of the site; however, the same area also included several metal culverts and light posts as features, which are also known to be responsible for increasing the target density. A saturated area is visible on the eastern portion of the site (Plate 3), but no cultural influences were apparent in the field.

UXO-10A displayed comparable target densities to UXO-10. The main concentrations of targets are

located in two areas and comprise approximately two-thirds of the selected targets. On the western edge of the collected area, a large saturated region is shown. This area is in close proximity to overhead power lines, and several cultural objects including a large utility cover, which suggests the possible existence of underground utilities. The second saturated region is located at the southern end of the collected area. Several construction items including large, metallic sewer pipes were noted on the surface here. It is possible that these large construction items, in addition to smaller discarded pieces of metal, could be the cause of the increased target density in this area.

Lacking in cultural influences, UXO-11 collection yielded a considerably decreased quantity of targets. The main concentration of the targets producing the highest mV responses is located in the center of the site, but does not exhibit saturation or any predictable cultural pattern.

UXO-14 produced a similar number of targets for each transect collected. The two transects, being only five meters apart, displayed analogous patterns of target location. Cultural influences were not noted in the dense vegetation surrounding the collected area of UXO-14; however, large pieces of sheet metal were observed upon arrival and moved prior to collection. It is possible that pieces of scrap metal that were not removed from the area are the cause of the large mV values that were recorded by the EM61-MK2.

While there are a low number of suspected noise targets, noise levels were not severe enough to adversely affect the detection of actual metallic objects, and there are no areas on the map that exhibit noise saturation. Even at the southwest boundary of UXO-10, where data collection passed directly under the lines, noise was only moderate. The overhead line location can be seen in Plate 3.

Since both UXO-07 and UXO-11 were used as training and education sites rather than live ranges or impact areas, any MEC present is expected to be quite shallow. Given that all the MRP Sites investigated during this survey have been previously redeveloped, with the exception of UXO-14, which is heavily wooded, no trenches or holes from training activities are visible. It is probable that any MEC, whether discrete objects in the top foot or so of soil, or items in burial pits, have been accurately located by this geophysical survey.

The enclosed CD contains all raw, preprocessed, and processed data, including processing reports, QC test results, color contour maps and target lists for each grid, and mosaic maps for both sites. A copy of this report may also be found in Adobe PDF and Microsoft Word formats.

7.0 REFERENCES

CH2M HILL. 2009. *Preliminary Assessment/Site Inspection at Site UXO-07, D-6 Practice Hand Grenade Course (ASR #2.77).* Prepared for Department of the Navy Naval Facilities Engineering Command. March.

CH2M HILL. 2009. *Preliminary Assessment/Site Inspection at Site UXO-10, D-11A Flame Tank and Flame Thrower Range (ASR #2.136).* Prepared for Department of the Navy Naval Facilities Engineering Command. March.

CH2M HILL. 2009. *Preliminary Assessment/Site Inspection at Site UXO-11, B-5 Practice Hand Grenade Course (ASR #2.81).* Prepared for Department of the Navy Naval Facilities Engineering Command. March.

CH2M HILL. 2009. *Preliminary Assessment/Site Inspection at Site UXO-14, Former Indoor Pistol Range and Gas Chamber (Rifle Range Area) ASR #2.199 and #2.200.* Prepared for Department of the Navy Naval Facilities Engineering Command. April.

CH2M HILL. 2006. *Master Ordering Agreement.* April.

Geonics Limited. 2005. *EM61-MK2 and EM61-MK2HP 4 Channel High Sensitivity Metal Detectors Operating Manual.* July.

TABLE 1: TRANSECT STATISTICS

Site	Data Set	Transects	Distance Traveled (m)	Acreage	Targets
UXO-07	UXO-07_1	91	2568.991	0.635	1105
UXO-07	UXO-07_2	35	725.990	0.180	328
UXO-10	UXO-10	43	1405.267	0.347	434
UXO-10	UXO-10A	1	2931.121	0.724	794
UXO-11	UXO-11	8	919.530	0.227	86
UXO-14	UXO-14	2	33.910	0.008	17
TOTALS	**6 Data Sets**	**180**	**8584.809**	**2.121**	**2764**

* Total data sets and targets do not include GPO figures

FIGURES

Figure 1: Proposed transect location for UXO-07_1

Figure 2: Proposed transect locations for UXO-07_2

Figure 3: SE portion of UXO-10 shot from Parking lot looking to SE corner

Figure 4: UXO-10A looking towards the SE from a midpoint of the area

Figure 5: Proposed Transect locations for UXO-11

Figure 6: UXO-14 shot from the SW to the NE

PLATES:

PLATE 1: EM61-MK2 MOSAIC – UXO-07_1 PRACTICE HAND GRENADE COURSE

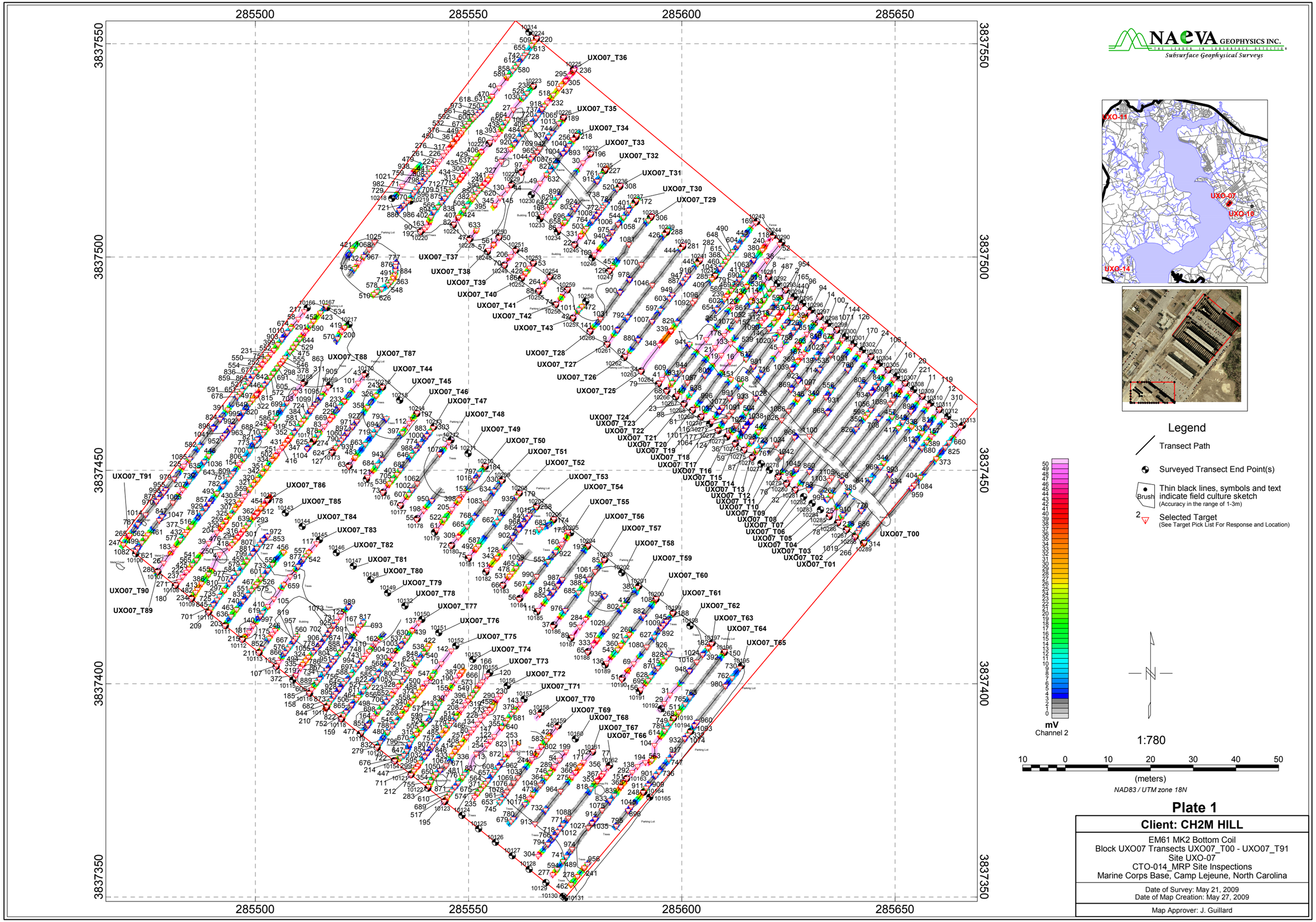
PLATE 2: EM61-MK2 MOSAIC – UXO-07_2 PRACTICE HAND GRENADE COURSE

PLATE 3: EM61-MK2 MOSAIC – UXO-10 FLAME TANK AND FLAME THROWER RANGE

PLATE 4: EM61-MK2 MOSAIC – UXO-10A FLAME TANK AND FLAME THROWER RANGE

PLATE 5: EM61-MK2 MOSAIC – UXO-11 PRACTICE HAND GRENADE COURSE

PLATE 6: EM61-MK2 MOSAIC – UXO-14 FORMER INDOOR PISTOL RANGE AND GAS CHAMBER



NAEVA GEOPHYSICS INC.
Subsurface Geophysical Surveys

Plate 1

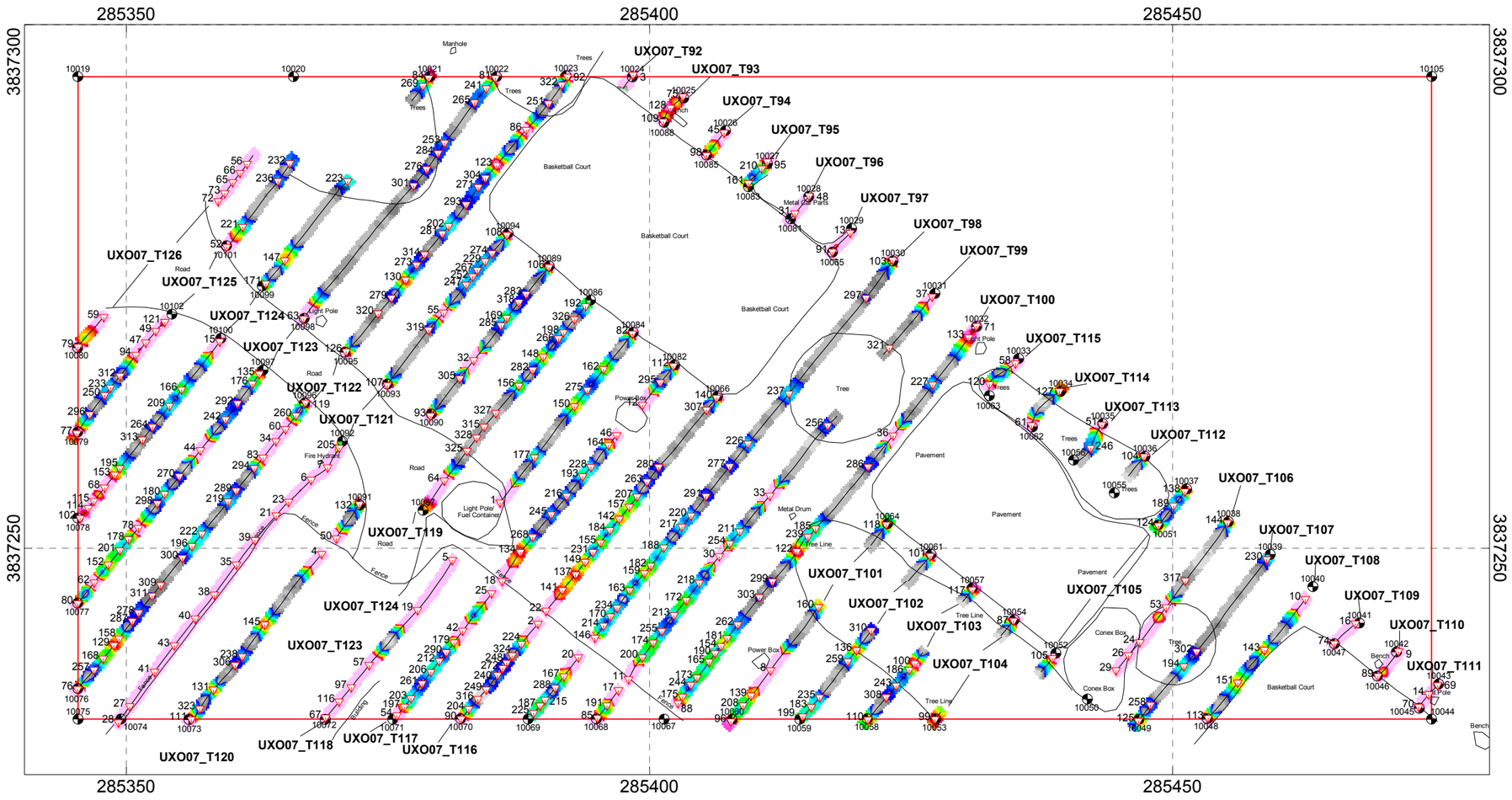
Client: CH2M HILL

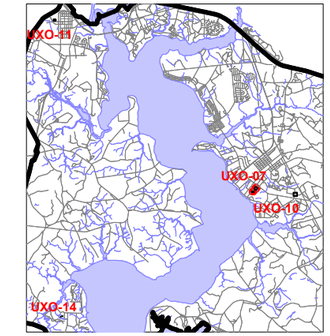
EM61 MK2 Bottom Coil
Block UXO07 Transects UXO07_T00 - UXO07_T91
Site UXO-07
CTO-014_MRP Site Inspections
Marine Corps Base, Camp Lejeune, North Carolina

Date of Survey: May 21, 2009
Date of Map Creation: May 27, 2009

Map Approver: J. Guillard

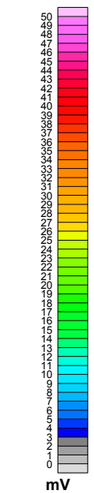
NAeVA GEOPHYSICS INC.
THE LEADER IN SUBSURFACE DETECTION
Subsurface Geophysical Surveys





Legend

- Transect Path
- Surveyed Transect End Point(s)
- Brush — Thin black lines, symbols and text indicate field culture sketch (Accuracy in the range of 1-3m)
- 2 — Selected Target (See Target Pick List For Response and Location)



1:480

5 0 5 10 15 20 25 30
(meters)

NAD83 / UTM zone 18N

Plate 2

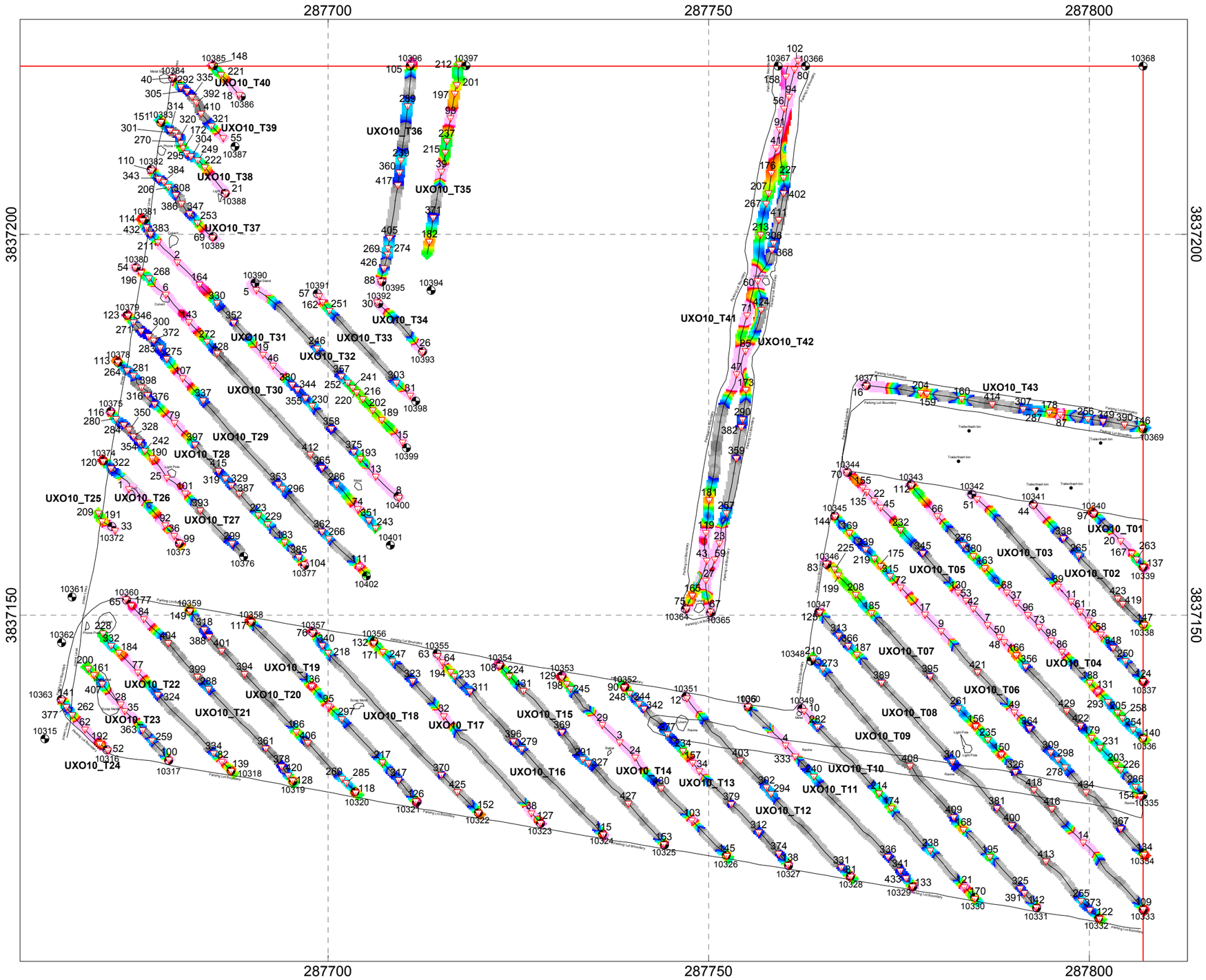
Client: CH2M HILL

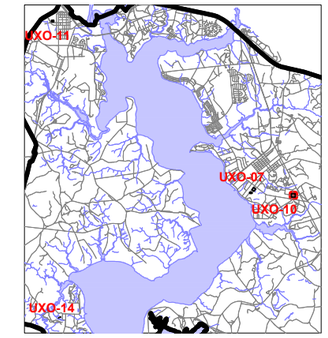
EM61 MK2 Bottom Coil
Block UXO07 Transects UXO07_T92 - UXO07_T126
Site UXO-07
CTO-014_MRP Site Inspections
Marine Corps Base, Camp Lejeune, North Carolina

Date of Survey: May 21, 2009
Date of Map Creation: May 28, 2009

Map Approver: J. Guillard

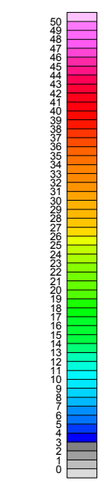
NAEVA GEOPHYSICS INC.
THE LEADER IN SUBSURFACE DETECTION
Subsurface Geophysical Surveys





Legend

- Transect Path
- Surveyed Transect End Point(s)
- Thin black lines, symbols and text indicate field culture sketch (Accuracy in the range of 1-3m)
- Selected Target (See Target Pick List For Response and Location)



1:540

10 0 10 20 30

(meters)

NAD83 / UTM zone 18N

Plate 3

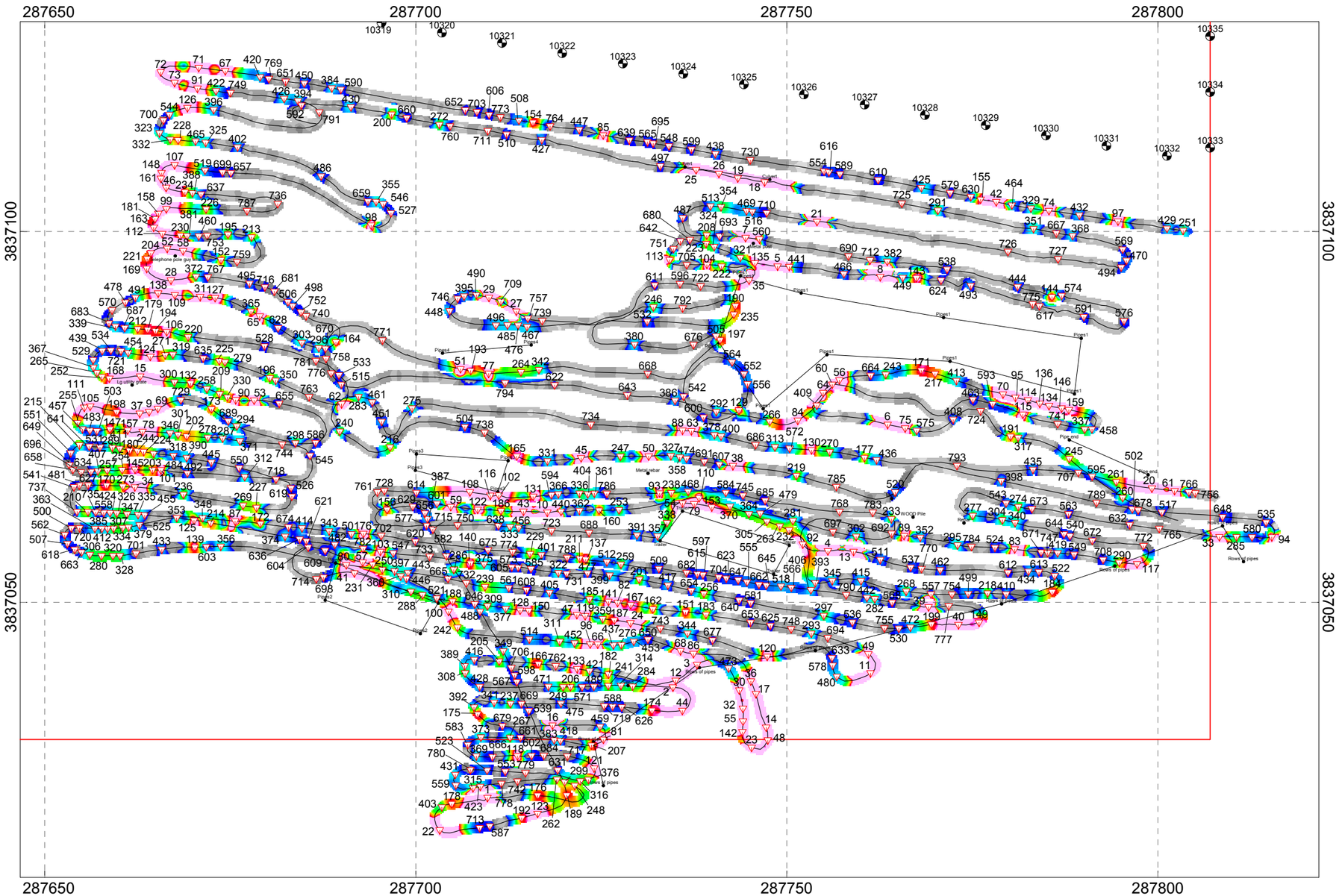
Client: CH2M HILL

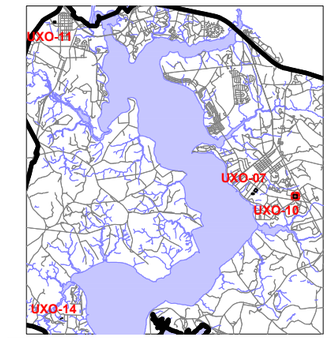
EM61 MK2 Bottom Coil
Block UXO10 Transects UXO10_T01 - UXO10_T43
Site UXO-10
CTO-014_MRP Site Inspections
Marine Corps Base, Camp Lejeune, North Carolina

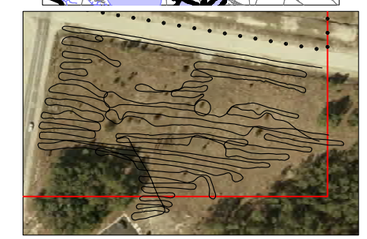
Date of Survey: May 21, 2009
Date of Map Creation: May 20, 2009

Map Approver: J. Guillard

NAEVA GEOPHYSICS INC.
THE LEADER IN SUBSURFACE DETECTION
Subsurface Geophysical Surveys







Legend

- Meandering Path
- Surveyed Transect End Point(s)
- Thin black lines, symbols and text indicate field culture sketch (Accuracy in the range of 1-3m)
- Selected Target (See Target Pick List For Response and Location)

mV
Channel 2

(meters)

NAD83 / UTM zone 18N

Plate 4

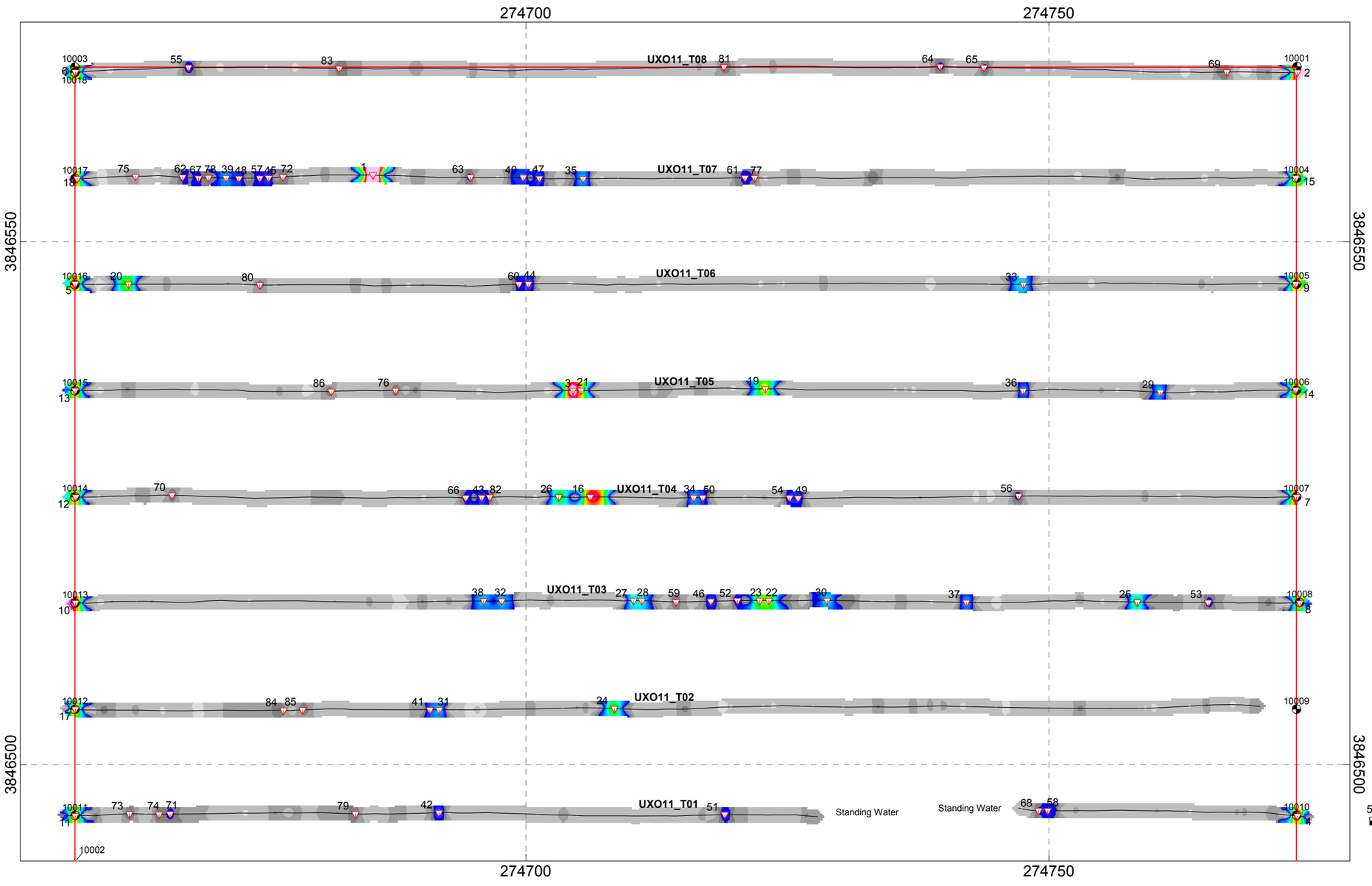
Client: CH2M HILL

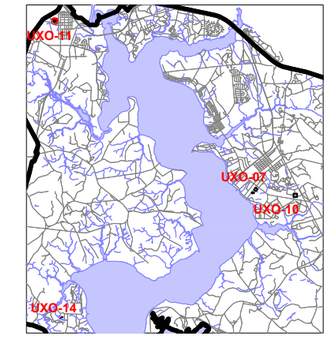
EM61 MK2 Bottom Coil
Block UXO10A Meandering Paths UXO10_MP
Site UXO-10
CTO-014_MRP Site Inspections
Marine Corps Base, Camp Lejeune, North Carolina

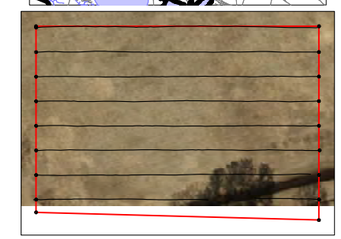
Date of Survey: May 20, 2009
Date of Map Creation: May 26, 2009

Map Approver: J. Guillard

NAEVA GEOPHYSICS INC.
THE LEADER IN SUBSURFACE DETECTION
Subsurface Geophysical Surveys

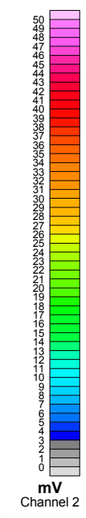






Legend

- Transect Path
- Surveyed Transect End Point(s)
- Brush — Thin black lines, symbols and text indicate field culture sketch (Accuracy in the range of 1-3m)
- 2 — Selected Target (See Target Pick List For Response and Location)



1:420

5 0 5 10 15 20 25
(meters)

NAD83 / UTM zone 18N

Plate 5

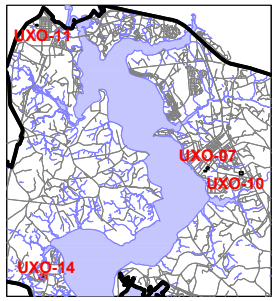
Client: CH2M HILL

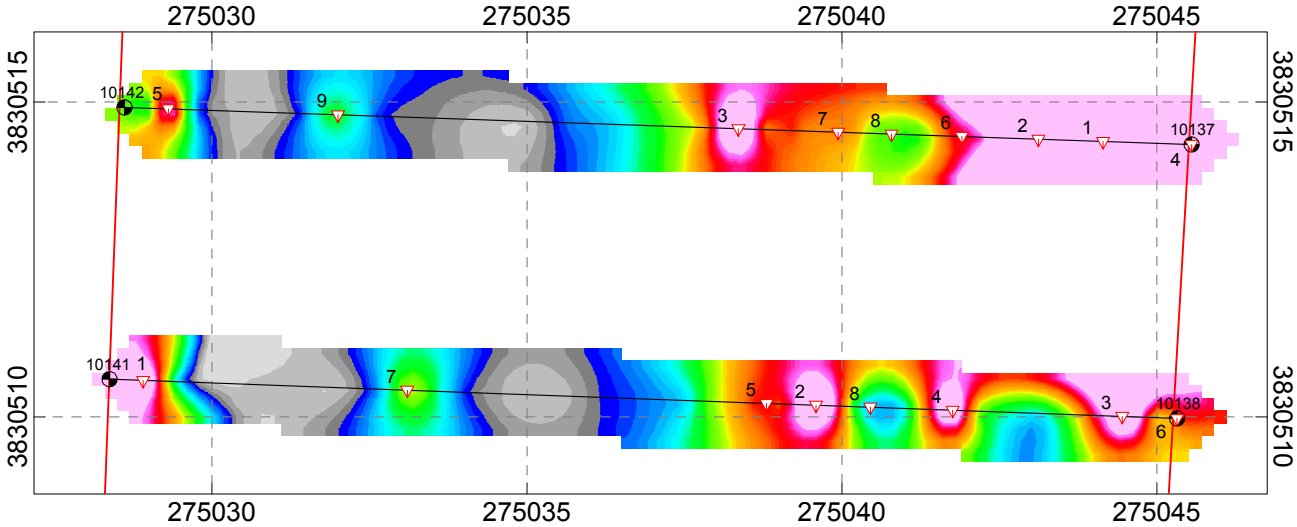
EM61 MK2 Bottom Coil
Block UXO11 Transects UXO11_T01 - UXO11_T08
Site UXO-11
CTO-014_MRP Site Inspections
Marine Corps Base, Camp Lejeune, North Carolina

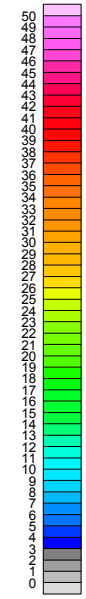
Date of Survey: May 20, 2009
Date of Map Creation: May 22, 2009

Map Approver: J. Guillard

NAeVA GEOPHYSICS INC.
THE LEADER IN SUBSURFACE DETECTION
Subsurface Geophysical Surveys







Legend

- Transect Path
- Surveyed Transect End Point(s)
- Brush — Thin black lines, symbols and text indicate field culture sketch (Accuracy in the range of 1-3m)
- Selected Target (See Target Pick List For Response and Location)

2.5 0 2.5
(meters)

Plate 6

NAD83 / UTM zone 18N

Client: CH2M HILL

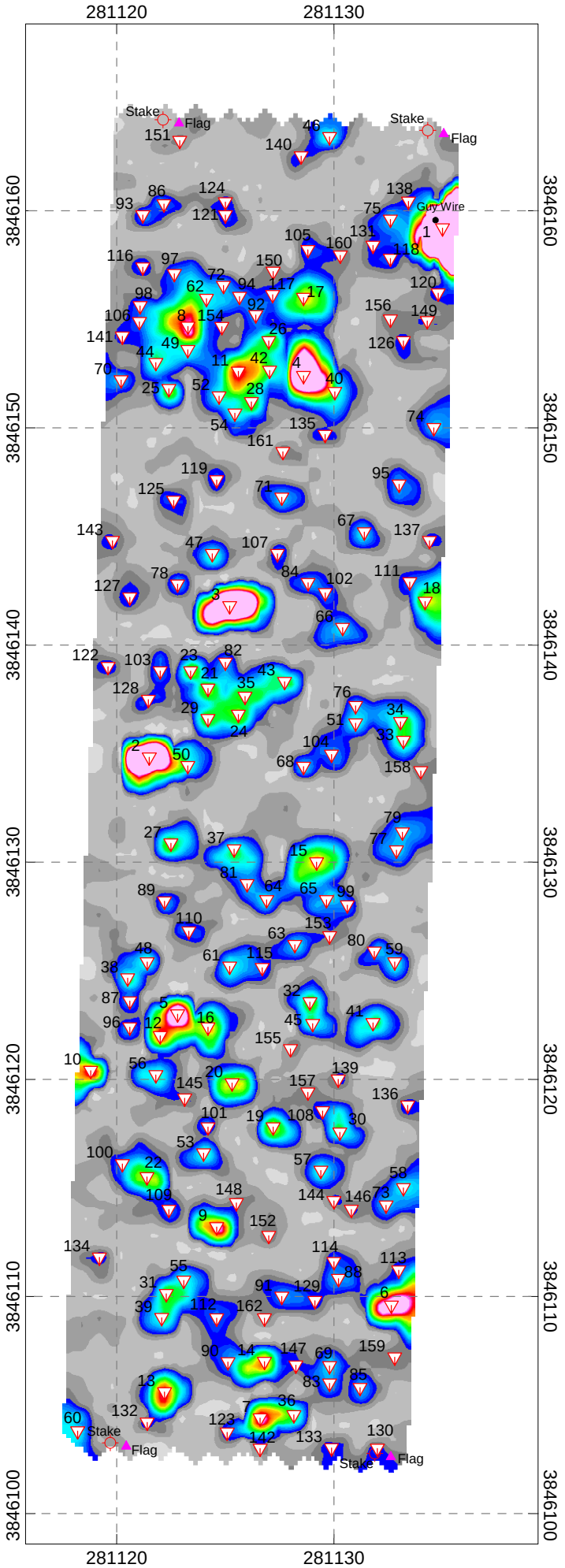
EM61 MK2 Bottom Coil
Block UXO14 Transects UXO14_T01, UXO14_T02
Site UXO-14
CTO-014_MRP Site Inspections
Marine Corps Base, Camp Lejeune, North Carolina

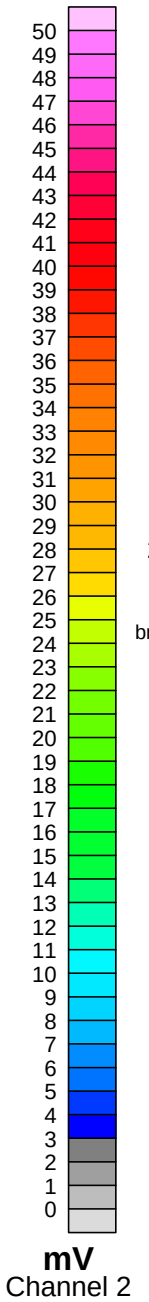
Date of Survey: May 19, 2009
Date of Map Creation: May 21, 2009

Map Approver: J. Guillard

APPENDIX A:
GPO COLOR CONTOUR MAPS

NAEVA GEOPHYSICS INC.
THE LEADER IN SUBSURFACE DETECTION
Subsurface Geophysical Surveys





Legend

- Selected Target (See Target Pick List For Response and Location) (Unique Target ID is XXX, eg. 002)
- Culture (if noted)
- Grid Corner (Idealized)
- Flag Location

Scale 1:300

5 0 5

(meters)

NAD83(NSRS2007) / UTM zone 18N

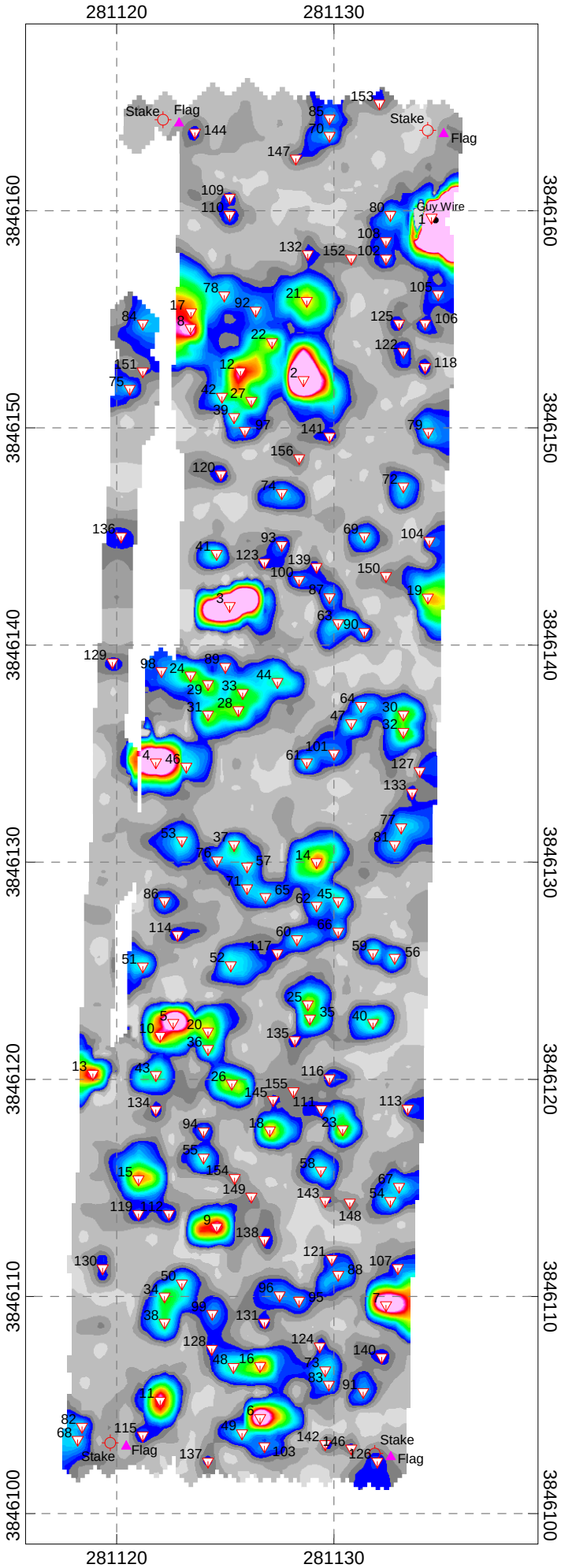
Client: CH2M HILL

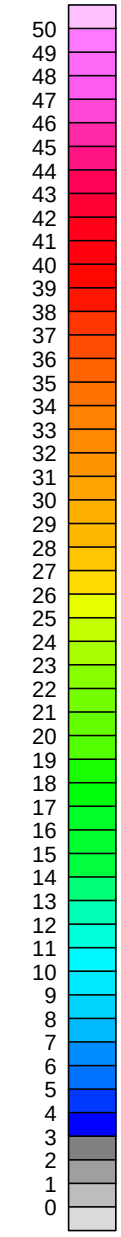
EM61 MK2 Bottom Coil
Geophysical Prove Out (GPO - FID)
Camp Lejeune CTO-014_MRP Site Inspections
Marine Corps Base, Camp Lejeune, North Carolina

Date of Survey: 05/19/2009
Date of Map Creation: 05/20/2009

Map Approver: K. Lemley

NAeVA GEOPHYSICS INC.
THE LEADER IN SUBSURFACE DETECTION
Subsurface Geophysical Surveys





Legend

- Selected Target (See Target Pick List For Response and Location) (Unique Target ID is XXX, eg. 002)
- Culture (if noted)
- Grid Corner (Idealized)
- Flag Location

Scale 1:300

5 0 5

(meters)

NAD83(NSRS2007) / UTM zone 18N

Client: CH2M HILL

EM61 MK2 Bottom Coil
Geophysical Prove Out (GPO - GPS)
Camp Lejeune CTO-014_MRP Site Inspections
Marine Corps Base, Camp Lejeune, North Carolina

Date of Survey: 05/19/2009
Date of Map Creation: 05/20/2009

Map Approver: K. Lemley

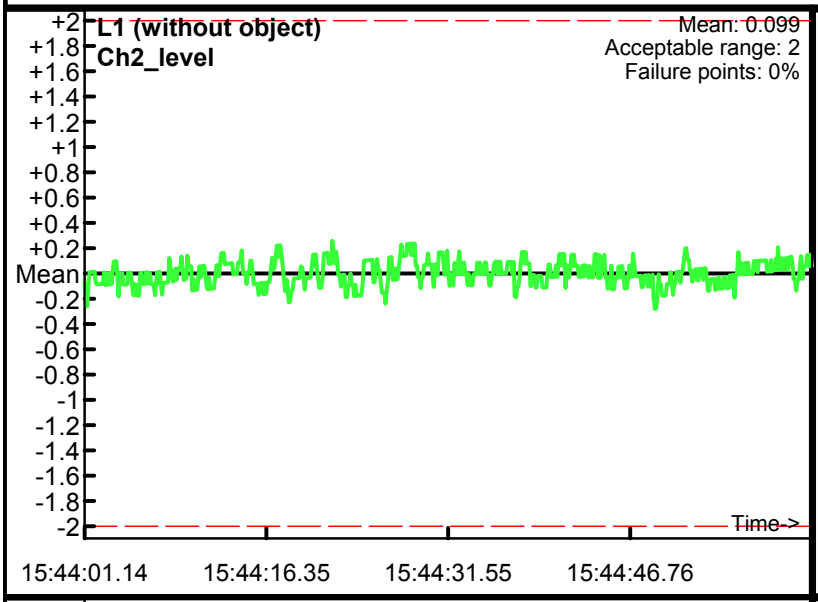
APPENDIX B:
EXAMPLES OF QC TEST RESULTS

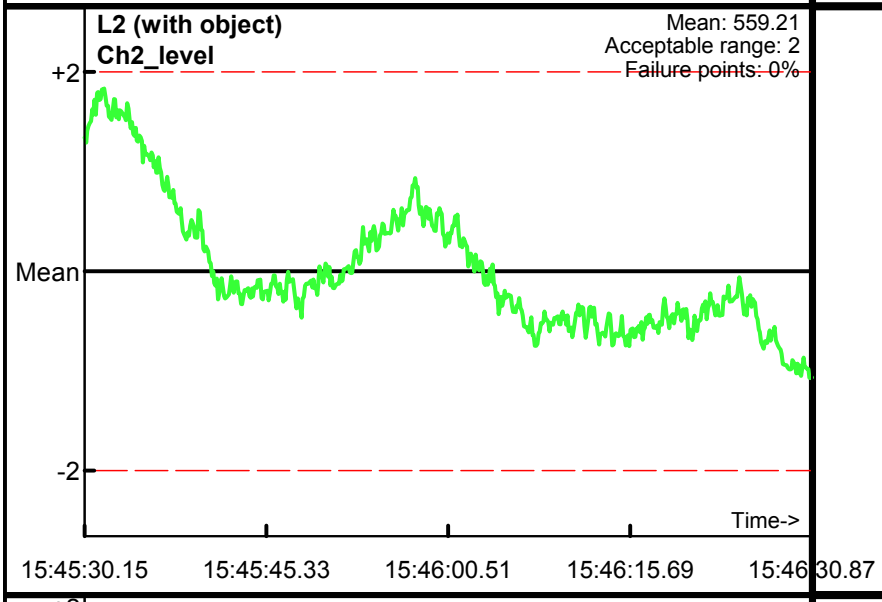
Static Calibration Test

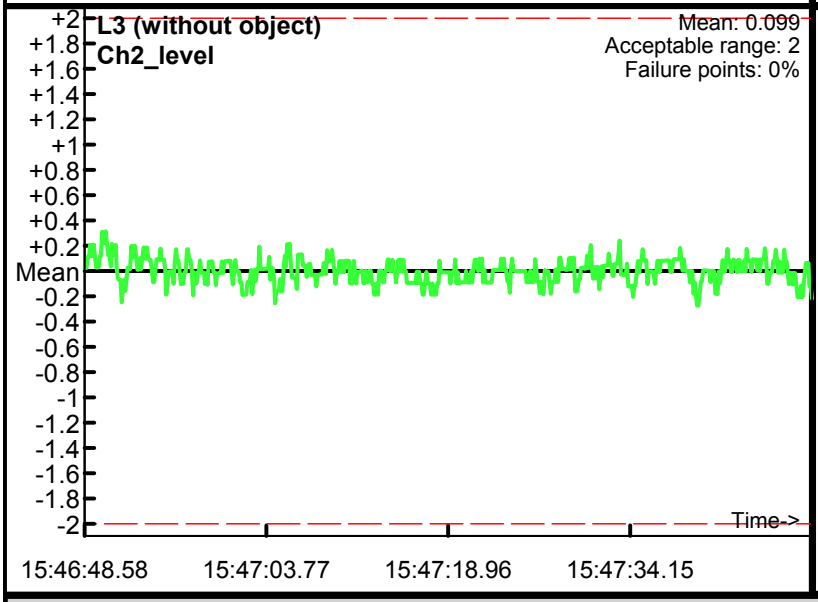
Project: CTO-014_MRP Site Inspections Camp Lejeune
Equipment: EM-61 Mark II
Grid/Location: Localized QC Area

Instrument Threshold: 20%
Outside range
Acceptable limits

PM test
Operator: Geo1
Date: 2009/05/19







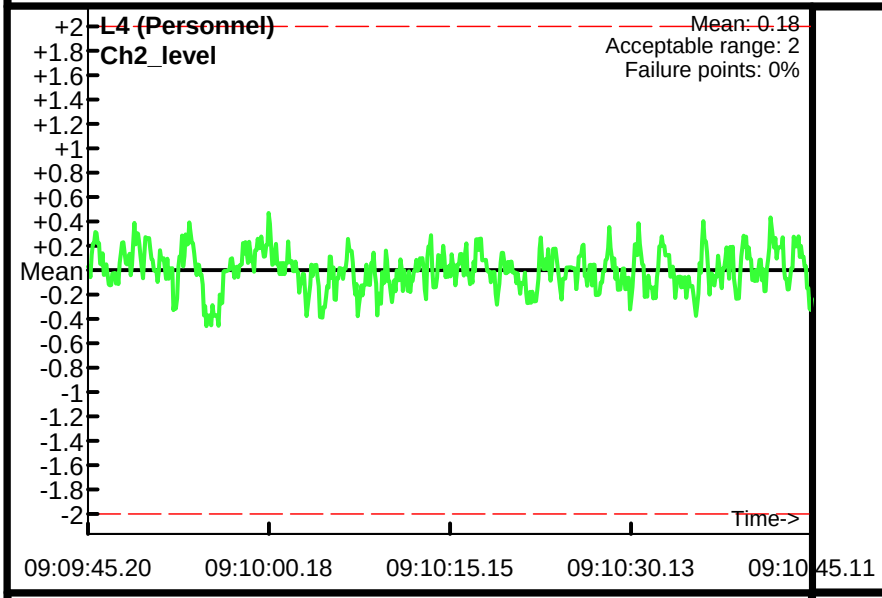
Database: Q:\Virginia Office\CH2M HILL\Camp Lejeune\CTO-014_MRP Site Inspections\Data\Geosoft\QC\0519\0519QC4.gdb
Line Name: L1 L2 L3

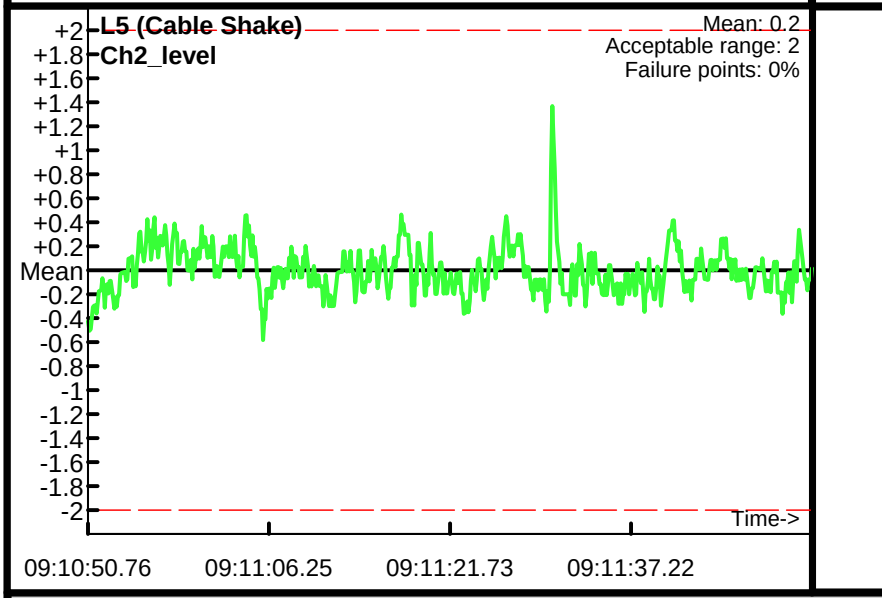
Personnel & Cable Shake Tests

Project: CTO-014_MRP Site Inspections Camp Lejeune
Equipment: EM-61 Mark II
Grid/Location: Localized QC Area

Instrument Threshold: 20%
Outside range
Acceptable limits

QC1 test
Operator: Geo1
Date: 2009/05/21





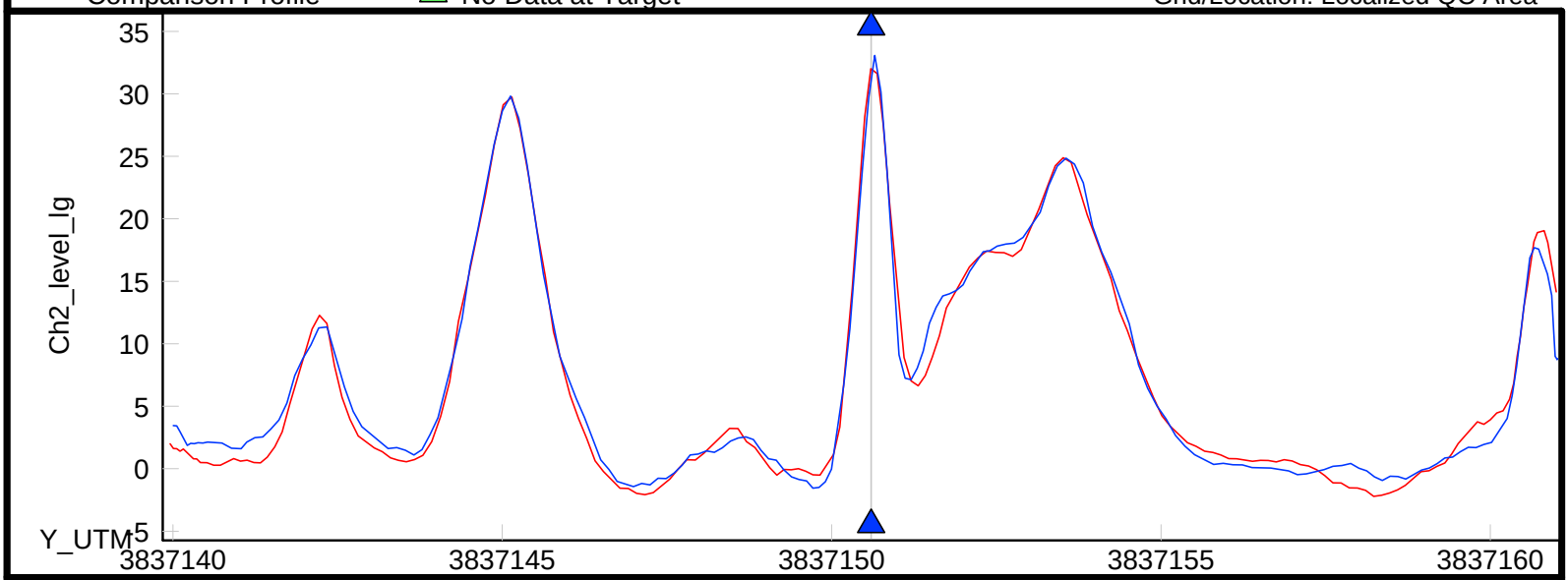
Database: Q:\Virginia Office\CH2M HILL\Camp Lejeune\CTO-014_MRP Site Inspections\Data\Geosoft\QC\0521\0521QC1.gdb
Line Name: L4 L5 L5

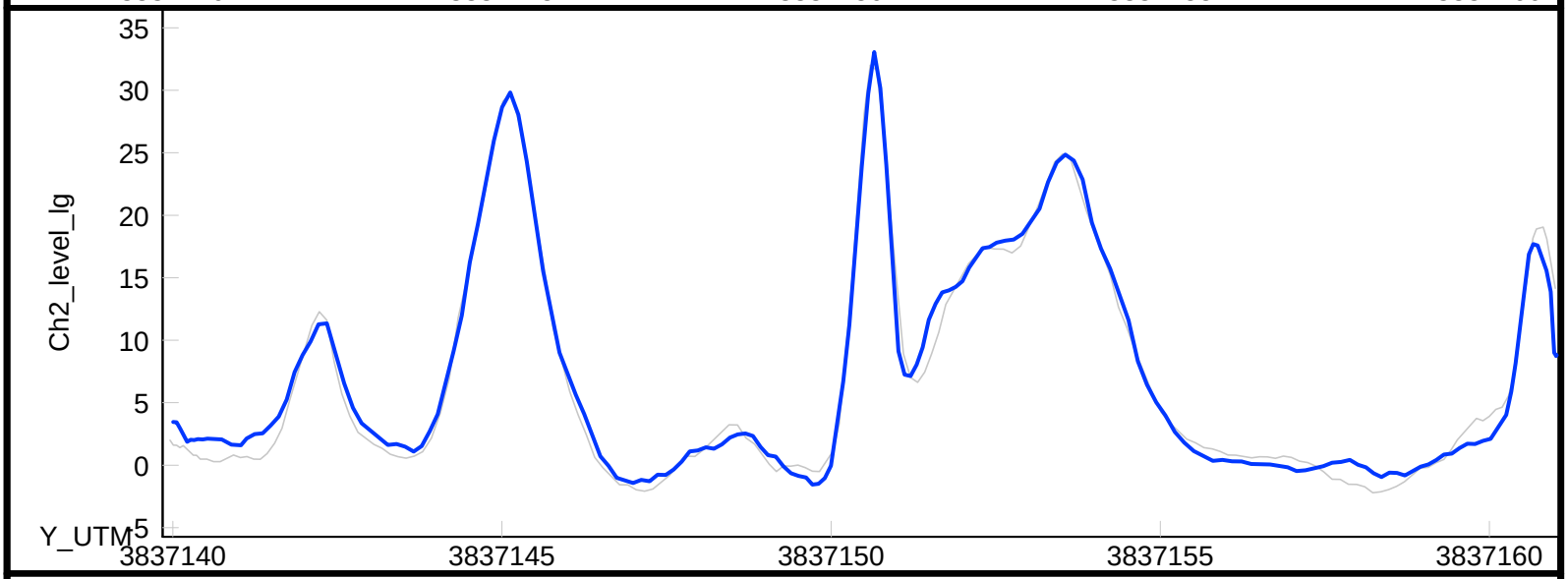
Dynamic Response Test

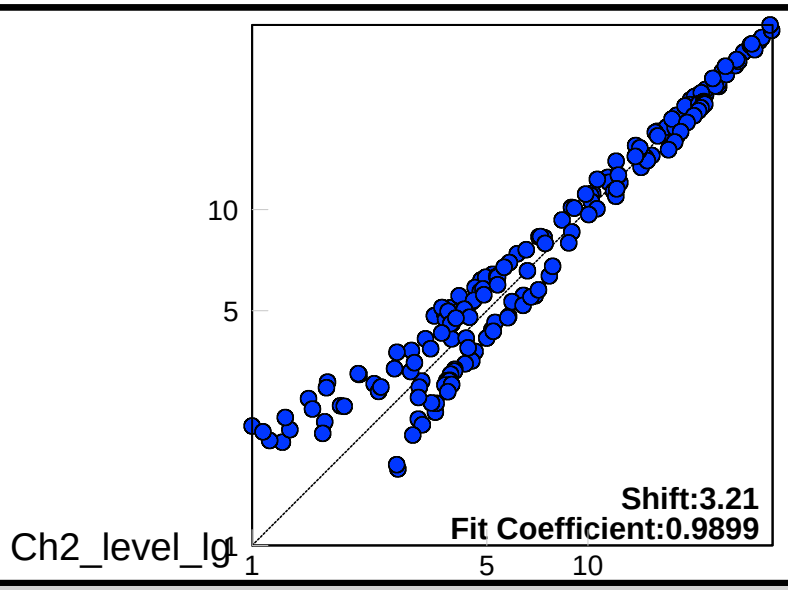
Previous Profiles
Reference Profile
Comparison Profile

Top:First/Bottom:Second Profile
Target Value <= Tolerance
Target Value > Tolerance
No Data at Target

Peak Tolerance(Value): 20(%)
Operator: Geo1
Project: CTO-014_MRP Site Inspections Camp Lejeune
Equipment: EM-61 Mark II
Grid/Location: Localized QC Area

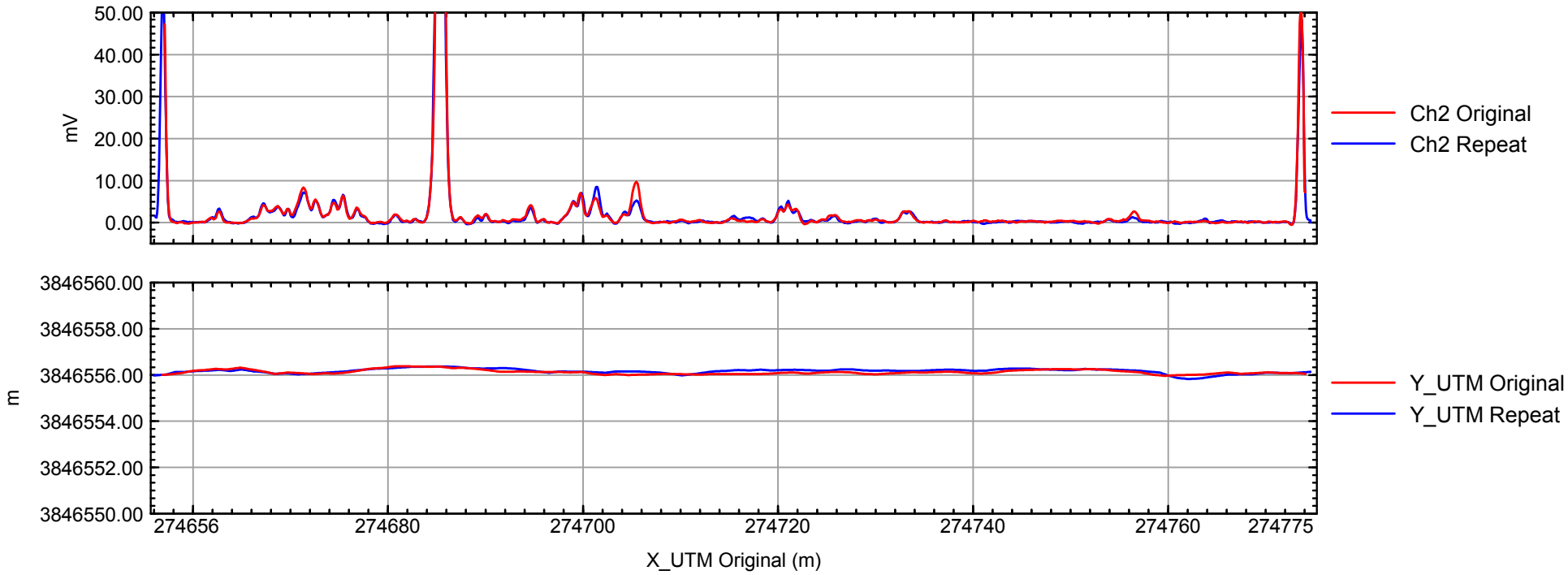






Reference Date: 2009/05/21(L6)
Database: Q:\Virginia Office\CH2M HILL\Camp Lejeune\CTO-014_MRP Site Inspections\Data\Geosoft\Q0105\2009\05\21\L7.gdb

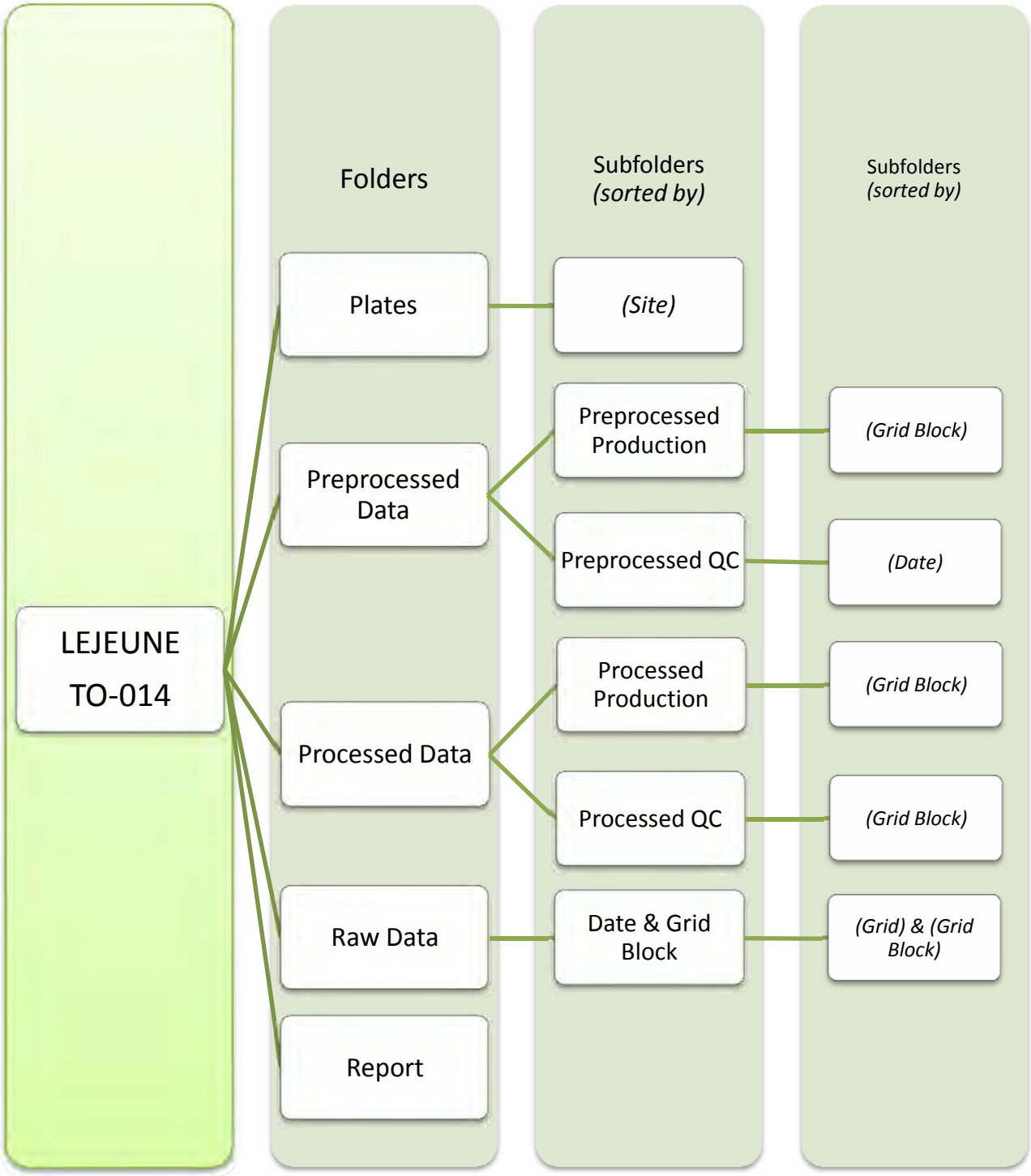
CTO-014_MRP Site Inspections - Camp Lejeune, North Carolina
EM61MK2 - Block UXO11 - Repeat Line 7



Database: UXO11 Repeat.gdb Line/Group: L7

Date: 05/20/2009

CONTENTS OF CD



Appendix D
Data Validation Summary Reports

ENVIRONMENTAL
Data Services, Inc.

METALS & CYANIDE
USEPA Region IV - Level IV Review

Site: MCB Camp Lejeune, CTO-014, UXO-011 SDG #: UX011_002

Client: CH2M HILL, Inc., Virginia Beach, Virginia Date: February 24, 2010

Laboratory: Empirical Laboratories, Nashville, Tennessee Reviewer: Nancy Weaver

EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1*	MR11-FB111209 (T)	0911122-01	Water
2	MR11-FB111209 (D)	0911122-02	Water
3*	MR11-EB111209-SD (T)	0911122-03	Water
4	MR11-EB111209-SD (D)	0911122-04	Water
5*	MR11-SW01-09D (T)	0911122-05	Water
6	MR11-SW01-09D (D)	0911122-06	Water
7*	MR11-SW01D-09D (T)	0911122-07	Water
8	MR11-SW01D-09D (D)	0911122-08	Water
9*	MR11-SD01-09D (T)	0911122-09	Soil
10*	MR11-SD01D-09D (T)	0911122-10	Soil
11*	MR11-SW02-09D (T)	0911122-11	Water
11MS*	MR11-SW02-09D (T)MS	0911122-11MS	Water
11MSD*	MR11-SW02-09D (T)MSD	0911122-11MSD	Water
12	MR11-SW02-09D (D)	0911122-12	Water
12MS	MR11-SW02-09D (D)MS	0911122-12MS	Water
12MSD	MR11-SW02-09D (D)MSD	0911122-12MSD	Water
13*	MR11-SD02-09D (T)	0911122-13	Soil
13MS*	MR11-SD02-09D (T)MS	0911122-13MS	Soil
13MSD*	MR11-SD02-09D (T)MSD	0911122-13MSD	Soil

* - Cyanide analysis samples 1, 3, 5, 7, 9, 10, 11, 13 only

The USEPA "Contract Laboratory Program National Functional Guidelines for Inorganic Data Review," October 2004, and professional judgement were used in evaluating the data in this summary report.

Holding Times - All samples were prepared and analyzed within 14 days for cyanide, 28 days for mercury and 180 days for all other metals.

Calibration - The ICV and CCV %R values were acceptable except the following.

Compound	%R	Qualifier	Affected Samples
Potassium	111%	None	Already qualified

CRDL Standard - The CRDL standards exhibited acceptable %R values.

Method and Calibration Blanks - The method blanks and continuing calibration blanks exhibited the following contamination.

Compound	Compound	Conc. mg/kg	Action Level mg/kg	Qualifier	Affected Samples
9K20003-BLK1	Cadmium	0.0719	0.3595	None	All >5X
	Selenium	0.271	1.355	U	9, 10, 13

Field and Equipment Blank - Field QC results are summarized below.

Blank ID	Compound	Conc. ug/L	Action Level ug/L	Qualifier	Affected Samples
MR11-FB111209 (T)	None - ND	-	-	-	-
MR11-FB111209 (D)	Iron	23.2	116	U	6, 8, 12
MR11-EB111209-SD (T)	Cadmium	0.27	1.37	U	9, 10, 13
MR11-EB111209-SD (D)	None - ND	-	-	-	-

ICP Interference Check Sample - All %R values were acceptable.

Matrix Spike/Duplicate - The matrix spike/duplicate samples exhibited acceptable %R and RPD values except the following.

MS/MSD Sample ID	Compound	%R	Qualifier	Affected Samples
13	Antimony	42%/43.7%/Ok	J/UJ	9, 10, 13
	Potassium	126%/Ok/Ok	J	9, 10, 13
	Sodium	127%/127%/Ok	None	All ND

LCS - The LCS samples exhibited acceptable %R values.

ICP Serial Dilution - The ICP serial dilution sample exhibited acceptable %D values.

Field Duplicates - Field duplicate results are summarized below.

Compound	MR11-SW01-09D (T) ug/L	MR11-SW01D-09D (T) ug/L	RPD	Qualifier
Aluminum	55.2	57.0	3%	None
Barium	3.64	3.69	1%	None
Cadmium	0.344	0.330	4%	None
Calcium	10700	11000	3%	None
Iron	22.4	22.7	1%	None
Magnesium	2000	2030	1%	None
Manganese	ND	0.918	NC	None
Potassium	2210	2270	3%	None
Sodium	1200	1220	2%	None
Zinc	2.39	2.44	2%	None

Compound	MR11-SW01-09D (D) ug/L	MR11-SW01D-09D (D) ug/L	RPD	Qualifier
Aluminum	38.3	36.1	6%	None
Barium	4.02	3.81	5%	None
Cadmium	0.362	0.333	8%	None
Calcium	11600	11500	1%	None
Copper	ND	4.11	NC	None
Magnesium	2090	2100	0%	None
Potassium	2310	2340	1%	None
Sodium	1480	1460	1%	None
Zinc	5.19	4.06	24%	None

Compound	MR11-SD01-09D (T) mg/kg	MR11-SD01D-09D (T) mg/kg	RPD	Qualifier
Aluminum	10300	9170	12%	None
Arsenic	1.55	1.33	15%	None
Barium	42.7	25.1	52%	None
Beryllium	0.221	0.193	14%	None
Calcium	20200	19400	4%	None
Chromium	17.8	18.3	3%	None
Cobalt	0.688	0.629	9%	None
Copper	5.42	5.38	1%	None
Iron	3230	2970	8%	None
Lead	87.8	91.3	4%	None
Magnesium	820	770	6%	None
Manganese	17.2	16.3	5%	None
Mercury	0.0492	0.0476	3%	None
Nickel	2.46	2.36	4%	None
Potassium	320	310	3%	None
Vanadium	13.7	12.7	8%	None
Zinc	36.5	39.3	7%	None

Compound Quantitation - No discrepancies were identified.

ANALYSIS DATA SHEET

MR11-FB111209

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Water
Sampled: 11/12/09 15:50
% Solids: 0.00

SDG: UXO11_002
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0911122-01
Received: 11/13/09 08:15

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
7439-97-6	Mercury		0.0800	0.200	1	U	SW7470A	9K17021	11/18/09 13:42
7429-90-5	Aluminum		12.5	50.0	1	U	SW6010B	9K18005	11/23/09 16:57
7440-36-0	Antimony		1.25	3.75	1	U	SW6010B	9K18005	11/23/09 16:57
7440-38-2	Arsenic		0.750	1.25	1	U	SW6010B	9K18005	11/23/09 16:57
7440-39-3	Barium		1.25	10.0	1	U	SW6010B	9K18005	11/23/09 16:57
7440-41-7	Beryllium		0.250	1.25	1	U	SW6010B	9K18005	11/23/09 16:57
7440-43-9	Cadmium		0.250	1.25	1	U	SW6010B	9K18005	11/23/09 16:57
7440-70-2	Calcium		250	1250	1	U	SW6010B	9K18005	11/23/09 16:57
7440-47-3	Chromium		0.500	1.25	1	U	SW6010B	9K18005	11/23/09 16:57
7440-48-4	Cobalt		1.25	3.12	1	U	SW6010B	9K18005	11/23/09 16:57
7440-50-8	Copper		1.25	2.50	1	U	SW6010B	9K18005	11/23/09 16:57
7439-89-6	Iron		7.50	25.0	1	U	SW6010B	9K18005	11/23/09 16:57
7439-92-1	Lead		0.500	0.750	1	U	SW6010B	9K18005	11/23/09 16:57
7439-95-4	Magnesium		250	1250	1	U	SW6010B	9K18005	11/23/09 16:57
7439-96-5	Manganese		0.750	3.75	1	U	SW6010B	9K18005	11/23/09 16:57
7440-02-0	Nickel		0.750	2.50	1	U	SW6010B	9K18005	11/23/09 16:57
7440-09-7	Potassium		250	1250	1	U	SW6010B	9K18005	11/23/09 16:57
7782-49-2	Selenium		0.750	1.25	1	U	SW6010B	9K18005	11/23/09 16:57
7440-22-4	Silver		0.250	1.25	1	U	SW6010B	9K18005	11/23/09 16:57
7440-23-5	Sodium		250	1250	1	U	SW6010B	9K18005	11/23/09 16:57
7440-28-0	Thallium		0.750	2.00	1	U	SW6010B	9K18005	11/23/09 16:57
7440-62-2	Vanadium		1.25	3.12	1	U	SW6010B	9K18005	11/23/09 16:57
7440-66-6	Zinc		1.25	5.00	1	U	SW6010B	9K18005	11/23/09 16:57
CAS NO.	Analyte	Concentration (mg/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
57-12-5	Cyanide		0.00500	0.0100	1	U	SW9012A	9K19020	11/20/09 12:13

lw
2/24/10

ANALYSIS DATA SHEET

MR11-FB111209 2

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Water
Sampled: 11/12/09 15:50
% Solids: 0.00

SDG: UXO11_002
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0911122-02
Received: 11/13/09 08:15

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
7439-97-6	Mercury (dissolved)		0.0800	0.200	1	U	SW7470A	9K23004	11/23/09 12:46
7429-90-5	Aluminum (dissolved)		12.5	50.0	1	U	SW6010B	9K20004	11/23/09 17:45
7440-36-0	Antimony (dissolved)		1.25	3.75	1	U	SW6010B	9K20004	11/23/09 17:45
7440-38-2	Arsenic (dissolved)		0.750	1.25	1	U ~~N~~	SW6010B	9K20004	11/23/09 17:45
7440-39-3	Barium (dissolved)		1.25	10.0	1	U	SW6010B	9K20004	11/23/09 17:45
7440-41-7	Beryllium (dissolved)		0.250	1.25	1	U	SW6010B	9K20004	11/23/09 17:45
7440-43-9	Cadmium (dissolved)		0.250	1.25	1	U	SW6010B	9K20004	11/23/09 17:45
7440-70-2	Calcium (dissolved)		250	1250	1	U	SW6010B	9K20004	11/23/09 17:45
7440-47-3	Chromium (dissolved)		0.500	1.25	1	U	SW6010B	9K20004	11/23/09 17:45
7440-48-4	Cobalt (dissolved)		1.25	3.12	1	U	SW6010B	9K20004	11/23/09 17:45
7440-50-8	Copper (dissolved)		1.25	2.50	1	U	SW6010B	9K20004	11/23/09 17:45
7439-89-6	Iron (dissolved)	23.2	7.50	25.0	1	J	SW6010B	9K20004	11/23/09 17:45
7439-92-1	Lead (dissolved)		0.375	0.750	1	U	SW6010B	9K20004	11/23/09 17:45
7439-95-4	Magnesium (dissolved)		250	1250	1	U	SW6010B	9K20004	11/23/09 17:45
7439-96-5	Manganese (dissolved)		0.750	3.75	1	U	SW6010B	9K20004	11/23/09 17:45
7440-02-0	Nickel (dissolved)		0.750	2.50	1	U	SW6010B	9K20004	11/23/09 17:45
7440-09-7	Potassium (dissolved)		250	1250	1	U ~~N~~	SW6010B	9K20004	11/23/09 17:45
7782-49-2	Selenium (dissolved)		0.750	1.25	1	U	SW6010B	9K20004	11/23/09 17:45
7440-22-4	Silver (dissolved)		0.250	1.25	1	U	SW6010B	9K20004	11/23/09 17:45
7440-23-5	Sodium (dissolved)		250	1250	1	U ~~N~~	SW6010B	9K20004	11/23/09 17:45
7440-28-0	Thallium (dissolved)		0.750	2.00	1	U	SW6010B	9K20004	11/23/09 17:45
7440-62-2	Vanadium (dissolved)		1.25	3.12	1	U	SW6010B	9K20004	11/23/09 17:45
7440-66-6	Zinc (dissolved)		1.25	5.00	1	U	SW6010B	9K20004	11/23/09 17:45

RW 2/24/10

ANALYSIS DATA SHEET

MR11-EB111209-SD

3

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Water
Sampled: 11/12/09 16:00
% Solids: 0.00

SDG: UXO11_002
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0911122-03
Received: 11/13/09 08:15

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
7439-97-6	Mercury		0.0800	0.200	1	U	SW7470A	9K17021	11/18/09 13:45
7429-90-5	Aluminum		12.5	50.0	1	U	SW6010B	9K18005	11/23/09 17:02
7440-36-0	Antimony		1.25	3.75	1	U	SW6010B	9K18005	11/23/09 17:02
7440-38-2	Arsenic		0.750	1.25	1	U	SW6010B	9K18005	11/23/09 17:02
7440-39-3	Barium		1.25	10.0	1	U	SW6010B	9K18005	11/23/09 17:02
7440-41-7	Beryllium		0.250	1.25	1	U	SW6010B	9K18005	11/23/09 17:02
7440-43-9	Cadmium	0.274	0.250	1.25	1	J	SW6010B	9K18005	11/23/09 17:02
7440-70-2	Calcium		250	1250	1	U	SW6010B	9K18005	11/23/09 17:02
7440-47-3	Chromium		0.500	1.25	1	U	SW6010B	9K18005	11/23/09 17:02
7440-48-4	Cobalt		1.25	3.12	1	U	SW6010B	9K18005	11/23/09 17:02
7440-50-8	Copper		1.25	2.50	1	U	SW6010B	9K18005	11/23/09 17:02
7439-89-6	Iron		7.50	25.0	1	U	SW6010B	9K18005	11/23/09 17:02
7439-92-1	Lead		0.500	0.750	1	U	SW6010B	9K18005	11/23/09 17:02
7439-95-4	Magnesium		250	1250	1	U	SW6010B	9K18005	11/23/09 17:02
7439-96-5	Manganese		0.750	3.75	1	U	SW6010B	9K18005	11/23/09 17:02
7440-02-0	Nickel		0.750	2.50	1	U	SW6010B	9K18005	11/23/09 17:02
7440-09-7	Potassium		250	1250	1	U	SW6010B	9K18005	11/23/09 17:02
7782-49-2	Selenium		0.750	1.25	1	U	SW6010B	9K18005	11/23/09 17:02
7440-22-4	Silver		0.250	1.25	1	U	SW6010B	9K18005	11/23/09 17:02
7440-23-5	Sodium		250	1250	1	U	SW6010B	9K18005	11/23/09 17:02
7440-28-0	Thallium		0.750	2.00	1	U	SW6010B	9K18005	11/23/09 17:02
7440-62-2	Vanadium		1.25	3.12	1	U	SW6010B	9K18005	11/23/09 17:02
7440-66-6	Zinc		1.25	5.00	1	U	SW6010B	9K18005	11/23/09 17:02
CAS NO.	Analyte	Concentration (mg/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
57-12-5	Cyanide		0.00500	0.0100	1	U	SW9012A	9K19020	11/20/09 12:14

MW 2/24/10

ANALYSIS DATA SHEET

MR11-EB111209-SD 4

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Water
Sampled: 11/12/09 16:00
% Solids: 0.00

SDG: UXO11_002
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0911122-04
Received: 11/13/09 08:15

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
7439-97-6	Mercury (dissolved)		0.0800	0.200	1	U	SW7470A	9K23004	11/23/09 12:47
7429-90-5	Aluminum (dissolved)		12.5	50.0	1	U	SW6010B	9K20004	11/23/09 17:50
7440-36-0	Antimony (dissolved)		1.25	3.75	1	U	SW6010B	9K20004	11/23/09 17:50
7440-38-2	Arsenic (dissolved)		0.750	1.25	1	U ~~N~~	SW6010B	9K20004	11/23/09 17:50
7440-39-3	Barium (dissolved)		1.25	10.0	1	U	SW6010B	9K20004	11/23/09 17:50
7440-41-7	Beryllium (dissolved)		0.250	1.25	1	U	SW6010B	9K20004	11/23/09 17:50
7440-43-9	Cadmium (dissolved)		0.250	1.25	1	U	SW6010B	9K20004	11/23/09 17:50
7440-70-2	Calcium (dissolved)		250	1250	1	U	SW6010B	9K20004	11/23/09 17:50
7440-47-3	Chromium (dissolved)		0.500	1.25	1	U	SW6010B	9K20004	11/23/09 17:50
7440-48-4	Cobalt (dissolved)		1.25	3.12	1	U	SW6010B	9K20004	11/23/09 17:50
7440-50-8	Copper (dissolved)		1.25	2.50	1	U	SW6010B	9K20004	11/23/09 17:50
7439-89-6	Iron (dissolved)		7.50	25.0	1	U	SW6010B	9K20004	11/23/09 17:50
7439-92-1	Lead (dissolved)		0.500	0.750	1	U	SW6010B	9K20004	11/23/09 17:50
7439-95-4	Magnesium (dissolved)		250	1250	1	U	SW6010B	9K20004	11/23/09 17:50
7439-96-5	Manganese (dissolved)		0.750	3.75	1	U	SW6010B	9K20004	11/23/09 17:50
7440-02-0	Nickel (dissolved)		0.750	2.50	1	U	SW6010B	9K20004	11/23/09 17:50
7440-09-7	Potassium (dissolved)		250	1250	1	U ~~N~~	SW6010B	9K20004	11/23/09 17:50
7782-49-2	Selenium (dissolved)		0.750	1.25	1	U	SW6010B	9K20004	11/23/09 17:50
7440-22-4	Silver (dissolved)		0.250	1.25	1	U	SW6010B	9K20004	11/23/09 17:50
7440-23-5	Sodium (dissolved)		250	1250	1	U ~~N~~	SW6010B	9K20004	11/23/09 17:50
7440-28-0	Thallium (dissolved)		0.750	2.00	1	U	SW6010B	9K20004	11/23/09 17:50
7440-62-2	Vanadium (dissolved)		1.25	3.12	1	U	SW6010B	9K20004	11/23/09 17:50
7440-66-6	Zinc (dissolved)		1.25	5.00	1	U	SW6010B	9K20004	11/23/09 17:50

MW
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ANALYSIS DATA SHEET

MR11-SW01-09D

5

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Water
Sampled: 11/12/09 15:25
% Solids: 0.00

SDG: UXO11_002
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0911122-05
Received: 11/13/09 08:15

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
7439-97-6	Mercury		0.0800	0.200	1	U	SW7470A	9K17021	11/18/09 13:46
7429-90-5	Aluminum	55.2	12.5	50.0	1		SW6010B	9K18005	11/23/09 17:07
7440-36-0	Antimony		1.25	3.75	1	U	SW6010B	9K18005	11/23/09 17:07
7440-38-2	Arsenic		0.750	1.25	1	U	SW6010B	9K18005	11/23/09 17:07
7440-39-3	Barium	3.64	1.25	10.0	1	J	SW6010B	9K18005	11/23/09 17:07
7440-41-7	Beryllium		0.250	1.25	1	U	SW6010B	9K18005	11/23/09 17:07
7440-43-9	Cadmium	0.344	0.250	1.25	1	J	SW6010B	9K18005	11/23/09 17:07
7440-70-2	Calcium	10700	250	1250	1		SW6010B	9K18005	11/23/09 17:07
7440-47-3	Chromium		0.500	1.25	1	U	SW6010B	9K18005	11/23/09 17:07
7440-48-4	Cobalt		1.25	3.12	1	U	SW6010B	9K18005	11/23/09 17:07
7440-50-8	Copper		1.25	2.50	1	U	SW6010B	9K18005	11/23/09 17:07
7439-89-6	Iron	22.4	7.50	25.0	1	J	SW6010B	9K18005	11/23/09 17:07
7439-92-1	Lead		0.375	0.750	1	U	SW6010B	9K18005	11/23/09 17:07
7439-95-4	Magnesium	2000	250	1250	1		SW6010B	9K18005	11/23/09 17:07
7439-96-5	Manganese		0.750	3.75	1	U	SW6010B	9K18005	11/23/09 17:07
7440-02-0	Nickel		0.750	2.50	1	U	SW6010B	9K18005	11/23/09 17:07
7440-09-7	Potassium	2210	250	1250	1		SW6010B	9K18005	11/23/09 17:07
7782-49-2	Selenium		0.750	1.25	1	U	SW6010B	9K18005	11/23/09 17:07
7440-22-4	Silver		0.250	1.25	1	U	SW6010B	9K18005	11/23/09 17:07
7440-23-5	Sodium	1200	250	1250	1	J	SW6010B	9K18005	11/23/09 17:07
7440-28-0	Thallium		0.750	2.00	1	U	SW6010B	9K18005	11/23/09 17:07
7440-62-2	Vanadium		1.25	3.12	1	U	SW6010B	9K18005	11/23/09 17:07
7440-66-6	Zinc	2.39	1.25	5.00	1	J	SW6010B	9K18005	11/23/09 17:07
CAS NO.	**Analyte**	**Concentration (mg/L)**	**MDL**	**RL**	**Dilution Factor**	**Q**	**Method**	**Batch**	**Analyzed**
57-12-5	Cyanide		0.00500	0.0100	1	U	SW9012A	9K23020	11/24/09 14:12

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ANALYSIS DATA SHEET

MR11-SW01-09D

6

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Water
Sampled: 11/12/09 15:25
% Solids: 0.00

SDG: UXO11_002
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0911122-06
Received: 11/13/09 08:15

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
7439-97-6	Mercury (dissolved)		0.0800	0.200	1	U	SW7470A	9K23004	11/23/09 12:48
7429-90-5	Aluminum (dissolved)	38.3	12.5	50.0	1	J	SW6010B	9K20004	11/23/09 17:54
7440-36-0	Antimony (dissolved)		1.25	3.75	1	U	SW6010B	9K20004	11/23/09 17:54
7440-38-2	Arsenic (dissolved)		0.750	1.25	1	U ~~N~~	SW6010B	9K20004	11/23/09 17:54
7440-39-3	Barium (dissolved)	4.02	1.25	10.0	1	J	SW6010B	9K20004	11/23/09 17:54
7440-41-7	Beryllium (dissolved)		0.250	1.25	1	U	SW6010B	9K20004	11/23/09 17:54
7440-43-9	Cadmium (dissolved)	0.362	0.250	1.25	1	J	SW6010B	9K20004	11/23/09 17:54
7440-70-2	Calcium (dissolved)	11600	250	1250	1		SW6010B	9K20004	11/23/09 17:54
7440-47-3	Chromium (dissolved)		0.500	1.25	1	U	SW6010B	9K20004	11/23/09 17:54
7440-48-4	Cobalt (dissolved)		1.25	3.12	1	U	SW6010B	9K20004	11/23/09 17:54
7440-50-8	Copper (dissolved)		1.25	2.50	1	U	SW6010B	9K20004	11/23/09 17:54
7439-89-6	Iron (dissolved) FBL	25 ~~160~~ U	7.50	25.0	1	J	SW6010B	9K20004	11/23/09 17:54
7439-92-1	Lead (dissolved)		0.375	0.750	1	U	SW6010B	9K20004	11/23/09 17:54
7439-95-4	Magnesium (dissolved)	2090	250	1250	1		SW6010B	9K20004	11/23/09 17:54
7439-96-5	Manganese (dissolved)		0.750	3.75	1	U	SW6010B	9K20004	11/23/09 17:54
7440-02-0	Nickel (dissolved)		0.750	2.50	1	U	SW6010B	9K20004	11/23/09 17:54
7440-09-7	Potassium (dissolved)	2310	250	1250	1	~~N~~	SW6010B	9K20004	11/23/09 17:54
7782-49-2	Selenium (dissolved)		0.750	1.25	1	U	SW6010B	9K20004	11/23/09 17:54
7440-22-4	Silver (dissolved)		0.250	1.25	1	U	SW6010B	9K20004	11/23/09 17:54
7440-23-5	Sodium (dissolved)	1480	250	1250	1	~~N~~	SW6010B	9K20004	11/23/09 17:54
7440-28-0	Thallium (dissolved)		0.750	2.00	1	U	SW6010B	9K20004	11/23/09 17:54
7440-62-2	Vanadium (dissolved)		1.25	3.12	1	U	SW6010B	9K20004	11/23/09 17:54
7440-66-6	Zinc (dissolved)	5.19	1.25	5.00	1		SW6010B	9K20004	11/23/09 17:54

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ANALYSIS DATA SHEET

MR11-SW01D-09D

7

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Water
Sampled: 11/12/09 15:30
% Solids: 0.00

SDG: UXO11_002
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0911122-07
Received: 11/13/09 08:15

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
7439-97-6	Mercury		0.0800	0.200	1	U	SW7470A	9K17021	11/18/09 13:47
7429-90-5	Aluminum	57.0	12.5	50.0	1		SW6010B	9K20004	11/23/09 17:59
7440-36-0	Antimony		1.25	3.75	1	U	SW6010B	9K20004	11/23/09 17:59
7440-38-2	Arsenic		0.750	1.25	1	U N	SW6010B	9K20004	11/23/09 17:59
7440-39-3	Barium	3.69	1.25	10.0	1	J	SW6010B	9K20004	11/23/09 17:59
7440-41-7	Beryllium		0.250	1.25	1	U	SW6010B	9K20004	11/23/09 17:59
7440-43-9	Cadmium	0.330	0.250	1.25	1	J	SW6010B	9K20004	11/23/09 17:59
7440-70-2	Calcium	11000	250	1250	1		SW6010B	9K20004	11/23/09 17:59
7440-47-3	Chromium		0.500	1.25	1	U	SW6010B	9K20004	11/23/09 17:59
7440-48-4	Cobalt		1.25	3.12	1	U	SW6010B	9K20004	11/23/09 17:59
7440-50-8	Copper		1.25	2.50	1	U	SW6010B	9K20004	11/23/09 17:59
7439-89-6	Iron	22.7	7.50	25.0	1	J	SW6010B	9K20004	11/23/09 17:59
7439-92-1	Lead		0.375	0.750	1	U	SW6010B	9K20004	11/23/09 17:59
7439-95-4	Magnesium	2030	250	1250	1		SW6010B	9K20004	11/23/09 17:59
7439-96-5	Manganese	0.918	0.750	3.75	1	J	SW6010B	9K20004	11/23/09 17:59
7440-02-0	Nickel		0.750	2.50	1	U	SW6010B	9K20004	11/23/09 17:59
7440-09-7	Potassium	2270	250	1250	1	N	SW6010B	9K20004	11/23/09 17:59
7782-49-2	Selenium		0.750	1.25	1	U	SW6010B	9K20004	11/23/09 17:59
7440-22-4	Silver		0.250	1.25	1	U	SW6010B	9K20004	11/23/09 17:59
7440-23-5	Sodium	1220	250	1250	1	J N	SW6010B	9K20004	11/23/09 17:59
7440-28-0	Thallium		0.750	2.00	1	U	SW6010B	9K20004	11/23/09 17:59
7440-62-2	Vanadium		1.25	3.12	1	U	SW6010B	9K20004	11/23/09 17:59
7440-66-6	Zinc	2.44	1.25	5.00	1	J	SW6010B	9K20004	11/23/09 17:59
CAS NO.	**Analyte**	**Concentration (mg/L)**	**MDL**	**RL**	**Dilution Factor**	**Q**	**Method**	**Batch**	**Analyzed**
57-12-5	Cyanide		0.00500	0.0100	1	U	SW9012A	9K23020	11/24/09 14:15

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ANALYSIS DATA SHEET

MR11-SW01D-09D

8

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Water
Sampled: 11/12/09 15:30
% Solids: 0.00

SDG: UXO11_002
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0911122-08
Received: 11/13/09 08:15

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
7439-97-6	Mercury (dissolved)		0.0800	0.200	1	U	SW7470A	9K23004	11/23/09 12:17
7429-90-5	Aluminum (dissolved)	36.1	12.5	50.0	1	J	SW6010B	9K20004	11/23/09 18:04
7440-36-0	Antimony (dissolved)		1.25	3.75	1	U	SW6010B	9K20004	11/23/09 18:04
7440-38-2	Arsenic (dissolved)		0.750	1.25	1	U ~~N*~~	SW6010B	9K20004	11/23/09 18:04
7440-39-3	Barium (dissolved)	3.81	1.25	10.0	1	J	SW6010B	9K20004	11/23/09 18:04
7440-41-7	Beryllium (dissolved)		0.250	1.25	1	U	SW6010B	9K20004	11/23/09 18:04
7440-43-9	Cadmium (dissolved)	0.333	0.250	1.25	1	J	SW6010B	9K20004	11/23/09 18:04
7440-70-2	Calcium (dissolved)	11500	250	1250	1		SW6010B	9K20004	11/23/09 18:04
7440-47-3	Chromium (dissolved)		0.500	1.25	1	U	SW6010B	9K20004	11/23/09 18:04
7440-48-4	Cobalt (dissolved)		1.25	3.12	1	U	SW6010B	9K20004	11/23/09 18:04
7440-50-8	Copper (dissolved)	4.11	1.25	2.50	1		SW6010B	9K20004	11/23/09 18:04
7439-89-6	Iron (dissolved) FBL	25 ~~15.3~~ U	7.50	25.0	1	~~J~~	SW6010B	9K20004	11/23/09 18:04
7439-92-1	Lead (dissolved)		0.375	0.750	1	U	SW6010B	9K20004	11/23/09 18:04
7439-95-4	Magnesium (dissolved)	2100	250	1250	1		SW6010B	9K20004	11/23/09 18:04
7439-96-5	Manganese (dissolved)		0.750	3.75	1	U	SW6010B	9K20004	11/23/09 18:04
7440-02-0	Nickel (dissolved)		0.750	2.50	1	U	SW6010B	9K20004	11/23/09 18:04
7440-09-7	Potassium (dissolved)	2340	250	1250	1	~~N~~	SW6010B	9K20004	11/23/09 18:04
7782-49-2	Selenium (dissolved)		0.750	1.25	1	U	SW6010B	9K20004	11/23/09 18:04
7440-22-4	Silver (dissolved)		0.250	1.25	1	U	SW6010B	9K20004	11/23/09 18:04
7440-23-5	Sodium (dissolved)	1460	250	1250	1	~~N~~	SW6010B	9K20004	11/23/09 18:04
7440-28-0	Thallium (dissolved)		0.750	2.00	1	U	SW6010B	9K20004	11/23/09 18:04
7440-62-2	Vanadium (dissolved)		1.25	3.12	1	U	SW6010B	9K20004	11/23/09 18:04
7440-66-6	Zinc (dissolved)	4.06	1.25	5.00	1	J	SW6010B	9K20004	11/23/09 18:04

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ANALYSIS DATA SHEET

MR11-SD01-09D

9

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Soil
Sampled: 11/12/09 15:40
% Solids: 59.63

SDG: UXO11_002
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0911122-09
Received: 11/13/09 08:15

CAS NO.	Analyte	Concentration (mg/Kg dry)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
57-12-5	Cyanide		0.210	0.419	1	U	SW9012A	9K23021	11/24/09 14:29
7439-97-6	Mercury	0.0492	0.0182	0.0461	1		SW7471A	9K20009	11/25/09 15:48
7429-90-5	Aluminum	10300	4.05	16.2	1		SW6010B	9K20003	11/24/09 16:03
7440-36-0	Antimony MSL	UJ	0.405	1.22	1	~~UN~~	SW6010B	9K20003	11/24/09 16:03
7440-38-2	Arsenic	1.55	0.243	0.405	1		SW6010B	9K20003	11/24/09 16:03
7440-39-3	Barium	42.7	0.405	3.24	1	~~N~~	SW6010B	9K20003	11/24/09 16:03
7440-41-7	Beryllium	0.221	0.0810	0.405	1	J	SW6010B	9K20003	11/24/09 16:03
7440-43-9	Cadmium EBL	0.487 U	0.0810	0.405	1	~~N~~	SW6010B	9K20003	11/24/09 16:03
7440-70-2	Calcium	20200	81.0	405	1		SW6010B	9K20003	11/24/09 16:03
7440-47-3	Chromium	17.8	0.162	0.405	1		SW6010B	9K20003	11/24/09 16:03
7440-48-4	Cobalt	0.688	0.405	1.01	1	J	SW6010B	9K20003	11/24/09 16:03
7440-50-8	Copper	5.42	0.405	0.810	1		SW6010B	9K20003	11/24/09 16:03
7439-89-6	Iron	3230	2.43	8.10	1		SW6010B	9K20003	11/24/09 16:03
7439-92-1	Lead	87.8	0.122	0.243	1		SW6010B	9K20003	11/24/09 16:03
7439-95-4	Magnesium	820	81.0	405	1	~~N~~	SW6010B	9K20003	11/24/09 16:03
7439-96-5	Manganese	17.2	0.243	1.22	1		SW6010B	9K20003	11/24/09 16:03
7440-02-0	Nickel	2.46	0.405	0.810	1		SW6010B	9K20003	11/24/09 16:03
7440-09-7	Potassium MSH	320 J	81.0	405	1	~~JN~~	SW6010B	9K20003	11/24/09 16:03
7782-49-2	Selenium MBL	1.04 U	0.243	0.405	1		SW6010B	9K20003	12/03/09 16:29
7440-22-4	Silver		0.243	0.405	1	U	SW6010B	9K20003	11/24/09 16:03
7440-23-5	Sodium		81.0	405	1	U ~~N~~	SW6010B	9K20003	11/24/09 16:03
7440-28-0	Thallium		0.324	0.648	1	U	SW6010B	9K20003	11/24/09 16:03
7440-62-2	Vanadium	13.7	0.405	1.01	1		SW6010B	9K20003	11/24/09 16:03
7440-66-6	Zinc	36.5	0.405	1.62	1		SW6010B	9K20003	11/24/09 16:03

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ANALYSIS DATA SHEET

MR11-SD01D-09D

10

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Soil
Sampled: 11/12/09 15:45
% Solids: 63.95

SDG: UXO11_002
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0911122-10
Received: 11/13/09 08:15

CAS NO.	Analyte	Concentration (mg/Kg dry)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
57-12-5	Cyanide		0.195	0.391	1	U	SW9012A	9K23021	11/24/09 14:30
7439-97-6	Mercury	0.0476	0.0218	0.0553	1	J	SW7471A	9K20009	11/25/09 15:51
7429-90-5	Aluminum	9170	3.97	15.9	1		SW6010B	9K20003	11/24/09 16:08
7440-36-0	Antimony MSL	UJ	0.397	1.19	1	~~UN~~	SW6010B	9K20003	11/24/09 16:08
7440-38-2	Arsenic	1.33	0.238	0.397	1		SW6010B	9K20003	11/24/09 16:08
7440-39-3	Barium	25.1	0.397	3.18	1	~~N~~	SW6010B	9K20003	11/24/09 16:08
7440-41-7	Beryllium	0.193	0.0794	0.397	1	J	SW6010B	9K20003	11/24/09 16:08
7440-43-9	Cadmium EBL	0.479 U	0.0794	0.397	1	~~N~~	SW6010B	9K20003	11/24/09 16:08
7440-70-2	Calcium	19400	79.4	397	1		SW6010B	9K20003	11/24/09 16:08
7440-47-3	Chromium	18.3	0.159	0.397	1		SW6010B	9K20003	11/24/09 16:08
7440-48-4	Cobalt	0.629	0.397	0.992	1	J	SW6010B	9K20003	11/24/09 16:08
7440-50-8	Copper	5.38	0.397	0.794	1		SW6010B	9K20003	11/24/09 16:08
7439-89-6	Iron	2970	2.38	7.94	1		SW6010B	9K20003	11/24/09 16:08
7439-92-1	Lead	91.3	0.119	0.238	1		SW6010B	9K20003	11/24/09 16:08
7439-95-4	Magnesium	770	79.4	397	1	~~N~~	SW6010B	9K20003	11/24/09 16:08
7439-96-5	Manganese	16.3	0.238	1.19	1		SW6010B	9K20003	11/24/09 16:08
7440-02-0	Nickel	2.36	0.397	0.794	1		SW6010B	9K20003	11/24/09 16:08
7440-09-7	Potassium MSH	310 J	79.4	397	1	~~JN~~	SW6010B	9K20003	11/24/09 16:08
7782-49-2	Selenium MBL	0.898 U	0.238	0.397	1		SW6010B	9K20003	12/03/09 16:34
7440-22-4	Silver		0.159	0.397	1	U	SW6010B	9K20003	11/24/09 16:08
7440-23-5	Sodium		79.4	397	1	U ~~N~~	SW6010B	9K20003	11/24/09 16:08
7440-28-0	Thallium		0.238	0.635	1	U	SW6010B	9K20003	11/24/09 16:08
7440-62-2	Vanadium	12.7	0.397	0.992	1		SW6010B	9K20003	11/24/09 16:08
7440-66-6	Zinc	39.3	0.397	1.59	1		SW6010B	9K20003	11/24/09 16:08

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ANALYSIS DATA SHEET

MR11-SW02-09D

11

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Water
Sampled: 11/12/09 14:55
% Solids: 0.00

SDG: UXO11_002
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0911122-11
Received: 11/13/09 08:15

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
7439-97-6	Mercury		0.0800	0.200	1	U	SW7470A	9K23004	11/23/09 12:20
7429-90-5	Aluminum	52.9	12.5	50.0	1		SW6010B	9K20004	11/23/09 18:09
7440-36-0	Antimony		1.25	3.75	1	U	SW6010B	9K20004	11/23/09 18:09
7440-38-2	Arsenic		0.750	1.25	1	U ~~N~~	SW6010B	9K20004	11/23/09 18:09
7440-39-3	Barium	3.14	1.25	10.0	1	J	SW6010B	9K20004	11/23/09 18:09
7440-41-7	Beryllium		0.250	1.25	1	U	SW6010B	9K20004	11/23/09 18:09
7440-43-9	Cadmium	0.325	0.250	1.25	1	J	SW6010B	9K20004	11/23/09 18:09
7440-70-2	Calcium	9470	250	1250	1		SW6010B	9K20004	11/23/09 18:09
7440-47-3	Chromium		0.500	1.25	1	U	SW6010B	9K20004	11/23/09 18:09
7440-48-4	Cobalt		1.25	3.12	1	U	SW6010B	9K20004	11/23/09 18:09
7440-50-8	Copper		1.25	2.50	1	U	SW6010B	9K20004	11/23/09 18:09
7439-89-6	Iron	24.9	7.50	25.0	1	J	SW6010B	9K20004	11/23/09 18:09
7439-92-1	Lead		0.375	0.750	1	U	SW6010B	9K20004	11/23/09 18:09
7439-95-4	Magnesium	1710	250	1250	1		SW6010B	9K20004	11/23/09 18:09
7439-96-5	Manganese		0.750	3.75	1	U	SW6010B	9K20004	11/23/09 18:09
7440-02-0	Nickel		0.750	2.50	1	U	SW6010B	9K20004	11/23/09 18:09
7440-09-7	Potassium	1890	250	1250	1	~~N~~	SW6010B	9K20004	11/23/09 18:09
7782-49-2	Selenium		0.750	1.25	1	U	SW6010B	9K20004	11/23/09 18:09
7440-22-4	Silver		0.250	1.25	1	U	SW6010B	9K20004	11/23/09 18:09
7440-23-5	Sodium	1010	250	1250	1	J ~~N~~	SW6010B	9K20004	11/23/09 18:09
7440-28-0	Thallium		0.750	2.00	1	U	SW6010B	9K20004	11/23/09 18:09
7440-62-2	Vanadium		1.25	3.12	1	U	SW6010B	9K20004	11/23/09 18:09
7440-66-6	Zinc	2.02	1.25	5.00	1	J	SW6010B	9K20004	11/23/09 18:09
CAS NO.	**Analyte**	**Concentration (mg/L)**	**MDL**	**RL**	**Dilution Factor**	**Q**	**Method**	**Batch**	**Analyzed**
57-12-5	Cyanide		0.00500	0.0100	1	U	SW9012A	9K23020	11/24/09 14:17

LW 2/24/10

ANALYSIS DATA SHEET

MR11-SW02-09D 12

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Water
Sampled: 11/12/09 14:55
% Solids: 0.00

SDG: UXO11_002
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0911122-12
Received: 11/13/09 08:15

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
7439-97-6	Mercury (dissolved)		0.0800	0.200	1	U	SW7470A	9K23004	11/23/09 12:23
7429-90-5	Aluminum (dissolved)	36.0	12.5	50.0	1	J	SW6010B	9K20004	11/23/09 18:32
7440-36-0	Antimony (dissolved)		1.25	3.75	1	U	SW6010B	9K20004	11/23/09 18:32
7440-38-2	Arsenic (dissolved)		0.750	1.25	1	U ~~N*~~	SW6010B	9K20004	11/23/09 18:32
7440-39-3	Barium (dissolved)	3.26	1.25	10.0	1	J	SW6010B	9K20004	11/23/09 18:32
7440-41-7	Beryllium (dissolved)		0.250	1.25	1	U	SW6010B	9K20004	11/23/09 18:32
7440-43-9	Cadmium (dissolved)	0.327	0.250	1.25	1	J	SW6010B	9K20004	11/23/09 18:32
7440-70-2	Calcium (dissolved)	10000	250	1250	1		SW6010B	9K20004	11/23/09 18:32
7440-47-3	Chromium (dissolved)		0.500	1.25	1	U	SW6010B	9K20004	11/23/09 18:32
7440-48-4	Cobalt (dissolved)		1.25	3.12	1	U	SW6010B	9K20004	11/23/09 18:32
7440-50-8	Copper (dissolved)		1.25	2.50	1	U	SW6010B	9K20004	11/23/09 18:32
7439-89-6	Iron (dissolved) FBC	25 ~~19.9~~ U	7.50	25.0	1	J	SW6010B	9K20004	11/23/09 18:32
7439-92-1	Lead (dissolved)		0.375	0.750	1	U	SW6010B	9K20004	11/23/09 18:32
7439-95-4	Magnesium (dissolved)	1750	250	1250	1		SW6010B	9K20004	11/23/09 18:32
7439-96-5	Manganese (dissolved)		0.750	3.75	1	U	SW6010B	9K20004	11/23/09 18:32
7440-02-0	Nickel (dissolved)		0.750	2.50	1	U	SW6010B	9K20004	11/23/09 18:32
7440-09-7	Potassium (dissolved)	1930	250	1250	1	~~N~~	SW6010B	9K20004	11/23/09 18:32
7782-49-2	Selenium (dissolved)		0.750	1.25	1	U	SW6010B	9K20004	11/23/09 18:32
7440-22-4	Silver (dissolved)		0.250	1.25	1	U	SW6010B	9K20004	11/23/09 18:32
7440-23-5	Sodium (dissolved)	1150	250	1250	1	J ~~N~~	SW6010B	9K20004	11/23/09 18:32
7440-28-0	Thallium (dissolved)		0.750	2.00	1	U	SW6010B	9K20004	11/23/09 18:32
7440-62-2	Vanadium (dissolved)		1.25	3.12	1	U	SW6010B	9K20004	11/23/09 18:32
7440-66-6	Zinc (dissolved)	2.52	1.25	5.00	1	J	SW6010B	9K20004	11/23/09 18:32

NW 2/24/10

ANALYSIS DATA SHEET

MR11-SD02-09D 13

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Soil
Sampled: 11/12/09 15:10
% Solids: 62.51

SDG: UXO11_002
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0911122-13
Received: 11/13/09 08:15

CAS NO.	Analyte	Concentration (mg/Kg dry)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
57-12-5	Cyanide		0.200	0.400	1	U	SW9012A	9K23021	11/24/09 14:43
7439-97-6	Mercury	0.0532	0.0173	0.0440	1		SW7471A	9K20009	11/25/09 15:53
7429-90-5	Aluminum	9030	4.06	16.2	1		SW6010B	9K20003	11/24/09 16:26
7440-36-0	Antimony MSL	UJ	0.406	1.22	1	~~UN~~	SW6010B	9K20003	11/24/09 16:26
7440-38-2	Arsenic	1.09	0.244	0.406	1		SW6010B	9K20003	11/24/09 16:26
7440-39-3	Barium	23.4	0.406	3.25	1	~~N~~	SW6010B	9K20003	11/24/09 16:26
7440-41-7	Beryllium	0.181	0.0812	0.406	1	J	SW6010B	9K20003	11/24/09 16:26
7440-43-9	Cadmium EBL	0.715 U	0.0812	0.406	1	~~N~~	SW6010B	9K20003	11/24/09 16:26
7440-70-2	Calcium	36800	81.2	406	1		SW6010B	9K20003	11/24/09 16:26
7440-47-3	Chromium	16.6	0.162	0.406	1		SW6010B	9K20003	11/24/09 16:26
7440-48-4	Cobalt	0.717	0.406	1.02	1	J	SW6010B	9K20003	11/24/09 16:26
7440-50-8	Copper	15.2	0.406	0.812	1		SW6010B	9K20003	11/24/09 16:26
7439-89-6	Iron	3340	2.44	8.12	1		SW6010B	9K20003	11/24/09 16:26
7439-92-1	Lead	53.1	0.122	0.244	1		SW6010B	9K20003	11/24/09 16:26
7439-95-4	Magnesium	1080	81.2	406	1	~~N~~	SW6010B	9K20003	11/24/09 16:26
7439-96-5	Manganese	18.5	0.244	1.22	1		SW6010B	9K20003	11/24/09 16:26
7440-02-0	Nickel	3.29	0.406	0.812	1		SW6010B	9K20003	11/24/09 16:26
7440-09-7	Potassium MSH	418 J	81.2	406	1	~~N~~	SW6010B	9K20003	12/03/09 16:38
7782-49-2	Selenium MBL	1.05 U	0.244	0.406	1		SW6010B	9K20003	12/03/09 16:38
7440-22-4	Silver		0.162	0.406	1	U	SW6010B	9K20003	11/24/09 16:26
7440-23-5	Sodium		81.2	406	1	U~~N~~	SW6010B	9K20003	11/24/09 16:26
7440-28-0	Thallium		0.244	0.650	1	U	SW6010B	9K20003	11/24/09 16:26
7440-62-2	Vanadium	11.8	0.406	1.02	1		SW6010B	9K20003	11/24/09 16:26
7440-66-6	Zinc	183	0.406	1.62	1		SW6010B	9K20003	11/24/09 16:26

lw 2/24/10

ENVIRONMENTAL
Data Services, Inc.

EXPLOSIVES

USEPA Region IV - Level IV Review

Site: MCB Camp Lejeune, CTO-014, UXO-011 SDG #: UX011_002

Client: CH2M HILL, Inc., Virginia Beach, Virginia Date: February 24, 2010

Laboratory: Empirical Laboratories, Nashville, Tennessee Reviewer: Nancy Weaver

EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	MR11-FB111209	0911122-01	Water
2	MR11-EB111209-SD	0911122-03	Water
3	MR11-SW01-09D	0911122-05	Water
4	MR11-SW01D-09D	0911122-07	Water
5	MR11-SD01-09D	0911122-09	Soil
6	MR11-SD01D-09D	0911122-10	Soil
7	MR11-SW02-09D	0911122-11	Water
7MS	MR11-SW02-09DMS	0911122-11MS	Water
7MSD	MR11-SW02-09DMSD	0911122-11MSD	Water
8	MR11-SD02-09D	0911122-13	Soil
8MS	MR11-SD02-09DMS	0911122-13MS	Soil
8MSD	MR11-SD02-09DMSD	0911122-13MSD	Soil

The USEPA "Contract Laboratory Program National Functional Guidelines for Organic Data Review," October 1999, and professional judgement were used in evaluating the data in this summary report.

Holding Times - All samples were extracted within 7 days for water samples, 14 days for soil samples and analyzed within 40 days.

Initial Calibration - The initial calibrations exhibited acceptable %RSD and/or correlation coefficient values.

Calibration Verification - The continuing calibrations exhibited acceptable %D values.

Surrogates - All samples exhibited acceptable surrogate recoveries.

MS/MSD - The MS/MSD sample exhibited acceptable %R and RPD values except the following.

MS/MSD Sample ID	Compound	MS/MSD %R/RPD	Qualifier
7	HMX	57%/64%/Ok	None - See LCS
	1,3,5-Trinitrobenzene	10%/11%/Ok	
	Tetryl	12%/13%/Ok	
8	Tetryl	Ok/Ok/32	None for RPD alone

Laboratory Control Sample - The LCS samples exhibited acceptable %R values except the following.

LCS ID	Compound	%R	Qualifier	Affected Samples
9K16007-BLK1	Tetryl	32%	J/UJ	5, 6, 8
9K16009-BLK1	HMX	53%	J/UJ	1-4, 7
	1,3,5-Trinitrobenzene	18%		
	Tetryl	10%		
	Nitroglycerin	56%		

Method Blank - The method blanks were free of contamination.

Field and Equipment Blank - Field QC results are summarized below.

Blank ID	Compound	Conc. ug/L	Action Level ug/L	Qualifier	Affected Samples
MR11-FB111209	RDX	0.16	0.80	None	All ND
	1,3,5-Trinitrobenzene	0.087	0.435		
	2,4-Dinitrotoluene	0.11	0.55		
	4-Amino-2,6-dinitrotoluene	0.085	0.425		
	4-Nitrotoluene	0.59	2.95		
	3-Nitrotoluene	0.17	0.85		
	PETN	0.33	1.65		
MR11-EB111209-SD	RDX	0.082	0.41	None	All ND
	1,3,5-Trinitrobenzene	0.090	0.45		
	2,4-Dinitrotoluene	0.10	0.50		
	2,6-Dinitrotoluene	0.17	0.85		
	4-Amino-2,6-Dinitrotoluene	0.056	0.28		
	2-Nitrotoluene	0.11	0.55		
	4-Nitrotoluene	0.98	4.9		
	3-Nitrotoluene	0.074	0.37		

Field Duplicates - Field duplicate results are summarized below.

Compound	MR11-SW01-09D ug/L	MR11-SW01D-09D ug/L	RPD	Qualifier
HMX	ND	0.080	NC	None
Nitrobenzene	0.16	0.16	0%	None
Tetryl	0.29	0.34	16%	None

Compound	MR11-SD01-09D ug/kg	MR11-SD01D-09D ug/kg	RPD	Qualifier
None	ND	ND	-	-

Compound Identification - Retention times were acceptable and no further action was taken.

Compound Quantitation - Several samples exhibited results with high %D values between columns and have been flagged (P) by the laboratory and further qualified (J).

FORM 1
EXPL ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

MR11-FB111209

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: Case No.: SAS No.: NA SDG No.: UX011_002

Matrix: (soil/water) WATER Lab Sample ID: 0911122-01

Sample wt/vol: 1060 (g/ml) ML Lab File ID: 054V5401

% Moisture: _____ decanted: (Y/N)___ Date Sampled: 11/12/09 15:50

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:11/17/09

Concentrated Extract Volume: 8.0(ml) Date Analyzed: 12/13/09 16:44

Injection Volume: 100.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
2691-41-0	HMX	0.047	0.14	BSL	~~U~~ UJ
121-82-4	RDX	0.047	0.14	2C 0.16	~~PM~~ J
98-95-3	Nitrobenzene	0.047	0.14		U
99-65-0	1,3-Dinitrobenzene	0.047	0.14		U
99-35-4	1,3,5-Trinitrobenzene	0.047	0.14	BSL 0.087	~~J~~ J
121-14-2	2,4-Dinitrotoluene	0.047	0.14	2C 0.11	~~JPM~~ J
606-20-2	2,6-Dinitrotoluene	0.047	0.14		U
118-96-7	2,4,6-Trinitrotoluene	0.047	0.14		U
35572-78-2	2-Amino-4,6-dinitrotoluene	0.047	0.14		U
479-45-8	Tetryl	0.047	0.14	BSL	~~U~~ UJ
19406-51-0	4-Amino-2,6-dinitrotoluene	0.047	0.14	2C 0.085	~~JPM~~ J
88-72-2	2-Nitrotoluene	0.047	0.14		U
99-99-0	4-Nitrotoluene	0.047	0.14	0.59	
99-08-1	3-Nitrotoluene	0.047	0.14	0.17	
55-63-0	Nitroglycerin	0.16	0.48	BSL	~~U~~ UJ
78-11-5	PETN	0.16	0.48	2C 0.33	~~PM~~ J

FORM I EXPL

WW
2/24/10

FORM 1
EXPL ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO. 2

MR11-EB1
11209-SD

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: Case No.: SAS No.: NA SDG No.: UX011_002

Matrix: (soil/water) WATER Lab Sample ID: 0911122-03

Sample wt/vol: 1070 (g/ml) ML Lab File ID: 055V5501

% Moisture: _____ decanted: (Y/N)___ Date Sampled: 11/12/09 16:00

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:11/17/09

Concentrated Extract Volume: 8.0(ml) Date Analyzed: 12/13/09 17:17

Injection Volume: 100.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
2691-41-0	HMX	0.047	0.14	BSL	~~U~~ UJ
121-82-4	RDX	0.047	0.14	2C 0.082	~~JPM~~ J
98-95-3	Nitrobenzene	0.047	0.14		U
99-65-0	1,3-Dinitrobenzene	0.047	0.14		U
99-35-4	1,3,5-Trinitrobenzene	0.047	0.14	BSL 0.090	~~J~~ J
121-14-2	2,4-Dinitrotoluene	0.047	0.14	2C 0.10	~~JPM~~ J
606-20-2	2,6-Dinitrotoluene	0.047	0.14	2C 0.17	~~PM~~ J
118-96-7	2,4,6-Trinitrotoluene	0.047	0.14		U
35572-78-2	2-Amino-4,6-dinitrotoluene	0.047	0.14		U
479-45-8	Tetryl	0.047	0.14	BSL	~~U~~ UJ
19406-51-0	4-Amino-2,6-dinitrotoluene	0.047	0.14	2C 0.056	~~JPM~~ J
88-72-2	2-Nitrotoluene	0.047	0.14	2C 0.11	~~JPM~~ J
99-99-0	4-Nitrotoluene	0.047	0.14	2C 0.98	↓
99-08-1	3-Nitrotoluene	0.047	0.14	2C 0.074	~~J~~ ↓
55-63-0	Nitroglycerin	0.16	0.48	BSL	~~U~~ UJ
78-11-5	PETN	0.16	0.48		U

FORM I EXPL

WW
2/24/10

FORM 1
EXPL ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO. 3

MR11-SW01-09D

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: Case No.: SAS No.: NA SDG No.: UX011_002

Matrix: (soil/water) WATER Lab Sample ID: 0911122-05

Sample wt/vol: 1060 (g/ml) ML Lab File ID: 056V5601

% Moisture: _____ decanted: (Y/N)___ Date Sampled: 11/12/09 15:25

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:11/17/09

Concentrated Extract Volume: 8.0(ml) Date Analyzed: 12/13/09 17:50

Injection Volume: 100.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
2691-41-0	HMX	0.047	0.14	BSL	~~U~~ UJ
121-82-4	RDX	0.047	0.14		U
98-95-3	Nitrobenzene	0.047	0.14	0.16	
99-65-0	1,3-Dinitrobenzene	0.047	0.14		U
99-35-4	1,3,5-Trinitrobenzene	0.047	0.14	BSL	~~U~~ UJ
121-14-2	2,4-Dinitrotoluene	0.047	0.14		U
606-20-2	2,6-Dinitrotoluene	0.047	0.14		U
118-96-7	2,4,6-Trinitrotoluene	0.047	0.14		U
35572-78-2	2-Amino-4,6-dinitrotoluene	0.047	0.14		U
479-45-8	Tetryl	0.047	0.14	BSL 0.29	J
19406-51-0	4-Amino-2,6-dinitrotoluene	0.047	0.14		U
88-72-2	2-Nitrotoluene	0.047	0.14		U
99-99-0	4-Nitrotoluene	0.047	0.14		U
99-08-1	3-Nitrotoluene	0.047	0.14		U
55-63-0	Nitroglycerin	0.16	0.48	BSL	~~U~~ UJ
78-11-5	PETN	0.16	0.48		U

FORM I EXPL

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FORM 1
EXPL ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO. 4

MR11-SW01D-09D

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: Case No.: SAS No.: NA SDG No.: UX011_002

Matrix: (soil/water) WATER Lab Sample ID: 0911122-07

Sample wt/vol: 1070 (g/ml) ML Lab File ID: 057V5701

% Moisture: _____ decanted: (Y/N)___ Date Sampled: 11/12/09 15:30

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:11/17/09

Concentrated Extract Volume: 8.0(ml) Date Analyzed: 12/13/09 18:23

Injection Volume: 100.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
2691-41-0	HMX	0.047	0.14	BSL 0.080	~~JP~~ J
121-82-4	RDX	0.047	0.14		U
98-95-3	Nitrobenzene	0.047	0.14	2L 0.16	J
99-65-0	1,3-Dinitrobenzene	0.047	0.14		U
99-35-4	1,3,5-Trinitrobenzene	0.047	0.14	BSL	~~U~~ UJ
121-14-2	2,4-Dinitrotoluene	0.047	0.14		U
606-20-2	2,6-Dinitrotoluene	0.047	0.14		U
118-96-7	2,4,6-Trinitrotoluene	0.047	0.14		U
35572-78-2	2-Amino-4,6-dinitrotoluene	0.047	0.14		U
479-45-8	Tetryl	0.047	0.14	BSL 0.34	J
19406-51-0	4-Amino-2,6-dinitrotoluene	0.047	0.14		U
88-72-2	2-Nitrotoluene	0.047	0.14		U
99-99-0	4-Nitrotoluene	0.047	0.14		U
99-08-1	3-Nitrotoluene	0.047	0.14		U
55-63-0	Nitroglycerin	0.16	0.48	BSL	~~U~~ UJ
78-11-5	PETN	0.16	0.48		U

FORM I EXPL

LW
2/24/10

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FORM 1
EXPL ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

MR11-SD01-09D

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: Case No.: SAS No.: NA SDG No.: UX011_002

Matrix: (soil/water) SOIL Lab Sample ID: 0911122-09

Sample wt/vol: 2.0 (g/mL) G Lab File ID: 023V2301

% Moisture: 0 decanted: (Y/N) N Date Sampled: 11/12/09 15:40

Extraction: (SepF/Cont/Sonc/Soxh) SONC Date Extracted: 11/17/09

Concentrated Extract Volume: 20.0(ml) Date Analyzed: 12/13/09 01:22

Injection Volume: 100.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
2691-41-0	HMX	62	190		U
121-82-4	RDX	62	190		U
98-95-3	Nitrobenzene	62	190		U
99-65-0	1,3-Dinitrobenzene	62	190		U
99-35-4	1,3,5-Trinitrobenzene	62	190		U
121-14-2	2,4-Dinitrotoluene	62	190		U
606-20-2	2,6-Dinitrotoluene	62	190		U
118-96-7	2,4,6-Trinitrotoluene	62	190		U
35572-78-2	2-Amino-4,6-dinitrotoluene	62	190		U
479-45-8	Tetryl	62	190	BSL	~~U~~ UJ
19406-51-0	4-Amino-2,6-dinitrotoluene	62	190		U
88-72-2	2-Nitrotoluene	62	190		U
99-99-0	4-Nitrotoluene	62	190		U
99-08-1	3-Nitrotoluene	62	190		U
55-63-0	Nitroglycerin	210	640		U
78-11-5	PETN	210	640		U

FORM I EXPL

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2/24/10

FORM 1
EXPL ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO. 6

MR11-SD01D-09D

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: Case No.: SAS No.: NA SDG No.: UX011_002

Matrix: (soil/water) SOIL Lab Sample ID: 0911122-10

Sample wt/vol: 2.0 (g/mL) G Lab File ID: 024V2401

% Moisture: 0 decanted: (Y/N) N Date Sampled: 11/12/09 15:45

Extraction: (SepF/Cont/Sonc/Soxh) SONC Date Extracted:11/17/09

Concentrated Extract Volume: 20.0(ml) Date Analyzed: 12/13/09 01:54

Injection Volume: 100.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
2691-41-0	HMX	62	190		U
121-82-4	RDX	62	190		U
98-95-3	Nitrobenzene	62	190		U
99-65-0	1,3-Dinitrobenzene	62	190		U
99-35-4	1,3,5-Trinitrobenzene	62	190		U
121-14-2	2,4-Dinitrotoluene	62	190		U
606-20-2	2,6-Dinitrotoluene	62	190		U
118-96-7	2,4,6-Trinitrotoluene	62	190		U
35572-78-2	2-Amino-4,6-dinitrotoluene	62	190		U
479-45-8	Tetryl	62	190	BSL	~~U~~ UJ
19406-51-0	4-Amino-2,6-dinitrotoluene	62	190		U
88-72-2	2-Nitrotoluene	62	190		U
99-99-0	4-Nitrotoluene	62	190		U
99-08-1	3-Nitrotoluene	62	190		U
55-63-0	Nitroglycerin	210	640		U
78-11-5	PETN	210	640		U

FORM I EXPL

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FORM 1
EXPL ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO. 7

MR11-SW02-09D

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: Case No.: SAS No.: NA SDG No.: UX011_002

Matrix: (soil/water) WATER Lab Sample ID: 0911122-11

Sample wt/vol: 1070 (g/ml) ML Lab File ID: 058V5801

% Moisture: _____ decanted: (Y/N)___ Date Sampled: 11/12/09 14:55

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:11/17/09

Concentrated Extract Volume: 8.0(ml) Date Analyzed: 12/13/09 18:56

Injection Volume: 100.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
2691-41-0	HMX	0.047	0.14	BSL	~~U~~ UJ
121-82-4	RDX	0.047	0.14		U
98-95-3	Nitrobenzene	0.047	0.14	2C 0.094	~~J~~ J
99-65-0	1,3-Dinitrobenzene	0.047	0.14		U
99-35-4	1,3,5-Trinitrobenzene	0.047	0.14	BSL	~~U~~ UJ
121-14-2	2,4-Dinitrotoluene	0.047	0.14		U
606-20-2	2,6-Dinitrotoluene	0.047	0.14		U
118-96-7	2,4,6-Trinitrotoluene	0.047	0.14		U
35572-78-2	2-Amino-4,6-dinitrotoluene	0.047	0.14		U
479-45-8	Tetryl	0.047	0.14	BSL 0.14	~~J~~ J
19406-51-0	4-Amino-2,6-dinitrotoluene	0.047	0.14		U
88-72-2	2-Nitrotoluene	0.047	0.14		U
99-99-0	4-Nitrotoluene	0.047	0.14		U
99-08-1	3-Nitrotoluene	0.047	0.14		U
55-63-0	Nitroglycerin	0.16	0.48	BSL	~~U~~ UJ
78-11-5	PETN	0.16	0.48		U

FORM I EXPL

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FORM 1
EXPL ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO. 8

MR11-SD02-09D

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: Case No.: SAS No.: NA SDG No.: UX011_002

Matrix: (soil/water) SOIL Lab Sample ID: 0911122-13

Sample wt/vol: 2.0 (g/mL) G Lab File ID: 025V2501

% Moisture: 0 decanted: (Y/N) N Date Sampled: 11/12/09 15:10

Extraction: (SepF/Cont/Sonc/Soxh) SONC Date Extracted: 11/17/09

Concentrated Extract Volume: 20.0(ml) Date Analyzed: 12/13/09 02:27

Injection Volume: 100.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
2691-41-0	HMX	62	190		U
121-82-4	RDX	62	190		U
98-95-3	Nitrobenzene	62	190		U
99-65-0	1,3-Dinitrobenzene	62	190		U
99-35-4	1,3,5-Trinitrobenzene	62	190		U
121-14-2	2,4-Dinitrotoluene	62	190		U
606-20-2	2,6-Dinitrotoluene	62	190		U
118-96-7	2,4,6-Trinitrotoluene	62	190		U
35572-78-2	2-Amino-4,6-dinitrotoluene	62	190		U
479-45-8	Tetryl	62	190	BSL	~~U~~ UJ
19406-51-0	4-Amino-2,6-dinitrotoluene	62	190		U
88-72-2	2-Nitrotoluene	62	190		U
99-99-0	4-Nitrotoluene	62	190		U
99-08-1	3-Nitrotoluene	62	190		U
55-63-0	Nitroglycerin	210	640		U
78-11-5	PETN	210	640		U

FORM I EXPL

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2/24/10

ENVIRONMENTAL
Data Services, Inc.

PERCHLORATE

USEPA Region IV - Level IV Review

Site: MCB Camp Lejeune, CTO-014, UXO-011 SDG #: UX011_002

Client: CH2M HILL, Inc., Virginia Beach, Virginia Date: February 24, 2010

Laboratory: Empirical Laboratories, Nashville, Tennessee Reviewer: Nancy Weaver

EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	MR11-FB111209	0911122-01	Water
2	MR11-EB111209-SD	0911122-03	Water
3	MR11-SW01-09D	0911122-05	Water
4	MR11-SW01D-09D	0911122-07	Water
5	MR11-SD01-09D	0911122-09	Soil
6	MR11-SD01D-09D	0911122-10	Soil
7	MR11-SW02-09D	0911122-11	Water
7MS	MR11-SW02-09DMS	0911122-11MS	Water
7MSD	MR11-SW02-09DMSD	0911122-11MSD	Water
8	MR11-SD02-09D	0911122-13	Soil
8MS	MR11-SD02-09DMS	0911122-13MS	Soil
8MSD	MR11-SD02-09DMSD	0911122-13MSD	Soil

The USEPA "Contract Laboratory Program National Functional Guidelines for Inorganic Data Review," October 2004, and professional judgement were used in evaluating the data in this summary report.

Holding Times - All samples were prepared and analyzed within 28 days for perchlorate.

Calibration - The ICV and CCV %R values were acceptable.

Method and Calibration Blanks - The method blanks and continuing calibration blanks were free of contamination.

Field and Equipment Blank - Field QC results are summarized below.

Blank ID	Compound	Conc. ug/L	Action Level ug/L	Qualifier	Affected Samples
MR11-FB111209	None - ND	-	-	-	-

MR11-EB111209-SD	None - ND	-	-	-	-

Matrix Spike/Duplicate - The matrix spike/duplicate samples exhibited acceptable %R and RPD values.

LCS - The LCS samples exhibited acceptable %R values.

Field Duplicates - Field duplicate results are summarized below.

Compound	MR11-SW01-09D ug/L	MR11-SW01D-09D ug/L	RPD	Qualifier
None	ND	ND	-	-

Compound	MR11-SD01-09D ug/kg	MR11-SD01D-09D ug/kg	RPD	Qualifier
None	ND	ND	-	-

Compound Quantitation - No discrepancies were identified.

ANALYSIS DATA SHEET

MR11-FB111209

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Water
Sampled: 11/12/09 15:50
% Solids: 0.00

SDG: UXO11_002
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0911122-01
Received: 11/13/09 08:15

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
14797-73-0	Perchlorate		0.0660	0.200	1	U	SW6850	9L01012	12/01/09 19:34

ANALYSIS DATA SHEET

MR11-EB111209-SD

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Water
Sampled: 11/12/09 16:00
% Solids: 0.00

SDG: UXO11_002
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0911122-03
Received: 11/13/09 08:15

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
14797-73-0	Perchlorate		0.0660	0.200	1	U	SW6850	9L01012	12/01/09 19:52

ANALYSIS DATA SHEET

MR11-SW01-09D

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Water
Sampled: 11/12/09 15:25
% Solids: 0.00

SDG: UXO11_002
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0911122-05
Received: 11/13/09 08:15

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
14797-73-0	Perchlorate		0.0660	0.200	1	U	SW6850	9L01012	12/01/09 21:21

ANALYSIS DATA SHEET

MR11-SW01D-09D

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Water
Sampled: 11/12/09 15:30
% Solids: 0.00

SDG: UXO11_002
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0911122-07
Received: 11/13/09 08:15

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
14797-73-0	Perchlorate		0.0660	0.200	1	U	SW6850	9L01012	12/01/09 22:50

ANALYSIS DATA SHEET

MR11-SD01-09D

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Soil
Sampled: 11/12/09 15:40
% Solids: 59.63

SDG: UXO11_002
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0911122-09
Received: 11/13/09 08:15

CAS NO.	Analyte	Concentration (ug/Kg dry)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
14797-73-0	Perchlorate		1.01	3.35	1	U	SW6850	9L02008	12/03/09 00:19

ANALYSIS DATA SHEET

MR11-SD01D-09D

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Soil
Sampled: 11/12/09 15:45
% Solids: 63.95

SDG: UXO11_002
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0911122-10
Received: 11/13/09 08:15

CAS NO.	Analyte	Concentration (ug/Kg dry)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
14797-73-0	Perchlorate		0.938	3.13	1	U	SW6850	9L02008	12/03/09 00:54

ANALYSIS DATA SHEET

MR11-SW02-09D

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Water
Sampled: 11/12/09 14:55
% Solids: 0.00

SDG: UXO11_002
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0911122-11
Received: 11/13/09 08:15

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
14797-73-0	Perchlorate		0.0660	0.200	1	U	SW6850	9L01012	12/01/09 23:08

ANALYSIS DATA SHEET

MR11-SD02-09D

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Soil
Sampled: 11/12/09 15:10
% Solids: 62.51

SDG: UXO11_002
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0911122-13
Received: 11/13/09 08:15

CAS NO.	Analyte	Concentration (ug/Kg dry)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
14797-73-0	Perchlorate		0.960	3.20	1	U	SW6850	9L02008	12/03/09 02:24

ENVIRONMENTAL
Data Services, Inc.

METALS & CYANIDE

USEPA Region IV - Level IV Review

Site: MCB Camp Lejeune, CTO-014, UXO-11 SDG #: UX011_003

Client: CH2M HILL, Inc., Virginia Beach, Virginia Date: February 24, 2010

Laboratory: Empirical Laboratories, Nashville, Tennessee Reviewer: Nancy Weaver

EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1*	MR11-IS02-4-5-09D	0912045-01	Soil
2*	MR11-IS05-2-3-09D	0912045-02	Soil
2MS*	MR11-IS05-2-3-09DMS	0912045-02MS	Soil
2MSD*	MR11-IS05-2-3-09DMSD	0912045-02MSD	Soil
3*	MR11-IS04-2-3-09D	0912045-03	Soil
4*	MR11-IS03-2-3-09D	0912045-04	Soil
5*	MR11-IS01-2-3-09D	0912045-05	Soil
6*	MR11-IS01D-2-3-09D	0912045-06	Soil
7*	MR11-EB120309-IS	0912045-07	Water
8*	MR11-FB120309	0912045-08	Water
9	MR11-TW02-09D	0912054-01	Water
10	MR11-TW04-09D	0912074-01	Water
11	MR11-TW03-09D	0912074-02	Water
12	MR11-TW01-09D	0912074-03	Water
13	MR11-TW01D-09D	0912074-04	Water
14	MR11-FB120709-GW	0912074-05	Water
15	MR11-TW05-09D	0912074-06	Water
15MS	MR11-TW05-09DMS	0912074-06MS	Water
15MSD	MR11-TW05-09DMSD	0912074-06MSD	Water
16D	MR11-TW01-09D-2	0912098-01	Water
17D	MR11-TW01D-09D-2	0912098-02	Water

* - Cyanide analysis samples 1-8 only

The USEPA "Contract Laboratory Program National Functional Guidelines for Inorganic Data Review," October 2004, and professional judgement were used in evaluating the data in this summary report.

Holding Times - All samples were prepared and analyzed within 14 days for cyanide, 28 days for mercury and 180 days for all other metals.

Calibration - The ICV and CCV %R values were acceptable except the following.

Compound	%R	Qualifier	Affected Samples
Aluminum	112%, 114%	J	1-6, 9
Manganese	111%, 113%, 114%	J	9-13, 15-17
Potassium	111%, 113%	J	9

CRDL Standard - The CRDL standards exhibited acceptable %R values.

Method and Calibration Blanks - The method blanks and continuing calibration blanks exhibited the following contamination.

Compound	Conc. mg/kg	Action Level mg/kg	Qualifier	Affected Samples
Zinc	0.306	1.53	None	All >5X or ND

Field and Equipment Blank - Field QC results are summarized below.

Blank ID	Compound	Conc. ug/L	Action Level mg/kg	Qualifier	Affected Samples
MR11-EB120309-IS	None - ND	-	-	-	-
MR11-FB120309	None - ND	-	-	-	-
MR11-FB120709-GW	None - ND	-	-	-	-

ICP Interference Check Sample - All %R values were acceptable.

Matrix Spike/Duplicate - The matrix spike/duplicate samples exhibited acceptable %R and RPD values except the following.

MS/MSD Sample ID	Compound	%R	Qualifier	Affected Samples
2	Antimony	22.8%/19.1%/Ok	J/UJ	1-6
	Chromium	128%/Ok/Ok	J	1-6
	Magnesium	166%/168%/Ok		
	Manganese	126%/Ok/Ok		
	Potassium	144%/145%/Ok		
15	Aluminum	Ok/131%/Ok	J	10-13, 15-17
	Potassium	Ok/126%/Ok	J	10, 11

LCS - The LCS samples exhibited acceptable %R values.

ICP Serial Dilution - The ICP serial dilution sample exhibited acceptable %D values.

Field Duplicates - Field duplicate results are summarized below.

Compound	MR11-IS01-2-3-09D mg/kg	MR11-IS01D-2-3-09D mg/kg	RPD	Qualifier
Aluminum	11100	10800	3%	None
Arsenic	0.827	0.772	7%	None
Barium	19.7	19.6	1%	None
Beryllium	0.136	0.132	3%	None
Calcium	106	106	0%	None
Chromium	10.2	9.93	3%	None
Cobalt	0.524	0.530	1%	None
Copper	0.529	0.513	3%	None
Iron	3190	2190	37%	None
Lead	6.08	6.04	1%	None
Magnesium	450	448	0%	None
Manganese	5.07	5.00	1%	None
Nickel	1.37	1.31	4%	None
Potassium	210	212	1%	None
Selenium	0.241	ND	NC	None
Vanadium	14.1	11.9	17%	None
Zinc	3.66	3.75	2%	None

Compound	MR11-TW01-09D mg/kg	MR11-TW01D-09D mg/kg	RPD	Qualifier
Aluminum	398	366	8%	None
Barium	49.2	46.6	5%	None
Beryllium	0.660	0.632	4%	None
Calcium	3680	3600	2%	None
Chromium	0.653	0.657	1%	None
Iron	234	233	0%	None
Magnesium	919	878	5%	None
Manganese	6.26	6.34	1%	None
Nickel	2.64	2.48	6%	None
Sodium	3180	3060	4%	None
Zinc	8.11	7.93	2%	None

Compound	MR11-TW01-09D-2 ug/L	MR11-TW01D-09D-2 ug/L	RPD	Qualifier
Aluminum	325	322	1%	None
Barium	48.2	46.2	4%	None
Beryllium	0.664	0.642	3%	None
Calcium	3750	3600	4%	None
Iron	229	209	9%	None
Magnesium	895	867	3%	None
Manganese	5.51	5.22	5%	None
Nickel	2.61	2.45	6%	None
Sodium	3160	3070	3%	None
Zinc	8.07	8.11	0%	None

Compound Quantitation - No discrepancies were identified.

ANALYSIS DATA SHEET

MR11-IS02-4-5-09D

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Soil
Sampled: 12/03/09 09:15
% Solids: 82.86

SDG: UXO11_003
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0912045-01
Received: 12/04/09 08:30

CAS NO.	Analyte	Concentration (mg/Kg dry)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
57-12-5	Cyanide		0.151	0.302	1	U	SW9012A	9L09017	12/10/09 14:42
7439-97-6	Mercury	0.0166	0.0138	0.0351	1	J	SW7471A	9L15011	12/16/09 12:19
7429-90-5	Aluminum CCH	5870 J	2.92	11.7	1		SW6010B	9L29001	12/30/09 22:35
7440-36-0	Antimony MSL	UJ	0.292	0.875	1	~~UN~~	SW6010B	9L29001	12/30/09 22:35
7440-38-2	Arsenic	0.462	0.175	0.292	1		SW6010B	9L29001	12/30/09 22:35
7440-39-3	Barium	11.8	0.292	2.33	1		SW6010B	9L29001	12/30/09 22:35
7440-41-7	Beryllium	0.0916	0.0583	0.292	1	J	SW6010B	9L29001	12/30/09 22:35
7440-43-9	Cadmium		0.0583	0.292	1	U	SW6010B	9L29001	12/30/09 22:35
7440-70-2	Calcium	215	58.3	292	1	~~J~~	SW6010B	9L29001	12/30/09 22:35
7440-47-3	Chromium MSH	6.72 J	0.117	0.292	1	~~N~~	SW6010B	9L29001	12/30/09 22:35
7440-48-4	Cobalt		0.292	0.729	1	U	SW6010B	9L29001	12/30/09 22:35
7440-50-8	Copper	0.500	0.292	0.583	1	J	SW6010B	9L29001	12/30/09 22:35
7439-89-6	Iron	1100	1.75	5.83	1		SW6010B	9L29001	12/30/09 22:35
7439-92-1	Lead	3.29	0.0875	0.175	1		SW6010B	9L29001	12/30/09 22:35
7439-95-4	Magnesium MSH	242 J	58.3	292	1	~~JN~~	SW6010B	9L29001	12/30/09 22:35
7439-96-5	Manganese MSH	2.74 J	0.175	0.875	1	~~N~~	SW6010B	9L29001	12/30/09 22:35
7440-02-0	Nickel	0.918	0.292	0.583	1		SW6010B	9L29001	12/30/09 22:35
7440-09-7	Potassium MSH	140 J	58.3	292	1	~~JN~~	SW6010B	9L29001	12/30/09 22:35
7782-49-2	Selenium		0.175	0.292	1	U	SW6010B	9L29001	12/30/09 22:35
7440-22-4	Silver		0.117	0.292	1	U	SW6010B	9L29001	12/30/09 22:35
7440-23-5	Sodium		58.3	292	1	U	SW6010B	9L29001	12/30/09 22:35
7440-28-0	Thallium		0.175	0.466	1	U	SW6010B	9L29001	12/30/09 22:35
7440-62-2	Vanadium	5.68	0.292	0.729	1	~~N~~	SW6010B	9L29001	12/30/09 22:35
7440-66-6	Zinc	2.33	0.292	1.17	1		SW6010B	9L29001	12/30/09 22:35

ALW
2/24/10

ANALYSIS DATA SHEET

MR11-IS05-2-3-09D 2

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Soil
Sampled: 12/03/09 09:30
% Solids: 85.14

SDG: UXO11_003
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0912045-02
Received: 12/04/09 08:30

CAS NO.	Analyte	Concentration (mg/Kg dry)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
57-12-5	Cyanide		0.147	0.294	1	U	SW9012A	9L09017	12/10/09 14:45
7439-97-6	Mercury		0.0139	0.0352	1	U	SW7471A	9L15011	12/16/09 12:21
7429-90-5	Aluminum CCH	7880 J	2.92	11.7	1		SW6010B	9L29001	12/30/09 22:40
7440-36-0	Antimony MSL	UJ	0.292	0.877	1	~~UN~~	SW6010B	9L29001	12/30/09 22:40
7440-38-2	Arsenic	0.830	0.175	0.292	1		SW6010B	9L29001	12/30/09 22:40
7440-39-3	Barium	13.5	0.292	2.34	1		SW6010B	9L29001	12/30/09 22:40
7440-41-7	Beryllium	0.152	0.0584	0.292	1	J	SW6010B	9L29001	12/30/09 22:40
7440-43-9	Cadmium		0.0584	0.292	1	U	SW6010B	9L29001	12/30/09 22:40
7440-70-2	Calcium	114	58.4	292	1	J ~~N~~	SW6010B	9L29001	12/30/09 22:40
7440-47-3	Chromium MSH	8.12 J	0.117	0.292	1	~~N~~	SW6010B	9L29001	12/30/09 22:40
7440-48-4	Cobalt	0.369	0.292	0.730	1	J	SW6010B	9L29001	12/30/09 22:40
7440-50-8	Copper	0.388	0.292	0.584	1	J	SW6010B	9L29001	12/30/09 22:40
7439-89-6	Iron	1770	1.75	5.84	1		SW6010B	9L29001	12/30/09 22:40
7439-92-1	Lead	4.18	0.0877	0.175	1		SW6010B	9L29001	12/30/09 22:40
7439-95-4	Magnesium MSH	355 J	58.4	292	1	~~N~~	SW6010B	9L29001	12/30/09 22:40
7439-96-5	Manganese MSH	4.05 J	0.175	0.877	1	~~N~~	SW6010B	9L29001	12/30/09 22:40
7440-02-0	Nickel	1.23	0.292	0.584	1		SW6010B	9L29001	12/30/09 22:40
7440-09-7	Potassium MSH	157 J	58.4	292	1	J ~~N~~	SW6010B	9L29001	12/30/09 22:40
7782-49-2	Selenium	0.227	0.175	0.292	1	J	SW6010B	9L29001	12/30/09 22:40
7440-22-4	Silver		0.117	0.292	1	U	SW6010B	9L29001	12/30/09 22:40
7440-23-5	Sodium		58.4	292	1	U	SW6010B	9L29001	12/30/09 22:40
7440-28-0	Thallium		0.175	0.467	1	U	SW6010B	9L29001	12/30/09 22:40
7440-62-2	Vanadium	8.64	0.292	0.730	1	~~N~~	SW6010B	9L29001	12/30/09 22:40
7440-66-6	Zinc	2.73	0.292	1.17	1		SW6010B	9L29001	12/30/09 22:40

RW 2/24/10

ANALYSIS DATA SHEET

MR11-IS04-2-3-09D 3

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Soil
Sampled: 12/03/09 10:20
% Solids: 83.78

SDG: UXO11_003
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0912045-03
Received: 12/04/09 08:30

CAS NO.	Analyte	Concentration (mg/Kg dry)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
57-12-5	Cyanide		0.149	0.298	1	U	SW9012A	9L09017	12/10/09 14:46
7439-97-6	Mercury		0.0126	0.0330	1	U	SW7471A	9L15011	12/16/09 12:24
7429-90-5	Aluminum CCH	12000 J	2.90	11.6	1		SW6010B	9L29001	12/30/09 23:03
7440-36-0	Antimony MSL	UJ	0.290	0.869	1	~~UN~~	SW6010B	9L29001	12/30/09 23:03
7440-38-2	Arsenic	0.847	0.174	0.290	1		SW6010B	9L29001	12/30/09 23:03
7440-39-3	Barium	13.8	0.290	2.32	1		SW6010B	9L29001	12/30/09 23:03
7440-41-7	Beryllium	0.0656	0.0579	0.290	1	J	SW6010B	9L29001	12/30/09 23:03
7440-43-9	Cadmium		0.0579	0.290	1	U	SW6010B	9L29001	12/30/09 23:03
7440-70-2	Calcium	201	57.9	290	1	J ~~N~~	SW6010B	9L29001	12/30/09 23:03
7440-47-3	Chromium MSH	9.12 J	0.116	0.290	1	~~N~~	SW6010B	9L29001	12/30/09 23:03
7440-48-4	Cobalt	0.340	0.290	0.724	1	J	SW6010B	9L29001	12/30/09 23:03
7440-50-8	Copper		0.290	0.579	1	U	SW6010B	9L29001	12/30/09 23:03
7439-89-6	Iron	6920	1.74	5.79	1		SW6010B	9L29001	12/30/09 23:03
7439-92-1	Lead	5.95	0.0869	0.174	1		SW6010B	9L29001	12/30/09 23:03
7439-95-4	Magnesium MSH	329 J	57.9	290	1	~~N~~	SW6010B	9L29001	12/30/09 23:03
7439-96-5	Manganese MSH	3.95 J	0.174	0.869	1	~~N~~	SW6010B	9L29001	12/30/09 23:03
7440-02-0	Nickel	1.39	0.290	0.579	1		SW6010B	9L29001	12/30/09 23:03
7440-09-7	Potassium MSH	135 J	57.9	290	1	J ~~N~~	SW6010B	9L29001	12/30/09 23:03
7782-49-2	Selenium	0.258	0.174	0.290	1	J	SW6010B	9L29001	12/30/09 23:03
7440-22-4	Silver		0.116	0.290	1	U	SW6010B	9L29001	12/30/09 23:03
7440-23-5	Sodium		57.9	290	1	U	SW6010B	9L29001	12/30/09 23:03
7440-28-0	Thallium		0.174	0.464	1	U	SW6010B	9L29001	12/30/09 23:03
7440-62-2	Vanadium	12.1	0.290	0.724	1	~~N~~	SW6010B	9L29001	12/30/09 23:03
7440-66-6	Zinc	2.31	0.290	1.16	1		SW6010B	9L29001	12/30/09 23:03

LW 2/24/10

ANALYSIS DATA SHEET

MR11-IS03-2-3-09D

4

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Soil
Sampled: 12/03/09 10:50
% Solids: 79.11

SDG: UXO11_003
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0912045-04
Received: 12/04/09 08:30

CAS NO.	Analyte	Concentration (mg/Kg dry)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
57-12-5	Cyanide		0.158	0.316	1	U	SW9012A	9L14013	12/15/09 14:46
7439-97-6	Mercury	0.0236	0.0133	0.0338	1	J	SW7471A	9L15011	12/16/09 12:26
7429-90-5	Aluminum CCM	13600 J	3.13	12.5	1		SW6010B	9L29001	12/30/09 23:08
7440-36-0	Antimony MSL	UJ	0.313	0.939	1	~~UN~~	SW6010B	9L29001	12/30/09 23:08
7440-38-2	Arsenic	1.40	0.188	0.313	1		SW6010B	9L29001	12/30/09 23:08
7440-39-3	Barium	33.4	0.313	2.50	1		SW6010B	9L29001	12/30/09 23:08
7440-41-7	Beryllium	0.209	0.0626	0.313	1	J	SW6010B	9L29001	12/30/09 23:08
7440-43-9	Cadmium		0.0626	0.313	1	U	SW6010B	9L29001	12/30/09 23:08
7440-70-2	Calcium	2180	62.6	313	1	~~N~~	SW6010B	9L29001	12/30/09 23:08
7440-47-3	Chromium MSH	16.0 J	0.125	0.313	1	~~N~~	SW6010B	9L29001	12/30/09 23:08
7440-48-4	Cobalt	0.625	0.313	0.782	1	J	SW6010B	9L29001	12/30/09 23:08
7440-50-8	Copper	0.397	0.313	0.626	1	J	SW6010B	9L29001	12/30/09 23:08
7439-89-6	Iron	5290	1.88	6.26	1		SW6010B	9L29001	12/30/09 23:08
7439-92-1	Lead	6.74	0.0939	0.188	1		SW6010B	9L29001	12/30/09 23:08
7439-95-4	Magnesium MSH	666 J	62.6	313	1	~~N~~	SW6010B	9L29001	12/30/09 23:08
7439-96-5	Manganese MSH	5.97 J	0.188	0.939	1	~~N~~	SW6010B	9L29001	12/30/09 23:08
7440-02-0	Nickel	1.99	0.313	0.626	1		SW6010B	9L29001	12/30/09 23:08
7440-09-7	Potassium MSH	282 J	62.6	313	1	~~JN~~	SW6010B	9L29001	12/30/09 23:08
7782-49-2	Selenium	0.354	0.188	0.313	1		SW6010B	9L29001	12/30/09 23:08
7440-22-4	Silver		0.188	0.313	1	U	SW6010B	9L29001	12/30/09 23:08
7440-23-5	Sodium		62.6	313	1	U	SW6010B	9L29001	12/30/09 23:08
7440-28-0	Thallium		0.188	0.501	1	U	SW6010B	9L29001	12/30/09 23:08
7440-62-2	Vanadium	16.2	0.313	0.782	1	~~N~~	SW6010B	9L29001	12/30/09 23:08
7440-66-6	Zinc	5.26	0.313	1.25	1		SW6010B	9L29001	12/30/09 23:08

MW 2/24/10

ANALYSIS DATA SHEET

MR11-IS01-2-3-09D 5

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Soil
Sampled: 12/03/09 11:40
% Solids: 86.69

SDG: UXO11_003
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0912045-05
Received: 12/04/09 08:30

CAS NO.	Analyte	Concentration (mg/Kg dry)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
57-12-5	Cyanide		0.144	0.288	1	U	SW9012A	9L14013	12/15/09 14:47
7439-97-6	Mercury		0.0145	0.0368	1	U	SW7471A	9L15011	12/16/09 12:27
7429-90-5	Aluminum CCH	11100 J	2.83	11.3	1		SW6010B	9L29001	12/30/09 23:12
7440-36-0	Antimony MSL	NJ	0.283	0.848	1	~~UN~~	SW6010B	9L29001	12/30/09 23:12
7440-38-2	Arsenic	0.827	0.170	0.283	1		SW6010B	9L29001	12/30/09 23:12
7440-39-3	Barium	19.7	0.283	2.26	1		SW6010B	9L29001	12/30/09 23:12
7440-41-7	Beryllium	0.136	0.0565	0.283	1	J	SW6010B	9L29001	12/30/09 23:12
7440-43-9	Cadmium		0.0565	0.283	1	U	SW6010B	9L29001	12/30/09 23:12
7440-70-2	Calcium	106	56.5	283	1	J ~~N~~	SW6010B	9L29001	12/30/09 23:12
7440-47-3	Chromium MSH	10.2 J	0.113	0.283	1	~~N~~	SW6010B	9L29001	12/30/09 23:12
7440-48-4	Cobalt	0.524	0.283	0.707	1	J	SW6010B	9L29001	12/30/09 23:12
7440-50-8	Copper	0.529	0.283	0.565	1	J	SW6010B	9L29001	12/30/09 23:12
7439-89-6	Iron	3190	1.70	5.65	1		SW6010B	9L29001	12/30/09 23:12
7439-92-1	Lead	6.08	0.0848	0.170	1		SW6010B	9L29001	12/30/09 23:12
7439-95-4	Magnesium MSH	450 J	56.5	283	1	~~N~~	SW6010B	9L29001	12/30/09 23:12
7439-96-5	Manganese MSH	5.07 J	0.170	0.848	1	~~N~~	SW6010B	9L29001	12/30/09 23:12
7440-02-0	Nickel	1.37	0.283	0.565	1		SW6010B	9L29001	12/30/09 23:12
7440-09-7	Potassium MSH	210 J	56.5	283	1	J ~~N~~	SW6010B	9L29001	12/30/09 23:12
7782-49-2	Selenium	0.241	0.170	0.283	1	J	SW6010B	9L29001	12/30/09 23:12
7440-22-4	Silver		0.170	0.283	1	U	SW6010B	9L29001	12/30/09 23:12
7440-23-5	Sodium		56.5	283	1	U	SW6010B	9L29001	12/30/09 23:12
7440-28-0	Thallium		0.170	0.452	1	U	SW6010B	9L29001	12/30/09 23:12
7440-62-2	Vanadium	14.7	0.283	0.707	1	~~N~~	SW6010B	9L29001	12/30/09 23:12
7440-66-6	Zinc	3.66	0.283	1.13	1		SW6010B	9L29001	12/30/09 23:12

LW 2/24/10

ANALYSIS DATA SHEET

MR11-IS01D-2-3-09D 6

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Soil
Sampled: 12/03/09 11:45
% Solids: 87.26

SDG: UXO11_003
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0912045-06
Received: 12/04/09 08:30

CAS NO.	Analyte	Concentration (mg/Kg dry)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
57-12-5	Cyanide		0.143	0.287	1	U	SW9012A	9L14013	12/15/09 14:48
7439-97-6	Mercury		0.0160	0.0405	1	U	SW7471A	9L15011	12/16/09 12:30
7429-90-5	Aluminum CCH	10800 J	2.74	11.0	1		SW6010B	9L29001	12/30/09 23:17
7440-36-0	Antimony MSL	UJ	0.274	0.823	1	~~UN~~	SW6010B	9L29001	12/30/09 23:17
7440-38-2	Arsenic	0.772	0.165	0.274	1		SW6010B	9L29001	12/30/09 23:17
7440-39-3	Barium	19.6	0.274	2.19	1		SW6010B	9L29001	12/30/09 23:17
7440-41-7	Beryllium	0.132	0.0548	0.274	1	J	SW6010B	9L29001	12/30/09 23:17
7440-43-9	Cadmium		0.0548	0.274	1	U	SW6010B	9L29001	12/30/09 23:17
7440-70-2	Calcium	106	54.8	274	1	J ~~N~~	SW6010B	9L29001	12/30/09 23:17
7440-47-3	Chromium MSH	9.93 J	0.110	0.274	1	~~N~~	SW6010B	9L29001	12/30/09 23:17
7440-48-4	Cobalt	0.530	0.274	0.685	1	J	SW6010B	9L29001	12/30/09 23:17
7440-50-8	Copper	0.513	0.274	0.548	1	J	SW6010B	9L29001	12/30/09 23:17
7439-89-6	Iron	2190	1.65	5.48	1		SW6010B	9L29001	12/30/09 23:17
7439-92-1	Lead	6.04	0.0823	0.165	1		SW6010B	9L29001	12/30/09 23:17
7439-95-4	Magnesium MSH	448 J	54.8	274	1	~~N~~	SW6010B	9L29001	12/30/09 23:17
7439-96-5	Manganese MSH	5.00 J	0.165	0.823	1	~~N~~	SW6010B	9L29001	12/30/09 23:17
7440-02-0	Nickel	1.31	0.274	0.548	1		SW6010B	9L29001	12/30/09 23:17
7440-09-7	Potassium MSH	212 J	54.8	274	1	~~JN~~	SW6010B	9L29001	12/30/09 23:17
7782-49-2	Selenium		0.165	0.274	1	U	SW6010B	9L29001	12/30/09 23:17
7440-22-4	Silver		0.165	0.274	1	U	SW6010B	9L29001	12/30/09 23:17
7440-23-5	Sodium		54.8	274	1	U	SW6010B	9L29001	12/30/09 23:17
7440-28-0	Thallium		0.165	0.439	1	U	SW6010B	9L29001	12/30/09 23:17
7440-62-2	Vanadium	11.9	0.274	0.685	1	~~N~~	SW6010B	9L29001	12/30/09 23:17
7440-66-6	Zinc	3.75	0.274	1.10	1		SW6010B	9L29001	12/30/09 23:17

lw
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ANALYSIS DATA SHEET

MR11-EB120309-IS

7

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Water
Sampled: 12/03/09 08:05
% Solids: 0.00

SDG: UXO11_003
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0912045-07
Received: 12/04/09 08:30

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
7439-97-6	Mercury		0.0800	0.200	1	U	SW7470A	9L07002	12/07/09 16:41
7429-90-5	Aluminum		12.5	50.0	1	U	SW6010B	9L15006	12/16/09 15:28
7440-36-0	Antimony		1.25	3.75	1	U	SW6010B	9L15006	12/16/09 15:28
7440-38-2	Arsenic		0.750	1.25	1	U	SW6010B	9L15006	12/16/09 15:28
7440-39-3	Barium		1.25	10.0	1	U	SW6010B	9L15006	12/16/09 15:28
7440-41-7	Beryllium		0.250	1.25	1	U	SW6010B	9L15006	12/16/09 15:28
7440-43-9	Cadmium		0.250	1.25	1	U	SW6010B	9L15006	12/16/09 15:28
7440-70-2	Calcium		250	1250	1	U	SW6010B	9L15006	12/16/09 15:28
7440-47-3	Chromium		0.500	1.25	1	U	SW6010B	9L15006	12/16/09 15:28
7440-48-4	Cobalt		1.25	3.12	1	U	SW6010B	9L15006	12/16/09 15:28
7440-50-8	Copper		1.25	2.50	1	U	SW6010B	9L15006	12/16/09 15:28
7439-89-6	Iron		7.50	25.0	1	U	SW6010B	9L15006	12/16/09 15:28
7439-92-1	Lead		0.375	0.750	1	U	SW6010B	9L15006	12/16/09 15:28
7439-95-4	Magnesium		250	1250	1	U	SW6010B	9L15006	12/16/09 15:28
7439-96-5	Manganese		0.750	3.75	1	U	SW6010B	9L15006	12/16/09 15:28
7440-02-0	Nickel		0.750	2.50	1	U	SW6010B	9L15006	12/16/09 15:28
7440-09-7	Potassium		250	1250	1	U	SW6010B	9L15006	12/16/09 15:28
7782-49-2	Selenium		0.750	1.25	1	U	SW6010B	9L15006	12/16/09 15:28
7440-22-4	Silver		0.250	1.25	1	U	SW6010B	9L15006	12/16/09 15:28
7440-23-5	Sodium		250	1250	1	U	SW6010B	9L15006	12/16/09 15:28
7440-28-0	Thallium		0.750	2.00	1	U	SW6010B	9L15006	12/16/09 15:28
7440-62-2	Vanadium		1.25	3.12	1	U	SW6010B	9L15006	12/16/09 15:28
7440-66-6	Zinc		1.25	5.00	1	U	SW6010B	9L15006	12/16/09 15:28
CAS NO.	**Analyte**	**Concentration (mg/L)**	**MDL**	**RL**	**Dilution Factor**	**Q**	**Method**	**Batch**	**Analyzed**
57-12-5	Cyanide		0.00500	0.0100	1	U	SW9012A	9L09018	12/10/09 14:55

lw
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ANALYSIS DATA SHEET

MR11-FB120309 8

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Water
Sampled: 12/03/09 08:10
% Solids: 0.00

SDG: UXO11_003
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0912045-08
Received: 12/04/09 08:30

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
7439-97-6	Mercury		0.0800	0.200	1	U	SW7470A	9L07002	12/07/09 16:42
7429-90-5	Aluminum		12.5	50.0	1	U	SW6010B	9L15006	12/16/09 15:33
7440-36-0	Antimony		1.25	3.75	1	U	SW6010B	9L15006	12/16/09 15:33
7440-38-2	Arsenic		0.750	1.25	1	U	SW6010B	9L15006	12/16/09 15:33
7440-39-3	Barium		1.25	10.0	1	U	SW6010B	9L15006	12/16/09 15:33
7440-41-7	Beryllium		0.250	1.25	1	U	SW6010B	9L15006	12/16/09 15:33
7440-43-9	Cadmium		0.250	1.25	1	U	SW6010B	9L15006	12/16/09 15:33
7440-70-2	Calcium		250	1250	1	U	SW6010B	9L15006	12/16/09 15:33
7440-47-3	Chromium		0.500	1.25	1	U	SW6010B	9L15006	12/16/09 15:33
7440-48-4	Cobalt		1.25	3.12	1	U	SW6010B	9L15006	12/16/09 15:33
7440-50-8	Copper		1.25	2.50	1	U	SW6010B	9L15006	12/16/09 15:33
7439-89-6	Iron		7.50	25.0	1	U	SW6010B	9L15006	12/16/09 15:33
7439-92-1	Lead		0.375	0.750	1	U	SW6010B	9L15006	12/16/09 15:33
7439-95-4	Magnesium		250	1250	1	U	SW6010B	9L15006	12/16/09 15:33
7439-96-5	Manganese		0.750	3.75	1	U	SW6010B	9L15006	12/16/09 15:33
7440-02-0	Nickel		0.750	2.50	1	U	SW6010B	9L15006	12/16/09 15:33
7440-09-7	Potassium		250	1250	1	U	SW6010B	9L15006	12/16/09 15:33
7782-49-2	Selenium		0.750	1.25	1	U	SW6010B	9L15006	12/16/09 15:33
7440-22-4	Silver		0.250	1.25	1	U	SW6010B	9L15006	12/16/09 15:33
7440-23-5	Sodium		250	1250	1	U	SW6010B	9L15006	12/16/09 15:33
7440-28-0	Thallium		0.750	2.00	1	U	SW6010B	9L15006	12/16/09 15:33
7440-62-2	Vanadium		1.25	3.12	1	U	SW6010B	9L15006	12/16/09 15:33
7440-66-6	Zinc		1.25	5.00	1	U	SW6010B	9L15006	12/16/09 15:33
CAS NO.	**Analyte**	**Concentration (mg/L)**	**MDL**	**RL**	**Dilution Factor**	**Q**	**Method**	**Batch**	**Analyzed**
57-12-5	Cyanide		0.00500	0.0100	1	U	SW9012A	9L14012	12/15/09 14:24

LW
2/24/10

ANALYSIS DATA SHEET

MR11-TW02-09D 9

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Ground Water
Sampled: 12/04/09 14:40
% Solids: 0.00

SDG: UXO11_003
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0912054-01
Received: 12/05/09 08:45

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
7439-97-6	Mercury		0.0800	0.200	1	U	SW7470A	9L10013	12/14/09 08:44
7429-90-5	Aluminum CCH	255 J	12.5	50.0	1		SW6010B	9L15006	12/16/09 17:29
7440-36-0	Antimony		1.25	3.75	1	U	SW6010B	9L15006	12/16/09 17:29
7440-38-2	Arsenic	1.46	0.750	1.25	1		SW6010B	9L15006	12/16/09 17:29
7440-39-3	Barium	13.5	1.25	10.0	1		SW6010B	9L15006	12/16/09 17:29
7440-41-7	Beryllium		0.250	1.25	1	U	SW6010B	9L15006	12/16/09 17:29
7440-43-9	Cadmium	0.643	0.250	1.25	1	J	SW6010B	9L15006	12/16/09 17:29
7440-70-2	Calcium	65900	250	1250	1		SW6010B	9L15006	12/16/09 17:29
7440-47-3	Chromium	1.63	0.500	1.25	1		SW6010B	9L15006	12/16/09 17:29
7440-48-4	Cobalt		1.25	3.12	1	U	SW6010B	9L15006	12/16/09 17:29
7440-50-8	Copper		1.25	2.50	1	U	SW6010B	9L15006	12/16/09 17:29
7439-89-6	Iron	331	7.50	25.0	1		SW6010B	9L15006	12/16/09 17:29
7439-92-1	Lead		0.375	0.750	1	U	SW6010B	9L15006	12/16/09 17:29
7439-95-4	Magnesium	1310	250	1250	1		SW6010B	9L15006	12/16/09 17:29
7439-96-5	Manganese CCH	16.6 J	0.750	3.75	1		SW6010B	9L15006	12/16/09 17:29
7440-02-0	Nickel	2.82	0.750	2.50	1		SW6010B	9L15006	12/16/09 17:29
7440-09-7	Potassium CCH	466 J	250	1250	1		SW6010B	9L15006	12/16/09 17:29
7782-49-2	Selenium	2.88	0.750	1.25	1		SW6010B	9L15006	12/16/09 17:29
7440-22-4	Silver		0.250	1.25	1	U	SW6010B	9L15006	12/16/09 17:29
7440-23-5	Sodium	2980	250	1250	1		SW6010B	9L15006	12/16/09 17:29
7440-28-0	Thallium		0.750	2.00	1	U	SW6010B	9L15006	12/16/09 17:29
7440-62-2	Vanadium	4.97	1.25	3.12	1		SW6010B	9L15006	12/16/09 17:29
7440-66-6	Zinc	42.1	1.25	5.00	1		SW6010B	9L15006	12/16/09 17:29

pw 2/24/10

ANALYSIS DATA SHEET

MR11-TW04-09D 10

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Ground Water
Sampled: 12/07/09 15:10
% Solids: 0.00

SDG: UXO11_003
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0912074-01
Received: 12/08/09 08:30

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
7439-97-6	Mercury		0.0800	0.200	1	U	SW7470A	9L10015	12/14/09 09:05
7429-90-5	Aluminum MSH	531 J	12.5	50.0	1	~~J~~	SW6010B	9L21004	12/30/09 15:55
7440-36-0	Antimony		1.25	3.75	1	U	SW6010B	9L21004	12/30/09 15:55
7440-38-2	Arsenic	2.36	0.750	1.25	1		SW6010B	9L21004	12/30/09 15:55
7440-39-3	Barium	49.4	1.25	10.0	1		SW6010B	9L21004	12/30/09 15:55
7440-41-7	Beryllium	0.540	0.250	1.25	1	J	SW6010B	9L21004	12/30/09 15:55
7440-43-9	Cadmium		0.250	1.25	1	U	SW6010B	9L21004	12/30/09 15:55
7440-70-2	Calcium	6030	250	1250	1		SW6010B	9L21004	12/30/09 15:55
7440-47-3	Chromium	1.30	0.500	1.25	1		SW6010B	9L21004	12/30/09 15:55
7440-48-4	Cobalt	4.30	1.25	3.12	1		SW6010B	9L21004	12/30/09 15:55
7440-50-8	Copper		1.25	2.50	1	U	SW6010B	9L21004	12/30/09 15:55
7439-89-6	Iron	1510	7.50	25.0	1		SW6010B	9L21004	12/30/09 15:55
7439-92-1	Lead		0.375	0.750	1	U	SW6010B	9L21004	12/30/09 15:55
7439-95-4	Magnesium	686	250	1250	1	J	SW6010B	9L21004	12/30/09 15:55
7439-96-5	Manganese CCH	17.2 J	0.750	3.75	1		SW6010B	9L21004	12/30/09 15:55
7440-02-0	Nickel	6.14	0.750	2.50	1		SW6010B	9L21004	12/30/09 15:55
7440-09-7	Potassium MSH	729 J	250	1250	1	~~J~~	SW6010B	9L21004	12/30/09 15:55
7782-49-2	Selenium		0.750	1.25	1	U	SW6010B	9L21004	12/30/09 15:55
7440-22-4	Silver		0.250	1.25	1	U	SW6010B	9L21004	12/30/09 15:55
7440-23-5	Sodium	4980	250	1250	1		SW6010B	9L21004	12/30/09 15:55
7440-28-0	Thallium		0.750	2.00	1	U	SW6010B	9L21004	12/30/09 15:55
7440-62-2	Vanadium	1.49	1.25	3.12	1	J	SW6010B	9L21004	12/30/09 15:55
7440-66-6	Zinc	6.95	1.25	5.00	1		SW6010B	9L21004	12/30/09 15:55

hw
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ANALYSIS DATA SHEET

MR11-TW03-09D

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Ground Water
Sampled: 12/07/09 14:00
% Solids: 0.00

SDG: UXO11_003
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0912074-02
Received: 12/08/09 08:30

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
7439-97-6	Mercury		0.0800	0.200	1	U	SW7470A	9L10015	12/14/09 09:08
7429-90-5	Aluminum MSH	443 J	12.5	50.0	1	~~J~~	SW6010B	9L21004	12/30/09 15:59
7440-36-0	Antimony		1.25	3.75	1	U	SW6010B	9L21004	12/30/09 15:59
7440-38-2	Arsenic	1.69	0.750	1.25	1		SW6010B	9L21004	12/30/09 15:59
7440-39-3	Barium	18.8	1.25	10.0	1		SW6010B	9L21004	12/30/09 15:59
7440-41-7	Beryllium		0.250	1.25	1	U	SW6010B	9L21004	12/30/09 15:59
7440-43-9	Cadmium	0.264	0.250	1.25	1	J	SW6010B	9L21004	12/30/09 15:59
7440-70-2	Calcium	97800	250	1250	1		SW6010B	9L21004	12/30/09 15:59
7440-47-3	Chromium	2.39	0.500	1.25	1		SW6010B	9L21004	12/30/09 15:59
7440-48-4	Cobalt		1.25	3.12	1	U	SW6010B	9L21004	12/30/09 15:59
7440-50-8	Copper		1.25	2.50	1	U	SW6010B	9L21004	12/30/09 15:59
7439-89-6	Iron	2340	7.50	25.0	1		SW6010B	9L21004	12/30/09 15:59
7439-92-1	Lead		0.375	0.750	1	U	SW6010B	9L21004	12/30/09 15:59
7439-95-4	Magnesium	2030	250	1250	1		SW6010B	9L21004	12/30/09 15:59
7439-96-5	Manganese CCM	22.0 J	0.750	3.75	1		SW6010B	9L21004	12/30/09 15:59
7440-02-0	Nickel		0.750	2.50	1	U	SW6010B	9L21004	12/30/09 15:59
7440-09-7	Potassium MSH	442 J	250	1250	1	~~J~~	SW6010B	9L21004	12/30/09 15:59
7782-49-2	Selenium		0.750	1.25	1	U	SW6010B	9L21004	12/30/09 15:59
7440-22-4	Silver		0.250	1.25	1	U	SW6010B	9L21004	12/30/09 15:59
7440-23-5	Sodium	3370	250	1250	1		SW6010B	9L21004	12/30/09 15:59
7440-28-0	Thallium		0.750	2.00	1	U	SW6010B	9L21004	12/30/09 15:59
7440-62-2	Vanadium	2.50	1.25	3.12	1	J	SW6010B	9L21004	12/30/09 15:59
7440-66-6	Zinc	2.76	1.25	5.00	1	J	SW6010B	9L21004	12/30/09 15:59

MW 2/24/10

ANALYSIS DATA SHEET

MR11-TW01-09D 12

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Ground Water
Sampled: 12/07/09 14:30
% Solids: 0.00

SDG: UXO11_003
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0912074-03
Received: 12/08/09 08:30

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
7439-97-6	Mercury		0.0800	0.200	1	U	SW7470A	9L10015	12/14/09 09:09
7429-90-5	Aluminum MSH	398 J	12.5	50.0	1	~~N~~	SW6010B	9L21004	12/30/09 16:04
7440-36-0	Antimony		1.25	3.75	1	U	SW6010B	9L21004	12/30/09 16:04
7440-38-2	Arsenic		0.750	1.25	1	U	SW6010B	9L21004	12/30/09 16:04
7440-39-3	Barium	49.2	1.25	10.0	1		SW6010B	9L21004	12/30/09 16:04
7440-41-7	Beryllium	0.660	0.250	1.25	1	J	SW6010B	9L21004	12/30/09 16:04
7440-43-9	Cadmium		0.250	1.25	1	U	SW6010B	9L21004	12/30/09 16:04
7440-70-2	Calcium	3680	250	1250	1		SW6010B	9L21004	12/30/09 16:04
7440-47-3	Chromium	0.653	0.500	1.25	1	J	SW6010B	9L21004	12/30/09 16:04
7440-48-4	Cobalt		1.25	3.12	1	U	SW6010B	9L21004	12/30/09 16:04
7440-50-8	Copper		1.25	2.50	1	U	SW6010B	9L21004	12/30/09 16:04
7439-89-6	Iron	234	7.50	25.0	1		SW6010B	9L21004	12/30/09 16:04
7439-92-1	Lead		0.375	0.750	1	U	SW6010B	9L21004	12/30/09 16:04
7439-95-4	Magnesium	919	250	1250	1	J	SW6010B	9L21004	12/30/09 16:04
7439-96-5	Manganese CCH	6.26 J	0.750	3.75	1		SW6010B	9L21004	12/30/09 16:04
7440-02-0	Nickel	2.64	0.750	2.50	1		SW6010B	9L21004	12/30/09 16:04
7440-09-7	Potassium		250	1250	1	U ~~N~~	SW6010B	9L21004	12/30/09 16:04
7782-49-2	Selenium		0.750	1.25	1	U	SW6010B	9L21004	12/30/09 16:04
7440-22-4	Silver		0.250	1.25	1	U	SW6010B	9L21004	12/30/09 16:04
7440-23-5	Sodium	3180	250	1250	1		SW6010B	9L21004	12/30/09 16:04
7440-28-0	Thallium		0.750	2.00	1	U	SW6010B	9L21004	12/30/09 16:04
7440-62-2	Vanadium		1.25	3.12	1	U	SW6010B	9L21004	12/30/09 16:04
7440-66-6	Zinc	8.11	1.25	5.00	1		SW6010B	9L21004	12/30/09 16:04

MW 2/24/10

ANALYSIS DATA SHEET

MR11-TW01D-09D 13

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Ground Water
Sampled: 12/07/09 14:35
% Solids: 0.00

SDG: UXO11_003
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0912074-04
Received: 12/08/09 08:30

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
7439-97-6	Mercury		0.0800	0.200	1	U	SW7470A	9L10015	12/14/09 09:10
7429-90-5	Aluminum MSH	366 J	12.5	50.0	1	~~N~~	SW6010B	9L21004	12/30/09 16:09
7440-36-0	Antimony		1.25	3.75	1	U	SW6010B	9L21004	12/30/09 16:09
7440-38-2	Arsenic		0.750	1.25	1	U	SW6010B	9L21004	12/30/09 16:09
7440-39-3	Barium	46.6	1.25	10.0	1		SW6010B	9L21004	12/30/09 16:09
7440-41-7	Beryllium	0.632	0.250	1.25	1	J	SW6010B	9L21004	12/30/09 16:09
7440-43-9	Cadmium		0.250	1.25	1	U	SW6010B	9L21004	12/30/09 16:09
7440-70-2	Calcium	3600	250	1250	1		SW6010B	9L21004	12/30/09 16:09
7440-47-3	Chromium	0.657	0.500	1.25	1	J	SW6010B	9L21004	12/30/09 16:09
7440-48-4	Cobalt		1.25	3.12	1	U	SW6010B	9L21004	12/30/09 16:09
7440-50-8	Copper		1.25	2.50	1	U	SW6010B	9L21004	12/30/09 16:09
7439-89-6	Iron	233	7.50	25.0	1		SW6010B	9L21004	12/30/09 16:09
7439-92-1	Lead		0.375	0.750	1	U	SW6010B	9L21004	12/30/09 16:09
7439-95-4	Magnesium	878	250	1250	1	J	SW6010B	9L21004	12/30/09 16:09
7439-96-5	Manganese CCH	6.34 J	0.750	3.75	1		SW6010B	9L21004	12/30/09 16:09
7440-02-0	Nickel	2.48	0.750	2.50	1	J	SW6010B	9L21004	12/30/09 16:09
7440-09-7	Potassium		250	1250	1	U ~~N~~	SW6010B	9L21004	12/30/09 16:09
7782-49-2	Selenium		0.750	1.25	1	U	SW6010B	9L21004	12/30/09 16:09
7440-22-4	Silver		0.250	1.25	1	U	SW6010B	9L21004	12/30/09 16:09
7440-23-5	Sodium	3060	250	1250	1		SW6010B	9L21004	12/30/09 16:09
7440-28-0	Thallium		0.750	2.00	1	U	SW6010B	9L21004	12/30/09 16:09
7440-62-2	Vanadium		1.25	3.12	1	U	SW6010B	9L21004	12/30/09 16:09
7440-66-6	Zinc	7.93	1.25	5.00	1		SW6010B	9L21004	12/30/09 16:09

hw
2/24/10

ANALYSIS DATA SHEET

MR11-FB120709-GW

14

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Water
Sampled: 12/07/09 13:40
% Solids: 0.00

SDG: UXO11_003
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0912074-05
Received: 12/08/09 08:30

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
7439-97-6	Mercury		0.0800	0.200	1	U	SW7470A	9L10015	12/14/09 09:11
7429-90-5	Aluminum		12.5	50.0	1	U ~~N~~	SW6010B	9L21004	12/30/09 16:13
7440-36-0	Antimony		1.25	3.75	1	U	SW6010B	9L21004	12/30/09 16:13
7440-38-2	Arsenic		0.750	1.25	1	U	SW6010B	9L21004	12/30/09 16:13
7440-39-3	Barium		1.25	10.0	1	U	SW6010B	9L21004	12/30/09 16:13
7440-41-7	Beryllium		0.250	1.25	1	U	SW6010B	9L21004	12/30/09 16:13
7440-43-9	Cadmium		0.250	1.25	1	U	SW6010B	9L21004	12/30/09 16:13
7440-70-2	Calcium		250	1250	1	U	SW6010B	9L21004	12/30/09 16:13
7440-47-3	Chromium		0.500	1.25	1	U	SW6010B	9L21004	12/30/09 16:13
7440-48-4	Cobalt		1.25	3.12	1	U	SW6010B	9L21004	12/30/09 16:13
7440-50-8	Copper		1.25	2.50	1	U	SW6010B	9L21004	12/30/09 16:13
7439-89-6	Iron		7.50	25.0	1	U	SW6010B	9L21004	12/30/09 16:13
7439-92-1	Lead		0.375	0.750	1	U	SW6010B	9L21004	12/30/09 16:13
7439-95-4	Magnesium		250	1250	1	U	SW6010B	9L21004	12/30/09 16:13
7439-96-5	Manganese		0.750	3.75	1	U	SW6010B	9L21004	12/30/09 16:13
7440-02-0	Nickel		0.750	2.50	1	U	SW6010B	9L21004	12/30/09 16:13
7440-09-7	Potassium		250	1250	1	U ~~N~~	SW6010B	9L21004	12/30/09 16:13
7782-49-2	Selenium		0.750	1.25	1	U	SW6010B	9L21004	12/30/09 16:13
7440-22-4	Silver		0.250	1.25	1	U	SW6010B	9L21004	12/30/09 16:13
7440-23-5	Sodium		250	1250	1	U	SW6010B	9L21004	12/30/09 16:13
7440-28-0	Thallium		0.750	2.00	1	U	SW6010B	9L21004	12/30/09 16:13
7440-62-2	Vanadium		1.25	3.12	1	U	SW6010B	9L21004	12/30/09 16:13
7440-66-6	Zinc		1.25	5.00	1	U	SW6010B	9L21004	12/30/09 16:13

fcw
2/24/10

ANALYSIS DATA SHEET

MR11-TW05-09D 15

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Ground Water
Sampled: 12/07/09 11:20
% Solids: 0.00

SDG: UXO11_003
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0912074-06
Received: 12/08/09 08:30

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
7439-97-6	Mercury		0.0800	0.200	1	U	SW7470A	9L10015	12/14/09 09:12
7429-90-5	Aluminum MSH	473 J	12.5	50.0	1	~~J~~	SW6010B	9L21004	12/30/09 16:18
7440-36-0	Antimony		1.25	3.75	1	U	SW6010B	9L21004	12/30/09 16:18
7440-38-2	Arsenic	1.37	0.750	1.25	1		SW6010B	9L21004	12/30/09 16:18
7440-39-3	Barium	10.3	1.25	10.0	1		SW6010B	9L21004	12/30/09 16:18
7440-41-7	Beryllium		0.250	1.25	1	U	SW6010B	9L21004	12/30/09 16:18
7440-43-9	Cadmium	0.311	0.250	1.25	1	J	SW6010B	9L21004	12/30/09 16:18
7440-70-2	Calcium	67200	250	1250	1		SW6010B	9L21004	12/30/09 16:18
7440-47-3	Chromium	1.50	0.500	1.25	1		SW6010B	9L21004	12/30/09 16:18
7440-48-4	Cobalt	1.48	1.25	3.12	1	J	SW6010B	9L21004	12/30/09 16:18
7440-50-8	Copper		1.25	2.50	1	U	SW6010B	9L21004	12/30/09 16:18
7439-89-6	Iron	220	7.50	25.0	1		SW6010B	9L21004	12/30/09 16:18
7439-92-1	Lead		0.375	0.750	1	U	SW6010B	9L21004	12/30/09 16:18
7439-95-4	Magnesium	1270	250	1250	1		SW6010B	9L21004	12/30/09 16:18
7439-96-5	Manganese ACH	11.4 J	0.750	3.75	1		SW6010B	9L21004	12/30/09 16:18
7440-02-0	Nickel	3.33	0.750	2.50	1		SW6010B	9L21004	12/30/09 16:18
7440-09-7	Potassium		250	1250	1	U ~~J~~	SW6010B	9L21004	12/30/09 16:18
7782-49-2	Selenium	1.16	0.750	1.25	1	J	SW6010B	9L21004	12/30/09 16:18
7440-22-4	Silver		0.250	1.25	1	U	SW6010B	9L21004	12/30/09 16:18
7440-23-5	Sodium	3100	250	1250	1		SW6010B	9L21004	12/30/09 16:18
7440-28-0	Thallium		0.750	2.00	1	U	SW6010B	9L21004	12/30/09 16:18
7440-62-2	Vanadium	4.21	1.25	3.12	1		SW6010B	9L21004	12/30/09 16:18
7440-66-6	Zinc	3.85	1.25	5.00	1	J	SW6010B	9L21004	12/30/09 16:18

MW 2/24/10

ANALYSIS DATA SHEET

MR11-TW01-09D-2

16

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Ground Water
Sampled: 12/09/09 12:45
% Solids: 0.00

SDG: UXO11_003
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0912098-01
Received: 12/10/09 08:15

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
7439-97-6	Mercury (dissolved)		0.0800	0.200	1	U	SW7470A	9L15020	12/16/09 15:55
7429-90-5	Aluminum (dissolved) MSH	325 J	12.5	50.0	1	~~N~~	SW6010B	9L21004	12/30/09 18:08
7440-36-0	Antimony (dissolved)		1.25	3.75	1	U	SW6010B	9L21004	12/30/09 18:08
7440-38-2	Arsenic (dissolved)		0.750	1.25	1	U	SW6010B	9L21004	12/30/09 18:08
7440-39-3	Barium (dissolved)	48.2	1.25	10.0	1		SW6010B	9L21004	12/30/09 18:08
7440-41-7	Beryllium (dissolved)	0.664	0.250	1.25	1	J	SW6010B	9L21004	12/30/09 18:08
7440-43-9	Cadmium (dissolved)		0.250	1.25	1	U	SW6010B	9L21004	12/30/09 18:08
7440-70-2	Calcium (dissolved)	3750	250	1250	1		SW6010B	9L21004	12/30/09 18:08
7440-47-3	Chromium (dissolved)		0.500	1.25	1	U	SW6010B	9L21004	12/30/09 18:08
7440-48-4	Cobalt (dissolved)		1.25	3.12	1	U	SW6010B	9L21004	12/30/09 18:08
7440-50-8	Copper (dissolved)		1.25	2.50	1	U	SW6010B	9L21004	12/30/09 18:08
7439-89-6	Iron (dissolved)	229	7.50	25.0	1		SW6010B	9L21004	12/30/09 18:08
7439-92-1	Lead (dissolved)		0.375	0.750	1	U	SW6010B	9L21004	12/30/09 18:08
7439-95-4	Magnesium (dissolved)	895	250	1250	1	J	SW6010B	9L21004	12/30/09 18:08
7439-96-5	Manganese (dissolved) CCH	5.51 J	0.750	3.75	1		SW6010B	9L21004	12/30/09 18:08
7440-02-0	Nickel (dissolved)	2.61	0.750	2.50	1		SW6010B	9L21004	12/30/09 18:08
7440-09-7	Potassium (dissolved)		250	1250	1	U ~~N~~	SW6010B	9L21004	12/30/09 18:08
7782-49-2	Selenium (dissolved)		0.750	1.25	1	U	SW6010B	9L21004	12/30/09 18:08
7440-22-4	Silver (dissolved)		0.250	1.25	1	U	SW6010B	9L21004	12/30/09 18:08
7440-23-5	Sodium (dissolved)	3160	250	1250	1		SW6010B	9L21004	12/30/09 18:08
7440-28-0	Thallium (dissolved)		0.750	2.00	1	U	SW6010B	9L21004	12/30/09 18:08
7440-62-2	Vanadium (dissolved)		1.25	3.12	1	U	SW6010B	9L21004	12/30/09 18:08
7440-66-6	Zinc (dissolved)	8.07	1.25	5.00	1		SW6010B	9L21004	12/30/09 18:08

LW
2/24/10

ANALYSIS DATA SHEET

MR11-TW01D-09D-2 17

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Ground Water
Sampled: 12/09/09 12:50
% Solids: 0.00

SDG: UXO11_003
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0912098-02
Received: 12/10/09 08:15

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
7439-97-6	Mercury (dissolved)		0.0800	0.200	1	U	SW7470A	9L15020	12/16/09 15:56
7429-90-5	Aluminum (dissolved) MSH	322 J	12.5	50.0	1	~~N~~	SW6010B	9L21004	12/30/09 18:12
7440-36-0	Antimony (dissolved)		1.25	3.75	1	U	SW6010B	9L21004	12/30/09 18:12
7440-38-2	Arsenic (dissolved)		0.750	1.25	1	U	SW6010B	9L21004	12/30/09 18:12
7440-39-3	Barium (dissolved)	46.2	1.25	10.0	1		SW6010B	9L21004	12/30/09 18:12
7440-41-7	Beryllium (dissolved)	0.642	0.250	1.25	1	J	SW6010B	9L21004	12/30/09 18:12
7440-43-9	Cadmium (dissolved)		0.250	1.25	1	U	SW6010B	9L21004	12/30/09 18:12
7440-70-2	Calcium (dissolved)	3600	250	1250	1		SW6010B	9L21004	12/30/09 18:12
7440-47-3	Chromium (dissolved)		0.500	1.25	1	U	SW6010B	9L21004	12/30/09 18:12
7440-48-4	Cobalt (dissolved)		1.25	3.12	1	U	SW6010B	9L21004	12/30/09 18:12
7440-50-8	Copper (dissolved)		1.25	2.50	1	U	SW6010B	9L21004	12/30/09 18:12
7439-89-6	Iron (dissolved)	209	7.50	25.0	1		SW6010B	9L21004	12/30/09 18:12
7439-92-1	Lead (dissolved)		0.375	0.750	1	U	SW6010B	9L21004	12/30/09 18:12
7439-95-4	Magnesium (dissolved)	867	250	1250	1	J	SW6010B	9L21004	12/30/09 18:12
7439-96-5	Manganese (dissolved) CCH	5.22 J	0.750	3.75	1		SW6010B	9L21004	12/30/09 18:12
7440-02-0	Nickel (dissolved)	2.45	0.750	2.50	1	J	SW6010B	9L21004	12/30/09 18:12
7440-09-7	Potassium (dissolved)		250	1250	1	U ~~N~~	SW6010B	9L21004	12/30/09 18:12
7782-49-2	Selenium (dissolved)		0.750	1.25	1	U	SW6010B	9L21004	12/30/09 18:12
7440-22-4	Silver (dissolved)		0.250	1.25	1	U	SW6010B	9L21004	12/30/09 18:12
7440-23-5	Sodium (dissolved)	3070	250	1250	1		SW6010B	9L21004	12/30/09 18:12
7440-28-0	Thallium (dissolved)		0.750	2.00	1	U	SW6010B	9L21004	12/30/09 18:12
7440-62-2	Vanadium (dissolved)		1.25	3.12	1	U	SW6010B	9L21004	12/30/09 18:12
7440-66-6	Zinc (dissolved)	8.11	1.25	5.00	1		SW6010B	9L21004	12/30/09 18:12

RW 2/24/10

ENVIRONMENTAL
Data Services, Inc.

EXPLOSIVES

USEPA Region IV - Level IV Review

Site: MCB Camp Lejeune, CTO-014, UXO-11 SDG #: UX011_003

Client: CH2M HILL, Inc., Virginia Beach, Virginia Date: February 24, 2010

Laboratory: Empirical Laboratories, Nashville, Tennessee Reviewer: Nancy Weaver

EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	MR11-IS02-4-5-09D	0912045-01	Soil
2	MR11-IS05-2-3-09D	0912045-02	Soil
2MS	MR11-IS05-2-3-09DMS	0912045-02MS	Soil
2MSD	MR11-IS05-2-3-09DMSD	0912045-02MSD	Soil
3	MR11-IS04-2-3-09D	0912045-03	Soil
4	MR11-IS03-2-3-09D	0912045-04	Soil
5	MR11-IS01-2-3-09D	0912045-05	Soil
6	MR11-IS01D-2-3-09D	0912045-06	Soil
7	MR11-EB120309-IS	0912045-07	Water
8	MR11-FB120309	0912045-08	Water
9	MR11-TW02-09D	0912054-01	Water
10	MR11-TW04-09D	0912074-01	Water
11	MR11-TW03-09D	0912074-02	Water
12	MR11-TW01-09D	0912074-03	Water
13	MR11-TW01D-09D	0912074-04	Water
14	MR11-FB120709-GW	0912074-05	Water
15	MR11-TW05-09D	0912074-06	Water
15MS	MR11-TW05-09DMS	0912074-06MS	Water
15MSD	MR11-TW05-09DMSD	0912074-06MSD	Water

The USEPA "Contract Laboratory Program National Functional Guidelines for Organic Data Review," October 1999, and professional judgement were used in evaluating the data in this summary report.

Holding Times - All samples were extracted within 7 days for water samples, 14 days for soil samples and analyzed within 40 days.

Initial Calibration - The initial calibrations exhibited acceptable %RSD and/or correlation coefficient values.

Calibration Verification - The continuing calibrations exhibited acceptable %D values.

Surrogates - Many samples exhibited acceptable surrogate recoveries on the primary column and slightly high recoveries on the confirmation column. No action was taken since the primary column recoveries were within QC limits.

MS/MSD - The MS/MSD sample exhibited acceptable %R and RPD values except the following.

MS/MSD Sample ID	Compound	MS/MSD %R/RPD	Qualifier
2	2,6-Dinitrotoluene	122%/123%/Ok	None - Sample ND

Laboratory Control Sample - The LCS samples exhibited acceptable %R values except the following.

LCS ID	Compound	%R	Qualifier	Affected Samples
9L16024-BLK1	2,6-Dinitrotoluene	126%	None	All ND
9L16025-BLK1	HMX	66%	J/UJ	7-9
9L17005-BLK1	HMX	75%	J/UJ	11-15
	PETN	127%	None	All ND

Method Blank - The method blanks were free of contamination.

Field and Equipment Blank - Field QC results are summarized below.

Blank ID	Compound	Conc. ug/L	Action Level ug/L	Qualifier	Affected Samples
MR11-EB120309-IS	1,3,5-Trinitrobenzene	0.25	1.25	None	All ND
	2,4-Dinitrotoluene	0.14	0.70		
	4-Nitrotoluene	0.19	0.95		
	3-Nitrotoluene	0.092	0.46		
MR11-FB120309	1,3,5-Trinitrobenzene	0.15	0.75	None	All ND
	2,4-Dinitrotoluene	0.092	0.46		
	2,6-Dinitrotoluene	0.049	0.245		
	3-Nitrotoluene	0.10	0.50		
MR11-FB120709-GW	RDX	0.18	0.90	None	All ND
	2,4-Dinitrotoluene	0.086	0.43		
	2,6-Dinitrotoluene	0.057	0.285		
	4-Nitrotoluene	0.12	0.60		
	3-Nitrotoluene	0.069	0.345	U	9

Field Duplicates - Field duplicate results are summarized below.

Compound	MR11-IS01-2-3-09D ug/kg	MR11-IS01D-2-3-09D ug/kg	RPD	Qualifier
RDX	170	440	89%	None

Compound	MR11-TW01-09D ug/L	MR11-TW01D-09D ug/L	RPD	Qualifier
Nitrobenzene	0.10	ND	NC	None
1,3,5-Trinitrobenzene	ND	0.076	NC	None
4-Nitrotoluene	0.094	0.069	31%	None

Compound Identification - Retention times were acceptable and no further action was taken.

Compound Quantitation - Several samples exhibited results with high %D values between columns and have been flagged (P) by the laboratory and further qualified (J).

FORM 1
EXPL ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

MR11-IS0
2-4-5-09D

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: Case No.: SAS No.: NA SDG No.: UX011_003

Matrix: (soil/water) SOIL Lab Sample ID: 0912045-01

Sample wt/vol: 2.0 (g/mL) G Lab File ID: 021V1901

% Moisture: 0 decanted: (Y/N) N Date Sampled: 12/03/09 09:15

Extraction: (SepF/Cont/Sonc/Soxh) SONC Date Extracted:12/16/09

Concentrated Extract Volume: 20.0(ml) Date Analyzed: 12/17/09 22:06

Injection Volume: 100.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
2691-41-0	HMX	62	190		U
121-82-4	RDX	62	190	300	
98-95-3	Nitrobenzene	62	190		U
99-65-0	1,3-Dinitrobenzene	62	190		U
99-35-4	1,3,5-Trinitrobenzene	62	190		U
121-14-2	2,4-Dinitrotoluene	62	190		U
606-20-2	2,6-Dinitrotoluene	62	190		U
118-96-7	2,4,6-Trinitrotoluene	62	190		U
35572-78-2	2-Amino-4,6-dinitrotoluene	62	190		U
479-45-8	Tetryl	62	190		U
19406-51-0	4-Amino-2,6-dinitrotoluene	62	190		U
88-72-2	2-Nitrotoluene	62	190		U
99-99-0	4-Nitrotoluene	62	190		U
99-08-1	3-Nitrotoluene	62	190		U
55-63-0	Nitroglycerin	210	640		U
78-11-5	PETN	210	640		U

FORM I EXPL

lw
2/24/10

FORM 1
EXPL ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO. 2

MR11-IS05-2-3-0

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: Case No.: SAS No.: NA SDG No.: UX011_003

Matrix: (soil/water) SOIL Lab Sample ID: 0912045-02

Sample wt/vol: 2.0 (g/mL) G Lab File ID: 022V2001

% Moisture: 0 decanted: (Y/N) N Date Sampled: 12/03/09 09:30

Extraction: (SepF/Cont/Sonc/Soxh) SONC Date Extracted:12/16/09

Concentrated Extract Volume: 20.0(ml) Date Analyzed: 12/17/09 22:39

Injection Volume: 100.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
2691-41-0	HMX	62	190		U
121-82-4	RDX	62	190	2C 370	~~P~~ J
98-95-3	Nitrobenzene	62	190		U
99-65-0	1,3-Dinitrobenzene	62	190		U
99-35-4	1,3,5-Trinitrobenzene	62	190		U
121-14-2	2,4-Dinitrotoluene	62	190		U
606-20-2	2,6-Dinitrotoluene	62	190		U
118-96-7	2,4,6-Trinitrotoluene	62	190		U
35572-78-2	2-Amino-4,6-dinitrotoluene	62	190		U
479-45-8	Tetryl	62	190		U
19406-51-0	4-Amino-2,6-dinitrotoluene	62	190		U
88-72-2	2-Nitrotoluene	62	190		U
99-99-0	4-Nitrotoluene	62	190		U
99-08-1	3-Nitrotoluene	62	190		U
55-63-0	Nitroglycerin	210	640		U
78-11-5	PETN	210	640		U

FORM I EXPL

MW 2/24/10

FORM 1
EXPL ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO. 3

MR11-IS0
4-2-3-09D

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: Case No.: SAS No.: NA SDG No.: UX011_003

Matrix: (soil/water) SOIL Lab Sample ID: 0912045-03

Sample wt/vol: 2.0 (g/mL) G Lab File ID: 027V2501

% Moisture: 0 decanted: (Y/N) N Date Sampled: 12/03/09 10:20

Extraction: (SepF/Cont/Sonc/Soxh) SONC Date Extracted:12/16/09

Concentrated Extract Volume: 20.0(ml) Date Analyzed: 12/18/09 01:23

Injection Volume: 100.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
2691-41-0	HMX	62	190		U
121-82-4	RDX	62	190	2C 103	~~JPM~~ J
98-95-3	Nitrobenzene	62	190		U
99-65-0	1,3-Dinitrobenzene	62	190		U
99-35-4	1,3,5-Trinitrobenzene	62	190		U
121-14-2	2,4-Dinitrotoluene	62	190		U
606-20-2	2,6-Dinitrotoluene	62	190		U
118-96-7	2,4,6-Trinitrotoluene	62	190		U
35572-78-2	2-Amino-4,6-dinitrotoluene	62	190		U
479-45-8	Tetryl	62	190		U
19406-51-0	4-Amino-2,6-dinitrotoluene	62	190		U
88-72-2	2-Nitrotoluene	62	190		U
99-99-0	4-Nitrotoluene	62	190		U
99-08-1	3-Nitrotoluene	62	190		U
55-63-0	Nitroglycerin	210	640		U
78-11-5	PETN	210	640		U

FORM I EXPL

CW
2/24/10

FORM 1
EXPL ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO. 4

MR11-IS0
3-2-3-09D

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: Case No.: SAS No.: NA SDG No.: UX011_003

Matrix: (soil/water) SOIL Lab Sample ID: 0912045-04

Sample wt/vol: 2.0 (g/mL) G Lab File ID: 028V2601

% Moisture: 0 decanted: (Y/N) N Date Sampled: 12/03/09 10:50

Extraction: (SepF/Cont/Sonc/Soxh) SONC Date Extracted:12/16/09

Concentrated Extract Volume: 20.0(ml) Date Analyzed: 12/18/09 01:56

Injection Volume: 100.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
2691-41-0	HMX	62	190		U
121-82-4	RDX	62	190	2C 400	~~P~~ J
98-95-3	Nitrobenzene	62	190		U
99-65-0	1,3-Dinitrobenzene	62	190		U
99-35-4	1,3,5-Trinitrobenzene	62	190		U
121-14-2	2,4-Dinitrotoluene	62	190		U
606-20-2	2,6-Dinitrotoluene	62	190		U
118-96-7	2,4,6-Trinitrotoluene	62	190		U
35572-78-2	2-Amino-4,6-dinitrotoluene	62	190		U
479-45-8	Tetryl	62	190		U
19406-51-0	4-Amino-2,6-dinitrotoluene	62	190		U
88-72-2	2-Nitrotoluene	62	190		U
99-99-0	4-Nitrotoluene	62	190		U
99-08-1	3-Nitrotoluene	62	190		U
55-63-0	Nitroglycerin	210	640		U
78-11-5	PETN	210	640		U

FORM I EXPL

RW
2/24/10

FORM 1
EXPL ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO. 5

MR11-IS0
1-2-3-09D

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: Case No.: SAS No.: NA SDG No.: UX011_003

Matrix: (soil/water) SOIL Lab Sample ID: 0912045-05

Sample wt/vol: 2.0 (g/mL) G Lab File ID: 029V2701

% Moisture: 0 decanted: (Y/N) N Date Sampled: 12/03/09 11:40

Extraction: (SepF/Cont/Sonc/Soxh) SONC Date Extracted:12/16/09

Concentrated Extract Volume: 20.0(ml) Date Analyzed: 12/18/09 02:29

Injection Volume: 100.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
2691-41-0-----	HMX	62	190		U
121-82-4------	RDX	62	190	20 170	~~JPM~~ J
98-95-3-------	Nitrobenzene	62	190		U
99-65-0-------	1,3-Dinitrobenzene	62	190		U
99-35-4-------	1,3,5-Trinitrobenzene	62	190		U
121-14-2------	2,4-Dinitrotoluene	62	190		U
606-20-2------	2,6-Dinitrotoluene	62	190		U
118-96-7------	2,4,6-Trinitrotoluene	62	190		U
35572-78-2----	2-Amino-4,6-dinitrotoluene	62	190		U
479-45-8------	Tetryl	62	190		U
19406-51-0----	4-Amino-2,6-dinitrotoluene	62	190		U
88-72-2-------	2-Nitrotoluene	62	190		U
99-99-0-------	4-Nitrotoluene	62	190		U
99-08-1-------	3-Nitrotoluene	62	190		U
55-63-0-------	Nitroglycerin	210	640		U
78-11-5-------	PETN	210	640		U

FORM I EXPL

pw 2/24/10

FORM 1
EXPL ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO. 6

MR11-IS01
D-2-3-09D

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: Case No.: SAS No.: NA SDG No.: UX011_003

Matrix: (soil/water) SOIL Lab Sample ID: 0912045-06

Sample wt/vol: 2.0 (g/mL) G Lab File ID: 030V2801

% Moisture: 0 decanted: (Y/N) N Date Sampled: 12/03/09 11:45

Extraction: (SepF/Cont/Sonc/Soxh) SONC Date Extracted:12/16/09

Concentrated Extract Volume: 20.0(ml) Date Analyzed: 12/18/09 03:02

Injection Volume: 100.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	MDL	RL	CONC	Q
2691-41-0	HMX	62	190		U
121-82-4	RDX	62	190	440	
98-95-3	Nitrobenzene	62	190		U
99-65-0	1,3-Dinitrobenzene	62	190		U
99-35-4	1,3,5-Trinitrobenzene	62	190		U
121-14-2	2,4-Dinitrotoluene	62	190		U
606-20-2	2,6-Dinitrotoluene	62	190		U
118-96-7	2,4,6-Trinitrotoluene	62	190		U
35572-78-2	2-Amino-4,6-dinitrotoluene	62	190		U
479-45-8	Tetryl	62	190		U
19406-51-0	4-Amino-2,6-dinitrotoluene	62	190		U
88-72-2	2-Nitrotoluene	62	190		U
99-99-0	4-Nitrotoluene	62	190		U
99-08-1	3-Nitrotoluene	62	190		U
55-63-0	Nitroglycerin	210	640		U
78-11-5	PETN	210	640		U

FORM I EXPL

MW 2/24/10

FORM 1
EXPL ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO. 7

MR11-EB1
20309-IS

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: Case No.: SAS No.: NA SDG No.: UX011_003

Matrix: (soil/water) WATER Lab Sample ID: 0912045-07

Sample wt/vol: 1000 (g/ml) ML Lab File ID: 017V1701

% Moisture: _____ decanted: (Y/N)___ Date Sampled: 12/03/09 08:05

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:12/17/09

Concentrated Extract Volume: 8.0(ml) Date Analyzed: 12/20/09 01:56

Injection Volume: 100.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
2691-41-0	HMX	0.050	0.15	BSL	~~U~~ UJ
121-82-4	RDX	0.050	0.15		U
98-95-3	Nitrobenzene	0.050	0.15		U
99-65-0	1,3-Dinitrobenzene	0.050	0.15		U
99-35-4	1,3,5-Trinitrobenzene	0.050	0.15	2C 0.25	~~P~~ J
121-14-2	2,4-Dinitrotoluene	0.050	0.15	0.14	J
606-20-2	2,6-Dinitrotoluene	0.050	0.15		U
118-96-7	2,4,6-Trinitrotoluene	0.050	0.15		U
35572-78-2	2-Amino-4,6-dinitrotoluene	0.050	0.15		U
479-45-8	Tetryl	0.050	0.15		U
19406-51-0	4-Amino-2,6-dinitrotoluene	0.050	0.15		U
88-72-2	2-Nitrotoluene	0.050	0.15		U
99-99-0	4-Nitrotoluene	0.050	0.15	2C 0.19	~~PM~~ J
99-08-1	3-Nitrotoluene	0.050	0.15	2C 0.092	~~JPM~~ J
55-63-0	Nitroglycerin	0.17	0.51		U
78-11-5	PETN	0.17	0.51		U

FORM I EXPL

LW 2/24/10

FORM 1
EXPL ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO. 8

MR11-FB120309

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: Case No.: SAS No.: NA SDG No.: UX011_003

Matrix: (soil/water) WATER Lab Sample ID: 0912045-08

Sample wt/vol: 1080 (g/ml) ML Lab File ID: 018V1801

% Moisture: _____ decanted: (Y/N)___ Date Sampled: 12/03/09 08:10

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:12/17/09

Concentrated Extract Volume: 8.0(ml) Date Analyzed: 12/20/09 02:29

Injection Volume: 100.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
2691-41-0	HMX	0.046	0.14	BSL	~~U~~ UJ
121-82-4	RDX	0.046	0.14		U
98-95-3	Nitrobenzene	0.046	0.14		U
99-65-0	1,3-Dinitrobenzene	0.046	0.14		U
99-35-4	1,3,5-Trinitrobenzene	0.046	0.14	0.14	J
121-14-2	2,4-Dinitrotoluene	0.046	0.14	ZC 0.092	~~JP~~ J
606-20-2	2,6-Dinitrotoluene	0.046	0.14	ZC 0.049	~~JPM~~ J
118-96-7	2,4,6-Trinitrotoluene	0.046	0.14		U
35572-78-2	2-Amino-4,6-dinitrotoluene	0.046	0.14		U
479-45-8	Tetryl	0.046	0.14		U
19406-51-0	4-Amino-2,6-dinitrotoluene	0.046	0.14		U
88-72-2	2-Nitrotoluene	0.046	0.14		U
99-99-0	4-Nitrotoluene	0.046	0.14		U
99-08-1	3-Nitrotoluene	0.046	0.14	ZC 0.10	~~JPM~~ J
55-63-0	Nitroglycerin	0.16	0.47		U
78-11-5	PETN	0.16	0.47		U

FORM I EXPL

RW
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FORM 1
EXPL ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO. 9

MR11-TW02-09D

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: Case No.: SAS No.: NA SDG No.: UX011_003

Matrix: (soil/water) WATER Lab Sample ID: 0912054-01

Sample wt/vol: 1000 (g/ml) ML Lab File ID: 003V0301

% Moisture: _____ decanted: (Y/N)___ Date Sampled: 12/04/09 14:40

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:12/17/09

Concentrated Extract Volume: 8.0(ml) Date Analyzed: 12/29/09 17:31

Injection Volume: 100.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
2691-41-0	HMX	0.050	0.15	BSL	~~U~~ UJ
121-82-4	RDX	0.050	0.15		U
98-95-3	Nitrobenzene	0.050	0.15	2C 0.48	~~P~~ J
99-65-0	1,3-Dinitrobenzene	0.050	0.15	0.12	J
99-35-4	1,3,5-Trinitrobenzene	0.050	0.15		U
121-14-2	2,4-Dinitrotoluene	0.050	0.15		U
606-20-2	2,6-Dinitrotoluene	0.050	0.15		U
118-96-7	2,4,6-Trinitrotoluene	0.050	0.15		U
35572-78-2	2-Amino-4,6-dinitrotoluene	0.050	0.15		U
479-45-8	Tetryl	0.050	0.15		U
19406-51-0	4-Amino-2,6-dinitrotoluene	0.050	0.15		U
88-72-2	2-Nitrotoluene	0.050	0.15		U
99-99-0	4-Nitrotoluene	0.050	0.15		U
99-08-1	3-Nitrotoluene	0.050	0.15	PBL 0.15 ~~0.060~~	~~J~~ PM U
55-63-0	Nitroglycerin	0.17	0.51		U
78-11-5	PETN	0.17	0.51		U

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FORM 1
EXPL ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO. 10

MR11-TW04-09D

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: Case No.: SAS No.: NA SDG No.: UX011_003

Matrix: (soil/water) WATER Lab Sample ID: 0912074-01

Sample wt/vol: 1020 (g/ml) ML Lab File ID: 012V1201

% Moisture: _____ decanted: (Y/N)___ Date Sampled: 12/07/09 15:10

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:12/10/09

Concentrated Extract Volume: 8.0(ml) Date Analyzed: 01/02/10 21:45

Injection Volume: 100.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
2691-41-0	HMX	0.049	0.15		U
121-82-4	RDX	0.049	0.15		U
98-95-3	Nitrobenzene	0.049	0.15	2C 0.064	~~JP~~ J
99-65-0	1,3-Dinitrobenzene	0.049	0.15	0.058	J
99-35-4	1,3,5-Trinitrobenzene	0.049	0.15	0.086	J
121-14-2	2,4-Dinitrotoluene	0.049	0.15		U
606-20-2	2,6-Dinitrotoluene	0.049	0.15		U
118-96-7	2,4,6-Trinitrotoluene	0.049	0.15		U
35572-78-2	2-Amino-4,6-dinitrotoluene	0.049	0.15		U
479-45-8	Tetryl	0.049	0.15		U
19406-51-0	4-Amino-2,6-dinitrotoluene	0.049	0.15		U
88-72-2	2-Nitrotoluene	0.049	0.15		U
99-99-0	4-Nitrotoluene	0.049	0.15	0.18	
99-08-1	3-Nitrotoluene	0.049	0.15	0.15	
55-63-0	Nitroglycerin	0.17	0.50		U
78-11-5	PETN	0.17	0.50		U

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FORM 1
EXPL ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO.

MR11-TW03-09D

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: Case No.: SAS No.: NA SDG No.: UX011_003

Matrix: (soil/water) WATER Lab Sample ID: 0912074-02

Sample wt/vol: 1020 (g/ml) ML Lab File ID: 008V0801

% Moisture: _____ decanted: (Y/N)___ Date Sampled: 12/07/09 14:00

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:12/17/09

Concentrated Extract Volume: 8.0(ml) Date Analyzed: 12/19/09 21:00

Injection Volume: 100.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
2691-41-0	HMX	0.049	0.15	BSL	~~U~~ UJ
121-82-4	RDX	0.049	0.15	0.10	J
98-95-3	Nitrobenzene	0.049	0.15	2C 0.20	J
99-65-0	1,3-Dinitrobenzene	0.049	0.15	2C 0.062	~~JP~~ J
99-35-4	1,3,5-Trinitrobenzene	0.049	0.15		U
121-14-2	2,4-Dinitrotoluene	0.049	0.15		U
606-20-2	2,6-Dinitrotoluene	0.049	0.15		U
118-96-7	2,4,6-Trinitrotoluene	0.049	0.15	0.053	J
35572-78-2	2-Amino-4,6-dinitrotoluene	0.049	0.15		U
479-45-8	Tetryl	0.049	0.15		U
19406-51-0	4-Amino-2,6-dinitrotoluene	0.049	0.15		U
88-72-2	2-Nitrotoluene	0.049	0.15	2C 0.064	~~JP~~ J
99-99-0	4-Nitrotoluene	0.049	0.15	↓ 0.41	~~PM~~ ↓
99-08-1	3-Nitrotoluene	0.049	0.15	↓ 0.12	~~JPM~~ ↓
55-63-0	Nitroglycerin	0.17	0.50	0.22	J
78-11-5	PETN	0.17	0.50		U

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FORM 1
EXPL ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO. 12

MR11-TW01-09D

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: Case No.: SAS No.: NA SDG No.: UX011_003

Matrix: (soil/water) WATER Lab Sample ID: 0912074-03

Sample wt/vol: 1000 (g/ml) ML Lab File ID: 009V0901

% Moisture: _____ decanted: (Y/N)___ Date Sampled: 12/07/09 14:30

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:12/17/09

Concentrated Extract Volume: 8.0(ml) Date Analyzed: 12/19/09 21:33

Injection Volume: 100.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
2691-41-0	HMX	0.050	0.15	BSL	~~U~~ UJ
121-82-4	RDX	0.050	0.15		U
98-95-3	Nitrobenzene	0.050	0.15	2C 0.10	~~JP~~ J
99-65-0	1,3-Dinitrobenzene	0.050	0.15		U
99-35-4	1,3,5-Trinitrobenzene	0.050	0.15		U
121-14-2	2,4-Dinitrotoluene	0.050	0.15		U
606-20-2	2,6-Dinitrotoluene	0.050	0.15		U
118-96-7	2,4,6-Trinitrotoluene	0.050	0.15		U
35572-78-2	2-Amino-4,6-dinitrotoluene	0.050	0.15		U
479-45-8	Tetryl	0.050	0.15		U
19406-51-0	4-Amino-2,6-dinitrotoluene	0.050	0.15		U
88-72-2	2-Nitrotoluene	0.050	0.15		U
99-99-0	4-Nitrotoluene	0.050	0.15	2C 0.094	~~JPM~~ J
99-08-1	3-Nitrotoluene	0.050	0.15		U
55-63-0	Nitroglycerin	0.17	0.51		U
78-11-5	PETN	0.17	0.51		U

FORM I EXPL

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FORM 1
EXPL ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO. 13

MR11-TW01D-09D

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: Case No.: SAS No.: NA SDG No.: UX011_003

Matrix: (soil/water) WATER Lab Sample ID: 0912074-04

Sample wt/vol: 1000 (g/ml) ML Lab File ID: 010V1001

% Moisture: _____ decanted: (Y/N)___ Date Sampled: 12/07/09 14:35

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:12/17/09

Concentrated Extract Volume: 8.0(ml) Date Analyzed: 12/19/09 22:06

Injection Volume: 100.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
2691-41-0	HMX	0.050	0.15	BSL	~~U~~ UJ
121-82-4	RDX	0.050	0.15		U
98-95-3	Nitrobenzene	0.050	0.15		U
99-65-0	1,3-Dinitrobenzene	0.050	0.15		U
99-35-4	1,3,5-Trinitrobenzene	0.050	0.15	0.076	J
121-14-2	2,4-Dinitrotoluene	0.050	0.15		U
606-20-2	2,6-Dinitrotoluene	0.050	0.15		U
118-96-7	2,4,6-Trinitrotoluene	0.050	0.15		U
35572-78-2	2-Amino-4,6-dinitrotoluene	0.050	0.15		U
479-45-8	Tetryl	0.050	0.15		U
19406-51-0	4-Amino-2,6-dinitrotoluene	0.050	0.15		U
88-72-2	2-Nitrotoluene	0.050	0.15		U
99-99-0	4-Nitrotoluene	0.050	0.15	ZC 0.069	~~JPM~~ J
99-08-1	3-Nitrotoluene	0.050	0.15		U
55-63-0	Nitroglycerin	0.17	0.51		U
78-11-5	PETN	0.17	0.51		U

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FORM 1
EXPL ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO. 14

MR11-FB1
20709-GW

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: Case No.: SAS No.: NA SDG No.: UX011_003

Matrix: (soil/water) WATER Lab Sample ID: 0912074-05

Sample wt/vol: 1000 (g/ml) ML Lab File ID: 011V1101

% Moisture: _____ decanted: (Y/N)___ Date Sampled: 12/07/09 13:40

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:12/17/09

Concentrated Extract Volume: 8.0(ml) Date Analyzed: 12/19/09 22:39

Injection Volume: 100.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
2691-41-0	HMX	0.050	0.15	BSL	~~U~~ UJ
121-82-4	RDX	0.050	0.15	0.18	
98-95-3	Nitrobenzene	0.050	0.15		U
99-65-0	1,3-Dinitrobenzene	0.050	0.15		U
99-35-4	1,3,5-Trinitrobenzene	0.050	0.15		U
121-14-2	2,4-Dinitrotoluene	0.050	0.15	ZC 0.086	~~JP~~ J
606-20-2	2,6-Dinitrotoluene	0.050	0.15	ZC 0.057	~~JPM~~ J
118-96-7	2,4,6-Trinitrotoluene	0.050	0.15		U
35572-78-2	2-Amino-4,6-dinitrotoluene	0.050	0.15		U
479-45-8	Tetryl	0.050	0.15		U
19406-51-0	4-Amino-2,6-dinitrotoluene	0.050	0.15		U
88-72-2	2-Nitrotoluene	0.050	0.15		U
99-99-0	4-Nitrotoluene	0.050	0.15	ZC 0.12	~~JPM~~ J
99-08-1	3-Nitrotoluene	0.050	0.15	ZC 0.069	~~JPM~~ J
55-63-0	Nitroglycerin	0.17	0.51		U
78-11-5	PETN	0.17	0.51		U

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FORM 1
EXPL ORGANICS ANALYSIS DATA SHEET

CLIENT SAMPLE NO. 15

MR11-TW05-09D

Lab Name: EMPIRICAL LABS Contract: CH2MHILL

Lab Code: Case No.: SAS No.: NA SDG No.: UX011_003

Matrix: (soil/water) WATER Lab Sample ID: 0912074-06

Sample wt/vol: 1020 (g/ml) ML Lab File ID: 012V1201

% Moisture: _____ decanted: (Y/N)___ Date Sampled: 12/07/09 11:20

Extraction: (SepF/Cont/Sonc/Soxh) SEPF Date Extracted:12/17/09

Concentrated Extract Volume: 8.0(ml) Date Analyzed: 12/19/09 23:12

Injection Volume: 100.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: NA Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	MDL	RL	CONC	Q
2691-41-0	HMX	0.049	0.15	BSL	~~U~~ UJ
121-82-4	RDX	0.049	0.15		U
98-95-3	Nitrobenzene	0.049	0.15		U
99-65-0	1,3-Dinitrobenzene	0.049	0.15		U
99-35-4	1,3,5-Trinitrobenzene	0.049	0.15		U
121-14-2	2,4-Dinitrotoluene	0.049	0.15		U
606-20-2	2,6-Dinitrotoluene	0.049	0.15		U
118-96-7	2,4,6-Trinitrotoluene	0.049	0.15		U
35572-78-2	2-Amino-4,6-dinitrotoluene	0.049	0.15		U
479-45-8	Tetryl	0.049	0.15		U
19406-51-0	4-Amino-2,6-dinitrotoluene	0.049	0.15		U
88-72-2	2-Nitrotoluene	0.049	0.15		U
99-99-0	4-Nitrotoluene	0.049	0.15	2C 0.086	~~JPM~~ J
99-08-1	3-Nitrotoluene	0.049	0.15		U
55-63-0	Nitroglycerin	0.17	0.50		U
78-11-5	PETN	0.17	0.50		U

FORM I EXPL

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ENVIRONMENTAL
Data Services, Inc.

PERCHLORATE

USEPA Region IV - Level IV Review

Site: MCB Camp Lejeune, CTO-014, UXO-11 SDG #: UX011_003

Client: CH2M HILL, Inc., Virginia Beach, Virginia Date: February 24, 2010

Laboratory: Empirical Laboratories, Nashville, Tennessee Reviewer: Nancy Weaver

EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	MR11-IS02-4-5-09D	0912045-01	Soil
2	MR11-IS05-2-3-09D	0912045-02	Soil
2MS	MR11-IS05-2-3-09DMS	0912045-02MS	Soil
2MSD	MR11-IS05-2-3-09DMSD	0912045-02MSD	Soil
3	MR11-IS04-2-3-09D	0912045-03	Soil
4	MR11-IS03-2-3-09D	0912045-04	Soil
5	MR11-IS01-2-3-09D	0912045-05	Soil
6	MR11-IS01D-2-3-09D	0912045-06	Soil
7	MR11-EB120309-IS	0912045-07	Water
8	MR11-FB120309	0912045-08	Water
9	MR11-TW02-09D	0912054-01	Water
10	MR11-TW04-09D	0912074-01	Water
11	MR11-TW03-09D	0912074-02	Water
12	MR11-TW01-09D	0912074-03	Water
13	MR11-TW01D-09D	0912074-04	Water
14	MR11-FB120709-GW	0912074-05	Water
15	MR11-TW05-09D	0912074-06	Water
15MS	MR11-TW05-09DMS	0912074-06MS	Water
15MSD	MR11-TW05-09DMSD	0912074-06MSD	Water

The USEPA "Contract Laboratory Program National Functional Guidelines for Inorganic Data Review," October 2004, and professional judgement were used in evaluating the data in this summary report.

Holding Times - All samples were prepared and analyzed within 28 days for perchlorate.

Calibration - The ICV and CCV %R values were acceptable.

Method and Calibration Blanks - The method blanks and continuing calibration blanks were free of contamination.

Field and Equipment Blank - Field QC results are summarized below.

Blank ID	Compound	Conc. ug/L	Action Level ug/L	Qualifier	Affected Samples
MR11-EB120309-IS	None - ND	-	-	-	-
MR11-FB120309	None - ND	-	-	-	-
MR11-FB120709-GW	None - ND	-	-	-	-

Matrix Spike/Duplicate - The matrix spike/duplicate samples exhibited acceptable %R and RPD values.

LCS - The LCS samples exhibited acceptable %R values.

Field Duplicates - Field duplicate results are summarized below.

Compound	MR11-IS01-2-3-09D ug/kg	MR11-IS01D-2-3-09D ug/kg	RPD	Qualifier
None	ND	ND	-	-

Compound	MR11-TW01-09D ug/L	MR11-TW01D-09D ug/L	RPD	Qualifier
None	ND	ND	-	-

Compound Quantitation - No discrepancies were identified.

ANALYSIS DATA SHEET

MR11-IS02-4-5-09D

Laboratory: Empirical Laboratories, LLC
Client: CH2M Hill, Inc.
Matrix: Soil
Sampled: 12/03/09 09:15
% Solids: 82.86

SDG: UXO11_003
Project: Lejeune CTO014 (UX11)
Laboratory ID: 0912045-01
Received: 12/04/09 08:30

CAS NO.	Analyte	Concentration (ug/Kg dry)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
14797-73-0	Perchlorate		0.724	2.41	1	U	SW6850	9L09020	12/21/09 17:18

LW
2/24/10

ANALYSIS DATA SHEET

MR11-IS05-2-3-09D

2

Laboratory:	Empirical Laboratories, LLC	SDG:	UXO11_003
Client:	CH2M Hill, Inc.	Project:	Lejeune CTO014 (UX11)
Matrix:	Soil	Laboratory ID:	0912045-02
Sampled:	12/03/09 09:30	Received:	12/04/09 08:30
% Solids:	85.14		

CAS NO.	Analyte	Concentration (ug/Kg dry)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
14797-73-0	Perchlorate		0.705	2.35	1	U	SW6850	9L09020	12/21/09 17:36

CW
2/24/10

ANALYSIS DATA SHEET

MR11-IS04-2-3-09D

3

Laboratory:	Empirical Laboratories, LLC	SDG:	UXO11_003
Client:	CH2M Hill, Inc.	Project:	Lejeune CTO014 (UX11)
Matrix:	Soil	Laboratory ID:	0912045-03
Sampled:	12/03/09 10:20	Received:	12/04/09 08:30
% Solids:	83.78		

CAS NO.	Analyte	Concentration (ug/Kg dry)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
14797-73-0	Perchlorate		0.716	2.39	1	U	SW6850	9L09020	12/21/09 19:05

MW
2/24/10

ANALYSIS DATA SHEET

MR11-IS03-2-3-09D

4

Laboratory:	Empirical Laboratories, LLC	SDG:	UXO11_003
Client:	CH2M Hill, Inc.	Project:	Lejeune CTO014 (UX11)
Matrix:	Soil	Laboratory ID:	0912045-04
Sampled:	12/03/09 10:50	Received:	12/04/09 08:30
% Solids:	79.11		

CAS NO.	Analyte	Concentration (ug/Kg dry)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
14797-73-0	Perchlorate	5.05	0.758	2.53	1		SW6850	9L09020	12/21/09 19:23

LW
2/24/10

ANALYSIS DATA SHEET

MR11-IS01-2-3-09D

5

Laboratory:	Empirical Laboratories, LLC	SDG:	UXO11_003
Client:	CH2M Hill, Inc.	Project:	Lejeune CTO014 (UX11)
Matrix:	Soil	Laboratory ID:	0912045-05
Sampled:	12/03/09 11:40	Received:	12/04/09 08:30
% Solids:	86.69		

CAS NO.	Analyte	Concentration (ug/Kg dry)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
14797-73-0	Perchlorate		0.692	2.31	1	U	SW6850	9L09020	12/21/09 19:41

2/24/10

ANALYSIS DATA SHEET

MR11-IS01D-2-3-09D

6

Laboratory:	Empirical Laboratories, LLC	SDG:	UXO11_003
Client:	CH2M Hill, Inc.	Project:	Lejeune CTO014 (UX11)
Matrix:	Soil	Laboratory ID:	0912045-06
Sampled:	12/03/09 11:45	Received:	12/04/09 08:30
% Solids:	87.26		

CAS NO.	Analyte	Concentration (ug/Kg dry)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
14797-73-0	Perchlorate		0.688	2.29	1	U	SW6850	9L09020	12/21/09 19:59

lew
2/24/10

ANALYSIS DATA SHEET

MR11-EB120309-IS

7

Laboratory:	Empirical Laboratories, LLC	SDG:	UXO11_003
Client:	CH2M Hill, Inc.	Project:	Lejeune CTO014 (UX11)
Matrix:	Water	Laboratory ID:	0912045-07
Sampled:	12/03/09 08:05	Received:	12/04/09 08:30
% Solids:	0.00		

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
14797-73-0	Perchlorate		0.0660	0.200	1	U	SW6850	9L09015	12/16/09 22:30

RW
2/24/10

ANALYSIS DATA SHEET

MR11-FB120309

8

Laboratory:	Empirical Laboratories, LLC	SDG:	UXO11_003
Client:	CH2M Hill, Inc.	Project:	Lejeune CTO014 (UX11)
Matrix:	Water	Laboratory ID:	0912045-08
Sampled:	12/03/09 08:10	Received:	12/04/09 08:30
% Solids:	0.00		

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
14797-73-0	Perchlorate		0.0660	0.200	1	U	SW6850	9L09015	12/17/09 00:17

MS
2/24/10

ANALYSIS DATA SHEET

MR11-TW02-09D

9

Laboratory:	Empirical Laboratories, LLC	SDG:	UXO11_003
Client:	CH2M Hill, Inc.	Project:	Lejeune CTO014 (UX11)
Matrix:	Ground Water	Laboratory ID:	0912054-01
Sampled:	12/04/09 14:40	Received:	12/05/09 08:45
% Solids:	0.00		

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
14797-73-0	Perchlorate	0.383	0.0660	0.200	1		SW6850	9L12002	12/13/09 17:25

WJ
2/24/10

ANALYSIS DATA SHEET

MR11-TW04-09D

10

Laboratory:	Empirical Laboratories, LLC	SDG:	UXO11_003
Client:	CH2M Hill, Inc.	Project:	Lejeune CTO014 (UX11)
Matrix:	Ground Water	Laboratory ID:	0912074-01
Sampled:	12/07/09 15:10	Received:	12/08/09 08:30
% Solids:	0.00		

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
14797-73-0	Perchlorate		0.0660	0.200	1	U	SW6850	9L16016	12/18/09 03:14

MW
2/24/10

ANALYSIS DATA SHEET

MR11-TW03-09D

Laboratory:	Empirical Laboratories, LLC	SDG:	UXO11_003
Client:	CH2M Hill, Inc.	Project:	Lejeune CTO014 (UX11)
Matrix:	Ground Water	Laboratory ID:	0912074-02
Sampled:	12/07/09 14:00	Received:	12/08/09 08:30
% Solids:	0.00		

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
14797-73-0	Perchlorate	0.202	0.0660	0.200	1		SW6850	9L16016	12/18/09 03:50

MW
2/24/10

ANALYSIS DATA SHEET

MR11-TW01-09D

12

Laboratory:	Empirical Laboratories, LLC	SDG:	UXO11_003
Client:	CH2M Hill, Inc.	Project:	Lejeune CTO014 (UX11)
Matrix:	Ground Water	Laboratory ID:	0912074-03
Sampled:	12/07/09 14:30	Received:	12/08/09 08:30
% Solids:	0.00		

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
14797-73-0	Perchlorate		0.0660	0.200	1	U	SW6850	9L16016	12/18/09 04:25

fw
2/24/10

ANALYSIS DATA SHEET

MR11-TW01D-09D

13

Laboratory:	Empirical Laboratories, LLC	SDG:	UXO11_003
Client:	CH2M Hill, Inc.	Project:	Lejeune CTO014 (UX11)
Matrix:	Ground Water	Laboratory ID:	0912074-04
Sampled:	12/07/09 14:35	Received:	12/08/09 08:30
% Solids:	0.00		

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
14797-73-0	Perchlorate		0.0660	0.200	1	U	SW6850	9L16016	12/18/09 05:01

MW
2/24/10

ANALYSIS DATA SHEET

MR11-FB120709-GW

14

Laboratory:	Empirical Laboratories, LLC	SDG:	UXO11_003
Client:	CH2M Hill, Inc.	Project:	Lejeune CTO014 (UX11)
Matrix:	Water	Laboratory ID:	0912074-05
Sampled:	12/07/09 13:40	Received:	12/08/09 08:30
% Solids:	0.00		

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
14797-73-0	Perchlorate		0.0660	0.200	1	U	SW6850	9L16016	12/18/09 05:37

MW 2/24/10

ANALYSIS DATA SHEET

MR11-TW05-09D

15

Laboratory:	Empirical Laboratories, LLC	SDG:	UXO11_003
Client:	CH2M Hill, Inc.	Project:	Lejeune CTO014 (UX11)
Matrix:	Ground Water	Laboratory ID:	0912074-06
Sampled:	12/07/09 11:20	Received:	12/08/09 08:30
% Solids:	0.00		

CAS NO.	Analyte	Concentration (ug/L)	MDL	RL	Dilution Factor	Q	Method	Batch	Analyzed
14797-73-0	Perchlorate	0.0793	0.0660	0.200	1	J	SW6850	9L16016	12/18/09 06:12

MW
2/24/10

Appendix E
Soil Boring Logs and Well Completion Diagrams

Prepared By: *Susan Forker*
Checked By: *Simon Kline*

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
378849.SI.FK	MR11-IS01 SHEET 1 OF 1

Soil Boring Log

CLIENT: NAVFAC PROJECT : CTO-14 LOCATION : UXO-11, Camp Lejeune, NC

ELEVATION : 19.7 ft DRILLING CONTRACTOR : Probe Technologies

COORDINATES : 3846507.9 N 274751.1 E DRILLING METHOD AND EQUIPMENT : DPT with Geoprobe 6620DT, Macro-core samplers

WATER LEVEL: 3 ft bgs at time of drilling START : 12/3/09 11:26 END : 12/3/09 12:06 LOGGER : S Forker

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	Sample ID	FID SCREENING LEVELS No charcoal filter With charcoal filter	GRAPHIC LOG	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR , MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, & INSTRUMENTATION	WELL DETAILS
	0.0					**POORLY GRADED SAND (SP)** very dark brown, moist, loose, little organics.		0ft: Bentonite Chips 0ft: Riser
		5.0	HA-1	0 ppm		**POORLY GRADED SAND (SP)** dark grayish brown, moist, medium dense, little clay.	Sample: MR11-IS01-2-3-09D @ 1140 Sample: MR11-IS01D-2-3-09D @ 1145	2ft: Filter pack
5	5.0					**CLAYEY SAND (SC)** dark gray, wet, medium dense. NR.		4ft: Pre-packed, 0.010 in slotted screen
		1.0	DP-1					
10	10.0					**CLAYEY SAND (SC)** grayish tan, wet, dense, little coarse sand. **POORLY GRADED SAND (SP)** gray, wet, dense, trace silt. NR.		
15							Boring terminated at 14'	
20								
25								

FID: Flame ionization detector

Prepared By: *Susan Forker*
Checked By: *Simon Kline*

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
378849.SI.FK	MR11-IS02 SHEET 1 OF 1

Soil Boring Log

CLIENT: NAVFAC PROJECT : CTO-14 LOCATION : UXO-11, Camp Lejeune, NC

ELEVATION : 20.3 ft DRILLING CONTRACTOR : Probe Technologies

COORDINATES : 3846517.4 N 274687.0 E DRILLING METHOD AND EQUIPMENT : DPT with Geoprobe 6620DT, Macro-core samplers

WATER LEVEL: 3 ft bgs at time of drilling START : 12/3/09 08:50 END : 12/3/09 09:05 LOGGER : S Forker

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	Sample ID	FID SCREENING LEVELS (No charcoal filter / With charcoal filter)	GRAPHIC LOG	SOIL DESCRIPTION (SOIL NAME, USCS GROUP SYMBOL, COLOR , MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY)	COMMENTS (DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, & INSTRUMENTATION)	WELL DETAILS
	0.0					**POORLY GRADED SAND (SP)** dark brown, saturated, loose, with organics.		0ft: Bentonite Chips 0ft: Riser 1ft: Filter pack 2ft: Pre-packed, 0.010 in slotted screen
		5.0	HA-1	0 ppm		**POORLY GRADED SAND (SP)** dark brownish gray, wet, loose.	Due to heavy rains 12-2-09, ground surface is wet. No sample recovery, set well @ 12ft. Sample: MR11-IS02-4-5-09D @ 0915	
				0 ppm		**POORLY GRADED SAND (SP)** dark brownish gray, wet, medium dense, some clay.		
5	5.0					NR.		
		0.0	DP-1					
10	10.0					NR.		
15							Boring terminated at 12'	
20								
25								

FID: Flame ionization detector

Prepared By: *Susan Forker*
Checked By: *Simon Kline*

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
378849.SI.FK	MR11-IS03 SHEET 1 OF 1

Soil Boring Log

CLIENT: NAVFAC PROJECT : CTO-14 LOCATION : UXO-11, Camp Lejeune, NC

ELEVATION : 19.3 ft DRILLING CONTRACTOR : Probe Technologies

COORDINATES : 3846524.0 N 274716.1 E DRILLING METHOD AND EQUIPMENT : DPT with Geoprobe 6620DT, Macro-core samplers

WATER LEVEL: 3 ft bgs at time of drilling START : 12/3/09 10:50 END : 12/3/09 11:01 LOGGER : S Forker

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	Sample ID	FID SCREENING LEVELS (No charcoal filter / With charcoal filter)	GRAPHIC LOG	SOIL DESCRIPTION (SOIL NAME, USCS GROUP SYMBOL, COLOR , MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY)	COMMENTS (DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, & INSTRUMENTATION)	COMMENTS (WELL DETAILS)
	0.0					**POORLY GRADED SAND (SP)** very dark brown, moist, loose, little organics, little ferrous nodules.		0ft: Riser
		5.0	HA-1	0 ppm			Sample: MR11-IS03-2-3-09D @ 1050	1ft: Bentonite Chips
						CLAYEY SAND (SC) dark grayish brown, wet, medium dense, little coarse sand.		3ft: Filter pack
5	5.0					NR.		5ft: Pre-packed, 0.010 in slotted screen
		1.5	DP-1					
						POORLY GRADED SAND (SP) very dark grayish brown, wet, medium dense, little silt.		
10	10.0					NR.		
15								
							Boring terminated at 15'	
20								
25								

FID: Flame ionization detector

Prepared By: *Susan Forker*
Checked By: *Simon Kline*

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
378849.SI.FK	MR11-IS04 SHEET 1 OF 1

Soil Boring Log

CLIENT: NAVFAC PROJECT : CTO-14 LOCATION : UXO-11, Camp Lejeune, NC

ELEVATION : 19.6 ft DRILLING CONTRACTOR : Probe Technologies

COORDINATES : 3846540.9 N 274739.5 E DRILLING METHOD AND EQUIPMENT : DPT with Geoprobe 6620DT, Macro-core samplers

WATER LEVEL: 3 ft bgs at time of drilling START : 12/3/09 10:12 END : 12/3/09 10:40 LOGGER : S Forker

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	Sample ID	FID SCREENING LEVELS (No charcoal filter / With charcoal filter)	GRAPHIC LOG	SOIL DESCRIPTION (SOIL NAME, USCS GROUP SYMBOL, COLOR , MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY)	COMMENTS (DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, & INSTRUMENTATION)	COMMENTS (WELL DETAILS)
	0.0					**POORLY GRADED SAND (SP)** very dark brown, moist, loose, some organics.		0ft: Riser
		5.0	HA-1	0 ppm		**POORLY GRADED SAND (SP)** gray with orange, moist to wet, medium dense, little clay.	Sample: MR11-IS04-2-3-09D @ 1020	1ft: Bentonite Chips
				0 ppm		**POORLY GRADED SAND (SP)** light gray, wet, loose, trace silt.		3ft: Filter pack
5	5.0					NR.		5ft: Pre-packed, 0.010 in slotted screen
		2.0	DP-1			**CLAYEY SAND (SC)** gray, wet, medium dense.		
10	10.0					**WELL GRADED SAND (SW)** gray, wet, dense. NR.		
15								
20							Boring terminated at 15'	
25								

FID: Flame ionization detector

Prepared By: *Susan Forker*
Checked By: *Simon Kline*

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
378849.SI.FK	MR11-IS05 SHEET 1 OF 1

Soil Boring Log

CLIENT: NAVFAC PROJECT : CTO-14 LOCATION : UXO-11, Camp Lejeune, NC

ELEVATION : 19.9 ft DRILLING CONTRACTOR : Probe Technologies

COORDINATES : 3846543.8 N 274683.9 E DRILLING METHOD AND EQUIPMENT : DPT with Geoprobe 6620DT, Macro-core samplers

WATER LEVEL: 3 ft bgs at time of drilling START : 12/3/09 09:30 END : 12/3/09 09:52 LOGGER : S Forker

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	Sample ID	FID SCREENING LEVELS (No charcoal filter / With charcoal filter)	GRAPHIC LOG	SOIL DESCRIPTION (SOIL NAME, USCS GROUP SYMBOL, COLOR , MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY)	COMMENTS (DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, & INSTRUMENTATION)	WELL DETAILS
	0.0	5.0	HA-1	0 ppm		**POORLY GRADED SAND (SP)** very dark brown, moist, loose, little clay.	Sample: MR11-IS05-2-3-09D @ 0930 + MS/MSD	0ft: Riser; 1ft: Bentonite Chips
5	5.0	1.2	DP-1			**POORLY GRADED SAND (SP)** very dark brown, moist, loose, no. NR.	Very little recovery due to sat soils. Set well to 15 ft.	3ft: Filter pack; 5ft: Pre-packed, 0.010 in slotted screen
10	10.0					**WELL GRADED SAND (SW)** very dark brown, wet, dense, little clay. NR.		
15							Boring terminated at 15'	
20								
25								

FID: Flame ionization detector

MR11-TW1

NON RESIDENTIAL WELL CONSTRUCTION RECORD / Well Abandonment

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 2736-A

1. WELL CONTRACTOR:

Chris Bost
Well Contractor (Individual) Name

Probe Technology, Inc.
Well Contractor Company Name

STREET ADDRESS P O Box 1369

Concord, NC 28026
City or Town State Zip Code

(704)- 933-5538
Area code- Phone number

2. WELL INFORMATION:

SITE WELL ID #(if applicable) MR11-TW1

STATE WELL PERMIT#(if applicable)

DWQ or OTHER PERMIT #(if applicable)

WELL USE (Check Applicable Box) Monitoring XX Municipal/Public ☐

Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐

Irrigation ☐ Other ☐ (list use)

DATE DRILLED 12/03/09

TIME COMPLETED AM ☐ PM ☐

3. WELL LOCATION:

CITY: Camp Lejeune COUNTY Onslow

UXO-11
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)

TOPOGRAPHIC / LAND SETTING:

☐ Slope ☐ Valley X Flat ☐ Ridge ☐ Other
(check appropriate box)

LATITUDE N 34 44' 3.2"

LONGITUDE W 77 27' 37.1"

May be in degrees, minutes, seconds or in a decimal format

Latitude/longitude source: XX GPS ☐ Topographic map

(location of well must be shown on a USGS topo map and attached to this form if not using GPS)

4. FACILITY- is the name of the business where the well is located.

FACILITY ID #(if applicable)

NAME OF FACILITY UXO-11 MCB Camp Lejeune

STREET ADDRESS

Jacksonville, NC
City or Town State Zip Code

CONTACT PERSON Bill Schmithorst

MAILING ADDRESS 3201 Beech Leaf Ct. Suite 300

Raleigh NC 27614
City or Town State Zip Code

(919)- 760-1769
Area code - Phone number

5. WELL DETAILS:

a. TOTAL DEPTH: 14

b. DOES WELL REPLACE EXISTING WELL? YES ☐ NO X

c. WATER LEVEL Below Top of Casing: 2 FT.
(Use "+" if Above Top of Casing)

d. TOP OF CASING IS 2 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.

e. YIELD (gpm): METHOD OF TEST

f. DISINFECTION: Type Amount

g. WATER ZONES (depth):

From To From To
From To From To
From To From To

6. CASING:

From	To	Ft.	Diameter	Thickness/ Weight	Material
+2	4		1 inch	Schd 40	PVC

7. GROUT:

From	To	Ft.	Material	Method
0	2		bentonite	pour

8. SCREEN:

From	To	Ft.	Diameter in.	Slot Size in.	Material
4	14		1	0.010	PVC

9. SAND/GRAVEL PACK:

From	To	Ft.	Size	Material
2	14		#2	silica

10. DRILLING LOG

From	To	Formation Description

11. REMARKS: Well material removed and boring abandoned with grout from bottom up.

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Chris Bost 12/17/09
SIGNATURE OF CERTIFIED WELL CONTRACTOR DATE

Chris Bost
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit the original to the Division of Water Quality within 30 days. Attn: Information Mgt., 1617 Mail Service Center – Raleigh, NC 27699-1617 Phone No. (919) 733-7015 ext 568.

Form GW-1b
Rev. 7/05

MR11-TW2

NON RESIDENTIAL WELL CONSTRUCTION RECORD / Well Abandonment

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 2736-A

1. WELL CONTRACTOR:

Chris Bost
Well Contractor (Individual) Name

Probe Technology, Inc.
Well Contractor Company Name

STREET ADDRESS P O Box 1369

Concord, NC 28026
City or Town State Zip Code

(704)- 933-5538
Area code- Phone number

2. WELL INFORMATION:

SITE WELL ID #(if applicable) MR11-TW2

STATE WELL PERMIT#(if applicable)

DWQ or OTHER PERMIT #(if applicable)

WELL USE (Check Applicable Box) Monitoring XX Municipal/Public ☐

Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐

Irrigation ☐ Other ☐ (list use)

DATE DRILLED 12/03/09

TIME COMPLETED AM ☐ PM ☐

3. WELL LOCATION:

CITY: Camp Lejeune COUNTY Onslow

UXO-11
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)

TOPOGRAPHIC / LAND SETTING:

☐ Slope ☐ Valley X Flat ☐ Ridge ☐ Other
(check appropriate box)

LATITUDE N 34 44' 9.4"

LONGITUDE W 77 27' 39.5"

May be in degrees, minutes, seconds or in a decimal format

Latitude/longitude source: XX GPS ☐ Topographic map

(location of well must be shown on a USGS topo map and attached to this form if not using GPS)

4. FACILITY- is the name of the business where the well is located.

FACILITY ID #(if applicable)

NAME OF FACILITY UXO-11 MCB Camp Lejeune

STREET ADDRESS

Jacksonville, NC
City or Town State Zip Code

CONTACT PERSON Bill Schmithorst

MAILING ADDRESS 3201 Beech Leaf Ct. Suite 300

Raleigh NC 27614
City or Town State Zip Code

(919)- 760-1769
Area code - Phone number

5. WELL DETAILS:

a. TOTAL DEPTH: 12

b. DOES WELL REPLACE EXISTING WELL? YES ☐ NO X

c. WATER LEVEL Below Top of Casing: 2 FT.
(Use "+" if Above Top of Casing)

d. TOP OF CASING IS 2 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.

e. YIELD (gpm): METHOD OF TEST

f. DISINFECTION: Type Amount

g. WATER ZONES (depth):

From To From To
From To From To
From To From To

6. CASING:

From	To	Ft.	Diameter	Thickness/ Weight	Material
+2	2		1 inch	Schd 40	PVC

7. GROUT:

From	To	Ft.	Material	Method
0	1		bentonite	pour

8. SCREEN:

From	To	Ft.	Diameter in.	Slot Size in.	Material
2	12		1	0.010	PVC

9. SAND/GRAVEL PACK:

From	To	Ft.	Size	Material
1	12		#2	silica

10. DRILLING LOG

From	To	Formation Description

11. REMARKS: Well material removed and boring abandoned with grout from bottom up.

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Chris Bost 12/17/09
SIGNATURE OF CERTIFIED WELL CONTRACTOR DATE

Chris Bost
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit the original to the Division of Water Quality within 30 days. Attn: Information Mgt., 1617 Mail Service Center – Raleigh, NC 27699-1617 Phone No. (919) 733-7015 ext 568.

Form GW-1b
Rev. 7/05

MR11-TW3

NON RESIDENTIAL WELL CONSTRUCTION RECORD / Well Abandonment

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 2736-A

1. WELL CONTRACTOR:

Chris Bost
Well Contractor (Individual) Name

Probe Technology, Inc.
Well Contractor Company Name

STREET ADDRESS P O Box 1369

Concord, NC 28026
City or Town State Zip Code

(704)- 933-5538
Area code- Phone number

2. WELL INFORMATION:

SITE WELL ID #(if applicable) MR11-TW3

STATE WELL PERMIT#(if applicable)

DWQ or OTHER PERMIT #(if applicable)

WELL USE (Check Applicable Box) Monitoring XX Municipal/Public ☐

Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐

Irrigation ☐ Other ☐ (list use)

DATE DRILLED 12/03/09

TIME COMPLETED AM ☐ PM ☐

3. WELL LOCATION:

CITY: Camp Lejeune COUNTY Onslow

UXO-11
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)

TOPOGRAPHIC / LAND SETTING:

☐ Slope ☐ Valley X Flat ☐ Ridge ☐ Other
(check appropriate box)

LATITUDE N 34 44' 9.6"

LONGITUDE W 77 27' 39.5"

May be in degrees, minutes, seconds or in a decimal format

Latitude/longitude source: XX GPS ☐ Topographic map

(location of well must be shown on a USGS topo map and attached to this form if not using GPS)

4. FACILITY- is the name of the business where the well is located.

FACILITY ID #(if applicable)

NAME OF FACILITY UXO-11 MCB Camp Lejeune

STREET ADDRESS

Jacksonville, NC
City or Town State Zip Code

CONTACT PERSON Bill Schmithorst

MAILING ADDRESS 3201 Beech Leaf Ct. Suite 300

Raleigh NC 27614
City or Town State Zip Code

(919)- 760-1769
Area code - Phone number

5. WELL DETAILS:

a. TOTAL DEPTH: 15

b. DOES WELL REPLACE EXISTING WELL? YES ☐ NO X

c. WATER LEVEL Below Top of Casing: 6 FT.
(Use "+" if Above Top of Casing)

d. TOP OF CASING IS 2 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.

e. YIELD (gpm): METHOD OF TEST

f. DISINFECTION: Type Amount

g. WATER ZONES (depth):

From To From To
From To From To
From To From To

6. CASING:

From	To	Ft.	Diameter	Thickness/ Weight	Material
+2	5		1 inch	Schd 40	PVC

7. GROUT:

From	To	Ft.	Material	Method
0	3		bentonite	pour

8. SCREEN:

From	To	Ft.	Diameter in.	Slot Size in.	Material
5	15		1	0.010	PVC

9. SAND/GRAVEL PACK:

From	To	Ft.	Size	Material
3	15		#2	silica

10. DRILLING LOG

From	To	Formation Description

11. REMARKS: Well material removed and boring abandoned with grout from bottom up.

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Chris Bost 12/17/09
SIGNATURE OF CERTIFIED WELL CONTRACTOR DATE

Chris Bost
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit the original to the Division of Water Quality within 30 days. Attn: Information Mgt., 1617 Mail Service Center – Raleigh, NC 27699-1617 Phone No. (919) 733-7015 ext 568.

Form GW-1b
Rev. 7/05

MR11-TW4

NON RESIDENTIAL WELL CONSTRUCTION RECORD / Well Abandonment

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 2736-A

1. WELL CONTRACTOR:

Chris Bost
Well Contractor (Individual) Name

Probe Technology, Inc.
Well Contractor Company Name

STREET ADDRESS P O Box 1369

Concord, NC 28026
City or Town State Zip Code

(704)- 933-5538
Area code- Phone number

2. WELL INFORMATION:

SITE WELL ID #(if applicable) MR11-TW4

STATE WELL PERMIT#(if applicable)

DWQ or OTHER PERMIT #(if applicable)

WELL USE (Check Applicable Box) Monitoring XX Municipal/Public ☐

Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐

Irrigation ☐ Other ☐ (list use)

DATE DRILLED 12/03/09

TIME COMPLETED AM ☐ PM ☐

3. WELL LOCATION:

CITY: Camp Lejeune COUNTY Onslow

UXO-11
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)

TOPOGRAPHIC / LAND SETTING:

☐ Slope ☐ Valley X Flat ☐ Ridge ☐ Other
(check appropriate box)

LATITUDE N 34 44' 10.0"

LONGITUDE W 77 27' 37.5"

May be in degrees, minutes, seconds or in a decimal format

Latitude/longitude source: XX GPS ☐ Topographic map

(location of well must be shown on a USGS topo map and attached to this form if not using GPS)

4. FACILITY- is the name of the business where the well is located.

FACILITY ID #(if applicable)

NAME OF FACILITY UXO-11 MCB Camp Lejeune

STREET ADDRESS

Jacksonville, NC
City or Town State Zip Code

CONTACT PERSON Bill Schmithorst

MAILING ADDRESS 3201 Beech Leaf Ct. Suite 300

Raleigh NC 27614
City or Town State Zip Code

(919)- 760-1769
Area code - Phone number

5. WELL DETAILS:

a. TOTAL DEPTH: 12

b. DOES WELL REPLACE EXISTING WELL? YES ☐ NO X

c. WATER LEVEL Below Top of Casing: 2 FT.
(Use "+" if Above Top of Casing)

d. TOP OF CASING IS 2 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.

e. YIELD (gpm): METHOD OF TEST

f. DISINFECTION: Type Amount

g. WATER ZONES (depth):

From To From To
From To From To
From To From To

6. CASING:

From	To	Ft.	Diameter	Thickness/ Weight	Material
+2	2		1 inch	Schd 40	PVC

7. GROUT:

From	To	Ft.	Material	Method
0	1		bentonite	pour

8. SCREEN:

From	To	Ft.	Diameter in.	Slot Size in.	Material
2	12		1	0.010	PVC

9. SAND/GRAVEL PACK:

From	To	Ft.	Size	Material
1	12		#2	silica

10. DRILLING LOG

From	To	Formation Description

11. REMARKS: Well material removed and boring abandoned with grout from bottom up.

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Chris Bost 12/17/09
SIGNATURE OF CERTIFIED WELL CONTRACTOR DATE

Chris Bost
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit the original to the Division of Water Quality within 30 days. Attn: Information Mgt., 1617 Mail Service Center – Raleigh, NC 27699-1617 Phone No. (919) 733-7015 ext 568.

Form GW-1b
Rev. 7/05

MR11-TW5

NON RESIDENTIAL WELL CONSTRUCTION RECORD / Well Abandonment

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 2736-A

1. WELL CONTRACTOR:

Chris Bost
Well Contractor (Individual) Name

Probe Technology, Inc.
Well Contractor Company Name

STREET ADDRESS P O Box 1369

Concord, NC 28026
City or Town State Zip Code

(704)- 933-5538
Area code- Phone number

2. WELL INFORMATION:

SITE WELL ID #(if applicable) MR11-TW5

STATE WELL PERMIT#(if applicable)

DWQ or OTHER PERMIT #(if applicable)

WELL USE (Check Applicable Box) Monitoring XX Municipal/Public ☐

Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐

Irrigation ☐ Other ☐ (list use)

DATE DRILLED 12/03/09

TIME COMPLETED AM ☐ PM ☐

3. WELL LOCATION:

CITY: Camp Lejeune COUNTY Onslow

UXO-11
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)

TOPOGRAPHIC / LAND SETTING:

☐ Slope ☐ Valley X Flat ☐ Ridge ☐ Other
(check appropriate box)

LATITUDE N 34 44' 10.1"

LONGITUDE W 77 27' 39.8"

May be in degrees, minutes, seconds or in a decimal format

Latitude/longitude source: XX GPS ☐ Topographic map

(location of well must be shown on a USGS topo map and attached to this form if not using GPS)

4. FACILITY- is the name of the business where the well is located.

FACILITY ID #(if applicable)

NAME OF FACILITY UXO-11 MCB Camp Lejeune

STREET ADDRESS

Jacksonville, NC
City or Town State Zip Code

CONTACT PERSON Bill Schmithorst

MAILING ADDRESS 3201 Beech Leaf Ct. Suite 300

Raleigh NC 27614
City or Town State Zip Code

(919)- 760-1769
Area code - Phone number

5. WELL DETAILS:

a. TOTAL DEPTH: 15

b. DOES WELL REPLACE EXISTING WELL? YES ☐ NO X

c. WATER LEVEL Below Top of Casing: 6 FT.
(Use "+" if Above Top of Casing)

d. TOP OF CASING IS 2 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.

e. YIELD (gpm): METHOD OF TEST

f. DISINFECTION: Type Amount

g. WATER ZONES (depth):

From To From To
From To From To
From To From To

6. CASING:

From	To	Ft.	Diameter	Thickness/ Weight	Material
+2	5		1 inch	Schd 40	PVC

7. GROUT:

From	To	Ft.	Material	Method
0	3		bentonite	pour

8. SCREEN:

From	To	Ft.	Diameter in.	Slot Size in.	Material
5	15		1	0.010	PVC

9. SAND/GRAVEL PACK:

From	To	Ft.	Size	Material
3	15		#2	silica

10. DRILLING LOG

From	To	Formation Description

11. REMARKS: Well material removed and boring abandoned with grout from bottom up.

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Chris Bost 12/17/09
SIGNATURE OF CERTIFIED WELL CONTRACTOR DATE

Chris Bost
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit the original to the Division of Water Quality within 30 days. Attn: Information Mgt., 1617 Mail Service Center – Raleigh, NC 27699-1617 Phone No. (919) 733-7015 ext 568.

Form GW-1b
Rev. 7/05

Appendix F
Groundwater Sampling Data Sheets

CH2MHILL

GROUNDWATER SAMPLING DATA SHEET

Client:	NAVFAC Mid-Atlantic	Project Number:	378849.SI.FK
Location:	MCB CAMP LEJEUNE	Well ID:	MR11-TW01
Event:	CTO-014	Sample ID:	MR11-TW01-09D
Date:	12/7/09	Sampling Team:	J. Diner/RDN
Weather:	50's overcast		D. Seed/RDN

Total Depth: 14.85 FT.(BTOC)
Depth to water: (-) 1.77 FT.(BTOC)
Water Column: 13.08 FT.
(x) 0.041 GAL/FT.
Well Volume: 0.54 GAL. = 1.61 gal
Total Purge Vol.: 1.7 GAL.
Purge Device: Peristaltic Pump

Measuring Device: YSI 556
Date and Time: Hanna Turbidimeter

Well Dia. (inches)	Volume (gallons/foot)
0.75	0.023
1	0.041
2	0.163
4	0.653
6	1.469

FIELD PARAMETERS

Time	Depth to Water (ft bgs)	Temp. °C	Cond. mS/cm	DO mg/L	pH SU	ORP mV	Turbidity NTU	Flow ~~Rate~~ (mL/min) Gal Purged	Color / Odor / Comments
Stabilization Criteria		± 10%	± 3%	± 10%	± 0.1	± 10 mV	± 10% or <10		
1410	1.77	NM						0.0	
1415	2.03	16.48	0.068	0.55	4.52	172.5	36.2	0.3	
1420	2.08	16.26	0.067	0.36	4.40	190.5	17.7	0.7	
1425	2.09	16.21	0.066	0.27	4.35	200.1	7.50	1.2	
1430	2.09	16.18	0.066	0.36	4.35	198.9	5.48	1.7	

SAMPLE DATA

Date: 12/7/09 Time: 1430	Temp. °C	Cond. mS/cm	DO mg/L	pH SU	ORP mV	Turbidity NTU	Gal Purged Other: ____	Color / Odor / Comments
Method: Low Flow	16.18	0.066	0.36	4.35	198.9	5.48	1.7	

Sample information: method, container number, size, and type, preservative used.

Analysis	Preservative	Container requirements	No. of containers
Total Metals	HNO_3	250 ml poly	1
Perchlorate	N/A	250 ml poly	1
Explosives Residues	N/A	1 L amber	2

Observations/Notes:
Total Volume Purged: 1.7 gal
NM - not measured

MS/MSD: YES (NO) Duplicate ID No.: MR11-TW01D-09D @ 1435

Signature(s): [signature]

CH2MHILL

GROUNDWATER SAMPLING DATA SHEET

Client:	NAVFAC Mid-Atlantic	Project Number:	378849.SI.FK
Location:	MCB CAMP LEJEUNE	Well ID:	MR11-TW02
Event:	CTO-014	Sample ID:	MR11-TW02-090
Date:	12/4/09	Sampling Team:	D. Seed/RDU
Weather:	60°		

Total Depth:	12.75	FT.(BTOC)	Measuring Device:	YS7556A 05730
Depth to water:	(-) 7.3	FT.(BTOC)	Date and Time:	HANNA # 05969
Water Column:	10.45	FT.		
	(x) 0.041	GAL/FT.		
Well Volume:	0.42	GAL.x5=		
Total Purge Vol.:	2.5	GAL.		
Purge Device:	Peristaltic Pump			

Well Dia. (inches)	Volume (gallons/foot)
0.75	0.023
1	0.041
2	0.163
4	0.653
6	1.469

FIELD PARAMETERS

Time	Depth to Water (ft bgs)	Temp. °C	Cond. mS/cm	DO mg/L	pH SU	ORP mV	Turbidity NTU	Flow Rate (mL/min)	Color / Odor / Comments
Stabilization Criteria		± 10%	± 3%	± 10%	± 0.1	± 10 mV	± 10% or <10		
1345	3.09	18.76	0.422	1.31	6.42	-97.7	140		
1355	3.09	18.84	0.425	1.25	6.54	-72.3	69		
1400	3.09	18.85	0.434	1.41	6.87	-89.5	50		
1410	3.09	18.82	0.433	1.12	7.20	-54.4	30		
1420	3.09	18.86	0.414	1.14	7.05	-127.9	17		
1430	3.09	18.86	0.414	1.15	7.05	-127	20		
1440	3.09	18.86	0.413	1.12	7.04	-127	10	2.5	

SAMPLE DATA

Date: 12/4/09 Time: 1440	Temp. °C	Cond. mS/cm	DO mg/L	pH SU	ORP mV	Turbidity NTU	Other: Bru	Color / Odor / Comments
Method: Low flow	18.86	0.413	1.12	7.04	-127	10	3.09	

Sample information: method, container number, size, and type, preservative used.

Analysis	Preservative	Container requirements	No. of containers
TAL Metals			
Explosives Residues			
Perchlorate			

Observations/Notes:

Total Volume Purged: 2.5 gallons

tubing intake @ 11 ft bgs

pump start 1340

purge rate .2L/min

MS/MSD: YES NO

Duplicate ID No.:

Signature(s):

CH2MHILL

GROUNDWATER SAMPLING DATA SHEET

Client:	NAVFAC Mid-Atlantic	Project Number:	378849.SI.FK
Location:	MCB CAMP LEJEUNE	Well ID:	MR11-TW03*
Event:	CTO-014	Sample ID:	MR11-TW03-04D
Date:	12/7/09	Sampling Team:	D. Seed/ROV
Weather:	60°		

Total Depth:	14.8	FT.(BTOC)	Measuring Device:	YSI 556H 05730
Depth to water:	(-) 1.55	FT.(BTOC)	Date and Time:	HANNAH 05969
Water Column:	13.25	FT.		
	(x) 0.041	GAL/FT.		
Well Volume:	0.53	GAL.		
Total Purge Vol.:	6.3	GAL.		
Purge Device:	Peristaltic Pump			

Well Dia. (inches)	Volume (gallons/foot)
0.75	0.023
1	0.041
2	0.163
4	0.653
6	1.469

FIELD PARAMETERS

Time	Depth to Water (ft bgs)	Temp. °C	Cond. mS/cm	DO mg/L	pH SU	ORP mV	Turbidity NTU	Flow Rate (mL/min)	Color / Odor / Comments
Stabilization Criteria		± 10%	± 3%	± 10%	± 0.1	± 10 mV	± 10% or <10	not purged	
1240	1.9	18.98	0.358	0.19	7.13	-89.6	750		
1300	1.9	19.05	0.355	0.18	7.05	-97.2	140		
1320	1.9	19.07	0.354	0.16	6.95	-102.5	65		
1330	1.9	19.08	0.355	0.15	6.91	-104.9	33		
1340	1.9	19.06	0.355	0.14	6.91	-105.4	28		
1350	1.9	19.07	0.355	0.14	7.00	-105.3	28		
1400	1.9	19.07	0.355	0.14	7.00	-104.9	25	6.3	

SAMPLE DATA

Date: 12/7/09 Time: 1400	Temp. °C	Cond. mS/cm	DO mg/L	pH SU	ORP mV	Turbidity NTU	Other: _____	Color / Odor / Comments
Method: Low flow	19.07	0.355	0.14	7.00	-104.9	25		

Sample information: method, container number, size, and type, preservative used.

Analysis	Preservative	Container requirements	No. of containers
Explosives Rounds			
TAL Metals			
Perchlorate			

Observations/Notes:

Total Volume Purged: 6.3 gallons

pump started @ 1230 tbg intake @ 12.5 ft bgs
purge rate .25 L/min

MS/MSD: YES NO Duplicate ID No.:

Signature(s):

CH2MHILL

GROUNDWATER SAMPLING DATA SHEET

Client:	NAVFAC Mid-Atlantic	Project Number:	378849.SI.FK
Location:	MCB CAMP LEJEUNE	Well ID:	MR11-TW04
Event:	CTO-014	Sample ID:	MR11-TW04-090
Date:	12/17/09	Sampling Team:	D. Seed/ROU
Weather:	60°		

Total Depth:	14.9	FT.(BTOC)	Measuring Device:	YSI 556A 05730
Depth to water:	(-) 1.37	FT.(BTOC)	Date and Time:	HANNAH 08960
Water Column:	13.53	FT.		
	(x) 0.041	GAL/FT.		
Well Volume:	0.54	GAL.		
Total Purge Vol.:	2.45	GAL.		
Purge Device:	Peristaltic Pump			

Well Dia. (inches)	Volume (gallons/foot)
0.75	0.023
1	0.041
2	0.163
4	0.653
6	1.469

FIELD PARAMETERS

Time	Depth to Water (ft bgs)	Temp. °C	Cond. mS/cm	DO mg/L	pH SU	ORP mV	Turbidity NTU	Flow Rate (mL/min)	Color / Odor / Comments
Stabilization Criteria		± 10%	± 3%	± 10%	± 0.1	± 10 mV	± 10% or <10		
1445	1.62	17.22	0.063	1.02	5.37	109	130		
1455	1.62	17.22	0.062	1.02	5.32	109.4	26		
1505	1.62	17.21	0.061	1.02	5.32	109.2	17		
1510	1.62	17.23	0.062	1.02	5.31	108.4	10		

SAMPLE DATA

Date: 12/17 Time: 1510	Temp. °C	Cond. mS/cm	DO mg/L	pH SU	ORP mV	Turbidity NTU	Other: _____	Color / Odor / Comments
Method: Low flow	17.23	0.062	1.02	5.31	108.4	10		

Sample information: method, container number, size, and type, preservative used.

Analysis	Preservative	Container requirements	No. of containers
Explosives			
TPH metals			
Trichlorate			

Observations/Notes:

Total Volume Purged: 2.45 gallons

pump start 1435

purge rate .25L/min tubing intake @ 12 ft bgs

MS/MSD:	YES	NO	Duplicate ID No.:

Signature(s):

CH2MHILL

GROUNDWATER SAMPLING DATA SHEET

Client:	NAVFAC Mid-Atlantic	Project Number:	378849.SI.FK
Location:	MCB CAMP LEJEUNE	Well ID:	MR11-TW05
Event:	CTO-014	Sample ID:	MR11-TW05-09D
Date:	12/7/09	Sampling Team:	D. Seel / RDU
Weather:	60°		

Total Depth:	14.8	FT.(BTOC)	Measuring Device:	45155L# 05730
Depth to water:	(-) 2.15	FT.(BTOC)	Date and Time:	HANNA# 68969
Water Column:	12.65	FT.		
	(x) 0.041	GAL/FT.		
Well Volume:	0.51	GAL.		
Total Purge Vol.:	4	GAL.		
Purge Device:	Peristaltic Pump			

Well Dia. (inches)	Volume (gallons/foot)
0.75	0.023
1	0.041
2	0.163
4	0.653
6	1.469

FIELD PARAMETERS

Time	Depth to Water (ft bgs)	Temp. °C	Cond. mS/cm	DO mg/L	pH SU	ORP mV	Turbidity NTU	Flow Rate (mL/min)	Color / Odor / Comments
Stabilization Criteria		± 10%	± 3%	± 10%	± 0.1	± 10 mV	± 10% or <10		
1040	2.50	19.13	0.271	0.56	6.84	156	65		
1050	2.5	19.21	0.265	0.54	6.84	135.2	38		
1100	2.5	19.30	0.254	0.48	6.68	116.3	24		
1110	2.5	19.33	0.254	0.48	6.69	116.3	17		
1120	2.5	19.34	0.254	0.47	6.68	116.3	12		

SAMPLE DATA

Date: 12/7/09 Time: 1120	Temp. °C	Cond. mS/cm	DO mg/L	pH SU	ORP mV	Turbidity NTU	Other: _____	Color / Odor / Comments
Method: Low flow	19.34	0.254	0.47	6.68	116.3	12		

Sample information: method, container number, size, and type, preservative used.

Analysis	Preservative	Container requirements	No. of containers
Explosives, Rdx			
Perchlorate			
TAL metals			

Observations/Notes:

Total Volume Purged: 4 gallons

Pump started @ 1030
tubing intake @ 12 ft
.34/min

MS/MSD: (YES) NO | Duplicate ID No.:

Signature(s):

Appendix G
Raw Analytical Data

Appendix G
UXO-11
Decision Unit Surface Soil Raw Analytical Results
November 2009

Station ID	MR11-DU01				MR11-DU02			MR11-DU03			
Sample ID	MR11-DU01-SS01-09D	MR11-DU01-SS01D-09D	MR11-DU01-SS02-09D	MR11-DU01-SS03-09D	MR11-DU02-SS01-09D	MR11-DU02-SS02-09D	MR11-DU02-SS03-09D	MR11-DU03-SS01-09D	MR11-DU03-SS02-09D	MR11-DU03-SS03-09D	MR11-DU04-SS01-09D
Sample Date	11/05/09	11/05/09	11/05/09	11/05/09	11/05/09	11/05/09	11/05/09	11/05/09	11/05/09	11/05/09	11/05/09
Chemical Name											
Explosives (µg/kg)											
1,3,5-Trinitrobenzene	190 UJ	190 UJ	190 U	190 UJ	190 UJ	190 UJ	190 UJ	190 UJ	190 UJ	190 UJ	190 UJ
1,3-Dinitrobenzene	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U
2,4,6-Trinitrotoluene	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U
2,4-Dinitrotoluene	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U
2,6-Dinitrotoluene	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U
2-Amino-4,6-dinitrotoluene	260 J	190 U	190 U	190 U	100 J	430	190 U	190 U	190 U	190 U	190 U
2-Nitrotoluene	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U
3-Nitrotoluene	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U
4-Amino-2,6-dinitrotoluene	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U
4-Nitrotoluene	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U
Nitrobenzene	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U
HMX	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U
Nitroglycerin	640 U	640 U	640 U	640 U	640 U	640 U	640 U	640 U	920	640 U	640 U
Perchlorate	3.72 U	3.69 U	2.64 U	2.69 U	2.69 U	2.78 U	3 U	2.9 U	2.83 U	2.94 U	2.78 U
PETN	640 U	640 U	640 U	640 U	640 U	640 U	640 U	640 U	640 U	640 U	640 U
RDX	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	290 J	190 U	190 U
Tetryl	190 UJ	190 UJ	190 UJ	190 UJ	180 J	190 UJ	190 UJ	190 UJ	190 UJ	190 UJ	190 UJ
Total Metals (mg/kg)											
Aluminum	4,390	3,750	4,370	4,990	4,610	4,940	5,170	4,460	4,680	5,190	4,870
Antimony	1.37 UJ	1.34 UJ	0.981 UJ	0.989 UJ	0.967 UJ	1.02 UJ	1.12 UJ	1.07 UJ	1.04 UJ	1.09 UJ	1.04 UJ
Arsenic	1.12	0.833	0.954	1.07	1.03	1.04	1.13	0.846	0.971	1.11	1.02
Barium	17.8 J	15.8 J	15.1 J	17 J	16.6 J	14.7 J	17.7 J	15.9 J	15.5 J	16.2 J	15.4 J
Beryllium	0.455 U	0.448 U	0.327 U	0.0942 J	0.0794 J	0.339 U	0.0805 J	0.0887 J	0.0881 J	0.0949 J	0.0946 J
Cadmium	0.455 U	0.448 U	0.327 U	0.33 U	0.322 U	0.339 U	0.373 U	0.356 U	0.348 U	0.364 U	0.399
Calcium	7,110 J	7,820 J	5,810 J	35,700 J	12,000 J	18,400 J	13,700 J	17,900 J	21,400 J	15,200 J	56,500 J
Chromium	5.43	4.86	4.91	6.49	5.6	5.42	5.95	6.29	6.4	7.25	6.8
Cobalt	1.14 U	1.12 U	0.818 U	0.824 U	0.806 U	0.846 U	0.932 U	0.89 U	0.87 U	0.91 U	0.87 U
Copper	3.84 J	3.78 J	3.03 J	5.78 J	2.83 J	3.05 J	3.5 J	3.93 J	3.81 J	4.19 J	3.27 J
Cyanide	0.465 U	0.461 U	0.33 U	0.336 U	0.337 U	0.645	0.375 U	0.262 J	0.202 J	0.19 J	0.221 J
Iron	1,460	1,470	1,510	1,840	1,750	1,740	1,870	1,750	1,950	2,180	1,850
Lead	18.5	13.2	11.1	11.4	12.5	10.3	12.3	15.7	15.6	17.5	14.4
Magnesium	685 J	663 J	629 J	959 J	487 J	703 J	697 J	714 J	730 J	568 J	1,160 J
Manganese	18.3	18.7	13.8	18.3	14.6	17.1	18.7	20.9	22.9	23.6	19
Mercury	0.0281 J	0.0237 J	0.0244 J	0.0273 J	0.0231 J	0.0347 J	0.0318 J	0.0286 J	0.023 J	0.0297 J	0.0283 J
Nickel	1.1 J	0.959 J	0.967 J	1.09 J	1.26 J	1.11 J	1.28 J	1.29 J	1.37 J	1.57 J	1.26 J
Potassium	225 J	227 J	194 J	231 J	180 J	240 J	251 J	229 J	239 J	266 J	232 J
Selenium	0.622 U	0.633 U	0.469 U	0.35 U	0.711 U	0.671 U	0.453 U	0.395 U	0.513 U	0.597 U	0.448 U
Silver	0.455 U	0.448 U	0.327 U	0.33 U	0.322 U	0.339 U	0.373 U	0.356 U	0.348 U	0.364 U	0.348 U
Sodium	455 U	448 U	327 U	330 U	322 U	339 U	373 U	356 U	348 U	364 U	115 J
Thallium	0.729 U	0.717 U	0.523 U	0.528 U	0.516 U	0.542 U	0.597 U	0.569 U	0.557 U	0.582 U	0.557 U
Vanadium	5.22	4.49	5.5	6.19	5.81	5.79	5.9	6.05	6.58	7.41	7.26
Zinc	22 J	18.9 J	14.3 J	17.6 J	12.7 J	15.6 J	16.4 J	23.9 J	24.5 J	41.4 J	20.7 J

Notes:

Shading indicates detections

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

mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

Appendix G
UXO-11
Decision Unit Surface Soil Raw Analytical Results
November 2009

Station ID	MR11-DU04		
Sample ID	MR11-DU04-SS02-09D	MR11-DU04-SS02D-09D	MR11-DU04-SS03-09D
Sample Date	11/05/09	11/05/09	11/05/09
Chemical Name			
Explosives (µg/kg)			
1,3,5-Trinitrobenzene	190 UJ	190 UJ	190 UJ
1,3-Dinitrobenzene	190 U	190 U	190 U
2,4,6-Trinitrotoluene	190 U	190 U	190 U
2,4-Dinitrotoluene	190 U	190 U	190 U
2,6-Dinitrotoluene	190 U	190 U	190 U
2-Amino-4,6-dinitrotoluene	190 U	190 U	190 U
2-Nitrotoluene	190 U	190 U	190 U
3-Nitrotoluene	190 U	190 U	190 U
4-Amino-2,6-dinitrotoluene	190 U	190 U	190 U
4-Nitrotoluene	190 U	190 U	190 U
Nitrobenzene	190 U	190 U	190 U
HMX	190 U	190 U	190 U
Nitroglycerin	640 U	640 U	640 U
Perchlorate	2.79 U	2.84 U	2.87 U
PETN	640 U	640 U	640 U
RDX	190 U	190 U	190 U
Tetryl	200 J	190 UJ	190 UJ
Total Metals (mg/kg)			
Aluminum	6,750	5,560	4,790
Antimony	1.05 UJ	1.02 UJ	1.07 UJ
Arsenic	1.05	1.19	1.1
Barium	19.4 J	17 J	14.4 J
Beryllium	0.133 J	0.113 J	0.0985 J
Cadmium	0.352 U	0.364 U	0.403
Calcium	21,700 J	38,200 J	56,100 J
Chromium	9.9	8.3	7.56
Cobalt	0.401 J	0.364 J	0.357 J
Copper	4.92 J	4.36 J	4.1 J
Cyanide	0.349 U	0.356 U	0.358 U
Iron	2,280	1,880	2,090
Lead	25.4	20.8	18.6
Magnesium	656 J	685 J	1,010 J
Manganese	18	19.1	23.3
Mercury	0.0353 J	0.0436	0.0416 J
Nickel	1.94 J	1.57 J	1.57 J
Potassium	284 J	243 J	253 J
Selenium	0.563 U	0.484 U	0.454 U
Silver	0.349 U	0.34 U	0.357 U
Sodium	349 U	84.9 J	104 J
Thallium	0.559 U	0.544 U	0.571 U
Vanadium	8.48	7.21	7.38
Zinc	41.2 J	36.6 J	29.6 J

Notes:

Shading indicates detections

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

mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

Appendix G
UXO - 11
Groundwater Raw Analytical Results
December 2009

Station ID	MR11-IS01				MR11-IS02	MR11-IS03	MR11-IS04	MR11-IS05
Sample ID	MR11-TW01-09D	MR11-TW01D-09D	MR11-TW01-09D-2	MR11-TW01D-09D-2	MR11-TW02-09D	MR11-TW03-09D	MR11-TW04-09D	MR11-TW05-09D
Sample Date	12/07/09	12/07/09	12/09/09	12/09/09	12/04/09	12/07/09	12/07/09	12/07/09
Chemical Name								
Explosives (µg/l)								
1,3,5-Trinitrobenzene	0.15 U	0.076 J	NA	NA	0.15 U	0.15 U	0.086 J	0.15 U
1,3-Dinitrobenzene	0.15 U	0.15 U	NA	NA	0.12 J	0.062 J	0.058 J	0.15 U
2,4-Dinitrotoluene	0.15 U	0.15 U	NA	NA	0.15 U	0.15 U	0.15 U	0.15 U
2,6-Dinitrotoluene	0.15 U	0.15 U	NA	NA	0.15 U	0.15 U	0.15 U	0.15 U
2,4,6-Trinitrotoluene	0.15 U	0.15 U	NA	NA	0.15 U	0.053 J	0.15 U	0.15 U
2-Amino-4,6-dinitrotoluene	0.15 U	0.15 U	NA	NA	0.15 U	0.15 U	0.15 U	0.15 U
2-Nitrotoluene	0.15 U	0.15 U	NA	NA	0.15 U	0.064 J	0.15 U	0.15 U
3-Nitrotoluene	0.15 U	0.15 U	NA	NA	0.15 U	0.12 J	0.15	0.15 U
4-Amino-2,6-dinitrotoluene	0.15 U	0.15 U	NA	NA	0.15 U	0.15 U	0.15 U	0.15 U
4-Nitrotoluene	0.094 J	0.069 J	NA	NA	0.15 U	0.41 J	0.18	0.086 J
HMX	0.15 UJ	0.15 UJ	NA	NA	0.15 UJ	0.15 UJ	0.15 U	0.15 UJ
Nitrobenzene	0.1 J	0.15 U	NA	NA	0.48 J	0.2 J	0.064 J	0.15 U
Nitroglycerin	0.51 U	0.51 U	NA	NA	0.51 U	0.22 J	0.5 U	0.5 U
Perchlorate	0.2 U	0.2 U	NA	NA	0.383	0.202	0.2 U	0.0793 J
PETN	0.51 U	0.51 U	NA	NA	0.51 U	0.5 U	0.5 U	0.5 U
RDX	0.15 U	0.15 U	NA	NA	0.15 U	0.1 J	0.15 U	0.15 U
Tetryl	0.15 U	0.15 U	NA	NA	0.15 U	0.15 U	0.15 U	0.15 U
Total Metals (µg/l)								
Aluminum	398 J	366 J	NA	NA	255 J	443 J	531 J	473 J
Antimony	3.75 U	3.75 U	NA	NA	3.75 U	3.75 U	3.75 U	3.75 U
Arsenic	1.25 U	1.25 U	NA	NA	1.46	1.69	2.36	1.37
Barium	49.2	46.6	NA	NA	13.5	18.8	49.4	10.3
Beryllium	0.66 J	0.632 J	NA	NA	1.25 U	1.25 U	0.54 J	1.25 U
Cadmium	1.25 U	1.25 U	NA	NA	0.643 J	0.264 J	1.25 U	0.311 J
Calcium	3,680	3,600	NA	NA	65,900	97,800	6,030	67,200
Chromium	0.653 J	0.657 J	NA	NA	1.63	2.39	1.3	1.5
Cobalt	3.12 U	3.12 U	NA	NA	3.12 U	3.12 U	4.3	1.48 J
Copper	2.5 U	2.5 U	NA	NA	2.5 U	2.5 U	2.5 U	2.5 U
Iron	234	233	NA	NA	331	2,340	1,510	220
Lead	0.75 U	0.75 U	NA	NA	0.75 U	0.75 U	0.75 U	0.75 U
Magnesium	919 J	878 J	NA	NA	1,310	2,030	686 J	1,270
Manganese	6.26 J	6.34 J	NA	NA	16.6 J	22 J	17.2 J	11.4 J
Mercury	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
Nickel	2.64	2.48 J	NA	NA	2.82	2.5 U	6.14	3.33
Potassium	1,250 U	1,250 U	NA	NA	466 J	442 J	729 J	1,250 U
Selenium	1.25 U	1.25 U	NA	NA	2.88	1.25 U	1.25 U	1.16 J
Silver	1.25 U	1.25 U	NA	NA	1.25 U	1.25 U	1.25 U	1.25 U
Sodium	3,180	3,060	NA	NA	2,980	3,370	4,980	3,100
Thallium	2 U	2 U	NA	NA	2 U	2 U	2 U	2 U
Vanadium	3.12 U	3.12 U	NA	NA	4.97	2.5 J	1.49 J	4.21
Zinc	8.11	7.93	NA	NA	42.1	2.76 J	6.95	3.85 J
Dissolved Metals (µg/l)								
Aluminum, Dissolved	NA	NA	325 J	322 J	NA	NA	NA	NA
Antimony, Dissolved	NA	NA	3.75 U	3.75 U	NA	NA	NA	NA
Arsenic, Dissolved	NA	NA	1.25 U	1.25 U	NA	NA	NA	NA
Barium, Dissolved	NA	NA	48.2	46.2	NA	NA	NA	NA
Beryllium, Dissolved	NA	NA	0.664 J	0.642 J	NA	NA	NA	NA
Cadmium, Dissolved	NA	NA	1.25 U	1.25 U	NA	NA	NA	NA
Calcium, Dissolved	NA	NA	3,750	3,600	NA	NA	NA	NA
Chromium, Dissolved	NA	NA	1.25 U	1.25 U	NA	NA	NA	NA
Cobalt, Dissolved	NA	NA	3.12 U	3.12 U	NA	NA	NA	NA
Copper, Dissolved	NA	NA	2.5 U	2.5 U	NA	NA	NA	NA
Iron, Dissolved	NA	NA	229	209	NA	NA	NA	NA
Lead, Dissolved	NA	NA	0.75 U	0.75 U	NA	NA	NA	NA
Magnesium, Dissolved	NA	NA	895 J	867 J	NA	NA	NA	NA
Manganese, Dissolved	NA	NA	5.51 J	5.22 J	NA	NA	NA	NA
Mercury, Dissolved	NA	NA	0.2 U	0.2 U	NA	NA	NA	NA
Nickel, Dissolved	NA	NA	2.61	2.45 J	NA	NA	NA	NA
Potassium, Dissolved	NA	NA	1,250 U	1,250 U	NA	NA	NA	NA
Selenium, Dissolved	NA	NA	1.25 U	1.25 U	NA	NA	NA	NA
Silver, Dissolved	NA	NA	1.25 U	1.25 U	NA	NA	NA	NA
Sodium, Dissolved	NA	NA	3,160	3,070	NA	NA	NA	NA
Thallium, Dissolved	NA	NA	2 U	2 U	NA	NA	NA	NA
Vanadium, Dissolved	NA	NA	3.12 U	3.12 U	NA	NA	NA	NA
Zinc, Dissolved	NA	NA	8.07	8.11	NA	NA	NA	NA

Notes:

Shading indicates detections

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 G
UXO - 11
Subsurface Soil Raw Analytical Results
December 2009

Station ID	MR11-IS01		MR11-IS02	MR11-IS03	MR11-IS04	MR11-IS05
Sample ID	MR11-IS01-2-3-09D	MR11-IS01D-2-3-09D	MR11-IS02-4-5-09D	MR11-IS03-2-3-09D	MR11-IS04-2-3-09D	MR11-IS05-2-3-09D
Sample Date	12/03/09	12/03/09	12/03/09	12/03/09	12/03/09	12/03/09
Chemical Name						
Semivolatile Organic Compounds (µg/kg)						
2,4-Dinitrotoluene	190 U	190 U	190 U	190 U	190 U	190 U
2,6-Dinitrotoluene	190 U	190 U	190 U	190 U	190 U	190 U
Nitrobenzene	190 U	190 U	190 U	190 U	190 U	190 U
Explosives (µg/kg)						
1,3,5-Trinitrobenzene	190 U	190 U	190 U	190 U	190 U	190 U
1,3-Dinitrobenzene	190 U	190 U	190 U	190 U	190 U	190 U
2,4,6-Trinitrotoluene	190 U	190 U	190 U	190 U	190 U	190 U
2-Amino-4,6-dinitrotoluene	190 U	190 U	190 U	190 U	190 U	190 U
2-Nitrotoluene	190 U	190 U	190 U	190 U	190 U	190 U
3-Nitrotoluene	190 U	190 U	190 U	190 U	190 U	190 U
4-Amino-2,6-dinitrotoluene	190 U	190 U	190 U	190 U	190 U	190 U
4-Nitrotoluene	190 U	190 U	190 U	190 U	190 U	190 U
HMX	190 U	190 U	190 U	190 U	190 U	190 U
Nitroglycerin	640 U	640 U	640 U	640 U	640 U	640 U
Perchlorate	2.31 U	2.29 U	2.41	5.05	2.39 U	2.35 U
PETN	640 U	640 U	640 U	640 U	640 U	640 U
RDX	170 J	440	300	400 J	103 J	370 J
Tetryl	190 U	190 U	190 U	190 U	190 U	190 U
Total Metals (mg/kg)						
Aluminum	11,100 J	10,800 J	5,870 J	13,600 J	12,000 J	7,880 J
Antimony	0.848 UJ	0.823 UJ	0.875 UJ	0.939 UJ	0.869 UJ	0.877 UJ
Arsenic	0.827	0.772	0.462	1.4	0.847	0.83
Barium	19.7	19.6	11.8	33.4	13.8	13.5
Beryllium	0.136 J	0.132 J	0.0916 J	0.209 J	0.0656 J	0.152 J
Cadmium	0.283 U	0.274 U	0.292 U	0.313 U	0.29 U	0.292 U
Calcium	106 J	106 J	215 J	2,180	201 J	114 J
Chromium	10.2 J	9.93 J	6.72 J	16 J	9.12 J	8.12 J
Cobalt	0.524 J	0.53 J	0.729 U	0.625 J	0.34 J	0.369 J
Copper	0.529 J	0.513 J	0.5 J	0.397 J	0.579 U	0.388 J
Cyanide	0.288 U	0.287 U	0.302 U	0.316 U	0.298 U	0.294 U
Iron	3,190	2,190	1,100	5,290	6,920	1,770
Lead	6.08	6.04	3.29	6.74	5.95	4.18
Magnesium	450 J	448 J	242 J	666 J	329 J	355 J
Manganese	5.07 J	5 J	2.74 J	5.97 J	3.95 J	4.05 J
Mercury	0.0368 U	0.0405 U	0.0166 J	0.0236 J	0.033 U	0.0352 U
Nickel	1.37	1.31	0.918	1.99	1.39	1.23
Potassium	210 J	212 J	140 J	282 J	135 J	157 J
Selenium	0.241 J	0.274 U	0.292 U	0.354	0.258 J	0.227 J
Silver	0.283 U	0.274 U	0.292 U	0.313 U	0.29 U	0.292 U
Sodium	283 U	274 U	292 U	313 U	290 U	292 U
Thallium	0.452 U	0.439 U	0.466 U	0.501 U	0.464 U	0.467 U
Vanadium	14.7	11.9	5.68	16.2	12.1	8.64
Zinc	3.66	3.75	2.33	5.26	2.31	2.73

Notes:

Shading indicates detections

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

mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

Appendix G
UXO - 11
Sediment Raw Analytical Results
December 2009

Station ID	MR11-SW/SD01	MR11-SW/SD02
Sample ID	MR11-SD01-09D	MR11-SD02-09D
Sample Date	11/12/09	11/12/09
Chemical Name		
Explosives (µg/kg)		
1,3,5-Trinitrobenzene	190 U	190 U
1,3-Dinitrobenzene	190 U	190 U
2,4,6-Trinitrotoluene	190 U	190 U
2,4-Dinitrotoluene	190 U	190 U
2,6-Dinitrotoluene	190 U	190 U
2-Amino-4,6-dinitrotoluene	190 U	190 U
2-Nitrotoluene	190 U	190 U
3-Nitrotoluene	190 U	190 U
4-Amino-2,6-dinitrotoluene	190 U	190 U
4-Nitrotoluene	190 U	190 U
HMX	190 U	190 U
Nitrobenzene	190 U	190 U
Nitroglycerin	640 U	640 U
Perchlorate	3.35 U	3.2 U
PETN	640 U	640 U
RDX	190 U	190 U
Tetryl	190 UJ	190 UJ
Total Metals (mg/kg)		
Aluminum	10,300	9,030
Antimony	1.22 UJ	1.22 UJ
Arsenic	1.55	1.09
Barium	42.7	23.4
Beryllium	0.221 J	0.181 J
Cadmium	0.487 U	0.715 U
Calcium	20,200	36,800
Chromium	17.8	16.6
Cobalt	0.688 J	0.717 J
Copper	5.42	15.2
Cyanide	0.419 U	0.4 U
Iron	3,230	3,340
Lead	87.8	53.1
Magnesium	820	1,080
Manganese	17.2	18.5
Mercury	0.0492	0.0532
Nickel	2.46	3.29
Potassium	320 J	418 J
Selenium	1.04 U	1.05 U
Silver	0.405 U	0.406 U
Sodium	405 U	406 U
Thallium	0.648 U	0.65 U
Vanadium	13.7	11.8
Zinc	36.5	183

Notes:

Shading indicates detections

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

mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

Appendix G
UXO - 11
Surface Water Raw Analytical Results
December 2009

Station ID	MR11-SW/SD01		MR11-SW/SD02
Sample ID	MR11-SW01-09D	MR11-SW01D-09D	MR11-SW02-09D
Sample Date	11/12/09	11/12/09	11/12/09
Chemical Name			
Explosives (µg/l)			
1,3,5-Trinitrobenzene	0.14 UJ	0.14 UJ	0.14 UJ
1,3-Dinitrobenzene	0.14 U	0.14 U	0.14 U
2,4,6-Trinitrotoluene	0.14 U	0.14 U	0.14 U
2,4-Dinitrotoluene	0.14 U	0.14 U	0.14 U
2,6-Dinitrotoluene	0.14 U	0.14 U	0.14 U
2-Amino-4,6-dinitrotoluene	0.14 U	0.14 U	0.14 U
2-Nitrotoluene	0.14 U	0.14 U	0.14 U
3-Nitrotoluene	0.14 U	0.14 U	0.14 U
4-Amino-2,6-dinitrotoluene	0.14 U	0.14 U	0.14 U
4-Nitrotoluene	0.14 U	0.14 U	0.14 U
HMX	0.14 UJ	0.08 J	0.14 UJ
Nitrobenzene	0.16	0.16 J	0.094 J
Nitroglycerin	0.48 UJ	0.48 UJ	0.48 UJ
Perchlorate	0.2 U	0.2 U	0.2 U
PETN	0.48 U	0.48 U	0.48 U
RDX	0.14 U	0.14 U	0.14 U
Tetryl	0.29 J	0.34 J	0.14 J
Total Metals (µg/l)			
Aluminum	55.2	57	52.9
Antimony	3.75 U	3.75 U	3.75 U
Arsenic	1.25 U	1.25 U	1.25 U
Barium	3.64 J	3.69 J	3.14 J
Beryllium	1.25 U	1.25 U	1.25 U
Cadmium	0.344 J	0.33 J	0.325 J
Calcium	10,700	11,000	9,470
Chromium	1.25 U	1.25 U	1.25 U
Cobalt	3.12 U	3.12 U	3.12 U
Copper	2.5 U	2.5 U	2.5 U
Cyanide	10 U	10 U	10 U
Iron	22.4 J	22.7 J	24.9 J
Lead	0.75 U	0.75 U	0.75 U
Magnesium	2,000	2,030	1,710
Manganese	3.75 U	0.918 J	3.75 U
Mercury	0.2 U	0.2 U	0.2 U
Nickel	2.5 U	2.5 U	2.5 U
Potassium	2,210	2,270	1,890
Selenium	1.25 U	1.25 U	1.25 U
Silver	1.25 U	1.25 U	1.25 U
Sodium	1,200 J	1,220 J	1,010 J
Thallium	2 U	2 U	2 U
Vanadium	3.12 U	3.12 U	3.12 U
Zinc	2.39 J	2.44 J	2.02 J
Dissolved Metals (µg/l)			
Aluminum, Dissolved	38.3 J	36.1 J	36 J
Antimony, Dissolved	3.75 U	3.75 U	3.75 U
Arsenic, Dissolved	1.25 U	1.25 U	1.25 U
Barium, Dissolved	4.02 J	3.81 J	3.26 J
Beryllium, Dissolved	1.25 U	1.25 U	1.25 U
Cadmium, Dissolved	0.362 J	0.333 J	0.327 J
Calcium, Dissolved	11,600	11,500	10,000
Chromium, Dissolved	1.25 U	1.25 U	1.25 U
Cobalt, Dissolved	3.12 U	3.12 U	3.12 U
Copper, Dissolved	2.5 U	4.11	2.5 U

Appendix G
UXO - 11
Surface Water Raw Analytical Results
December 2009

Station ID	MR11-SW/SD01		MR11-SW/SD02
Sample ID	MR11-SW01-09D	MR11-SW01D-09D	MR11-SW02-09D
Sample Date	11/12/09	11/12/09	11/12/09
Chemical Name			
Iron, Dissolved	25 U	25 U	25 U
Lead, Dissolved	0.75 U	0.75 U	0.75 U
Magnesium, Dissolved	2,090	2,100	1,750
Manganese, Dissolved	3.75 U	3.75 U	3.75 U
Mercury, Dissolved	0.2 U	0.2 U	0.2 U
Nickel, Dissolved	2.5 U	2.5 U	2.5 U
Potassium, Dissolved	2,310	2,340	1,930
Selenium, Dissolved	1.25 U	1.25 U	1.25 U
Silver, Dissolved	1.25 U	1.25 U	1.25 U
Sodium, Dissolved	1,480	1,460	1,150 J
Thallium, Dissolved	2 U	2 U	2 U
Vanadium, Dissolved	3.12 U	3.12 U	3.12 U
Zinc, Dissolved	5.19	4.06 J	2.52 J

Notes:

Shading indicates detections

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 H
Human Health Risk Screening Tables

TABLE H-1
Occurrence, Distribution, and Selection of Chemicals of Potential Concern
Site UXO-11 Former Practice Hand Grenade Course
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 [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
Surface Soil	121-14-2	2,4-Dinitrotoluene	ND	ND	MG/KG		0/12	0.19 - 0.19	1.9E-01	N/A	1.6E+00 C*	N/A		NO	DLBSL
	606-20-2	2,6-Dinitrotoluene	ND	ND	MG/KG		0/12	0.19 - 0.19	1.9E-01	N/A	6.1E+00 N	N/A		NO	DLBSL
	98-95-3	Nitrobenzene	ND	ND	MG/KG		0/12	0.19 - 0.19	1.9E-01	N/A	4.8E+00 C*	N/A		NO	DLBSL
	99-35-4	1,3,5-Trinitrobenzene	ND	ND	MG/KG		0/12	0.19 - 0.19	1.9E-01	N/A	2.2E+02 N	N/A		NO	DLBSL
	99-65-0	1,3-Dinitrobenzene	ND	ND	MG/KG		0/12	0.19 - 0.19	1.9E-01	N/A	6.1E-01 N	N/A		NO	DLBSL
	118-96-7	2,4,6-Trinitrotoluene	ND	ND	MG/KG		0/12	0.19 - 0.19	1.9E-01	N/A	3.6E+00 C**	N/A		NO	DLBSL
	35572-78-2	2-Amino-4,6-dinitrotoluene	1.0E-01 J	4.3E-01	MG/KG	MR11-DU02-SS02-09D	3/12	0.19 - 0.19	4.3E-01	N/A	1.5E+01 N	N/A		NO	BSL
	88-72-2	2-Nitrotoluene	ND	ND	MG/KG		0/12	0.19 - 0.19	1.9E-01	N/A	2.9E+00 C*	N/A		NO	DLBSL
	99-08-1	3-Nitrotoluene	ND	ND	MG/KG		0/12	0.19 - 0.19	1.9E-01	N/A	6.1E-01 N	N/A		NO	DLBSL
	19406-51-0	4-Amino-2,6-dinitrotoluene	ND	ND	MG/KG		0/12	0.19 - 0.19	1.9E-01	N/A	1.5E+01 N	N/A		NO	DLBSL
	99-99-0	4-Nitrotoluene	ND	ND	MG/KG		0/12	0.19 - 0.19	1.9E-01	N/A	2.4E+01 C**	N/A		NO	DLBSL
	2691-41-0	HMX	ND	ND	MG/KG		0/12	0.19 - 0.19	1.9E-01	N/A	3.8E+02 N	N/A		NO	DLBSL
	55-63-0	**Nitroglycerin**	**9.2E-01**	**9.2E-01**	**MG/KG**	**MR11-DU03-SS02-09D**	**1/12**	**0.64 - 0.64**	**9.2E-01**	**N/A**	**6.1E-01 N**	**N/A**		**YES**	**ASL**
	14797-73-0	Perchlorate	ND	ND	MG/KG		0/12	0.00264 - 0.00372	3.7E-03	N/A	5.5E+00 N	N/A		NO	DLBSL
	78-11-5	PETN	ND	ND	MG/KG		0/12	0.64 - 0.64	6.4E-01	N/A	N/A	N/A		NO	NTX
	121-82-4	RDX	2.9E-01 J	2.9E-01 J	MG/KG	MR11-DU03-SS02-09D	1/12	0.19 - 0.19	2.9E-01	N/A	5.5E+00 C*	N/A		NO	BSL
	479-45-8	Tetryl	1.8E-01 J	2.0E-01 J	MG/KG	MR11-DU04-SS02-09D	2/12	0.19 - 0.19	2.0E-01	N/A	2.4E+01 N	N/A		NO	BSL
	7429-90-5	Aluminum	4.4E+03	6.8E+03	MG/KG	MR11-DU04-SS02-09D	12/12	12.9 - 28.5	6.8E+03	5.5E+03	7.7E+03 N	N/A		NO	BSL
	7440-36-0	Antimony	ND	ND	MG/KG		0/12	0.967 - 1.37	1.4E+00	4.5E-01	3.1E+00 N	N/A		NO	DLBSL
	7440-38-2	**Arsenic**	**8.5E-01**	**1.2E+00**	**MG/KG**	**MR11-DU04-SS02D-09D**	**12/12**	**0.322 - 0.455**	**1.2E+00**	**6.3E-01**	**3.9E-01 C***	**5.8E+00**	**NCSSL**	**YES**	**ASL**
	7440-39-3	Barium	1.4E+01 J	1.9E+01 J	MG/KG	MR11-DU04-SS02-09D	12/12	2.58 - 3.64	1.9E+01	1.5E+01	1.5E+03 N	5.8E+02	NCSSL	NO	BSL
	7440-41-7	Beryllium	7.9E-02 J	1.3E-01 J	MG/KG	MR11-DU04-SS02-09D	9/12	0.322 - 0.455	1.3E-01	1.0E-01	1.6E+01 N	N/A		NO	BSL
	7440-43-9	Cadmium	4.0E-01	4.0E-01	MG/KG	MR11-DU04-SS03-09D	2/12	0.322 - 0.455	4.0E-01	3.3E-02	7.0E+00 N	3.0E+00	NCSSL	NO	BSL
	7440-70-2	Calcium	5.8E+03 J	5.7E+04 J	MG/KG	MR11-DU04-SS01-09D	12/12	322 - 713	5.7E+04	6.4E+03	N/A	N/A		NO	NUT
	7440-47-3	**Chromium**	**4.9E+00**	**9.9E+00**	**MG/KG**	**MR11-DU04-SS02-09D**	**12/12**	**0.322 - 0.455**	**9.9E+00**	**6.1E+00**	**2.9E-01 C**	**3.8E+00**	**NCSSL**	**YES**	**ASL**
	7440-48-4	Cobalt	3.6E-01 J	4.0E-01 J	MG/KG	MR11-DU04-SS02-09D	2/12	0.806 - 1.14	4.0E-01	2.9E-01	2.3E+00 N	N/A		NO	BSL
	7440-50-8	Copper	2.8E+00 J	5.8E+00 J	MG/KG	MR11-DU01-SS03-09D	12/12	0.644 - 0.911	5.8E+00	4.8E+00	3.1E+02 N	7.0E+02	NCSSL	NO	BSL
	57-12-5	Cyanide	1.9E-01 J	6.5E-01	MG/KG	MR11-DU02-SS02-09D	5/12	0.33 - 0.465	6.5E-01	N/A	1.6E+02 N	2.8E-01	NCSSL	NO	BSL
	7439-89-6	Iron	1.5E+03	2.3E+03	MG/KG	MR11-DU04-SS02-09D	12/12	6.44 - 9.11	2.3E+03	3.2E+03	5.5E+03 N	1.5E+02	NCSSL	NO	BSL
	7439-92-1	Lead	1.0E+01	2.5E+01	MG/KG	MR11-DU04-SS02-09D	12/12	0.193 - 0.428	2.5E+01	1.2E+01	4.0E+02 NL	2.7E+02	NCSSL	NO	BSL
	7439-95-4	Magnesium	4.9E+02 J	1.2E+03 J	MG/KG	MR11-DU04-SS01-09D	12/12	322 - 455	1.2E+03	2.4E+02	N/A	N/A		NO	NUT
	7439-96-5	Manganese	1.4E+01	2.4E+01	MG/KG	MR11-DU03-SS03-09D	12/12	0.967 - 1.37	2.4E+01	1.4E+01	1.8E+02 N	6.5E+01	NCSSL	NO	BSL
	7439-97-6	Mercury	2.3E-02 J	4.4E-02	MG/KG	MR11-DU04-SS02D-09D	12/12	0.037 - 0.0634	4.4E-02	8.1E-02	2.3E+00 N	1.0E+00	NCSSL	NO	BSL
	7440-02-0	Nickel	9.7E-01 J	1.9E+00 J	MG/KG	MR11-DU04-SS02-09D	12/12	0.644 - 0.911	1.9E+00	1.2E+00	1.5E+02 N	1.3E+02	NCSSL	NO	BSL

TABLE H-1

Occurrence, Distribution, and Selection of Chemicals of Potential Concern

Site UXO-11 Former Practice Hand Grenade Course

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 [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
	7440-09-7	Potassium	1.8E+02 J	2.8E+02 J	MG/KG	MR11-DU04-SS02-09D	12/12	322 - 455	2.8E+02	1.2E+02	N/A	N/A		NO	NUT
	7782-49-2	Selenium	ND	ND	MG/KG		0/12	0.322 - 0.455	4.6E-01	5.6E-01	3.9E+01 N	2.1E+00	NCSSL	NO	DLBSL
	7440-22-4	Silver	ND	ND	MG/KG		0/12	0.322 - 0.455	4.6E-01	1.4E-01	3.9E+01 N	3.4E+00	NCSSL	NO	DLBSL
	7440-23-5	Sodium	8.5E+01 J	1.2E+02 J	MG/KG	MR11-DU04-SS01-09D	3/12	322 - 455	1.2E+02	8.1E+01	N/A	N/A		NO	NUT
	7440-28-0	Thallium	ND	ND	MG/KG		0/12	0.516 - 0.729	7.3E-01	3.6E-01	N/A	N/A		NO	NTX
	7440-62-2	Vanadium	5.2E+00	8.5E+00	MG/KG	MR11-DU04-SS02-09D	12/12	0.806 - 1.14	8.5E+00	8.9E+00	3.9E+01 N	N/A		NO	BSL
	7440-66-6	Zinc	1.3E+01 J	4.1E+01 J	MG/KG	MR11-DU03-SS03-09D	12/12	1.29 - 2.85	4.1E+01	1.1E+01	2.3E+03 N	1.2E+03	NCSSL	NO	BSL

[1] Minimum/Maximum detected concentrations.

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

[3] Background values are two times the arithmetic mean basewide background surface 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). November, 2010. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm
Residential soil RSLs. RSLs based on noncarcinogenic effects divided by 10 to account for exposure to more than on constituent that effects the same target organ.
The soil value of 400 mg/kg for lead is from the Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities, USEPA, July 14, 1994.
RSL value for chromium VI used for chromium.
RSL value for mercury (inorganic salts) used for mercury.

[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)
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 Preliminary Soil Remediation Goal, January, 2010
J = Estimated Value
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
MG/KG = micrograms per kilogram
N = Noncarcinogenic
N/A = Not available
ND = Non-detect
NL = Noncarcinogenic lead residential soil RSL not adjusted by dividing by 10.

TABLE H-2

Risk Ratio Screening for Surface Soil, Maximum Detected Concentration

Site UXO-11 Former Practice Hand Grenade Course

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
Explosives (mg/kg)								
Nitroglycerin	1 / 12	9.2E-01	MR11-DU03-SS02-09D	6.1E+00	1	0.2	NA	NA
Metals (mg/kg)								
Arsenic	12 / 12	1.2E+00	MR11-DU04-SS02D-09D	3.9E-01	1E-06	NA	3E-06	NA
Chromium	12 / 12	9.9E+00	MR11-DU04-SS02-09D	2.9E-01	1E-06	NA	3E-05	NA
Cumulative Corresponding Hazard Index[c]						**0.2**		
Cumulative Corresponding Cancer Risk[d]							**4E-05**	

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.

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 H-3

Occurrence, Distribution, and Selection of Chemicals of Potential Concern

Site UXO-11 Former Practice Hand Grenade Course

MCB Camp Lejeune, North Carolina

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

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
Surface Water	121-14-2	2,4-Dinitrotoluene	ND	ND	UG/L		0/2	0.14 - 0.14	1.4E-01	N/A	1.1E-01	NR	2.2E-01	R	YES	DLASL
	606-20-2	2,6-Dinitrotoluene	ND	ND	UG/L		0/2	0.14 - 0.14	1.4E-01	N/A	3.7E+00	R	N/A		NO	DLBSL
	98-95-3	Nitrobenzene	9.4E-02 J	1.6E-01 J	UG/L	MR11-SW01-09D : MR11-SW01D-09D	2/2	0.14 - 0.14	1.6E-01	N/A	1.7E+01	NR	1.2E-01	R	NO	BSL
	99-35-4	1,3,5-Trinitrobenzene	ND	ND	UG/L		0/2	0.14 - 0.14	1.4E-01	N/A	1.1E+02	R	N/A		NO	DLBSL
	99-65-0	1,3-Dinitrobenzene	ND	ND	UG/L		0/2	0.14 - 0.14	1.4E-01	N/A	3.7E-01	R	N/A		NO	DLBSL
	118-96-7	2,4,6-Trinitrotoluene	ND	ND	UG/L		0/2	0.14 - 0.14	1.4E-01	N/A	1.8E+00	R	N/A		NO	DLBSL
	35572-78-2	2-Amino-4,6-dinitrotoluene	ND	ND	UG/L		0/2	0.14 - 0.14	1.4E-01	N/A	7.3E+00	R	N/A		NO	DLBSL
	88-72-2	2-Nitrotoluene	ND	ND	UG/L		0/2	0.14 - 0.14	1.4E-01	N/A	3.1E-01	R	N/A		NO	DLBSL
	99-08-1	3-Nitrotoluene	ND	ND	UG/L		0/2	0.14 - 0.14	1.4E-01	N/A	3.7E-01	R	N/A		NO	DLBSL
	19406-51-0	4-Amino-2,6-dinitrotoluene	ND	ND	UG/L		0/2	0.14 - 0.14	1.4E-01	N/A	7.3E+00	R	N/A		NO	DLBSL
	99-99-0	4-Nitrotoluene	ND	ND	UG/L		0/2	0.14 - 0.14	1.4E-01	N/A	4.2E+00	R	N/A		NO	DLBSL
	2691-41-0	HMX	8.0E-02 J	8.0E-02 J	UG/L	MR11-SW01D-09D	1/2	0.14 - 0.14	8.0E-02	N/A	1.8E+02	R	N/A		NO	BSL
	55-63-0	Nitroglycerin	ND	ND	UG/L		0/2	0.48 - 0.48	4.8E-01	N/A	3.7E-01	R	N/A		YES	DLASL
	14797-73-0	Perchlorate	ND	ND	UG/L		0/2	0.2 - 0.2	2.0E-01	N/A	2.6E+00	R	N/A		NO	DLBSL
	78-11-5	PETN	ND	ND	UG/L		0/2	0.48 - 0.48	4.8E-01	N/A	N/A		N/A		NO	NTX
	121-82-4	RDX	ND	ND	UG/L		0/2	0.14 - 0.14	1.4E-01	N/A	6.1E-01	R	N/A		NO	DLBSL
	479-45-8	Tetryl	1.4E-01 J	3.4E-01 J	UG/L	MR11-SW01D-09D	2/2	0.14 - 0.14	3.4E-01	N/A	1.5E+01	R	N/A		NO	BSL
	7429-90-5	Aluminum	5.3E+01	5.7E+01	UG/L	MR11-SW01D-09D	2/2	50 - 50	5.7E+01	N/A	3.7E+03	R	N/A		NO	BSL
	7440-36-0	Antimony	ND	ND	UG/L		0/2	3.75 - 3.75	3.8E+00	N/A	5.6E+00	NR	1.5E+00	R	NO	DLBSL
	7440-38-2	Arsenic	ND	ND	UG/L		0/2	1.25 - 1.25	1.3E+00	N/A	1.0E+01	NC	1.8E-02	NR	NO	DLBSL
	7440-39-3	Barium	3.1E+00 J	3.7E+00 J	UG/L	MR11-SW01D-09D	2/2	10 - 10	3.7E+00	N/A	1.0E+03	NC,NR	7.3E+02	R	NO	BSL
	7440-41-7	Beryllium	ND	ND	UG/L		0/2	1.25 - 1.25	1.3E+00	N/A	4.0E+00	NR, M	7.3E+00	R	NO	DLBSL
	7440-43-9	Cadmium	3.3E-01 J	3.4E-01 J	UG/L	MR11-SW01-09D	2/2	1.25 - 1.25	3.4E-01	N/A	5.0E+00	NR, M	1.8E+00	R	NO	BSL
	7440-70-2	Calcium	9.5E+03	1.1E+04	UG/L	MR11-SW01D-09D	2/2	1250 - 1250	1.1E+04	N/A	N/A		N/A		NO	NUT
	7440-47-3	Chromium	ND	ND	UG/L		0/2	1.25 - 1.25	1.3E+00	N/A	1.0E+02	NR, M	4.3E-02	R	NO	DLBSL
	7440-48-4	Cobalt	ND	ND	UG/L		0/2	3.12 - 3.12	3.1E+00	N/A	1.1E+00	R	N/A		YES	DLASL
	7440-50-8	Copper	ND	ND	UG/L		0/2	2.5 - 2.5	2.5E+00	N/A	1.3E+03	NR	1.5E+02	R	NO	DLBSL
	57-12-5	Cyanide	ND	ND	UG/L		0/2	10 - 10	1.0E+01	N/A	1.4E+02	NR	7.3E+01	R	NO	DLBSL
	7439-89-6	Iron	2.3E+01 J	2.5E+01 J	UG/L	MR11-SW02-09D	2/2	25 - 25	2.5E+01	N/A	3.0E+02	NR	2.6E+03	R	NO	BSL
	7439-92-1	Lead	ND	ND	UG/L		0/2	0.75 - 0.75	7.5E-01	N/A	1.5E+01	AL	N/A		NO	DLBSL
	7439-95-4	Magnesium	1.7E+03	2.0E+03	UG/L	MR11-SW01D-09D	2/2	1250 - 1250	2.0E+03	N/A	N/A		N/A		NO	NUT
	7439-96-5	Manganese	9.2E-01 J	9.2E-01 J	UG/L	MR11-SW01D-09D	1/2	3.75 - 3.75	9.2E-01	N/A	2.0E+02	NC	5.0E+01	NR	NO	BSL
	7439-97-6	Mercury	ND	ND	UG/L		0/2	0.2 - 0.2	2.0E-01	N/A	3.0E-01	NR	3.7E-01	R	NO	DLBSL
	7440-02-0	Nickel	ND	ND	UG/L		0/2	2.5 - 2.5	2.5E+00	N/A	2.5E+01	NC	6.1E+02	NR	NO	DLBSL

TABLE H-3

Occurrence, Distribution, and Selection of Chemicals of Potential Concern

Site UXO-11 Former Practice Hand Grenade Course

MCB Camp Lejeune, North Carolina

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

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
	7440-09-7	Potassium	1.9E+03	2.3E+03	UG/L	MR11-SW01D-09D	2/2	1250 - 1250	2.3E+03	N/A	N/A	N/A		NO	NUT
	7782-49-2	Selenium	ND	ND	UG/L		0/2	1.25 - 1.25	1.3E+00	N/A	1.7E+02 NR	1.8E+01	R	NO	DLBSL
	7440-22-4	Silver	ND	ND	UG/L		0/2	1.25 - 1.25	1.3E+00	N/A	1.8E+01 R	N/A		NO	DLBSL
	7440-23-5	Sodium	1.0E+03 J	1.2E+03 J	UG/L	MR11-SW01D-09D	2/2	1250 - 1250	1.2E+03	N/A	N/A	N/A		NO	NUT
	7440-28-0	Thallium	ND	ND	UG/L		0/2	2 - 2	2.0E+00	N/A	2.4E-01 NR	N/A		YES	DLASL
	7440-62-2	Vanadium	ND	ND	UG/L		0/2	3.12 - 3.12	3.1E+00	N/A	1.8E+01 R	N/A		NO	DLBSL
	7440-66-6	Zinc	2.0E+00 J	2.4E+00 J	UG/L	MR11-SW01D-09D	2/2	5 - 5	2.4E+00	N/A	7.4E+03 NR	1.1E+03	R	NO	BSL

[1] Minimum/Maximum detected concentrations.

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

[3] Background values not available.

[4] Used North Carolina WQS for Human Health followed by Water Supply or Federal Ambient Water Quality Criteria, Consumption of Water and Organisms.
Where North Carolina WQS or Federal Ambient Water Quality Criteria are not available, used the Tap Water RSL, Nov. 2010, (based on $1x10^{-6}$ for carcinogens and noncarcinogens adjusted by dividing by 10).
For mercury, used values for methyl mercury since methylated form of mercury likely to be present in surface water.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Detection Limit Above Screening Level (DLASL), not quantitatively evaluated in HHRA but discussed in uncertainty assessment

Deletion Reason: Below Screening Level (BSL)
Detection Limit Below Screening Level (DLBSL)
No Toxicity Information (NTX)
Essential Nutrient (NUT)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
M = Safe Drinking Water Act Maximum Contaminant Level (MCL), since the National Recommended Water Quality Criteria (NR) refers to the MCL, value is the MCL.
NC = North Carolina WQS for Human Health and Water Supply, 2010.
NR = National Recommended Water Quality Criteria, Consumption of Water and Organisms, 2009.
R = RSL, tap water RSL from Regional Screening Level Table , November 2010, if based on noncarcinogenic effects, RSL is divided by 10.
AL = Action Level from Safe Drinking Water Act.
ND = Not detected
UG/L = micrograms per liter

TABLE H-4
Occurrence, Distribution, and Selection of Chemicals of Potential Concern
Site UXO-11 Former Practice Hand Grenade Course
MCB Camp Lejeune, North Carolina

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

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
Sediment	121-14-2	2,4-Dinitrotoluene	ND	ND	MG/KG		0/2	0.19 - 0.19	1.9E-01	N/A	1.6E+00 C*	N/A		NO	DLBSL
	606-20-2	2,6-Dinitrotoluene	ND	ND	MG/KG		0/2	0.19 - 0.19	1.9E-01	N/A	6.1E+00 N	N/A		NO	DLBSL
	98-95-3	Nitrobenzene	ND	ND	MG/KG		0/2	0.19 - 0.19	1.9E-01	N/A	4.8E+00 C*	N/A		NO	DLBSL
	99-35-4	1,3,5-Trinitrobenzene	ND	ND	MG/KG		0/2	0.19 - 0.19	1.9E-01	N/A	2.2E+02 N	N/A		NO	DLBSL
	99-65-0	1,3-Dinitrobenzene	ND	ND	MG/KG		0/2	0.19 - 0.19	1.9E-01	N/A	6.1E-01 N	N/A		NO	DLBSL
	118-96-7	2,4,6-Trinitrotoluene	ND	ND	MG/KG		0/2	0.19 - 0.19	1.9E-01	N/A	3.6E+00 C**	N/A		NO	DLBSL
	35572-78-2	2-Amino-4,6-dinitrotoluene	ND	ND	MG/KG		0/2	0.19 - 0.19	1.9E-01	N/A	1.5E+01 N	N/A		NO	DLBSL
	88-72-2	2-Nitrotoluene	ND	ND	MG/KG		0/2	0.19 - 0.19	1.9E-01	N/A	2.9E+00 C*	N/A		NO	DLBSL
	99-08-1	3-Nitrotoluene	ND	ND	MG/KG		0/2	0.19 - 0.19	1.9E-01	N/A	6.1E-01 N	N/A		NO	DLBSL
	19406-51-0	4-Amino-2,6-dinitrotoluene	ND	ND	MG/KG		0/2	0.19 - 0.19	1.9E-01	N/A	1.5E+01 N	N/A		NO	DLBSL
	99-99-0	4-Nitrotoluene	ND	ND	MG/KG		0/2	0.19 - 0.19	1.9E-01	N/A	2.4E+01 C**	N/A		NO	DLBSL
	2691-41-0	HMX	ND	ND	MG/KG		0/2	0.19 - 0.19	1.9E-01	N/A	3.8E+02 N	N/A		NO	DLBSL
	55-63-0	Nitroglycerin	ND	ND	MG/KG		0/2	0.64 - 0.64	6.4E-01	N/A	6.1E-01 N	N/A		YES	DLASL
	14797-73-0	Perchlorate	ND	ND	MG/KG		0/2	0.0032 - 0.00335	3.4E-03	N/A	5.5E+00 N	N/A		NO	DLBSL
	78-11-5	PETN	ND	ND	MG/KG		0/2	0.64 - 0.64	6.4E-01	N/A	N/A	N/A		NO	NTX
	121-82-4	RDX	ND	ND	MG/KG		0/2	0.19 - 0.19	1.9E-01	N/A	5.5E+00 C*	N/A		NO	DLBSL
	479-45-8	Tetryl	ND	ND	MG/KG		0/2	0.19 - 0.19	1.9E-01	N/A	2.4E+01 N	N/A		NO	DLBSL
	7429-90-5	**Aluminum**	**9.0E+03**	**1.0E+04**	**MG/KG**	**MR11-SD01-09D**	**2/2**	**16.2 - 16.2**	**1.0E+04**	**N/A**	**7.7E+03 N**	**N/A**		**YES**	**ASL**
	7440-36-0	Antimony	ND	ND	MG/KG		0/2	1.22 - 1.22	1.2E+00	N/A	3.1E+00 N	N/A		NO	DLBSL
	7440-38-2	**Arsenic**	**1.1E+00**	**1.6E+00**	**MG/KG**	**MR11-SD01-09D**	**2/2**	**0.405 - 0.406**	**1.6E+00**	**N/A**	**3.9E-01 C***	**N/A**		**YES**	**ASL**
	7440-39-3	Barium	2.3E+01	4.3E+01	MG/KG	MR11-SD01-09D	2/2	3.24 - 3.25	4.3E+01	N/A	1.5E+03 N	N/A		NO	BSL
	7440-41-7	Beryllium	1.8E-01 J	2.2E-01 J	MG/KG	MR11-SD01-09D	2/2	0.405 - 0.406	2.2E-01	N/A	1.6E+01 N	N/A		NO	BSL
	7440-43-9	Cadmium	ND	ND	MG/KG		0/2	0.405 - 0.406	4.1E-01	N/A	7.0E+00 N	N/A		NO	DLBSL
	7440-70-2	Calcium	2.0E+04	3.7E+04	MG/KG	MR11-SD02-09D	2/2	405 - 406	3.7E+04	N/A	N/A	N/A		NO	NUT
	7440-47-3	**Chromium**	**1.7E+01**	**1.8E+01**	**MG/KG**	**MR11-SD01-09D**	**2/2**	**0.405 - 0.406**	**1.8E+01**	**N/A**	**2.9E-01 C**	**N/A**		**YES**	**ASL**
	7440-48-4	Cobalt	6.9E-01 J	7.2E-01 J	MG/KG	MR11-SD02-09D	2/2	1.01 - 1.02	7.2E-01	N/A	2.3E+00 N	N/A		NO	BSL
	7440-50-8	Copper	5.4E+00	1.5E+01	MG/KG	MR11-SD02-09D	2/2	0.81 - 0.812	1.5E+01	N/A	3.1E+02 N	N/A		NO	BSL
	57-12-5	Cyanide	ND	ND	MG/KG		0/2	0.4 - 0.419	4.2E-01	N/A	1.6E+02 N	N/A		NO	DLBSL
	7439-89-6	Iron	3.2E+03	3.3E+03	MG/KG	MR11-SD02-09D	2/2	8.1 - 8.12	3.3E+03	N/A	5.5E+03 N	N/A		NO	BSL
	7439-92-1	Lead	5.3E+01	8.8E+01	MG/KG	MR11-SD01-09D	2/2	0.243 - 0.244	8.8E+01	N/A	4.0E+02 NL	N/A		NO	BSL
	7439-95-4	Magnesium	8.2E+02	1.1E+03	MG/KG	MR11-SD02-09D	2/2	405 - 406	1.1E+03	N/A	N/A	N/A		NO	NUT
	7439-96-5	Manganese	1.7E+01	1.9E+01	MG/KG	MR11-SD02-09D	2/2	1.22 - 1.22	1.9E+01	N/A	1.8E+02 N	N/A		NO	BSL
	7439-97-6	Mercury	4.9E-02	5.3E-02	MG/KG	MR11-SD02-09D	2/2	0.044 - 0.0461	5.3E-02	N/A	2.3E+00 N	N/A		NO	BSL

Occurrence, Distribution, and Selection of Chemicals of Potential Concern
Site UXO-11 Former Practice Hand Grenade Course
MCB Camp Lejeune, North Carolina

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

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
	7440-02-0	Nickel	2.5E+00	3.3E+00	MG/KG	MR11-SD02-09D	2/2	0.81 - 0.812	3.3E+00	N/A	1.5E+02 N	N/A		NO	BSL
	7440-09-7	Potassium	3.2E+02 J	4.2E+02 J	MG/KG	MR11-SD02-09D	2/2	405 - 406	4.2E+02	N/A	N/A	N/A		NO	NUT
	7782-49-2	Selenium	ND	ND	MG/KG		0/2	0.405 - 0.406	4.1E-01	N/A	3.9E+01 N	N/A		NO	DLBSL
	7440-22-4	Silver	ND	ND	MG/KG		0/2	0.405 - 0.406	4.1E-01	N/A	3.9E+01 N	N/A		NO	DLBSL
	7440-23-5	Sodium	ND	ND	MG/KG		0/2	405 - 406	4.1E+02	N/A	N/A	N/A		NO	NUT
	7440-28-0	Thallium	ND	ND	MG/KG		0/2	0.648 - 0.65	6.5E-01	N/A	N/A	N/A		NO	NTX
	7440-62-2	Vanadium	1.2E+01	1.4E+01	MG/KG	MR11-SD01-09D	2/2	1.01 - 1.02	1.4E+01	N/A	3.9E+01 N	N/A		NO	BSL
	7440-66-6	Zinc	3.7E+01	1.8E+02	MG/KG	MR11-SD02-09D	2/2	1.62 - 1.62	1.8E+02	N/A	2.3E+03 N	N/A		NO	BSL

[1] Minimum/Maximum detected concentrations.
[2] Maximum concentration is used for screening. If chemical was not detected, the maximum detection limit is used for screening.
[3] Background values not available.
[4] Oak Ridge National Laboratory (ORNL). Nov 2010. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
Available: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm.
Adjusted (noncarcinogenic RSLs adjusted by dividing by 10) residential soil RSLs.
The soil value of 400 mg/kg for lead is from the Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities, USEPA, July 14, 1994.
RSL value for chromium VI used for chromium.
RSL value for mercury (inorganic salts) used for mercury.
[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Detection Limit Above Screening Level (DLASL), not quantitatively evaluated in HHRA but discussed in uncertainty assessment

Deletion Reason: Below Screening Level (BSL)
Detection Limit Below Screening Level (DLBSL)
No Toxicity Information (NTX)
Essential Nutrient (NUT)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
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
MG/KG = micrograms per kilogram
N = Noncarcinogenic
N/A = Not available
ND = Not detected
NL = Noncarcinogenic lead residential soil RSL not adjusted by dividing by 10.

TABLE H-5

Risk Ratio Screening for Sediment, Maximum Detected Concentration

Site UXO-11 Former Practice Hand Grenade Course

MCB Camp Lejeune, North Carolina

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier)	Sample	Screening Level	Acceptable Risk Level	Corresponding Hazard Index[a]	Corresponding Cancer Index[b]	Target Organ
METAL (mg/kg)								
Aluminum	2 / 2	1.0E+04	MR11-SD01-09D	7.7E+04	1	0.1		Neurological, Developmental
Arsenic	**2 / 2**	**1.6E+00**	**MR11-SD01-09D**	**3.9E-01**	**1E-06**		**4E-06**	**NA**
Chromium	**2 / 2**	**1.8E+01**	**MR11-SD01-09D**	**2.9E-01**	**1E-06**		**6E-05**	**NA**
Cumulative Corresponding Hazard Index[c]						**0.1**		
Cumulative Corresponding Cancer Risk[d]							**7E-05**	
							Total Developmental HI =	0.1
							Total Neurological HI =	0.1

Notes:

[a] Corresponding Hazard Index equals maximum detected concentration divided by the SL divided by the acceptable risk level.

[b] Corresponding Cancer Risk equals maximum detected concentration divided by the SL 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.

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 = milligrams per kilogram

NA = Not available/not applicable.

TABLE H-6
Occurrence, Distribution, and Selection of Chemicals of Potential Concern
Site UXO-11 Former Practice Hand Grenade Course
MCB Camp Lejeune, North Carolina

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

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
Groundwater	121-14-2	2,4-Dinitrotoluene	ND	ND	UG/L		0/5	0.15 - 0.15	1.5E-01	N/A	2.2E-01 C	N/A		NO	DLBSL
	606-20-2	2,6-Dinitrotoluene	ND	ND	UG/L		0/5	0.15 - 0.15	1.5E-01	N/A	3.7E+00 N	N/A		NO	DLBSL
	98-95-3	**Nitrobenzene**	**6.4E-02 J**	**4.8E-01 J**	**UG/L**	**MR11-TW02-09D**	**4/5**	**0.15 - 0.15**	**4.8E-01**	**N/A**	**1.2E-01 C**	**N/A**		**YES**	**ASL**
	99-35-4	1,3,5-Trinitrobenzene	7.6E-02 J	8.6E-02 J	UG/L	MR11-TW04-09D	2/5	0.15 - 0.15	8.6E-02	N/A	1.1E+02 N	N/A		NO	BSL
	99-65-0	1,3-Dinitrobenzene	5.8E-02 J	1.2E-01 J	UG/L	MR11-TW02-09D	3/5	0.15 - 0.15	1.2E-01	N/A	3.7E-01 N	N/A		NO	BSL
	118-96-7	2,4,6-Trinitrotoluene	5.3E-02 J	5.3E-02 J	UG/L	MR11-TW03-09D	1/5	0.15 - 0.15	5.3E-02	N/A	1.8E+00 C**	N/A		NO	BSL
	35572-78-2	2-Amino-4,6-dinitrotoluene	ND	ND	UG/L		0/5	0.15 - 0.15	1.5E-01	N/A	7.3E+00 N	N/A		NO	DLBSL
	88-72-2	2-Nitrotoluene	6.4E-02 J	6.4E-02 J	UG/L	MR11-TW03-09D	1/5	0.15 - 0.15	6.4E-02	N/A	3.1E-01 C	N/A		NO	BSL
	99-08-1	3-Nitrotoluene	1.2E-01 J	1.5E-01	UG/L	MR11-TW04-09D	2/5	0.15 - 0.15	1.5E-01	N/A	3.7E-01 N	N/A		NO	BSL
	19406-51-0	4-Amino-2,6-dinitrotoluene	ND	ND	UG/L		0/5	0.15 - 0.15	1.5E-01	N/A	7.3E+00 N	N/A		NO	DLBSL
	99-99-0	4-Nitrotoluene	8.6E-02 J	4.1E-01 J	UG/L	MR11-TW03-09D	4/5	0.15 - 0.15	4.1E-01	N/A	4.2E+00 C*	N/A		NO	BSL
	2691-41-0	HMX	ND	ND	UG/L		0/5	0.15 - 0.15	1.5E-01	N/A	1.8E+02 N	N/A		NO	DLBSL
	55-63-0	Nitroglycerin	2.2E-01 J	2.2E-01 J	UG/L	MR11-TW03-09D	1/5	0.5 - 0.51	2.2E-01	N/A	3.7E-01 N	N/A		NO	BSL
	14797-73-0	Perchlorate	7.9E-02 J	3.8E-01	UG/L	MR11-TW02-09D	3/5	0.2 - 0.2	3.8E-01	N/A	2.6E+00 N	N/A		NO	BSL
	78-11-5	PETN	ND	ND	UG/L		0/5	0.5 - 0.51	5.1E-01	N/A	N/A	N/A		NO	NTX
	121-82-4	RDX	1.0E-01 J	1.0E-01 J	UG/L	MR11-TW03-09D	1/5	0.15 - 0.15	1.0E-01	N/A	6.1E-01 C	N/A		NO	BSL
	479-45-8	Tetryl	ND	ND	UG/L		0/5	0.15 - 0.15	1.5E-01	N/A	1.5E+01 N	N/A		NO	DLBSL
	7429-90-5	Aluminum	2.6E+02 J	5.3E+02 J	UG/L	MR11-TW04-09D	5/5	50 - 50	5.3E+02	1.9E+03	3.7E+03 N	50 - 200	SMCL	NO	BSL
	7440-36-0	Antimony	ND	ND	UG/L		0/5	3.75 - 3.75	3.8E+00	3.3E+00	1.5E+00 N	6.0E+00	MCL	YES	DLASL
	7440-38-2	**Arsenic**	**1.4E+00**	**2.4E+00**	**UG/L**	**MR11-TW04-09D**	**4/5**	**1.25 - 1.25**	**2.4E+00**	**5.8E+00**	**4.5E-02 C**	**1.0E+01**	**MCL, NC2LGW**	**YES**	**ASL**
	7440-39-3	Barium	1.0E+01	4.9E+01	UG/L	MR11-TW04-09D	5/5	10 - 10	4.9E+01	8.6E+01	7.3E+02 N	2.0E+03	MCL	NO	BSL
												7.0E+02	NC2LGW		
	7440-41-7	Beryllium	5.4E-01 J	6.6E-01 J	UG/L	MR11-TW01-09D	2/5	1.25 - 1.25	6.6E-01	3.1E-01	7.3E+00 N	4.0E+00	MCL	NO	BSL
	7440-43-9	Cadmium	2.6E-01 J	6.4E-01 J	UG/L	MR11-TW02-09D	3/5	1.25 - 1.25	6.4E-01	3.6E-01	1.8E+00 N	5.0E+00	MCL	NO	BSL
												2.0E+00	NC2LGW		
	7440-70-2	Calcium	3.7E+03	9.8E+04	UG/L	MR11-TW03-09D	5/5	1250 - 1250	9.8E+04		N/A	N/A		NO	NUT
	7440-47-3	**Chromium**	**6.6E-01 J**	**2.4E+00**	**UG/L**	**MR11-TW03-09D**	**5/5**	**1.25 - 1.25**	**2.4E+00**	**3.1E+00**	**4.3E-02 C**	**1.0E+02**	**MCL**	**YES**	**ASL**
												1.0E+01	**NC2LGW**		
	7440-48-4	**Cobalt**	**1.5E+00 J**	**4.3E+00**	**UG/L**	**MR11-TW04-09D**	**2/5**	**3.12 - 3.12**	**4.3E+00**	**3.4E+00**	**1.1E+00 N**	**N/A**		**YES**	**ASL**
	7440-50-8	Copper	ND	ND	UG/L		0/5	2.5 - 2.5	2.5E+00	2.8E+00	1.5E+02 N	1.3E+03	MCL	NO	DLBSL
												1.0E+03	NC2LGW		
	7439-89-6	Iron	2.2E+02	2.3E+03	UG/L	MR11-TW03-09D	5/5	25 - 25	2.3E+03	6.0E+03	2.6E+03 N	3.0E+02	SMCL, NC2LGW	NO	BSL
	7439-92-1	Lead	ND	ND	UG/L		0/5	0.75 - 0.75	7.5E-01	2.8E+00	N/A	1.5E+01	MCL, NC2LGW	NO	NTX
	7439-95-4	Magnesium	6.9E+02 J	2.0E+03	UG/L	MR11-TW03-09D	5/5	1250 - 1250	2.0E+03	6.4E+03	N/A	N/A		NO	NUT

TABLE H-6

Occurrence, Distribution, and Selection of Chemicals of Potential Concern

Site UXO-11 Former Practice Hand Grenade Course

MCB Camp Lejeune, North Carolina

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

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
	7439-96-5	Manganese	6.3E+00 J	2.2E+01 J	UG/L	MR11-TW03-09D	5/5	3.75 - 3.75	2.2E+01	2.1E+02	8.8E+01 N	5.0E+01	NC2LGW	NO	BSL
	7439-97-6	Mercury	ND	ND	UG/L		0/5	0.2 - 0.2	2.0E-01	1.0E-01	1.1E+00 N	2.0E+00	MCL	NO	DLBSL
												1.0E+00	NC2LGW		
	7440-02-0	Nickel	2.6E+00	6.1E+00	UG/L	MR11-TW04-09D	4/5	2.5 - 2.5	6.1E+00	8.0E+00	7.3E+01 N	1.0E+02	NC2LGW	NO	BSL
	7440-09-7	Potassium	4.4E+02 J	7.3E+02 J	UG/L	MR11-TW04-09D	3/5	1250 - 1250	7.3E+02	3.3E+03	N/A	N/A		NO	NUT
	7782-49-2	Selenium	1.2E+00 J	2.9E+00	UG/L	MR11-TW02-09D	2/5	1.25 - 1.25	2.9E+00	3.1E+00	1.8E+01 N	5.0E+01	MCL	NO	BSL
												2.0E+01	NC2LGW		
	7440-22-4	Silver	ND	ND	UG/L		0/5	1.25 - 1.25	1.3E+00	7.7E-01	1.8E+01 N	2.0E+01	NC2LGW	NO	DLBSL
												1.0E+02	SMCL		
	7440-23-5	Sodium	3.0E+03	5.0E+03	UG/L	MR11-TW04-09D	5/5	1250 - 1250	5.0E+03	2.3E+04	N/A	N/A		NO	NUT
	7440-28-0	Thallium	ND	ND	UG/L		0/5	2 - 2	2.0E+00	3.8E+00	N/A	2.0E+00	MCL	NO	NTX
	7440-62-2	Vanadium	1.5E+00 J	5.0E+00	UG/L	MR11-TW02-09D	4/5	3.12 - 3.12	5.0E+00	4.7E+00	1.8E+01 N	N/A		NO	BSL
	7440-66-6	Zinc	2.8E+00 J	4.2E+01	UG/L	MR11-TW02-09D	5/5	5 - 5	4.2E+01	4.2E+01	1.1E+03 N	1.0E+03	NC2LGW	NO	BSL
												5.0E+03	SMCL		

[1] Minimum/Maximum detected concentrations.

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

[3] Background values are two times the arithmetic mean basewide background shallow groundwater 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). November, 2010. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm
Tap water RSLs. RSLs based on noncarcinogenic effects divided by 10 to account for exposure to more than on constituent that effects the same target organ.
RSL value for chromium VI used for 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)
Detection Limit Below Screening Level (DLBSL)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
MCL = Maximum Contaminant Level from EPA's National Primary Drinking Water Standards
SMCL = Secondary Maximum Contaminant Level
NC2LGW = North Carolina Classifications and Groundwater Quality Standards, January, 2010.
J = Estimated Value
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 = Not detected
UG/L = micrograms per liter

TABLE H-7

Risk Ratio Screening for Groundwater, Maximum Detected Concentration

Site UXO-11 Former Practice Hand Grenade Course

MCB Camp Lejeune, North Carolina

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier)	Sample Location of Maximum Detected Concentration	Tap Water RSL	Acceptable Risk Level	Corresponding Hazard Index[a]	Corresponding Cancer Risk[b]	Target Organ
Explosives (ug/L)								
Nitrobenzene	**4 / 5**	**4.8E-01 J**	**MR11-TW02-09D**	**1.2E-01**	**1E-06**	**NA**	**4E-06**	**NA**
Metals (ug/L)								
Arsenic	**4 / 5**	**2.4E+00**	**MR11-TW04-09D**	**4.5E-02**	**1E-06**	**NA**	**5E-05**	**NA**
Chromium	**5 / 5**	**2.4E+00**	**MR11-TW03-09D**	**4.3E-02**	**1E-06**	**NA**	**6E-05**	**NA**
Cobalt	2 / 5	4.3E+00	MR11-TW04-09D	1.1E+01	1	0.4	NA	Thyroid
Cumulative Corresponding Hazard Index[c]						**0.4**		
Cumulative Corresponding Cancer Risk[d]							**1E-04**	
							Total Thyroid HI =	0.4

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.

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

J = Estimated Value

ug/L = micrograms per liter

NA = Not available/not applicable.

Generated by: Geanine Howard-Peebles/DAY Checked by: Checked by: Martha White/ATL

TABLE H-8

Risk Ratio Screening for Groundwater, 95% UCL Concentration

Site UXO-11 Former Practice Hand Grenade Course

MCB Camp Lejeune, North Carolina

Analyte	Detection Frequency	95% UCL		95% UCL Rationale	Tap Water RSL	Acceptable Risk Level	Corresponding Hazard Index[a]	Corresponding Cancer Risk[b]	Target Organ
Explosives (ug/L)									
Nitrobenzene	**4 / 5**	**3.6E-01**	**95% KM-t**	**1, 2, 3**	**1.2E-01**	**1E-06**	**NA**	**3E-06**	**NA**
Metals (ug/L)									
Arsenic	**4 / 5**	**2.1E+00**	**95% KM-t**	**1, 2, 3**	**4.5E-02**	**1E-06**	**NA**	**5E-05**	**NA**
Chromium	**5 / 5**	**2.1E+00**	**95% Stud-t**	**1, 2, 3**	**4.3E-02**	**1E-06**	**NA**	**5E-05**	**NA**
Cumulative Corresponding Hazard Index[c]							**NA**		
Cumulative Corresponding Cancer Risk[d]								**1E-04**	

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.

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

HI = Hazard Index

NA = Not available/not applicable.

ug/L = micrograms per liter

ProUCL, Version 4.00.04 used to determine distribution of data and calculate 95% UCL, following recommendations in users guide (USEPA. February 2009. ProUCL, Version 4.0. Prepared by Lockheed Martin Environmental Services).

Statistics: 95% Kaplan-Meier (t) UCL (95% KM-t); 95% Student's-t UCL (95% Stud-t)

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

Generated by: Geanine Howard-Peebles/DAY Checked by: Checked by: Martha White/ATL

TABLE H-9
Occurrence, Distribution, and Selection of Chemicals of Potential Concern
Site UXO-11 Former Practice Hand Grenade Course
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
Subsurface Soil	121-14-2	2,4-Dinitrotoluene	ND	ND	MG/KG		0/5	0.19 - 0.19	1.9E-01	N/A	1.6E+00 C*	N/A		NO	DLBSL
	606-20-2	2,6-Dinitrotoluene	ND	ND	MG/KG		0/5	0.19 - 0.19	1.9E-01	N/A	6.1E+00 N	N/A		NO	DLBSL
	98-95-3	Nitrobenzene	ND	ND	MG/KG		0/5	0.19 - 0.19	1.9E-01	N/A	4.8E+00 C*	N/A		NO	DLBSL
	99-35-4	1,3,5-Trinitrobenzene	ND	ND	MG/KG		0/5	0.19 - 0.19	1.9E-01	N/A	2.2E+02 N	N/A		NO	DLBSL
	99-65-0	1,3-Dinitrobenzene	ND	ND	MG/KG		0/5	0.19 - 0.19	1.9E-01	N/A	6.1E-01 N	N/A		NO	DLBSL
	118-96-7	2,4,6-Trinitrotoluene	ND	ND	MG/KG		0/5	0.19 - 0.19	1.9E-01	N/A	3.6E+00 C**	N/A		NO	DLBSL
	35572-78-2	2-Amino-4,6-dinitrotoluene	ND	ND	MG/KG		0/5	0.19 - 0.19	1.9E-01	N/A	1.5E+01 N	N/A		NO	DLBSL
	88-72-2	2-Nitrotoluene	ND	ND	MG/KG		0/5	0.19 - 0.19	1.9E-01	N/A	2.9E+00 C*	N/A		NO	DLBSL
	99-08-1	3-Nitrotoluene	ND	ND	MG/KG		0/5	0.19 - 0.19	1.9E-01	N/A	6.1E-01 N	N/A		NO	DLBSL
	19406-51-0	4-Amino-2,6-dinitrotoluene	ND	ND	MG/KG		0/5	0.19 - 0.19	1.9E-01	N/A	1.5E+01 N	N/A		NO	DLBSL
	99-99-0	4-Nitrotoluene	ND	ND	MG/KG		0/5	0.19 - 0.19	1.9E-01	N/A	2.4E+01 C**	N/A		NO	DLBSL
	2691-41-0	HMX	ND	ND	MG/KG		0/5	0.19 - 0.19	1.9E-01	N/A	3.8E+02 N	N/A		NO	DLBSL
	55-63-0	Nitroglycerin	ND	ND	MG/KG		0/5	0.64 - 0.64	6.4E-01	N/A	6.1E-01 N	N/A		YES	DLASL
	14797-73-0	Perchlorate	2.4E-03	5.1E-03	MG/KG	MR11-IS03-2-3-09D	2/5	0.00229 - 0.00253	5.1E-03	N/A	5.5E+00 N	N/A		NO	BSL
	78-11-5	PETN	ND	ND	MG/KG		0/5	0.64 - 0.64	6.4E-01	N/A	N/A	N/A		NO	NTX
	121-82-4	RDX	1.0E-01 J	4.4E-01	MG/KG	MR11-IS01D-2-3-09D	5/5	0.19 - 0.19	4.4E-01	N/A	5.5E+00 C*	N/A		NO	BSL
	479-45-8	Tetryl	ND	ND	MG/KG		0/5	0.19 - 0.19	1.9E-01	N/A	2.4E+01 N	N/A		NO	DLBSL
	7429-90-5	**Aluminum**	**5.9E+03 J**	**1.4E+04 J**	**MG/KG**	**MR11-IS03-2-3-09D**	**5/5**	**11 - 12.5**	**1.4E+04**	**10369**	**7.7E+03 N**	**N/A**		**YES**	**ASL**
	7440-36-0	Antimony	ND	ND	MG/KG		0/5	0.823 - 0.939	9.4E-01	0.36	3.1E+00 N	N/A		NO	DLBSL
	7440-38-2	**Arsenic**	**4.6E-01**	**1.4E+00**	**MG/KG**	**MR11-IS03-2-3-09D**	**5/5**	**0.274 - 0.313**	**1.4E+00**	**2.12**	**3.9E-01 C***	**5.8E+00**	**NCSSL**	**YES**	**ASL**
	7440-39-3	Barium	1.2E+01	3.3E+01	MG/KG	MR11-IS03-2-3-09D	5/5	2.19 - 2.5	3.3E+01	16.6	1.5E+03 N	5.8E+02	NCSSL	NO	BSL
	7440-41-7	Beryllium	6.6E-02 J	2.1E-01 J	MG/KG	MR11-IS03-2-3-09D	5/5	0.274 - 0.313	2.1E-01	0.165	1.6E+01 N	N/A		NO	BSL
	7440-43-9	Cadmium	ND	ND	MG/KG		0/5	0.274 - 0.313	3.1E-01	0.023	7.0E+00 N	3.0E+00	NCSSL	NO	DLBSL
	7440-70-2	Calcium	1.1E+02 J	2.2E+03	MG/KG	MR11-IS03-2-3-09D	5/5	274 - 313	2.2E+03	441	N/A	N/A		NO	NUT
	7440-47-3	**Chromium**	**6.7E+00 J**	**1.6E+01 J**	**MG/KG**	**MR11-IS03-2-3-09D**	**5/5**	**0.274 - 0.313**	**1.6E+01**	**14.5**	**2.9E-01 C**	**3.8E+00**	**NCSSL**	**YES**	**ASL**
	7440-48-4	Cobalt	3.4E-01 J	6.3E-01 J	MG/KG	MR11-IS03-2-3-09D	4/5	0.685 - 0.782	6.3E-01	0.822	2.3E+00 N	N/A		NO	BSL
	7440-50-8	Copper	3.9E-01 J	5.3E-01 J	MG/KG	MR11-IS01-2-3-09D	4/5	0.548 - 0.626	5.3E-01	2.56	3.1E+02 N	7.0E+02	NCSSL	NO	BSL
	57-12-5	Cyanide	ND	ND	MG/KG		0/5	0.287 - 0.316	3.2E-01	N/A	1.6E+02 N	2.8E-01	NCSSL	NO	DLBSL
	7439-89-6	**Iron**	**1.1E+03**	**6.9E+03**	**MG/KG**	**MR11-IS04-2-3-09D**	**5/5**	**5.48 - 6.26**	**6.9E+03**	**5439**	**5.5E+03 N**	**1.5E+02**	**NCSSL**	**YES**	**ASL**
	7439-92-1	Lead	3.3E+00	6.7E+00	MG/KG	MR11-IS03-2-3-09D	5/5	0.165 - 0.188	6.7E+00	8.49	4.0E+02 NL	2.7E+02	NCSSL	NO	BSL
	7439-95-4	Magnesium	2.4E+02 J	6.7E+02 J	MG/KG	MR11-IS03-2-3-09D	5/5	274 - 313	6.7E+02	363	N/A	N/A		NO	NUT
	7439-96-5	Manganese	2.7E+00 J	6.0E+00 J	MG/KG	MR11-IS03-2-3-09D	5/5	0.823 - 0.939	6.0E+00	9.25	1.8E+02 N	6.5E+01	NCSSL	NO	BSL
	7439-97-6	Mercury	1.7E-02 J	2.4E-02 J	MG/KG	MR11-IS03-2-3-09D	2/5	0.033 - 0.0405	2.4E-02	0.071	2.3E+00 N	1.0E+00	NCSSL	NO	BSL
	7440-02-0	Nickel	9.2E-01	2.0E+00	MG/KG	MR11-IS03-2-3-09D	5/5	0.548 - 0.626	2.0E+00	2.27	1.5E+02 N	1.3E+02	NCSSL	NO	BSL

TABLE H-9

Occurrence, Distribution, and Selection of Chemicals of Potential Concern

Site UXO-11 Former Practice Hand Grenade Course

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
	7440-09-7	Potassium	1.4E+02 J	2.8E+02 J	MG/KG	MR11-IS03-2-3-09D	5/5	274 - 313	2.8E+02	361	N/A	N/A		NO	NUT
	7782-49-2	Selenium	2.3E-01 J	3.5E-01	MG/KG	MR11-IS03-2-3-09D	4/5	0.274 - 0.313	3.5E-01	0.505	3.9E+01 N	2.1E+00	NCSSL	NO	BSL
	7440-22-4	Silver	ND	ND	MG/KG		0/5	0.274 - 0.313	3.1E-01	0.129	3.9E+01 N	3.4E+00	NCSSL	NO	DLBSL
	7440-23-5	Sodium	ND	ND	MG/KG		0/5	274 - 313	3.1E+02	68.3	N/A	N/A		NO	NUT
	7440-28-0	Thallium	ND	ND	MG/KG		0/5	0.439 - 0.501	5.0E-01	0.38	N/A	N/A		NO	NTX
	7440-62-2	Vanadium	5.7E+00	1.6E+01	MG/KG	MR11-IS03-2-3-09D	5/5	0.685 - 0.782	1.6E+01	17.2	3.9E+01 N	N/A		NO	BSL
	7440-66-6	Zinc	2.3E+00	5.3E+00	MG/KG	MR11-IS03-2-3-09D	5/5	1.1 - 1.25	5.3E+00	6.59	2.3E+03 N	1.2E+03	NCSSL	NO	BSL

[1] Minimum/Maximum detected concentrations.

[2] Maximum concentration is used for screening.

[3] Maximum concentration is used for screening. If chemical was not detected, the maximum detection limit is used for screening.
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). November, 2010. Regional Screening Levels for Chemical Contaminants at Superfund Sites.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm
Residential soil RSLs. RSLs based on noncarcinogenic effects divided by 10 to account for exposure to more than on constituent that effects the same target organ.
The soil value of 400 mg/kg for lead is from the Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities, USEPA, July 14, 1994.
RSL value for chromium VI used for chromium.
RSL value for mercury (inorganic salts) used for mercury.

[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)
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 Preliminary Soil Remediation Goal, January, 2010
J = Estimated Value
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
MG/KG = micrograms per kilogram
N = Noncarcinogenic
N/A = Not available

TABLE H-10

Risk Ratio Screening for Subsurface Soil, Maximum Detected Concentration

Site UXO-11 Former Practice Hand Grenade Course

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 (mg/kg)								
Aluminum	5 / 5	1.4E+04 J	MR11-IS03-2-3-09D	7.7E+04	1	0.2	NA	Neurological, Developmental
Arsenic	**5 / 5**	**1.4E+00**	**MR11-IS03-2-3-09D**	**3.9E-01**	**1E-06**	**NA**	**4E-06**	**NA**
Chromium	**5 / 5**	**1.6E+01 J**	**MR11-IS03-2-3-09D**	**2.9E-01**	**1E-06**	**NA**	**6E-05**	**NA**
Iron	5 / 5	6.9E+03	MR11-IS04-2-3-09D	5.5E+04	1	0.1	NA	Gastrointestinal
Cumulative Corresponding Hazard Index[c]						**0.3**		
Cumulative Corresponding Cancer Risk[d]							**6E-05**	

Total Developmental HI =	0.2
Total Gastrointestinal HI =	0.1
Total Neurological HI =	0.2

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.

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

J = Estimated Value

mg/kg = micrograms per kilogram

TABLE H-11

Risk Ratio Screening for Subsurface Soil, 95% UCL Concentration

Site UXO-11 Former Practice Hand Grenade Course

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 (mg/kg)									
Arsenic	5 / 5	1.2E+00	1, 2, 3	95% Stud-t	3.9E-01	1E-06	NA	3E-06	NA
Chromium	5 / 5	1.3E+01	1, 2, 3	95% Stud-t	2.9E-01	1E-06	NA	5E-05	NA
Cumulative Corresponding Hazard Index[c]							**NA**		
Cumulative Corresponding Cancer Risk[d]								**5E-05**	

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.

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.

mg/kg = micrograms per kilogram

HI = Hazard Index

NA = Not available/not applicable.

ProUCL, Version 4.00.04 used to determine distribution of data and calculate 95% UCL, following recommendations in users guide (USEPA. February 2009. ProUCL, Version 4.0. Prepared by Lockheed Martin Environmental Services).

Options: 95% Student's-t UCL (95% Stud-t)

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.

Generated by: Geanine Howard-Peebles/DAY Checked by: Checked by: Martha White/ATL

Appendix I
Ecological Risk Screening Tables

TABLE I-1

ERS Surface Soil Screening for CTO-0014 UXO-11

MCB Camp Lejeune, North Carolina

Chemical	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Screening Value	Frequency of Exceedance[1]	Maximum Hazard Quotient	Arithmetic Mean Concentration	Mean Hazard Quotient	2 x Mean Background	Maximum Exceeds 2 x Mean Background?	Supplemental Screening Value	Supplemental Screening Value Source	Supplemental Screening Value Maximum HQ	Retain?	Rationale
Semivolatile Organic Compounds (UG/KG)																
2,4-Dinitrotoluene	190 - 190	0 / 12	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	--	--	No	Not detected
2,6-Dinitrotoluene	190 - 190	0 / 12	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	--	--	No	Not detected
Nitrobenzene	190 - 190	0 / 12	--	--	40,000	-- / --	0.0048	95.0	0.0024	--	--	--	--	--	No	HQ less than one, not detected
Explosives (UG/KG)																
1,3,5-Trinitrobenzene	190 - 190	0 / 12	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	--	--	No	Not detected
1,3-Dinitrobenzene	190 - 190	0 / 12	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	--	--	No	Not detected
2,4,6-Trinitrotoluene	190 - 190	0 / 12	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	--	--	No	Not detected
2-Amino-4,6-dinitrotoluene	190 - 190	3 / 12	430	MR11-DU02-SS02-09D	NSV	-- / --	NSV	137	NSV	--	--	80,000	Talmage et al., 1999	0.005375	No	Supplemental HQ less than one
2-Nitrotoluene	190 - 190	0 / 12	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	--	--	No	Not detected
3-Nitrotoluene	190 - 190	0 / 12	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	--	--	No	Not detected
4-Amino-2,6-dinitrotoluene	190 - 190	0 / 12	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	--	--	No	Not detected
4-Nitrotoluene	190 - 190	0 / 12	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	--	--	No	Not detected
HMX	190 - 190	0 / 12	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	--	--	No	Not detected
Nitroglycerin	640 - 640	1 / 12	920	MR11-DU03-SS02-09D	NSV	-- / --	NSV	370	NSV	--	--	2,400	NRCC, 2008	0.38	No	Supplemental HQ less than one
Perchlorate	2.64 - 3.72	0 / 12	--	--	NSV	-- / --	NSV	1.45	NSV	--	--	--	--	--	No	Not detected
PETN	640 - 640	0 / 12	--	--	NSV	-- / --	NSV	320	NSV	--	--	--	--	--	No	Not detected
RDX	190 - 190	1 / 12	290	MR11-DU03-SS02-09D	NSV	-- / --	NSV	111	NSV	--	--	400	NRCC, 2008	0.73	No	Supplemental HQ less than one
Tetryl	190 - 190	2 / 12	200	MR11-DU04-SS02-09D	NSV	-- / --	NSV	111	NSV	--	--	25,000	Talmage et al., 1999	0.01	No	Supplemental HQ less than one
Inorganics (MG/KG)																
Aluminum	-- - --	12 / 12	6,750	MR11-DU04-SS02-09D	50.0	12 / 12	135	4,934	98.6833	5487	Yes	--	--	--	No	Within range of background
Antimony	0.97 - 1.37	0 / 12	--	--	0.27	-- / --	5.07	0.53	1.9764	0.447	--	--	--	--	No	Not detected
Arsenic	-- - --	12 / 12	1.19	MR11-DU04-SS02-09D	18.0	0 / 12	0.066	1.05	0.0582	0.626	Yes	--	--	--	No	HQ less than one, detected
Barium	-- - --	12 / 12	19.4	MR11-DU04-SS02-09D	330	0 / 12	0.059	16.3	0.0494	14.5	Yes	--	--	--	No	HQ less than one, detected
Beryllium	0.33 - 0.46	9 / 12	0.13	MR11-DU04-SS02-09D	21.0	0 / 12	0.0063	0.12	0.0056	0.103	Yes	--	--	--	No	HQ less than one, detected
Cadmium	0.32 - 0.46	2 / 12	0.40	MR11-DU04-SS03-09D	0.36	2 / 12	1.12	0.22	0.5998	0.033	Yes	--	--	--	No	Mean HQ less than one
Calcium [2]	-- - --	12 / 12	56,500	MR11-DU04-SS01-09D	NSV	-- / --	NSV	24,894	NSV	6360	Yes	--	--	--	No	Macronutrient
Chromium	-- - --	12 / 12	9.90	MR11-DU04-SS02-09D	26.0	0 / 12	0.38	6.50	0.2500	6.05	Yes	--	--	--	No	HQ less than one, detected
Cobalt	0.81 - 1.14	2 / 12	0.40	MR11-DU04-SS02-09D	13.0	0 / 12	0.031	0.43	0.0334	0.294	Yes	--	--	--	No	HQ less than one, detected
Copper	-- - --	12 / 12	5.78	MR11-DU01-SS03-09D	28.0	0 / 12	0.21	3.85	0.1376	4.83	Yes	--	--	--	No	HQ less than one, detected
Cyanide	0.33 - 0.47	5 / 12	0.65	MR11-DU02-SS02-09D	0.9	-- / --	0.72	0.23	0.2591	--	--	--	--	--	No	HQ less than one, detected
Iron	-- - --	12 / 12	2,280	MR11-DU04-SS02-09D	200	12 / 12	11.4	1,857	9.2833	3245	No	--	--	--	No	Consistent with background
Lead	-- - --	12 / 12	25.4	MR11-DU04-SS02-09D	11.0	11 / 12	2.31	15.3	1.3886	12.3	Yes	--	--	--	No	Within range of background
Magnesium [2]	-- - --	12 / 12	1,160	MR11-DU04-SS01-09D	NSV	-- / --	NSV	752	NSV	238	Yes	--	--	--	No	Macronutrient
Manganese	-- - --	12 / 12	23.6	MR11-DU03-SS03-09D	220	0 / 12	0.11	19.2	0.0871	13.7	Yes	--	--	--	No	HQ less than one, detected
Mercury	-- - --	12 / 12	0.044	MR11-DU04-SS02-09D	0.10	0 / 12	0.44	0.030	0.3035	0.081	No	--	--	--	No	HQ less than one, detected
Nickel	-- - --	12 / 12	1.94	MR11-DU04-SS02-09D	38.0	0 / 12	0.051	1.32	0.0347	1.21	Yes	--	--	--	No	HQ less than one, detected
Potassium [2]	-- - --	12 / 12	284	MR11-DU04-SS02-09D	NSV	-- / --	NSV	236	NSV	116	Yes	--	--	--	No	Macronutrient
Selenium	0.35 - 0.71	0 / 12	--	--	0.52	-- / --	1.37	0.26	0.5014	0.563	--	--	--	--	No	Not detected
Silver	0.32 - 0.46	0 / 12	--	--	4.20	-- / --	0.11	0.18	0.0423	0.14	--	--	--	--	No	HQ less than one, not detected
Sodium [2]	322 - 455	3 / 12	115	MR11-DU04-SS01-09D	NSV	-- / --	NSV	159	NSV	80.9	Yes	--	--	--	No	Macronutrient
Thallium	0.52 - 0.73	0 / 12	--	--	1.00	-- / --	0.73	0.28	0.2846	0.36	--	--	--	--	No	HQ less than one, not detected
Vanadium	-- - --	12 / 12	8.48	MR11-DU04-SS02-09D	7.80	1 / 12	1.09	6.46	0.8287	8.9	No	--	--	--	No	Consistent with background
Zinc	-- - --	12 / 12	41.4	MR11-DU03-SS03-09D	46.0	0 / 12	0.90	23.3	0.5071	10.8	Yes	--	--	--	No	HQ less than one, detected

NOTES

1 - Count of detected samples exceeding or equaling Screening Value

2 - Macronutrient - Not considered to be a COPC

HQ - Hazard Quotient

NSV - No Screening Value

MG/KG - Milligrams per kilogram

UG/KG - Micrograms per kilogram

Generated by: Sara Kent

Checked by: Kelly Taylor

TABLE I-2
ERS Subsurface Soil Screen for CTO-0014 UXO-11
MCB Camp Lejeune, North Carolina

Chemical	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Screening Value	Frequency of Exceedance[1]	Maximum Hazard Quotient	Arithmetic Mean Concentration	Mean Hazard Quotient	2 x Mean Background	Maximum Exceeds 2 x Mean Background?	Supplemental Screening Value	Supplemental Screening Value Source	Supplemental Screening Value Maximum HQ	Retain?	Rationale
Semivolatile Organic Compounds (UG/KG)																
2,4-Dinitrotoluene	190 - 190	0 / 5	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	--	--	No	Not detected
2,6-Dinitrotoluene	190 - 190	0 / 5	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	--	--	No	Not detected
Nitrobenzene	190 - 190	0 / 5	--	--	40,000	-- / --	0.0048	95.0	0.0024	--	--	--	--	--	No	HQ less than one, not detected
Explosives (UG/KG)																
1,3,5-Trinitrobenzene	190 - 190	0 / 5	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	--	--	No	Not detected
1,3-Dinitrobenzene	190 - 190	0 / 5	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	--	--	No	Not detected
2,4,6-Trinitrotoluene	190 - 190	0 / 5	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	--	--	No	Not detected
2-Amino-4,6-dinitrotoluene	190 - 190	0 / 5	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	--	--	No	Not detected
2-Nitrotoluene	190 - 190	0 / 5	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	--	--	No	Not detected
3-Nitrotoluene	190 - 190	0 / 5	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	--	--	No	Not detected
4-Amino-2,6-dinitrotoluene	190 - 190	0 / 5	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	--	--	No	Not detected
4-Nitrotoluene	190 - 190	0 / 5	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	--	--	No	Not detected
HMX	190 - 190	0 / 5	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	--	--	No	Not detected
Nitroglycerin	640 - 640	0 / 5	--	--	NSV	-- / --	NSV	320	NSV	--	--	--	--	--	No	Not detected
Perchlorate [2]	2.31 - 2.39	2 / 5	5.05	MR11-IS03-2-3-09D	NSV	-- / --	NSV	2.20	NSV	--	--	4,450	Callahan and Sprenger,1998/100	1.135E-03	No	Supplemental HQ less than one
PETN	640 - 640	0 / 5	--	--	NSV	-- / --	NSV	320	NSV	--	--	--	--	--	No	Not detected
RDX	-- - --	5 / 5	440	MR11-IS01-2-3-09D	NSV	-- / --	NSV	323	NSV	--	--	500	NRCC, 2008	0.880	No	Supplemental HQ less than one
Tetryl	190 - 190	0 / 5	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	--	--	No	Not detected
Inorganics (MG/KG)																
Aluminum	-- - --	5 / 5	13,600	MR11-IS03-2-3-09D	50.0	5 / 5	272	10,090	201.8000	10,369	Yes	--	--	--	No	Within range of background
Antimony	0.85 - 0.94	0 / 5	--	--	0.27	-- / --	3.48	0.44	1.6326	0.360	--	--	--	--	No	Not detected
Arsenic	-- - --	5 / 5	1.40	MR11-IS03-2-3-09D	18.0	0 / 5	0.078	0.87	0.0485	2.12	No	--	--	--	No	HQ less than one, detected
Barium	-- - --	5 / 5	33.4	MR11-IS03-2-3-09D	330	0 / 5	0.10	18.4	0.0559	16.56	Yes	--	--	--	No	HQ less than one, detected
Beryllium	-- - --	5 / 5	0.21	MR11-IS03-2-3-09D	21.0	0 / 5	0.0100	0.13	0.0062	0.1652	Yes	--	--	--	No	HQ less than one, detected
Cadmium	0.28 - 0.31	0 / 5	--	--	0.36	-- / --	0.87	0.15	0.4083	0.023	--	--	--	--	No	HQ less than one, not detected
Calcium [3]	-- - --	5 / 5	2,180	MR11-IS03-2-3-09D	NSV	-- / --	NSV	563	NSV	441	Yes	--	--	--	No	Macronutrient
Chromium	-- - --	5 / 5	16.0	MR11-IS03-2-3-09D	26.0	0 / 5	0.62	10.0	0.3858	14.49	Yes	--	--	--	No	HQ less than one, detected
Cobalt	0.73 - 0.73	4 / 5	0.63	MR11-IS03-2-3-09D	13.0	0 / 5	0.048	0.45	0.0343	0.822	No	--	--	--	No	HQ less than one, detected
Copper	0.58 - 0.58	4 / 5	0.53	MR11-IS01-2-3-09D	28.0	0 / 5	0.019	0.42	0.0150	2.56	No	--	--	--	No	HQ less than one, detected
Cyanide	0.29 - 0.32	0 / 5	--	--	NSV	-- / --	NSV	0.15	NSV	--	--	--	--	--	No	Not detected
Iron	-- - --	5 / 5	6,920	MR11-IS04-2-3-09D	200	5 / 5	34.6	3,654	18.2700	5,439	Yes	--	--	--	No	Within range of background
Lead	-- - --	5 / 5	6.74	MR11-IS03-2-3-09D	11.0	0 / 5	0.61	5.25	0.4771	8.49	No	--	--	--	No	HQ less than one, detected
Magnesium [3]	-- - --	5 / 5	666	MR11-IS03-2-3-09D	NSV	-- / --	NSV	408	NSV	363	Yes	--	--	--	No	Macronutrient
Manganese	-- - --	5 / 5	5.97	MR11-IS03-2-3-09D	220	0 / 5	0.027	4.36	0.0198	9.25	No	--	--	--	No	HQ less than one, detected
Mercury	0.033 - 0.041	2 / 5	0.024	MR11-IS03-2-3-09D	0.10	0 / 5	0.24	0.019	0.1891	0.0710	No	--	--	--	No	HQ less than one, detected
Nickel	-- - --	5 / 5	1.99	MR11-IS03-2-3-09D	38.0	0 / 5	0.052	1.38	0.0363	2.27	No	--	--	--	No	HQ less than one, detected
Potassium [3]	-- - --	5 / 5	282	MR11-IS03-2-3-09D	NSV	-- / --	NSV	185	NSV	361	No	--	--	--	No	Macronutrient
Selenium	0.29 - 0.29	4 / 5	0.35	MR11-IS03-2-3-09D	0.52	0 / 5	0.68	0.25	0.4715	0.505	No	--	--	--	No	HQ less than one, detected
Silver	0.28 - 0.31	0 / 5	--	--	4.20	-- / --	0.075	0.15	0.0350	0.129	--	--	--	--	No	HQ less than one, detected
Sodium [3]	283 - 313	0 / 5	--	--	NSV	-- / --	NSV	147	NSV	68.3	--	--	--	--	No	Macronutrient
Thallium	0.45 - 0.50	0 / 5	--	--	1.00	-- / --	0.50	0.24	0.2350	0.380	--	--	--	--	No	HQ less than one, detected
Vanadium	-- - --	5 / 5	16.2	MR11-IS03-2-3-09D	7.80	4 / 5	2.08	11.5	1.4697	17.21	No	--	--	--	No	Within range of background
Zinc	-- - --	5 / 5	5.26	MR11-IS03-2-3-09D	46.0	0 / 5	0.11	3.28	0.0712	6.59	No	--	--	--	No	HQ less than one, detected

NOTES
1 - Count of detected samples exceeding or equaling Screening Value
2 - Divided supplemental value by 100 to convert from acute to chronic value
3 - Macronutrient - Not considered to be a contaminant of potential concern (COPC)
NSV - No Screening Value
MG/KG - Milligrams per kilogram
UG/KG - Micrograms per kilogram
Generated by: Sara Kent
Checked by: Kelly Taylor

TABLE I-3

ERS Sediment screen for CTO-0014 UXO-11

MCB Camp Lejeune, North Carolina

Chemical	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Screening Value	Frequency of Exceedance[1]	Maximum Hazard Quotient	Arithmetic Mean Concentration	Mean Hazard Quotient	Supplemental Screening Value	Supplemental Screening Value Source	Supplemental Screening Value Maximum HQ	Retain?	Rationale
Semivolatile Organic Compounds (UG/KG)														
2,4-Dinitrotoluene	190 - 190	0 / 2	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	No	Not detected
2,6-Dinitrotoluene	190 - 190	0 / 2	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	No	Not detected
Nitrobenzene	190 - 190	0 / 2	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	No	Not detected
Explosives (UG/KG)														
1,3,5-Trinitrobenzene	190 - 190	0 / 2	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	No	Not detected
1,3-Dinitrobenzene	190 - 190	0 / 2	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	No	Not detected
2,4,6-Trinitrotoluene	190 - 190	0 / 2	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	No	Not detected
2-Amino-4,6-dinitrotoluene	190 - 190	0 / 2	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	No	Not detected
2-Nitrotoluene	190 - 190	0 / 2	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	No	Not detected
3-Nitrotoluene	190 - 190	0 / 2	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	No	Not detected
4-Amino-2,6-dinitrotoluene	190 - 190	0 / 2	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	No	Not detected
4-Nitrotoluene	190 - 190	0 / 2	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	No	Not detected
HMX	190 - 190	0 / 2	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	No	Not detected
Nitroglycerin	640 - 640	0 / 2	--	--	NSV	-- / --	NSV	320	NSV	--	--	--	No	Not detected
Perchlorate	3.20 - 3.35	0 / 2	--	--	NSV	-- / --	NSV	1.64	NSV	--	--	--	No	Not detected
PETN	640 - 640	0 / 2	--	--	NSV	-- / --	NSV	320	NSV	--	--	--	No	Not detected
RDX	190 - 190	0 / 2	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	No	Not detected
Tetryl	190 - 190	0 / 2	--	--	NSV	-- / --	NSV	95.0	NSV	--	--	--	No	Not detected
Inorganics (MG/KG)														
Aluminum	-- - --	2 / 2	10,300	MR11-SD01-09D	NSV	-- / --	NSV	9,665	NSV	25,500	Ingersoll et al., 1996	0.40	No	Supplemental HQ less than one
Antimony	1.22 - 1.22	0 / 2	--	--	2.00	-- / --	0.61	0.61	0.31	--	--	--	No	HQ less than one, not detected
Arsenic	-- - --	2 / 2	1.55	MR11-SD01-09D	7.24	0 / 2	0.21	1.32	0.18	--	--	--	No	HQ less than one, detected
Barium	-- - --	2 / 2	42.7	MR11-SD01-09D	NSV	-- / --	NSV	33.1	NSV	--	--	--	No	See text for discussion
Beryllium	-- - --	2 / 2	0.22	MR11-SD01-09D	NSV	-- / --	NSV	0.20	NSV	--	--	--	No	See text for discussion
Cadmium	0.49 - 0.72	0 / 2	--	--	0.68	-- / --	1.06	0.30	0.44	--	--	--	No	Not detected
Calcium [2]	-- - --	2 / 2	36,800	MR11-SD02-09D	NSV	-- / --	NSV	28,500	NSV	--	--	--	No	Macronutrient
Chromium	-- - --	2 / 2	17.8	MR11-SD01-09D	52.3	0 / 2	0.34	17.2	0.33	--	--	--	No	HQ less than one, detected
Cobalt	-- - --	2 / 2	0.72	MR11-SD02-09D	NSV	-- / --	NSV	0.70	NSV	50	Persaud et al., 1993	0.01	No	Supplemental HQ less than one
Copper	-- - --	2 / 2	15.2	MR11-SD02-09D	18.7	0 / 2	0.81	10.3	0.55	--	--	--	No	HQ less than one, detected
Cyanide	0.40 - 0.42	0 / 2	--	--	NSV	-- / --	NSV	0.20	NSV	--	--	--	No	Not detected
Iron	-- - --	2 / 2	3,340	MR11-SD02-09D	NSV	-- / --	NSV	3,285	NSV	20,000	Persaud et al., 1993	0.17	No	Supplemental HQ less than one
Lead	-- - --	2 / 2	87.8	MR11-SD01-09D	30.2	2 / 2	2.91	70.5	2.33	--	--	--	No	See text for discussion
Magnesium [2]	-- - --	2 / 2	1,080	MR11-SD02-09D	NSV	-- / --	NSV	950	NSV	--	--	--	No	Macronutrient
Manganese	-- - --	2 / 2	18.5	MR11-SD02-09D	NSV	-- / --	NSV	17.9	NSV	460	Persaud et al., 1993	0.04	No	Supplemental HQ less than one
Mercury	-- - --	2 / 2	0.053	MR11-SD02-09D	0.13	0 / 2	0.41	0.051	0.39	--	--	--	No	HQ less than one, detected
Nickel	-- - --	2 / 2	3.29	MR11-SD02-09D	15.9	0 / 2	0.21	2.88	0.18	--	--	--	No	HQ less than one, detected
Potassium [2]	-- - --	2 / 2	418	MR11-SD02-09D	NSV	-- / --	NSV	369	NSV	--	--	--	No	Macronutrient
Selenium	1.04 - 1.05	0 / 2	--	--	NSV	-- / --	NSV	0.52	NSV	--	--	--	No	Not detected
Silver	0.41 - 0.41	0 / 2	--	--	0.73	-- / --	0.55	0.20	0.28	--	--	--	No	HQ less than one, not detected
Sodium [2]	405 - 406	0 / 2	--	--	NSV	-- / --	NSV	203	NSV	--	--	--	No	Not detected
Thallium	0.65 - 0.65	0 / 2	--	--	NSV	-- / --	NSV	0.32	NSV	--	--	--	No	Not detected
Vanadium	-- - --	2 / 2	13.7	MR11-SD01-09D	NSV	-- / --	NSV	12.8	NSV	--	--	--	No	See text for discussion
Zinc	-- - --	2 / 2	183	MR11-SD02-09D	124	1 / 2	1.48	110	0.89	--	--	--	No	Mean HQ less than one

NOTES

1 - Count of detected samples exceeding or equaling Screening Value

2 - Macronutrient - Not considered to be a contaminant of potential concern (COPC)

HQ - Hazard Quotient

NSV - No Screening Value

MG/KG - Milligrams per kilogram

UG/KG - Micrograms per kilogram

Generated by: Sara Kent

Checked by: Kelly Taylor

TABLE I-4
ERS Surface Water screen for CTO-0014 UXO-11
MCB Camp Lejeune, North Carolina

Chemical	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Screening Value	Frequency of Exceedance[1]	Maximum Hazard Quotient	Arithmetic Mean Concentration	Mean Hazard Quotient	Supplemental Screening Value	Supplemental Screening Value Source	Supplemental Screening Value Maximum HQ	Retain?	Rationale
Semivolatile Organic Compounds (UG/L)														
2,4-Dinitrotoluene	0.14 - 0.14	0 / 2	--	--	NSV	-- / --	NSV	0.070	NSV	--	--	--	No	Not detected
2,6-Dinitrotoluene	0.14 - 0.14	0 / 2	--	--	NSV	-- / --	NSV	0.070	NSV	--	--	--	No	Not detected
Nitrobenzene	-- - --	2 / 2	0.16	MR11-SW01-09D	270	0 / 2	5.93E-04	0.13	4.70E-04	--	--	--	No	HQ less than one, detected
Explosives (UG/L)														
1,3,5-Trinitrobenzene	0.14 - 0.14	0 / 2	--	--	NSV	-- / --	NSV	0.070	NSV	--	--	--	No	Not detected
1,3-Dinitrobenzene	0.14 - 0.14	0 / 2	--	--	NSV	-- / --	NSV	0.070	NSV	--	--	--	No	Not detected
2,4,6-Trinitrotoluene	0.14 - 0.14	0 / 2	--	--	NSV	-- / --	NSV	0.070	NSV	--	--	--	No	Not detected
2-Amino-4,6-dinitrotoluene	0.14 - 0.14	0 / 2	--	--	NSV	-- / --	NSV	0.070	NSV	--	--	--	No	Not detected
2-Nitrotoluene	0.14 - 0.14	0 / 2	--	--	NSV	-- / --	NSV	0.070	NSV	--	--	--	No	Not detected
3-Nitrotoluene	0.14 - 0.14	0 / 2	--	--	NSV	-- / --	NSV	0.070	NSV	--	--	--	No	Not detected
4-Amino-2,6-dinitrotoluene	0.14 - 0.14	0 / 2	--	--	NSV	-- / --	NSV	0.070	NSV	--	--	--	No	Not detected
4-Nitrotoluene	0.14 - 0.14	0 / 2	--	--	NSV	-- / --	NSV	0.070	NSV	--	--	--	No	Not detected
HMX	0.14 - 0.14	1 / 2	0.080	MR11-SW01-09D	NSV	-- / --	NSV	0.075	NSV	150	TCEQ, 2006	5.33E-04	No	Supplemental HQ less than one
Nitroglycerin	0.48 - 0.48	0 / 2	--	--	NSV	-- / --	NSV	0.24	NSV	--	--	--	No	Not detected
Perchlorate	0.20 - 0.20	0 / 2	--	--	NSV	-- / --	NSV	0.10	NSV	--	--	--	No	Not detected
PETN	0.48 - 0.48	0 / 2	--	--	NSV	-- / --	NSV	0.24	NSV	--	--	--	No	Not detected
RDX	0.14 - 0.14	0 / 2	--	--	NSV	-- / --	NSV	0.070	NSV	--	--	--	No	Not detected
Tetryl	-- - --	2 / 2	0.34	MR11-SW01-09D	NSV	-- / --	NSV	0.24	NSV	13	Nipper et al., 2001	2.62E-02	No	Supplemental HQ less than one
Inorganics (UG/L)														
Aluminum	-- - --	2 / 2	57.0	MR11-SW01-09D	87.0	0 / 2	0.66	55.0	0.63	--	--	--	No	HQ less than one, detected
Antimony	3.75 - 3.75	0 / 2	--	--	160	-- / --	0.023	1.88	0.012	--	--	--	No	HQ less than one, not detected
Arsenic	1.25 - 1.25	0 / 2	--	--	150	-- / --	0.0083	0.63	0.0042	--	--	--	No	HQ less than one, not detected
Barium	-- - --	2 / 2	3.69	MR11-SW01-09D	NSV	-- / --	NSV	3.42	NSV	16,000	TCEQ, 2006	2.31E-04	No	Supplemental HQ less than one
Beryllium	1.25 - 1.25	0 / 2	--	--	0.53	-- / --	2.36	0.63	1.18	--	--	--	No	Not detected
Cadmium	-- - --	2 / 2	0.34	MR11-SW01-09D	0.25	2 / 2	1.38	0.33	1.34	--	--	--	No	Low magnitude of exceedance; drainage swale not aquatic habitat
Calcium [3]	-- - --	2 / 2	11,000	MR11-SW01-09D	NSV	-- / --	NSV	10,235	NSV	--	--	--	No	Macronutrient
Chromium	1.25 - 1.25	0 / 2	--	--	117	-- / --	0.011	0.63	0.0053	--	--	--	No	HQ less than one, not detected
Cobalt	3.12 - 3.12	0 / 2	--	--	NSV	-- / --	NSV	1.56	NSV	--	--	--	No	Not detected
Copper	2.50 - 2.50	0 / 2	--	--	9.00	-- / --	0.28	1.25	0.14	--	--	--	No	HQ less than one, not detected
Cyanide	10.0 - 10.0	0 / 2	--	--	NSV	-- / --	NSV	5.00	NSV	--	--	--	No	Not detected
Iron	-- - --	2 / 2	24.9	MR11-SW02-09D	1,000	0 / 2	0.025	23.8	0.024	--	--	--	No	HQ less than one, detected
Lead	0.75 - 0.75	0 / 2	--	--	25.0	-- / --	0.030	0.38	0.015	--	--	--	No	HQ less than one, not detected
Magnesium [3]	-- - --	2 / 2	2,030	MR11-SW01-09D	NSV	-- / --	NSV	1,870	NSV	--	--	--	No	Macronutrient
Manganese	3.75 - 3.75	1 / 2	0.92	MR11-SW01-09D	NSV	-- / --	NSV	1.40	NSV	120	Suter and Tsao, 1996	7.65E-03	No	Supplemental HQ less than one
Mercury	0.20 - 0.20	0 / 2	--	--	0.77	-- / --	0.26	0.10	0.13	--	--	--	No	HQ less than one, not detected
Nickel	2.50 - 2.50	0 / 2	--	--	52.0	-- / --	0.048	1.25	0.024	--	--	--	No	HQ less than one, not detected
Potassium [3]	-- - --	2 / 2	2,270	MR11-SW01-09D	NSV	-- / --	NSV	2,080	NSV	--	--	--	No	Macronutrient
Selenium	1.25 - 1.25	0 / 2	--	--	5.00	-- / --	0.25	0.63	0.13	--	--	--	No	HQ less than one, not detected
Silver	1.25 - 1.25	0 / 2	--	--	0.012	-- / --	104	0.63	52.1	--	--	--	No	Not detected
Sodium [3]	-- - --	2 / 2	1,220	MR11-SW01-09D	NSV	-- / --	NSV	1,115	NSV	--	--	--	No	Macronutrient
Thallium	2.00 - 2.00	0 / 2	--	--	4.00	-- / --	0.50	1.00	0.25	--	--	--	No	HQ less than one, not detected
Vanadium	3.12 - 3.12	0 / 2	--	--	NSV	-- / --	NSV	1.56	NSV	--	--	--	No	Not detected
Zinc	-- - --	2 / 2	2.44	MR11-SW01-09D	120	0 / 2	0.020	2.23	0.019	--	--	--	No	HQ less than one, detected

TABLE I-4
ERS Surface Water screen for CTO-0014 UXO-11
MCB Camp Lejeune, North Carolina

Chemical	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Screening Value	Frequency of Exceedance[1]	Maximum Hazard Quotient	Arithmetic Mean Concentration	Mean Hazard Quotient	Supplemental Screening Value	Supplemental Screening Value Source	Supplemental Screening Value Maximum HQ	Retain?	Rationale
Dissolved Inorganics (UG/L)														
Aluminum, Dissolved	-- - --	2 / 2	38.3	MR11-SW01-09D	87.0	0 / 2	0.44	37.2	0.43	--	--	--	No	HQ less than one, detected
Antimony, Dissolved	3.75 - 3.75	0 / 2	--	--	160	-- / --	0.023	1.88	0.012	--	--	--	No	HQ less than one, not detected
Arsenic, Dissolved	1.25 - 1.25	0 / 2	--	--	150	-- / --	0.0083	0.63	0.0042	--	--	--	No	HQ less than one, not detected
Barium, Dissolved	-- - --	2 / 2	4.02	MR11-SW01-09D	NSV	-- / --	NSV	3.64	NSV	16,000	TCEQ, 2006	2.51E-04	No	Supplemental HQ less than one
Beryllium, Dissolved	1.25 - 1.25	0 / 2	--	--	0.53	-- / --	2.36	0.63	1.18	--	--	--	No	Not detected
Cadmium, Dissolved	-- - --	2 / 2	0.36	MR11-SW01-09D	0.25	2 / 2	1.45	0.34	1.38	--	--	--	No	Low magnitude of exceedance; drainage swale not aquatic habitat
Calcium, Dissolved [2]	-- - --	2 / 2	11,600	MR11-SW01-09D	NSV	-- / --	NSV	10,800	NSV	--	--	--	No	Macronutrient
Chromium, Dissolved	1.25 - 1.25	0 / 2	--	--	117	-- / --	0.011	0.63	0.0053	--	--	--	No	HQ less than one, not detected
Cobalt, Dissolved	3.12 - 3.12	0 / 2	--	--	NSV	-- / --	NSV	1.56	NSV	--	--	--	No	Not detected
Copper, Dissolved	2.50 - 2.50	1 / 2	4.11	MR11-SW01-09D	9.00	0 / 2	0.46	2.68	0.61	--	--	--	No	HQ less than one, detected
Iron, Dissolved	25.0 - 25.0	0 / 2	--	--	NSV	-- / --	NSV	12.5	NSV	--	--	--	No	Not detected
Lead, Dissolved	0.75 - 0.75	0 / 2	--	--	25.0	-- / --	0.030	0.38	0.015	--	--	--	No	HQ less than one, not detected
Magnesium, Dissolved [2]	-- - --	2 / 2	2,100	MR11-SW01-09D	NSV	-- / --	NSV	1,925	NSV	--	--	--	No	Macronutrient
Manganese, Dissolved	3.75 - 3.75	0 / 2	--	--	NSV	-- / --	NSV	1.88	NSV	--	--	--	No	Not detected
Mercury, Dissolved	0.20 - 0.20	0 / 2	--	--	0.77	-- / --	0.26	0.10	0.13	--	--	--	No	HQ less than one, not detected
Nickel, Dissolved	2.50 - 2.50	0 / 2	--	--	52.0	-- / --	0.048	1.25	0.024	--	--	--	No	HQ less than one, not detected
Potassium, Dissolved [2]	-- - --	2 / 2	2,340	MR11-SW01-09D	NSV	-- / --	NSV	2,135	NSV	--	--	--	No	Macronutrient
Selenium, Dissolved	1.25 - 1.25	0 / 2	--	--	5.00	-- / --	0.25	0.63	0.13	--	--	--	No	HQ less than one, not detected
Silver, Dissolved	1.25 - 1.25	0 / 2	--	--	0.012	-- / --	104	0.63	52.1	--	--	--	No	Not detected
Sodium, Dissolved [2]	-- - --	2 / 2	1,480	MR11-SW01-09D	NSV	-- / --	NSV	1,315	NSV	--	--	--	No	Macronutrient
Thallium, Dissolved	2.00 - 2.00	0 / 2	--	--	4.00	-- / --	0.50	1.00	0.25	--	--	--	No	HQ less than one, not detected
Vanadium, Dissolved	3.12 - 3.12	0 / 2	--	--	NSV	-- / --	NSV	1.56	NSV	--	--	--	No	Not detected
Zinc, Dissolved	-- - --	2 / 2	5.19	MR11-SW01-09D	120	0 / 2	0.043	3.86	0.032	--	--	--	No	HQ less than one, detected

NOTES
1 - Count of detected samples exceeding or equaling Screening Value
2 - Macronutrient - Not considered to be a COPC
HQ - Hazard Quotient
NSV - No Screening Value
UG/L - Micrograms per liter
Generated by: Sara Kent
Checked by: Kelly Taylor

TABLE I-5
ERS Groundwater screen for CTO-0014 UXO-11
MCB Camp Lejeune, North Carolina

Chemical	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Screening Value[1]	Frequency of Exceedance[2]	Maximum Hazard Quotient	Arithmetic Mean Concentration	Mean Hazard Quotient	2 x Mean Background	Maximum Exceeds 2 x Mean Background?	Supplemental Screening Value	Supplemental Screening Value Source	Supplemental Screening Value Maximum HQ	Retain?	Rationale
Semivolatile Organic Compounds (UG/L)																
2,4-Dinitrotoluene	0.15 - 0.15	0 / 5	--	--	NSV	-- / --	NSV	0.075	NSV	--	--	--	--	--	No	Not detected
2,6-Dinitrotoluene	0.15 - 0.15	0 / 5	--	--	NSV	-- / --	NSV	0.075	NSV	--	--	--	--	--	No	Not detected
Nitrobenzene	0.15 - 0.15	4 / 5	0.48	MR11-TW02-09D	30.0	0 / 5	0.016	0.18	0.0061	--	--	--	--	--	No	HQ less than one, detected
Explosives (UG/L)																
1,3,5-Trinitrobenzene	0.15 - 0.15	2 / 5	0.086	MR11-TW04-09D	NSV	-- / --	NSV	0.077	NSV	--	--	5,000	Kuperman et al., 2006	1.72E-05	No	Supplemental HQ less than one
1,3-Dinitrobenzene	0.15 - 0.15	3 / 5	0.12	MR11-TW02-09D	NSV	-- / --	NSV	0.078	NSV	--	--	72	TCEQ, 2006	1.67E-03	No	Supplemental HQ less than one
2,4,6-Trinitrotoluene	0.15 - 0.15	1 / 5	0.053	MR11-TW03-09D	NSV	-- / --	NSV	0.071	NSV	--	--	50	TCEQ, 2006	1.06E-03	No	Supplemental HQ less than one
2-Amino-4,6-dinitrotoluene	0.15 - 0.15	0 / 5	--	--	NSV	-- / --	NSV	0.075	NSV	--	--	--	--	--	No	Not detected
2-Nitrotoluene	0.15 - 0.15	1 / 5	0.064	MR11-TW03-09D	NSV	-- / --	NSV	0.073	NSV	--	--	440	TCEQ, 2006	1.45E-04	No	Supplemental HQ less than one
3-Nitrotoluene	0.15 - 0.15	2 / 5	0.15	MR11-TW04-09D	NSV	-- / --	NSV	0.099	NSV	--	--	375	TCEQ, 2006	4.00E-04	No	Supplemental HQ less than one
4-Amino-2,6-dinitrotoluene	0.15 - 0.15	0 / 5	--	--	NSV	-- / --	NSV	0.075	NSV	--	--	--	--	--	No	Not detected
4-Nitrotoluene	0.15 - 0.15	4 / 5	0.41	MR11-TW03-09D	NSV	-- / --	NSV	0.17	NSV	--	--	950	TCEQ, 2006	4.32E-04	No	Supplemental HQ less than one
HMX	0.15 - 0.15	0 / 5	--	--	NSV	-- / --	NSV	0.075	NSV	--	--	--	--	--	No	Not detected
Nitroglycerin	0.50 - 0.51	1 / 5	0.22	MR11-TW03-09D	NSV	-- / --	NSV	0.25	NSV	--	--	69	TCEQ, 2006	3.19E-03	No	Supplemental HQ less than one
Perchlorate	0.20 - 0.20	3 / 5	0.38	MR11-TW02-09D	NSV	-- / --	NSV	0.17	NSV	--	--	9300	Dean et al., 2004	4.12E-05	No	Supplemental HQ less than one
PETN	0.50 - 0.51	0 / 5	--	--	NSV	-- / --	NSV	0.25	NSV	--	--	--	--	--	No	Not detected
RDX	0.15 - 0.15	1 / 5	0.10	MR11-TW03-09D	NSV	-- / --	NSV	0.080	NSV	--	--	180	TCEQ, 2006	5.56E-04	No	Supplemental HQ less than one
Tetryl	0.15 - 0.15	0 / 5	--	--	NSV	-- / --	NSV	0.075	NSV	--	--	--	--	--	No	Not detected
Inorganics (UG/L)																
Aluminum	-- - --	5 / 5	531	MR11-TW04-09D	87.0	5 / 5	6.10	420	4.8276	1886	No	--	--	--	No	Consistent with of background
Antimony	3.75 - 3.75	0 / 5	--	--	160	-- / --	0.023	1.88	0.0117	3.28	Yes	--	--	--	No	HQ less than one, not detected
Arsenic	1.25 - 1.25	4 / 5	2.36	MR11-TW04-09D	36.0	0 / 5	0.066	1.50	0.0417	5.77	No	--	--	--	No	HQ less than one, detected
Barium	-- - --	5 / 5	49.4	MR11-TW04-09D	NSV	-- / --	NSV	28.2	NSV	86.20	No	16,000	TCEQ, 2006	3.09E-03	No	Supplemental HQ less than one, consistent with background
Beryllium	1.25 - 1.25	2 / 5	0.66	MR11-TW01-09D	0.53	2 / 5	1.25	0.62	1.1604	0.31	Yes	--	--	--	No	Low magnitude of exceedance
Cadmium	1.25 - 1.25	3 / 5	0.64	MR11-TW02-09D	0.25	3 / 5	2.57	0.49	1.9744	0.36	Yes	--	--	--	No	Not detected in filtered sample
Calcium [3]	-- - --	5 / 5	97,800	MR11-TW03-09D	NSV	-- / --	NSV	48,122	NSV	69078	Yes	--	--	--	No	Macronutrient
Chromium	-- - --	5 / 5	2.39	MR11-TW03-09D	50.0	0 / 5	0.048	1.50	0.0299	3.13	No	--	--	--	No	HQ less than one, detected
Cobalt	3.12 - 3.12	2 / 5	4.30	MR11-TW04-09D	NSV	-- / --	NSV	2.09	NSV	3.40	Yes	1,500	TCEQ, 2006	2.87E-03	No	Supplemental HQ less than one
Copper	2.50 - 2.50	0 / 5	--	--	3.10	-- / --	0.81	1.25	0.4032	2.76	Yes	--	--	--	No	HQ less than one, not detected
Iron	-- - --	5 / 5	2,340	MR11-TW03-09D	1,000	2 / 5	2.34	927	0.9270	5999	No	--	--	--	No	Mean HQ less than one, consistent with background
Lead	0.75 - 0.75	0 / 5	--	--	8.10	-- / --	0.093	0.38	0.0463	2.80	Yes	--	--	--	No	HQ less than one, not detected
Magnesium [3]	-- - --	5 / 5	2,030	MR11-TW03-09D	NSV	-- / --	NSV	1,243	NSV	6363	No	--	--	--	No	Macronutrient
Manganese	-- - --	5 / 5	22.0	MR11-TW03-09D	NSV	-- / --	NSV	14.7	NSV	214	No	120	Suter and Tsao, 1996	0.183	No	Supplemental HQ less than one, consistent with background
Mercury	0.20 - 0.20	0 / 5	--	--	0.77	-- / --	0.26	0.10	0.1299	0.10	Yes	--	--	--	No	HQ less than one, not detected
Nickel	2.50 - 2.50	4 / 5	6.14	MR11-TW04-09D	8.20	0 / 5	0.75	3.24	0.3946	7.97	No	--	--	--	No	HQ less than one, detected
Potassium [3]	1,250 - 1,250	3 / 5	729	MR11-TW04-09D	NSV	-- / --	NSV	577	NSV	3277	No	--	--	--	No	Macronutrient
Selenium	1.25 - 1.25	2 / 5	2.88	MR11-TW02-09D	5.00	0 / 5	0.58	1.18	0.2366	3.14	No	--	--	--	No	HQ less than one, detected
Silver	1.25 - 1.25	0 / 5	--	--	0.012	-- / --	104	0.63	52.0833	0.77	Yes	--	--	--	No	Not detected
Sodium [3]	-- - --	5 / 5	4,980	MR11-TW04-09D	NSV	-- / --	NSV	3,522	NSV	22508	No	--	--	--	No	Macronutrient
Thallium	2.00 - 2.00	0 / 5	--	--	4.00	-- / --	0.50	1.00	0.2500	3.78	Yes	--	--	--	No	HQ less than one, not detected
Vanadium	3.12 - 3.12	4 / 5	4.97	MR11-TW02-09D	NSV	-- / --	NSV	2.95	NSV	4.72	Yes	20	Suter and Tsao, 1996	0.249	No	Supplemental HQ less than one
Zinc	-- - --	5 / 5	42.1	MR11-TW02-09D	81.0	0 / 5	0.52	12.8	0.1575	42.10	No	--	--	--	No	HQ less than one, detected

TABLE I-5
ERS Groundwater screen for CTO-0014 UXO-11
MCB Camp Lejeune, North Carolina

Chemical	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Screening Value[1]	Frequency of Exceedance[2]	Maximum Hazard Quotient	Arithmetic Mean Concentration	Mean Hazard Quotient	2 x Mean Background	Maximum Exceeds 2 x Mean Background?	Supplemental Screening Value	Supplemental Screening Value Source	Supplemental Screening Value Maximum HQ	Retain?	Rationale
Dissolved Metals (UG/L)																
Aluminum, Dissolved	-- - --	1 / 1	325	MR11-TW01-09D-2	87.0	1 / 1	3.74	325	3.7356	1886.00	No	--	--	--	No	Consistent with of background
Antimony, Dissolved	3.75 - 3.75	0 / 1	--	--	160	-- / --	0.023	1.88	0.0117	3.28	Yes	--	--	--	No	HQ less than one, not detected
Arsenic, Dissolved	1.25 - 1.25	0 / 1	--	--	36.0	-- / --	0.035	0.63	0.0174	5.77	Yes	--	--	--	No	HQ less than one, not detected
Barium, Dissolved	-- - --	1 / 1	48.2	MR11-TW01-09D-2	NSV	-- / --	NSV	48.2	NSV	86.20	No	16,000	TCEQ, 2006	3.01E-03	No	Supplemental HQ less than one, consistent with background
Beryllium, Dissolved	-- - --	1 / 1	0.66	MR11-TW01-09D-2	0.53	1 / 1	1.25	0.66	1.2528	0.31	Yes	--	--	--	No	Low magnitude of exceedance
Cadmium, Dissolved	1.25 - 1.25	0 / 1	--	--	0.25	-- / --	5.00	0.63	2.5000	0.36	Yes	--	--	--	No	Not detected
Calcium, Dissolved [3]	-- - --	1 / 1	3,750	MR11-TW01-09D-2	NSV	-- / --	NSV	3,750	NSV	69078.00	No	--	--	--	No	Macronutrient
Chromium, Dissolved	1.25 - 1.25	0 / 1	--	--	50.0	-- / --	0.025	0.63	0.0125	3.13	Yes	--	--	--	No	HQ less than one, not detected
Cobalt, Dissolved	3.12 - 3.12	0 / 1	--	--	NSV	-- / --	NSV	1.56	NSV	3.40	Yes	--	--	--	No	Not detected
Copper, Dissolved	2.50 - 2.50	0 / 1	--	--	3.10	-- / --	0.81	1.25	0.4032	2.76	Yes	--	--	--	No	HQ less than one, not detected
Iron, Dissolved	-- - --	1 / 1	229	MR11-TW01-09D-2	1,000	-- / --	0.23	229	NSV	5999.00	No	--	--	--	No	HQ less than one, detected
Lead, Dissolved	0.75 - 0.75	0 / 1	--	--	8.10	-- / --	0.093	0.38	0.0463	2.80	Yes	--	--	--	No	HQ less than one, not detected
Magnesium, Dissolved [3]	-- - --	1 / 1	895	MR11-TW01-09D-2	NSV	-- / --	NSV	895	NSV	6363.00	No	--	--	--	No	Macronutrient
Manganese, Dissolved	-- - --	1 / 1	5.51	MR11-TW01-09D-2	NSV	-- / --	NSV	5.51	NSV	214.00	No	120	Suter and Tsao, 1996	0.046	No	Supplemental HQ less than one, consistent with background
Mercury, Dissolved	0.20 - 0.20	0 / 1	--	--	0.77	-- / --	0.26	0.10	0.1299	0.10	Yes	--	--	--	No	HQ less than one, not detected
Nickel, Dissolved	-- - --	1 / 1	2.61	MR11-TW01-09D-2	52.0	0 / 1	0.050	2.61	0.0502	7.97	No	--	--	--	No	HQ less than one, detected
Potassium, Dissolved [3]	1,250 - 1,250	0 / 1	--	--	NSV	-- / --	NSV	625	NSV	3277.00	Yes	--	--	--	No	Macronutrient
Selenium, Dissolved	1.25 - 1.25	0 / 1	--	--	5.00	-- / --	0.25	0.63	0.1250	3.14	Yes	--	--	--	No	HQ less than one, not detected
Silver, Dissolved	1.25 - 1.25	0 / 1	--	--	0.012	-- / --	104	0.63	52.0833	0.77	Yes	--	--	--	No	Not detected
Sodium, Dissolved [3]	-- - --	1 / 1	3,160	MR11-TW01-09D-2	NSV	-- / --	NSV	3,160	NSV	22508.00	No	--	--	--	No	Macronutrient
Thallium, Dissolved	2.00 - 2.00	0 / 1	--	--	4.00	-- / --	0.50	1.00	0.2500	3.78	Yes	--	--	--	No	HQ less than one, not detected
Vanadium, Dissolved	3.12 - 3.12	0 / 1	--	--	NSV	-- / --	NSV	1.56	NSV	4.72	Yes	--	--	--	No	Not detected
Zinc, Dissolved	-- - --	1 / 1	8.11	MR11-TW01-09D-2	120	0 / 1	0.068	8.11	0.0676	42.10	No	--	--	--	No	HQ less than one, detected

NOTES
1 - The lowest of the marine and fresh water screening value
2 - Count of detected samples exceeding or equaling Screening Value
3 - Macronutrient - Not considered to be a contaminant of potenital concern (COPC)
HQ - Hazard Quotient
NSV - No Screening Value
UG/L - Micrograms per liter
Generated by: Sara Kent
Checked by: Kelly Taylor