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Final

Focused Site Inspection Work Plan Addendum for Site UXO-06 Base Borrow Pit Expansion

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Prepared for

Department of the Navy

Naval Facilities Engineering Command
Mid-Atlantic Division

Contract No.
N62470-08-D-1000
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August 2009

Prepared by

CH2MHILL

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Charlotte, North Carolina

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Acronyms and Abbreviations

AHA	Activity Hazard Analysis
APP	accident prevention plan
ASR	Archives Search Report
ASTM	American Society for Testing and Materials
bgs	below ground surface
BIP	blow-in-place
BPEA	Borrow Pit Expansion Area
COC	Chain-of-Custody
COPC	chemical of potential concern
CWM	chemical warfare materiel
DDESB	Department of Defense Explosives Safety Board
DFOW	definable feature of work
DGM	digital geophysical mapping
DoD	Department of Defense
DPT	direct push technology
DQO	data quality objective
DRO	diesel range organics
EMP	Explosives Management Plan
EOD	Explosives Ordnance Disposal
ESQD	explosive safety quantity distance
ESS	Explosives Safety Submission
ESV	ecological screening values
EZ	exclusion zone
FTL	Field Team Leader
GIP	Geophysical Investigation Plan
GIS	Geographical Information System
GPO	Geophysical Prove-Out
GPS	global positioning system
H&S	health and safety
HE	high explosive
HWS	hazardous waste section
IBD	inhabited building distance
IDW	investigation-derived waste
ISO	industry standard object
m	meter
MARCORSYSCOM	Marine Corps Systems Command
MC	munitions constituent

MCB	Marine Corps Base
MD	munitions debris
MEC	munitions and explosives of concern
MGFD	munition with the greatest fragmentation distance
MI	multi-increment
MILCON	military construction
MMRP	Military Munitions Response Program
MPPEH	material potentially presenting an explosive hazard
MR	munitions response
MRP	Munitions Response Program
MRS	Munitions response site
MS/MSD	matrix spike/matrix spike duplicate
MSD	minimum separation distance
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NC SSL	North Carolina Soil Screening Level
NCDENR	North Carolina Department of Environment and Natural Resources
NCGWQS	North Carolina Groundwater Quality Standards
NOSSA	Naval Ordnance Safety and Security Activity
ONWASA	Onslow County Water and Sewer Authority
PA/SI	Preliminary Assessment/Site Inspection
PETN	pentaerythritol tetranitrate
PM	Project Manager
PRG	preliminary remediation goal
PTR	public transportation route
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
QCP	Quality Control Plan
RSL	regional screening level
RTK	real time kinetic
SI	Site Inspection
SLERA	Screening Level Ecological Risk Assessment
SOP	standard operating procedure
SSHP	site safety and health plan
SUXOS	Senior Unexploded Ordnance Supervisor
TAL	target analyte list
TPH	total petroleum hydrocarbons
TSD	team separation distance
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UST	underground storage tank

UXO	unexploded ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist
WMP	Waste Management Plan
WP	white phosphorus
WWTP	wastewater treatment plant

SECTION 1

Introduction

Marine Corps Base (MCB) Camp Lejeune is close to reaching the limits of the current base borrow pit and will need to increase the capacity of this area to support the various facility projects underway. The proposed 54-acre borrow pit expansion area (BPEA) is located within Military Munitions Response Program (MMRP) Site Unexploded Ordnance 6 (UXO-06), the Former Fortified Beach Assault Area that was previously the subject of a site-wide Preliminary Assessment/Site Inspection (PA/SI) between 2007 and 2008. The objectives of the PA/SI were to evaluate the potential presence and nature of impacts to environmental media resulting from historical activities. The PA/SI concluded that the only human health threat posed by site conditions pertained to potential exposure of future residents to groundwater. No adverse effects to ecological receptors were identified. However, small arms ammunition and material potentially presenting an explosive hazard (MPPEH) were discovered during the field investigation activities. The MCB Camp Lejeune Explosive Ordnance Disposal (EOD) Company was contacted to dispose of the small arms ammunition and MPPEH.

Because the site is planned for future borrow pit expansion, additional investigation activities will be conducted to meet the objectives described below. The BPEA consists of three separate areas, designated as Phase 1A, Phase 1, and Phase 2 (**Figure 1-1**). Phase 1A will be investigated first to allow the Base to immediately expand the borrow pit (assuming the findings of the investigation support expansion). Phase 1 will be investigated afterwards followed by Phase 2. The Phase 2 area will be divided into subareas (to be determined based on the Base's need for additional borrow materials). This will allow the Base to incrementally expand the borrow pit as subarea investigations are completed.

1.1 Project Objectives

The objectives of the Focused Site Inspection (SI) are to:

- Evaluate the potential presence and nature of impacts to the environment resulting from historical activities and the potential for human health and ecological risks in the Phase 1 BPEA that was not investigated as part of the previous PA/SI activities.
- Evaluate the nature and extent of potential munitions and explosives of concern (MEC) contamination and reduce potential exposure of site workers to MEC. Also, determine the presence and nature of any resulting munitions constituent (MC) soil contamination.

1.2 Work Plan Addendum Scope and Organization

The following investigative activities will be performed in accordance with methods and procedures detailed in the MCB Camp Lejeune Munitions Response Program (MRP) Master Project Plans (CH2M HILL, 2008a) (referred to herein as the MRP Master Project Plans) to accomplish the objectives described in **Section 1.1**:

- Although digital geophysical mapping (DGM) was previously conducted over portions of the BPEA (see Figure 1-3), DGM will be completed over 100 percent of Phases 1A, 1, and 2 of the BPEA as part of the Focused SI.
- Collect and analyze surface and subsurface soil samples for the presence of MC contamination.
- Prepare technical memorandums summarizing the field investigation findings for each phase.
- Reacquire all geophysical anomalies identified by the DGM activities that potentially represent subsurface MEC, and conduct MEC intrusive investigation.
- Verify removal of MEC items
- Perform demilitarization of all MEC and MPPEH identified during the intrusive activity.
- Prepare an After Action Report documenting the MEC intrusive investigation.

This Work Plan Addendum is divided into sections providing information on the detailed approach, including procedures to be employed during the execution of the project. Appendices to the Work Plan Addendum provide supporting documentation that details specific procedures for the execution of the project.

This Work Plan Addendum is organized as follows:

- **Section 1, Introduction,** provides general information about this Work Plan Addendum, describes Site UXO-06, summarizes the history of the site, and presents the project scope and objectives.
- **Section 2, Technical Management Plan,** identifies the technical approach, methods, and operational procedures that will be used to execute the Focused SI.
- **Section 3, Field Investigation Plan,** identifies the technical approach, methods, and operational procedures that will be used to execute the field investigation activities, including mobilization and demobilization, land surveying, vegetation clearing, sampling of environmental media, and DGM.
- **Section 4, MEC Intrusive Investigation Plan,** identifies the technical approach, methods, and operational procedures that will be used to execute the MEC intrusive investigation including demolition of MEC and MPPEH (if required).
- **Section 5, Explosives Management Plan (EMP),** provides details for management of explosives in accordance with applicable regulations.
- **Section 6, Explosives Siting Plan,** provides explosives safety criteria for planning and siting explosives operations.
- **Section 7, Quality Control Plan (QCP),** provides details of the approach, methods, and operational procedures to be employed for quality control (QC) of the Focused SI.

- **Section 8, Environmental Protection Plan,** describes the approach, methods, and operational procedures to be employed to protect the natural environment during the performance of all Focused SI tasks.
- **Section 9, References,** lists the references cited in the preceding sections.
- **Appendix A, Geophysical Prove-Out (GPO) Plan**, details the activities to be performed for validating DGM systems to be utilized at the site.
- **Appendix B, Geophysical Investigation Plan (GIP)**, details the approach, methods, and operational procedures that will be used in performing geophysical investigations at the site.
- **Appendix C, Quality Assurance Project Plan,** details specific quality assurance (QA) and QC activities, and laboratory activities necessary to achieve the objectives of the project.
- **Appendix D, Accident Prevention Plan (APP),** Along with the Site Safety and Health Plan (SSHP), the APP comprises the health and safety (H&S) policy and procedures for work performed by CH2M HILL and its subcontractors for work at Site UXO-06.
- **Appendix E, MEC Removal Standard Operating Procedures (SOPs),** details the approach, methods, and operational procedures that will be used in performing removal of geophysical anomalies and MEC, if discovered, during the MEC intrusive investigation.

An Explosives Safety Submission (ESS) Amendment has been submitted to Marine Corps Systems Command (MARCORSYSCOM) under separate cover for review and forwarding to the Department of Defense Explosives Safety Board (DDESB). The ESS Amendment was prepared in support of MEC investigation and removal activities to be performed at the site. The ESS Amendment will be reviewed by MARCORSYSCOM and DDESB for conformance with applicable United States Marine Corps, Department of the Navy (Navy), and Department of Defense (DoD) requirements for the safe handling of MEC and explosives. The ESS Amendment must be approved by these agencies prior to the start of the intrusive investigation activities.

1.3 Site Location and Description

Site UXO-06 (Archive Search Report [ASR] Range No. 2.65, D-27) is located in the French Creek area of 'mainside' MCB Camp Lejeune south of McHugh Boulevard and west of Sneads Ferry Road (**Figure 1-1).** The site is approximately 177 acres in size. The Site UXO-06 area north of Gonzalez Boulevard, which crosses through Site UXO-06, is mostly developed while the area south of Gonzalez Boulevard is largely undeveloped.

The BPEA is located within the undeveloped and largely wooded portion of Site UXO-06 located south of Gonzalez Boulevard. The 3-acre Phase 1 BPEA is completely vegetated with trees and dense undergrowth. The Phase 1A and Phase 2 BPEA have similar vegetation, although only on 30 of the 51 acres. Unpaved vehicle accessible roads provide access to the BPEA. There are also two ponds within the Phase 2 BPEA. The topography within the BPEA

varies; some areas are relatively flat while some areas consisting of hills with up to 20 feet of topographic relief.

1.4 Site History

In May and August 2007, CH2M HILL conducted a detailed investigative review of existing information pertaining to Site UXO-06, including interviews with site personnel. The review emphasized obtaining information on historical activities that may have resulted in environmental contamination or MEC being present at Site UXO-06. Information obtained from this review is presented in the Archival Records Search Report which is Appendix B of the D*raft Preliminary Assessment/Site Inspection Report for Site UXO-06 Former Fortified Beach Assault Area* (CH2M HILL, 2009).

Site UXO-06 was used from 1953 until 1977 as a training area for fortified beach assault and assault of fortified positions. During initial site operations from 1953 to 1970, the range was authorized to use blank small arms, demolition charges, practice rockets, flame throwers, smoke grenades, and pyrotechnics (USACE, 2001). From 1970 until range closure in 1977, the range was authorized to use blank small arms, 3.5-inch practice rockets, thickened and unthickened fuel, half-pound demolition charges, practice rifle grenades, and smoke and white phosphorus (WP) hand grenades (USACE, 2001). All fire was reportedly directed away from service roads and main thoroughfares. The potential MEC hazards associated with this former range include UXO and MC. It is anticipated that potential MEC would have originally been deposited at or near the ground surface, but over the years, site activities (e.g., construction of the access roads) may have caused the MEC to become buried to unknown depths.

1.5 Previous Investigations

Three previous phases of investigation have been conducted within the bounds of Site UXO-06. Two of these investigations were conducted to support construction activities (Armory military construction (MILCON) Focused SI and Onslow County Water and Sewer Authority [ONWASA]) PA/SI); although both of these investigations were conducted outside of the BPEA. The third investigation (Site UXO-06 PA/SI) was a site-wide investigation to evaluate the presence of impacts related to historical activities. Each investigation is discussed in detail below.

1.5.1 Armory MILCON Focused SI and MEC Intrusive Investigation

In 2006, CH2M HILL conducted a Focused SI to evaluate the presence of MEC and/or environmental contamination within a 4.4-acre MILCON area located north and south of Gonzalez Boulevard (**Figure 1-2**). DGM was conducted across the entire 4.4-acre area, and a total of 20 surface and subsurface soil samples and five groundwater samples were collected for laboratory analysis (CH2M HILL, 2007). Surface soil samples were collected from 0 to 2 inches below ground surface (bgs) and subsurface samples were generally collected in the range of 5-12 feet bgs. One of the groundwater samples was collected from the Upper Castle Hayne aquifer at an interval of 36–40 feet bgs and the remainders were collected from the Surficial aquifer at depths ranging from 10–19 feet bgs.

The analytical results for the soil samples indicated that dieldrin and iron exceeded their respective North Carolina Soil Screening Levels (NC SSLs). Subsequent human health and ecological risk screening resulted in the identification of several chemicals of potential concern (COPCs) for soil, including total petroleum hydrocarbons (TPH), dieldrin, endrin, aluminum, arsenic, chromium, iron, manganese, and vanadium. The COPCs identified for groundwater included chloroform, bis(2-ethylhexyl)phthalate, and several metals.

The DGM activities identified 851 anomalies representing potential subsurface MEC. The subsequent intrusive investigation, conducted in January and February 2008, resulted in the discovery of an M29 series 3.5-inch practice Rocket, an M18 Colored Smoke Hand Grenade with M201A1 Fuze, and an MK13 MOD-0 Marine Hand Signal Flare.

1.5.2 ONWASA Focused Preliminary Assessment/Site Inspection

In May 2007, Arcadis conducted a focused PA/SI to evaluate the presence of MEC and/or impacted soil or groundwater within a proposed force main easement that bisects Site UXO-06 from northeast to southwest. DGM was performed over 100 percent of the easement, and a total of 42 shallow soil borings were advanced using direct push technology (DPT). Soil samples were collected at the depth of the proposed force main (between 3 and 7 feet bgs). The original plan called for collection of groundwater samples by DPT from every other soil boring; however, groundwater was only encountered at two locations (MMRP06-TW04 and MMRP06-TW06). Sample locations are shown on **Figure 1-2**.

The DGM activities identified 791 anomalies representing potential subsurface MEC within the easement. The laboratory analytical results for soil samples indicated that arsenic and/or vanadium were detected above either the United States Environmental Protection Agency (USEPA) Region 9 Preliminary Remediation Goals (PRGs) (USEPA, 2004) or the North Carolina Soil Remediation Goal in 17 of the 42 soil samples. TPH-diesel range organics (DRO) was detected in 9 of the 42 soil samples; since health based standards do not exist for TPH-DRO, these detections were compared to the non-underground storage tank (UST) petroleum release action level (40,000 micrograms per kilogram) (NCDENR, 2007). None of the detected TPH-DRO concentrations were above the non-UST petroleum release action level. Several metals were also detected in the groundwater samples at concentrations slightly above either the USEPA Tap Water PRG or the North Carolina Groundwater Quality Standards (NCGWQS). However, since the groundwater samples were collected directly from the DPT tooling it is possible that suspended solids contributed to the detected metals concentrations.

The resulting data was used to conduct a preliminary evaluation of human health risks related to exposure to soil and groundwater during construction activities; the evaluation concluded that site media does not pose a risk to construction workers (Arcadis, 2007).

Further evaluation of potential subsurface MEC within the proposed force main easement was conducted in May 2009 by intrusively investigating and removing the sources of geophysical anomalies that had been identified during the DGM activities. Subsurface MEC was not encountered during the intrusive investigation activities; however, two M29 3.5" practice rockets and one M22 expended smoke rifle grenade were recovered during the intrusive investigation (ZAPATA, 2008).

1.5.3 Site UXO-06 PA/SI

From November 2007 to August 2008 CH2M HILL conducted a PA/SI of Site UXO-06, with the primary objective of evaluating the potential presence and nature of impacts to environmental media resulting from historical activities at the site. A secondary objective was to gather geophysical data as a preliminary step in determining the nature and extent of potential subsurface MEC that may be present at the site.

Environmental sampling consisted of collecting samples of soil, groundwater, surface water, and sediment as shown on **Figure 1-2**. A total of 27 surface soil samples, nine subsurface soil samples, two groundwater samples, three surface water samples, and three sediment samples were collected within the combined Phase 1A and Phase 2 BPEA. Environmental samples were not collected within the Phase 1 BPEA. Surface soil samples analyzed for explosives residues, perchlorate, and metals were collected from 0-2 inches because the highest MC concentrations are mostly likely to exist in the first two inches of soil. Surface soil samples analyzed for other parameters were collected from 0-6 inches bgs and subsurface samples were generally collected from 12 to 13 feet bgs. Groundwater samples were collected at depths ranging from 8–20 feet bgs (CH2M HILL, 2009).

The analytical results from the PA/SI soil samples indicated that organics and metals were detected at concentrations above the regulatory standards. Of the samples collected from within the combined Phase 1A and Phase 2 BPEA, methylene chloride was the only organic detected at a concentration above a regulatory standard. Methylene chloride exceeded the NC SSL at one sample location (MR06-IS57). In addition, four metals (aluminum, arsenic, iron, and manganese) were detected at concentrations above two times the mean background concentration and at least one regulatory standard.

The analytical results from the PA/SI groundwater samples indicated that organics and metals were detected at concentrations above regulatory standards. Within the Phase 2 BPEA, iron was the only analyte detected that exceeded regulatory standards. The iron concentrations in the Phase 2 BPEA exceeded the NCGWQS, the USEPA Adjusted Tap Water Regional Screening Levels (RSLs), and two times the mean background concentration. No groundwater samples were collected within the Phase 1A BPEA.

Laboratory analysis of the PA/SI surface water samples showed that organics and metals were detected at concentrations above regulatory standards. Analytical results for the surface water samples collected from the two ponds located within the Phase 2 BPEA showed that aluminum, beryllium, chromium, iron, and vanadium, and bis[2-ethylhexylphthalate concentrations were above either the USEPA Adjusted Tap Water RSLs, the NC 2B water quality standards, or the National Recommended Water Quality Criteria.

The analytical results from the PA/SI sediment samples show that metals were detected at concentrations above regulatory standards. Within the Phase 2 BPEA, two metals (arsenic and aluminum) were detected at concentrations above regulatory standards. Arsenic was detected above the USEPA Adjusted Industrial Soil RSL and aluminum was detected above the USEPA Adjusted Residential RSL.

Human health and ecological risks screenings were completed based on the potential exposure to Site UXO-06 soil, sediment, surface water, and groundwater. Both evaluations concluded that based on the current and anticipated future land use scenario for the site,

exposure to site media was not expected to result in any unacceptable risk to human health or ecological receptors.

DGM activities were conducted over a total of 28,210 linear meters of transects; 9,031 linear meters of these transects were in the BPEA (**Figure 1-3**). The DGM activities identified a total of 1,335 anomalies (209 of these anomalies were located within the BPEA) representing potential subsurface MEC. Further evaluation of potential subsurface MEC was conducted in November 2008 through January 2009 by intrusively investigating and removing the sources of geophysical anomalies that had been identified during the Site UXO-06 PA/SI. Subsurface MEC was not encountered during the intrusive investigation activities; however, buried small arms ammunition and munitions debris (MD) was recovered and MPPEH was observed on the ground surface in areas not evaluated during the intrusive investigation activities. The following MD items were recovered from Site UXO-06 during the intrusive investigation:

- 3.5-inch Practice Rocket, M29
- 2.36-inch Practice Rocket, M7
- 35-mm, Subcaliber Rocket, M73
- Signal, Illuminating Flare, Ground, M125A1
- Signal, Illuminating Flare, Ground, M22
- Signal, Illuminating Flare, M23
- Rifle Grenade, M9
- Rifle Grenade, Smoke, M20
- Grenade, White Phosphorus, M15
- Grenade, White Phosphorus, M34
- Landmine, Practice, M16 A1
- 90mm M27 Cartridge Case Blank

1.6 Geology and Hydrogeology

The regional geology and hydrogeology at MCB Camp Lejeune are discussed in Sections 1.6 and 1.7 of the MRP Master Project Plans.

Site specific subsurface conditions were found to consist of sands, silts, and clays to the maximum depth of investigation, roughly 20 feet bgs. Shallow soils typically consisted of interbedded sandy silts and silty sands transitioning to white to light gray silty sand containing clay and coarse-grained sand stringers from approximately 5–10 feet bgs, and extending to at least 20 feet bgs.

Water level measurements recorded in shallow temporary monitoring wells installed during the Site UXO-06 PA/SI field activities were used in concert with top of well casing survey data to develop the potentiometric surface map of the Surficial aquifer depicted on **Figure 1-4**. The potentiometric surface suggests that shallow groundwater to the west of the unnamed north-south tributary that bisects Site UXO-06 flows towards the east and southeast, likely discharging into this surface water body, while groundwater flow to the east of this tributary generally flows to the south towards the wetlands bordering Cowhead Creek.

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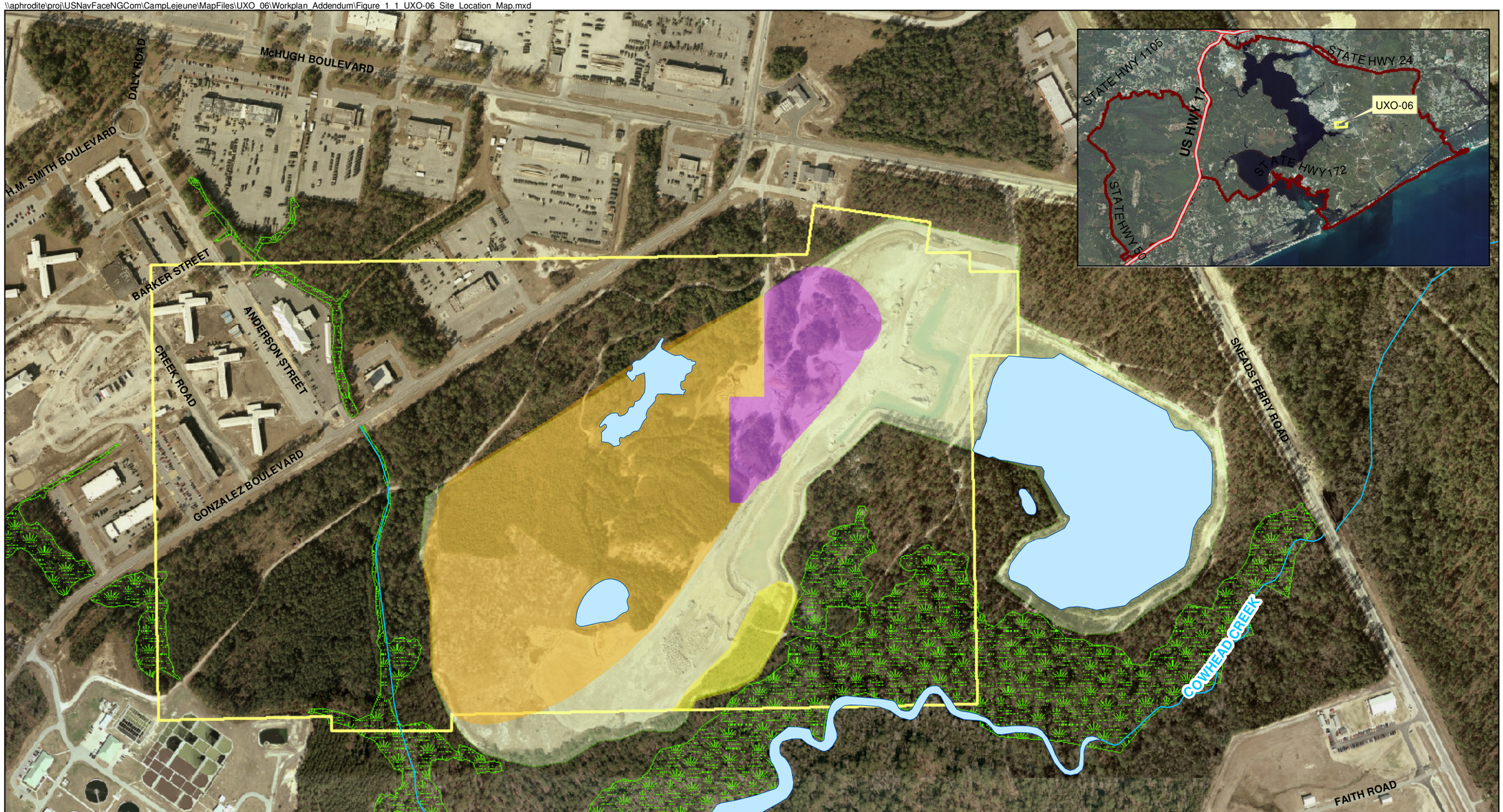

Legend

- Stream
- Surface Water Body
- Phase 1 Borrow Pit Expansion Area
- Phase 1A Borrow Pit Expansion Area
- Phase 2 Borrow Pit Expansion Area
- Active Borrow Pit
- UXO-06 Site Boundary
- Jurisdictional Wetlands

N

0 225 450 900 Feet

1 inch = 450 feet

Figure 1-1
Site Map
Site UXO-06 Base Borrow Pit Expansion
MCB Camp Lejeune
North Carolina

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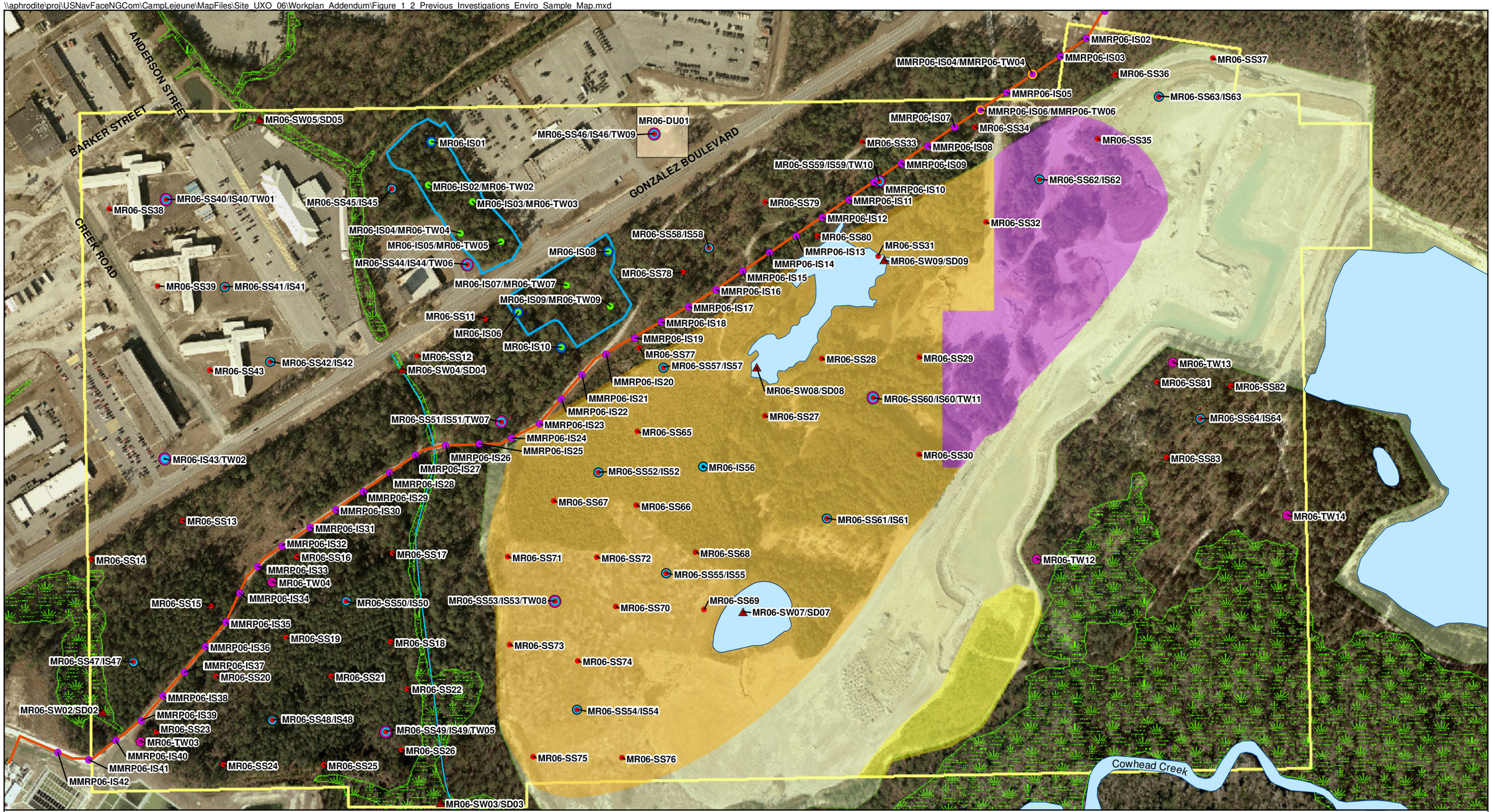

Legend

- (2008) PA/SI Surface Soil Sample
- (2008) PA/SI Surface and Subsurface Soil Sample
- (2008) PA/SI Subsurface Soil Sample
- (2008) PA/SI Temporary Well
- (2008) PA/SI Subsurface Soil Sample/Temporary Well
- (2008) PA/SI Surface Water and Sediment Sample
- (2008) PA/SI Surface/Subsurface Soil Sample and Temporary Well
- (2007) Focused PA/SI Soil Sample
- (2007) Focused PA/SI Soil/Groundwater Sample
- (2006) Focused SI Soil Sample
- (2006) Focused SI Soil/Groundwater Sample
- Proposed Force Main
- MILCON Area
- Stream
- Surface Water Body
- Phase 1 Borrow Pit Expansion Area
- Phase 1A Borrow Pit Expansion Area
- Phase 2 Borrow Pit Expansion Area
- Active Borrow Pit
- PA/SI Decision Unit
- UXO-06 Site Boundary
- Jurisdictional Wetlands

N

0 150 300 600 Feet

1 inch = 300 feet

Figure 1-2
Previous Investigations Environmental Sampling Locations
Site UXO-06 Base Borrow Pit Expansion
MCB Camp Lejeune
North Carolina

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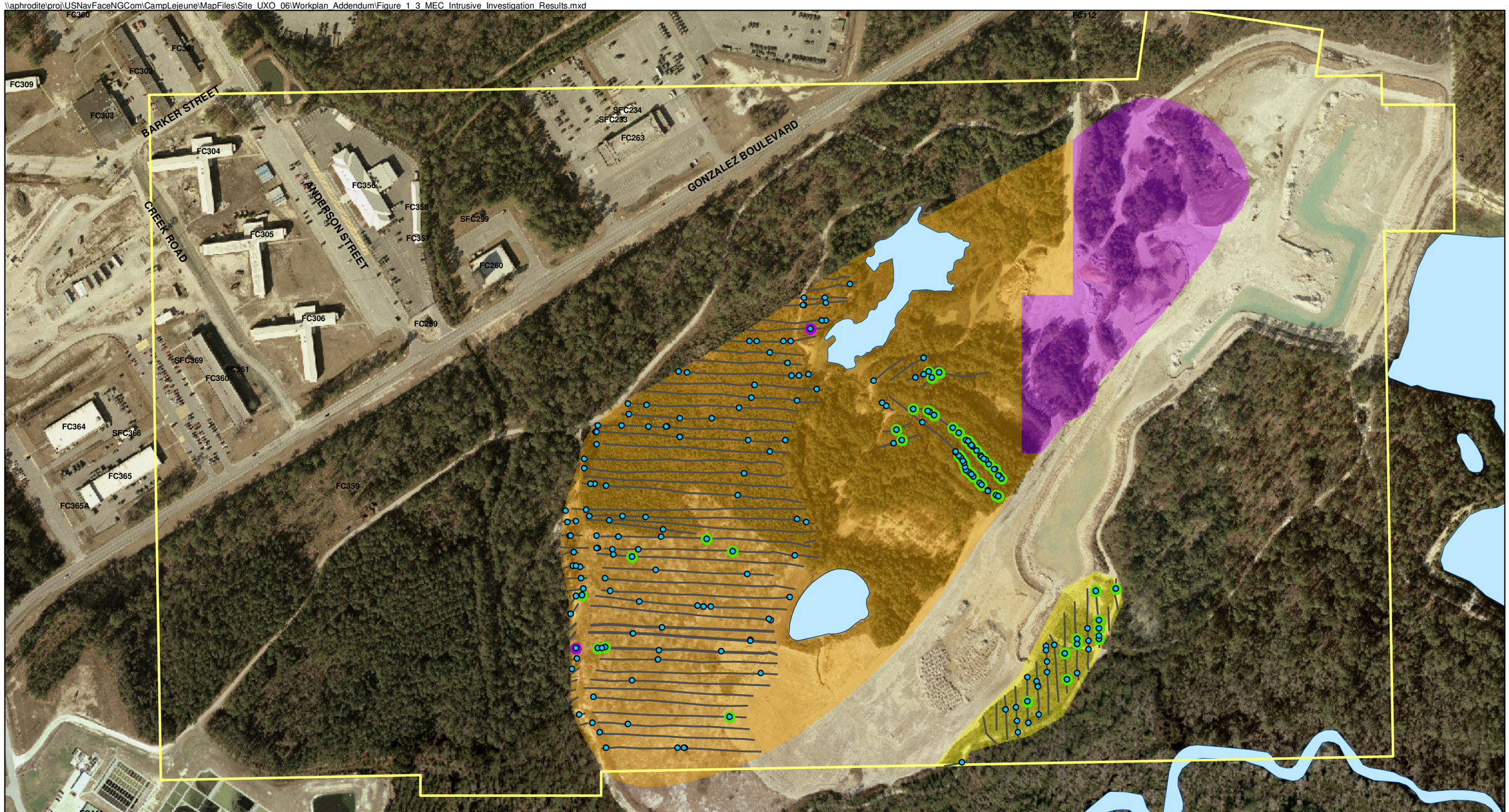

Legend

- Investigated Anomaly
- Investigated Anomaly- Small Arms Ammunition Discovered
- Investigated Anomaly- Munitions Debris Discovered
- DGM Transects within Phase 1 and 2 Areas
- UXO-06 Site Boundary
- Phase 1 Borrow Pit Expansion Area
- Phase 1A Borrow Pit Expansion Area
- Phase 2 Borrow Pit Expansion Area
- Surface Water Body

N

0 150 300 600 Feet

1 inch = 300 feet

Figure 1-3
DGM Transects and MEC Intrusive Investigation Results
Site UXO-06 Base Borrow Pit Expansion
MCB Camp Lejeune
North Carolina

CH2MHILL

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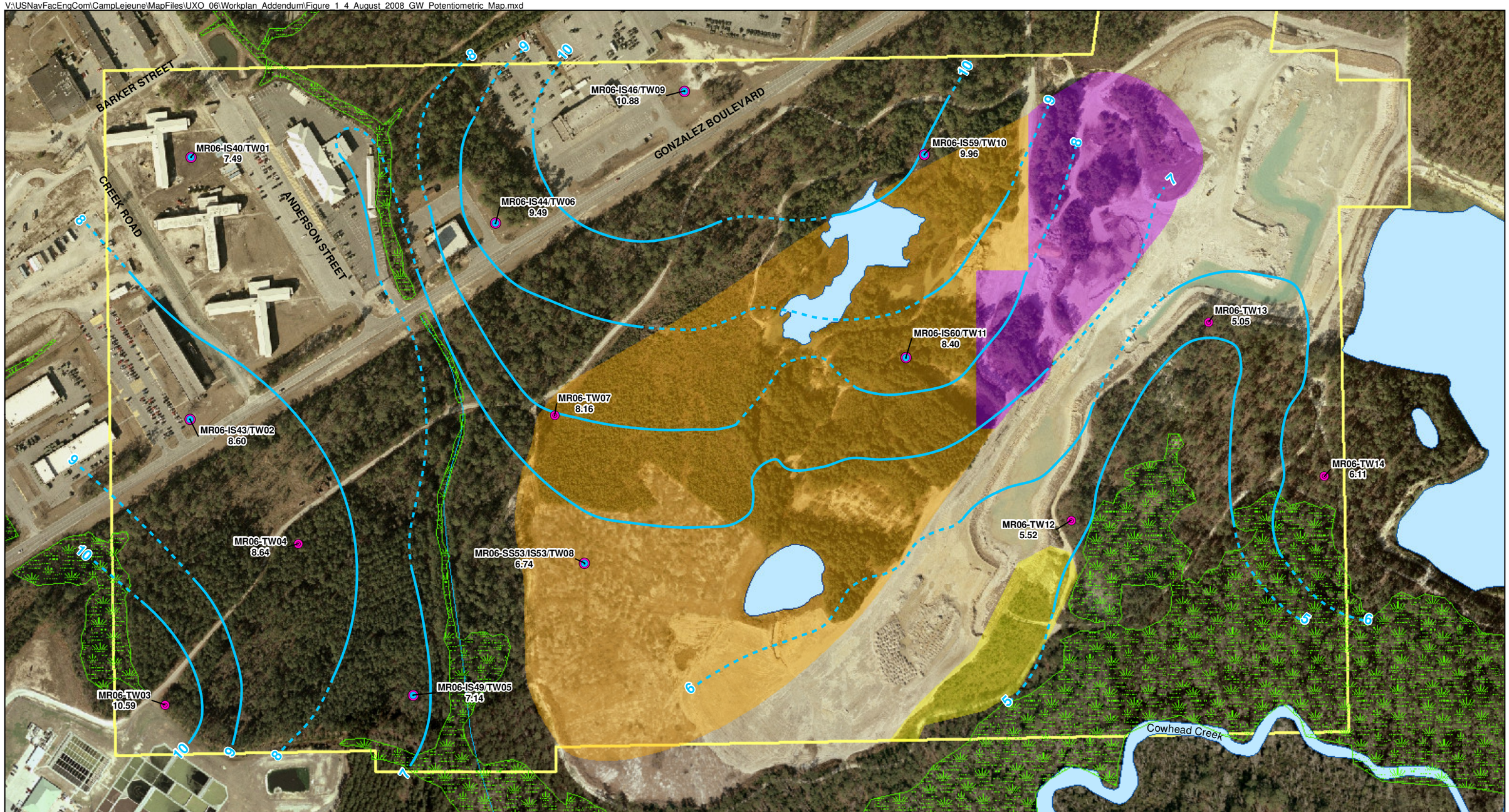

Legend

- Subsurface Soil Sample Locations/Temporary Wells
- Temporary Wells
- Potentiometric Surface Contours (Dashed where inferred)
- Phase 1 Borrow Pit Expansion Area
- Phase 1A Borrow Pit Expansion Area
- Phase 2 Borrow Pit Expansion Area
- UXO-06 Site Boundary
- Jurisdictional Wetlands
- Stream
- Surface Water Body

Note: Potentiometric surface contours have been interpolated between temporary monitoring well locations. Actual conditions may differ from those shown here.
All measurements shown are in feet above mean sea level

N

0 300 600 Feet

1 inch = 300 feet

Figure 1-4
August 2008 Potentiometric Surface Map
Site UXO-06 Base Borrow Pit Expansion
MCB Camp Lejeune
North Carolina

CH2MHILL

SECTION 2

Technical Management Plan

2.1 Munitions Response Guidance, Regulations, and Policy

The munitions response (MR) intrusive investigation within the BPEA will be conducted under the guidance documents, regulations, and polices described in Section 2.1 of the MRP Master Project Plans.

2.2 MEC Contingency Procedures

Based on the documented history of DoD activities at Site UXO-06, it is anticipated that if MEC is discovered it can be destroyed onsite. Therefore, alternatives to onsite disposal are not identified in this Work Plan Addendum. Likewise, the discovery of unidentified MEC is not anticipated. If any MEC items are discovered that cannot be identified, MEC contingency procedures will be conducted in accordance with Section 2.2 of the MRP Master Project Plans.

2.3 Chemical Warfare Materiel Contingency Procedures

Based on the documented history of DoD activities at Site UXO-06, it is not anticipated that chemical warfare materiel (CWM) will be discovered. If CWM is encountered, all work will immediately cease and CWM contingency procedures will be conducted in accordance with Section 2.3 of the MRP Master Project Plans.

2.4 Project Personnel, Organization, and Schedule

2.4.1 Project Organization

The key organizations involved in this project are Naval Facilities Engineering Command (NAVFAC), MCB Camp Lejeune, the North Carolina Department of Environment and Natural Resources (NCDENR), USEPA, and CH2M HILL. The organization chart for the project is presented in Figure 2-1.

Project execution will be conducted by CH2M HILL and its subcontractors; specific duties for CH2M HILL and its subcontractors are described in Section 2.4 of the MRP Master Project Plans. CH2M HILL will issue subcontracts for MEC support, buried utility locating, DGM, land surveying, vegetation clearing, DPT soil sampling, laboratory analysis, and data validation.

2.4.2 Project Personnel

The reporting relationship between key project personnel and the roles and responsibilities of the key personnel are discussed in Section 2.4 of the MRP Master Project Plans. Contact information for key project personnel is shown in **Table 2-1**.

2.4.3 Project Schedule

Figure 2-2 presents a detailed project schedule, including key milestones.

2.5 Technical Approach

2.5.1 Task 1—Project Planning

This task includes project management, meetings, Work Plan Addendum preparation, and subcontractor procurement.

Project management includes all work necessary for controlling the project budget and schedule. This includes monthly status reports and invoicing, as well as all other administrative tasks needed for project performance.

Meetings are planned throughout the course of this project. The meetings will be held to discuss proposed work, present investigation findings, and discuss project status. The meetings are planned to be held at MCB Camp Lejeune, CH2M HILL's Charlotte office, or at other locations as necessary.

Three versions of the Work Plan Addendum will be prepared under this task. A draft Work Plan Addendum will be submitted electronically for NAVFAC and MCB Camp Lejeune review. A revised Work Plan Addendum will be submitted to NAVFAC, MCB Camp Lejeune, USEPA, and NCDENR for review upon incorporating comments from NAVFAC and MCB Camp Lejeune. A final Work Plan Addendum will be prepared that will address all comments on the draft document.

Subcontractor procurement is also included under this task. Anticipated subcontractor services include MEC support, buried utility locating, DGM, land surveying, vegetation clearing, DPT soil sampling, laboratory analysis, and data validation.

2.5.2 Task 2—Data Evaluation/Archive Review

A detailed investigative review of existing Site UXO-06 information and interviews with site personnel was conducted by CH2M HILL in May and August 2007. Information obtained by this effort is in the Archival Records Search Report presented in Appendix B of the D*raft Preliminary Assessment/Site Inspection Report for Site UXO-06 Former Fortified Beach Assault Area* (CH2M HILL, 2009).

2.5.3 Task 3—Site Investigation

All field investigation activities will be performed under this task. The field investigation will be conducted in phases. The scope of the field investigation and the technical approach are presented in **Section 3**. The primary field investigation activities include:

- MEC avoidance
- Land Surveying
- Vegetation clearance
- MEC surface clearance (if necessary)
- DGM
- Field work support
- Environmental sampling

The MEC intrusive investigation will be performed under Task 6 (see Section 2.5.6).

2.5.4 Task 4—Sample Management, Analysis, and Validation

This task includes management of environmental sample data from the time the samples are collected until the validated data is received and incorporated into the project reports. Details for this task are provided in the Section 8.1 of the MRP Master Project Plans.

2.5.5 Task 5—Geographical Information System

All DGM data will be collected in preparation for the creation of a geographical information system (GIS) tailored for the site investigative needs. All digital data will be created using a software platform that will allow it to be loaded directly into the GIS. The main purpose of the GIS is to assemble all the data required to associate the non-intrusive subsurface geophysics investigative data with its correct geographical location, the relational database, mapping, and remote sensing data. The GIS tools are used to manage the project, assemble data, and help determine areas requiring further investigation.

CH2M HILL will also provide the site GIS data for upload into the existing MCB Camp Lejeune GIS. This data will include ArcView project and shape files that best delineate the area on the basis of uses, site conditions, and other information gathered during the study.

2.5.6 Task 6—MEC Intrusive Investigation

Geophysical anomalies identified during any phase of the site investigation (Task 3) that potentially represent subsurface MEC will be intrusively investigated. The scope of the MEC intrusive investigation and the technical approach are presented in **Section 3**. The primary intrusive investigation activities include the following:

- Site preparation
- Anomaly reacquisition/detection
- Manual excavation
- Anomaly identification and verification
- MEC/MPPEH demilitarization
- Scrap disposal

2.5.7 Task 7—Reporting

Phase 1A BPEA Technical Memorandum

A technical memorandum will be prepared to document the findings from the Phase 1A BPEA field investigation. The memorandum will include a description of field investigation activities, findings, and conclusions. The data collected will be evaluated to determine if removal actions are necessary in areas where MEC or MPPEH is discovered or where explosives operations are conducted. After the draft technical memorandum is completed it will be submitted electronically for concurrent review by NAVFAC and MCB Camp Lejeune. Following receipt of review comments, CH2M HILL will issue a revised draft memorandum to NAVFAC, MCB Camp Lejeune, USEPA, and NCDENR for review. A final memorandum will be prepared that will address all comments received on the draft document.

Phase 1 BPEA Technical Memorandum

A technical memorandum will be prepared to document the findings from the Phase 1 BPEA field investigation. The memorandum will include a description of field investigation activities, findings, and conclusions. Because the Phase 1 BPEA was not evaluated as part of the PA/SI, a human health and ecological risk screening will also be included in the Phase 1 BPEA technical memorandum. The human health and ecological risk screening will be conducted to evaluate the presence and nature of MC contamination related to historical activities. Data collected to evaluate MC soil contamination in areas where MEC or MPPEH is discovered or where explosives operations are conducted, will be evaluated to determine if removal actions are necessary in those areas.

The preliminary ecological risk screenings will include a brief description of the ecosystems potentially at risk and a comparison of the maximum detected concentrations to ecological screening values (ESVs). This preliminary ecological risk screenings will not constitute a full Screening Level Ecological Risk Assessment (SLERA). The human health risk screening will be conducted using select soil data collected during the Focused SI. Soil data will be screened against the USEPA Residential and Industrial adjusted soil RSLs (USEPA, 2008) and the NC Hazardous Waste Section (HWS) SSLs (NCDENR, 2005). Both the ecological and human health risk screenings will compare the soil data to the Camp Lejeune background soil data from the *Final Base Background Soil Study Report* (Baker, 2001). The background values will be two times the mean Base background concentrations.

After the draft technical memorandum is completed it will be submitted for review. The Phase 1 BPEA technical memorandum will follow the same review process described above for the Phase 1A BPEA technical memorandum.

Phase 2 BPEA Technical Memorandums

A technical memorandum will be prepared to document the findings from the investigation of each Phase 2 subarea. The memorandums will include a description of field investigation activities, findings, and conclusions. The data collected from each of the Phase 2 subareas will be evaluated to determine if removal actions are necessary in areas where MEC or MPPEH is discovered or where explosives operations are conducted. After each draft technical memorandum is completed it will be submitted for review. The Phase 2 BPEA technical memorandums will follow the same review process described above for the Phase 1A BPEA technical memorandum.

After Action Reports

An After Action Report will be prepared in accordance with Naval Ordnance Safety and Security Activity (NOSSA) Instruction 8020.15b (NOSSA, 2009) to document the results of each phase of the MEC intrusive investigation. The reports will provide a summary of all MEC found during the investigations, summarize all the MEC removal activities, and provide an evaluation of the selected removal methods and relative effectiveness. Prior to submittal of the final reports, a draft will be provided in electronic format to NAVFAC, MCB Camp Lejeune, and MARCORSYSCOM.

TABLE 2-1
Project Personnel Contact Information
Focused Site Inspection Work Plan Addendum for Site UXO-06 Base Borrow Pit Expansion
MCB Camp Lejeune
Jacksonville, North Carolina

Name/Title/Organization	Mailing Address	Telephone/Fax/E-mail
Phil Smith Program Manager	CH2M HILL 5700 Cleveland Street Suite 101 Virginia Beach, VA 23462	757-671-8311 x46255 (office) 757-497-6885 (fax) Phillip.Smith@ch2m.com
Keri Hallberg, P.E. Project Manager	CH2M HILL 11301 Carmel Commons Blvd Suite 304 Charlotte, NC 28226	704-543-3260 (office) keri.hallberg@ch2m.com
Matt Louth Activity Manager	CH2M HILL 5700 Cleveland Street Suite 101 Virginia Beach, VA 23462	757-671-6240 (office) 703-376-5988 (fax) Matt.Louth@ch2m.com
Thomas M. Roth, P.E. Senior Consultant	CH2M HILL 2607 Lavista Road Decatur, GA 30033-1725	404-474-7640 (office) 404-259-6674 (cell) 770-604-9183 (fax) Tom.Roth@ch2m.com
Michael Goldman, C.I.H. Program H&S Manager	CH2M HILL 1000 Abernathy Road Suite 1600 Atlanta, GA 30328	770-604-9182 x54133 (office) 770-604-9183 (fax) Michael.Goldman@ch2m.com
Tamir Klaff Senior MR Geophysicist	CH2M HILL 15010 Conference Center Dr. Suite 200 Chantilly, VA 20151	703-669-9611 (office) 703-376-5010 (fax) tamir.klaff@ch2m.com
Tim Garretson MEC Integrator/Senior MEC Technical Consultant	CH2M HILL 5700 Cleveland Street Suite 101 Virginia Beach, VA 23462	757-671-6224 (office) 757-287-5222 (cell) timothy.garretson@ch2m.com
Dan Young, CSP, CSRP Corporate MEC H&S Manager	CH2M HILL 10687 Aloe Lane Lillian, AL 36549	251-962-2963 (home office) 251-752-0148 (cell) Dan.Young@ch2m.com
Kevin Lombardo MR Operations Manager	CH2M HILL 15010 Conference Center Dr. Suite 200 Chantilly, VA 20151	703-376-5175 x45175 (office) 703-608-8247 (cell) Kevin.Lombardo@ch2m.com

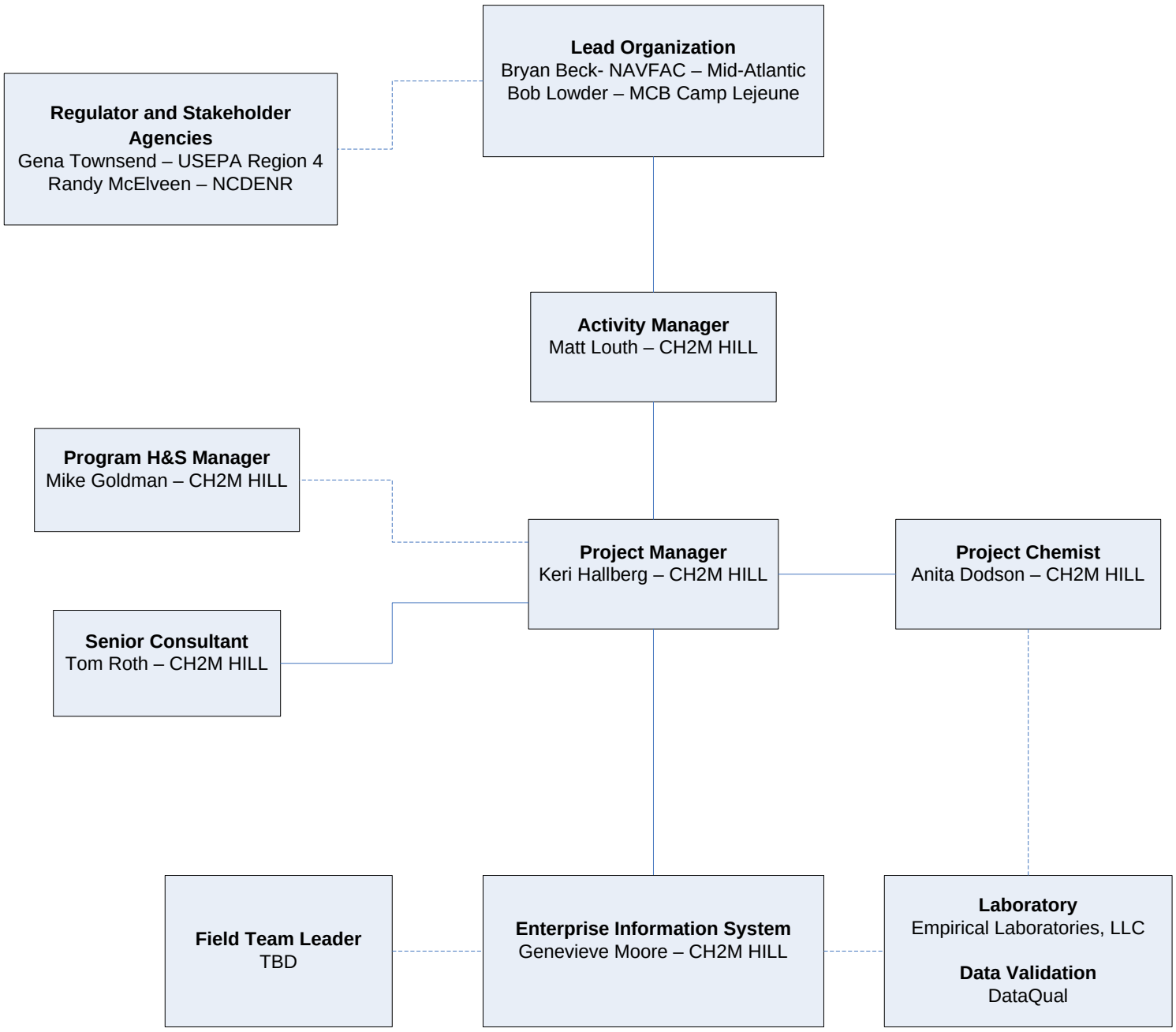

Figure 2-1
Project Organization
Site UXO-06 Base Borrow Pit Expansion
MCB Camp Lejeune
North Carolina

ID	Task Name	Duration	Start	Finish
1	**UXO-06 Additional Investigation Activities**	**569 days**	**Mon 4/6/09**	**Thu 6/9/11**
2	**Work Plan Addendum**	**74 days**	**Fri 5/1/09**	**Wed 8/12/09**
3	Work Plan - draft	35 days	Fri 5/1/09	Thu 6/18/09
4	Client review	5 days	Fri 6/19/09	Thu 6/25/09
5	Work Plan - revised draft	9 days	Fri 6/26/09	Wed 7/8/09
6	Regulatory review	15 days	Thu 7/9/09	Wed 7/29/09
7	Work Plan - final	10 days	Thu 7/30/09	Wed 8/12/09
8	**ESS Amendment**	**160 days**	**Mon 4/6/09**	**Fri 11/13/09**
9	ESS Amendment - draft	29 days	Mon 4/6/09	Thu 5/14/09
10	Client review	2 days	Fri 5/15/09	Mon 5/18/09
11	Address comments/revise ESS	4 days	Tue 5/19/09	Fri 5/22/09
12	MARCORSYSCOM review	50 days	Mon 5/25/09	Fri 7/31/09
13	Address comments/revise ESS	5 days	Mon 8/3/09	Fri 8/7/09
14	DDESB review	60 days	Mon 8/10/09	Fri 10/30/09
15	ESS Amendment- final	10 days	Mon 11/2/09	Fri 11/13/09
16	**Phase 1A (9 acre area)**	**247 days**	**Mon 7/20/09**	**Tue 6/29/10**
17	**Field Investigation**	**127 days**	**Mon 7/20/09**	**Tue 1/12/10**
18	Survey - Site Boundary	2 days	Mon 7/20/09	Tue 7/21/09
19	Vegetation Clearing (coordinate with Base loggers)	20 days	Thu 7/23/09	Wed 8/19/09
20	Survey - DGM and QC Seeds	5 days	Tue 9/1/09	Mon 9/7/09
21	Geophysical Investigation	21 days	Tue 9/8/09	Tue 10/6/09
22	MEC Intrusive Investigation	41 days	Mon 11/16/09	Mon 1/11/10
23	Soil sampling at MEC locations (if identified on site)	1 day	Tue 1/12/10	Tue 1/12/10
24	**Sample Analysis (if MEC location sampling performed)**	**40 days**	**Wed 1/13/10**	**Tue 3/9/10**
25	Lab Analysis (MEC location sampling)	10 days	Wed 1/13/10	Tue 1/26/10
26	Data Management (preparation for validation)	5 days	Wed 1/27/10	Tue 2/2/10
27	Data Validation	15 days	Wed 2/3/10	Tue 2/23/10
28	Data Management	10 days	Wed 2/24/10	Tue 3/9/10
29	**Summary Tech Memo**	**80 days**	**Wed 3/10/10**	**Tue 6/29/10**
30	Summary TM- draft	25 days	Wed 3/10/10	Tue 4/13/10
31	Client review	5 days	Wed 4/14/10	Tue 4/20/10
32	Summary TM - revised draft	10 days	Wed 4/21/10	Tue 5/4/10
33	Regulatory Review	30 days	Wed 5/5/10	Tue 6/15/10
34	Summary TM - final	10 days	Wed 6/16/10	Tue 6/29/10
35	**After Action Report**	**90 days**	**Tue 1/12/10**	**Mon 5/17/10**
36	After Action Report - draft	60 days	Tue 1/12/10	Mon 4/5/10
37	Review	20 days	Tue 4/6/10	Mon 5/3/10
38	After Action Report - final	10 days	Tue 5/4/10	Mon 5/17/10
39	**Phase 1 (3 acre area)**	**256 days**	**Wed 7/22/09**	**Wed 7/14/10**
40	**Field Investigation**	**139 days**	**Wed 7/22/09**	**Mon 2/1/10**
41	Survey - Site Boundary	1 day	Wed 7/22/09	Wed 7/22/09
42	Vegetation Clearing	5 days	Thu 8/20/09	Wed 8/26/09
43	Survey - DGM and QC Seeds	2 days	Tue 9/8/09	Wed 9/9/09
44	Geophysical Investigation	7 days	Wed 10/7/09	Thu 10/15/09
45	Survey - Sample Locations	1 day	Thu 9/10/09	Thu 9/10/09

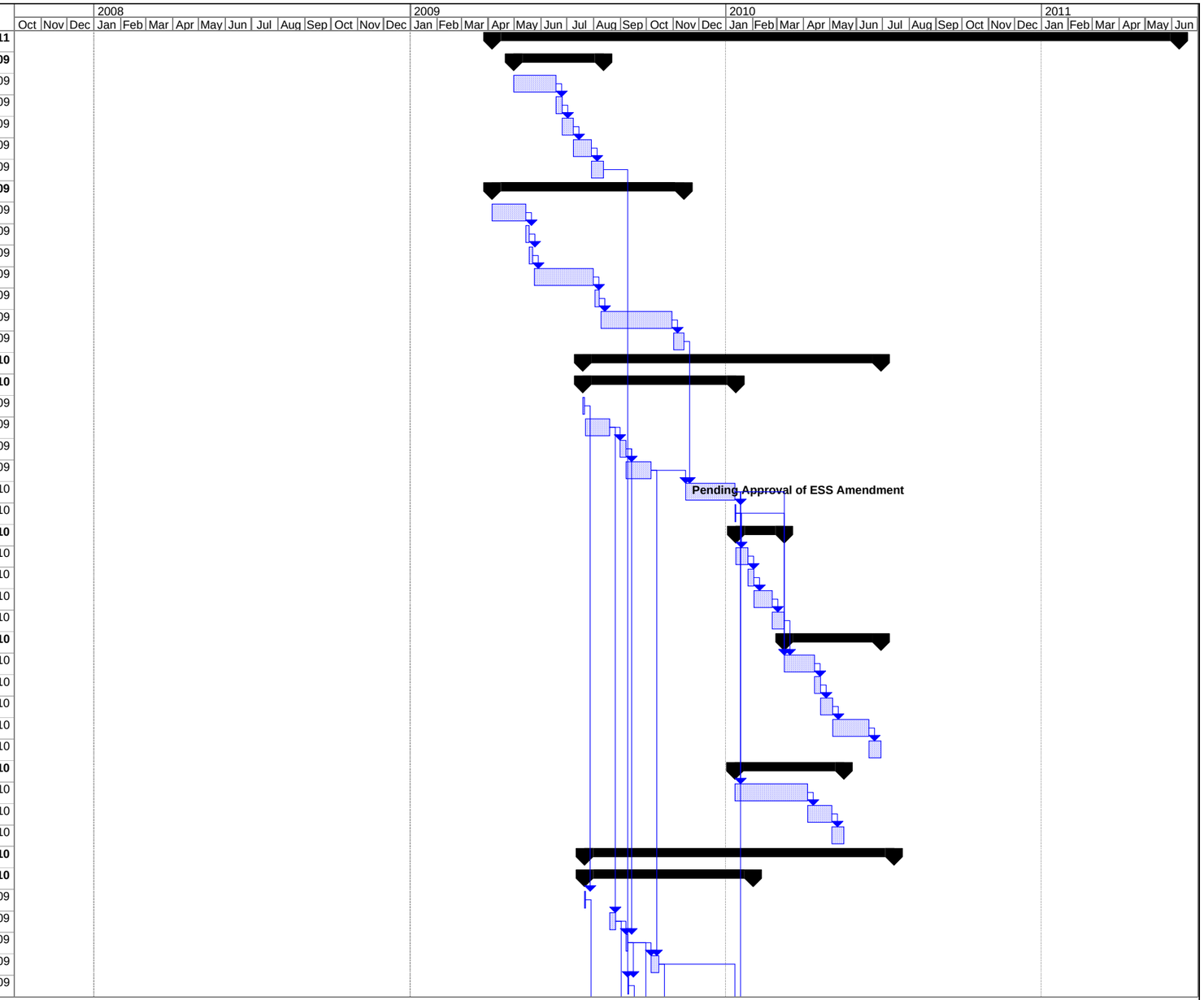

Figure 2-2
Project Schedule
Site UXO-06 BPEA
MCB Camp Lejeune

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

Figure 2-2
Project Schedule
Site UXO-06 BPEA
MCB Camp Lejeune
North Carolina

ID	Task Name	Duration	Start	Finish
46	Utility locating	1 day	Fri 9/11/09	Fri 9/11/09
47	Soil sampling	3 days	Mon 9/14/09	Wed 9/16/09
48	MEC Intrusive Investigation	14 days	Tue 1/12/10	Fri 1/29/10
49	Soil sampling at MEC locations	1 day	Mon 2/1/10	Mon 2/1/10
50	**Sample Analysis**	**135 days**	**Thu 9/17/09**	**Wed 3/24/10**
51	Lab Analysis (Environmental Sampling)	10 days	Thu 9/17/09	Wed 9/30/09
52	Data Management (preparation of lab report for validation)	5 days	Thu 10/1/09	Wed 10/7/09
53	Data Validation (Environmental Sampling)	15 days	Thu 10/8/09	Wed 10/28/09
54	Data Management (Environmental Sampling)	10 days	Thu 10/29/09	Wed 11/11/09
55	Lab Analysis (MEC location sampling)	7 days	Tue 2/2/10	Wed 2/10/10
56	Data Management (preparation for validation)	5 days	Thu 2/11/10	Wed 2/17/10
57	Data Validation (MEC location sampling)	15 days	Thu 2/18/10	Wed 3/10/10
58	Data Management (MEC location sampling)	10 days	Thu 3/11/10	Wed 3/24/10
59	**Summary Tech Memo**	**80 days**	**Thu 3/25/10**	**Wed 7/14/10**
60	Summary TM- draft	25 days	Thu 3/25/10	Wed 4/28/10
61	Client review	5 days	Thu 4/29/10	Wed 5/5/10
62	Summary TM - revised draft	10 days	Thu 5/6/10	Wed 5/19/10
63	Regulatory Review	30 days	Thu 5/20/10	Wed 6/30/10
64	Summary TM - final	10 days	Thu 7/1/10	Wed 7/14/10
65	**After Action Report**	**90 days**	**Mon 2/1/10**	**Fri 6/4/10**
66	After Action Report - draft	60 days	Mon 2/1/10	Fri 4/23/10
67	Review	20 days	Mon 4/26/10	Fri 5/21/10
68	After Action Report - final	10 days	Mon 5/24/10	Fri 6/4/10
69	**Phase 2 (42 acre area)**	**491 days**	**Thu 7/23/09**	**Thu 6/9/11**
70	**Field Investigation**	**351 days**	**Thu 7/23/09**	**Thu 11/25/10**
71	Survey - Site Boundary	7 days	Thu 7/23/09	Fri 7/31/09
72	Vegetation Clearing (coordinate with Base loggers)	20 days	Thu 8/27/09	Wed 9/23/09
73	Survey - DGM and QC Seeds	7 days	Thu 10/1/09	Fri 10/9/09
74	Geophysical Investigation	85 days	Fri 10/16/09	Thu 2/11/10
75	MEC Intrusive Investigation and Soil Sampling at MEC locations	190 days	Fri 3/5/10	Thu 11/25/10
76	**Sample Analysis (if MEC location sampling performed)**	**45 days**	**Fri 11/26/10**	**Thu 1/27/11**
77	Lab Analysis (MEC location sampling)	15 days	Fri 11/26/10	Thu 12/16/10
78	Data Management (preparation of lab report for validation)	5 days	Fri 12/17/10	Thu 12/23/10
79	Data Validation	15 days	Fri 12/24/10	Thu 1/13/11
80	Data Management	10 days	Fri 1/14/11	Thu 1/27/11
81	**Summary Tech Memo**	**95 days**	**Fri 1/28/11**	**Thu 6/9/11**
82	Summary TM- draft	40 days	Fri 1/28/11	Thu 3/24/11
83	Client review	5 days	Fri 3/25/11	Thu 3/31/11
84	Summary TM - revised draft	10 days	Fri 4/1/11	Thu 4/14/11
85	Regulatory Review	30 days	Fri 4/15/11	Thu 5/26/11
86	Summary TM - final	10 days	Fri 5/27/11	Thu 6/9/11
87	**After Action Report**	**90 days**	**Fri 11/26/10**	**Thu 3/31/11**
88	After Action Report - draft	60 days	Fri 11/26/10	Thu 2/17/11
89	Review	20 days	Fri 2/18/11	Thu 3/17/11
90	After Action Report - final	10 days	Fri 3/18/11	Thu 3/31/11

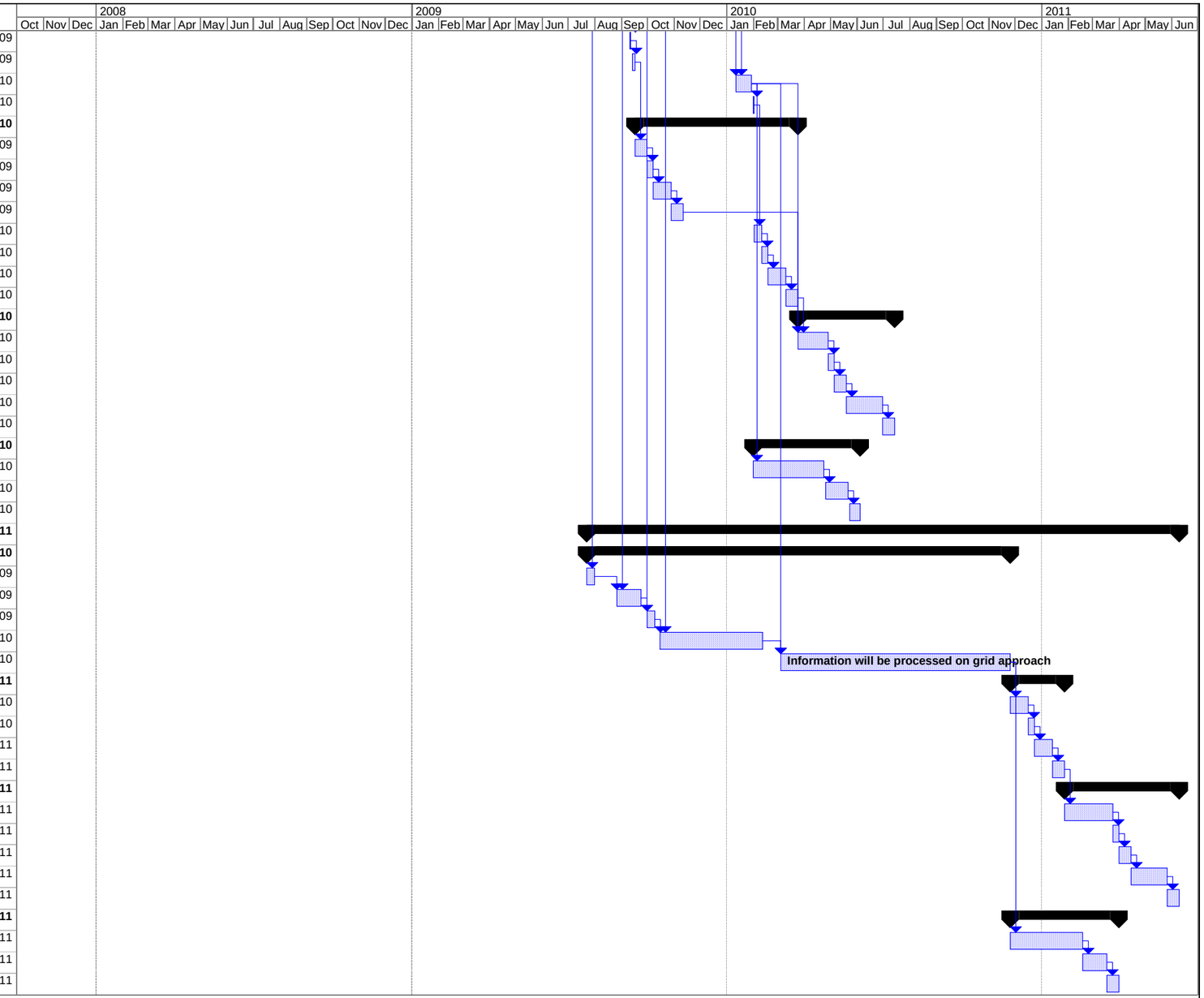

Figure 2-2
Project Schedule
Site UXO-06 BPEA
MCB Camp Lejeune

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

Figure 2-2
Project Schedule
Site UXO-06 BPEA
MCB Camp Lejeune
North Carolina

SECTION 3

Field Investigation Plan

3.1 Overall Approach

A field investigation will be conducted to meet the objectives described in Section 1.1. All field activities will be conducted in accordance with the SOPs provided in the MRP Master Project Plans. The field investigation will accomplish the project objectives through the following activities:

3.1.1 Phase 1

- Perform DGM over approximately three acres (100 percent) of the Phase 1 BPEA[1]
- Collect composite surface soil samples from three decision units using the multi-increment (MI) sampling approach; this approach is described in the *Systematic Random Multi-Increment Sampling* SOP in Appendix C of the MRP Master Project Plans
- Collect up to three composite surface soil samples using a modified TR-02-1 sampling approach (described in detail in **Section 3.6** of this Work Plan Addendum) at locations where MEC or MPPEH is identified or where explosive operations are conducted as part of the MEC intrusive investigation
- Collect three subsurface soil samples from soil borings advanced using DPT or hand augers

3.1.2 Phase 1A and Phase 2

- Perform DGM over approximately 51 acres (100 percent) of the Phase 1A and Phase 2 BPEA[1]
- Collect up to 48 composite surface soil samples using a modified TR-02-1 sampling approach at locations where MEC or MPPEH is identified or where explosive operations are conducted as part of the MEC intrusive investigation

The field investigation activities are detailed below and reference the MRP Master Project Plans. MEC intrusive investigation activities are addressed in **Section 4**.

3.2 Site Preparation and Restoration

The following subsections describe the procedures associated with site preparation, including mobilization of personnel and equipment, preparation for intrusive environmental investigation activities, and preparation for DGM.

[1] Refer to Figure 1-3 to see where DGM was previously conducted within the BPEA

3.2.1 Mobilization

Mobilization will include identifying, briefing, and mobilizing staff, as well as securing and deploying equipment.

General Activities

- Identify/procure, package, ship, and inventory project equipment, including geophysical instrumentation, hand tools and supplies, and vegetation clearance equipment
- Coordinate with local agencies, including MCB Camp Lejeune, Base Range Control, police, hospital, and fire department, as appropriate
- Test and inspect equipment
- Conduct site-specific training on the Work Plan Addendum and MEC procedures and hazards
- Review subcontractor Activity Hazard Analysis (AHA) forms
- Verify that all forms and project documentation are in order and project team members understand their responsibilities regarding completing project-reporting requirements

Kickoff/Safety Meeting

During mobilization, a kickoff and site safety meeting will be conducted. This meeting will include a review of this Work Plan Addendum and a review and acknowledgment of the APP by all site personnel. Additional meetings will occur as needed, as new personnel, visitors, and/or subcontractors arrive at the site.

3.2.2 Buried Utility Clearance

Prior to initiation of intrusive activities, all buried utilities will be identified within a 20-foot radius of each subsurface sampling location.

3.2.3 Site Survey

Land surveying services will be conducted in accordance with Section 7.4 of the MRP Master Project Plans. The surveying services will be completed under two mobilizations:

- **Mobilization 1** will be a survey of the BPEA investigation area boundary (**Figure 1-1**). The BPEA investigation area boundary survey will delineate the extent of the investigation area which will also designate the area that will be subjected to vegetation clearing for the DGM effort.
- **Mobilization 2** will occur after the vegetation clearing and will involve the layout of the DGM grid. For the purposes of the DGM, the site will be divided into 50 meter (m) x 50m survey grids coinciding with the existing Base-wide grid system previously established for MR investigations to correspond with the North American Datum of 1983 Universal Transverse Mercator, Zone 18, meters. The four corners of each survey grid will be marked with non-metallic stakes. Each corner stake will be marked with the grid number and the compass direction (e.g., NE, SW) indicating which grid corner is represented. After the DGM Grid layout is complete, the decision unit layout survey will be conducted to identify the boundary of each decision unit shown on **Figure 3-1**.

MEC avoidance will be performed during the surveying activities. UXO Technicians will escort surveying personnel while onsite, and will clear all locations where stakes are driven.

3.2.4 Vegetation Clearing

Vegetation clearance will be conducted to facilitate access for DGM and environmental sampling. Because of the intended use as a borrow pit, the BPEA will be clear-cut of all trees and other vegetation growing more than six inches above ground surface. Prior to vegetation clearance, the Base Forester will be notified to allow time to contract services for the harvesting of all marketable timber. All vegetation remaining after the Base Forester's contractor has harvested the marketable timber will be cut and mulched on-site. Tree stumps will be ground to within 6 inches of ground surface. Root balls will be left intact and will not be removed. The vegetated area within the BPEA is approximately 33 acres.

During the vegetation removal process, UXO technicians will conduct MEC avoidance activities in accordance with the MEC avoidance procedures included in the APP (**Appendix D**).

3.2.5 Surface MEC Clearance

Following vegetation clearance, surface MEC clearance may be conducted depending on the amount of metallic surface debris. Surface MEC clearance will be performed by a UXO subcontractor after the DGM survey grids have been staked within the BPEAs as described in **Section 3.2.3.** All metallic debris will be inspected by UXO Technicians to determine whether it is MEC, MPPEH, or cultural debris as described in **Section 4.7**. All MEC, MPPEH, and cultural debris will be disposed of as described in **Section 4.6**.

3.2.6 Site Restoration and Demobilization

Site Restoration

Damage caused by equipment or other site activities (e.g., deep ruts) will be repaired and revegetated as necessary to prevent erosion.

Demobilization

Full demobilization will occur when the project is completed and appropriate QA/QC checks have been performed. The following activities will occur prior to demobilization:

- Confirmation that DGM is complete
- Chain-of-custody (COC) records will be reviewed to ensure that all field and QC samples were collected as planned and were submitted for appropriate analyses
- Verification of adequate site restoration
- All field equipment will be inspected, packaged, and shipped to the appropriate location

3.3 Geophysical Prove-out Plan

A GPO will be performed as part of the process for validating DGM systems to be utilized during the DGM activities. A GPO Plan, provided in **Appendix A,** provides details of the equipment, approach, methods, operational procedures and QC to be used in performing the GPO.

3.4 Geophysical Investigation Plan

DGM will be conducted over all accessible areas within the 54 acres of the BPEA using a single coil EM61-MK2 to map geophysical anomalies that could potentially represent subsurface MEC. In areas where DGM cannot be conducted due to site conditions, handheld magnetometers will be used to locate anomalies. It is anticipated that the ponds in the Phase 2 BPEA may become dry at certain times of the year; if this occurs during the Focused SI investigation, DGM will be conducted within the dry pond beds. If the ponds are not dry during the Focused SI investigation, a separate investigation will be conducted for the ponds before expanding the borrow pit into these areas.

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. For the purposes of the DGM, the site will be divided into 50 m survey grids. The locations and actual acreages surveyed will be based on field conditions, including presence of utilities and other cultural features that may interfere with the collection of DGM data.

Four QC seed items will be emplaced within the Phase 1 BPEA and 73 QC seeds within the Phase 1A and Phase 2 BPEA to validate both the DGM surveys and the intrusive operations at the site. Industry Standard Objects (ISOs)[2] will be used as blind QC seeds in the areas to be surveyed to perform ongoing verification that the DGM system is properly functioning and the munitions detection and positioning data quality objectives (DQOs) are continuing to be met. Seeds will be placed with the intent of a DGM team encountering at least one per day. Because of production variability, weather conditions and other logistical considerations, there may be days in which a seed is not within the survey area.

Each blind seed will be placed at an easily detectable depth (in order that a response can be evaluated against the expected response for that item) and the depth, orientation and azimuth will be recorded. The depth will be measured to the center of mass of the item. The location of each item will then be surveyed by a land surveyor.

The location of blind seeds will not be shared with personnel performing DGM surveys and data processing/interpretation until those tasks have been completed.

The GIP provided in **Appendix B** provides additional details of the equipment, approach, methods, operational procedures and QC to be used in performing the geophysical investigations at the BPEA.

3.5 Geospatial Information and Electronic Submittals

Methods, equipment, accuracy, and submittal requirements for location surveys and mapping are described in Section 7.4 of the MRP Master Project Plans.

[2] Naval Research Laboratory (NRL), *EM61-MK2 Response of Three Munitions Surrogates*, NRL/MR/6110—09-9183 (March 2009)

3.6 Field Sampling Plan

3.6.1 Field Operations

In order to evaluate the presence and nature of MC contamination that may exist within the BPEA, a soil investigation will be conducted. This investigation will include collecting surface soil samples (using MI sampling and modified TR-02-1 sampling approach) and subsurface soil samples (using DPT or hand augers). QA/QC samples will be collected per **Section 3.6.2** and are described in the Quality Assurance Project Plan **(Appendix C)**.

Phase 1 BPEA: Multi-increment Surface Soil Sampling

The presence and nature of MC surface soil contamination related to historical activities was not evaluated for the Phase 1 BPEA during the PA/SI; therefore, three composite MI surface soil samples will be collected from each of three Decision Units (designated MR06-DU02-SS## through MR06- DU04-SS##) for a total of nine composite MI samples (**Figure 3-1**). MEC anomaly avoidance will be practiced as described in APP (**Appendix D**). The dimensions of each decision unit are proposed to be approximately to be 30 m × 46 m. The MI samples will be collected using the *Systematic Random Multi-Increment Sampling* SOP in Appendix C of the MRP Master Project Plans. Since MC are generally immobile within the soil profile, the MI samples will be collected from depths of 0-2 inches bgs where the highest MC concentrations are mostly likely to exist, if present (Thiboutot, Ampleman, and Hewitt, 2002). Each composite sample must weigh at least 2.2 pounds.

Samples will be analyzed by a fixed-base laboratory for the following parameters (**Tables 3-1 through 3-3**):

- Explosives residues (SW-846 USEPA Method 8330)
- Pentaerythritol tetranitrate (PETN) (SW-846 USEPA Method 8330)
- Nitroglycerine (SW-846 USEPA Method 8332)
- Perchlorate (SW-846 USEPA Method 6850)
- Target Analyte List (TAL) metals (SW-846 USEPA Method 6010B)

Phase 1 BPEA: Surface Soil Modified TR-02-1 Sampling

During the Focused SI, MEC or MPPEH may be identified that could have impacted the surrounding soils. In addition, the use of explosives during the MEC intrusive investigation could also impact the surrounding soils. Up to three surface soil samples (MR06-SS83 through MR06-SS85) will be collected from the Phase 1 BPEA at locations where soils may have been impacted by MEC, MPPEH or where explosives are used during the MEC intrusive investigation. Samples will only be collected from locations where MPPEH items are identified if, based on field observations, the items appears it could have released MC to the surrounding soils. Samples will be collected from areas of expended munitions if it is suspected that MC may have been released. It is not expected that there would be any MC where MD is located. If more than three locations are identified for sampling, the sampling approach in this Work Plan Addendum will be revisited with the key organizations discussed in **Section 2.4** to determine if additional samples should be collected.

Surface soil samples will be collected using the TR-02-1 approach described in the United States Army Corps of Engineers (USACE) Technical Report ERDC/CRREL TR-02-1, *Guide for Characterization of Sites Contaminated with Energetic Materials* (Thiboutot, Ampleman, and

Hewitt, 2002) with the exception of the collection depth of the sample increments. Each sampling location will be defined as an area 1m × 1m in size. Coordinates of the sampling locations will be based on the center of the sampling area. Soil samples will be collected by compositing a minimum of 30 sample increments from random locations within each 1m × 1m sampling location. The sample increments will be approximately equal in the amount of soil, which will be collected from depths of 0 to 6 inches bgs. The sample increments at each location will be composited into a single sample following the *Homogenization of Soil and Sediment Samples* SOP in Appendix C of the MRP Master Project Plans prior to being transferred to the appropriate sample containers.

Samples will be analyzed by a fixed base laboratory for the following parameters (**Tables 3-1 through 3-3**):

- Explosives residues (SW-846 USEPA Method 8330)
- PETN (SW-846 USEPA Method 8330)
- Nitroglycerine (SW-846 USEPA Method 8332)
- Perchlorate (SW-846 USEPA Method 6850)
- TAL metals (SW-846 USEPA Method 6010B)

Phase 1 BPEA: Direct Push Subsurface Soil Sampling

During Phase 1 of the Focused SI, a track-mounted DPT rig will be used to collect subsurface soil samples in accordance with the *Direct-Push Soil Sample Collection* SOP in Appendix C of the MRP Master Project Plans. Three subsurface soil samples (designated MR06-IS65 through MR06-IS67) will be collected from just above the water table (expected to range from 9 to 20 feet bgs) at the locations shown in **Figure 3-1.**

Soil cores will be classified according to American Society for Testing and Materials (ASTM) Standard D2488-69, *Description of Soils (Visual-Manual Procedure).*

MEC anomaly avoidance will be practiced during DPT subsurface soil sampling as described in the APP (**Appendix D**). At the start of each borehole, a UXO technician will hand auger to a depth of 5 feet bgs, checking the borehole with a downhole magnetometer at one foot increments. If the water table is encountered at a depth less than 5 feet bgs, subsurface soil samples will be collected with a hand auger.

Samples will be analyzed by a fixed base laboratory for the following parameters (**Tables 3-1 through 3-3**):

- Explosives residues (SW-846 USEPA Method 8330)
- PETN (SW-846 USEPA Method 8330)
- Nitroglycerine (SW-846 USEPA Method 8332)
- Perchlorate (SW-846 USEPA Method 6850)
- TAL metals (SW-846 USEPA Method 6010B)

Phase 1A and Phase 2 BPEA: Surface Soil Modified TR-02-1 Sampling

Soil samples were previously collected from within the Phase 1A and Phase 2 BPEA as part of the PA/SI investigation (CH2M HILL, 2009); therefore, additional soil samples will only be collected at locations identified during this Focused SI where soils may have been impacted by MEC, MPPEH, or where explosives are used during the MEC intrusive

investigation. Up to 48 samples (MR06-SS86 through MR06-SS133) will be collected from within the Phase 1A and Phase 2 BPEA. Sample locations will be selected using the methodology described above for the Phase 1 surface soil modified TR-02-01 sampling. If more than 48 locations are identified for sampling, the sampling approach in this Work Plan Addendum will be revisited with the key organizations discussed in **Section 2.4** to determine if additional samples should be collected.

Samples will be analyzed by a fixed base laboratory for the following parameters (**Tables 3-1 through 3-3**):

- Explosives residues (SW-846 USEPA Method 8330)
- PETN (SW-846 USEPA Method 8330)
- Nitroglycerine (SW-846 USEPA Method 8332)
- Perchlorate (SW-846 USEPA Method 6850)
- TAL metals (SW-846 USEPA Method 6010B)

A summary of the sampling program for the Focused SI activities at the BPEA is presented in **Table 3-1**.

3.6.2 Analytical Requirements and Sample Handling

Sample Preservation and Handling

Sample preservation must occur in the field immediately after collection. The containers supplied by the laboratory will contain the applicable preservative. This will protect field personnel from transporting, handling, and measuring concentrated acids and bases. QA/QC samples will be collected in the same types of preserved containers as the field samples. The preservative and holding time requirements for analysis are shown in **Table 3-2**.

Quality Assurance and Quality Control

QA/QC requirements for environmental sampling, handling, and management are detailed in Section 4 of the MRP Master Project Plans. Field QC samples (including field blanks, equipment blanks, duplicate samples, and matrix spike/matrix spike duplicate [MS/MSD] samples) will be collected during the investigation and submitted for laboratory analysis. Required QA/QC samples and the required frequency of collection are summarized in **Table 3-3**.

Sample Collection Frequencies

Table 3-4 presents the anticipated number of field samples and their associated QA/QC samples.

Sample Identification System

The following is a general guide for sample identification; an electronic sample–tracking program will be used to manage the flow of information from the field sampling team to the laboratory and to internal and external data users. The tracking program is used to manage the entry of sampling-related data, such as station locations and field measurements.

While in the custody of the sampling team, the sample analysis data will be recorded in field logbooks, along with sample identity information.

Labels for samples to be shipped to a fixed-base laboratory will be produced electronically. If they cannot be produced electronically, they must be written legibly in indelible ink.

The following information typically is included on the sample label:

- Site name or identifier
- Unique sample identification number
- Date and time of sample collection
- Sampler's initials
- Sample matrix or matrix identifier
- Type of analyses to be conducted

Each analytical sample will be assigned a unique number using the following format:

Site#-Media/Station# or *QA/QC-Year/Quarter* or *Depth Interval*

An explanation of each of these identifiers is given below.

Site#: This investigation includes MMRP Site UXO-06 under the MRP; therefore, the prefix "MR06" will be used.

Media: SS = Surface soil
IS = Subsurface soil

Station#: Soil borings will be numbered consecutively.

QA/QC: D = Duplicate sample (following sample type/number)
FB = Field blank
ER = Equipment rinsate
MS= Matrix Spike
SD = Matrix Spike Duplicate

Year/Quarter#: Year/Quarter indicators will be used for all samples. Each round of sampling will have a distinct identification number:

"09" = Year 2009
"C" = Sampling during the third quarter

Depth Interval: Depth indicators will be used for soil samples collected using DPT. The number will reference the depth interval (in feet) of the sample:

2–3 = 2 to 3 feet bgs

Under this sample designation format, "MR06-IS01-2-3" would mean the following:

MR06-IS01-2-3-09C	MMRP Site UXO-06
MR06-IS01-2-3-09C	subsurface soil sample from soil boring #1
MR06-IS01-2-3-09C	subsurface soil sample collected from 2 to 3 feet bgs
MR06-IS01-2-3-09C	sampling in the third quarter of year 2009

This sample designation format will be followed throughout the project. Required deviations to this format in response to field conditions will be documented in the field log book.

Sample Packaging and Shipping

Samples will be packed in a cooler with bubble wrap packaging material and double-bagged ice. The samples will be either picked up at the site by the analytical laboratory or shipped to the laboratory via overnight courier. The Field Team Leader (FTL) is responsible for the following activities related to shipment of the samples:

- Verification that all sample bottles are correctly labeled, sealed, and packaged
- Check to ensure that sample bottles in each cooler correspond to the accompanying COC form
- Affixing a custody seal to each cooler
- Use of appropriate labels and forms required for shipment

Custody of the samples will be maintained and documented at all times. COC will begin with the collection of the samples in the field and will continue through the analysis of the sample at the analytical laboratory (samplers must transfer custody to the person responsible for shipping the samples).

3.6.3 Investigation-Derived Waste Management

All investigation-derived waste (IDW) generated during the investigation will be managed in accordance with the MCB Camp Lejeune Waste Management Plan (WMP) (CH2M HILL, 2008b)

Anticipated IDW includes soil cuttings and decontamination fluids. Based upon the previous investigations conducted at Site UXO-06, soil IDW generated at this site is not suspected to be from a known source area. Therefore, the soil cuttings generated during soil sampling activities will be returned to the borehole from which they were removed unless field observations indicated the soil cuttings are impacted. Decontamination fluids generated during the field activities will be properly containerized in labeled 55-gallon drums and disposed of at a certified offsite disposal facility.

3.7 Accident Prevention Plan

The APP is provided in **Appendix D**. Due to the potential presence of MEC at this site, MEC avoidance techniques will be employed during the field investigation to ensure the safety of all onsite personnel. Procedures for conducting MEC avoidance are provided in the APP.

3.8 Data Documentation and Processing Procedures

Documentation and processing of field data, lab data, and investigation results will be completed in accordance with Section 7.2 of the MRP Master Project Plans.

3.9 Project File Requirements

This project will require the administration of a central project file. Project data and records will be managed in accordance with Section 7.3 of the MRP Master Project Plans.

TABLE 3-1
Summary of Sampling Program
Focused Site Inspection Work Plan Addendum for Site UXO-06 Base Borrow Pit Expansion
MCB Camp Lejeune
Jacksonville, North Carolina

Sample Media	Sample ID Number	Sample Depth/Location and Rationale	Analysis				
			Explosives Residues	Perchlorate	PETN	Nitroglycerine	TAL Metals
Phase 1							
Multi-Increment Surface Soil	MR06-DU (02 through 04)-SS01 through MR06-DU(02 through 04)-SS03	Collected from an interval of 0 - 2 inches bgs at each location shown on Figure 3-1. Will allow for characterization surface soil across the investigation area.	x	x	x	x	x
Direct Push Soil	MR06-IS65-T-B - 09C through MR06-IS67-T-B-09C	Collected from a 2 ft interval just above the water table at each location shown on Figure 3-1. Will allow for characterization of subsurface soil across the investigation area.	x	x	x	x	x
Modified TR-02-1 Surface Soil	MR06-SS83-09C through MR06-SS85-09C	Collected from an interval of 0 - 6 inches bgs in the vicinity of MEC, MPPEH, or where explosives are used during the MEC intrusive investigation. Will allow for characterization of surface soil in these locations.	x	x	x	x	x
Phase 1A and Phase 2							
Modified TR-02-1 Surface Soil	MR06-SS86-10B through MR06-SS133-10B	Collected from an interval of 0 - 6 inches bgs in the vicinity of MEC, MPPEH, or where explosives are used during the MEC intrusive investigation. Will allow for characterization of surface soil in these locations.	x	x	x	x	x

Notes and Abbreviations:
For Direct Push Soil Samples: "T-B" refers to the top depth and bottom depth of the sample interval
PETN: Pentaerythritol tetranitrate

TABLE 3-2
Analyses, Bottleware, Preservation, and Holding Time Requirements
Focused Site Inspection Work Plan Addendum for Site UXO-06 Base Borrow Pit Expansion
MCB Camp Lejeune
Jacksonville, North Carolina

Media	Analysis	Method	Container	Preservation & Storage	Holding Times
Soil	Explosives Residues/ PETN and Nitroglycerin	SW-846 USEPA Method 8330/8332	1x4-oz glass jar	4ºC	14 days to extraction, 40 days from extraction to analysis
	Perchlorate	SW-846 USEPA Method 6850	1x8-oz bottle, Teflon cap	4ºC	28 days to extraction, 40 days from extraction to analysis
	TAL Metals	SW-846 USEPA Method 6010B	1x4-oz bottle, Teflon cap	4ºC	6 months, Mercury: 28 days

Notes:
ºC= degrees Celsius
oz = ounce
PETN: Pentaerythritol tetranitrate
USEPA= United States Environmental Protection Agency
TAL- Target Analyte List

TABLE 3-3
Required QA/QC Samples
Focused Site Inspection Work Plan Addendum for Site UXO-06 Base Borrow Pit Expansion
MCB Camp Lejeune
Jacksonville, North Carolina

Sample Type	Description	Frequency	Analytes
Field Blank	Designed to detect contamination in the decontamination water. A field blank is decontamination water collected directly in the sample bottle. It shall be handled like a sample and transported to the laboratory for analysis.	One field blank from each source of decontamination water for each sampling event, where a sampling event is defined as one week	All laboratory analyses requested for the environmental samples collected at the site for that week
Equipment Blank	Designed to detect contamination of environmental samples caused by contamination of sampling equipment. An equipment blank is analyte-free water that is poured into or pumped through the sampling device, transferred to a sample bottle, and transported to the laboratory for analysis.	One per day for reusable sampling equipment and one per lot of disposable sampling equipment	All laboratory analyses requested for environmental samples collected at the site on that day
Field Duplicate	Designed to check precision of data in the laboratory. A field duplicate is a sample collected in addition to the native sample at the same sampling location during the same sampling event.	10%	Same parameters as native sample
MS/MSD	Designed to evaluate potential matrix interferences, accuracy, and precision. Three aliquots of a single sample—one native and two spiked with the same concentration of matrix spike compounds—are analyzed.	5%	Same parameters as native sample

TABLE 3-4
Sample Collection Frequencies
Focused Site Inspection Work Plan Addendum for Site UXO-06 Base Borrow Pit Expansion
MCB Camp Lejeune
Jacksonville, North Carolina

Analysis	Sample Matrix	Field Samples	Field Duplicates	Equipment Blanks	Field Blanks	MS/MSDs
Phase 1						
Surface Soil Samples						
Explosives Residues, including PETN and Nitroglycerine	Solid	12	2	1	1	1
Perchlorate		12	2	1	1	1
TAL Metals		12	2	1	1	1
Direct Push Subsurface Soil Samples						
Explosives Residues, including PETN and Nitroglycerine	Solid	3	1	1	1	1
Perchlorate		3	1	1	1	1
TAL Metals		3	1	1	1	1
Phase 1A and Phase 2						
Surface Soil Samples						
Explosives Residues, including PETN and Nitroglycerine	Solid	48	5	5	1	3
Perchlorate		48	5	5	1	3
TAL Metals		48	5	5	1	3

Notes:
MS/MSD = Matrix Spike and Matrix Spike Duplicate pair
PETN= Pentaerythritol tetranitrate
TAL-Target Analyte List
The maximum numbers of samples proposed in the Work Plan are displayed in this table.

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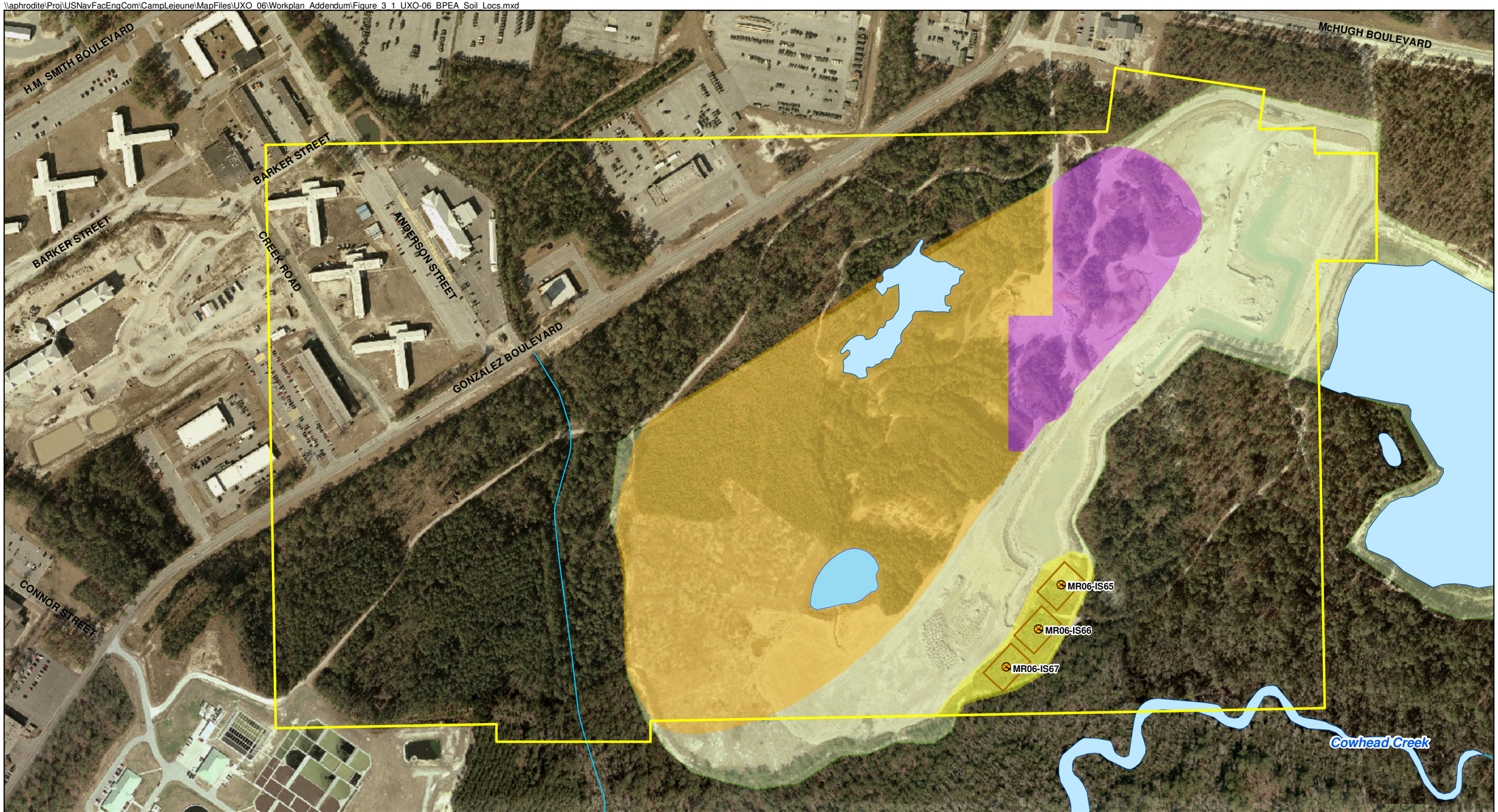

Legend

- Subsurface Soil Sample
- Stream
- Surface Water Body
- UXO-06 Site Boundary
- Phase 1 Borrow Pit Expansion Area
- Phase 1A Borrow Pit Expansion Area
- Phase 2 Borrow Pit Expansion Area
- Active Borrow Pit
- Decision Units (30m x 46m)

N

0 175 350 700 Feet

1 inch = 350 feet

Figure 3-1
BPEA Soil Sampling Locations
Site UXO-06 Base Borrow Pit Expansion
MCB Camp Lejeune
North Carolina

CH2MHILL

SECTION 4

MEC Intrusive Investigation Plan

Based on the results of the BPEA geophysical investigations, MEC intrusive investigations of selected geophysical anomalies will be conducted to evaluate the nature and extent of potential MEC contamination and reduce potential exposure of site workers to MEC. The equipment, approach, methods, operation procedures, and QC to be used during the MEC intrusive investigations are detailed below.

4.1 Planning

The following actions require advanced planning and will be conducted prior to mobilization:

- Finalize procurement actions for items and services needed during the mobilization.
- Hold a pre-mobilization meeting and Operations Readiness Review with the project team.
- Coordinate with NAVFAC Project Manager (PM) and Base Point of Contact on notification to local stakeholders of upcoming project activities.
- Reconfirm site personnel documentation of proper training, certifications, and medical monitoring.

4.2 Site Preparation

The following subsections describe the procedures associated with site preparation, including mobilization of personnel and equipment and the activities required to prepare the site for intrusive activities.

4.2.1 Mobilization

A mobilization period will include identifying, briefing, and mobilizing staff and securing and deploying equipment. Mobilization activities include general activities, establishing a command post, and a kickoff and safety meeting.

General Activities

- Identify/procure, package, ship, and inventory project equipment, including geophysical detection equipment, hand tools and supplies, excavator (if necessary), portable toilets, and any other miscellaneous supplies.
- Coordinate with local agencies, including police, hospital, and fire department, as appropriate.
- Finalize operating schedules.
- Establish MPPEH storage area.

- Organize support facilities and test communication equipment.
- Test and inspect equipment.
- Assemble and transport the work force.
- Conduct site-specific training on the Work Plan Addendum, APP, and MEC procedures and hazards.
- Verify that all forms and project documentation are in order and project team members understand their responsibilities with regard to completion of project reporting requirements.

Command Post

- A project command post will be established in an area that is convenient to intrusive activities, but outside the exclusion zones (EZs) that will be established for intrusive activities.
- A field office equipped with power and communications will be established at the command post. The field office will be the central point of communications for the project and the command location for direction and coordination of intrusive activities at the BPEA. Personnel will report to this building at the beginning of each workday for the daily H&S briefing. Site documents, including H&S records, will also be maintained in the field office.
- Sanitary facilities will be located at the command post.
- Lockable storage will be provided, either in the field office or in storage trailers, for portable field equipment.

Kickoff/Safety Meeting

During mobilization, a kickoff and site safety meeting will be conducted. This meeting will include a review of this Work Plan Addendum and review and acknowledgment of the APP by all site personnel. Additional meetings will occur as needed, as new personnel, visitors, and/or subcontractors arrive at the site.

4.3 MEC Removal Operations

Anomaly reacquisition/intrusive investigation is the only MEC removal technique anticipated to be employed during the MEC intrusive investigation at Site UXO-06. This operation will be performed using hand excavation tools (where possible) to identify the source of individual anomalies following reacquisition operations. Where hand-excavation tools are insufficient to excavate individual DGM anomalies, heavy equipment will be used.

4.3.1 Anomaly Reacquisition/Intrusive Investigation

All geophysical anomalies identified for excavation will be reacquired by an intrusive investigation team, composed of UXO technicians, to an exact location using real time kinetic (RTK) global positioning system (GPS) and a handheld magnetometer. After locating the approximate anomaly position with the GPS, the magnetometer will be used to confirm the exact position of the anomaly. If the anomaly is not immediately intrusively

investigated, the location will be flagged using a polyvinyl chloride (PVC) flag with the unique identifier number recorded in indelible ink. The location will be flagged 1 foot north of the actual field location of each reacquired anomaly shown on the tracking sheet.

Excavation of individual geophysical anomalies will be performed by UXO technicians. The UXO teams performing this work will be composed of UXO technicians supervised by a UXO Technician III. Details associated with this operation are included in the MEC Removal SOPs **(Appendix E).**

Hand tools will be used for the majority of the items, which generally are expected to be found near the surface. The following basic technique will be used for anomaly excavation:

- The UXO technician will investigate within a 1-m radius of the flagged anomaly with an appropriate geophysical instrument.
- Until identified otherwise, the anomaly is assumed to be MEC. Excavation will be initiated adjacent to the subsurface anomaly. The excavation will continue until the excavated area has reached a depth below the top of the anomaly as determined by frequent inspection with an appropriate geophysical instrument.
- Using progressively smaller and more delicate tools to remove the soil carefully, the excavation team will expand the sidewall to expose the metallic item for inspection and identification without moving or disturbing the item.
- Once the item is exposed for inspection, the excavation team will determine whether the item is MEC or MPPEH. All MEC, with the exception of 3.5-inch rockets, will be blown-in-place (BIP) as discussed in **Section 4.6**. If 3.5-inch rockets are found in multiple locations during a single workday, up to five may be consolidated within the munitions response site (MRS) for treatment as discussed in **Section 4.6**.
- Following MPPEH removal or MEC demolition, the area will be rechecked with the Schonstedt GA-52Cx or the EM61-MK2 to ensure that another item was not hidden beneath the removed item. The excavation team will then annotate the results of the excavation on the dig sheet and move on to the next marked geophysical anomaly.

4.4 Removal Verification

The following is the procedure to be followed for QC inspections of the MEC intrusive investigation:

- After the dig team intrusively investigates an anomaly location, the hole is to be left open to the depth investigated and the PVC flag placed in the hole or bent after the investigation is completed.
- The UXO QC Specialist (UXOQCS) will inspect at least 10 percent of the intrusively investigated anomaly locations using a Schonstedt GA-52Cx or an EM61-MK2 to determine whether the anomalies have been removed. The locations checked will be distributed in a spatially representative sample across each grid.
- All holes related to intrusive investigations will be filled back to original grade or covered before departing the project site each day.

- Anomaly locations inspected, along with results of the inspection and corrective actions planned in the event that the UXOQCS determines that inspection results require a change in intrusive team procedures or a re-performance of any work, will be documented by the subcontractor and provided to the CH2M HILL geophysicist.
- Additional QC analysis of intrusive results vs. original amplitude of geophysical anomalies will be performed by the CH2M HILL geophysicist. Anomaly locations that are determined to need re-investigation through this process will be re-inspected.

4.5 Demobilization

Full demobilization will occur when the project is completed and appropriate QA/QC checks have been performed. Personnel who are no longer needed during the course of field operations may be demobilized prior to the final project completion date. The following will occur prior to demobilization:

- All areas to be investigated will be verified as completed.
- Restoration of the site to an appropriate level will be verified.
- All equipment will be inspected, packaged, and shipped to the appropriate location.
- All facilities-support infrastructures will be dismantled and shipped to the appropriate location, and the field site will be returned to the original condition prior to mobilization.

4.6 Procedures for Reporting and Disposition of MEC and MPPEH Items

This section discusses the procedures for reporting and disposing of MEC and MPPEH items encountered during the project, including the responsibilities of personnel, overall safety precautions, data reporting, transportation, safe holding areas, operations in populated/areas, demolition operations, and required engineering controls and EZs for intrusive operations and intentional detonations.

4.6.1 Responsibilities of Personnel

The general responsibilities of project personnel are described in **Section 2.4**.

4.6.2 Overall Safety Precautions

The overall safety precautions described in Section 2.5.1 of the MRP Master Project Plans will be adhered to during the intrusive investigation.

All MEC items, with the exception of 3.5-inch rockets, will be disposed of by BIP methods by countercharging these items with an explosive donor charge and detonating the donor charge. If 3.5-inch rockets are found in multiple locations during a single workday, up to five may be consolidated within the MRS for treatment. Practice 3.5-inch rockets will be cracked open with a shape charge to expose the filler. Prior to all planned detonations, the Senior Unexploded Ordnance Supervisor (SUXOS) will notify the MCB Camp Lejeune EOD Company by contacting the MCB Camp Lejeune Range Control office (910-451-1236).

4.6.3 Data Reporting

Data reporting for each geophysical anomaly will be done in accordance with Section 2.5.2 of the MRP Master Project Plans.

4.6.4 Operations in Populated and Sensitive Areas

Although no populated areas are located directly within the BPEA, there are populated areas around the perimeter that could be impacted by intrusive operations. If the MEC intrusive operations proceed towards areas containing transportation routes which fall within the public transportation route (PTR) distance, the FTL will coordinate with Base operations to implement traffic controls. Such controls may include temporarily closing unpaved access roads located throughout the BPEA during intrusive or detonation operations in which the PTR distance arc intersects the roadway.

If detonation of recovered MEC or MPPEH is required, these detonations would not impact inhabitants of buildings. The EZ for intentional detonation will be determined for each detonation operation. If an inhabited building is impacted, the demolition team will attempt to mitigate this impact through the use of engineering controls. If engineering controls do not adequately reduce the EZ, the FTL will coordinate with Base operations to evacuate the inhabited buildings. If possible, demolition operations will be performed after regular building occupation hours. There are no sensitive habitats or threatened and endangered species located within the project area.

4.6.5 Exclusion Zones and Separation Distance

Based on the types of munitions used at Site UXO-06, the munition with the greatest fragmentation distance (MGFD) assumed for the BPEA is 3.5-inch practice rocket. In addition, a 3.5-inch high explosives (HE) rocket is included as a contingency MGFD. Explosive Safety Quantity Distance (ESQD) arcs were developed based on the primary and contingency MGFD calculations and are a shown on **Figures 4-1 and 4-2,** respectively.

Primary and contingency ESQD values are identified on **Tables 4-1 and 4-2** respectively, which include the team separation distance (TSD) for personnel conducting intrusive operations within BPEA, the minimum separation distance (MSD) for non-essential personnel, the PTR distance, and the inhabited building distance (IBD) for the 3.5-inch practice rocket, the 3.5-inch HE rocket, and MPPEH under specified scenarios.

If, during the course of this project, a MEC item with a greater fragmentation distance than that of the primary MGFD is encountered, the ESQD arcs will be adjusted to the contingency MGFD distances. In the unlikely case a MEC item with a greater fragmentation distance than the contingency MGFD is encountered, the ESQD arcs will be adjusted and the ESS will be amended.

4.7 Scrap and Munitions Debris Disposition

4.7.1 Inspection and Segregation

The approach for collecting, inspecting, and segregating site debris is discussed in Section 2.6.1 of the MRP Master Project Plans. If the item is identified as MEC, it is handled as described in **Section 6**.

4.7.2 Inspection, Certification, and Verification

MPPEH will be inspected, certified, and verified in accordance with Section 2.6.2 of the MRP Master Project Plans. MPPEH that cannot be certified and verified as "Safe" will remain at the grid collection point and will be treated in the same manner as MEC (**Section 6**).

4.7.3 Recording, Reporting, and Implementation of Lessons Learned during the Project

Lessons learned will be performed in accordance with Section 2.7 of the MRP Master Project Plans.

TABLE 4-1
Exclusion Zone Parameters – Primary MGFD
Focused Site Inspection Work Plan Addendum for Site UXO-06 Base Borrow Pit Expansion
MCB Camp Lejeune
Jacksonville, North Carolina

Scenario	Item	Net Explosives Weight (NEW) (lb)	TSD (ft)	MSD for Public & Non-Essential Personnel (ft)	IBD (ft)	PTR (ft)
Unintentional Detonation	Practice 3.5-inch rocket	.44 lbs. M 7 Propellant	31 feet	31 feet	N/A	N/A
Demolition Set-Up	M 28 3.5-inch HEAT rocket (1 each)	1.88 lbs. Comp B	56 feet	235 feet	N/A	N/A
Demolition Set-Up	M 28 3.5 inch HEAT Rocket (5 each)	11.40 lbs.	91 feet	235 feet	N/A	N/A
Intentional Detonation for public and all personnel	M 28 3.5-inch HEAT Rocket (1 each)	1.88 lbs. Comp B	N/A	1420 feet (Single HE rocket no engineering controls)	N/A	N/A
Intentional Detonation for public and all personnel	M 28 3.5-inch HEAT rocket (5 each)	11.40 lbs.	N/A	383 feet (5 rockets using engineered control Buried Explosion Module plus 33% safety factor)	N/A	N/A
Onsite Consolidation, Storage, and Re-inspection	MPPEH	10 lbs.	N/A	N/A	474 feet	284 feet

Notes:

All exclusion zone parameters are based on the calculating the appropriate K factor. For unintentional detonations, shot setup and TSD = D=40W1/3. MSD for public and non-essential personnel during demolition set up = HFD from TP 16. Intentional detonation = DDESB Buried Explosion Module Version 4.0 and employment of engineering controls. Intentional detonation distance = 288ft Fragment Hazard Range + 20% due to multiple rounds IAW TP 16 appendix C.

IBD – Inhabited Building Distance; MPPEH – Material Presenting a Potential Explosive Hazard; MSD – Minimum Separation Distance; NA – Not Applicable; PTR – Public Transportation Route; TSD – Team Separation Distance

TABLE 4-2
Exclusion Zone Parameters – Contingency MGFD
Focused Site Inspection Work Plan Addendum for Site UXO-06 Base Borrow Pit Expansion
MCB Camp Lejeune
Jacksonville, North Carolina

Scenario	Item	NEW (lb)	TSD (ft)	MSD for Public & Non-essential Personnel (ft)	IBD (ft)	PTR (ft)
Unintentional Detonation	3.5-inch HE rocket	1.88 lbs. Comp B	56 feet[a]	235 feet	N/A	N/A
Demolition Set-Up	M 28 3.5 inch HEAT Rocket (1 each)	1.88 lbs. Comp B	56 feet[a]	235 feet	N/A	N/A
Demolition Set-Up	M 28 3.5 inch HEAT Rocket (5 each)	11.40 lbs.	91 feet	235 feet	N/A	N/A
Intentional Detonation for public and all personnel	M 28 3.5-inch HEAT Rocket (1 each)	1.88 lbs. Comp B	N/A	1420 feet (Single HE rocket no engineering controls)	N/A	N/A
Intentional Detonation for public and all personnel	M 28 3.5 inch HEAT rocket (5 each)	11.40 lbs.	N/A	383 feet (5 rockets using engineered control Buried Explosion Module plus 33% safety factor)	N/A	N/A
Onsite Consolidation, Storage, and Re-inspection	MPPEH	10 lbs.	N/A	N/A	474 feet	284 feet

Notes:

All exclusion zone parameters are based on the fragmentation distances in DDESB TP 16
IBD – Inhabited Building Distance; MPPEH – Material Presenting a Potential Explosive Hazard; MSD – Minimum Separation Distance; NA – Not Applicable; PTR – Public Transportation Route; TSD – Team Separation Distance

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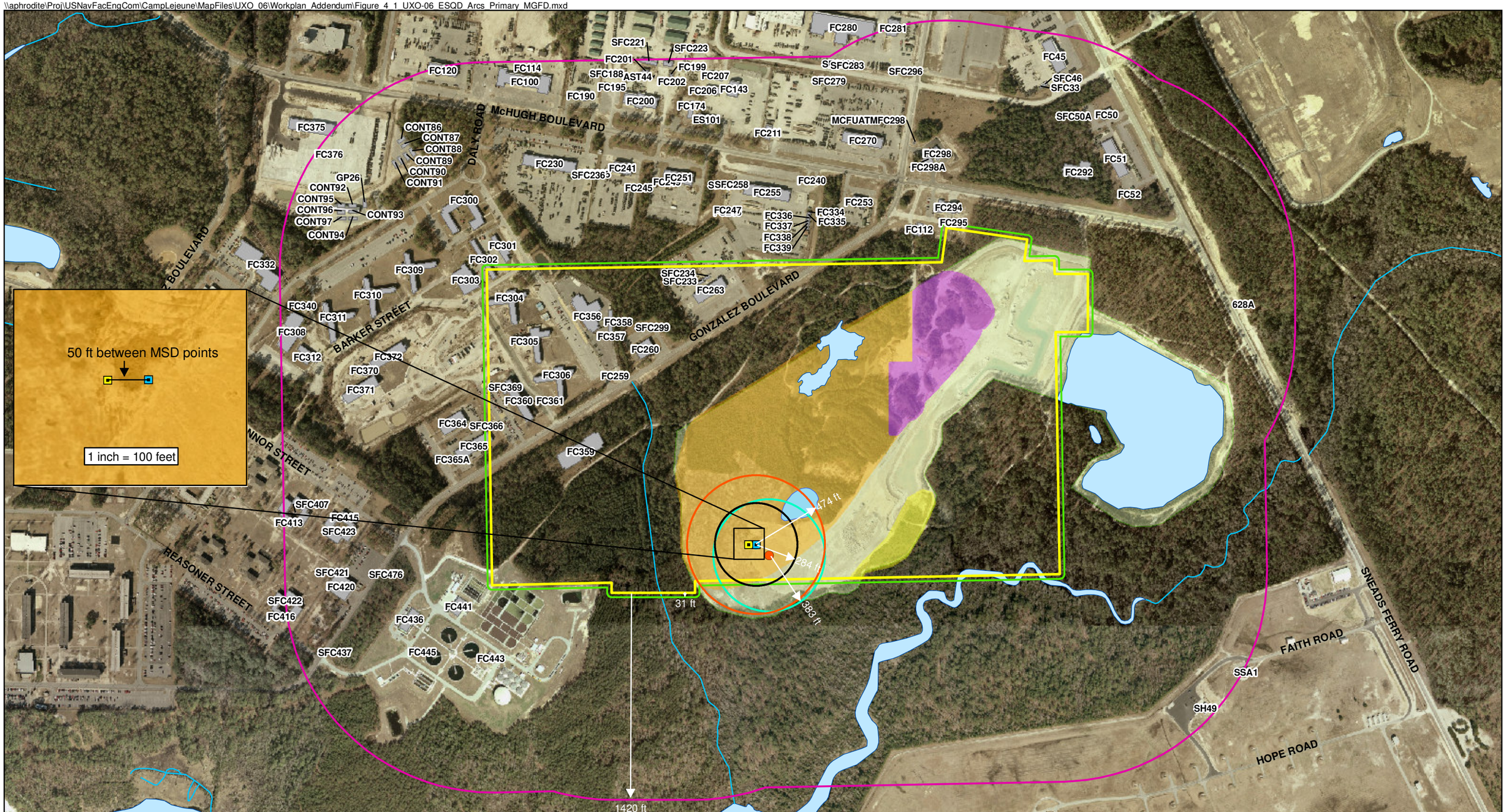

Legend

- Controlled Detonation Area
- MPPEH - Scrap Collection Point
- Non-MPPEH - Scrap Collection Point
- UXO-06 Site Boundary
- MPPEH Scrap Collection Point PTR = 284 ft
- MPPEH Scrap Collection Point IBD = 474 ft
- Intentional Detonation MSD based on BEM (5 Rockets) plus 33% safety factor = 383 ft
- Unintentional Detonation TSD and MSD = 31 ft
- Intentional Detonation MSD without engineering controls = 1,420 ft
- Active Borrow Pit
- Phase 1 Borrow Pit Expansion Area
- Phase 1A Borrow Pit Expansion Area
- Phase 2 Borrow Pit Expansion Area
- Buildings within the ESQD Arcs
- Stream
- Surface Water Body

MSD - Minimum Separation Distance
TSD - Team Separation Distance
PTR - Public Transportation Route
BEM - Buried Explosion Module

N

0 325 650 1,300 Feet

1 inch = 650 feet

Figure 4-1
Explosives Safety Quantity Distance (ESQD) Arcs
for Primary MGFD (3.5" Practice Rocket)
Site UXO-06 Base Borrow Pit Expansion
MCB Camp Lejeune
North Carolina

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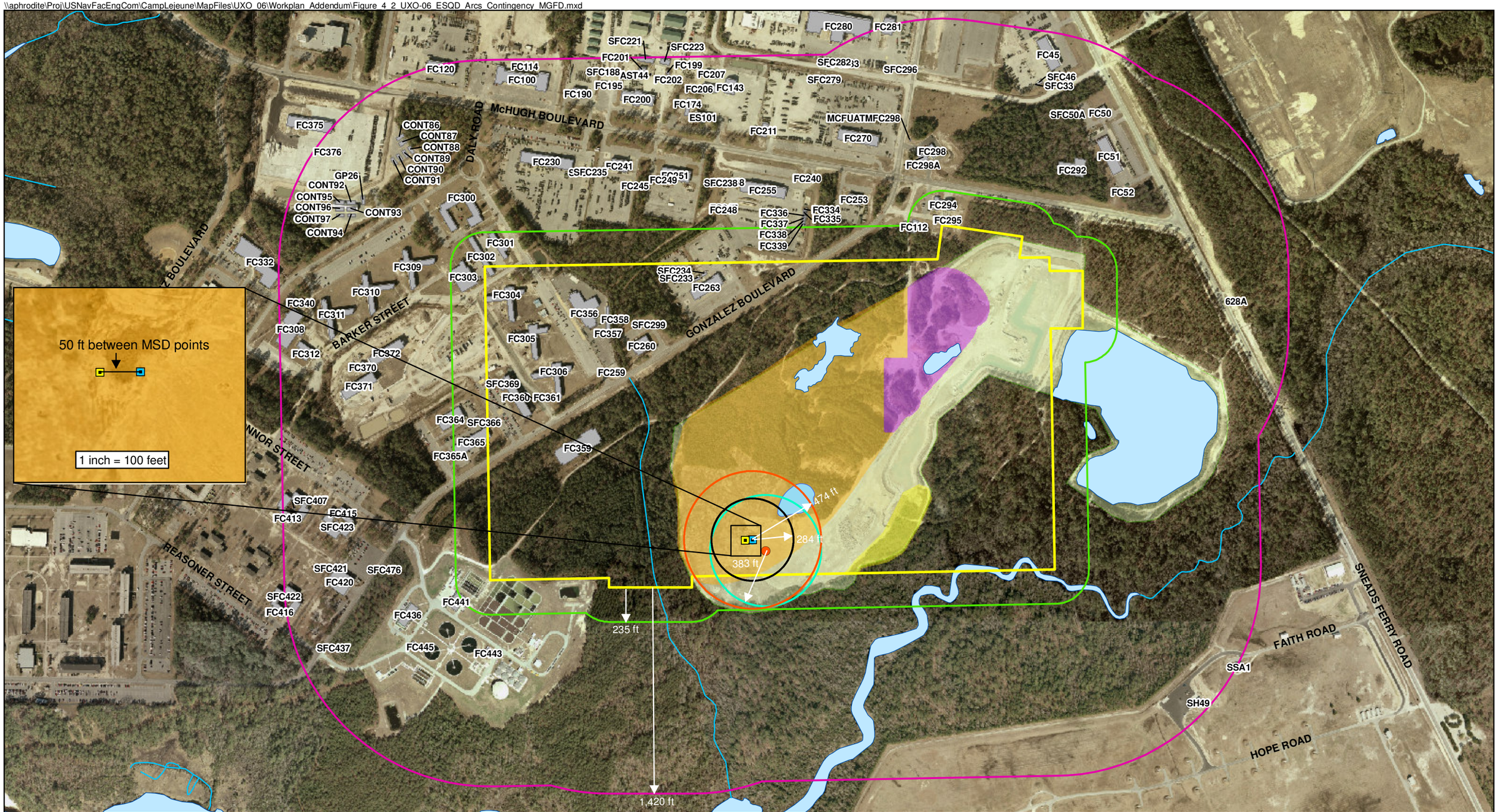

Legend

- Controlled Detonation Area
- MPPEH - Scrap Collection Point
- Non-MPPEH - Scrap Collection Point
- UXO-06 Site Boundary
- MPPEH - Scrap Collection Point PTR = 284 ft
- MPPEH Scrap Collection Point IBD = 474 ft
- Intentional Detonation MSD based on BEM (5 Rockets) plus 33% safety factor = 383 ft
- Unintentional Detonation MSD = 235 ft
- Intentional Detonation MSD without engineering controls = 1,420 ft
- Active Borrow Pit
- Phase 1 Borrow Pit Expansion Area
- Phase 1A Borrow Pit Expansion Area
- Phase 2 Borrow Pit Expansion Area
- Buildings within the ESQD Arcs
- Stream
- Surface Water Body

MSD - Minimum Separation Distance
TSD - Team Separation Distance
PTR - Public Transportation Route
BEM - Buried Explosion Module

N

0 325 650 1,300 Feet

1 inch = 650 feet

Figure 4-2
Explosives Safety Quantity Distance (ESQD) Arcs
for Contingency MGFD (3.5" HE Rocket)
Site UXO-06 Base Borrow Pit Expansion
MCB Camp Lejeune
North Carolina

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SECTION 5

Explosives Management Plan

The management of explosives to support the removal and disposal of MEC and MPPEH items that may be discovered during the investigation within the BPEA will be done in accordance with Section 3 of the MRP Master Project Plans.

SECTION 6

Explosives Siting Plan

Planning and siting explosives operations for the MEC removal action within the BPEA will be done in accordance with Section 4 of the MRP Master Project Plans. ESQD arcs for the primary and contingency MGFD are a shown on **Figures 4-1 and 4-2,** respectively. Primary and contingency ESQD values are identified on **Tables 4-1 and 4-2** respectively.

There are no planned or established MEC detonation areas. MEC, with the exception of 3.5-inch rockets, will be BIP where it is found. If 3.5-inch rockets are found in multiple locations during a single workday, up to five may be consolidated at a single locations within the BPEA for treatment. The rockets will be transported only short distances within the BPEA and under no circumstances will they be transported on PTRs.

SECTION 7

Quality Control Plan

All applicable work conducted by CH2M HILL and its subcontractors at Site UXO-06 will be performed in accordance with the QCP in Section 8 of the MRP Master Project Plans. The QCP describes the QC approach and procedures to be employed during the investigation of Site UXO-06. The QCP is divided into two parts: Section 8.1 addresses environmental investigation activities and Section 8.2 addresses MEC avoidance, surveying, and DGM activities.

The specific QC audit procedures for the definable features of work (DFOW) to be employed at the BPEA, including the phase during which it is performed, the frequency of performance, the pass/fail criteria, and actions to take if failure occurs, are presented in **Table 7-1**.

TABLE 7-1
Definable Features of Work Auditing Procedures
Focused Site Inspection Work Plan Addendum for Site UXO-06 Base Borrow Pit Expansion
MCB Camp Lejeune
Jacksonville, North Carolina

Definable Feature of Work with Auditable Function	Responsible Person(s)[1]	Audit Procedure[2]	QC Phase[3]	Freq. of Audit	Pass/Fail Criteria	Action if Failure Occurs
Planning						
Geographical Information System (GIS) Setup (Pre-mobilization Activities)	Project GIS Manager	Verify GIS system has been set up and is ready for site data.	PP	O	GIS system has been set up and is ready for site data.	Do not proceed with field activities until criterion is passed.
Document management and control (Pre-mobilization Activities)	Project Manager/Site Manager	Verify appropriate measures are in place to manage and control project documents.	PP	O	Appropriate measures are in place to manage and control project documents.	Do not proceed with field activities until criterion is passed.
Data Management (Pre-mobilization Activities)	Project Manager, Project Geophysicist	Verify appropriate measures are in place to manage and control project data.	PP	O	Appropriate measures are in place to manage and control project data.	Do not proceed with field activities until criterion is passed.
Subcontracting (Pre-mobilization Activities)	Project Manager, Site Manager	Verify subcontractor qualifications, training, and licenses.	PP/IP	O	Subcontractors' qualifications, training, and licenses are up to date and acceptable.	Ensure subcontractor provides the qualifications, training, and licenses or change subcontractor.
Technical and Operational approach (Project Planning)	Project Manager/Site Manager	Verify technical and operational approaches have been agreed on by the project team.	PP/IP	O	Technical and operational approaches have been agreed on by project team and incorporated into the Work Plans.	Do not proceed with field activities until criterion is passed
Geophysical Prove-out (GPO) Plan preparation and approval	Project Manager/Site Manager	Verify GPO Plan has been prepared and approved.	PP/IP	O	GPO Plan has been approved	Do not proceed with field activities until criterion is passed.
Work Plan preparation and approval	Project Manager	Verify Work Plan prepared and approved.	PP/IP	O	Work Plan has been approved	Do not proceed with field activities (excluding site mobilization) until criterion is passed.
Field Operations						
Site preparation (Mobilization)	Project Manager, Site Manager	Verify local agencies are coordinated.	PP/IP	O	Local agencies are coordinated.	Do not proceed with field activities until criterion is passed.
Site preparation (Mobilization)	Project Manager, Site Manager	Verify equipment has been inspected and tested.	PP/IP	E	Equipment passes inspection and testing.	Proceed only with activities for which equipment has passed inspection and testing.
Site preparation (Mobilization)	Project Manager, Site Manager	Verify communications and other logistical support are coordinated.	PP/IP	O	Communications and other logistical support are coordinated.	Do not proceed with field activities until criterion is passed.
Site preparation (Mobilization)	Project Manager, Site Manager	Verify emergency services have been coordinated.	PP/IP	O	Emergency services are coordinated.	Do not proceed with field activities until criterion is passed.
Site preparation (Mobilization)	UXOQCS, Project Manager, Site Manager	Verify site-specific training is performed and acknowledged.	PP/IP	O	Site-specific training is performed and acknowledged	Do not proceed with field activities until criterion is passed.
Site preparation (Mobilization)	UXOQCS, Project Manager, Site Manager	Hold pre-mobilization meeting and Operations Readiness Review (ORR) with the project team.	PP/IP	O	Project plans are reviewed and acknowledged by team members.	Do not proceed with field activities until criterion is passed.
Site Preparation (Site Survey)	Site Manager	Verify benchmarks for survey have been established and documented.	PP/IP	O	Benchmarks for survey have been established and documented.	Ensure benchmarks for survey are established and documented prior to performing survey.
Site Preparation (Site Survey)	Site Manager	Verify site boundaries and grids have been established.	PP/IP	O	Site boundaries and grids have been established.	Do not proceed with dependent field activities until criterion is passed.
Site Preparation (Site Survey)	Site Manager	Verify surveyor notes are legible, accurate, and complete.	IP	O	Surveyor notes are legible, accurate and complete.	Ensure surveyor replaces deficient notes with legible, accurate and complete notes.
Site Preparation (Vegetation Removal)	Site Manager	Verify personnel qualifications and training.	PP/IP	O	Personnel qualifications and training are appropriate.	Ensure subcontractor provides appropriately trained and qualified personnel or replace with properly trained personnel.
Site Preparation (Vegetation Removal)	Site Manager	Verify environmental controls are correct and functional.	IP/FP	O	Environmental controls are correct and functional.	Ensure that appropriate environmental controls are in place prior to proceeding with vegetation removal.
Site Preparation (Vegetation Removal)	Site Manager, UXOQCS	Verify vegetation removal is conducted IAW Work Plan.	FP	D	Vegetation removal is conducted IAW Work Plan.	Stop vegetation removal activities until full compliance can be assured and any activities not performed within compliance are re-evaluated and re-performed if necessary.

TABLE 7-1
Definable Features of Work Auditing Procedures
Focused Site Inspection Work Plan Addendum for Site UXO-06 Base Borrow Pit Expansion
MCB Camp Lejeune
Jacksonville, North Carolina

Definable Feature of Work with Auditable Function	Responsible Person(s)[1]	Audit Procedure[2]	QC Phase[3]	Freq. of Audit	Pass/Fail Criteria	Action if Failure Occurs
GPO Execution	Project Manager, Project Geophysicist	Verify data quality objectives (DQOs) established in GPO Plan have been accomplished.	PP/IP	O	DQOs identified in GPO Plan have been achieved	Continue with GPO until DQOs are achieved.
DGM Survey	Project Geophysicist	Verify DGM Survey conducted IAW Geophysical Investigation Plan	IP/FP	O/D	DGM Survey conducted IAW Geophysical Investigation Plan	Stop activity until full compliance can be assured and any activities not performed within compliance are re-evaluated and re-performed if necessary.
DGM Survey	Project Geophysicist	Check results of QC tests performed as specified in GIP	FP	E	QC tests must pass IAW standards determined during the GIP	If a QC test does not pass, a root-cause analysis must be performed and the project team must meet to discuss and determine appropriate action.
DGM Survey	Project Geophysicist	Confirm that DGM survey DQOs established during GPO are being met.	FP	E	DGM survey DQOs are being met.	If the DQOs are not being met, a root-cause analysis must be performed and the project team must meet to discuss and determine appropriate action.
DGM Data Processing	Project Geophysicist	Verify data checks specified in GIP and GPO Work Plan	FP	E	Data checks must pass in accordance with standards determined during the GPO and referenced SOPs.	If a QC test does not pass, a root-cause analysis must be performed and the project team must meet to discuss and determine appropriate action.
Reacquisition Accuracy	Project Geophysicist	Confirm that anomalies are located within a 1-meter radius of flagged location as selected by DGM.	FP	E	Anomaly located within 1-meter radius of flag	If anomalies are being located beyond 1-meter radius of flag or are not being located within 1-meter radius of the flag, a root-cause analysis must be performed and the project team must meet to discuss and determine appropriate action.
Intrusive Investigation	UXOQCS	Verify equipment tested IAW Section 7.0 of the Work Plan	IP/FP	D	Equipment testing performed and tests passed	Repair or replace instrument.
Intrusive Investigation	UXOQCS	Verify team separation distance is as established in Section 4.6.5 of the Work Plan	IP/FP	D	Team separation distance is appropriate for work being performed	Stop activities until appropriate separation distance is being followed
Intrusive Investigation	UXOQCS	Verify that the anomaly recovered during intrusive excavations is appropriate to the amplitude of the initial anomaly detected during the DGM.	IP/FP	D	Recovered anomaly is appropriate to the amplitude of the initial anomaly detected during the DGM.	Return to the location of the anomaly excavation to determine if additional anomalies are present. If anomalies being recovered continue to be inappropriate for the amplitude as detected during the DGM, a root-cause analysis must be performed and the project team must meet to discuss and determine appropriate action.
Intrusive Investigation	QC Geophysicist	QC seed items to be placed at detectable depths IAW GPO Work Plan	IP/FP	E	All QC seed items in area of operation recovered.	A root-cause analysis must be performed and the project team must meet to discuss and determine appropriate action
Intrusive Investigation	UXOQCS	Verify operations are conducted IAW Work Plan, MEC Removal SOPs, and the HSP: - Survey/Sweeps - MEC Surface Sweeps - Analog Detection and Removal Actions - DGM Anomaly Investigation - Ammunition and Explosives Transportation - Explosives Storage and Accountability - Disposal/Demolition Operations - Scrap Inspection Operations	IP/FP	D	Work performed IAW Work Plan, referenced MEC SOPs, and the HSP.	Stop activity until full compliance can be assured and any activities not performed within compliance are re-evaluated and re-performed if necessary
MPPEH/MD Management	UXOQCS	Verify inspections conducted IAW Work Plan	IP/FP	D/E	Inspections being conducted IAW Work Plan	Stop activity until full compliance can be assured and any activities not performed within compliance are re-evaluated and re-performed if necessary
MPPEH/MD Management	UXOQCS	Verify certification conducted IAW Work Plan	IP/FP	D/E	Certification is conducted IAW Work Plan	Stop activity until full compliance can be assured and any activities not performed within compliance are re-evaluated and re-performed if necessary
MPPEH/MD Management	UXOQCS	Verify disposal is conducted IAW Work Plan	IP/FP	D/E	Disposal is conducted IAW Work Plan	Stop activity until full compliance can be assured and any activities not performed within compliance are re-evaluated and re-performed if necessary
Site Restoration	Site Manager	Verify the damage caused by excavation and removal of anomalies is backfilled and laid to original grade and completed IAW Work Plan.	FP	O	Damage caused by excavation and removal of anomalies is backfilled and laid to original grade	Ensure that damage caused by excavation and removal of anomalies is backfilled and laid to original grade
Demobilization	Project Manager, Site Manager	Verify facilities-support infrastructures are dismantled and shipped to appropriate location and area is returned to original condition.	FP	O	Facilities-support infrastructures are dismantled and shipped to appropriate location and site is returned to original condition.	Ensure that all support facilities are removed and that the site is returned to original condition

TABLE 7-1
Definable Features of Work Auditing Procedures
Focused Site Inspection Work Plan Addendum for Site UXO-06 Base Borrow Pit Expansion
MCB Camp Lejeune
Jacksonville, North Carolina

Definable Feature of Work with Auditable Function	Responsible Person(s)[1]	Audit Procedure[2]	QC Phase[3]	Freq. of Audit	Pass/Fail Criteria	Action if Failure Occurs
Final Project Reports and Closeout						
Site Specific Final Report preparation and approval	Project Manager, Project Geophysicist	Verify tabulations of all material identified/recovered during the field actions are accurate and complete.	IP	O	Tabulations of all material identified/recovered during the field actions are accurate and complete.	Ensure tabulations of all material identified/recovered during the field actions are accurate and complete.
Site Specific Final Report preparation and approval	Project Manager, Project Geophysicist	Verify all dig sheets where geophysical mapping and investigation performed are accurate and complete.	FP	O	All dig sheets where geophysical mapping and investigation performed are accurate and complete.	Ensure all dig sheets where geophysical mapping and investigation performed are accurate and complete
Archiving	GIS Manager	Verify data back-up systems are in place.	IP	O	Data back-up systems are in place	Ensure data back-up systems are in place
Project Closeout	Project Manager	Verify purchase orders have been closed out.	IP	O	Purchase orders have been closed out	Ensure purchase orders are closed out
Project Closeout	Project Manager	Verify invoices completed and approved.	IP	O	Invoices completed and approved	Ensure invoices are completed and approved

Notes:
IAW = in accordance with

QC Phase	Frequency
PP = Preparatory Phase	O = Once
IP = Initial Phase	D = Daily
FP = Follow-up Phase	W = Weekly
	E = Each occurrence

[1] The responsible person (if other than the UXOQCS) is the individual with whom the UXOQCS will coordinate with to ensure compliance with requirements and to verify that any necessary follow-up actions are taken.
[2] Where appropriate, a reference has been included referring the reader to a more detailed description of the procedures being audited.
[3] Documentation to be in accordance with the three-phase control process as outlined in the Quality Control Plan.

SECTION 8

Environmental Protection Plan

The environmental protection plan for Site UXO-06 is included in Section 5 of the *Site-Specific Work Plan Addendum for PA/SI, Site UXO-06 Former Fortified Beach Assault Area* (CH2M HILL, 2008c).

SECTION 9

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Appendix A
Geophysical Prove-Out Plan

Final

Geophysical Prove Out Work Plan
Focused Site Inspection of
MCB Camp Lejeune Borrow Pit Expansion Area,
Site UXO-06 Former Fortified Beach Assault Area

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Contract Task Order 0011

August 2009

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Under the

NAVFAC CLEAN 1000 Program
Contract No. N62470-08-D-1000

Prepared by

CH2MHILL

Charlotte, North Carolina

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APPENDIX A

Geophysical Prove Out Work Plan

This Geophysical Prove Out (GPO) Work Plan (WP) is a supplement to the Master GPO WP in the MCB Camp Lejeune Munitions Response Master Project Plan (CH2M HILL, 2008) (herein referred to as MRP Master Project Plan) and provides additional site specific details related to GPO activities for digital geophysical mapping (DGM) surveys at the MCB Camp Lejeune base borrow pit expansion area located within Former Fortified Beach Assault Area, Site UXO-06. Only additional detail, modifications, or additions to the information provided in the Master GPO WP are discussed herein.

A.1 Project Data Quality Objectives

All data quality objectives (DQOs) from the Master GPO WP are applicable to the GPO for the subject site.

A.2 Procedures

Because an existing GPO plot is to be used (discussed in Section A.3) for the GPO activities, a modified Figure A-1 presented in this section illustrates the GPO process and the procedures to be employed (numbered in accordance with the steps shown in this section).

1. DGM surveys will be performed by the DGM subcontractor using an EM61-MK2 time domain metal detector system. The system configurations to be tested are shown in Table A-1 but may be modified based on actual conditions observed at Site UXO-06. The data will be processed and interpreted by the DGM subcontractor and anomaly selections made. Draft data will be provided to the CH2M HILL Project Geophysicist for evaluation within 4 hours of completing each GPO survey and final data packages within one working day of GPO completion.

2. If the initial DQOs have not been met, the CH2M HILL Project Geophysicist will meet with the DGM subcontractor to discuss whether modifications (e.g., sensor spacing) or procedures can be made to the DGM system in order to meet the DQOs.

3. If the DQOs cannot be met by the DGM subcontractor, the CH2M HILL Project Manager and Project Geophysicist will meet with the NAVFAC Project Manager to discuss a resolution (i.e., modification of a DQO) prior to completing the GPO.

4. Once the surveys have been performed and at least one of the configurations has been determined capable of meeting the initial (or modified) DQOs, the GPO will be complete.

A.3 Additional GPO Considerations

Additional topics taken into consideration for the design of the GPO include plot location, size, and shape; quantities of seeded items; and geophysical and positioning instruments and technologies.

A.3.1 GPO Plot Location

The location of the GPO was determined on the basis that a plot already exists at Camp Lejeune in similar geologic conditions and multiple previous surveys have been performed over the plot that can be used to validate that the selected DGM system is functioning within industry standards.

A.3.2 Number and Types of Geophysical Instruments and Technologies Selected for Testing

Because of the type of targets to be detected at the site, a pre-field analysis of the two primary techniques used in the industry, magnetics and time domain electromagnetics (TDEM) was conducted. Based on experience at multiple other sites at which small and shallow items have consistently been detected at a higher rate with TDEM than with magnetics, CH2M HILL recommends testing of the TDEM technique only.

A complete description of the EM61-MK2 is provided in the Master Geophysical Investigation Plan (GIP) as part of the MRP Master Project Plan.

A.3.3 Number and Types of Positioning Instruments and Technologies Selected for Testing

The positioning systems to be tested during the GPO for positioning of the geophysical data include fiducial methods (wheel odometer) and a Real-Time Kinematic (RTK) Global Positioning System (GPS). A full description of the positioning methods is provided in the Master GIP as part of the MRP Master Project Plan.

A.4 Data Quality Objectives

A.4.1 Survey Coverage (Lane Spacing)

The DQO for lane spacing is to maintain appropriate lane spacing to provide 100 percent coverage of the survey area. The measurement performance criterion for this is that the lane spacing varies no more than ±20 percent of 1m. This will be evaluated during the GPO by verifying that all of the DGM data collected and used for anomaly selection meets this standard.

A.5 Quality Control

A.5.1 DGM Instruments Quality Control

All systems will be field tested by the DGM subcontractor to ensure that they are operating properly. All quality control (QC) tests described in the Master GPO WP will be performed with the exception of the test designed for magnetometers only.

A.5.2 QC Seed Items

QC seed items are generally emplaced at a frequency of one per 0.7 acres of covered area. Four QC seed items will be emplaced within the Phase 1 BPEA and 73 QC seeds within the combined Phase 1A and Phase 2 BPEA to be surveyed with the DGM system. The small Industry Standard Object (ISO) (ASTM specification 1-inch by 4-inch steel pipes as shown on Figure A-2) will be used for QC seed items during the geophysical investigation. Instrument response curves for this ISO have been developed by the Naval Research Laboratory (NRL) demonstrating their standard response under their best orientation (perpendicular to the EM61-MK2 instrument plane to cause the highest peak amplitude response) and worst orientation (parallel to the instrument plane and perpendicular to the direction of travel to cause the lowest peak amplitude response) at multiple distances from the instrument's bottom transmit/receive coil (H.H. Nelson, T. Bell, J. Kingdon, N. Khadr, and D.A. Steinhurst, 2009). QC seeds wll be emplaced at varying orientations at the anticipated depth of potential MEC items which is anywhere from near-surface to 2 feet, based on penetration calculations of the types of ammunition previously used on the site.

A.6 References

CH2M HILL. 2008. *Munitions Response Master Project Plan, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina.*

H.H. Nelson, T. Bell, J. Kingdon, N. Khadr, and D.A. Steinhurst. 2009. *EM61-MK2 Response of Three Munitions Surrogates, Report No. NRL/MR/6110 – 09-9183, Naval Research Laboratory, Washington DC.*

TABLE A-1
Geophysical Surveys to be Performed During GPO

Test	Instrument	Platform/Positioning System	Approximate Sensor Height Above Ground Surface (m)	Data Collection Rate	Approximate Survey Speed (m/s)
1	EM61-MK2 Single Coil	Wheel mode/ odometer positioning	0.4	Every 10cm	1
2	EM61-MK2 Single Coil	Wheel mode/RTK GPS	0.4	10 or greater per second	1

Note: Some data elements are subject to evaluation and modification in the field.
ft = foot/feet; GPS = global positioning system; m = meter; m/s = meters per second; RTK = real-time kinetic

FIGURE A-1
GPO Process

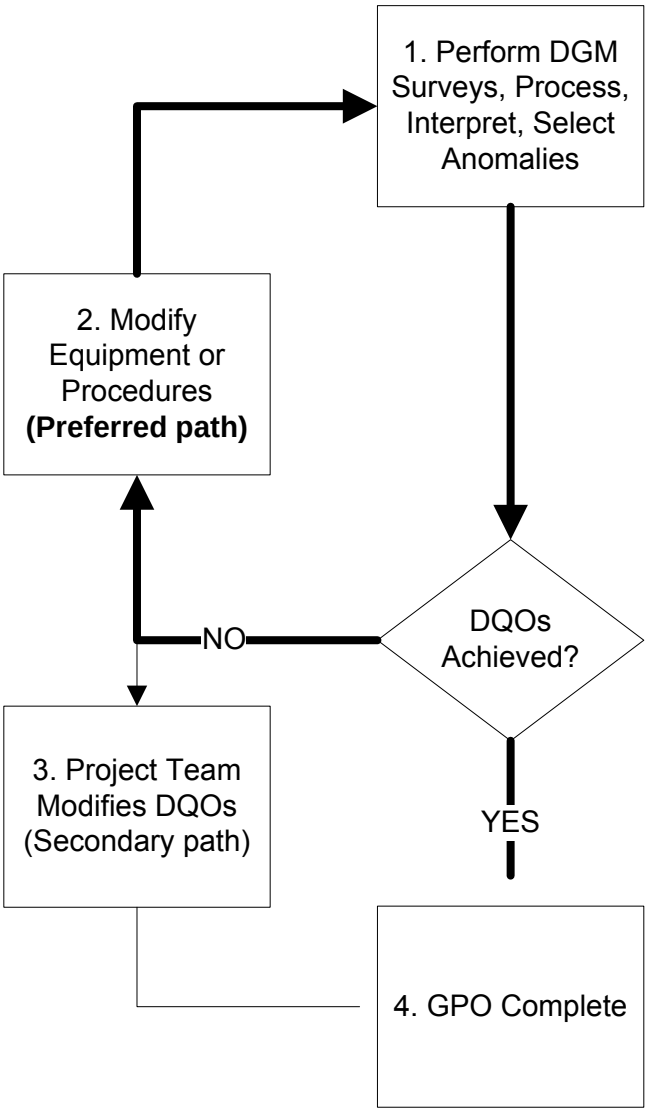
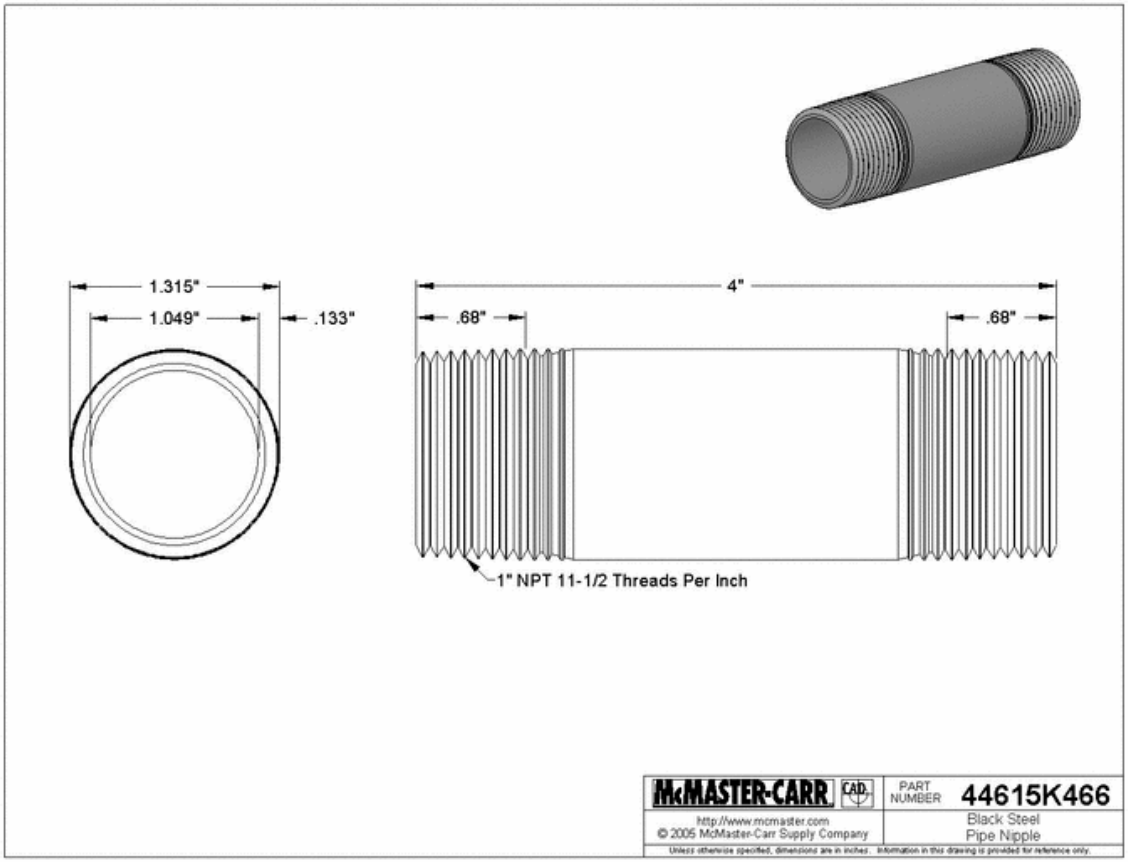


FIGURE A-2
Small Industry Standard Object



Appendix B
Geophysical Investigation Plan

Final

Geophysical Investigation Work Plan
Focused Site Inspection of MCB Camp Lejeune
Borrow Pit Expansion Area,
Site UXO-06 Former Fortified Beach Assault Area

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Contract Task Order 0011

August 2009

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Under the

NAVFAC CLEAN 1000 Program
Contract No. N62470-08-D-1000

Prepared by

CH2MHILL

Charlotte, North Carolina

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B-2 Small Industry Standard Object

APPENDIX B

Geophysical Investigation Plan

This Geophysical Investigation Plan (GIP) is a supplement to the MCB Camp Lejeune Master GIP (Appendix D) in the MCB Camp Lejeune MRP Project Plan (CH2M HILL, 2008) and provides additional site specific details related to the digital geophysical mapping (DGM) operations at the base borrow pit expansion area (BPEA) located within the Former Fortified Beach Assault Area, Site Unexploded Ordnance (UXO)-06, at MCB Camp Lejeune, North Carolina. Only additional details, modifications or additions to the information provided in the Master GIP are discussed herein.

B.1 Areas to be Investigated

DGM will be conducted over the entire 54 acres of the BPEA using single-coil manually-towed methods. For the purposes of the DGM, the BPEA will be divided into 50 m survey grids coinciding with the existing Base-wide grid system previously established for MR investigations to correspond with the North American Datum of 1983 (NAD83) Universal Transverse Mercator (UTM), Zone 18, meters as shown on **Figure B-1**. The locations and actual acreages surveyed will be based on field conditions. DGM will be conducted over the BPEA in phases (refer to the Work Plan Addendum for more information).

B.1.1 Site UXO-06 Area to be Investigated

The proposed 54 acre BPEA is located within Site UXO-06, the Former Fortified Beach Assault Area (**Figure B-1**). Site UXO-06 is approximately 177 acres in size and is crossed by Gonzalez Boulevard. The site is located west of Sneads Ferry Road and south of Main Service Road. No buildings, parking lots, or paved roads are located within the BPEA. Based on site reconnaissance, approximately 60 percent of the BPEA is heavily vegetated with trees and thick undergrowth; however, vegetation clearance will be conducted in these areas before the start of DGM activities.

B.2 Anticipated MEC Types, Composition, Quantities, and Depth

Site UXO-06 was identified in the Range Identification and Preliminary Assessment (USACE, 2001) as a fortified beach assault area. The Range Identification and Preliminary Assessment listed the following types of munitions as having been authorized for use at this range:

- Blank small arms
- Demolitions (½-pound blocks)
- 3.5-inch Rocket, Practice
- Rifle Grenade, Practice
- Hand Grenade, Smoke

- Hand Grenade, White Phosphorous

The practice munitions do not contain high explosives (HE). Practice hand grenades typically contain a small charge of black powder, while practice 3.5-inch rockets and practice rifle grenades are typically inert.

The following types of MEC or MD were discovered during previous investigations at Site UXO-06:

- Rockets, mostly M29 Series 3.5-inch Practice, some including fuzes
- M18 Colored Smoke Hand Grenade with M201A1 Fuze
- MK13 MOD-0 Marine Hand Signal Flare
- 3.5-inch Practice Rocket, M29
- 2.36-inch Practice Rocket, M7
- 35-mm, Subcaliber Rocket, M73
- Signal, Illuminating Flare, Ground, M125A1
- Signal, Illuminating Flare, Ground, M22
- Signal, Illuminating Flare, M23
- Rifle Grenade, M9
- Rifle Grenade, Smoke, M20
- Grenade, White Phosphorus, M15
- Grenade, White Phosphorus, M34
- Landmine, Practice, M16 A1
- 90mm M27 Cartridge Case Blank

The maximum quantities and depths are unknown. The depths to which ordnance items penetrate are dependent on many different parameters and can not be accurately predicted; however, industry experience indicates that most thrown ordnance are found within the top foot of ground surface.

B.3 Vegetation and Topography

The investigation area has a gently sloping terrain and portions of it are heavily vegetated with trees and thick undergrowth. Prior to commencement of DGM activities, the entire project area will have vegetation removal performed to include removing undergrowth and cutting of all trees to a height of no more than six inches above ground surface.

B.4 Geologic Conditions

The geology underlying Site UXO-06 consist of layered laterally-discontinuous fine grained sediments. Particle sizes noted from soil boring logs drilling activities within Site UXO-06 indicate sediments ranging from clay and silt to medium-coarse sand. Site UXO-06 is dominated by interbedded sandy silt/silty sand at the surface to approximately 10 feet below ground surface (bgs) with a white to light gray silty sand containing clay and coarse sand stringers (1- to 2-inch thicknesses) from approximately 5–10 feet bgs to the bottom of the borings (up to 20 ft bgs).

The local geology is likely to be amenable to electromagnetic detection techniques. Because some of the items of interest at Site UXO-06 are generally small, the magnetics technique will not be considered for use as it has been shown at multiple sites to be less effective for finding smaller items at shallow depths than electromagnetic induction techniques. No geologic conditions at the BPEA that will impede geophysical operations are known.

B.5 Shallow Groundwater Conditions

Groundwater is anticipated to be present at depths ranging from 9 to 20 feet bgs based on previous investigations. MEC items, if present within the BPEA, are anticipated to be within a few feet of the ground surface.

B.6 Adverse Geophysical Conditions

No geophysical conditions, other than those discussed under Section C.7 and C.8, that might interfere with electromagnetic near-surface geophysical instrument operation are anticipated.

B.7 Site Utilities

The presence of underground utilities is unknown at the site. There are no above ground utilities evident.

B.8 Manmade Features Potentially Affecting Geophysical Operations

No manmade features are anticipated at the BPEA that might affect geophysical operations.

B.9 Site-Specific Dynamic Events

No site-specific dynamic events (e.g., unusually strong winds, harsh weather conditions) that might affect geophysical operations at the BPEA are anticipated. Although it is possible that weather conditions may impede operations at some time during the project, no significant delays or effects on geophysical instruments resulting from abnormally severe weather are expected.

B.10 Overall Site Accessibility and Impediments

There are no known impediments that will limit access to the work areas at the BPEA. Vegetation will be cleared to within six inches of ground surface within the work areas prior to commencement of geophysical operations.

B.11 Potential Worker Hazards

No potential worker hazards are apparent at the site other than those associated with conducting project fieldwork, which are addressed in the Accident Prevention Plan (refer to Appendix D in the Work Plan Addendum).

B.12 Geophysical Prove-out

A GPO will be used to finalize project Data Quality Objectives (DQOs) and validate the geophysical system selected for the DGM surveys at the subject site. The GPO Work Plan is provided as Appendix A in the Work Plan Addendum.

B.13 DGM Data Quality Objectives

The primary objective of the DGM activities at the Site UXO-06 is to identify metallic anomalies that may represent subsurface MEC or Material Potentially Presenting an Explosive Hazard (MPPEH). DQOs specific to the DGM survey at the site are identified in the Master GPO Work Plan and the site specific GPO Work Plan and will carry through to the site survey.

B.14 Geophysical Instrumentation

A geophysical subcontractor will use a single coil EM61-MK2 to map geophysical anomalies that could potentially represent subsurface MEC at Site UXO-06. The EM61-MK2 is described in the Master GIP.

B.15 DGM Systems Quality Control

The QC program described in the Master GIP will be followed. Supplemental information for those steps is provided in the following subsections.

B.15.1 DGM Instruments Quality Control

Because the EM61-MK2 will be used for the DGM surveys, the QC tests designed for magnetometer operations (discussed in the Master GIP) will not be performed.

B.15.2 QC Seed Items

QC seed items are generally emplaced at a frequency of one per 0.7 acres of covered area. Four QC seed items will be emplaced within the Phase 1 BPEA and 73 QC seeds within the

Phase 2 BPEA to be surveyed with the DGM system. The small Industry Standard Object (ISO) (ASTM specification 1-inch by 4-inch steel pipes as shown on **Figure B-2**) will be used for QC seed items during the geophysical investigation. Instrument response curves for this ISO have been developed by the Naval Research Laboratory (NRL) demonstrating their standard response under their best orientation (perpendicular to the EM61-MK2 instrument plane to cause the highest peak amplitude response) and worst orientation (parallel to the instrument plane and perpendicular to the direction of travel to cause the lowest peak amplitude response) at multiple distances from the instrument's bottom transmit/receive coil (H.H. Nelson, T. Bell, J. Kingdon, N. Khadr, and D.A. Steinhurst, 2009). QC seeds wll be emplaced at varying orientations at the anticipated depth of potential MEC items which is anywhere from near-surface to 2 feet, based on penetration calculations of the types of ammunition previously used on the site.

B.16 References

CH2M HILL. 2008. *Munitions Response Master Project Plan, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina.* May.

United States Army Corps of Engineers (USACE). 2001. *Final Range Identification and Preliminary Range Assessment*, Marine Corps Base Camp Lejeune, Onslow, North Carolina. St. Louis District. December.

H.H. Nelson, T. Bell, J. Kingdon, N. Khadr, and D.A. Steinhurst. 2009. *EM61-MK2 Response of Three Munitions Surrogates, Report No. NRL/MR/6110 – 09-9183, Naval Research Laboratory, Washington DC.*

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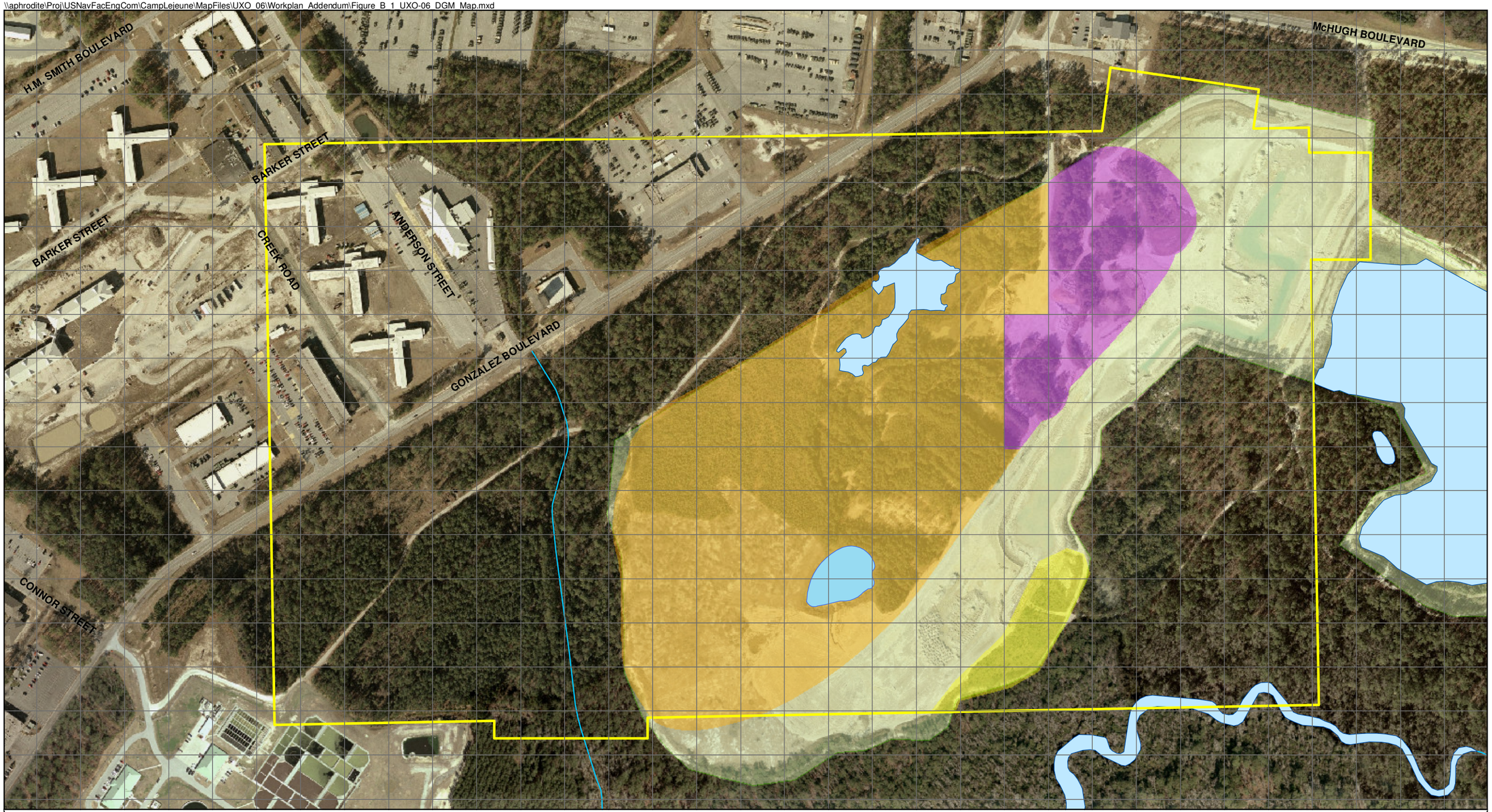


Legend

- Stream
- Base-wide 50 Meter Grid
- UXO-06 Site Boundary
- Phase 1 Borrow Pit Expansion Area
- Phase 1A Borrow Pit Expansion Area
- Phase 2 Borrow Pit Expansion Area
- Active Borrow Pit
- Surface Water Body

N

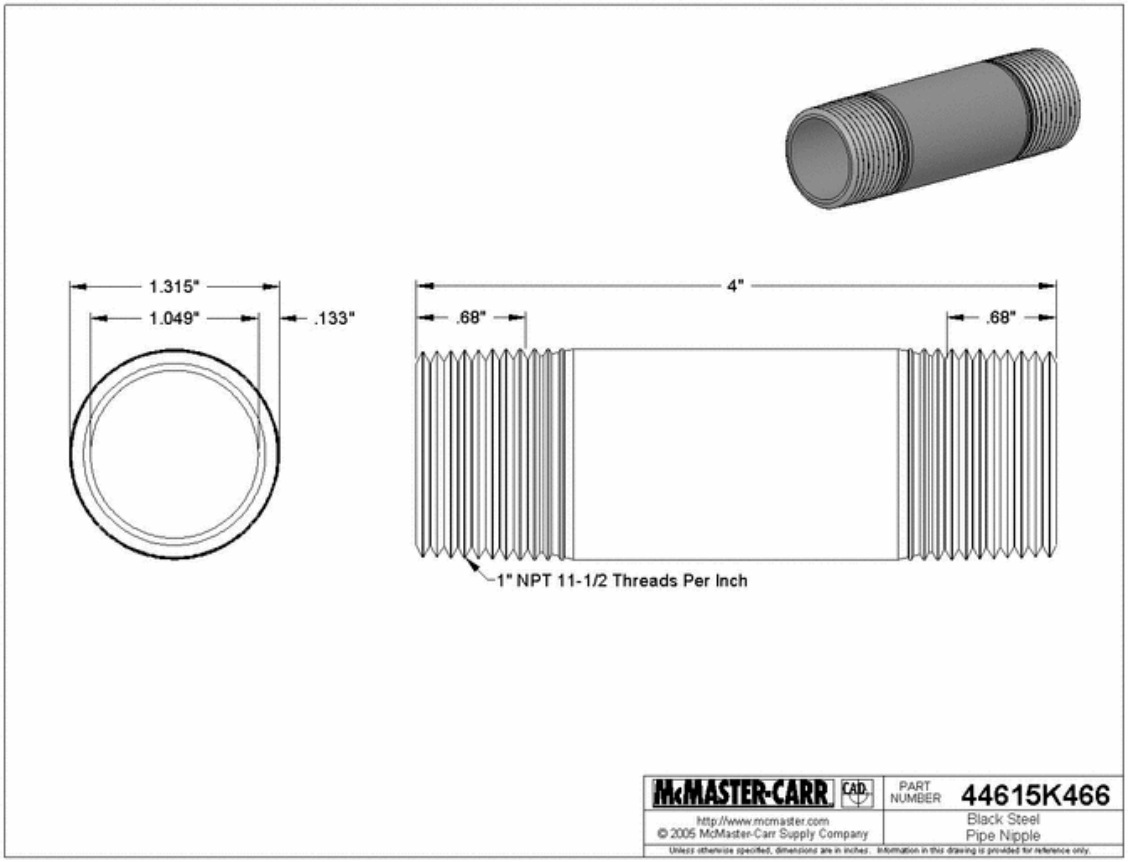
0 175 350 700 Feet

1 inch = 350 feet

Figure B-1
DGM Grid Layout
Site UXO-06 Borrow Pit Expansion Area
MCB Camp Lejeune
North Carolina

CH2MHILL

FIGURE B-2
Small Industry Standard Object



Appendix C
Quality Assurance Project Plan

Final

Quality Assurance Project Plan for Focused Site Inspection of Site UXO-06 Base Borrow Pit Expansion

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Contract Task Order 0011

August 2009

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Under the

NAVFAC CLEAN 1000 Program
Contract No. N62470-08-D-1000

Prepared by

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Charlotte, North Carolina

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Acronyms and Abbreviations

A2LA	American Association of Laboratory Accreditation
AES	atomic emission spectroscopy
AM	Activity Manager
APP	Accident Prevention Plan
ASTM	American Society for Testing and Materials
BPEA	Borrow Pit Expansion Area
CA	corrective action
CCB	continuing calibration blank
CCV	continuing calibration
CD	compact disc
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-term Environmental Action—Navy
CLP	Contract Laboratory Program
COC	chain-of-custody
CompQAP	Comprehensive Quality Assurance Plan
COPC	constituents of potential concern
CRQL	contract required quantitation limit
CTO	contract task order
°C	degrees Celsius
DI	deionized
DO	dissolved oxygen
DoD	Department of Defense
DQE	data quality evaluation
DQI	data quality indicator
EDD	electronic data deliverables
EIS	Environmental Information Specialist
EMD	Environmental Management Division
ERB	equipment rinsate blank
ESI	electrospray ionization
FB	field blank
FTL	Field Team Leader
g	gram
GC/MS	gas chromatograph/mass spectrometer
HPLC	high performance liquid chromatography
HSM	Health and Safety Manager
ICB	initial calibration blank
ICP	inductively coupled plasma

ICS	interference check samples
ICV	initial calibration verification
IDL	instrument detection limit
IDW	investigation-derived waste
IS	internal standard
LCS	laboratory control sample
LODV	limit of detection verification
µg/kg	micrograms per kilogram
M&TE	measuring and test equipment
MC	munitions constituents
MCB	Marine Corps Base
MDL	method detection limit
MEC	munitions and explosives of concern
mg/kg	milligrams per kilogram
mm	millimeter
MMRP	Military Munitions Response Program
MPPEH	material potentially presenting an explosive hazard
MS	mass spectrometer
MS/MS	tandem mass spectrometry
MS/MSD	matrix spike/matrix spike duplicate
N/A	not applicable
NAVFAC	Naval Facilities Engineering Command
NC	no critera
NC SSL	North Carolina Soil Screening Levels
NCDENR	North Carolina Department of Environment and Natural Resources
NIST	National Institute of Standards and Technology
ORP	oxidation-reduction potential
oz	ounce
PAL	project action limit
PARCC	precision, accuracy, representativeness, completeness, and comparability
PC	Project Chemist
PETN	pentaerythritol tetranitrate
PM	Project Manager
POC	point of contact
PQO	project quality objective
psi	pounds per square inch
QA	quality assurance
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QC	quality control
QL	quantitation limit
RFP	Request for Proposal
RL	reporting limit

RPD	relative percent difference
RPM	Remedial Project Manager
RSD	relative standard deviation
RSL	regional screening level
SDG	sample delivery group
SI	Site Inspection
SOP	standard operating procedure
SOW	Statement of Work
SQL	sample quantitation limit
SSC	Site Safety Coordinator
STC	Senior Technical Consultant
TAL	target analyte list
TAT	turnaround time
TBD	to be determined
TOC	total organic carbon
TPH	total petroleum hydrocarbon
UFP	Uniform Federal Policy
USEPA	United States Environmental Protection Agency
UV	ultraviolet
UXO	unexploded ordnance
VOC	volatile organic compound
WP	Work Plan

QAPP Identifying Information

Site Name/Number: Marine Corps Base (MCB) Camp Lejeune Borrow Pit Expansion Area (BPEA) located within Former Fortified Beach Assault Area, Site Unexploded Ordnance (UXO)-06

Operable Unit: Not applicable (N/A)

Contractor Name: CH2M HILL

Contract Number: N62470-08-D-1000

Contract Title: Naval Facilities Engineering Command (NAVFAC), Comprehensive Long-term Environmental Action—Navy (CLEAN) 1000 Program

Work Assignment Number (optional): Contract Task Order (CTO) 11

1. This Quality Assurance Project Plan (QAPP) was prepared in accordance with the requirements of *the Uniform Federal Policy for Quality Assurance Plans (UFP-QAPP)* (USEPA, 2005) and *EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5, QAMS* (USEPA, 2002) . Identify any additional guidance used to prepare QAPP: N/A

2. Identify regulatory program: Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

3. This QAPP is a project-specific QAPP.

4. List dates of scoping sessions that were held:

Scoping Session	Date
NAVFAC Request for Proposal (RFP)	3/02/09
CH2M HILL Implementation Plan/Fee Proposal	4/16/09

5. List dates and titles of any QAPP documents written for previous site work that are relevant to the current investigation. N/A

6. List organizational partners (stakeholders) and connection with lead organization: MCB Camp Lejeune, United States Environmental Protection Agency (USEPA) Region IV, North Carolina Department of the Environment and Natural Resources (NCDENR)

7. Lead organization: NAVFAC Mid-Atlantic

8. If any required QAPP elements or required information are not applicable to the project or are provided elsewhere, then note the omitted QAPP elements and provide an explanation for their exclusion below:
   Worksheet #9 – Not applicable. Scope was issued by NAVFAC. Worksheet #13 – Not applicable. No secondary data was used in developing this QAPP.

Crosswalk to Related Information

In an effort to comply with the requirements of the Uniform Federal Policy for Quality Assurance Plans (UFP-QAPP) (USEPA, 2005), the following crosswalk table has been provided. Because this project is Activity-Funded, this QAPP does not follow the UFP-QAPP 37 worksheet format; however, this Crosswalk Table identifies where the key elements of the UFP-QAPP are located within the enclosed QAPP or the Work Plan (WP) Addendum.

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
A. Project Management		
Documentation		
1	Title and Approval Page	QAPP Page i
2	Table of Contents QAPP Identifying Information	QAPP Page iii QAPP Page xi
3	Distribution List	QAPP Table C-1-1
4	Project Personnel Sign-off Sheet	QAPP Table C-1-1
Project Organization		
5	Project Organizational Chart	WP Addendum Figure 2-1
6	Communication Pathways	QAPP Section C.1.2.3
7	Personnel Responsibilities and Qualifications	QAPP Section C.1.2
8	Special Personnel Training Requirements Table	QAPP Section C.1.6
Project Planning/ Problem Definition		
9	Project Planning Session Documentation (including Data Needs tables) Project Scoping Session Participants Sheet	N/A
10	Problem Definition, Site History, and Background. Site Maps (historical and present)	WP Addendum Section 1
11	Site-Specific Project Quality Objectives (PQOs)	QAPP Section C.1.5
12	Measurement Performance Criteria	QAPP Section C.1.5
13	Sources of Secondary Data and Information Secondary Data Criteria and Limitations Table	N/A
14	Summary of Project Tasks	WP Addendum Section 2.5
15	Reference Limits and Evaluation Table	QAPP Section C.2.4
16	Project Schedule/Timeline Table	WP Addendum Figure 2-1
B. Measurement Data Acquisition		
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SECTION C.1

Project Management

This project-specific Quality Assurance Plan (QAPP) is meant to serve in conjunction with the Marine Corps Base (MCB) Camp Lejeune Master Project QAPP (CH2M HILL, 2008). This document applies only to the *Focused Site Inspection Work Plan Addendum for Marine Corps Base Camp Lejeune Borrow Pit Expansion, Site UXO-06 Former Fortified Beach Assault Area.* The QAPP describes the project objectives, specific quality assurance (QA) and quality control (QC) activities, and laboratory activities necessary to achieve the project objectives. Subcontractors will be required to review both the Master QAPP and the project-specific QAPP. Subcontractors will be expected to adhere to the procedures specified in these documents. All field activities will be conducted by CH2M HILL or subcontractors under the direct supervision of CH2M HILL.

C.1.1 Introduction

This QAPP provides QA/QC requirements for sampling activities, sample analyses, and other tests that will generate data as part of the activities performed for the Focused Site Inspection. This QAPP is a component of the Work Plan (WP) Addendum and has been prepared in accordance with the *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations* (USEPA, 2001).

QA involves all those planned and systematic actions necessary to provide adequate confidence that field activities will be performed satisfactorily and safely. The goal of QA is to ensure that activities are planned and performed according to accepted standards and practices to ensure that the resulting data are valid and useable for the project decision-making process, while continuing to meet safety requirements. QC is an integral part of the overall QA function and is comprised of all those actions necessary to control and verify that project activities and the resulting data meet established requirements.

The requirements of this document apply to contractors and subcontractors. Deviations from these procedures will be documented.

This section provides an overview of project management and addresses the following topics:

- Project organization and roles and responsibilities
- Project definition and background
- Project description
- Quality objectives and criteria for measurement data
- Documentation and records management

Section C.2 describes the measurement and data acquisition procedures and the analytical methods to be performed in support of this monitoring. It addresses the following aspects of measurement and data acquisition:

- Sampling process design
- Sampling method requirements
- Sample handling and custody requirements
- Analytical method requirements
- QC requirements
- Instrument and equipment testing, inspection, and maintenance requirements
- Instrument calibration and frequency
- Inspection and acceptance requirements for supplies and consumables
- Data acquisition requirements

Section C.3 describes the assessment and oversight activities that will be followed to determine whether the QC identified in this QAPP is being implemented and documented as required.

Section C.4 presents the data review, validation, and evaluation requirements.

C.1.2 Project Organization Roles and Responsibilities

This subsection identifies key project team members associated with the planned sampling work and lists the responsibilities associated with each position. The organizational structure and responsibilities are designed to provide project control and QA for the proposed monitoring.

C.1.2.1 Project Manager

The Project Manager (PM) for this project will be Mrs. Keri Hallberg. The PM is responsible for overall activities for a specific project. The PM is responsible for cost and schedule control and for technical quality; in addition, she develops the WP Addendum and monitors contract task order (CTO) activities to ensure compliance with project objectives and scope. The PM also communicates with the Agencies, and as appropriate, other designated parties regarding project progress.

The PM has ultimate responsibility within the project team for producing deliverables that are technically adequate, satisfactory to, Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic Division for meeting Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requirements, and cost-effective. To accomplish this, the PM develops an internal project review schedule, provides written instructions and frequent guidance to the project team, and monitors budgets and schedules. The PM works with the project team to select an internal QA/QC review team and to coordinate review efforts, and works with the project team in addressing review comments and adjudicating technical disagreements.

C.1.2.2 Senior Consultants

The Senior Consultants (SCs) for this project will be Mr. Tom Roth. The SCs have significant experience in the various technical aspects involved in a complex project. The SCs coordinate all internal QA/QC review for technical validity and adherence to United States Environmental Protection Agency (USEPA) criteria. The review team is responsible for evaluating the technical merit of the work planning documents before field activities begin, and for reviewing all deliverables before submittal to the Agencies. The SCs assist the PM in selecting an internal QA/QC review team and coordinating review efforts, and works with the project team in addressing review comments and resolving technical issues.

C.1.2.3 Project Chemist

The Project Chemist (PC) for this will be Ms. Anita Dodson. The PC assists with the preparation of the project work planning documents, provides a point of contact (POC) between the laboratory and the project team, supervises the analytical data quality evaluation (DQE), and participates in preparing deliverables to the client. The PC coordinates with the project team and the analytical laboratory during the field activities. The PC also is responsible for monitoring project-specific laboratory activities (including checking laboratory invoices and reports) and may audit the laboratory operations at the PM's direction. The PC also monitors field and laboratory activities such that QA/QC requirements described in this project-specific QAPP are coordinated effectively.

C.1.2.4 Environmental Information Specialist

The Environmental Information Specialist (EIS) for this project is Ms. Genevieve Moore. The EIS is responsible for tracking the data from sample collection, through submission to third party validator, through internal chemist review. She is also responsible for sending data to load into the database.

C.1.2.5 Field Team Leader

The Field Team Leader (FTL) reports to the PM and is responsible for the coordination of field efforts, provides for the availability and maintenance of sampling equipment and materials, and provides shipping and packing materials. The FTL will supervise completion of all chain-of-custody (COC) records, supervise the proper handling and shipping of samples, and be responsible for accurate completion of the field notebooks. As the lead field representative, the FTL will be responsible for consistently implementing program QA/QC measures at the site and for performing field activities in accordance with approved WPs, policies, and field procedures.

C.1.2.6 Site Safety Coordinator

The Site Safety Coordinator (SSC) develops and implements the project Accident Prevention Plan (APP) in the field. The SSC will assist in conducting site briefings and perform all final safety checks. The SSC is responsible for stopping any investigation-related operation that threatens the health and safety of the field team or surrounding populace.

C.1.2.7 Health and Safety Manager

The program Health and Safety Manager (HSM) is Mr. Michael Goldman. The program HSM reviews and approves the project-specific APP. The program HSM serves as the POC for the SSC for any health- and safety-related issues, and may conduct project audits. The program HSM also is responsible for investigating accidents should any occur during the course of the project.

C.1.2.8 Distribution List

Table C-1-1 identifies all recipients of the QAPP and WP Addendum and identifies which recipients need to sign off on the QAPP.

C.1.2.9 Laboratory Work Group

The selected laboratory (Empirical Laboratories, LLC) is responsible for analyzing samples collected during field activities, in accordance with the WP Addendum and the laboratory Comprehensive Quality Assurance Plan (CompQAP). The laboratory PM or client service manager acts as a liaison between the PC and the field and laboratory operations and is responsible for the following:

- Receipt of sample custody from the field team members, verification of sample integrity, and transfer of sample fractions to the appropriate analytical departments
- Coordination of sample analyses to meet project objectives
- Preparation of analytical reports
- Review of laboratory data for compliance with method requirements
- Review of any QC deficiencies reported by the analytical department manager
- Coordination of any data changes resulting from review by the project QA supervisor or the PM
- Completion of data package deliverables
- Communication with the PC pertaining to analytical and QC issues
- Response to questions from the project team during the DQE process

C.1.2.10 Project Communication

Effective communication among all project personnel will be established and maintained throughout the course of the project. At the beginning of the project, and/or at the start or end of major milestones, the PM will prepare written project instructions that will be distributed to all team members. These instructions will document project and task objectives and each team member's responsibility in meeting the objectives, as well as a budget and schedule for successfully executing the work.

TABLE C-1-1
Project Personnel Distribution and Signoff

Name of QAPP Recipients	Title/Role	Organization	Telephone Number (Optional)	E-mail Address or Mailing Address	Signature/email receipt (if Required)
Bryan Beck	Remedial Project Manager (RPM)-Camp Lejeune	NAVFAC Mid-Atlantic	757-322-4734	bryan.k.beck@navy.mil	Not Applicable (N/A)
Bob Lowder	Environmental Engineer	MCB Camp Lejeune-Environmental Management Division (EMD)	910-451-9607	robert.a.lowder@usmc.mil	N/A
Gena Townsend	RPM	USEPA - Region 4	404-562-8538	townsend.gena@epa.gov	N/A
Randy McElveen	RPM	NCDENR	919-508-8467	randy.mcelveen@ncmail.net	N/A
Martin Morgan	RPM	NCDENR	919-508-8447	Martha.Morgan@ncmail.net	N/A
Matt Louth	Activity Manager (AM)	CH2M HILL	704-543-3260	matt.louth@ch2m.com	N/A
Keri Hallberg, P.E.	PM	CH2M HILL	757-671-6240	keri.hallberg@ch2m.com	N/A
Anita Dodson	PC	CH2M HILL	757-671-6218	anita.dodson@ch2m.com	N/A
Janice Shilling	Laboratory Manager	Empirical Laboratories, LLC	615-345-1115	jshilling@empirlabs.com	N/A
Laura Maschoff	Data Validator	DataQual	314-330-1327	dataqual@charter.net	N/A

Before field activity begins, a project team meeting will be held to review the project objectives. Periodic meetings will be held to review data validity, technical evaluations, major decisions, and overall progress toward completing the project. Additionally, a team kickoff meeting will be held before work on each task is started. Senior personnel may participate in the meetings to help focus the project approach and to define specific issues.

During the field sampling phases of this project, the field team will meet daily to review the status of the project and to discuss technical and safety issues. When necessary, other meetings will be scheduled or the FTL will meet individually with field personnel or other stakeholders to resolve problems.

During the field effort, the FTL will be in regular telephone or face-to-face contact with the project team. When significant problems or decisions requiring additional authority occur, the FTL will immediately contact the PM for assistance. The PC will coordinate communication with the laboratory through sample collection, sample analysis, and DQE and consult with the PM as needed.

All analytical laboratory QA/QC issues will be reported the same day the issue is identified to the PC and project EIS. Should analytical corrective actions (CAs) be warranted, they will be communicated to the CH2M HILL PC on a same day basis. The PC will facilitate resolution to ensure WP requirements are met by the laboratory. Communications with subs shall be by phone, followed up with e-mail to document decisions and actions as soon as issues are identified.

The Project EIS will track data from sample collection through upload to the database. Issues will be reported to the PM and PC as they are identified.

C.1.3 Problem Definition and Background

MCB Camp Lejeune is planning to expand the capacity of the Base borrow pit in order to support the various facility projects underway. The proposed 54-acre expansion area is located within Military Munitions Response Program (MMRP) UXO-06, the Former Fortified Beach Assault Area. Refer to Section 1 in the WP Addendum for more details on the site background.

C.1.4 Project Description

The objectives of the Focused SI are presented in Section 1.1 of the WP Addendum.

C.1.5 Quality Objectives and Criteria for Measurement Data

QA involves all those planned and systematic actions necessary to provide adequate confidence that field activities are planned and performed according to accepted standards and practices. This process ensures that the resulting data are valid and retrievable, while continuing to meet minimum safety requirements. QC is an integral part of the overall QA function and is comprised of all those actions necessary to control and verify that project activities and resulting data meet established requirements.

To ensure that a minimum level of certainty about the quality of field data is being met, the following elements will be addressed to meet the requirements specified by the client and regulatory agencies:

- Field operations will be conducted in accordance with written procedures.
- To maintain accuracy within necessary limits, measuring and test equipment (M&TE) used in field investigations will be calibrated against traceable standards at specific intervals, using approved standard operating procedures (SOPs) or manufacturer's instructions.
- When M&TE is found to be out of specification, the previous inspection or test results will be evaluated for validity and acceptability. This evaluation will be documented.
- Before project field work begins, all project staff will be trained to ensure that they are familiar with the WP Addendum and associated documents.
- Internal audits may be performed to assess the quality of project activities and to evaluate compliance with established QA requirements.
- QC samples will be used to monitor the quality of field and laboratory techniques and of the data.

This subsection defines the levels of data. The level of data quality is dependent on the objective use of the results supported by the data. This subsection also provides the quantitative quality objectives and measurement performance criteria for the analytical data.

C.1.5.1 Levels of Data Quality

The data use determines the required levels of data quality. The two categories of data quality established by USEPA, ***screening*** and ***definitive***, are defined as follows:

Screening data are generated by rapid methods of analysis with less rigorous sample preparation, calibration and/or QC requirements as compared to the requirements for producing definitive data. Sample preparation steps commonly are restricted to simple procedures such as dilution with a solvent, instead of elaborate extraction/digestion and cleanup. Screening data may provide analyte identification and quantitation, although the quantitation may be relatively imprecise, unless USEPA reference methods are used. Physical test methods (e.g., dissolved oxygen [DO] measurements, temperature and pH measurements, moisture content, turbidity, conductance) have been designated by definition as screening techniques.

Screening methods may require confirmation samples that generate definitive data. Confirmation samples will be selected to include both detected and nondetected results from the screening technique.

Definitive data are generated using rigorous analytical methods such as approved USEPA reference methods. Data are analyte-specific, and both identification and quantitation are confirmed. These methods have standardized QC and documentation requirements.

Definitive data are not restricted in their use unless quality problems require data qualification.

Four levels of data reporting may be performed as part of this field effort, with each level having different supporting QA/QC documentation. The four levels correspond to QC Levels I, II, III, and IV. Level I data reporting includes field monitoring activities such as measurements of pH, temperature, conductivity, DO, oxidation-reduction potential (ORP), and turbidity. Level II data reporting may include screening activities, which are indicative of the nature of contamination, whereas Level III data reporting provides definitive or confirmation data. Level IV data reporting includes the highest level of QC with significant additional documentation.

Level IV data packages will be requested for this project.

Level I–Field Surveys

Level I encompasses field monitoring or screening activities and does not require formal data package deliverables. Level I activities are focused on easily measured bulk characteristics of a sample such as pH, conductivity, ORP, and DO. Monitoring results, as well as pertinent data concerning the sampling event, will be documented in the bound field book. Level I documentation will consist of the following:

- Instrument identification
- Calibration information (standards used and results)
- Date and time of calibration and field measurements
- Field measurement results

The logbooks will be reviewed daily by the FTL for completeness and correctness. No additional documentation or DQE is required.

Level I data will not collected to support this project.

Level II–Screening Activities, Physical Parameters, and Investigation-derived Waste Analyses

Level II includes the analyses submitted to the laboratories for screening, physical parameter testing, and analyses associated with the characterization of the investigation-derived waste (IDW) samples. Samples submitted for analysis under Level II will require the delivery of an analytical data package. Level II documentation will consist of the following:

- Case narrative
- Sample results
- Selected QC information such as surrogate recovery
- Associated blank results
- Completed COC and any sample receipt information

Level III–Laboratory Analysis

The purposes of Level 3 data include the following:

- To further define the nature and extent of contamination at MCB Camp Lejeune
- To define the risk associated with contamination

- To define the fate and transport mechanisms of site-related contaminants
- To monitor contaminant levels at the Base

The list of methods and the corresponding target compound lists will be designed to meet the needs of the specific project. In general, samples will be analyzed using USEPA-approved methods from the current edition of *SW-846, Test Methods for Evaluating Solid Waste* (USEPA, 1988).

Level IV–Laboratory Analysis

This level provides the most stringent level of documentation, and allows the data reviewer or data validator to recreate the analytical sequence and evaluate raw data such as quantitation reports generated from the instrumentation used in the analyses. The list of methods (presented in **Table C-2-3**) and the corresponding target analytes have been designed to evaluate the potential for contamination at the site. Samples will be analyzed using USEPA-approved methods, including methods from the following documents:

- SW-846–*Test Methods for Evaluating Solid Waste* (USEPA, 1998)
- *Annual Book of the American Society for Testing and Materials (ASTM) Standards* (1993)

C.1.5.2 Method Performance Objectives

The sampling approach and rationale are presented in Section 3 of the WP Addendum. One activity associated with developing the sampling approach and rationale is developing a list of samples to be collected, sample types, sampling intervals, analytical parameters, and required detection and quantification limits for each required parameter.

C.1.5.3 Quality of Data

Analytical performance requirements are expressed in terms of precision, accuracy, representativeness, comparability, and completeness (PARCC). Summarized below are brief definitions for each PARCC parameter and calculation equations as appropriate.

Precision

Precision is a measure of the agreement or repeatability of a set of replicate results obtained from duplicate analyses made under identical conditions. Precision can be estimated by comparing duplicate matrix spike concentrations and field duplicate sample results. The precision of a duplicate determination can be expressed as the relative percent difference (RPD), calculated as:

$$\text{RPD} = \left\{ \frac{|X_1 - X_2|}{\frac{(X_1 + X_2)}{2}} \right\} x100$$

where X_1 is the result from the native sample, and X_2 is the result from the duplicate sample.

Accuracy

Accuracy is a measure of the agreement between an experimental determination and the true value of the parameter being measured. Accuracy is estimated through the use of

known reference materials and matrix spikes. It is calculated from analytical data and is not measured directly. Spiking of reference materials into a sample matrix provides a measure of the matrix effects on analytical accuracy. Spiking of reference materials into a "non-matrix", such as deionized (DI) water or Ottawa sand, provides a measure of the accuracy of the analytical method itself. Accuracy, defined as percent recovery (P), is calculated as:

$$P = \left[\frac{(SSR - SR)}{SA}\right] x\ 100$$

where SSR is the spiked sample result, SR is the sample result (native), and SA is the spike concentration added to the spiked sample.

Representativeness

Representativeness is a measure of the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is most concerned with the proper design of the sampling program. Representativeness is demonstrated by providing full descriptions in the project planning documents of the sampling techniques and by making certain that the sampling locations are selected and the number of samples collected such that the accuracy and precision criteria are met.

Comparability

Comparability is another qualitative measure designed to express the confidence with which one data set may be compared to another. Sample collection and handling techniques, sample matrix type, and analytical method all affect comparability. Comparability is limited by the other PARCC parameters because data sets can be compared with confidence only when precision and accuracy are known. Data from one phase of an investigation can be compared to others when similar methods are used and similar data packages are obtained.

Completeness

Completeness is defined as the percentage of measurements judged to be valid, compared to the total number of measurements made for a specific sample matrix and analysis. Completeness is calculated using the formula:

$$Completeness = \frac{Valid\ Measurements}{Total\ Measurements} x100$$

Experience on similar projects has shown that laboratories typically achieve approximately 95 percent completeness. All validated data will be used. During the data validation process, an assessment will be made of whether the valid data are sufficient to meet project objectives. If sufficient valid data are not obtained, the PM will initiate CA.

C.1.5.4 Project Quality/Systematic Planning Process Statements

Who will use the data?

The data will be used by the Navy, CH2M HILL, NCDENR, and USEPA. Within each organization the data will be used by staff scientists/engineers and PMs.

What are the Project Action Limits (PALs)?

- Concentrations of the surface and subsurface soil contaminants identified in the focused SI will be compared to USEPA Residential Regional Screening Levels (RSLs) and North Carolina Soil Screening Limits (NC SSLs).
- Wastes generated for offsite disposal/treatment will be compared to hazardous waste criteria and transport, storage and disposal facility acceptance criteria.

What will the data be used for?

- Data will be used to complete a Focused SI for the BPEA.

What types of data are needed?

- The analytical data for munitions constituents (MC) potentially present in BPEA soil. MC potentially present in BPEA soils include explosives residues, pentaerythritol tetranitrate (PETN), nitroglycerine, perchlorate, and metals.

How "good" must the data be to support the environmental decision?

- Explosives residues, PETN, nitroglycerine, perchlorate, and metals should achieve RLs at or lower than USEPA Residential RSL and NC SSLs.
- Data QA and validation procedures for the soil analyses will be performed.

How much data should be collected (number of samples for each analytical group, matrix, and concentration)? Where, when, and how should the data be collected/ generated?

- During Phase 1 of the Focused SI, nine composite surface soil samples and three subsurface soil samples will be collected. A maximum of three additional composite surface soil samples may also be collected in locations where soils may have been impacted by munitions and explosives of concern (MEC), material potentially presenting an explosive hazard (MPPEH), or where explosives are used during the MEC intrusive investigation.
- During Phase 2 of the Focused SI, a maximum of 48 composite surface soil samples will be collected at locations where soils may have been impacted by MEC, MPPEH, or where explosives are used during the MEC intrusive investigation.
- Numbers of QA/QC samples for each chemical analysis are discussed in **Table C-2-2**.
- The data will be collected following the SOPs presented in **Attachment C-1.**

Who will collect and generate the data? How will the data be reported?

- CH2M HILL will collect the chemical data.

- Chemical analyses will be performed by Empirical Laboratories, LLC, Navy-approved laboratory under subcontract to CH2M HILL.
- Once generated, all chemical analytical data will be submitted to a yet-to-be selected, third party data validator under subcontract to CH2M HILL for validation by National Functional Guidelines.
- CH2M HILL will receive validated data and upload the data into a centralized electronic database used for Navy projects by the project team(s).
- All chemical data will be reported in a report following the sampling.

How will the data be archived?

Data will be archived according to procedures dictated via the Navy Comprehensive Long-term Environmental Action—Navy (CLEAN) program. All analytical data will be uploaded into a centralized database developed and maintained by CH2M HILL and used for Navy projects. At the end of the project, paper copies of archived laboratory data and validation reports will be returned to the Navy.

PQOs listed in the form of if/then qualitative and quantitative statements.

Use of Reference Area Data PQOs

- If constituents are detected at concentrations exceeding comparison criteria (i.e., USEPA RSLs), then those constituents will be considered constituents of potential concern (COPCs) and further action will be necessary.

C.1.6 Special Training, Requirements, and Certifications

The PM works with the project delivery manager to assemble a project team that has the necessary experience and technical skills. Part of the work planning process is to identify special training requirements or certifications necessary to execute the project successfully. Special training or certifications required beyond the normal routine requirements have not been identified for this project.

C.1.7 Documentation and Records

This subsection defines which records are critical to the project and what information needs to be included in reports, as well as the data reporting format and the document control procedures. It is imperative for the defensibility of critical decisions made at the site that proper documents and records be maintained for the field and offsite data gathering activities, so that specific events can be recreated or independently evaluated. The PM will be responsible for organizing, storing, and cataloging all project information. The PM also is responsible for collecting records and support data from all project team members. Individual project team members may maintain separate notebooks for individual tasks; any files necessary to be retained in the permanent file will be forwarded to the PM for real-time archiving upon preparation. Permanent files will not be retained in individual team member's possession, but will be forwarded to the PM at the close of the project. However, copies of permanent records may be retained in their individual files for use during the

project and discarded at the close of the project. Personal copies of permanent records will not be forwarded to the PM at the close of the project; it is the individual's responsibility to ensure that records in their possession are archived real-time.

C.1.7.1 Field Documentation

Field documentation includes:

- Soil boring logs
- Photographic documentation for intrusive as well as non-intrusive work
- Field logbook to record data collection activities and observations (including date and time, sample locations, depth, health and safety measures, weather conditions, sampling personnel, analyses requested, and sketches)
- Sample collection field sheets or COC documentation
- Field instrument calibration and maintenance logs
- Additionally, field QC and CA documents may be generated as a result of field audits

Field documentation will be stored with the project records.

C.1.7.2 Laboratory Documentation

Calculations to be used for data reduction are specified in the referenced analytical methods.

Whenever possible, analytical data will be transferred directly from the instrument to a computerized data system. Raw data will be stored electronically, and a hard copy file will be maintained. Laboratory data entered will be sufficient to document information used to arrive at reported values.

Electronic data storage will be utilized when possible. All electronic data will be maintained in a manner that prevents inadvertent loss, corruption, and inappropriate alteration.

Raw data will be examined to assess compliance with QC guidelines. Surrogate, matrix spike, and QC check sample recoveries will be checked. In addition, samples and laboratory blanks will be checked for possible contamination or interferences. Chromatograms and concentrations will be checked to ensure that sample results are within the calibration range; if necessary, dilutions will be performed as defined by the initial calibration range.

Deviations from guidelines will call for CA. Deviations determined to be caused by factors outside the laboratory's control, such as matrix interference, will be noted with an explanation in the report narrative. Calculations will be checked and the report reviewed for errors and oversights.

Upon completion, a report will be reviewed for discrepancies, errors, or omissions. Data will then be submitted to the laboratory Quality Assurance Manager (QAM) for review and approval. The laboratory QAM will review the package, ensure that any necessary corrections are made, and give the package to the laboratory PM for review. A copy of the data package will be filed in the project file. Mailed data packages, along with applicable

electronic data deliverables (EDD), will be sealed in an appropriate shipping container and logged into a document mailing log.

The laboratory data package deliverables are discussed in Section C.2.4.4. The requested turn-around time for the majority of the definitive data will be 28 calendar days from the time of sample receipt at the laboratory.

SECTION C.2

Measurement and Data Acquisition

This subsection describes the procedures for collection, handling, measurement, data acquisition, and management activities to be performed in support of the focused SI. It addresses the following aspects of measurement and data acquisition:

- Sampling process design
- Sample handling and custody requirements
- Analytical method requirements
- QC requirements
- Instrument and equipment testing, inspection, and maintenance requirements
- Instrument calibration and frequency
- Inspection and acceptance requirements for supplies and consumables
- Data acquisition requirements

C.2.1 Sampling Process Design

Refer to Section 3 of the WP Addendum for details on sampling design and rationale.

C.2.2 Sample Handling and Custody Requirements

Proper sample handling, preservation, shipment, and maintenance of a COC are key components to building the documentation and support for data within the evidentiary process in order that the data can be used for decision-making. It is essential that all sample handling and sample COC requirements be performed in a complete, accurate, and consistent manner. Sample handling and custody requirements must be followed for all samples collected as part of the investigation.

The FTL is responsible for proper sampling, labeling, preserving, and shipping samples to the laboratory to meet the required holding times.

C.2.2.1 Sample Identification

The sample identification system is discussed in Section 3.6.2 of the WP Addendum. Sample custody and COC records will be maintained in accordance with the MCB Camp Lejeune Master QAPP.

C.2.2.2 Sample Custody

The sample custody and documentation procedures described in this subsection will be followed throughout all sample collection activities. Components of sample custody procedures include the use of field logbooks, sample labels, custody seals, and COC forms. Each person involved with sample handling must be trained in COC procedures before the

start of the field project. The COC form must accompany the samples during shipment from the field to the laboratory.

A sample is under custody under the following conditions:

- It is in one's actual possession
- It is in one's view, after being in one's physical possession
- It was in one's physical possession and that person locks it up to prevent tampering
- It is in a designated and identified secure area

C.2.2.3 Field Custody

The following procedures must be used to document, establish, and maintain custody of field samples:

- Sample labels must be completed for each sample with waterproof ink, ensuring that the labels are legible and affixed firmly on the sample container.
- All sample-related information must be recorded in the project logbook.
- The field sampler must retain custody of samples until they are transferred or properly dispatched.
- One individual from the field sampling team should be designated as the individual responsible for all sample transfer activities. This field investigator will be responsible for the care and custody of samples until they are properly transferred to another person or facility.
- All samples will be accompanied by a COC record. This record documents the transfer of custody of samples from the field investigator to another person, to the laboratory, or to other organizational entities. Each change of possession must be accompanied by an authorized signature for relinquishment and receipt of the samples.
- Completed COC forms will be enclosed in a "sealed" plastic Zip-Lock ® bag (or its equivalent) and placed inside the shipping container used for sample transport from the field to the laboratory.
- When samples are relinquished to a shipping company for transport, the tracking number from the shipping bill or receipt will be recorded on the COC form.
- Custody seals must be affixed on shipping containers when samples are shipped to the laboratory to prevent sample tampering during transportation. If seals are numbered, record the numbers on the chain of custody and in the field log book.

C.2.2.4 Laboratory Sample Custody

Each laboratory receiving samples must comply with the laboratory sample custody requirements outlined in the subcontract document and its own CompQAP. The FTL or PC will notify the laboratory of upcoming field sampling activities and the subsequent transfer of samples to the laboratory. This notification will include information concerning the number and type of samples to be shipped and the expected date of arrival.

The following procedures will be used by the laboratory sample custodian, once the samples have arrived at the laboratory:

- The laboratory will designate a sample custodian who will be responsible for maintaining custody of the samples and for maintaining all associated records documenting that custody.
- Upon receipt of the samples, the custodian will check the original chain of custody and request-for-analysis documents and compare them with the labeled contents of each sample container for corrections and traceability. The sample custodian will sign the chain of custody and record the date and time received. The sample custodian also will assign a unique laboratory sample number to each sample.
- Cooler temperature (temperature blank) will be checked and recorded.
- Care will be exercised to annotate any labeling or descriptive errors. If discrepancies occur in the documentation, the laboratory will immediately contact the FTL as part of the CA process. A qualitative assessment of each sample container will be performed to note anomalies, such as broken or leaking bottles. This assessment will be recorded as part of the incoming chain of custody procedure.
- If all data and samples are correct and there has been no tampering with the custody seals, the "Received by Laboratory" box will be signed and dated.
- Samples will be stored in a secured area and at a temperature of approximately 4 degrees Celsius (°C), if necessary, until analyses are to begin.
- The laboratory will send a sample acknowledgment letter to the PC as a record that the shipment arrived and noting the conditions of the containers upon arrival. Any discrepancy will be identified and CAs performed. These remarks will be documented on a “sample receipt checklist” or its equivalent. The PC may need to be contacted to provide guidance concerning additional CAs or guidance. The PM and PC will retain copies of the sample acknowledgment with the COC.
- All samples will be accompanied by a COC form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the field sampler to another person or to the laboratory. Overnight carriers will be treated as a single entity, and a single signature will be required when samples are delivered to the laboratory.
- A laboratory chain of custody form will accompany the sample or sample fraction through final analysis for control.
- Copies of the COC and request-for-analysis forms will accompany the laboratory report and will become a permanent part of the project records.
- Samples must be properly packaged for shipment and dispatched to the appropriate laboratory for analysis with a separate signed COC form enclosed in each sample box or cooler.

- All packages must be accompanied by a chain of custody form identifying the contents. The original record must accompany the shipment, and the FTL must retain a copy. Additional details about laboratory sample custody will be included in the CompQAP.

C.2.2.5 Sample Packing and Shipping

Sample packing and shipping is discussed in Section 3.6.2 of the WP Addendum.

C.2.3 Analytical Method Requirements

This subsection summarizes the target analytes, analytical methods, RLs, and data package deliverables.

Samples will be analyzed using USEPA-approved methods or other recognized standard methods (USEPA, 1992). The three principal sources for analytical methods are as follows:

- *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (USEPA, 1998)

Table C-2-1 presents the analytical services to be performed during the Focused SI.

Table C-2-2 presents a summary of field and QA/QC samples.

Table C-2-3 presents the analytical methods, preservatives, containers, and holding times to be used for the analysis of the target compounds.

TABLE C-2-1
Analytical Services

Matrix	Analytical Group	Number of Samples	Analytical Method	Data Package Turnaround Time	Laboratory / Organization (name and address, contact person, and telephone number)	Backup Laboratory / Organization (name and address, contact person, and telephone number)
Soil	Explosives residues (including PETN)	63	SW846 8330	*Phase 1 Samples:* 14 calendar-day turnaround time (TAT) *Phase 1 contingency samples*: 7 calendar-day TAT *Phase 2 Samples*: 28 calendar-day TAT	Empirical Laboratories, LLC 621 Mainstream Drive, Suite 270 Nashville, TN 37228 Janice Shilling 615-345-1115	To be determined (TBD), if primary lab cannot perform work, backup will be identified
Soil	Nitroglycerin	63	SW846 8332			
Soil	Perchlorate	63	SW846 6850			
Soil	Metals	63	SW846 6010B			

TABLE C-2-2
Sample Analysis Summary

Analysis	Sample Matrix	Field Samples	Field Duplicates	Equipment Blanks	Field Blanks	Matrix Spike/Matrix Spike Duplicates (MS/MSDs)
Explosives Residues (including PETN)	Soil	63	8	7	3	5
Nitroglycerin	Soil	63	8	7	3	5
Perchlorate	Soil	63	8	7	3	5
Target analyte list (TAL) Metals	Soil	63	8	7	3	5

TABLE C-2-3
Required Analytical Method, Sample Containers, Preservation, and Holding Times

Analyses	Analytical Method	Sample Matrix[a]	Container	Qty	Preservative[b]	Holding Time
Explosives Residues (including PETN and Nitroglycerine)	SW-846 8330/8332	SS/SB	Four 8 ounce (oz.) glass jar	1	4ºC	14 days to extraction, 40 days from extraction to analysis
Perchlorate	SW-846 USEPA 6850	SS/SB	One 8-oz bottle, Teflon cap	1	4ºC	28 days to extraction, 40 days from extraction to analysis
TAL Metals	SW-846 6010B	SS/SB	Four 8 oz. glass jar	1	4ºC	6 months, Mercury: 28 days

Notes:
Sample container, and volume requirements will be specified by the analytical laboratory performing the tests.
Three times the required volume should be collected for samples designated as MS/MSD samples.
[a]Sample matrix: SS= surface soil; SB = subsurface soil
[b]All samples will be stored promptly at 4°C in an insulated chest.

C.2.3.1 Analytical Methods for Organics and Inorganics

SW846 Method 8330—Explosives Residues and PETN

This method is intended for the trace analysis of explosives residues by high performance liquid chromatography (HPLC) using a ultraviolet (UV) detector. **Table C-2-4** refers to explosives residues and PETN reference limits and evaluations.

SW-846 Method 8332—Nitroglycerin

Method 8332 is used to determine the concentration of nitroglycerin (CAS No. 55-63-0) in aqueous matrices such as wastewater, groundwater, and surface water. This method may also be applicable to other matrices. Method 8332 also provides a qualitative procedure utilizing HPLC for determining the presence or absence of nitroglycerine using a UV detector. **Table C-2-5** refers to nitroglycerin reference limits and evaluations.

SW-846 Method 6850-Perchlorate

This method uses HPLC coupled with electrospray ionization (ESI) mass spectrometry (MS) or tandem mass spectrometry (MS/MS) for the determination of perchlorate in surface water, groundwater, wastewater, salt water and soil. **Table C-2-6** refers to perchlorate reference limits and evaluations.

SW846 6010B–Metals Analysis

This method provides procedures for the detection and quantitative measurement of selected metals. The analytical method calls for the use of inductively-coupled plasma (ICP)/atomic emission spectroscopy (AES) on sample extracts. **Table C-2-7** refers to metals reference limits and evaluations.

TABLE C-2-4
Explosive Residues and PETN Reference Limits and Evaluation Table

Analyte	CAS Number	Project Action Limit (milligrams per kilogram [mg/kg])	Project Action Limit Reference	Project Quantitation Limit (PQL) Goal (mg/kg)	Laboratory-specific	
					Quantitation Limits (QLs) (mg/kg)	MDLs (mg/kg)
1,3,5-Trinitobenzene	99-35-4	220	RSL Residential	0.5	0.5	0.1
1,3-Dinitrobenzene	99-65-0	0.61	RSL Residential	0.5	0.5	0.1
2,4,6-Trinitrotoluene	118-96-7	3.6	RSL Residential	0.5	0.5	0.1
2,4-Dinitrotoluene	121-14-2	No criteria (NC)	N/A	0.5	0.5	0.1
2,6-Dinitrotoluene	606-20-2	NC	N/A	0.5	0.5	0.1
2-Amino-4,6-dinitrotoluene	35572-78-2	15	RSL Residential	0.5	0.5	0.1
2-Nitrotoluene	88-72-2	2.9	RSL Residential	0.5	0.5	0.1
3-Nitrotoluene	99-08-1	120	RSL Residential	0.5	0.5	0.1
4-Amino-2,6-dinitrotoluene	19406-51-0	15	RSL Residential	0.5	0.5	0.1
4-Nitrotoluene	99-99-0	24	RSL Residential	0.5	0.5	0.1
HMX	2691-41-0	380	RSL Residential	0.5	0.5	0.1
Nitrobenzene	98-95-3	NC	N/A	0.5	0.5	0.1
PETN	78-11-5	NC	N/A	0.6	0.6	0.2
RDX	121-82-4	5.5	RSL Residential	0.5	0.5	0.1
Tetryl	479-45-8	24	RSL Residential	0.5	0.5	0.1

TABLE C-2-5
Nitroglycerin Reference Limits and Evaluation Table

Analyte	CAS Number	PAL (micrograms per kilogram [µg/kg])	PAL Reference	PQL Goal (µg/kg)	Laboratory-specific	
					QLs (µg/kg)	MDLs (µg/kg)
Nitroglycerin	55-63-0	0.61	RSL Residential	0.5	0.5	0.15

TABLE C-2-6
Perchlorate Reference Limits and Evaluation Table

Analyte	CAS Number	PAL (µg/kg)	PAL Reference	PQL Goal (µg/kg)	Laboratory-specific	
					QLs (µg/kg)	MDLs (µg/kg)
Perchlorate	14797-73-0	5	RSL Residential	0.2	0.2	0.05

TABLE C-2-7
Metals Reference Limits and Evaluation Table

Analyte	CAS Number	PAL (mg/kg)	PAL Reference	PQL Goal (mg/kg)	Laboratory-specific	
					QLs (mg/kg)	MDLs (mg/kg)
Aluminum	7429-90-5	7700	RSL Residential	20	20	6.0
Antimony	7440-36-0	3.1	RSL Residential	3.0	3.0	1.0
Arsenic	7440-38-2	0.39	RSL Residential	0.5	0.5	0.15
Barium	7440-39-3	848	NC SSL	20	20	6.0
Beryllium	7440-41-7	3.38	NC SSL	0.5	0.5	0.15
Cadmium	7440-43-9	0.95	NC SSL	0.5	0.5	0.15
Calcium	7440-70-2	NC	N/A	500	500	150
Chromium	7440-47-3	27.2	NC SSL	1.0	1.0	0.2
Cobalt	7440-48-4	2.3	RSL Residential	2.0	2.0	0.6
Copper	7440-50-8	0.0000409	RSL Industrial	0.5	0.5	0.15
Iron	7439-89-6	151	NC SSL	10	10	2.0
Lead	7439-92-1	270	NC SSL	1.0	1.0	0.3
Magnesium	7439-95-4	NC	N/A	500	500	150
Manganese	7439-96-5	65.2	NC SSL	1.5	1.5	0.5
Mercury	7439-97-6	.015	NC SSL	0.03	0.03	0.01
Nickel	7440-02-0	56.4	NC SSL	4.0	4.0	1.0
Potassium	7440-09-7	NC	N/A	500	500	150
Selenium	7782-49-2	12.2	NC SSL	2.0	2.0	0.6
Silver	7440-22-4	.217	NC SSL	0.5	0.5	0.05
Sodium	7440-23-5	NC	N/A	500	500	150
Thallium	7440-28-0	0.51	RSL Residential	0.5	0.5	0.15
Vanadium	7440-62-2	55	RSL Residential	2.5	2.5	0.5
Zinc	7440-66-6	550	NC SSL	4.0	4.0	1.0

Grey shading denotes where laboratory QL exceeds PAL

C.2.3.2 Analytical Laboratory

The analytical laboratory contracted out to perform the work is Empirical Laboratories, LLC.

The laboratories selected undergo annual evaluations to determine if they are meeting project requirements. Laboratories may be added or deleted based on their performance.

C.2.3.3 Detection, Quantitation and Reporting Limits

The laboratory will supply analyte-specific quantification limits, with laboratory-specific method detection limit (MDL) studies, as part of its laboratory CompQAP.

Method Detection Limits

MDL is the minimum amount of an analyte that can be routinely identified using a specific method and instrument measured and reported with 99 percent confidence that the analyte concentration is greater than zero. MDLs are operationally determined as three times the standard deviation of seven replicate spiked samples run according to the complete method. However, the evaluation is routinely completed on reagent grade water. As a result, potentially significant matrix interferences that decrease analyte recoveries are not addressed.

Determine the MDL for each analyte as follows:

MDL = 3.14(s)

Note:

s - The standard deviation for each analyte from the seven replicate analyses.

3.14 - The one-sided t-statistic at the 99 percent confidence level appropriate for determining the MDL using seven replicates.

When the concentration of concern (or project-specific action level) is greater than the MDL, to the extent that the confidence limits of both the MDL and concentration of concern do not overlap, then both “non-detect” and “detect” results can be used with confidence. There will be a possibility of false positives and false negatives if the confidence limits of the MDL and the concentration of concern overlap. When the concentration of concern is sufficiently less than the MDL that the confidence limits do not overlap, then there is a strong possibility of false negatives and only “detect” results are useable.

The laboratory will establish MDLs for each method, matrix, and analyte for each instrument the laboratory plans to use for the project. The laboratory will revalidate these MDLs at least once per 12-month period. The laboratory will provide the MDL at the beginning of the project. Project and laboratory specific MDLs will be included in the project-specific addendum.

40 CFR 136, Appendix B, or Chapter 1 of SW846 Methods, has not set frequency requirements for revalidating the MDLs. The MDLs be validated once per 12-month period.

Where multiple instruments are used, the MDL used for reporting purposes will represent the least sensitive instrument.

Instrument Detection Limit

The instrument detection limit (IDL) includes only the instrument portion of the detection, not sample preparation, concentration/dilution factors, or method-specific parameters. The IDL is operationally defined as three times the standard deviation of seven replicate analyses at the lowest concentration that is statistically different from a blank. This represents 99 percent confidence that the signal identified is the result of the presence of the analyte, not random noise. The IDL is not the same as the MDL. There is no formal procedure for IDL outside the USEPA Contract Laboratory Program (CLP) Statement of Work (SOW) for inorganic analysis.

Quantitation Limits

The QL as defined in SW-846 methods, is the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. The sample QL (SQL) is the QL adjusted to reflect sample-specific actions such as dilution or use of smaller aliquot sizes than prescribed in the method, or for percent moisture. These adjustments may be due to matrix effects or the high concentration of some analytes. The SQL is the more useful limit for data users such as risk assessors.

For the same chemical, the SQL in one sample may be higher than, lower than, or equal to the SQL values for other samples. In addition, preparation or analytical adjustments, such as dilution of the sample for quantitation high levels target and non-target analytes, could result in non-detects for other analytes included in the analysis, even though target analytes may have been present at trace quantities in the undiluted sample.

All results will be reported on a dry-weight basis.

Reporting Limits

The laboratories participating in this work effort will compare the results of the experimental MDLs to RLs for each analyte. The MDL may not be more than one-half the corresponding RL. The laboratories also will verify RLs by including a standard at the RL as the lowest point on the calibration curve. For methods that do not include the RL as the low point of the calibration curve, a RL verification standard will be analyzed immediately following calibration. The RL verification standard must include all target analytes. All results will be reported at or above the MDL values. No numerical results will be reported below the MDL; however, for those results falling between the MDL and the RL, a “J” flag will be applied to the results indicating the variability associated with the result.

Analytical SOPs

The laboratory has submitted a list of specific SOPs that will be used to perform off-site analysis of samples. Refer to **Table C-2-8** for Analytical SOP References. Laboratory SOPs are provided in **Attachment C-2.**

TABLE C-2-8
Analtyical SOP References

Matrix	Analytical Group	Analytical and Preparation Method / SOP Reference	Containers	Sample volume	Preservation Requirements	Maximum Holding Time[1]
Soil	TAL Metals	SW-846 3005A/6010B/7470A, SOP-100/103/105	4 oz. glass	1-2 grams (g)/ 0.3 g mercury	HNO3 to a pH<2; Cool to 4° C	180 days to analysis, 28 days mercury
Soil	Explosives	SW-846 8330A/8332, SOP-327	4 oz. glass	2 g	Cool to 4°C	14 days until extraction/ 40 days to analysis
Soil	Perchlorate	SW-846 6850/HPLC-DoDPerchlorate	4 oz glass	1 g	Cool to 4°C	28 days

C.2.3.4 Data Package Deliverables

There are no data package requirements for Level I (screening results). The FTL is responsible for reviewing the field logbooks, which will contain the following information for Level I field screening results.

QC data package deliverables are summarized in **Table C-2-9** by analytical fraction and will include sample results and QC summary forms, but not unreduced instrument data. Level III data packages will contain sufficient information so that sample analysis can be reconstructed, calculations can be verified, and a data quality assessment can be made to evaluate whether the data meet project requirements.

In addition, the laboratory must have the capability of providing the data package on compact disc (CD) in a scanned .pdf format. At this time, it is anticipated that the laboratory will provide one hardcopy data package and one CD to the PC, and one CD to the PM.

Refer to **Table C-2-9** for Data Package Deliverables.

TABLE C-2-9
Data Package Deliverables

All Analytical Fractions			
Case Narrative – A detailed case narrative per analytical fraction is required and will include explanation of any non-compliance and/or exceptions and CA. Exceptions will be noted for receipt, holding times, methods, preparation, calibration, blanks, spikes, surrogates (if applicable), and sample exceptions.			•
Sample Identification (ID) Cross Reference Sheet (Lab IDs and Client IDs)			•
Completed COC and any sample receipt information			•
Sample preparation (extraction/digestion) logs			•
Copies of non-conformance memos and CAs			•
Form *	**GC/MS Organic Fractions**	**Level II**	**Level IV**
1	Sample results	•	• + raw
2	Surrogate Recovery Summary (w/ applicable control limits)	•	•
3	MS/MSD Accuracy & Precision Summary **	•	• + raw
3	Laboratory Control Sample (LCS) Accuracy Summary	•	• + raw
4	Method Blank Summary	•	• + raw
5	Instrument Tuning Summary (including tuning summary for applicable initial calibrations)		•
6	Initial Calibration Summary (including concentration levels of standards)		• + raw
7	Continuing Calibration Summary		• + raw
8	Internal Standard Summary (including applicable initial calibrations)		•
Form *	**GC/HPLC Organic Fractions**	**Level II**	**Level IV**
1	Sample results	•	• + raw
2	Surrogate Recovery Summary (with applicable control limits)	•	•
3	MS/MSD Accuracy and Precision Summary **	•	• + raw
3	LCS Accuracy Summary	•	• + raw
4	Method Blank Summary	•	• + raw
6	Initial Calibration Summary (including concentration levels of standards) ***		• + raw
7	Continuing Calibration Summary ***		• + raw
7	Degradation Summary (Organochlorine Pesticides only) ***		• + raw
8	Analytical Sequence (including internal standard area performance where applicable) ***		•
10	Compound Identification Summary (where confirmation required) ***		•
Form *	**Metals Inorganic Fractions**	**Level II**	**Level IV**
1	Sample Results	•	• + raw
2A	Initial and Continuing Calibration Summary		• + raw
3	Initial and Continuing Calibration Blanks and Method Blanks Summary	•	• + raw
4	Interference Check Standard Summary		• + raw
5A	Pre-digestion Matrix Spike Recoveries Summary	•	• + raw
5B	Post-digestion Spike Recoveries Summary		• + raw
6	Native Duplicate or MS/MSD Precision Summary **	•	• + raw
7	LCS Recovery Summary	•	• + raw
8	Method of Standard Addition (if necessary)		• + raw
9	Serial Dilution		• + raw
10	Instrument or Method Detection Limit Summary		•
11	ICP Interelement Correction Factors		•
12	Linear Range Summary		•
13	Preparation Log Summary		• + raw
14	Analytical Run Sequence and GFAA Post-spike Recovery Summary		• + raw
Form *	**General Chemistry Fractions: (Includes potentiometric, gravimetric, colorimetric, and titrimetric analytical techniques. [e.g., total petroleum hydrocarbon (TPH) [418.1], total organic compound (TOC)])**	**Level II**	**Level IV**
1	Sample Results	•	• + raw
2A	Initial and Continuing Calibration Summary		• + raw
3	Initial and Continuing Calibration Blanks and Method Blanks Summary	•	• + raw
5A	Pre-digestion Matrix Spike Recoveries Summary	•	• + raw
6	Native Duplicate or MS/MSD Precision Summary **	•	• + raw
7	LCS Recovery Summary	•	• + raw
10	Instrument or Method Detection Limit Summary		•

* CLP Form or summary form with equivalent information
** with RPD calculated according to method specifications (CLP using % recovery, SW-846 using concentration)
*** including deliverables for primary and confirmation analysis (where applicable)

C.2.4 Quality Control Requirements

The following text describes this project's QC requirements.

C.2.4.1 Field QC Blank Samples and Duplicate Field Samples

The type and frequency of field QC samples should be evaluated as part of the project planning process. In the following subsections, typical field QC blank samples and duplicate field samples are defined.

Blank samples should not contain any target parameter of interest. There are certain organic compounds known to be common laboratory contaminants, such as acetone, methylene chloride, and the common phthalates. However, the laboratory must make all efforts to eliminate these compounds as contaminants. The concentration of all target compounds must be less than the RL, except for the common contaminants; the concentration of the common contaminants must be less than five times the RL.

Equipment Rinsate Blank Samples

Equipment rinsate blanks (ERBs) are samples of ASTM Type II water passed through and over the surface of decontaminated sampling equipment. The rinse water is collected in sample bottles, preserved, and handled in the same manner that is used when collecting aqueous samples, even if the ERBs are being collected for soil samples. ERBs are used to monitor the effectiveness of the decontamination process. One ERB will be collected per day, per type of sampling equipment and analyzed for the same parameters as the corresponding samples.

Field/Decontamination Source Water Blanks

Field blanks (FBs) are samples of the source water used for decontamination and steam cleaning. This blank is used to monitor potential contaminants present in the source water during field decontamination procedures. One FB will be collected for each source of water used for decontamination and analyzed for the same parameters as the corresponding samples. One FB will be collected per week while sampling.

Temperature Blanks

Temperature blanks are sent with each cooler shipped to the offsite laboratory containing samples requiring preservation at 4°C. Temperature blanks consist of a non-preserved volatile organic compounds (VOC) vial, or similar laboratory container, filled with ASTM reagent grade water. Temperature blanks are measured at the laboratory upon receipt to verify the temperature of the samples contained in the cooler. One temperature blank will be shipped with each cooler to each offsite laboratory.

Duplicate Field Samples

Duplicate field samples are collected to monitor the precision of the field sampling process. The FTL will choose at least 10 percent (per matrix) of the total number of sample locations known or suspected to contain moderate contamination, and duplicate field samples will then be collected at these locations. The identity of the duplicate samples will be recorded in the field sampling logbook, and this information will be forwarded to the DQE team to aid

in reviewing and evaluating the data. A control limit of ±20 percent for the RPD will be used for original and duplicate concentrations greater than five times the RL in water matrices. A control limit of ± 35 percent for the RPD will be used for original and duplicate concentrations greater than five times the RL in soil matrices. A control limit of ± the RL will be used for waters and ± 2 times the RL for soils when concentrations are reported as less than five times the RL.

Table C-2-10 has Field QC sample parameters.

TABLE C-2-10
Field QC Samples

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Cooler Temperature Blank	Explosives Residues/ Perchlorate/ Metals	One per cooler	Accuracy/ Representativeness	Temperature should be 0-6°C upon arrival at laboratory	S
Field blank	Explosives Residues/ Perchlorate/ Metals	1 per week	Contamination/bias	All target compounds <1/2 PQL	S
Equipment blank	Explosives Residues/ Perchlorate/ Metals	1 per day per equipment type	Contamination/bias	All target compounds <1/2 PQL	S
MS	Explosives Residues/ Perchlorate/ Metals	1 per 20 samples or analytical batch	accuracy	See attachment; S-VO-002, TABLE DoD-IV	A
MSD	Explosives Residues/ Perchlorate/ Metals	1 per 20 samples or analytical batch	Accuracy/precision	See attachment; S-VO-002, TABLE DoD-IV	A

C.2.4.2 Laboratory QC Blank and Matrix Spike Samples

Laboratory Method/Preparation Blanks

Laboratory method blanks are blank matrices (such as ASTM Type II water or Ottawa sand) that are treated as environmental samples, being prepared and analyzed along with the field samples. Laboratory method blanks are used to monitor laboratory performance and to check for contamination introduced during the preparation and analytical procedures. A method blank is required for every 20 field samples or for each analytical batch, whichever is more frequent.

Blank samples should not contain any target parameter of interest. There are certain organic compounds known to be common laboratory contaminants, such as acetone, methylene chloride, and the common phthalates. However, the laboratory must make all efforts to eliminate these compounds as contaminants. The concentration of all target compounds must be less than the RL, except for the common contaminants; the concentration of the common contaminants must be less than five times the RL.

Matrix Spike/Matrix Spike Duplicate Samples

For MS/MSD samples, three aliquots of a single sample are analyzed: one native and two spiked with target compounds or metals. Spike recovery is used to evaluate potential matrix interferences, as well as accuracy. The duplicate spike results (MS and MSD) are compared to evaluate precision. MS/MSDs will be collected at a frequency of 5 percent (one MS/MSD sample set for every 20 field samples) of the number of field samples. The MS/MSD accuracy limits are presented in the attached laboratory SOPs.

The laboratory MS/MSD accuracy and precision limits for the remaining analyses will be used as guidance when evaluating the data.

Surrogate Spikes

Surrogate spike compounds are added to each sample for the organic analytical methods. Surrogate spike compounds are structurally similar (but not identical) to target compounds and should behave in a similar manner during analysis. Surrogate spike recoveries are used to monitor both laboratory performance and matrix interferences. Surrogate spike recoveries from field and laboratory blanks are used to evaluate laboratory performance because these blanks represent an ideal sample matrix. Surrogate spike recoveries for field samples are used to evaluate the potential for matrix interferences. When surrogate spike recoveries for field samples fall outside the method target acceptance windows, the samples are re-extracted if appropriate, then re-analyzed. If the surrogate spike recovery is still outside the acceptance window for the re-analyzed sample, then the sample results are qualified as affected by matrix interferences.

Laboratory Control Spike Samples

The LCSs are analyte-free water (for aqueous analyses) or Ottawa sand (for soil analyses) (except metals where glass beads of 1-millimeter [mm] diameter or smaller may be used) spiked with all target analytes. The appropriate spiking concentration will be spiked at a level less than or equal to the midpoint of the calibration curve for each analyte.

The LCS will be carried through the complete sample preparation and analysis procedure. The LCS is used to evaluate each preparation and analytical batch and to determine if the method is in control. The LCS cannot be used as the continuing calibration verification. One LCS will be included in every preparation and analytical batch. If more than on LCS is analyzed in an analytical batch, results from all LCSs analyzed will be reported.

Whenever an analyte in a LCS is outside the acceptance limit, CA will be performed. After the system problems have been resolved and system control has been reestablished, all samples in the analytical batch will be reanalyzed for the out-of-control analyte(s). When an analyte in a LCS exceeds the upper or lower control limit and no CA is performed or the CA was ineffective, the laboratory should discuss the issue with the PC or QAM personnel.

Interference Check Samples

The interference check sample (ICS), used in ICP analyses only, contains both interfering and analyte elements of known concentrations. The ICS is used to verify background and interelement correction factors and is run at the beginning and end of each run sequence.

When the ICS results are outside of the acceptance limits as prescribed in the method, CA will be performed. After the system problems have been resolved and system control has been re-established, re-analyze the ICS. If the ICS result is acceptable, re-analyze all affected samples.

Internal Standards

Internal standards (ISs) are known amounts of certain compounds added after preparation or extraction of a sample. These compounds are used in an IS calibration method to correct sample results affected by column injection losses, purging losses, or viscosity effects. ISs will be added to environmental samples, control samples, and blanks in accordance with the method requirements.

When the IS results are outside of the acceptance limits, CAs will be performed. After the system problems have been resolved and system control has been reestablished, all samples analyzed while the system was malfunctioning will be reanalyzed.

C.2.4.3 Retention Time Windows

Retention time windows are established to compensate for minor shifts in absolute retention times resulting from normal chromatographic variability. Absolute retention times are used for analyte identification in all gas chromatography (GC) and HPLC methods that do not employ IS calibration. Retention time windows are used in GC and HPLC analysis for qualitative identification of analytes. They are calculated from replicate analyses of a standard on multiple days. If the analyte retention time is outside the established window, new retention windows must be established.

C.2.4.4 Confirmation of Identification

Quantitative confirmation of results at or above the RL for samples analyzed by GC or HPLC will be required and will be completed within the method-required holding times. For GC methods, a second column is used for confirmation. For HPLC methods, a second column or a different detector is used. The result from the lowest quantitation between the primary and secondary column/detector will be used for reporting purposes. The lowest quantitation will be reported to minimize the reporting of bias high results arising from co-elution of non-target analytes with the analyte of interest.

C.2.4.5 Standard Materials

Standard materials, including second source materials, used in calibration and to prepare samples will be traceable to National Institute of Standards and Technology (NIST), USEPA, American Association of Laboratory Accreditation (A2LA) or other equivalent approved source, if available. If an NIST, USEPA, or A2LA standard material is not available, the standard material proposed for use will be included in an addendum to the QAPP and approved before use. The standard materials will be current, and the following expiration policy will be followed: The expiration dates for ampulated solutions will not exceed the manufacturer's expiration date or 1 year from the date of receipt, whichever comes first. Expiration dates for laboratory-prepared stock and diluted standards will be no later than the expiration date of the stock solution or material or the date calculated from the holding time allowed by the applicable analytical method, whichever comes first. Expiration dates

for pure chemicals will be established by the laboratory and be based on chemical stability, possibility of contamination, and environmental and storage conditions. Expired standard materials will be either revalidated prior to use or discarded. Revalidation may be performed through assignment of a true value and error window statistically derived from replicate analyses of the material as compared to an unexpired standard. The laboratory will label standard and QC materials with expiration dates.

A second source standard is used to independently confirm initial calibration. A second source standard is a standard purchased from a different vendor than the vendor supplying the material used in the initial calibration standards. The second source material can be used for the continuing calibration standards or for the LCS (but will be used for one of the two). Two different lot numbers from the same vendor do not constitute a second source.

Tables C-2-11 through C-2-13 present laboratory QC sample information.

TABLE C-2-11
Laboratory QC Information - Metals

Matrix	Soil
Analytical Group	TAL Metals
Analytical Method / SOP Reference	SW-846 3050B, 6010B/7471A/SOP-100/104/105

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Method Blank	One per digestion batch of 20 or fewer samples.	Contaminants in the method blank must be less than ½ the reporting limit.	1) Investigate the source of the contamination. Redigest and reanalyze all associated samples if the sample concentration ≥ the reporting limit and <10x the blank concentration.	Analyst, Laboratory Supervisor and Data Validator	Bias / Contamination	Contaminants in the method blank must be less than half the reporting limit.
LCS	One per digestion batch of 20 or fewer samples.	Recovery must be within ± 20% of the true value, unless vendor-supplied or statistical limits have been established.	Investigate source of problem. Redigest and reanalyze all associated samples.	Analyst, Laboratory Supervisor and Data Validator	Accuracy / Bias / Contamination	Recovery must be within ± 20% of the true value, unless vendor-supplied or statistical limits have been established
Duplicate Sample	One per digestion batch of 20 or fewer samples.	The relative percent difference should be within ≤20% for duplicate spikes.	Flag results	Analyst, Laboratory Supervisor and Data Validator	Precision	The relative percent difference should be within ≤20% for duplicate spikes.
Matrix Spike	One per digestion batch of 20 or fewer samples.	Recovery should be ± 25% of the true value, if sample < 4x spike added.	Flag results.	Analyst, Laboratory Supervisor and Data Validator	Accuracy / Bias	Recovery should be ± 25% of the true value, if sample < 4x spike added.
ICP Serial Dilution	One per digestion batch.	If original sample result is at least 50x the instrument detection limit, 5-fold dilution must agree within ± 10% of the original result.	Flag result or dilute and reanalyze sample to eliminate interference.	Analyst, Laboratory Supervisor and Data Validator	Accuracy / Bias	If original sample result is at least 50x the instrument detection limit, 5-fold dilution must agree within ± 10% of the original result.

TABLE C-2-12
Laboratory QC Information Explosive Residues, Nitroglycerin, and PETN

Matrix	Soil
Analytical Group	Empirical Laboratories, LLC
Analytical Method / SOP Reference	8330A/8332/ Empirical SOP-327

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI
Method Blank	One per batch of 20 or less	No target compounds ≥1/2 contract required quantitation limit (CRQL) except common lab contaminants which should be < RL	Reclean, retest, re-extract, reanalyze, and/or qualify data	Analyst, Laboratory Supervisor and Data Validator	Bias / Contamination
Surrogates	1 per sample	Department of Defense (DoD) limits.	Reprep and reanalyze for confirmation of matrix interference when appropriate.	Analyst, Laboratory Supervisor and Data Validator	Accuracy / Bias
Laboratory Control Spike	One per batch of 20 or less	DoD limits.	Evaluate and reanalyze if possible If an MS/MSD was performed in the same batch and acceptable narrate. If the LCS recoveries are high but the sample results are <QL narrate otherwise reprep and reanalyze	Analyst, Laboratory Supervisor and Data Validator	Precision / Accuracy / Bias
MS/MSD	One per sample delivery group (SDG) or every 20 samples.	DoD limits.	CA will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met If both the LCS and MS/MSD are unacceptable reprep the samples and QC.	Analyst, Laboratory Supervisor and Data Validator	Precision / Accuracy / Bias

TABLE C-2-13
Laboratory QC Information – Perchlorate

Matrix	Soil
Analytical Group	Perchlorate
Analytical Method/ SOP Reference	SW-846 6850/ CAS HPLC-6850

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Method Blank	One per batch of 20 or less	No perchlorate ≥1/2 CRQL	Reclean, retest, re-extract, reanalyze, and/or qualify data	Analyst, Laboratory Supervisor and Data Validator	Bias / Contamination	No target compounds ≥1/2 CRQL
Reagent Blank	Prior to calibration and after each batch analyzed	No perchlorate ≥1/2 CRQL	If contaminated, reanalyze reagent blanks until no carryover is observed (< ½ the reporting limit). Reanalyze all samples processed since the last clean reagent blank or flag.	Analyst, Laboratory Supervisor and Data Validator	Contamination	No target compounds ≥1/2 CRQL
Laboratory Control Spike	One per batch of 20 field samples or less	Spike Recovery within 80-120%.	(1) Re-extract and reanalyze if possible (2) If the LCS recoveries are high but the sample results are <QL narrate otherwise reprep and reanalyze	Analyst, Laboratory Supervisor and Data Validator	Accuracy / Bias	Spike Recovery limits must be within 80-120%.
ICS	1/batch	Spike Recovery must be within the range of 70-130%	Correct problem and reextract and reanalyze associated samples	Analyst, Laboratory Supervisor and Data Validator	Interference	Spike Recovery must be within the range of 70-130%
limit of detection verification (LODV)	At beginning and end of each batch	70-130% Recovery	Reanalyze samples in associated batch which are < MRL	Analyst, Laboratory Supervisor and Data Validator	Accuracy / Bias	70-130% Recovery
MS/MSD	If requested, one per SDG or every 20 samples.	Spike Recovery within 80-120%; RPD limits are 15% .	Evaluate LCS; may report with qualifier and note outliers in case narrative.	Analyst, Laboratory Supervisor and Data Validator	Precision / Accuracy / Bias	Spike Recovery within 80-120%; RPD limits are 15%

C.2.5 Field and Laboratory Corrective Action

The procedures that will be followed in identifying problems and performing CAs in the field and in the laboratory are described below.

C.2.5.1 Field Corrective Action

The task manager is responsible for overseeing the CA process, but any team member may initiate it. The CA process consists of identifying a problem, acting to eliminate the problem, monitoring the effectiveness of the CA, verifying that the problem has been eliminated, and documenting the CA.

Examples of CA are correcting COC forms; problems associated with sample collection, packaging, shipping, or field record keeping; or additional training in sampling and analysis. Additional approaches may include re-sampling or evaluating and amending sampling procedures.

C.2.5.2 Laboratory Corrective Action

The laboratory department supervisors will review the data generated to verify that all QC samples have been run as specified in the procedure. Laboratory personnel are alerted that CAs may be necessary under the following conditions:

- QC data are outside the warning or acceptable windows for precision and accuracy established for laboratory samples.
- Blanks contain contaminants at concentrations above the levels specified in the laboratory QA plan for any target compound.
- Deficiencies are detected by the laboratory QA director during internal or external audits, or from the results of performance evaluation samples.

CAs are implemented immediately when non-conformances in QC sample results are identified by the bench analyst. CA procedures are handled initially at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors and checks such parameters as instrument calibration, spike and calibration mixes, and instrument sensitivity.

The analyst immediately notifies his or her supervisor of the problem and the investigation being conducted. If the problem persists or cannot be identified, the matter must be referred to the laboratory supervisor and the QA/QC officer for further investigation. At this point, the PC and the PM must be notified about the nonconformance. All laboratory QC problems that will affect the final data must be discussed with the PC as part of the CA process. Once resolved, full documentation of the CA procedure must be filed with the laboratory supervisor, and the QA/QC officer must be provided with a CA memorandum for inclusion in the project file if data are affected. A copy of the CA memorandum must be included in the laboratory data package deliverable.

CAs may include the following:

- Reanalyzing suspect samples
- Recalibration with new standards
- Eliminating blank contamination
- Resampling and analyzing new samples
- Evaluating and amending sampling and analytical procedures
- Accepting data with an acknowledged level of uncertainty
- Recalibrating analytical instruments
- Qualifying or rejecting the data

After implementation of the required CA measures, data that are deemed unacceptable may not be accepted by the PM, and follow-up CAs may be explored. Details of laboratory CAs are provided in the laboratory CompQAM.

C.2.6 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

This subsection describes the inspection and acceptance of environmental sampling and measurement systems and components to ensure their intended use as specified by the design.

C.2.6.1 Field Instruments

All equipment used for field measurements will be maintained in accordance with the manufacturer's instructions. Routine maintenance and all equipment repairs will be documented in the site logbook. Whenever a piece of equipment fails to operate properly, the instrument either will be repaired in-house, if possible, or be sent out for repair, and another instrument equivalent to the original will be substituted, if possible. Other than solutions/standards for calibrating the equipment, the field team keeps only a limited amount of supplies on hand. Parts are ordered on an as-needed basis.

C.2.6.2 Analytical Laboratory Instruments

Preventive maintenance for laboratory instruments is discussed in greater detail in the laboratory's CompQAP.

It is required that designated laboratory personnel will be trained in routine maintenance procedures for all major instrumentation. Either trained staff or trained service engineers or technicians employed by the instrument manufacturer will make repairs. The laboratory should have multiple instruments that will serve as back-up to minimize potential downtime. All maintenance will be documented and kept in permanent logs. These logs will be available for review by auditing personnel.

Laboratory equipment testing, inspection, and maintenance will be in accordance with the laboratory's CompQAP. The laboratory CompQAP should discuss the schedule, procedures, criteria, and documentation for verifying that all analytical equipment is operating in an accurate and precise manner. To minimize instrument downtime, each laboratory should have an internal instrument repair department or have a contract with a

local instrument repair company. The laboratory keeps an inventory of certain supplies and consumables, as described in the laboratory's CompQAP. Additional parts or supplies are ordered on an as-needed basis.

C.2.7 Instrument Calibration and Frequency

Calibration procedures for field instruments and laboratory equipment are discussed below.

Because instruments used during field investigation activities may be of several models and manufacturers, it is not feasible to present instrument-specific details in this subsection. Instead, instrument-specific calibration will be performed in accordance with the manufacturer's instructions, as provided in the instrument's SOP.

Field instruments will be calibrated daily in accordance with manufacturers' specifications before the beginning of sampling activities. The calibration of all field equipment will be documented in the field notebook. Standards used to calibrate the field survey instruments will be traceable to NIST standards whenever possible. The method and frequency of calibration for the instruments used for each field activity are described in the manufacturer's instructions. These procedures will be followed at a minimum.

C.2.8 Laboratory Equipment

Laboratory instruments will be calibrated in accordance with the manufacturer's directions and applicable method specifications. Laboratory instrument calibration procedures will be summarized in the laboratory CompQAP, which will be reviewed and approved by the PM or designee before samples are submitted for analysis. The calibration of all laboratory equipment will be documented in the specific maintenance logbook, or analytical logbook, as described in the laboratory's CompQAP.

Analytical instruments will be calibrated in accordance with the analytical methods (**Table C-2-14**). All target analytes reported will be present in the initial and continuing calibrations. All results reported will be within the calibration range. Records of standard preparation and instrument calibration will be maintained. Records will unambiguously trace the preparation of standards and their use in calibration and quantitation of sample results. Calibration standards will be traceable to standard materials.

Additionally, analytical instruments will be inspected and maintained according to **Table C-2-15**.

TABLE C-2-14
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
HPLC / UV Detector	Initial Calibration - A minimum 5 point calibration is required.	Calibrate the instrument when it is received and after a major change or if the daily calibration fails.	The relative standard deviation (RSD) for each compound must be < 20%. A linear curve (> 0.995 correlation) or quadratic curve (>0.99 correlation, minimum 6 points) for quantitation.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst/ Supervisor	Empirical SOP-327
HPLC / UV Detector	Continuing Calibration (CCV)	Analyze standard at the beginning and end of sequence and every 10 samples.	< 15% difference.	If percent difference (% D) > +15% and samples are < the QL, narrate, If %D > + 15% only on one column, narrate, If % D > + 15% for closing CCV, and is likely due to matrix interference, narrate Otherwise reanalyze all samples back to the last acceptable CCV	Analyst/ Supervisor	Empirical SOP-327
HPLC / UV Detector	Initial Calibration Verification (ICV)	Once after initial calibration	85-115%	Identify source of problem, correct, repeat calibration, rerun samples	Analyst/ Supervisor	Empirical SOP-327
ICP Spectrometer	Initial Calibration	The instrument is calibrated at the beginning of each day or if the QC is out of criteria.	The instrument is calibrated by a one point calibration per manufacturer's guidelines. Analytes ran at their calibration levels must fall within 90-110% of the true values.	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst/ Supervisor	Empirical SOP-105
ICP Spectrometer	CCV	Analyze a standard at the beginning and end of the sequence and after every 10 samples	The acceptance criteria for the continuing calibration standard is 90-110% of true value	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst/ Supervisor	Empirical SOP-105
ICP Spectrometer	Initial Calibration Blank (ICB)	Before beginning a sample sequence	No analytes detected > 2x MDL	Correct the problem, then reprep and reanalyze.	Analyst/ Supervisor	Empirical SOP-105

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
ICP Spectrometer	Continuing Calibration Blank (CCB)	After every ten samples and at the end of the sequence	No analytes detected > 2x MDL	Correct the problem, then reprep and reanalyze calibration blank and previous ten samples	Analyst/ Supervisor	Empirical SOP-105
Flow Injection Mercury System	Initial Calibration	The instrument is calibrated at the beginning of each day or if the QC is out of criteria.	The calibration correlation coefficient is >0.995	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst/ Supervisor	Empirical SOP-103
Flow Injection Mercury System	CCV	The CCV is analyzed at the beginning and end of the sequence and after every 10 samples.	The acceptance criteria is 80-120% of the true value	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst/ Supervisor	Empirical SOP-103
Flow Injection Mercury System	ICB	Before beginning a sample sequence	No analytes detected > 2x MDL	Correct the problem, then reprep and reanalyze.	Analyst/ Supervisor	Empirical SOP
HPLC/ESI/MS	Minimum five point calibration	Instrument receipt, instrument change (column, etc.), when CCV does not meet criteria	Correlation coefficient > 0.995 or with an RSD of > 20%	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst/ Supervisor	CAS HPLC-6850
HPLC/ESI/MS	Continuing calibration	The CCV is analyzed at the beginning and end of the sequence and after every 10 samples.	The acceptance criteria is 85-115% of the true value	Recalibrate and/or perform necessary equipment maintenance. Reanalyze samples not bracketed by passing CCVs	Analyst/ Supervisor	CAS HPLC-6850
HPLC/ESI/MS	ICV	Once after each initial calibration	+15% Individual Compounds	Identify source of problem, correct, repeat calibration, rerun samples	Analyst/ Supervisor	CAS HPLC-6850

TABLE C-2-15
Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
HPLC / UV Detector	Check pressure and gas supply daily – change when <200psi, change analytical column as needed, change mobile phase when insufficient for run or contamination, change inlet filters as needed for contamination	Explosives	Check pump pressure, check for leaks, check for adequate mobile phase	Prior to initial calibration or as necessary	CCV < 15% difference.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst/ Supervisor	Empirical SOP-327
ICP Spectrometer	Clean the torch assembly and the spray chamber when they become discolored or when degradation in data quality is observed. Clean the nebulizer, and check the argon supply. Replace the peristaltic pump tubing as needed	TAL Metals	Inspect the torch, nebulizer chamber, pump, and tubing	Maintenance is performed prior to initial calibration or as necessary.	The acceptance criteria for the continuing calibration standard is 90-110% of true value	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst/ Supervisor	Empirical SOP-105
Flow Injection Mercury System	Change the tubing, filter, clean windows, and check gas flow. Check the reagents and standards.	Mercury	Inspect the tubing, filter, and the optical cell	Maintenance is performed prior to initial calibration or as necessary.	The acceptance criteria is 80-120% of the true value	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst/ Supervisor	Empirical SOP-103
HPLC/ESI/MS	Check pressure and gas supply daily – change when <200 pounds per square inch (psi), change analytical column as needed, change mobile phase when insufficient for run or contamination, change inlet filters as needed for contamination	Perchlorate	Check pump pressure, check for leaks, check for adequate mobile phase	Instrument receipt, instrument change (e.g., new column), when CCV does not meet criteria	ICV 15% Diff, Linear Corr >0.995, RSD ≤ 20%	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data	Analyst/ Supervisor	CAS HPLC-6850

C.2.9 Inspection and Acceptance Requirements for Supplies and Consumables

All services, including subcontracted services and supplies received from vendors, must meet the project scope, specified levels of quality, and the submittal schedule. Field and laboratory personnel must evaluate the vendor's ability to provide the services and specify acceptance requirements for supplies and consumables. For example, laboratories rely on suppliers for solvents, gases, consumables, and analytical equipment, including instrument maintenance. The laboratory should have and maintain adequate contracts with its vendors to receive uninterrupted supplies, parts, and services.

C.2.10 Data Acquisition Requirements

In addition to the electronic data, the laboratory provides hard-copy deliverables of the analytical results. Upon receipt, the data packages are prepared for data validation. After the data validation has been completed and a DQE report has been written, the hard-copy data packages are filed onsite until the project is completed. At that time, the data packages are sent to the PM for inclusion into the project files. Alternatively, the hard-copy data packages are stored at an offsite warehouse for a period of 10 years after the project close out.

SECTION C.3

Assessment and Oversight

Assessment and oversight activities are performed to determine whether the QC measures identified in the WP Addendum and in this QAPP are being implemented and documented as required. Audits and reviews are the tools used to implement this process. For example, during a review, the auditor may check that a monitoring well has been correctly sampled or that the field QC samples were collected at the appropriate frequency. During an audit or review, the auditor may check for:

- Adherence to the WP Addendum
- Documentation of the process or system
- Proper identification, resolution, and documentation of nonconformance with the process or system
- Correction of identified deficiencies

C.3.1 Assessments and Response Actions

The need for an audit can be determined independently by the PM. Assessment activities may include surveillance, inspection, peer review, management system review, readiness review, technical systems audit, performance evaluation, and data quality assessment. The PM will be responsible for initiating audits, selecting the audit team, and overseeing audit implementation. For the fieldwork, a monthly audit will be conducted throughout the duration of sampling activities.

The laboratory will be audited in accordance with the laboratory subcontract. The PC or a designee will perform laboratory audits in compliance with the subcontract. One laboratory audit will be performed before the receipt of samples at the laboratory. A follow-up meeting will be held to address any deficiencies or issues identified during the audit.

Field audits will be conducted by a review team member as designated by the PM. One field audit, if requested, will be performed during the first week of sampling.

C.3.1.1 Laboratory Performance and System Audits

Laboratory systems will be audited in accordance with the project-specific requirements. Contracted laboratories must submit a laboratory CompQAP. The CompQAP must reference relevant SOPs and the laboratory's internal procurement policies and CA program.

The laboratory audit will address at least the following issues:

- Is the laboratory operation being performed as required by the subcontract?
- Are internal laboratory operations being conducted in accordance with the laboratory CompQAP?
- Are the laboratory analyses being performed in accordance with method requirements?

Any nonconformance noted during an audit will result in a CA.

C.3.1.2 Field Team Performance and System Audits

The PC or other member of the review team, as designated by the PM, will conduct an audit of the field activities in accordance with the program requirements. The audit will address at least the following issues:

- Are sampling operations being performed as stated in the WP Addendum?
- Are the sample labels being filled out completely and accurately?
- Are the COC records complete and accurate?
- Are the field notebooks being filled out completely and accurately?
- Are the sampling activities being conducted in accordance with the WP Addendum and approved SOPs?
- Are the documents generated in association with the field effort being stored as described in the WP Addendum?

The generation and documentation of field data also will be audited. Audits will focus on verifying that proper procedures are followed so that subsequent sample data will be valid. Any nonconformance noted during an audit will result in a CA.

The results of the assessment and oversight activities will be reported back to the PM, who has ultimate responsibility for ensuring that the CA response is completed, verified, and documented.

C.3.2 Reports to Management

Reports to the PM include project status reports, the results of evaluation and system audits, data quality assessments, and significant QA problems and recommended solutions. The status reports, submitted in accordance with the requirements of the WP Addendum, will discuss at least current activities, problems encountered and their resolution, and planned work.

QA reports will be submitted in accordance with the WP Addendum. QA reports document implementation of the QAPP and the results of the site-specific QA/QC audits. A final QA report must be submitted as part of each project's final report. The topics to be covered are outlined in the WP Addendum, but each will include at least the following information:

- Identification of nonconformances that required CA and resolution of the nonconformance
- Data quality assessment in terms of precision and accuracy and how they affect the usability of the analytical results
- Limitations of the qualified results and a discussion of rejected results
- Discussion of the field and laboratory QA/QC sample results
- The results of external laboratory audits

The FTL will provide feedback to the PM discussing all field activities, changes to field procedures, problems encountered, and CAs taken.

SECTION C.4

Data Validation and Usability

This subsection addresses the QA activities that occur after the data collection has been completed. Implementation of these elements, which include data review and validation, will determine the extent to which the data conform to the specified criteria and satisfy the project objectives.

C.4.1 Data Review, Validation, and Verification Requirements

Data review and validation are processes whereby data generated in support of this project are reviewed against the QA/QC requirements. The data are evaluated for precision, accuracy, and completeness against the analytical protocol requirements. Non-conformances or deficiencies that could affect the usability of data are identified as noted. The types of data that will be validated are described further in the following subsections.

All analytical data will be supported by a data package. The data package will contain the supporting QC data for the associated field samples. Before the laboratory will release each data package, the laboratory QAM (or the analytical section supervisor) must carefully review the sample and laboratory performance QC data to verify sample identity, the completeness and accuracy of the sample and QC data, and compliance with method specifications.

C.4.1.1 Level I–Field Measurements

Field instruments used to collect field survey (or bulk measurements such as pH or conductivity) are direct reading, thus making field calculations and subsequent data reduction unnecessary. Field data will be recorded in the site log books by appropriately trained field personnel. Field data (Level I data reporting) will include the following:

- Instrument identification
- Calibration information (standards used and results)
- Date and time of calibration and sample measurement
- Sample results
- Supporting information, if appropriate

Data will be reviewed by the FTL, who is responsible for the collection and verification of all field data while in the field. Recorded data will be accepted or rejected by the FTL before leaving the sampling site. Extreme readings (readings that appear significantly different from other readings at the same site) will be accepted only after the instrument has been checked for malfunction and/or if the readings are verified by re-testing.

Field documentation, sample data, instrument calibrations, and QC data will be reviewed by the PC (or a designee) before being included in the project files.

C.4.1.2 Level II–Physical Parameters and IDW Characterization

The data package deliverables associated with Level II data reporting consist of the components listed below (also described in **Table C-2-9**). The data package will be reviewed by the PC for completeness and correctness. No further validation will be performed.

- Case narrative
- Sample results
- Selected QC information such as surrogate recovery
- Associated blank results
- Completed COC and any sample receipt information

C.4.1.3 Level III–Laboratory Analyses

The PC or designee will perform DQE. The DQE process is used to assess the effect of the overall analytical process on the usability of the data. The two major categories of data evaluation are laboratory performance and matrix interferences. Evaluation of laboratory performance is a check for compliance with the method requirements and identifies whether the laboratory did, or did not, analyze the samples within the limits of the analytical method. Evaluation of the matrix interferences is more subtle and involves analysis of several results including surrogate spike recoveries, matrix spike recoveries, and duplicate sample results.

Before the analytical results are released by the laboratory, both the sample and QC data will be reviewed carefully to verify sample identify, instrument calibration, detection limits, dilution factors, numerical computations, accuracy of transcriptions, and chemical interpretations. Additionally, the QC data will be reduced and spike recoveries will be included in control charts, and the resulting data will be reviewed to ascertain whether they are within the laboratory-defined limits for accuracy and precision. Any non-conforming data will be discussed in the data package cover letter and case narrative. The laboratory will retain all of the analytical and QC documentation associated with each data package.

Analytical methods and laboratory SOPs as presented in this QAPP will be used to evaluate compliance against QA/QC criteria. Should adherence to QA/QC criteria yield deficiencies, data may be qualified. The data qualifiers that may be used are those presented in *National Functional Guidelines for Organic Data Review* (USEPA, 1999) *and National Functional Guidelines for Inorganic Data Review* (USEPA, 2004). National Functional Guidelines will not be used for data validation; however, the specific qualifiers listed therein may be applied to data should non-conformances against the QA/QC criteria as presented in this QAPP be identified.

The data review and validation process is independent of the laboratory's checks; it focuses on the usability of the data to support the project data interpretation and decision-making process. Areas of review include data package completeness, holding time compliance, initial and continuing calibration, spiked sample results, method blank results, and duplicate sample results. A data review worksheet will be completed for each data package. Acceptance criteria for each area of review are specified in the analytical method.

C.4.1.4 Level IV–Laboratory Analyses

The data package deliverables associated with Level IV data reporting are listed in **Table C-2-9**. Approximately 10 percent of data packages may be requested as Level IV, and a more in-depth validation performed, such as the re-creation of calculations.

Level IV contains the QC summary forms. Definitive data can be generated by a variety of measurements, ranging from onsite field analyses to laboratory analyses. In the evaluation of definitive data, not all data require the same effort for validation. One hundred percent of the laboratory and definitive data (Level III and IV) generated in support of this project will be validated.

C.4.2 Verification and Validation Methods

C.4.2.1 Data Verification

Before the analytical results are released by the laboratory, both the sample and QC data will be reviewed carefully to verify sample identity, instrument calibration, detection limits, dilution factors, numerical computations, accuracy of transcriptions, and chemical interpretations. Additionally, the QC data will be reduced and spike recoveries will be included in control charts, and the resulting data will be reviewed to ascertain whether they are within the laboratory-defined limits for accuracy and precision. Any non-conforming data will be discussed in the data package cover letter and case narrative. The laboratory will retain all of the analytical and QC documentation associated with each data package.

As discussed previously, the data are also verified to assess whether the EDDs and the hard-copy data deliverables are consistent with one another to ensure an accurate database.

C.4.2.2 Data Validation

Data validation is at times based on professional judgment. To achieve consistent data validation, data worksheets will be completed for each data validation effort. A data validation worksheet is a summary form on which the data validator records data validation notes and conclusions specific to each analytical method. The worksheets will help the validator track and summarize the overall quality of the data. Sample results will then be assigned a degree of usability based upon the overall data quality.

One hundred percent of the laboratory Level IV data reporting packages will be validated.

The data package will be validated by the PC using a process analogous to that outlined in the guidance documents, *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (USEPA, 2002), *Contract Laboratory Program National Functional Guidelines for Organic Data Review* (USEPA, 1999), and *Contract Laboratory Program National Functional Guidelines for Chlorinated Dioxin/Furan Data Review* (USEPA, 2002) and will use QC criteria established in this QAPP or in the analytical method. The data review and validation process is independent of the laboratory's checks; it focuses on the usability of the data to support the project data interpretation and decision-making process.

Sample results that do not meet the acceptance limit criteria will be indicated with a qualifying flag, which is a one or two-letter abbreviation that indicates a possible problem with the data. Flags used in the text may include the following:

- **U** Undetected. Samples were analyzed for this analyte, but it was not detected above the MDL or IDL
- **UJ** Detection limit estimated. Samples were analyzed for this analyte, but the results were qualified as not detected. The result is estimated
- **J** Estimated. The analyte was present, but the reported value may not be accurate or precise
- **R** Rejected. The data are unusable. (Note: Analyte/compound may or may not be present)

It is important to note that laboratory qualifying flags are included on the data summary forms (Form I) that are submitted to the project by the laboratory. However, during the data review and validation process, the laboratory qualifying flags are evaluated and replaced with the project-specific validation flags.

C.4.2.3 Data Quality Evaluation

The PC or designee will perform the DQE. The DQE process is used to assess the effect of the overall analytical process on the usability of the data. The two major categories of data evaluation are laboratory performance and matrix interferences. Evaluation of laboratory performance is a check for compliance with the method requirements. It is a straight-forward examination–either the laboratory did, or did not, analyze the samples within the limits of the analytical method. Evaluation of the matrix interferences is more subtle and involves analysis of several results, including surrogate spike recoveries, matrix spike recoveries, and duplicate sample results. The project team will evaluate the data validation results. This evaluation will assess how the data, as qualified by the data validation, can be used on the project.

Once each of the data packages has been validated, and the data validation worksheets completed, then the entire data set will be evaluated for overall trends in data quality and usability. Information summarized as part of the DQE may include chemical compound frequencies of detection, dilution factors that might affect data usability, and patterns of target compound distribution. The data set also will be evaluated to identify potential data limitations or uncertainties in the laboratory.

C.4.3 Usability Assessment

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:

It is the joint responsibility of PC and the data validation subcontractor to ensure that the analytical data meet the MDLs, RLs, and laboratory QC limits listed in this WP Addendum, the laboratory SOW, and the various methods. During this assessment, non-conformances

are documented, the data are qualified for use in decision making, and for 10 percent of the results, the entire analytical process is reconstructed and recalculated from the raw data.

Non-detected site contaminants will be evaluated to ensure that project required QLs in Section C.2.4.1 were achieved. If project QLs were achieved and the verification and validation steps yielded acceptable data the data is considered usable. During verification and validation steps, data may be qualified as estimated with the following qualifiers: J or UJ. These qualifiers represent minor QC deficiencies which will not affect the usability of the data. When major QC deficiencies are encountered, data will be qualified with an R and in most cases is not considered usable for project decisions. For statistical comparisons non-detect values will be represented by a concentration equal to one-half the sample RL. For duplicate sample results, the most conservative value will be used for project decisions. Analytical data will be checked to ensure the values and any qualifiers are appropriately transferred to the electronic database. These checks include comparison of hardcopy data and qualifiers to the electronic data deliverable. Once the data has been uploaded into the electronic database, another check will be performed to ensure all results were loaded accurately. Field and laboratory precision will be compared as RPD) between the two results. Deviations from the QAPP will be reviewed to assess whether CA is warranted and to assess impacts to achievement of project objectives.

Describe the evaluative procedures used to assess overall measurement error associated with the project:

In-depth assessment occurs during the data validation process. The third-party validation contractor will follow the laboratory SOPs and applicable portions of the USEPA National Functional Guidelines to assess conformance with the QC limits. The findings of the data validation reports and the qualifiers applied to the data will be considered in context with field logs and CA reports to assess overall usability.

To assess whether a sufficient quantity of acceptable data are available for decision making, the data will be reconciled with measurement performance criteria following validation and review of DQI. If significant biases are detected with laboratory QA/QC samples it will be evaluated to assess impact on decision making. Low biases will be described in greater detail as they represent a possible inability to detect compounds that may be present at the site. If significant deviations are noted between lab and field precision the cause will be further evaluated to assess impact on decision making.

Identify the personnel responsible for performing the usability assessment:

PC – Anita Dodson/CH2M HILL
PM – Keri Hallberg/CH2M HILL

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

The data validation reports will identify precision and accuracy exceedances with respect to the laboratory performance for each batch of samples, as well as comparability of field and lab duplicates. All the results will be assembled and statistically reported for an overall quality assessment provided in the final project event report. Discussion will cover

completeness and representativeness. Attachments supporting this report will include data validation narratives, CA forms, and field audit reports.

Data tables will be produced to reflect detected and non-detected site contaminants and geochemical parameters. Data qualifiers will be reflected in the tables and discussed in the DQE. Figures will be produced representing concentrations of contamination.

Table C-4-1 presents project documentation and records.

TABLE C-4-1
Project Documents and Records

Document	Where Maintained
Field Notebooks	Electronic .pdf copies in the project file. Hardcopy (bound notebook) in the project file. Archived at project closeout.
COC Records	Electronic .pdf copies in the project file. Hardcopy in the project file. Archived at project closeout.
Air Bills	Hardcopy in the project file. Archived at project closeout.
Telephone Logs	Hardcopy in the project file. Archived at project closeout.
Corrective Action Forms	Electronic .pdf copies in the project file. Hardcopy in the project file. Archived at project closeout.
Various field measurements	Recorded in Field Notebook.
All equipment calibration information	Recorded in Field Notebook.
Pertinent telephone conversations	Recorded in Field Notebook.
Equipment maintenance records	Inspected by FTL. Not maintained.
Sample Receipt, Custody, and Tracking Records	Electronic .pdf copies in the project file. Hardcopy in the full data package.
Standard Traceability Logs	Hardcopy in the full data package. Archived at project closeout.
Equipment Calibration Logs	Hardcopy in the full data package. Archived at project closeout.
Sample Prep Logs	Hardcopy in the full data package. Archived at project closeout.
Run Logs	Hardcopy in the full data package. Archived at project closeout.
Equipment Maintenance, Testing, and Inspection Logs	Hardcopy in the full data package. Archived at project closeout.
Reported Field Sample Results	Electronic .pdf copies in the project file. Hardcopy in the data package. Archived at project closeout.
Reported Results for Standards, QC Checks, and QC Samples	Hardcopy in the full data package. Archived at project closeout.
Instrument Printouts (raw data) for Field Samples, Standards, QC Checks, and QC Samples	Hardcopy in the full data package. Archived at project closeout.
Data Package Completeness Checklists	Hardcopy in the data validation report. Archived at project closeout.
Sample Disposal Records	Maintained by the laboratory.
Extraction/Clean-up Records	Maintained by the laboratory.
Raw Data	Hardcopy in the full data package. Archived at project closeout.
Field Sampling Audit Checklists	Hardcopy in the project file. Archived at project closeout.
Fixed Laboratory Audit Checklists	If completed, hardcopy in the project file. Archived at project closeout.
Data Validation Reports	Electronic .pdf copies in the project file. Hardcopy stored with the data package. Archived at project closeout.

Table C-4-2 presents field sampling SOPs.

TABLE C-4-2
Field Sampling SOPs

Reference Number	Title, Revision Date and / or Number	Originating Organization of Sampling SOP	Modified for Project Work?
Attachment C-1	Preparing Field Log Books; January 2008	CH2M HILL	No
Attachment C-1	Homogenization of Soil and Sediment Samples; January 2008	CH2M HILL	No
Attachment C-1	Shallow Soil Sampling; January 2008	CH2M HILL	No
Attachment C-1	Direct-Push Soil Sample Collection; July 2007	CH2M HILL	No
Attachment C-1	Systematic Multi-Increment Sampling; July 2007	CH2M HILL	No
Attachment C-1	Chain of Custody; January 2008	CH2M HILL	No
Attachment C-1	Packaging and Shipping Procedures for Low-Concentration Samples; January 2008	CH2M HILL	No

Attachment C-1
Field Standard Operating Procedures

STANDARD OPERATING PROCEDURE

Preparing Field Log Books

I. Purpose

To provide general guidelines for entering field data into log books during site investigation and remediation field activities.

II. Scope

This is a general description of data requirements and format for field log books. Log books are needed to properly document all field activities in support of data evaluation and possible legal activities.

III. Equipment and Materials

- Log book
- Indelible pen

IV. Procedures and Guidelines

Properly completed field log books are a requirement of much of the work we perform under the Navy CLEAN contract. Log books are legal documents and, as such, must be prepared following specific procedures and must contain required information to ensure their integrity and legitimacy. This SOP describes the basic requirements for field log book entries.

A. PROCEDURES FOR COMPLETING FIELD LOG BOOKS

1. Field notes commonly are kept in bound, orange-covered logbooks used by surveyors and produced, for example, by Peninsular Publishing Company and Sesco, Inc. Pages should be water-resistant and notes should be taken only with water-proof, non-erasable permanent ink, such as that provided in Sanford Sharpie® permanent markers.

2. On the inside cover of the log book the following information should be included:

   - Company name and address
   - Log-holders name if log book was assigned specifically to that person

- Activity or location
- Project name
- Project manager's name
- Phone numbers of the company, supervisors, emergency response, etc.

3. All lines of all pages should be used to prevent later additions of text, which could later be questioned. Any line not used should be marked through with a line and initialed and dated. Any pages not used should be marked through with a line, the author's initials, the date, and the note "Intentionally Left Blank."

4. If errors are made in the log book, cross a single line through the error and enter the correct information. All corrections shall be initialed and dated by the personnel performing the correction. If possible, all corrections should be made by the individual who made the error.

5. Daily entries will be made chronologically.

6. Information will be recorded directly in the field log book during the work activity. Information will not be written on a separate sheet and then later transcribed into the log book.

7. Each page of the log book will have the date of the work and the note takers initials.

8. The final page of each day's notes will include the note-takers signature as well as the date.

9. Only information relevant to the subject project will be added to the log book.

10. The field notes will be copied and the copies sent to the Project Manager or designee in a timely manner (at least by the end of each week of work being performed).

B. INFORMATION TO BE INCLUDED IN FIELD LOG BOOKS

1. Entries into the log book should be as detailed and descriptive as possible so that a particular situation can be recalled without reliance on the collector's memory. Entries must be legible and complete.

2. General project information will be recorded at the beginning of each field project. This will include the project title, the project number, and project staff.

3. Scope: Describe the general scope of work to be performed each day.

4. Weather: Record the weather conditions and any significant changes in the weather during the day.

5. Tail Gate Safety Meetings: Record time and location of meeting, who was present, topics discussed, issues/problems/concerns identified, and corrective actions or adjustments made to address concerns/ problems, and other pertinent information.

6. Standard Health and Safety Procedures: Record level of personal protection being used (e.g., level D PPE), record air monitoring data on a regular basis and note where data were recording (e.g., reading in borehole, reading in breathing zone, etc). Also record other required health and safety procedures as specified in the project specific health and safety plan.

7. Instrument Calibration; Record calibration information for each piece of health and safety and field equipment.

8. Personnel: Record names of all personnel present during field activities and list their roles and their affiliation. Record when personnel and visitors enter and leave a project site and their level of personal protection.

9. Communications: Record communications with project manager, subcontractors, regulators, facility personnel, and others that impact performance of the project.

10. Time: Keep a running time log explaining field activities as they occur chronologically throughout the day.

11. Deviations from the Work Plan: Record any deviations from the work plan and document why these were required and any communications authorizing these deviations.

12. Heath and Safety Incidents: Record any health and safety incidents and immediately report any incidents to the Project Manager.

13. Subcontractor Information: Record name of company, record names and roles of subcontractor personnel, list type of equipment being used and general scope of work. List times of starting and stopping work and quantities of consumable equipment used if it is to be billed to the project.

14. Problems and Corrective Actions: Clearly describe any problems encountered during the field work and the corrective actions taken to address these problems.

15. Technical and Project Information: Describe the details of the work being performed. The technical information recorded will vary significantly between projects. The project work plan will describe the specific activities to be performed and may also list requirements for note taking. Discuss note-taking expectations with the Project Manager prior to beginning the field work.

16. Any conditions that might adversely affect the work or any data

obtained (e.g., nearby construction that might have introduced excessive amounts of dust into the air).

17. Sampling Information; Specific information that will be relevant to most sampling jobs includes the following:

- Description of the general sampling area – site name, buildings and streets in the area, etc.
- Station/Location identifier
- Description of the sample location – estimate location in comparison to two fixed points – draw a diagram in the field log book indicating sample location relative to these fixed points – include distances in feet.
- Sample matrix and type
- Sample date and time
- Sample identifier
- Draw a box around the sample ID so that it stands out in the field notes
- Information on how the sample was collected – distinguish between "grab," "composite," and "discrete" samples
- Number and type of sample containers collected
- Record of any field measurements taken (i.e. pH, turbidity, dissolved oxygen, and temperature, and conductivity)
- Parameters to be analyzed for, if appropriate
- Descriptions of soil samples and drilling cuttings can be entered in depth sequence, along with PID readings and other observations. Include any unusual appearances of the samples.

C. SUGGESTED FORMAT FOR RECORDING FIELD DATA

1. Use the left side border to record times and the remainder of the page to record information (see attached example).

2. Use tables to record sampling information and field data from multiple samples.

3. Sketch sampling locations and other pertinent information.

4. Sketch well construction diagrams.

V. Attachments

Example field notes.

STANDARD OPERATING PROCEDURE

Systematic Random Multi-Increment Sampling

I. Purpose

The Systematic Random Multi-Increment (MI) sampling of surface soil samples is performed to minimize any bias of sample representativeness introduced by compositional and distribution heterogeneity of constituents within the sample. This procedure should only be used when sampling surface soils for explosive residuals and metals.

II. Scope

Standard techniques for surface soil MI sampling for the analysis of explosives residuals and metals, and required equipment are provided in this SOP. These procedures do not apply to aliquots collected for VOCs, SVOCs, pesticides/herbicides, PCBs, or field GC screening (samples for these analyses should NOT be collected using MI sampling).

III. Equipment and Materials

MI sampling will be performed with clean hardened plastic or metal scoops, spoons, or coring tools depending on the cohesiveness of the soil. Sample containers will consist of two clean 16 ounce wide mouth glass jars for 1 kg samples and two clean 32 ounce wide mouth glass jars for 2 kg samples as required by the applicable analytical method. Soil will be homogenized in a clean stainless steel pan or bowl. Individual laboratory sample bottles will be required for Method 8330 and metals analysis, per analytical method requirements. Method 8330B samples will be shipped to the contract laboratory in a mass of not less than 3 kg per Decision Unit in sample containers supplied by the laboratory.

IV. Procedures and Guidelines

Surface soil composite samples will be collected from Decision Units for analysis for explosives residues and total metals. Each Decision Unit will be defined based on past range activities discovered during an archival records search. Decision units will have surveyed boundaries that may range in size from 10m x 10m to 100m x 100m. Each Decision Unit location and a summary of sampling activities will be recorded in a field book.

Multi-increment composite surface soil samples will be collected within the Decision Unit using a systematic sampling pattern with a random starting point. Number of increments should be between 30 and 100 depending on the size of the Decision

Unit. Samples will be collected by walking from one corner of the grid systematically back and forth across the entire grid area, collecting an increment of soil every so many paces, depending on the grid size and number of increments to be collected. The sample increments will be approximately equal in the amount of soil, which will be collected from depths of 0-2 inches below ground surface. After the entire Decision Unit has been walked, the individual increment samples will be composited into a single sample following the *Homogenization of Soil and Sediment Samples* SOP, prior to being transferred to the appropriate sample containers. Two replicate samples should be collected from each Decision Unit. Each replicate sample will be collected using the same method as the original sample. The replicate samples should be started from a different corner of the decision unit to avoid sampling the same location as the original sample. Figure 1 shows an example of how to do MI sampling in a Decision Unit that is 50m x 50m.

A total of 3 composite surface soil samples (1 original sample and two replicate samples) will be collected at each Decision Unit. Samples will be stored on ice in clean plastic bags or clean large mouth glass bottles and submitted for laboratory analysis by one or more of the following analytical methods: EPA SW-846 Method 8330, Method 8330B, and the appropriate project specific analytical methods for metals. Method 8330B uses an air drying and mechanical grinding process. Mechanical grinding will not be conducted for samples submitted for metals analysis. A minimum of 1 kg of soil will be collected per MI sample.

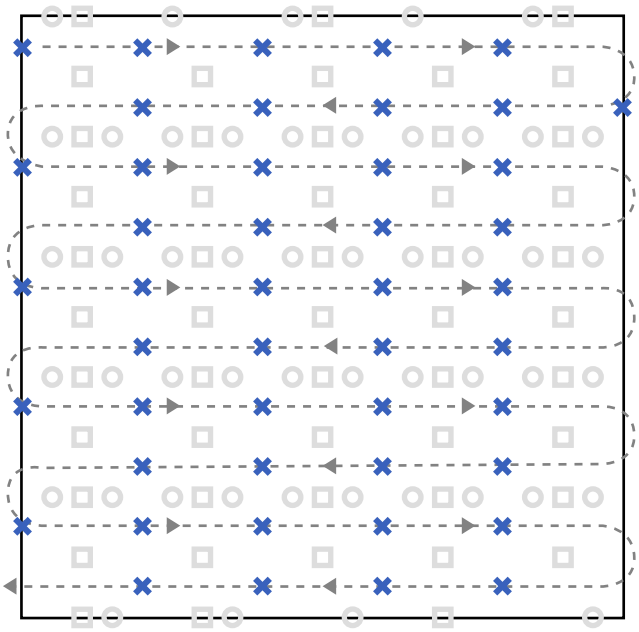
The sampling tools will not need to be cleaned between increments since each individual increment will be apart of the same sample, but tools will be cleaned between each MI sample. The decontamination process involves first removing all adhering soil, then rinsing the sampling head and pan/bowl with deionized water, concluding with an acetone rinse.

V. Attachments

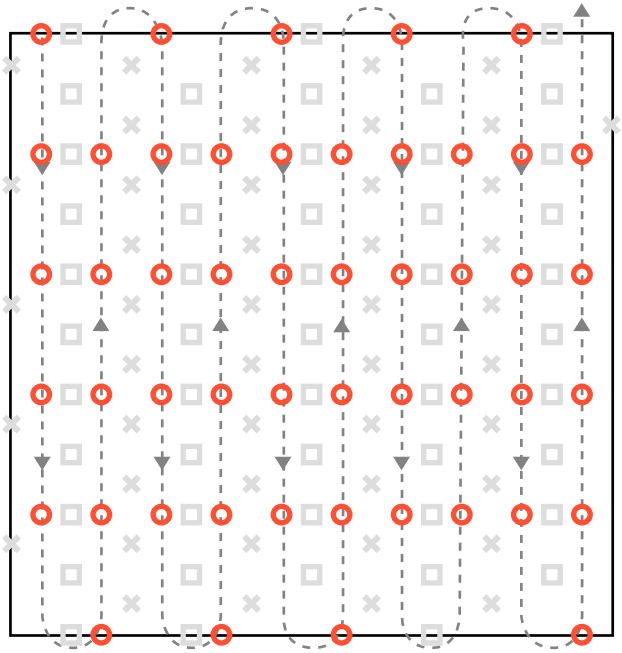
Figure 1- Systematic Random Multi-increment Sampling Pattern

VI. Key Checks and Items

- A total of 3 composite surface soil samples (1 original sample and two replicate samples) will be collected at each Decision Unit.
- Replicate samples should be started from a different corner of the decision unit to avoid sampling the same location as the original sample.
- Increment samples should be homogenized in the field in a clean, stainless steel pan/bowl. Sampling method is only applicable to explosives residues and metals.
- Number of increments should be between 30 and 100 depending on the size of the Decision Unit.
- Check that decontamination of equipment is thorough.



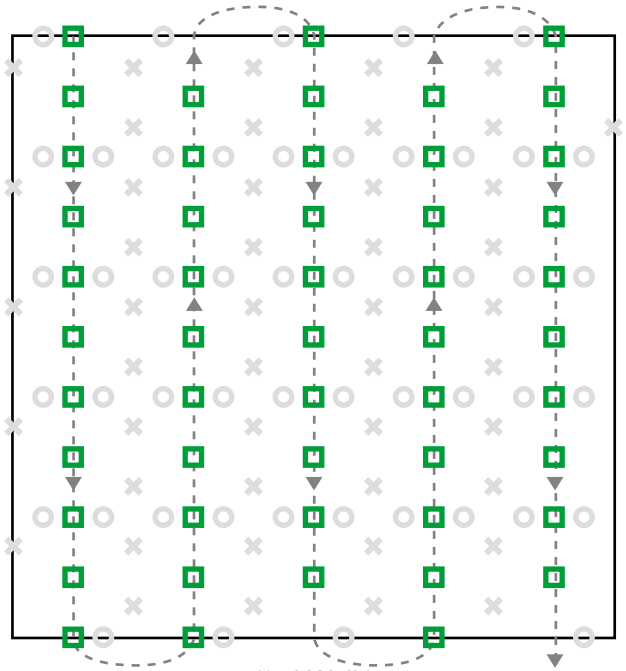
(1st Walk)



(2nd Walk)

LEGEND

- Path of Travel
- Sample Collection Point
- 10 m
- 5 m



(3rd Walk)

FIGURE 1
Systematic- Random Multi-Increment Sampling Pattern

STANDARD OPERATING PROCEDURE

Shallow Soil Sampling

I. Purpose

To provide general guidelines for the collection and handling of surface soil samples during field operations.

II. Scope

The method described for surface soil sampling is applicable for loosely packed earth and is used to collect disturbed-soil samples.

III. Equipment and Materials

- Sample jars.
- A hand auger or other device that can be used to remove the soil from the ground. Only stainless steel, Teflon, or glass materials should be used. The only exception is split spoons, which are most commonly available in carbon steel; these are acceptable for use only if they are not rusty.
- A stainless steel spatula should be used to remove material from the sampling device.
- Unpainted wooden stakes or pin flags
- Fiberglass measuring tape (at least 200 feet in length)
- GPS Unit (if available)

IV. Procedures and Guidelines

A. Wear protective gear, as specified in the Health and Safety Plan.

B. To locate samples, identify the correct location using the pin flags or stakes. Proceed to collect a sample from the undisturbed soil adjacent to the marker following steps C and D. If markers are not present, the following procedures will be used.

1. For samples on a grid:

   a. Use measuring tape to locate each sampling point on the first grid line as prescribed in the sampling plan. As each point is located, drive a numbered stake in the ground and record its location on the site map and in the logbook.

b. Proceed to sample the points on the grid line.

c. Measure to location where next grid line is to start and stake first sample. For subsequent samples on the line take two orthogonal measurements: one to the previous grid line, and one to the previous sample on the same grid line.

d. Proceed to sample the points on the grid line as described in Section C below.

e. Repeat 1c and 1d above until all samples are collected from the area.

f. Or, a GPS unit can be used to identify each location based on map coordinated, if available.

2. For non-grid samples:

a. Use steel measuring tape to position sampling point at location described in the sampling plan by taking two measurements from fixed landmarks (e.g., corner of house and fence post).

b. Note measurements, landmarks, and sampling point on a sketch in the field notebook, and on a site location map.

c. Proceed to sample as described in Section C below.

d. Repeat 2a through 2c above until all samples are collected from the area.

e. Or, a GPS unit can be used to identify each location based on map coordinated, if available.

C. To the extent possible, differentiate between fill and natural soil. If both are encountered at a boring location, sample both as prescribed in the field sampling plan. Do not locate samples in debris, tree roots, or standing water. In residential areas, do not sample in areas where residents' activities may impact the sample (e.g., barbecue areas, beneath eaves of roofs, driveways, garbage areas). If an obstacle prevents sampling at a measured grid point, move as close as possible, but up to a distance of one half the grid spacing in any direction to locate an appropriate sample. If an appropriate location cannot be found, consult with the Field Team Leader (FTL). If the FTL concurs, the sampling point will be deleted from the program. The FTL will contact the CH2M HILL project manager (PM) immediately. The PM and Navy Technical Representative (NTR) will discuss whether the point should be deleted from the program. If it is deleted, the PM will follow-up with the NTR in writing.

D. To collect samples:

1. Use a decontaminated stainless steel scoop/trowel to scrape away surficial organic material (grass, leaves, etc.) adjacent to the stake. New disposable scoops or trowels may also be used to reduce the need for equipment blanks.

2. If sampling:

   a. Surface soil: Obtain soil sample by scooping soil using the augering scoop/trowel, starting from the surface and digging down to a depth of about 6 inches, or the depth specified in the workplan.

   b. Subsurface soil: Obtain the subsurface soil sample using an auger down to the depths prescribed in the field sampling plan.

3. Take a photoionizaton detector (PID) reading of the sampled soil if organics are anticipated to be present and record the response in the field notebook. Also record lithologic description and any pertinent observations (such as discoloration) in the logbook.

4. Empty the contents of the scoop/trowel into a decontaminated stainless steel pan.

5. Repeat this procedure until sufficient soil is collected to meet volume requirements.

6. For TCL VOC and field GC aliquots, fill sample jars directly with the trowel/ scoop and cap immediately upon filling. DO NOT HOMOGENIZE.

7. For TCL pesticides/PCBs and SVOCs, TAL metals, and field XRF aliquots, homogenize cuttings in the pan using a decontaminated stainless steel utensil in accordance with SOP *Decontamination of Drilling Rigs and Equipment*.

8. Transfer sample for analysis into appropriate containers with a decontaminated utensil.

9. Backfill the hole with soil removed from the borehole. To the extent possible, replace topsoil and grass and attempt to return appearance of sampling area to its pre-sampled condition. For samples in non-residential, unmowed areas, mark the sample number on the stake and leave stake in place. In mowed areas, remove stake.

V. Attachments

None.

VI. Key Checks and Items

- Use phthalate-free latex or surgical gloves and other personal protective equipment.
- Transfer volatiles first, avoid mixing.
- Decontaminate utensils before reuse, or use dedicated, disposable utensils.

STANDARD OPERATING PROCEDURE

Homogenization of Soil and Sediment Samples

I. Purpose

The homogenization of soil and sediment samples is performed to minimize any bias of sample representativeness introduced by the natural stratification of constituents within the sample.

II. Scope

Standard techniques for soil and sediment homogenization and equipment are provided in this SOP. These procedures do not apply to aliquots collected for VOCs or field GC screening; samples for these analyses should NOT be homogenized.

III. Equipment and Materials

Sample containers, stainless steel spoons or spatulas, and stainless steel pans.

IV. Procedures and Guidelines

Soil and sediment samples to be analyzed for semivolatiles, pesticides, PCBs, metals, cyanide, or field XRF screening should be homogenized in the field. After a sample is taken, a stainless steel spatula should be used to remove the sample from the split spoon or other sampling device. The sampler should not use fingers to do this, as gloves may introduce organic interferences into the sample.

Samples for VOCs should be taken immediately upon opening the spoon and should not be homogenized.

Prior to homogenizing the soil or sediment sample, any rocks, twigs, leaves, or other debris should be removed from the sample. The sample should be placed in a decontaminated stainless steel pan and thoroughly mixed using a stainless steel spoon. The soil or sediment material in the pan should be scraped from the sides, corners, and bottom, rolled into the middle of the pan, and initially mixed. The sample should then be quartered and moved to the four corners of the pan. Each quarter of the sample should be mixed individually, and then rolled to the center of the pan and mixed with the entire sample again.

All stainless steel spoons, spatulas, and pans must be decontaminated following procedures specified in SOP *Decontamination of Personnel and Equipment* prior to homogenizing the sample. A composite equipment rinse blank of homogenization equipment should be taken each day it is used.

V. Attachments

None.

VI. Key Checks and Items

- Take VOC samples immediately and do not homogenize the soil.
- Homogenize soil for analyses other than VOCs in a clean, stainless steel bowl.

STANDARD OPERATING PROCEDURE

Chain-of-Custody

I Purpose

The purpose of this SOP is to provide information on chain-of-custody procedures to be used under the CLEAN Program.

II Scope

This procedure describes the steps necessary for transferring samples through the use of Chain-of-Custody Records. A Chain-of-Custody Record is required, without exception, for the tracking and recording of samples collected for on-site or off-site analysis (chemical or geotechnical) during program activities (except wellhead samples taken for measurement of field parameters). Use of the Chain-of-Custody Record Form creates an accurate written record that can be used to trace the possession and handling of the sample from the moment of its collection through analysis. This procedure identifies the necessary custody records and describes their completion. This procedure does not take precedence over region specific or site-specific requirements for chain-of-custody.

III Definitions

Chain-of-Custody Record Form - A Chain-of-Custody Record Form is a printed two-part form that accompanies a sample or group of samples as custody of the sample(s) is transferred from one custodian to another custodian. One copy of the form must be retained in the project file.

Custodian - The person responsible for the custody of samples at a particular time, until custody is transferred to another person (and so documented), who then becomes custodian. A sample is under one's custody if:

- It is in one's actual possession.
- It is in one's view, after being in one's physical possession.
- It was in one's physical possession and then he/she locked it up to prevent tampering.
- It is in a designated and identified secure area.

Sample - A sample is physical evidence collected from a facility or the environment, which is representative of conditions at the point and time that it was collected.

IV Responsibilities

Project Manager - The Project Manager is responsible for ensuring that project-specific plans are in accordance with these procedures, where applicable, or that other, approved procedures are developed. The Project Manager is responsible for development of documentation of procedures which deviate from those presented herein. The Project Manager is responsible for ensuring that chain-of-custody procedures are implemented. The Project Manager also is responsible for determining that custody procedures have been met by the analytical laboratory.

Field Team Leader - The Field Team Leader is responsible for determining that chain-of-custody procedures are implemented up to and including release to the shipper or laboratory. It is the responsibility of the Field Team Leader to ensure that these procedures are implemented in the field and to ensure that personnel performing sampling activities have been briefed and trained to execute these procedures.

Sample Personnel - It is the responsibility of the field sampling personnel to initiate chain-of-custody procedures, and maintain custody of samples until they are relinquished to another custodian, the sample shipper, or to a common carrier.

V Procedures

The term "chain-of-custody" refers to procedures which ensure that evidence presented in a court of law is valid. The chain-of-custody procedures track the evidence from the time and place it is first obtained to the courtroom, as well as providing security for the evidence as it is moved and/or passed from the custody of one individual to another.

Chain-of-custody procedures, recordkeeping, and documentation are an important part of the management control of samples. Regulatory agencies must be able to provide the chain-of-possession and custody of any samples that are offered for evidence, or that form the basis of analytical test results introduced as evidence. Written procedures must be available and followed whenever evidence samples are collected, transferred, stored, analyzed, or destroyed.

V.1 Sample Identification

The method of identification of a sample depends on the type of measurement or analysis performed. When *in situ* measurements are made, the data are recorded directly in bound logbooks or other field data records with identifying information.

Information which shall be recorded in the field logbook, when in-situ measurements or samples for laboratory analysis are collected, includes:

- Field Sampler(s),
- Contract Task Order (CTO) Number,
- Project Sample Number,
- Sample location or sampling station number,

- Date and time of sample collection and/or measurement,
- Field observations,
- Equipment used to collect samples and measurements, and
- Calibration data for equipment used

Measurements and observations shall be recorded using waterproof ink.

V.1.1 Sample Label

Samples, other than for *in situ* measurements, are removed and transported from the sample location to a laboratory or other location for analysis. Before removal, however, a sample is often divided into portions, depending upon the analyses to be performed. Each portion is preserved in accordance with the Sampling and Analysis Plan. Each sample container is identified by a sample label (see Attachment A). Sample labels are provided, along with sample containers, by the analytical laboratory. The information recorded on the sample label includes:

- Project - CTO Number.
- Station Location - The unique sample number identifying this sample.
- Date - A six-digit number indicating the day, month, and year of sample collection (e.g., 01/21/08).
- Time - A four-digit number indicating the 24-hour time of collection (for example: 0954 is 9:54 a.m., and 1629 is 4:29 p.m.).
- Medium - Water, soil, sediment, sludge, waste, etc.
- Sample Type - Grab or composite.
- Preservation - Type and quantity of preservation added.
- Analysis - VOA, BNAs, PCBs, pesticides, metals, cyanide, other.
- Sampled By - Printed name of the sampler.
- Remarks - Any pertinent additional information.

Using only the work assignment number of the sample label maintains the anonymity of sites. This may be necessary, even to the extent of preventing the laboratory performing the analysis from knowing the identity of the site (e.g., if the laboratory is part of an organization that has performed previous work on the site). The field team should always follow the sample ID system prepared by the project EIS and reviewed by the Project Manager.

V.2 Chain-of-Custody Procedures

After collection, separation, identification, and preservation, the sample is maintained under chain-of-custody procedures until it is in the custody of the analytical laboratory and has been stored or disposed of.

V.2.1 Field Custody Procedures

- Samples are collected as described in the site Sampling and Analysis Plan. Care must be taken to record precisely the sample location and to ensure that the sample number on the label matches the Chain-of-Custody Record exactly.

- The person undertaking the actual sampling in the field is responsible for the care and custody of the samples collected until they are properly transferred or dispatched.

- When photographs are taken of the sampling as part of the documentation procedure, the name of the photographer, date, time, site location, and site description are entered sequentially in the site logbook as photos are taken. Once downloaded to the server or developed, the electronic files or photographic prints shall be serially numbered, corresponding to the logbook descriptions; photographic prints will be stored in the project files. To identify sample locations in photographs, an easily read sign with the appropriate sample/ location number should be included.

- Sample labels shall be completed for each sample, using waterproof ink unless prohibited by weather conditions (e.g., a logbook notation would explain that a pencil was used to fill out the sample label if the pen would not function in freezing weather.)

V.2.2 Transfer of Custody and Shipment

Samples are accompanied by a Chain-of-Custody Record Form. A Chain-of-Custody Record Form example is shown in Attachment B. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the Record. This Record documents sample custody transfer from the sampler, often through another person, to the analyst in the laboratory. The Chain-of-Custody Record is filled out as given below:

- Enter header information (CTO number, samplers, and project name).

- Enter sample specific information (sample number, media, sample analysis required and analytical method grab or composite, number and type of sample containers, and date/time sample was collected).

- Sign, date, and enter the time under "Relinquished by" entry.

- Have the person receiving the sample sign the "Received by" entry. If shipping samples by a common carrier, print the carrier to be used in this space (i.e., Federal Express).

- If a carrier is used, enter the airbill number under "Remarks," in the bottom right corner;

- Place the original (top, signed copy) of the Chain-of-Custody Record Form in a plastic zipper-type bag or other appropriate sample-shipping package. Retain the copy with field records.

- Sign and date the custody seal, a 1-inch by 3-inch white paper label with black lettering and an adhesive backing. Attachment C is an example of a custody seal. The custody seal is part of the chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field. Custody seals shall be provided by the analytical laboratory.

- Place the seal across the shipping container opening (front and back) so that it would be broken if the container were to be opened.

- Complete other carrier-required shipping papers.

The custody record is completed using waterproof ink. Any corrections are made by drawing a line through and initialing and dating the change, then entering the correct information. Erasures are not permitted.

Common carriers will usually not accept responsibility for handling Chain-of-Custody Record Forms; this necessitates packing the record in the shipping container (enclosed with other documentation in a plastic zipper-type bag). As long as custody forms are sealed inside the shipping container and the custody seals are intact, commercial carriers are not required to sign the custody form.

The laboratory representative who accepts the incoming sample shipment signs and dates the Chain-of-Custody Record, completing the sample transfer process. It is then the laboratory's responsibility to maintain internal logbooks and custody records throughout sample preparation and analysis.

VI Quality Assurance Records

Once samples have been packaged and shipped, the Chain-of-Custody copy and airbill receipt become part of the quality assurance record.

VII Attachments

A. Sample Label
B. Chain of Custody Form
C. Custody Seal

VIII References

USEPA. *User's Guide to the Contract Laboratory Program*. Office of Emergency and Remedial Response, Washington, D.C. (EPA/540/P-91/002), January 1991.

STANDARD OPERATING PROCEDURE

Packaging and Shipping Procedures for Low-Concentration Samples

I. Purpose and Scope

The purpose of this guideline is to describe the packaging and shipping of low-concentration samples of various media to a laboratory for analysis.

II. Scope

The guideline only discusses the packaging and shipping of samples that are anticipated to have low concentrations of chemical constituents. Whether or not samples should be classified as low-concentration or otherwise will depend upon the site history, observation of the samples in the field, odor, and photoionization-detector readings.

If the site is known to have produced high-concentration samples in the past or the sampler suspects that high concentrations of contaminants might be present in the samples, then the sampler should conservatively assume that the samples cannot be classified as low-concentration. Samples that are anticipated to have medium to high concentrations of constituents should be packaged and shipped following procedures for dangerous-goods shipping specified by the intended shipper (e.g., Federal Express).

III. Equipment and Materials

- Coolers
- Clear tape
- "This Side Up" labels
- "Fragile" labels
- Vermiculite
- Ziplock bags or bubble wrap
- Ice
- Chain-of-Custody form (completed)
- Custody seals

IV. Procedures and Guidelines

Low-Concentration Samples

A. Prepare coolers for shipment:

- Tape drains shut.
- Affix "This Side Up" labels on all four sides and "Fragile" labels on at least two sides of each cooler.
- Place mailing label with laboratory address on top of coolers.
- Fill bottom of coolers with about 3 inches of vermiculite or absorbent pads.

B. Arrange decontaminated sample containers in groups by sample number. Consolidate VOC samples into one cooler to minimize the need for trip blanks.

C. Affix appropriate adhesive sample labels to each container. Protect with clear label protection tape.

D. Seal each sample bottle within a separate ziplock plastic bag or bubble wrap, if available. Tape the bag around bottle. Sample label should be visible through the bag.

E. Arrange sample bottles in coolers so that they do not touch.

F. If ice is required to preserve the samples, cubes should be repackaged in zip-lock bags and placed on and around the containers.

G. Fill remaining spaces with vermiculite or absorbent pads.

H. Complete and sign chain-of-custody form (or obtain signature) and indicate the time and date it was relinquished to Federal Express or the courier.

J Close lid and latch.

K. Carefully peel custody seals from backings and place intact over lid openings (right front and left back). Cover seals with clear protection tape.

L. Tape cooler shut on both ends, making several complete revolutions with strapping tape. Cover custody seals with tape to avoid seals being able to be peeled from the cooler.

M. Relinquish to Federal Express or to a courier arranged with the laboratory. Place airbill receipt inside the mailing envelope and send to the sample documentation coordinator along with the other documentation.

Medium- and High-Concentration Samples:

Medium- and high-concentration samples are packaged using the same techniques used to package low-concentration samples, with several additional restrictions. The sample handler must refer to instructions associated with the shipping of dangerous goods for the necessary procedures for shipping by Federal Express or other overnight carrier.

V. Attachments

None.

VI. Key Checks and Items

- Be sure laboratory address is correct on the mailing label
- Pack sample bottles carefully, with adequate vermiculite or other packaging and without allowing bottles to touch
- Be sure there is adequate ice
- Include chain-of-custody form
- Include custody seals

STANDARD OPERATING PROCEDURE

Direct-Push Soil Sample Collection

I. Purpose

To provide a general guideline for the collection of soil samples using direct-push (e.g., Geoprobe®) sampling methods.

II. Scope

Standard direct-push (e.g., Geoprobe®) soil sampling methods.

III. Equipment and Materials

- Truck-mounted hydraulic percussion hammer.
- Sampling rods
- Sampling tubes and acetate liners (if desired)
- Pre-cleaned sample containers and stainless-steel sampling implements
- Clean latex or surgical gloves.

IV. Procedures and Guidelines

1. Decontaminate sampling tubes and other non-dedicated downhole equipment in accordance with SOP *Decontamination of Personnel and Equipment*.

2. Drive sampling tube to the desired sampling depth using the truck-mounted hydraulic percussion hammer. If soil above the desired depth is not to be sampled, first drive the lead rod, without a sampling tube, to the top of the desired depth.

3. Remove the rods and sampling tube from the borehole and remove the sample from the tube.

4. Fill all sample containers, beginning with the containers for VOC analysis, using a decontaminated or dedicated sampling implement.

5. Decontaminate all non-dedicated downhole equipment (rods, sampling tubes, etc.) in accordance with SOP *Decontamination of Personnel and Equipment*.

6. Backfill borehole at each sampling location with grout or bentonite and repair the surface with like material (bentonite, asphalt patch, concrete, etc.), as required.

V. Key Checks and Items

1. Verify that the hydraulic percussion hammer is clean and in proper working order.

2. Ensure that the direct-push operator thoroughly completes the decontamination process between sampling locations.

3. Verify that the borehole made during sampling activities has been properly backfilled.

Attachment C-2
Laboratory Standard Operating Procedures

Laboratory SOPs are proprietary and confidential.
They are provided upon request at the discretion of the Project Manager.

Appendix D
Accident Prevention Plan

Accident Prevention Plan
for Focused Site Inspection of Site UXO-06
Borrow Pit Expansion

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Contract Task Order 0011

July 2009

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Under the

NAVFAC CLEAN 1000 Program
Contract No. N62470-08-D-1000

Prepared by

CH2MHILL

Charlotte, North Carolina

Plan Prepared by:

June 22, 2009

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Program Health and Safety Manager
Contact: 770-604-9182 ext. 54133

Approved:

Daniel N. Young

June 24, 2009

Dan Young, CSP — Date
Corporate MR Safety Officer
Contact: 251-752-0148

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Acronyms and Abbreviations

AHA	activity hazard analysis
APP	Accident Prevention Plan
BPEA	borrow pit expansion area
CFR	Code of Federal Regulations
CPR	cardiopulmonary resuscitation
DoD	Department of Defense
DGM	digital geophysical mapping
DPT	direct push technology
EOD	explosives ordnance disposal
ERP	Emergency Response Plan
EZ	exclusion zone
H&S	health and safety
PHSM	program health and safety manager
IDW	investigation-derived waste
MARCORSYSCOM	Marine Corps Systems Command
MC	munitions constituents
MCB	Marine Corps Base
MD	munitions debris
MEC	munitions and explosives of concern
MMRP	Military Munitions Response Program
MPPEH	material potentially presenting an explosive hazard
MR	munitions response
OSHA	Occupational Safety & Health Administration
PA/SI	Preliminary Assessment/Site Inspection
PM	Project Manager
PPE	personal protective equipment
QA	quality assurance
QC	quality control
SOP	standard operating procedure
SSC	Site Saftey Coordinator
SSHP	Site Safety and Health Plan
SI	Site Inspection
SUXOS	Senior UXO Supervisor
USACE	United States Amory Corps of Engineers
UXO	unexploded ordnance
UXOSO	UXO Safety Officer

APPENDIX D

Accident Prevention Plan

D.1 Background Information

This Accident Prevention Plan (APP) has been prepared in support of the Focused Site Inspection (SI) at the Marine Corps Base (MCB) Camp Lejeune base borrow pit expansion area (BPEA) located within Military Munitions Response Program (MMRP) Site Unexploded Ordnance (UXO) -06, Former Fortified Beach Assault Area. United States Amory Corps of Engineers (USACE) DID FPRT-005-06 was used in the development of this APP. Along with the Site Safety and Health Plan (SSHP), provided as Attachment D-1, the APP comprises the health and safety (H&S) policy and procedures for work performed by CH2M HILL and its subcontractors for work at Site UXO-06. The APP and SSHP identify the responsibilities of all safety personnel and provide the specific procedures and protocols to be followed by field personnel to ensure the health and safety of all onsite workers.

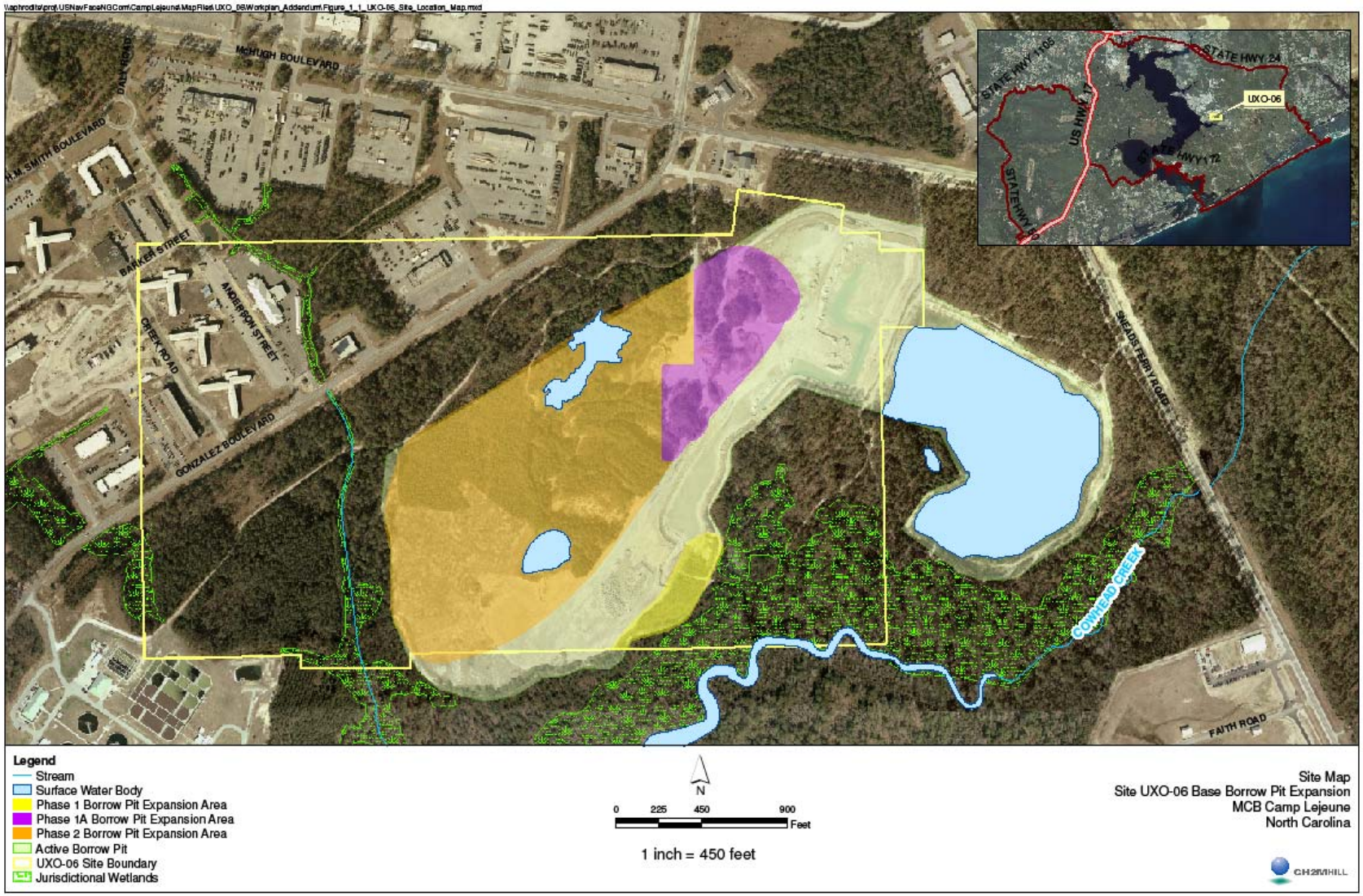
D.1.1 Identifying Information

Contractor:	CH2M HILL 9191 S. Jamaica Street Englewood, CO 80112
Contract Number:	N62470-08-D-1000
Task Order Number:	CTO-0011
Project Name	Focused SI Site UXO-06 BPEA MCB Camp Lejeune, NC

D.1.2 Project Description

MCB Camp Lejeune is close to reaching the limits of the current base borrow pit and will need to increase the capacity of this area to support the various facility projects underway. The proposed 54-acre BPEA is located within MMRP Site UXO-06 that was previously the subject of a site-wide Preliminary Assessment/Site Inspection (PA/SI) between 2007 and 2008. The objectives of the PA/SI were to evaluate the potential presence and nature of impacts to environmental media resulting from historical activities. The PA/SI concluded that the only human health threat posed by site conditions pertained to potential exposure of future residents to groundwater. No adverse effects to ecological receptors were identified. However, small arms ammunition and material potentially presenting an explosive hazard (MPPEH) were discovered during the field investigation activities. Because the site is planned for future borrow pit expansion, a Focused SI will be conducted to meet the objectives described below.

FIGURE D-1


MCHUGH BOULEVARD
BALLY ROAD
H.M. SMITH BOULEVARD
BARKER STREET
ANDERSON STREET
CREEK ROAD
GONZALEZ BOULEVARD
SNEADS FERRY ROAD
COWHEAD CREEK
FAITH ROAD
STATE HWY 24
STATE HWY 1105
US HWY 17
STATE HWY 172
UXO-06
Legend
Stream
Surface Water Body
Phase 1 Borrow Pit Expansion Area
Phase 1A Borrow Pit Expansion Area
Phase 2 Borrow Pit Expansion Area
Active Borrow Pit
UXO-06 Site Boundary
Jurisdictional Wetlands
N
0 225 450 900
Feet
1 inch = 450 feet
Site Map
Site UXO-06 Base Borrow Pit Expansion
MCB Camp Lejeune
North Carolina
CH2MHILL

- Evaluate the potential presence and nature of impacts to the environment resulting from historical activities and the potential for human health and ecological risks in the Phase 1 BPEA that was not investigated as part of the previous PA/SI activities.
- Evaluate the nature and extent of potential munitions and explosives of concern (MEC) contamination and reduce potential exposure of site workers to MEC. Also, determine the presence and nature of any resulting munitions constituent (MC) soil contamination.

D.1.3 Description of Work

- The Focused SI at the BPEA will include:
- Site mobilization and setup
- Land surveying*
- Vegetation removal*
- Surface MEC clearance operations (if necessary)
- Digital geophysical mapping (DGM)*
- Soil sampling*
- Utility locating*
- Direct push technology (DPT) drilling*
- Investigation-derived waste (IDW) management
- MEC intrusive Investigation
- Explosive demolition of MEC items (blasting operations)
- MPPEH/munitions debris (MD) management, inspection, certification and disposal
- Documentation of findings
- Site restoration and demobilization

* MEC avoidance will also be conducted during these tasks.

D.1.4 Tasks Requiring Activity Hazard Analysis

The following is a list of tasks that are known to require an activity hazard analysis (AHA) based on Hazard/Risk analysis.

- Site mobilization and setup
- Land Surveying
- Vegetation removal
- Surface MEC clearance operations (if necessary)
- DGM
- Soil Sampling
- Utility Locating
- DPT drilling
- IDW Management
- MEC demolition and disposal (blasting operations)
- MPPEH/MD management
- Site restoration and demobilization

If other tasks are identified prior to or during project execution, the UXO Safety Officer (UXOSO) or Site Safety Coordinator (SSC) will coordinate with the Program Health and Safety Manager (HSM) and/or the Corporate Munitions Response (MR) Safety Officer to develop and publish the appropriate AHAs for the newly identified tasks.

D.2 Corporate Health and Safety Policy

CH2M HILL's Health, Safety, Security, and Environment Policy, which has been signed by senior corporate executives, is provided as Attachment D-2.

D.2.1 Safe Work Policy

It is the policy of CH2M HILL to perform work in the safest manner possible. Safety must never be compromised. To fulfill the requirements of this policy, an organized and effective safety program must be carried out at each location where work is performed.

CH2M HILL believes that all injuries are preventable, and we are dedicated to the goal of a safe work environment. To achieve this goal, every employee on the project must assume responsibility for safety.

Every employee is empowered to:

- Conduct their work in a safe manner
- Stop work immediately to correct any unsafe condition that is encountered
- Take corrective actions so that work may proceed in a safe manner

Safety, occupational health, and environmental protection will not be sacrificed for production. These elements are integrated into quality control (QC), cost reduction, and job performance, and they are crucial to our success.

D.2.2 Health and Safety Commitment

CH2M HILL has embraced a philosophy for H&S excellence. The primary driving force behind this commitment to H&S is simple: employees are CH2M HILL's most significant asset and CH2M HILL management values their safety, health, and welfare. In addition, top management believes that all injuries are preventable. CH2M HILL's safety culture empowers employees at all levels to accept ownership for safety and take whatever actions are necessary to eliminate injury. Our company is committed to world-class performance in H&S and understands that world-class performance in H&S is a critical element in overall business success.

CH2M HILL is committed to the prevention of personal injuries, occupational illnesses, and damage to equipment and property in all its operations; the protection of the public whenever it comes in contact with the company's work; and the prevention of pollution and environmental degradation.

Company management, field supervisors, and employees plan safety into each work task in order to prevent occupational injuries and illnesses. The ultimate success of our safety program depends on the full cooperation and participation of each employee.

CH2M HILL will exceed recognized MR industry standards as we work to be a model in the MMRP industry. CH2M HILL management extends its full commitment to H&S excellence.

D.3 Responsibilities and Lines of Authority

The following listed Program and project personnel are responsible and accountable for safety on the project:

- Project Manager (PM)—Keri Hallberg
- Corporate MR Safety and QC Officer—Dan Young
- Senior Consultant (SC)—Tom Roth
- Program HSM (HSM)—Mike Goldman
- SSC – Clif White
- UXOSO—TBD
- Senior UXO Supervisor (SUXOS)—TBD
- UXO QC Officer—TBD
- UXO Technician III—TBD

Safety responsibilities, accountability, and lines of authority are further discussed in Section 4, Staff Organization, Qualifications, and Responsibilities, of the SSHP.

PM—Keri Hallberg, P.E., is responsible for overall project activities, including cost control, schedule control, and technical quality. In addition, the PM develops the work plan addendum and monitors task order activities to ensure compliance with project objectives and scope. The PM has ultimate responsibility within the project team for producing deliverables that are technically adequate, satisfactory to the client, and cost-effective. To accomplish this, the PM develops an internal project review schedule, provides written instructions and frequent guidance to the project team, and monitors budgets and schedules. The PM will work with the project team to select an internal quality assurance (QA)/QC review team, coordinate review efforts, address review comments, and adjudicate technical issues.

SC—Thomas M. Roth, P.E. is a company-wide resource with significant experience in the various technical aspects involved in a complex project. The senior technical consultant is responsible for evaluating the technical merit of the work planning documents before field activities begin, and reviewing all deliverables before submittal. The senior consultant assists the PM in coordinating review efforts, addressing review comments, and resolving technical issues.

Corporate MR Safety and QC Officer—Dan Young will oversee the implementation of the APP to ensure that it meets all specific needs of the project and that appropriate H&S requirements are defined. The APP is provided as Appendix D of the Focused SI Work Plan Addendum. The Corporate MR Safety and QC Officer will also provide guidance to the UXOSO.

SUXOS—To Be Determined, will have responsibility for the execution of all onsite MEC-related activities in the exclusion zones (EZs) of Site UXO-06. The SUXOS will be responsible for overseeing scheduling and ensuring that field activities are performed in accordance with the specified plans. The SUXOS will be familiar with all aspects of H&S as related to MEC and will coordinate with the UXOSO to ensure H&S of site personnel. The SUXOS will also be responsible for coordinating the MEC subcontractor at the site. The SUXOS will oversee and manage the MEC subcontractor, which includes reviewing their progress, schedules, resources, costs, and performance. The SUXOS will be responsible for scheduling work, logistics-related issues, and the day-to-day conduct of site activities.

UXOSO—To Be Determined, will be responsible for implementing the APP, inclusive of the MEC-related and general safety components. The UXOSO will verify compliance with applicable H&S requirements. He will report independently of project management to the Program HSM and Corporate MR Safety Officer. The UXOSO will implement the approved safety programs in compliance with all Department of Defense (DoD), federal, state, and local statutes and codes; analyze operational risks, hazards, and safety requirements; enforce personnel limits and safety EZs for MEC clearance operations, transportation, storage, and destruction; and conduct safety inspections to ensure compliance with safety codes.

SSC—To Be Determined, will be responsible for implementing the APP, during tasks other than the MEC intrusive investigation.

D.4 Subcontractors and Suppliers

D.4.1 Subcontractor Information

CH2M HILL will subcontract the following services to support the field investigation at Site UXO-06 BPEA: MEC support, buried utility locating, DGM, land surveying, vegetation clearing, and DPT soil sampling. These subcontractors will be identified prior to mobilization and will be required to follow all applicable H&S requirements identified in this APP and SSHP.

D.4.2 Subcontractor/Supplier Coordination and Control

CH2M HILL subcontractors will be screened for safety performance and compliance with federal Alcohol and Drug testing requirements prior to being issued any contract for site work. CH2M HILL subcontractors will comply with the requirements for site safety as outlined in SSHP.

D.4.3 Subcontractor/Supplier Safety Responsibilities

All subcontractor employees are subject to the same training and medical surveillance requirements as project team personnel, depending on job activity. All activities involving the potential for exposure to hazardous waste materials will require medical and training certification as mandated by the Occupational Safety & Health Administration (OSHA) (29 Code of Federal Regulations [CFR] 1910.120). All subcontractor personnel will be required to sign-in daily and will be required to attend a daily meeting to discuss operations and safety issues. Subcontractors will submit AHAs specific to their work activities to the

SSC or UXOSO. All incidents involving subcontractor employees shall be reported orally to the SSC or UXOSO and a copy of the subcontractor's injury/illness report shall be submitted to the SSC or UXOSO within 24 hours.

Subcontractors are required to sign and comply with all requirements of the SSHP (Attachment D-1). Plans to address specific hazards may be added to the APP during the course of work. Subcontractors will be required to sign and comply with any supplemental plans. Subcontractors not in compliance will be immediately dismissed from the site.

Subcontractors must comply with the following activities and are responsible for:

- Complying with applicable federal, state and local safety standards
- Actively participating in the project safety program and attending all required safety meetings
- Providing a site supervisor who is qualified as a competent person for the subcontractor's work activities and who also serves as the subcontractor's safety representative to coordinate their compliance with the SSHP with the SSC or UXOSO
- Maintaining a first aid kit for the subcontractor's work crews onsite
- Maintaining and replacing safety protection systems damaged or removed by the subcontractor's operations
- Notifying the SSC or UXOSO of any accident, injury, and/or incident immediately and submitting reports to CH2M HILL within 24 hours
- Installing contractually required general conditions for safety for lower tier subcontractors (e.g., engineering controls)
- Conducting and documenting weekly safety inspections of their specific tasks and associated work areas

Suppliers delivering materials to the project site or providing equipment or equipment maintenance will comply with the H&S procedures in the SSHP. Non-UXO-qualified personnel will not be permitted into areas potentially containing MEC or MPPEH without a qualified UXO escort, and only essential UXO qualified personnel will be allowed within the EZs during MEC operations.

Subcontractors will not ride on tractors, forklifts, or similar vehicles unless specific seats are provided. Trucks will be loaded and unloaded in a safe and effective manner and materials will be stored safely in designated locations only. Associated packaging will be properly disposed of and litter will not be permitted to be scattered or blown from truck beds. Operators of mobile equipment on site must observe all traffic rules, such as speed limits and right-of-ways of pedestrians.

D.5 Training

D.5.1 Safety Indoctrination

Prior to commencement of site activities, the SSC or UXOSO will ensure that all employees engaged in MEC operations are informed of the nature and degree of exposure to chemical and physical hazards that are likely to result from participation in site operations. The SSC or UXOSO will ensure that all personnel entering the site have received the appropriate OSHA and site-specific training prior to participation in site activities. At a minimum, the following site-specific topics will be covered:

- Details of the SSHP
- Specific munitions and explosive safety
- Employee rights and responsibilities
- Safe work practices
- Nature and extent of anticipated chemical and physical hazards
- Measures and procedures for controlling site hazards
- Safety arcs and identified hazard areas
- Response to emergencies and accidents
- Rules and regulations for vehicle use
- Safe use of field equipment
- Handling, storage, and transportation of hazardous materials
- Use, care, and limitations of personal protective equipment (PPE)
- Hazard communication per OSHA 29 CFR 1910.1200

D.5.2 Mandatory Training and Certifications

The following certifications are required for the listed personnel operating on this project site.

UXO-Qualified Personnel

All UXO-qualified personnel performing work that involves decisions of safety and condition of MEC/MPPEH must be graduates of the United States Army Bomb Disposal School (Aberdeen Proving Ground, Maryland) or the United States Naval Explosive Ordnance Disposal (EOD) Schools (Indian Head, Maryland, or Eglin Air Force Base, Florida). All UXO qualified personnel will meet or exceed the minimum requirements established and verified by United States Army Engineering Support Center in Huntsville, Alabama. Refer to Table 5-1 in the SSHP for specific levels and qualifications.

Heavy Equipment Operators

All personnel who will operate any heavy equipment other than motor vehicles, such as forklifts, backhoes, excavators, and earth moving equipment, will hold certifications of training and competency from their employer in compliance with the applicable OSHA regulation.

First Aid/Cardiopulmonary Resuscitation Qualified Personnel

A minimum of two fully qualified First Aid and Cardiopulmonary Resuscitation (CPR) trained individuals will be on the project site at all times. These individuals will hold certifications in first aid and CPR from the American Heart Association or from an organization with equivalent training. The certificates shall state the date of issue and the length of validity. The qualified individuals will be identified to all personnel onsite during the morning safety briefing.

D.5.3 Personal Protective Equipment

CH2M HILL will provide training to each project team member who is required to use PPE. Project personnel shall demonstrate an understanding of the training and their ability to use PPE properly before being allowed to perform work requiring the use of PPE.

D.5.4 Explosives Certifications

All personnel required to handle explosives on the project site will be designated in writing as having clearance by the Bureau of Alcohol, Tobacco, Fireams, and Explosives as either an authorized possessor or responsible person. Designated blaster personnel will be required to have a state Blaster's Permit.

D.5.5 HAZWOPER Certifications

General site workers, UXO-qualified personnel, general laborers, and supervisory personnel engaged in MEC removal actions (e.g., SUXOS, UXO Technician III) or other activities that expose or potentially expose them to health hazards, will meet the requirements of 29 CFR 1910.120 (e)(3)(i).

Other employees who perform work on the site, such as land surveying, shall meet the requirements of 29 CFR 1910.120(e)(iii).

Managers and supervisors shall be additionally certified as having received management and supervisory training that meets the requirements of 29 CFR 1910.120(e)(4).

Copies of certifications or certifications from the employer will be kept onsite.

D.5.6 Periodic Retraining/Re-Certification

Periodic retraining and re-certification will comply with the applicable regulations and standards. Re-training will also be required when the employer has reason to believe that any affected employee who has already been trained does not have the understanding and skill required.

Circumstances where retraining is required include, but are not limited to, situations where:

- Changes in the workplace render previous training obsolete or there is an accident or incident involving the employee and the equipment or task.
- Changes in the types of PPE to be used render previous training obsolete or inadequacies in an affected employee's knowledge or use of assigned PPE indicate that the employee has not retained the requisite understanding or skill.

D.5.7 Emergency Response Training

All site personnel will be trained in the requirements of the Emergency Response Plan (ERP), which is Section 15 of the SSHP. The training will include the following topics:

- Procedures and tests
- Spill response
- Firefighting response
- Personal injury response
- Location of emergency supplies and equipment
- Evacuation and assembly areas
- Their responsibility and roles in emergencies

D.5.8 Safety Meetings

All personnel onsite will attend initial site training and all daily safety briefings. The SSC or UXOSO will conduct site-specific training. Specific information on site-specific training topics and content are described in Section 5 of the SSHP.

D.6 Health and Safety Inspections

D.6.1 Internal Safety Inspections

The SSC or UXOSO will perform daily site inspections to ensure that project activities are being performed in accordance with the SSHP. Any serious H&S deficiencies observed during the daily site inspections will be corrected immediately or that specific work operation will be suspended until it complies with the SSHP requirements. Results of these inspections will be documented daily in the field logbook. Any H&S deficiency or non-compliant observation will be discussed during the next day's safety meeting.

The SSC or UXOSO will also perform weekly H&S inspections, using the activity-specific H&S self-assessment checklist provided in the SSHP, to confirm specific project activities are performed in compliance with the hazard control procedures of the SSHP. All deficiencies and corrective actions, along with the date they were taken or required to be taken, will be documented in the self-assessment checklists at the time of the inspection. The SSC or UXOSO will confirm that all deficiencies are closed out with appropriate corrective actions taken. Copies of these inspection checklists will be maintained on file at the project location.

The UXOSO and UXOQCS are responsible for conducting and preparing reports of daily safety inspections of UXO work processes, site conditions, and equipment conditions and submitting them to Site Manager.

The Program HSM will periodically conduct site visits and perform site H&S audits. These reports will be kept on file and the action items noted during the visit will be tracked with written confirmation of the corrective actions for each item. These responses are compiled and provided to program management for review.

D.6.2 External Inspections/Certifications

There are currently no scheduled or required external inspections or certifications. The Project Management team will make every effort to accommodate requests for external inspections, reviews, and surveys. Marine Corps Systems Command (MARCORSYSCOM) may request to inspect any operations that will be governed by the Site UXO-06 Explosives Safety Submission (ESS); therefore, notification will be given to MARCORSYSCOM two weeks prior to performing these operations.

D.7 Health and Safety Expectations, Incentive Programs, and Compliance

D.7.1 Company Safety Program Goals

CH2M HILL considers safety the highest priority during work at all project sites and its business offices and has established a goal of zero incidents. All projects will be conducted in a manner that minimizes the probability of near misses, equipment and/or property damage, or injury. CH2M HILL will establish programs to recognize people and projects that demonstrate excellence in safety performance. CH2M HILL will use safety observation programs to identify and correct unsafe acts and conditions. Safety awareness programs will be used to provide continuous training and development of good safety practices. CH2M HILL site supervision will investigate all incidents to determine root causes and institute corrective actions to prevent recurrence. CH2M HILL will provide and enforce safety rules to protect employees, subcontractors, clients, and the public. Project supervisory personnel that demonstrate superior safety performance will be rewarded.

D.7.2 Employee Safety Responsibilities

Each employee is responsible for personal safety as well as the safety of others in the area and is expected to participate fully in the H&S Program. The employee will use all equipment in a safe and responsible manner as directed by the SSC or UXOSO. All CH2M HILL personnel will follow the policies set forth in this APP and SSHP. Site personnel concerned with any aspect of H&S shall bring the issue to the attention of the PM or the SSC or UXOSO. All project personnel have the authority to stop work if, in their judgment, serious injury could result from continued activity. The SSC or UXOSO shall be notified immediately if this becomes necessary. To protect the H&S of all personnel, employees that knowingly disregard safety policies and procedures may be subject to disciplinary actions up to, and including, termination.

D.7.3 Managers and Supervisors Safety Accountability

It is the duty of the first line supervisor to motivate employees to adhere to CH2M HILL's safety policy in each work situation. For these purposes, a first line supervisor is defined as that person designated to give immediate onsite supervision to personnel involved in a task.

All supervisors shall have complete knowledge of the safe procedures for all jobs and tasks under their supervision. When in doubt, they shall seek assistance prior to initiating a task. This is the only acceptable manner in which to perform the task. If the task cannot be accomplished safely, it will not be attempted.

Supervisors will:

- Explain the safety procedure involved with a task to each employee and check frequently to see that the employee understands and works as instructed.
- Allocate sufficient time for the training and coaching of all employees to ensure that everyone knows the correct procedure for safely accomplishing required tasks.
- Prevent new employees from performing any tasks until required training is completed.
- Immediately correct unsafe conditions that involve CH2M HILL employees or subcontractors.
- Ensure that the employees are outfitted with and wear PPE as specified by this APP, SSHP, other CH2M HILL procedures, or as directed by the PM, SSC or UXOSO, or Program HSM.
- Set a good safety example.
- Obtain the cooperation of employees and subcontractors.
- Provide a safe work environment for employees and subcontractors.
- Confirm subcontractor safety performance records have been verified prior to contract award and monitor contractor performance during operations.
- Report all accidents, near misses, and property damage in accordance with CH2M HILL Incident Reporting Procedures.
- Establish a safety culture, using the elements of the CH2M HILL Safety Improvement process, which promotes awareness, encourages participation, and recognizes excellence.

D.7.4 Incentive Program

CH2M HILL has a spot bonus incentive program that can be used to reward workers for exhibiting exemplary safety behaviors. Actions that qualify are those that go above and beyond what is expected (i.e., wearing your own safety equipment, seatbelt). Actions that will be rewarded include spotting and correcting a hazard, bringing a hazard to the attention of your supervisor, telling your supervisor about an incident, determining a safer way to get the work done, and stopping a crewmember from doing something unsafe. The incentive program will be communicated to all employees during the project employee orientation and project safety meetings.

D.7.5 Stop Work Authority

Each employee on the project has the obligation and authority to shut down any perceived unsafe work. During employee orientation, each employee will be informed of their authority to do so.

Once stop work is declared by an employee, the SSC or UXOSO shall investigate the cause of the cessation, rendering appropriate mitigation and controls after consulting with offsite

personnel (if required) and documenting the event in the SSC or UXOSO project logbook. Appropriate entries will also be made in the QC logbook and daily reports.

D.7.6 Standards of Conduct Violations

All individuals associated with this project are expected to act in a professional manner. Violations of the standards of conduct include, but are not limited to, the following:

- Failure to perform work
- Inefficient performance, incompetence, or neglect of work
- Willful refusal to perform work as directed (insubordination)
- Negligence in observing safety regulations, poor housekeeping, or failure to report on-the-job injuries or unsafe conditions
- Unexcused or excessive absence or tardiness
- Unwillingness or inability to work in harmony with others
- Discourtesy, irritation, friction, or other conduct that creates disharmony
- Harassment or discrimination against another individual
- Failure to be prepared for work by wearing the appropriate clothing, PPE, or bringing the necessary tools
- Violation of any other commonly accepted reasonable rule of responsible personal conduct

D.7.7 Intolerable Offenses

Certain employee conduct may be so intolerable as to justify removal from the project. Intolerable offenses and actions include, but are not limited to, the following:

- Any manager, supervisor, or other person in charge of the work being performed who requires, requests, asks, threatens with their job, allows, or condones employees to work in or around unsafe acts or conditions.
- Any employee, supervisor, or manager who knowingly falsifies any investigative documents or testimony involving an investigation.
- Any employee, supervisor, or manager who openly exhibits disregard, defiance, or disrespect for the safety program.
- Any employee who violates established safety rules, regulations, or codes and endangers themselves or other employees.
- All parties involved in workplace violence, including physical encounters (fighting) or threats of violence, theft, or destruction of property.
- Any employee, supervisor, or manager failing to comply with procedures contained in the SSHP, USACE EM 385-1-1 Safety and Health Requirements Manual, or any

applicable federal, state, local safety laws and regulations that create the potential for serious or costly consequences.

- Any employee who commits repeated minor offenses and shows a lack of responsible effort to correct these offenses.

D.7.8 Enforcement and Discipline

CH2M HILL's Enforcement and Discipline procedures, the Standards of Conduct, the Intolerable Offenses, and the Drug Free Workplace policy will be thoroughly reviewed with each employee during the employee project orientation.

Intolerable Offenses

CH2M HILL practices zero tolerance for intolerable offenses. Those individuals found participating in such offenses will be either suspended from work for three days without pay or immediately discharged and not allowed to return to work.

Other Violations

Other violations, as outlined in the Standards of Conduct, will be handled accordingly:

- First Offense – Employee will receive a written warning
- Second Offense – Employee will receive a two-day suspension without pay
- Third Offense – Employee will be discharged

D.8 Accident Reporting

D.8.1 Accident Investigations, Reports and Logs

The Accident and Incident Reports located in the SSHP will be used for reporting accidents and incidents that occur on the work site or in connection with the stated work of this contract. The report shall contain as much information as is known concerning the incident.

D.8.2 Immediate Notification of Major Incidents

CH2M HILL will immediately notify Naval Facilities Engineering Command Mid-Atlantic of any major incident, including injury, fire, equipment or property damage, and environmental incident. Procedures to be followed in response to any major personal injury are detailed in the SSHP. The following are considered major incidents:

1. Accidents and/or incidents that result in a fatality, injury of employees, or lost workdays
2. Property damage assessed at a cost of $2,000 or more
3. Any incident that could bring adverse attention or publicity to MCB Camp Lejeune

D.9 Medical Support

D.9.1 Medical and First Aid Requirements

Prior to starting site work, the SSC or UXOSO will arrange with the local medical facility and emergency response personnel to provide prompt medical attention in the event of an accident. Local emergency services and phone numbers are provided in Section 14.7 of the SSHP.

First Aid and CPR Training

A minimum of two fully qualified first aid and CPR-trained individuals will be on the project site at all times. These individuals will hold certifications in first aid and CPR from the American Heart Association or from an organization with equivalent training. The certificates shall state the date of issue and the length of validity. The qualified individuals will be identified to all personnel onsite during the daily safety briefing.

First Aid Kits

At a minimum, first aid kits will be provided in the ratio of 1 for every 25 people onsite. Preferably, there will be one first aid kit for each individual team conducting operations within the exclusion area. The first aid kits will be Type III, 16-unit first aid kits that meet ANSI Z308.1-1998. First aid kits will be easily accessible to all workers and protected from the weather with sterility of each item maintained. The locations of the kits will be clearly marked and distributed as appropriate throughout the site.

D.10 Personal Protective Equipment

PPE requirements and selection criteria are outlined in Section 6 of the SSHP. Protection levels provided in the SSHP have been established for the anticipated scope of work. Once onsite, visual inspection of the work activities may indicate the need for changes in the PPE level(s). Any significant change in the PPE level(s) will be approved by the SSC or UXOSO in consultation with the Regoinal HSM, and/or Corporate MR Safety Officer. Currently there are no identified hazards or areas that would require a respiratory protection program on the project site.

D.11 Required Plans

D.11.1 Layout Plans

The MPPEH, debris collection points, and EZs are shown on Figures 4-1 and 4-2 of the Focused SI Work Plan Addendum.

D.11.2 Emergency Response Plans

The site-specific ERP is included as Section 15 of the SSHP.

D.11.3 Hazard Communication

The site-specific Hazard Communication Program is included as Section 10.2.2 of the SSHP. The CH2M HILL Hazard Communication Program complies with 29 CFR 1926.59/1910.1200.

D.11.4 Respiratory Protection Program

There are currently no known or identified chemical hazards that would require a respiratory protection program to be implemented for this project. If conditions or work processes change onsite during project execution, warranting the need for respiratory protection, the UXOSO will consult with the PM and obtain the approval of the Program HSM and Corporate MR Safety Officer before implementing a respiratory protection program on the project. The respiratory protection program will be included as an amendment to the SSHP. The program will require all respirator wearers to be cleared by a physician for respirator use, be fit-tested to ensure an acceptable fit, and complete a site-specific respirator training program.

D.11.5 Health Hazard Control Program

The potential chemical hazards and inclement weather posed by project activities and relevant controls are provided in Section 3.5 and Section 15.4.4 of the SSHP, respectively.

D.11.6 Blasting Program

MEC/MPPEH disposal operations will be in compliance with the Site UXO-06 Explosives Safety Submission Amendment. A MEC/MPPEH Disposal AHA will be provided in Attachment 2 of the SSHP upon submission from the selected MR subcontractor, and the Explosive Storage and Accountability and the Ammunition and Explosives Transportation Standard Operating Procedures (SOPs) are provided in the SSHP.

D.11.7 Drug Free Workplace

CH2M HILL does not tolerate illegal drugs or any use of drugs, controlled substances, or alcohol that impairs an employee's work performance or behavior. CH2M HILL has established a policy that its employees and subcontractors shall not be involved in any manner with the unlawful manufacture, distribution, dispensation, possession, sale, or use of illegal drugs in the workplace. The use or possession of alcohol in the workplace is also prohibited. Any violation of these prohibitions may result in discipline or immediate discharge. Please reference CH2M HILL SOP 105, *Drug-Free Workplace Standard of Practice*, for more information. The following subsections describe mandatory program requirements.

Policy Statement

The policy statement for the Drug Free Workplace Program details prohibited conduct and ramifications, along with the following:

- Prohibits drug, alcohol, and/or controlled substances use or abuse
- Prohibits involvement in the manufacture, distribution, dispensation, possession, sale, or use of illegal drugs in the workplace
- Describes disciplinary actions

Subcontractor Management

All subcontractors must comply with the provisions of the Drug Free Workplace Program. It is the responsibility of subcontractors to transfer this information to the lower-tiered subcontractors.

Prescription and Non-Prescription Drugs

Employees using prescription or non-prescription drugs that could impair their function on the project are required to notify the employer in advance of such drug use.

Failure to report prescription and non-prescription drugs as required above, illegally obtaining the substance, or use that is inconsistent with the prescription or label may be subject to disciplinary action.

Employee Education

Employees and supervisors must be provided with a Drug Free Workplace Program and an Alcohol Education Awareness Program.

D.11.8 Sanitation Plan

Adequate sanitation facilities will be provided at each work site to ensure proper personal hygiene. Site sanitation will be established and maintained in accordance with OSHA 29 CFR 1910.120(n).

D.12 Contractor Information

In addition to this APP, the SSHP is provided as Attachment D-1. The SSHP provides the procedures necessary for each project task.

D.13 Site-Specific Hazards and Controls

AHAs will be prepared for each definable feature of work contained in the Focused SI Work Plan Addendum, as listed below:

- Mobilization and setup
- Site layout surveys with MEC avoidance
- Vegetation removal with MEC avoidance
- Surface MEC clearance operations (if necessary)

- DGM with MEC avoidance
- Subsurface utility location with MEC avoidance
- DPT soil sampling with MEC avoidance
- IDW management
- MEC Intrusive Investigation
- MEC demolition and disposal (blasting operations)
- MPPEH/MD management
- Site restoration and demobilization

Detailed site-specific hazards and controls are provided in Section 3 of the SSHP and the AHAs are provided in the SSHP.

Attachment D-1
Site Safety and Health Plan

Site Safety and Health Plan
Focused Site Inspection Site UXO-06
Borrow Pit Expansion Area

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Contract Task Order 0011

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7 HAZCOM Specific Training Forms
8 Chemical Inventory/Register Form
9 Incident Report Form
10 Root Cause Analysis Form/Flow Chart

Figure

12-1 Personnel Decontamination Line

Acronyms and Abbreviations

AHA	activity hazard analysis
ANSI	American National Standards Institute
APR	air-purifying respirator
BBLPS	Behavior Based Loss Prevention System
BD	base detonating
BG	business group
BPEA	Borrow Pit Expansion Area
bpm	beats per minute
CFR	Code of Federal Regulations
cm	centimeter
CPR	cardiopulmonary resuscitation
CWM	chemical warfare materiel
°F	degrees Fahrenheit
dBA	decibel
DDESB	Department of Defense Explosive Safety Board
DEET	N,N-diethyl-meta-toluamide
DGM	digital geophysical mapping
DID	data item description
DoD	Department of Defense
DPT	direct push technology
EMP	Explosives Management Plan
EOD	Explosive Ordnance Disposal
ERC	Emergency Response Coordinator
ERP	Emergency Response Plan
ERT	Emergency Response Team
ESP	Explosives Siting Plan
ESS	Explosives Safety Submission
ESQD	explosives safety quantity-distance
EZ	exclusion zone
FID	flame ionization detector
GPR	Ground Penetrating Radar
H&S	health and safety
HAZCOM	hazardous communication
HAZWOPER	hazardous waste operations and emergency response
HE	high explosives
HEPA	high-efficiency particulate air
HSM	Health and Safety Manager
HSSE	health, safety, security, and environmental

HW	hazardous waste
IC	Incident Commander
ICS	Incident Command System
IDW	investigation-derived waste
IRF	Incident Report Form
KA	Contracts Administrator
kV	kilovolt
MC	munitions constituent
MCB	Marine Corps Base
MD	munitions debris
MEC	munitions and explosives of concern
MGFD	munition with the greatest fragmentation distance
mm	millimeter
MMRP	Military Munitions Response Program
MPPEH	munitions potentially presenting an explosive hazard
MR	munitions response
MSA	
MSDS	material safety data sheet
NSC	National Safety Council
NLI	Loss and Near Loss Investigations
OSHA	Occupational Safety and Health Administration
PA/SI	Preliminary Assessment/Site Inspection
PIM	potentially infectious material
PM	Project Manager
POC	point of contact
POL	petroleum, oil, and lubricant
PPE	personal protective equipment
PPM	parts per million
PTSP	Pre-task Safety Plan
PZ	piezoelectric
QC	quality control
QCP	Quality Control Plan
RF	radio frequency
RMSF	Rocky Mountain Spotted Fever
SBO	Safe Behavior Observation
SSC	Site Safety Coordinator
SI	Site Inspection
SSHP	Site Safety and Health Plan
SOP	standard operating procedure
SUXOS	Senior Unexploded Ordnance Supervisor

TBD	to be determined
TSD	treatment, storage, and disposal
USACE	United States Army Corps of Engineers
UV	ultraviolet
UXO	unexploded ordnance
UXOSO	Unexploded Ordnance Safety Officer
WP	white phosphorus

SECTION 1

Introduction

This Site Safety and Health Plan (SSHP) addresses all occupational health and safety (H&S) hazards associated with site operations during implementation of the Focused Site Inspection (SI) at the Marine Corps Base (MCB) Camp Lejeune base borrow pit expansion area (BPEA) located within Military Munitions Response Program (MMRP) Site Unexploded Ordnance (UXO)-06, Former Fortified Beach Assault Area. This SSHP also addresses the requirements of United States Army Corps of Engineers (USACE) Data Item Description (DID) FPRI-005-06, 29 *Code of Federal Regulations* (CFR) 1910.120(b)(4)(iii), 29 CFR 1926.65(b)(4)(ii), *USACE Safety and Health Requirements Manual EM 385-1-1* (USACE Manual EM 385-1-1), ER 385-1-95 and all other applicable federal, state and local safety and health requirements.

This SSHP will be kept onsite during field activities and will be reviewed as necessary. The plan will be amended or revised as project activities or conditions change or when supplemental information becomes available. The plan adopts, by reference, the Standard Operating Procedures (SOPs) in the CH2M HILL H&S Program, Program and Training Manual, as appropriate. In addition, this plan adopts procedures in the Focused SI Work Plan Addendum. The designated UXO Safety Officer (UXOSO) or Site Safety Coordinator (SSC) is to be familiar with these SOPs and the contents of this plan. All site personnel, including subcontractor personnel, must review this SSHP, agree to abide by this plan, and sign the SSHP Acceptance Form, which is provided as **Attachment 1**.

SECTION 2

Site Description and Contamination Characterization

2.1 Site Description and History

Site UXO-06 is located in the French Creek area of 'mainside' MCB Camp Lejeune south of McHugh Boulevard and west of Sneads Ferry Road. The site is approximately 177 acres in size. The Site UXO-06 area north of Gonzalez Boulevard, which crosses through Site UXO-06, is mostly developed while the area south of Gonzalez Boulevard is largely undeveloped. The BPEA is located within the undeveloped and largely wooded portion of Site UXO-06 located south of Gonzalez Boulevard.

Site UXO-06 was used from 1953 until 1977 as a training area for fortified beach assault and assault of fortified positions. During initial site operations from 1953 to 1970, the range was authorized to use blank small arms, demolition charges, practice rockets, flame throwers, smoke grenades, and pyrotechnics. From 1970 until range closure in 1977, the range was authorized to use blank small arms, 3.5-inch practice rockets, thickened and unthickened fuel, half-pound demolition charges, practice rifle grenades, and smoke and white phosphorus (WP) hand grenades. All fire was reportedly directed away from service roads and main thoroughfares. The potential munitions and explosives of concern (MEC) hazards associated with this former range include UXO and munitions constituents (MC). It is anticipated that potential MEC would have originally been deposited at or near the ground surface, but over the years, site activities (e.g., construction of the access roads) may have caused the MEC to become buried to unknown depths.

2.2 Site Characterization

Previous investigations, site geology, and site hydrogeology are discussed in detail in Sections 1.5 and 1.6 of the Focused SI Work Plan Addendum. The previous investigations at Site UXO-06 that encompassed the BPEA are discussed below.

A site-wide Preliminary Assessment/Site Inspection (PA/SI) was conducted over the 177 acres of Site UXO-06 between 2007 and 2008. The objectives of the PA/SI were to evaluate the potential presence and nature of impacts to environmental media resulting from historical activities. The PA/SI concluded that potential exposure to groundwater by future residents was the only human health risk identified in PA/SI. No adverse effects to ecological receptors were identified. However, small arms ammunition and material potentially presenting an explosive hazard (MPPEH) were discovered during the field investigation activities. The MCB Camp Lejeune Explosive Ordnance Disposal (EOD) Company was contacted to dispose of the small arms ammunition and MPPEH.

Digital geophysical mapping (DGM) activities were conducted as part of the PA/SI over a total of 28,210 linear meters of transects; 9,031 linear meters of these transects were in the

BPEA. The DGM activities identified a total of 1,335 anomalies (209 of these anomalies were located within the BPEA) representing potential MEC. Further evaluation of potential subsurface MEC was conducted in November 2008 through January 2009 by intrusively investigating and removing the sources of geophysical anomalies that had been identified during the Site UXO-06 PA/SI. Subsurface MEC was not encountered during the intrusive investigation activities; however, buried small arms ammunition and munitions debris (MD) was recovered and MPPEH was observed on the ground surface in areas not evaluated during the intrusive investigation activities.

SECTION 3

Hazard/Risk Analysis

3.1 Activity Hazard Analysis

An Activity Hazard Analysis (AHA) has been developed by the subcontractors for their respective task or operation that will be performed during site operations. The AHAs will be submitted by the subcontractors and provided in **Attachment 2** before site operations commence. The AHAs will address all hazards likely to be encountered while performing the work, including conventional safety, explosive ordnance, and chemical, physical, and biological hazards. In accordance with USACE Manual EM 385-1-1 (01.A.13), the AHAs define the activities being performed and identify the sequences of work, the specific hazards anticipated, site conditions, equipment, materials, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level of risk.

3.1.1 Tasks Requiring Activity Hazard Analysis

The following tasks are known to require AHAs based on the hazard/risk analysis. A hazard analysis for the tasks to be performed during site operations is provided in Table 3-1. If other tasks are identified prior to or during project execution, the, SSC or UXOSO will coordinate with the Program Health and Safety Manager (HSM) and/or the Corporate Munitions Response (MR) Safety Officer to develop and publish appropriate AHAs.

- Site mobilization and setup
- Land Surveying*
- Vegetation removal*
- Surface MEC clearance operations (if necessary)
- DGM*
- Soil Sampling*
- Utility Locating*
- Direct Push Technology (DPT) Drilling*
- Investigation Derived Waste (IDW) Management
- MEC demolition and disposal (blasting operations)
- MPPEH/MD management
- Site restoration and demobilization

* MEC Avoidance will be performed simultaneously to facilitate these tasks.

3.1.2 Task Specific Activity Hazard Analyses

AHAs for the tasks listed in Section 3.1.1 will located in **Attachment 2** upon submission from the site subcontractors.

TABLE 3-1
Task Hazard Analysis
(Refer Tto Section 3.3 For Hazard Controls)

Potential Hazards	**Tasks**							
	DPT Drilling	**Soil Sampling**	**Utility Locating**	**Surveying**	**IDW Drum Sampling**	**Observation of Loading Material for Offsite Disposal**	**DGM**	**MEC Intrusive Investigation**
Flying debris/objects	X							
Noise > 85 decibels (dBA)	X							X
Electrical	X						X	
Suspended loads	X					X	X	
Buried utilities, drums, tanks	X							
Slip, trip, fall	X	X	X	X	X	X	X	X
Back injury	X	X	X	X	X	X	X	X
Confined space entry								
Trenches/excavations								X
Visible lightning	X	X	X	X	X	X	X	X
Vehicle traffic						X		
Elevated work areas/falls								
Fires	X	X	X	X	X	X	X	X
Entanglement	X							
Drilling	X							
Heavy equipment	X					X	X	X
Working near water								
Working from boat								
Explosion hazard								X

3.2 Behavior Based Loss Prevention System

(Reference CH2M HILL SOP HSE-103, Behavior Based Loss Prevention System)

A Behavior Based Loss Prevention System (BBLPS) is a system to prevent or reduce losses using behavior-based tools and proven management techniques to focus on behaviors or acts that could lead to losses.

The four basic Loss Prevention tools that will be used by CH2M HILL projects to implement the BBLPS include:

- AHA (discussed in Section 3.1)
- Pre-task Safety Plans (PTSP)
- Safe Behavior Observations (SBO)
- Loss and Near Loss Investigations (NLI) (discussed in **Section 14.5**)

The SSC, UXOSO, or designated CH2M HILL representative onsite is responsible for implementing the BBLPS on the project site. The Project Manager (PM) remains accountable for its implementation. The SSC, UXOSO, or designee shall only oversee the subcontractor's implementation of their AHAs and PTSPs processes on the project.

3.2.1 Pre-task Safety Plans

Daily safety meetings are held with all project personnel in attendance to review the hazards posed and required H&S procedures/AHAs, which apply for each day's project activities. The PTSPs serve the same purpose as these general assembly safety meetings, but the PTSPs are held between the crew supervisor and their work crews to focus on those hazards posed to individual work crews. At the start of each day's activities, the crew supervisor completes the PTSP, provided in **Attachment 3**, with input from the work crew, during their daily safety meeting. The day's tasks, personnel, tools and equipment that will be used to perform these tasks are listed, along with the hazards posed and required H&S procedures, as identified in the AHA. The use of PTSPs, better promotes worker participation in the hazard recognition and control process, while reinforcing the task-specific hazard and required H&S procedures with the crew each day. The use of PTSPs is a common safety practice in the construction industry.

3.2.2 Safe Behavior Observations

SBOs shall be conducted by SSC, UXOSO, or designee for specific work tasks or operations comparing the actual work process against established safe work procedures identified in the project-specific HSP and AHAs. SBOs are a tool to be used by supervisors to provide positive reinforcement for work practices performed correctly, while also identifying and eliminating deviations from safe work procedures that could result in a loss. At least one SBO each week will be performed for tasks/operations addressed in the SSHP or AHA. The SBO form in **Attachment 4** will be completed for the task/operation being observed and submit the SBO form weekly to Elaine Kyle/DEN.

3.3 General Safety Hazards and Controls

The Hazard Analysis provided in **Table 3-1** and the AHAs that will be provided in **Attachment 2** identify the general safety hazards posed for tasks performed during site operations. The following discussion identifies these hazards, along with required hazard control procedures.

3.3.1 General Practices and Housekeeping

Site personnel will adhere to the following guidelines regarding general work practices and site housekeeping:

- Site work should be performed during daylight hours whenever possible.
- Good housekeeping must be maintained at all times in all project work areas.
- Common paths of travel should be established and kept free from the accumulation of materials.
- Keep access to aisles, exits, ladders, stairways, scaffolding, and emergency equipment free from obstructions.
- Provide slip-resistant surfaces, ropes, and/or other devices to be used.
- Specific areas should be designated for the proper storage of materials.
- Tools, equipment, materials, and supplies shall be stored in an orderly manner.
- As work progresses, scrap and unessential materials must be neatly stored or removed from the work area.
- Containers should be provided for collecting trash and other debris and shall be removed at regular intervals.
- All spills shall be quickly cleaned up. Oil and grease shall be cleaned from walking and working surfaces.
- Review the safety requirements of each job you are assigned to with your SSC or UXOSO. You are not expected to perform a job that may result in injury or illness to yourself or to others.
- Familiarize yourself with, understand, and follow jobsite emergency procedures.
- Do not fight or horseplay while conducting the firm's business.
- Do not use or possess firearms or other weapons while conducting the firm's business.
- Report unsafe conditions or unsafe acts to your SSC or UXOSO immediately.
- Report occupational illnesses, injuries, and vehicle accidents.
- Do not remove or make ineffective safeguards or safety devices attached to any piece of equipment.

- Report unsafe equipment, defective or frayed electrical cords, and unguarded machinery to your SSC or UXOSO.
- Shut down and lock out machinery and equipment before cleaning, adjustment, or repair. Do not lubricate or repair moving parts of machinery while the parts are in motion.
- Do not run in the workplace.
- When ascending or descending stairways, use the handrail and take one step at a time.
- Do not apply compressed air to any person or clothing.
- Do not wear steel taps or shoes with metal exposed to the sole at any CH2M HILL project location.
- Do not wear finger rings, loose clothing, wristwatches, and other loose accessories when within arm's reach of moving machinery.
- Remove waste and debris from the workplace and dispose of in accordance with federal, state, and local regulations.
- Note the correct way to lift heavy objects (secure footing, firm grip, straight back, lift with legs), and get help if needed. Use mechanical lifting devices whenever possible.
- Check the work area to determine what problems or hazards may exist.

3.3.2 Personal Hygiene

- Keep hands away from nose, mouth, and eyes.
- Keep areas of broken skin (e.g., chapped, burned) covered.
- Wash hands with hot water and soap frequently prior to eating and smoking.

3.3.3 Substance Abuse

(Reference CH2M HILL SOP HSE-105, Drug-Free Workplace)

Employees who work under the influence of controlled substances, drugs, or alcohol may prove to be dangerous or otherwise harmful to themselves, other employees, clients, the company, the company's assets and interests, or the public. CH2M HILL does not tolerate illegal drug use, or any use of drugs, controlled substances, or alcohol that impairs an employee's work performance or behavior. Drug and/or alcohol testing is applicable under MR projects performed in the United States. In addition, employees may be required to submit to drug and/or alcohol testing as required by clients. When required, this testing is performed in accordance with SOP *HSE-105, Drug-Free Workplace*. Employees who are enrolled in drug or alcohol testing are required to complete annual training located on the CH2M HILL virtual office.

Prohibitions onsite include:

- Use or possession of intoxicating beverages while performing CH2M HILL work.
- Abuse of prescription or nonprescription drugs.
- Use or possession of illegal drugs or drugs obtained illegally.

- Sale, purchase, or transfer of legal, illegal, or illegally obtained drugs.
- Arrival at work under the influence of legal or illegal drugs or alcohol.

3.3.4 Driving

- Always be aware of surroundings while operating a vehicle. Avoid intellectual stress and worries, talking on a cellular phone, eating, drinking, smoking, reading a map, adjusting controls, or looking at a passenger while driving.
- Use prudent speed limits, assure that backup warning devices are working, be aware of blind spots or other hazards associated with low visibility. Use a spotter if necessary.
- Do not drive while drowsy. Drowsiness can occur at any time, but is most likely after 18 hours or more without sleep.

3.3.5 Shipping and Transportation of Chemical Products

(Reference CH2M HILL's Procedures for Shipping and Transporting Dangerous Goods)

Chemicals brought to the site might be defined as hazardous materials by the United States Department of Transportation. All staff who ship the materials or transport them by road must receive CH2M HILL training in shipping dangerous goods. All hazardous materials that are shipped (e.g., via FedEx) or are transported by road must be properly identified, labeled, packed, and documented by trained staff. Contact the HSM for additional information.

3.3.6 Drilling Safety

- The drill rig is not to be operated in inclement weather.
- The driller is to verify that the rig is properly leveled and stabilized before raising the mast.
- Personnel should be cleared from the sides and rear of the rig before the mast is raised.
- The driller is not to drive the rig with the mast in the raised position.
- The driller must check for overhead power lines before raising the mast. A minimum distance of 15 feet between mast and overhead lines (<50 kilovolts [kV]) is recommended. Increased separation may be required for lines greater than 50 kV.
- Personnel should stand clear before rig startup.
- The driller is to verify that the rig is in neutral when the operator is not at the controls.
- Become familiar with the hazards associated with the drilling method used (e.g., cable tool, air rotary, hollow-stem auger).
- Do not wear loose-fitting clothing, watches, or other accessories that could get caught in moving parts.
- Do not smoke or permit other spark-producing equipment around the drill rig.

- The drill rig must be equipped with a kill wire or switch, and personnel are to be informed of its location.
- Be aware and stand clear of heavy objects that are hoisted overhead.
- The driller is to verify that the rig is properly maintained in accordance with the drilling company's maintenance program.
- The driller is to verify that all machine guards are in place while the rig is in operation.
- The driller is responsible for housekeeping (maintaining a clean work area).
- The drill rig should be equipped with at least one fire extinguisher.
- If the drill rig comes into contact with electrical wires and becomes electrically energized, do not touch any part of the rig or any person in contact with the rig, and stay as far away as possible. Notify emergency personnel immediately

3.3.7 Field Vehicles

- Field vehicles may be personal vehicles, rental vehicles, fleet vehicles, or project vehicles.
- Emergency kits are available for personal and rental vehicles. Fleet vehicles are equipped with emergency supplies. It is a project responsibility to equip all project vehicles with emergency equipment.
- Maintain both a first aid kit and fire extinguisher in the field vehicle at all times.
- Utilize a rotary beacon on vehicle if working adjacent to active roadway.
- Car rental must meet the following requirements:
  - Dual air bags
  - Antilock brakes
  - Be midsize or larger
- Familiarize yourself with rental vehicle features:
  - Mirror adjustments
  - Seat adjustments
  - Cruise control features, if offered
  - Pre-program radio stations
- Always wear seatbelt while operating vehicle.
- Adjust headrest to proper position.
- Tie down loose items if utilizing a van.
- Pull off the road, put the car in park and turn on flashers before talking on a mobile phone.
- Close car doors slowly and carefully. Fingers can get pinched in doors.

- Park vehicle in a location where it can be accessed easily in the event of an emergency. If not possible, carry a phone.
- Have a designated place for storing the field vehicle keys when not in use.

3.3.8 Fire Prevention

- Fire extinguishers shall be provided so that the travel distance from any work area to the nearest extinguisher is less than 100 feet. When 5 gallons or more of a flammable or combustible liquid is being used, an extinguisher must be within 50 feet. Extinguishers must:
  - Be maintained in a fully charged and operable condition
  - Be visually inspected each month
  - Undergo a maintenance check each year
- The area in front of extinguishers must be kept clear.
- Post "Exit" signs over exiting doors, and post "Fire Extinguisher" signs over extinguisher locations.
- Combustible materials stored outside should be at least 10 feet from any building.
- Solvent waste and oily rags must be kept in a fire resistant, covered container until removed from the site.
- Flammable/combustible liquids must be kept in approved containers, and must be stored in an approved storage cabinet.

3.3.9 Knife Use

Knives (fixed/utility) shall not be used. If it is demonstrated that a knife is the right tool for the job, this plan will be amended and the activity that knife use will be used for shall be reviewed. An AHA shall also be developed to address hazards and subsequent controls, personal protective equipment (PPE), and training.

Responsibilities	Supervisors with assistance from the SSC or Senior Unexploded Ordnance Supervisor (SUXOS) are responsible for funding and ensuring the correct tool is being used, employees wear the proper PPE when using knives, and they have reviewed this policy. Employees are responsible for having and utilizing the proper PPE while performing an activity requiring the use of a knife. Employees are also responsible for understanding the proper use of a knife.
Glove Requirements	In general, Kevlar® cut-resistant gloves are to be worn when using a knife in an occupational setting. Other types of gloves may be required and will be identified within the AHA/written procedure. Example - Leather gloves may be worn when using the acetate sleeve cutter.

Training (Refer to the CH2M HILL Virtual Office for additional hand safety topics)	All employees that will use a knife must be trained in the proper use. When using a knife always cut away from yourself. Many tasks using a utility knife require a knife edge but not a sharp point. For these tasks you can add protection against puncture wounds by using a rounded-tip blade. If you use a folding knife, it must be a locking blade type. Never use a knife that will fold under pressure. If you use a fixed-blade knife, make sure there is a handle guard to keep your hand from slipping forward. Also make sure the handle is dry and not greasy or slippery to assure a better grip. When cutting, make the force of the cut carry the blade away from any part of your body. If you have a peculiar situation where this is not possible, protect yourself with a leather apron, or other material placed between you and the blade. Consider putting the material to be cut in a vise or other holding device. If you carry a fixed-blade knife, use a sheath or holder. Store utility knives safely, retract the blade or sheath an open blade before storing. Never leave a knife with the blade exposed on the floor, on a pallet, on a work surface, or in a drawer or cabinet. Keep your knife sharp. A dull blade requires you to use more force to cut, and consequently increases the risk of slip or mistake. Knives used on the job, but not carried with you , must be properly stored when not in use Never use a defective knife. Utility knife blades are brittle and can snap easily. Do not bend them or apply side loads to them by using them to open cans or pry loose objects. Use the knife only to cut. It was not designed to work as a prybar, screw driver, or hole punch. If you do get cut, seek medical attention to treat the injury by notifying your supervisor and contacting Health Resources at 1-866-893-2514.

Examples of preferred tools and Kevlar® cut-resistant gloves:

A safety spring provides for automatic blade "shoot-back" into the handle when contact w/cutting surface is lost

Stay focused on the cutting job. It only takes a second of inattention with a sharp blade to produce a serious cut. Letting the mind wander or talking with others while using a knife greatly increases the risk of an accident and injury. If you are interrupted while working with a knife, stop cutting, retract the blade, and place the knife down on a secure surface before dealing with the interruption. You should never continue cutting while distracted!

As always, utilize the hierarchy of controls and first attempt to engineer out the hazard and frequently ask ourselves do we have the right tool for the job.

3.3.10 Utilities (Underground)

Do not begin subsurface construction activities (e.g., trenching, excavation, drilling) until a check for underground utilities and similar obstructions has been conducted. The use of as-built drawings and utility company searches must be supplemented with a geophysical or other survey by a qualified, independent survey contractor to identify additional and undiscovered buried utilities.

Examples of the type of geophysical technologies include:

- **Ground Penetrating Radar (GPR),** which can detect pipes, including gas pipes, tanks, conduits, cables, etc., both metallic and non-metallic, at depths up to 30 feet depending on equipment. Sensitivity for both minimum object size and maximum depth detectable depends on equipment selected, and soil conditions.
- **Radio Frequency (RF),** involves inducing an RF signal in the pipe or cable and using a receiver to trace it. Some electric and telephone lines emit RF naturally and can be detected without an induced signal. This method requires knowing where the conductive utility can be accessed to induce RF field if necessary.
- **Dual RF**, a modified version of RF detection using multiple frequencies to enhance sensitivity but with similar limitations to RF.
- **Ferromagnetic Detectors**, are metal detectors that will detect ferrous and non-ferrous utilities. Sensitivity is limited, e.g. a 100 millimeter (mm) iron disk to a depth of about one meter or a 25 mm steel paper clip to a depth of about 20 centimeter (cm).
- **Electronic Markers,** are emerging technologies that impart a unique electronic signature to materials such as polyethylene pipe to facilitate location and tracing after installation. Promising for future installations but not of help for most existing utilities already in place.

Procedure

The following procedures shall be used to identify and mark underground utilities during subsurface construction activities on the project:

- The survey contractor shall determine the most appropriate geophysical technique or combinations of techniques to identify the buried utilities on the project, based on the survey contractor's experience and expertise, types of utilities anticipated to be present, and specific site conditions.
- The survey contractor shall employ the same geophysical techniques used on the project to identify the buried utilities, to survey the proposed path of subsurface construction work, and to confirm no buried utilities are present.
- Identify customer specific permit and/or procedural requirements for excavation and drilling activities. For military installations contact the Base Civil Engineer and obtain the appropriate form to begin the clearance process.
- Contact utility companies or the state/regional utility protection service at least 2 working days prior to excavation activities to advise of the proposed work, and ask them to establish the location of the utility underground installations prior to the start of actual excavation.
- Schedule the independent survey.
- Obtain utility clearances for subsurface work on both public and private property.
- Clearances are to be in writing, signed by the party conducting the clearance.

- Underground utility locations must be physically verified by hand digging using wood or fiberglass-handled tools when any adjacent subsurface construction activity (e.g. mechanical drilling, excavating) work is expected to come within 5 feet of the marked underground system. If subsurface construction activity is within 5 feet and parallel to a marked existing utility, the utility location must be exposed and verified by hand digging every 100 feet.
- Protect and preserve the markings of approximate locations of facilities until the markings are no longer required for safe and proper excavations. If the markings of utility locations are destroyed or removed before excavation commences or is completed, the PM must notify the utility company or utility protection service to inform them that the markings have been destroyed.
- Conduct a site briefing for employees regarding the hazards associated with working near the utilities and the means by which the operation will maintain a safe working environment. Detail the method used to isolate the utility and the hazards presented by breaching the isolation.

3.3.11 Utilities (overhead)

Proximity to Power Lines

No work is to be conducted within 50 feet of overhead power lines without first contacting the utility company to determine the voltage of the system. No aspect of any piece of equipment is to be operated within 50 feet of overhead power lines without first making this determination.

Operations adjacent to overhead power lines are PROHIBITED unless one of the following conditions is satisfied:

- Power has been shut off, positive means (such as lockout) have been taken to prevent the lines from being energized, lines have been tested to confirm the outage, and the utility company has provided a signed certification of the outage.
- The minimum clearance from energized overhead lines is as shown in the table below, or the equipment will be repositioned and blocked to ensure that no part, including cables, can come within the minimum clearances shown in the table.

Minimum Distances from Powerlines

Powerlines Nominal System (kV)	Minimum Required Distance (Feet)
0-50	10
51-100	12
101-200	15
201-300	20
301-500	25
501-750	35
751-1000	45

(These distances have been determined to eliminate the potential for arcing based on the line voltage.)

- The power line(s) has been isolated through the use of insulating blankets which have been properly placed by the utility. If insulating blankets are used, the utility will determine the minimum safe operating distance; get this determination in writing with the utility representative's signature.
- All inquiries regarding electric utilities must be made in writing and a written confirmation of the outage/isolation must be received by the PM prior to the start of work.

3.3.12 Visible Lighting

- While work is in progress outside construction areas shall have at least 33 lux.
- Construction work conducted inside buildings should be provided with at least 55 lux light.
- The means of egress shall be illuminated with emergency and non-emergency lighting to provide a minimum 11 lux measured at the floor. Egress illumination shall be arranged so that the failure of any single lighting unit, including the burning out of an electric bulb will not leave any area in total darkness.

3.4 Munitions and Explosives of Concern Hazards and Controls

3.4.1 Munitions and Explosives of Concern

MPPEH has been identified at Site UXO-06. Site UXO-06 was a Former Fortified Beach Assault Area used for military troop training. The area is not associated with an impact area, range, range fan, safety danger zone, or the disposal of military munitions. Munitions ranging from small arms ammunition to practice rockets and grenades have been discovered during previous intrusive investigations in this area. All work will follow the approved Work Plan Addendum which is based on the Explosives Safety Submission (ESS) Amendment.

3.4.2 Munitions with the Greatest Fragmentation Distance

Based on the types of munitions used at Site UXO-06, the primary munition with the greatest fragmentation distance (MGFD) assumed for the site is a 3.5-inch Practice Rocket. In addition, a 3.5-inch high explosives (HE) rocket is included as a contingency MGFD.

3.4.3 Hazard Mitigation

The Explosives Safety Quantity-Distance (ESQD) information for the MGFD is provided in Section 4 of the Work Plan Addendum. If, during the course of this project, a MEC item with a greater fragmentation distance than that of the primary MGFD is encountered, the ESQD arcs will be adjusted to the contingency MGFD distances. In the unlikely case a MEC item with a greater fragmentation distance than the contingency MGFD is encountered, the ESQD arcs will be adjusted and the ESS will be amended.

3.4.4 Types of Explosives to be used Onsite

No explosives will be stored on the project site. If MEC is discovered and demolition is required, all necessary explosives will be provided by an on-call provider and unused explosives will be removed by the on-call provider at the conclusion of demolition activities. Types of explosives that may be supplied by the on-call provide include HE (e.g., booster, detonating cord, shaped charge) and initiating explosives (i.e., detonator assembly).

3.4.5 Explosives Storage, Transportation and Management

Explosives will not be stored onsite. Transportation and management will be in compliance with the Explosives Management Plan (EMP) and the Explosives Siting Plan (ESP) for this project. The ESP and EMP are provided in Section 5 and Section 6 of the Work Plan Addendum, respectively.

3.4.6 MEC Procedures

All field activities will be conducted in accordance with the approved Work Plan Addendum and ESS amendment. In addition to the Work Plan Addendum a copy of the approved ESS Addendum will be onsite during all field activities. All personnel are required to follow these instructions at all times. When a conflict between these documents and working conditions exists, work will stop and consultation with CH2M HILL MR Safety Quality Control (QC) Officer, and the PM will be sought.

3.4.7 MEC Avoidance Procedures

MEC avoidance operations will be required during all field operations except the MEC Intrusive Investigation. The following procedures will be required during sampling operations. Avoidance operations will consist of a team composed of one or more UXO Technicians. A single-person team will consist of a UXO Technician III. Additional personnel will be UXO Technician III or less. Contact with MEC is prohibited. The UXO Team will not destroy any MEC encountered until the sampling team and non MR subcontractors have stopped work. Field operations will not continue until MEC is disposed of as described in the ESS amendment and work plan. All MEC contacts and suspected MEC anomalies will be reported to the site manager who will in turn notify MCB Camp Lejeune personnel in accordance with contractual requirements.

Access routes to sampling locations: Prior to sampling, the UXO Technicians will conduct a reconnaissance of the sampling area. The reconnaissance will include locating the designated sampling or drilling location(s) and insuring that they are free of surface MEC. If surface MEC is detected the point will be relocated as directed. Once the designated point has been cleared, an access route for the sampling crew's vehicles and equipment will be cleared for surface MEC. The access route, at a minimum will be twice the width of the widest vehicle and the boundaries will be clearly marked to prevent personnel from straying into non-cleared areas. If surface MEC is encountered, the UXO Team will mark and report the item and divert the approach path around the MEC.

Soil Sampling Locations: The UXO Technicians will clear the surface area of the work site for soil sampling. The area will be clearly marked, and large enough to accommodate the direct push equipment and provide a work area for the crews. As a minimum, the cleared area will

be a square, with a side dimension equal to twice the length of the largest vehicle or piece of equipment for use onsite. If a pre-selected area indicates magnetic anomalies, a new sampling/drill site will be chosen.

Borehole Sampling: If surface samples are required they will be obtained prior to the start of boring. The borehole procedures will be completed using DPT equipment. Prior to DPT sampling, an UXO Technician will advance a borehole using a hand auger, and check the borehole with a down hole magnetometer a minimum of every one foot, to the deepest sampling depth or a maximum of 5 feet to ensure that smaller items of MEC, undetectable from the surface will be detected. The anticipated depth of potential MEC items is anywhere from near-surface to 2 feet, based on penetration calculations of the types of ammunition previously used on the site.

3.5 Potential Chemical Hazards and Controls

The potential chemical hazards posed by the Focused SI field activities are dermal contact and ingestion of MC-contaminated soil and inhalation of airborne MC particulate. The dermal contact and ingestion hazards posed by MC-contaminated soil will be controlled using personal protective clothing and decontamination procedures with personal hygiene practices. The potential inhalation hazard posed by airborne MEC particulate will be controlled using engineering controls, which consist of applying wet methods during MEC operations when visible dust emissions are observed in the personnel breathing zone. **Table 3-2** presents a list of chemical hazards that may be encountered during site operations.

3.6 Physical Hazards

3.6.1 Temperature Extremes

Each employee is responsible for the following:

- Recognizing the symptoms of heat or cold stress
- Taking appropriate precautionary measures to minimize their risk of exposure to temperature extremes
- Communicating any concerns regarding heat and cold stress to the SSC or SUXOS

Heat Stress

General

Physical fitness influences a person's ability to perform work under heat loads. At a given level of work, the more fit a person is, the less the physiological strain, the lower the heart rate, the lower the body temperature (indicates less retrained body heat—a rise in internal temperature precipitates heat injury), and the more efficient the sweating mechanism.

TABLE 3-2
Contaminants of Concern
(Refer to Project Files for more detailed contaminant information)

Contaminant	Location and Maximum[a] Concentration	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Arsenic	SD: MR06-SD07 (2 mg/kg) SB: MR06-IS54 (5.3 mg/kg) SS: MR06-SS60 (2.3 mg/kg)	0.01 mg/m^3	5 Ca	Ulceration of nasal septum, respiratory irritation, dermatitis, gastrointestinal disturbances, peripheral neuropathy, hyperpigmentation	NA
Cobalt	No exceedances in project area	0.1 mg/m^3	20	Cough, dyspnea (breathing difficulty), wheezing, decreased pulmonary function; weight loss; dermatitis; diffuse nodular fibrosis; respiratory hypersensitivity, asthma	NA
Iron	GW: MR06-TW11 (64,000 µg/L) SW: MR06-SW07 (9,930 µg/L) SS: MR06-SS62 (7,370 mg/kg)	10 mg/m^3	2500	Benign pneumoconiosis with X-ray shadows indistinguishable from fibrotic pneumoconiosis (siderosis)	NA
Manganese	SS: MR06-SS65 (133 mg/kg)	5 mg/m^3	500	Manganism; asthenia, insomnia, mental confusion; metal fume fever: dry throat, cough, chest tightness, dyspnea (breathing difficulty), rales, flu-like fever; low-back pain; vomiting; malaise (vague feeling of discomfort); lassitude (weakness, exhaustion); kidney damage	NA
Thallium	No exceedances in project area	0.1 mg/m^3	15	Nausea, diarrhea, abdominal pain, vomiting; ptosis, strabismus; peri neuritis, tremor; retrosternal (occurring behind the sternum) tightness, chest pain, pulmonary edema; convulsions, chorea, psychosis; liver, kidney damage; alopecia; paresthesia legs	NA

Footnotes:
[a] Specify sample-designation and media: SB (Soil Boring), A (Air), D (Drums), GW (Groundwater), L (Lagoon), TK (Tank), S (Surface Soil), SL (Sludge), SW (Surface Water).
[b] Appropriate value of Possible Exposure Limit (PEL), Recommended Exposure Limit (REL), or Threshold limit Value (TLV) listed.
[c] IDLH = immediately dangerous to life and health (units are the same as specified “Exposure Limit” units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen.
[d] PIP = photoionization potential; mg/kg = milligrams per kilogram; NA = Not applicable; UK = Unknown. NR = Not Regulated
UK
Potential Routes of Exposure
Dermal: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 6.

Acclimatization is the degree to which a worker's body has physiologically adjusted or acclimatized to working under hot conditions. Acclimatization affects their ability to do work. Acclimatized individuals sweat sooner and more profusely than unacclimatized individuals. Acclimatization occurs gradually over 1 to 2 weeks of continuous exposure, but it can be lost in as little as 3 days in a cooler environment.

Dehydration reduces body water volume. This reduces the body's sweating capacity and directly affects its ability to dissipate excess heat.

The ability of a body to dissipate heat depends on the ratio of its surface area to its mass (surface area/weight). **Heat dissipation** is a function of surface area, while heat production depends on body mass. Therefore, overweight individuals (those with a low ratio) are more susceptible to heat-related illnesses because they produce more heat per unit of surface area than if they were thinner. Monitor these persons carefully if heat stress is likely.

When wearing **impermeable clothing**, the weight of an individual is not as important in determining the ability to dissipate excess heat because the primary heat dissipation mechanism, evaporation of sweat, is ineffective.

Symptoms and Treatment of Heat Stress

	Heat Syncope	Heat Rash	Heat Cramps	Heat Exhaustion	Heat Stroke
Signs and Symptoms	Sluggishness or fainting while standing erect or immobile in heat.	Profuse tiny raised red blister-like vesicles on affected areas, along with prickling sensations during heat exposure.	Painful spasms in muscles used during work (arms, legs, or abdomen); onset during or after work hours.	Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or flushed; may faint on standing; rapid thready pulse and low blood pressure; oral temperature normal or low	Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature.
Treatment	Remove to cooler area. Rest lying down. Increase fluid intake. Recovery usually is prompt and complete.	Use mild drying lotions and powders, and keep skin clean for drying skin and preventing infection.	Remove to cooler area. Rest lying down. Increase fluid intake.	Remove to cooler area. Rest lying down, with head in low position. Administer fluids by mouth. Seek medical attention.	Cool rapidly by soaking in cool–but not cold–water. Call ambulance, and get medical attention immediately!

Precautions

- Drink 16 ounces of water before beginning work. Disposable cups and water maintained at 50 degrees Fahrenheit (°F) to 60°F should be available. Under severe conditions, drink 1 to 2 cups every 20 minutes, for a total of 1 to 2 gallons per day. Do not use alcohol in place of water or other nonalcoholic fluids. Decrease your intake of coffee and caffeinated soft drinks during working hours.
- Acclimate yourself by slowly increasing workloads (e.g., do not begin with extremely demanding activities).

- Use cooling devices, such as cooling vests, to aid natural body ventilation. These devices add weight, so their use should be balanced against efficiency.
- Use mobile showers or hose-down facilities to reduce body temperature and cool protective clothing.
- Conduct field activities in the early morning or evening and rotate shifts of workers, if possible.
- Avoid direct sun whenever possible, which can decrease physical efficiency and increase the probability of heat stress. Take regular breaks in a cool, shaded area. Use a wide-brim hat or an umbrella when working under direct sun for extended periods.
- Provide adequate shelter/shade to protect personnel against radiant heat (sun, flames, hot metal).
- Maintain good hygiene standards by frequently changing clothing and showering.
- Observe one another for signs of heat stress. Persons who experience signs of heat syncope, heat rash, or heat cramps should consult the SSC or UXOSO to avoid progression of heat-related illness.

Thermal Stress Monitoring

The following procedures should be considered when the ambient air temperature exceeds 70°F, the relative humidity is high (greater than 50 percent), or when the workers exhibit symptoms of heat stress.

- The heart rate should be measured by the radial pulse for 30 seconds, as early as possible in the resting period.
- The heart rate at the beginning of the rest period should not exceed 110 beats per minute (bpm), or 20 beats per minute above resting pulse.
- If the heart rate is higher, the next work period should be shortened by 33 percent, while the length of the rest period stays the same.
- If the pulse rate still exceeds 110 bpm at the beginning of the next rest period, the following work cycle should be further shortened by 33 percent.
- Continue this procedure until the rate is maintained below 110 bpm, or 20 bpm above resting pulse.
- Alternately, the oral temperature can be measured before the workers have something to drink.
- If the oral temperature exceeds 99.6°F at the beginning of the rest period, the following work cycle should be shortened by 33 percent.
- Continue this procedure until the oral temperature is maintained below 99.6°F. While an accurate indication of heat stress, oral temperature is difficult to measure in the field.

Cold

General

- Low ambient temperatures increase the heat lost from the body to the environment by radiation and convection. In cases where the worker is standing on frozen ground, the heat loss is also due to conduction.
- Wet skin and clothing, whether because of water or perspiration, may conduct heat away from the body through evaporative heat loss and conduction. Thus, the body cools suddenly when chemical protective clothing is removed if the clothing underneath is perspiration soaked.
- Movement of air across the skin reduces the insulating layer of still air just at the skin's surface. Reducing this insulating layer of air increases heat loss by convection.
- Non-insulating materials in contact or near-contact with the skin, such as boots constructed with a metal toe or shank, conduct heat rapidly away from the body.
- Certain common drugs, such as alcohol, caffeine, or nicotine, may exacerbate the effects of cold, especially on the extremities. These chemicals reduce the blood flow to peripheral parts of the body, which are already high-risk areas because of their large surface area to volume ratios. These substances may also aggravate an already hypothermic condition.

Precautions

- Be aware of the symptoms of cold-related disorders, and wear proper, layered clothing for the anticipated fieldwork. Appropriate rain gear is a must in wet weather.
- Consider monitoring the work conditions and adjusting the work schedule using guidelines developed by the U.S. Army (wind-chill index) and the National Safety Council.
- Wind-chill index (below) is used to estimate the combined effect of wind and low air temperatures on exposed skin. The wind-chill index does not take into account the body part that is exposed, the level of activity, or the amount or type of clothing worn. For those reasons, it should only be used as a guideline to warn workers when they are in a situation that can cause cold-related illnesses.
- *National Safety Council Guidelines for Work and Warm-Up Schedules* can be used with the wind-chill index to estimate work and warm-up schedules for fieldwork. The guidelines are not absolute; workers should be monitored for symptoms of cold-related illnesses. If symptoms are not observed, the work duration can be increased.
- Persons who experience initial signs of immersion foot, frostbite, and/or hypothermia should report it immediately to the SSC or SUXOS to avoid progression of cold-related illness.
- Observe one another for initial signs of cold-related disorders.
- Obtain and review weather forecast—be aware of predicted weather systems along with sudden drops in temperature, increase in winds, and precipitation.

Symptoms and Treatment of Cold Stress

	Immersion (Trench) Foot	Frostbite	Hypothermia
Signs and Symptoms	Feet discolored and painful; infection and swelling present.	Blanched, white, waxy skin, but tissue resilient; tissue cold and pale.	Shivering, apathy, sleepiness; rapid drop in body temperature; glassy stare; slow pulse; slow respiration.
Treatment	Seek medical treatment immediately.	Remove victim to a warm place. Re-warm area quickly in warm–but not hot–water. Have victim drink warm fluids, but not coffee or alcohol. Do not break blisters. Elevate the injured area, and get medical attention.	Remove victim to a warm place. Have victim drink warm fluids, but not coffee or alcohol. Get medical attention.

3.6.2 Ultraviolet Radiation (Sun Exposure)

Health effects regarding ultraviolet (UV) radiation are confined to the skin and eyes. Overexposure can result in many skin conditions, including erythema (redness or sunburn), photoallergy (skin rash), phototoxicity (extreme sunburn acquired during short exposures to UV radiation while on certain medications), premature skin aging, and numerous types of skin cancer.

Acute overexposure of UV radiation to the eyes may lead to photokeratitis (inflammation of the cornea), also known as snow blindness. Symptoms include redness of the eyes and a gritty feeling, which progresses to pain and an inability to tolerate any kind of light. This condition can also occur when working in or around water and other UV radiation reflectors. In addition, long-term exposure to sunlight is thought to cause cataracts or clouding of the lens of the eye.

Limit Exposure Time

- Rotate staff so the same personnel are not exposed all of the time.
- Limit exposure time when UV radiation is at peak levels (approximately 2 hours before and after the sun is at its highest point in the sky).
- Avoid exposure to the sun, or take extra precautions when the UV index rating is high.

Provide Shade

- Take lunch and breaks in shaded areas.
- Create shade or shelter through the use of umbrellas, tents, and canopies.
- Fabrics such as canvas, sailcloth, awning material and synthetic shade cloth create good UV radiation protection.
- Check the UV protection of the materials before buying them. Seek protection levels of 95 percent or greater, and check the protection levels for different colors.

Clothing

- Reduce UV radiation damage by wearing proper clothing; for example, long sleeved shirts with collars, and long pants. The fabric should be closely woven and should not let light through.
- Head protection should be worn to protect the face, ears, and neck. Wide-brimmed hats with a neck flap or "Foreign Legion" style caps offer added protection.
- Wear UV-protective sunglasses or safety glasses. These should fit closely to the face. Wrap-around style glasses provide the best protection.

Sunscreen

- Apply sunscreen generously to all exposed skin surfaces at least 20 minutes before exposure, allowing time for it to adhere to the skin.
- Re-apply sunscreen at least every 2 hours, and more frequently when sweating or performing activities where sunscreen may be wiped off.
- Choose a sunscreen with a high sun protection factor. Most dermatologists advocate sun protection factor 30 or higher for significant sun exposure.
- Waterproof sunscreens should be selected for use in or near water, and by those who perspire sufficiently to wash off non-waterproof products.
- Check for expiration dates, because most sunscreens are only good for about 3 years. Store in a cool place out of the sun.
- Remember—no sunscreen provides 100 percent protection against UV radiation. Other precautions must be taken to avoid overexposure.

3.6.3 Noise

(Reference CH2M HILL SOP HSE-108, Hearing Conservation)

- A noise assessment shall be conducted by the HSM or designee based on potential to emit noise above 85 dBA.
- Areas or equipment emitting noise at or above 90 dBA shall be evaluated to determine feasible engineering controls. When engineering controls are not feasible, administrative controls can be developed and appropriate hearing protection will be provided.
- Areas or equipment emitting noise levels at or above 85 dBA, hearing protection must be worn.
- Employees exposed to 84 dBA or a noise dose of 50 percent must participate in the Hearing Conservation program including initial and annual (as required) audiograms.
- The HSM will evaluate appropriate controls measures and work practices for employees who have experienced a standard threshold shift in their hearing.
- Hearing protection is selected based upon noise levels and specific tasks to be performed.

- Employees are trained in the hazards of noise and how to properly wear and maintain their hearing protection.
- Hearing protection will be maintained in a clean and reliable condition, inspected prior to use and after any occurrence to identify any deterioration or damage, and damaged or deteriorated hearing protection repaired or discarded.
- In work areas where actual or potential high noise levels are present at any time, hearing protection must be worn by employees working or walking through the area.
- Areas where tasks requiring hearing protection are taking place may become hearing protection required areas as long as that specific task is taking place.
- High noise areas requiring hearing protection should be posted or employees must be informed of the requirements in an equivalent manner.

3.7 Ionizing Radiation

There are no identified sources or potential sources of ionizing radiation on the project site.

3.8 Biological Hazards and Controls

3.8.1 Bees and Other Stinging Insects

Bees and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic. Watch for and avoid nests. Keep exposed skin to a minimum. Carry a kit if you have had allergic reactions in the past, and inform your supervisor and/or buddy. If a stinger is present, remove it carefully with tweezers. Wash and disinfect the wound, cover it, and apply ice. Watch for allergic reaction; contact the occupational nurse at 1-866-893-2514 immediately if a reaction develops or 911 if the reaction is severe.

3.8.2 Bloodborne Pathogens

(Reference CH2M HILL SOP HSE-202, Bloodborne Pathogens)

Exposure to bloodborne pathogens may occur when rendering first aid or CPR, or when coming into contact with landfill waste or waste streams containing potentially infectious material (PIM).

- Employees trained in first-aid/cardiopulmonary resuscitation (CPR) or those exposed to PIM must complete CH2M HILL's 1-hour bloodborne computer-based training module annually.
- Hepatitis B vaccine is offered to employees who may be exposed to PIM when they complete training and within 10 working days of assignment. (Note: Employees whose exposure stems only from rendering first aid as a collateral duty receives the vaccine after exposure.)

- Employees who decline the Hepatitis B vaccine must sign the declination form (contact regional Safety Program Assistant) indicating they declined the vaccination. Anyone who declines the vaccination and chooses to receive the vaccination at a later time may still receive the vaccination by contacting the Safety Program Assistant.
- Hepatitis B and tetanus vaccinations can be requested by completing the medical portion of the enrollment form, located under Tools & Forms at the Health, Safety, Security, and Environment web page, or by contacting the regional Safety Program Assistant.

Work Controls

- Observe universal precautions to prevent contact with blood or other PIMs. Where differentiation between body fluid types is difficult or impossible, consider all body fluids to be PIMs.
- Consider all sharps encountered at industrial, medical, dental, or biological waste facilities or sampling locations to be contaminated and PIMs.
- Always wash your hands and face with soap and running water after contacting PIMs. If washing facilities are unavailable, use an antiseptic cleanser with clean paper towels or moist towelettes. These must be provided for employees who have been exposed to PIMs. When antiseptic cleansers or towelettes are used, always rewash your hands and face with soap and running water as soon as available. Do not consume food or beverages until after thoroughly washing your hands and face.
- Decontaminate all potentially contaminated equipment and environmental surfaces with chlorine bleach as soon as possible. Clean and decontaminate on a regular basis (and immediately upon visible contamination) all bins, pails, cans, and other receptacles intended for reuse that have the potential for becoming contaminated.
- Use one part chlorine bleach (5.25 percent sodium hypochlorite solution) diluted with 10 parts water for decontaminating equipment or surfaces after initially removing blood or other PIMs. Remove contaminated PPE as soon as possible before leaving a work area.
- Place regulated waste in containers that are closable; are constructed to contain all contents and prevent leakage of fluids during handling, storage, transport or shipping; are labeled with a Biological warning label or color-coded; and are tightly closed prior to removal to prevent spillage or protrusion of contents during handling, storage, transport, or shipping.
- Employees who participate in waste characterization studies, sort or sample refuse, or contact medical, dental, or biological waste streams should follow these procedures:
- If exposure is anticipated, this group of employees should wear safety goggles or glasses, puncture-resistant utility gloves with inner latex glove liners, Tyvek® coveralls or cotton coveralls with a rubber apron, and puncture-resistant shoes or boots.

- If splash potential is present, employees should wear a full-face shield.
- If a respiratory hazard is present, a full-face respirator with high-efficiency particulate air (HEPA) filters should be worn.

Post Exposure

CH2M HILL will provide exposed employees with a confidential medical examination should an exposure to PIM occur. This examination includes the following procedures:

- Documenting the exposure
- Testing the exposed employee's and the source individual's blood (with consent)
- Administering post-exposure prophylaxis

3.8.3 Mosquito Bites

Due to the recent detection of the West Nile Virus in the Southwestern United States it is recommended that **preventative measures** be taken to reduce the probability of being bitten by mosquitoes whenever possible. Mosquitoes are believed to be the primary source for exposure to the West Nile Virus as well as several other types of encephalitis. The following guidelines should be followed to reduce the risk of these concerns for working in areas where mosquitoes are prevalent.

- Stay indoors at dawn, dusk, and in the early evening.
- Wear long-sleeved shirts and long pants whenever you are outdoors.
- Spray clothing with repellents containing permethrin or N,N-diethyl-meta-toluamide (DEET) since mosquitoes may bite through thin clothing.
- Apply insect repellent sparingly to exposed skin. An effective repellent will contain 35 percent DEET. Repellents may irritate the eyes and mouth, so avoid applying repellent to the hands.
- Whenever you use an insecticide or insect repellent, be sure to read and follow the manufacturer's directions for use, as printed on the product.
- Note: Vitamin B and "ultrasonic" devices are NOT effective in preventing mosquito bites.

Symptoms of Exposure to the West Nile Virus

Most infections are mild, and symptoms include fever, headache, and body aches, occasionally with skin rash and swollen lymph glands. More severe infection may be marked by headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, paralysis, and, rarely, death.

The West Nile Virus incubation period is from 3 to 15 days.

Contact the program HSM with questions, and immediately report any suspicious symptoms to the SUXOS, SSC, PM, and the occupational nurse at 1-866-893-2514.

3.8.4 Poison Ivy, Poison Oak, and Poison Sumac

Poison ivy, poison oak, and poison sumac typically are found in brush or wooded areas. They are more commonly found in moist areas or along the edges of wooded areas. Shrubs are usually 12 to 30 inches high, or can also be a tree-climbing vine, with triple leaflets and short, smooth hair underneath. Plants are red and dark green in spring and summer, with yellowing leaves anytime especially in dry areas. Leaves may achieve bright reds in fall, but plants lose its (yellowed, then brown) leaves in winter, leaving toxic stems. All parts of the plant remain toxic throughout the seasons. These plants contain urushiol, a colorless or pale yellow oil that oozes from any cut or crushed part of the plant, including the roots, stems and leaves and causes allergic skin reactions when contacted. The oil is active year round.

Become familiar with the identity of these plants (see below). Wear protective clothing that covers exposed skin and clothes. Avoid contact with plants and the outside of protective clothing. If skin contacts a plant, wash the area with soap and water immediately. If the reaction is severe or worsens, seek medical attention.

Poison Ivy

Poison Sumac

Poison Oak

Contamination with poison ivy, sumac or oak can happen through several pathways, including:

- Direct skin contact with any part of the plant (even roots once above ground foliage has been removed).
- Contact with clothing that has been contaminated with the oil.
- Contact from removing shoes that have been contaminated (shoes are coated with urushiol oil).
- Sitting in a vehicle that has become contaminated.
- Contact with any objects or tools that have become contaminated.
- Inhalation of particles generated by weed whacking, chipping, vegetation clearing.

If you must work on a site with poison ivy, sumac or oak the following precautions are necessary:

- Do not drive vehicles onto the site where it will come into contact with poison ivy, sumac, or oak. Vehicles which need to work in the area, such as drill rigs or heavy equipment must be washed as soon as possible after leaving the site.
- All tools used in the poison ivy, sumac or oak area, including those used to cut back poison oak, surveying instruments used in the area, air monitoring equipment or other test apparatus must be decontaminated before they are placed back into the site vehicle. If onsite decontamination is not possible, use plastic to wrap any tools or equipment until they can be decontaminated.
- PPE, including Tyvek® coveralls, gloves, and boot covers must be worn. PPE must be placed into plastic bags and sealed if they are not disposed immediately into a trash receptacle.
- As soon as possible following the work, shower to remove any potential contamination. Any body part with suspected or actual exposure should be washed with Tecnu® or other product designed for removing urushiol. If you do not have Tecnu® wash with cold water. Do not take a bath, as the oils can form and invisible film on top of the water and contaminate your entire body upon exiting the bath.
- Tecnu® may also be used to decontaminate equipment.
- Use IvyBlock® or similar products to prevent poison oak, ivy and sumac contamination. Check with the closest CH2M HILL warehouse to see if these products are available. Follow all directions for application.

If you do come into contact with one of these poisonous plants and a reaction develops, contact the SUXOS, SSC, PM, and the occupational nurse 1-866-893-2514.

3.8.5 Snakes

Snakes typically are found in underbrush and tall grassy areas. If you encounter a snake, stay calm and look around; there may be other snakes. Turn around and walk away on the same path you used to approach the area. If a person is bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Call the occupational nurse at 1-866-893-2514 immediately. **DO NOT** apply ice, cut the wound, or apply a tourniquet. Try to identify the type of snake: note color, size, patterns, and markings.

3.8.6 Spiders—Brown Recluse

It is regarded by many as the most dangerous spider in the United States. Because of interstate shipping/transportation, the Brown Recluse spider can be found most anywhere in the United States. Brown Recluse Spiders are usually 1 inch or larger in size, including the legs and can grow as large as 3 inches. Young Brown Recluse spiders are smaller. Brown recluse spider bites do

not always hurt right away. In fact, you may not know that you have been bitten until other symptoms appear. Symptoms of a brown recluse spider bite may include the following:

- Reddened skin followed by a blister that forms at the bite site.
- Mild to intense pain and itching for 2 to 8 hours following the bite.
- An open sore with a breakdown of tissue (necrosis) that develops within a few hours to 3 to 4 days following the bite and the area may become painful, itchy, hot, swollen, red and tender. An irregular ulcerous sore, caused by necrosis, will often appear that is from one-quarter to 10 inches in diameter. Prompt attention is the best defense against preventing the necrosis. The wound is often described as being reddish and surrounded by a bluish area with a narrow whitish separation in between the red and the blue. This gives it the famous "bull's eye" pattern. In just hours, a bite from the highly venomous Brown Recluse spider can create blisters and cause tissue damage.

Some people have a severe, systemic (whole-body) reaction to brown recluse spider bites, including the rapid destruction of red blood cells and anemia. Signs and symptoms include:

- Fever and chills.
- Skin rash all over the body with many tiny, flat purple and red spots.
- Nausea or vomiting.
- Joint pain.

If you think you have been bitten by a brown recluse spider:

- Remain calm. Too much excitement or movement will increase the flow of venom into the blood.
- Try to collect the spider, without being bitten, (even a mangled specimen has diagnostic value), if possible, for positive identification by a spider expert. A plastic bag, small jar, or pill vial is useful and no preservative is necessary, but rubbing alcohol helps to preserve the spider.
- Apply a cool, wet cloth to the bite or cover the bite with a cloth and apply an ice bag to the bite.
- Do not apply a tourniquet. It may cause more harm than benefit.
- Try to positively identify the spider to confirm its type.
- Seek prompt medical attention.

A brown recluse spider bite can be serious and will likely require immediate medical care. Seek medical attention if you believe you have been bitten by a brown recluse spider, especially if severe symptoms develop throughout your body or an open sore and necrosis develop. A brown recluse spider bite is diagnosed through a physical examination and questions about the bite. You should be prepared to describe the spider, where and when the bite took place, and what you were doing at the time. Your health professional will ask what your main symptoms are, when they began, and how they have developed, progressed, or changed since the bite.

3.8.7 Widow Spiders

The Northern Black Widow spider may be encountered in Northern Regions of the United States. Other similar widow spiders are the Red Widow and the Brown Widow. Female widow spiders range from 8 to 15 mm in body length; males are smaller, sometimes very small (2 mm). Most have globose, shiny abdomens that are predominantly black with red markings (although some may be pale and/or have lateral stripes), with moderately long, slender legs. These spiders are nocturnal and build a three-dimensional tangled web, often with a conical tent of dense silk in a corner where the spider hides during the day. In nature, most species are found under rocks and logs, but they readily adapt to human-altered environments, where they are most commonly found in outbuildings (e.g., sheds, barns, privies), water meter holes, nursery cans, and under any item or structure (e.g., barbeque grill, slide, sand box) that has been undisturbed for a lengthy period. Formerly, most bites by black widows (almost all by female spiders) occurred in outhouses, but presently, widow bites occur most frequently when the spider is trapped against human skin, either by reaching under objects where the spider is hiding or when putting on clothing, gloves, or shoes containing the spider. Widow spiders are generally very timid and only bite in self-defense when they accidentally contact humans.

Black Widow

Red Widow

Brown Widow

Bite symptoms are systemic, spreading through the lymphatic system, and usually start about 1 to 3 hours after the bite. The most common symptoms are intense pain, rigid abdominal muscles, muscle cramping, malaise, local sweating, nausea, vomiting, and hypertension. Other symptoms may includetremors, labored breathing, restlessness, increased blood pressure, and fever. If left untreated, widow bite symptoms usually last 3 to 5 days.

If bitten, remain calm, and immediately seek medical attention (contact your physician, hospital and/or poison control center). Apply an ice pack directly to the bite area to relieve swelling and pain. Try to collect the spider, without being bitten, (even a mangled specimen has diagnostic value), if possible, for positive identification by a spider expert. A plastic bag, small jar, or pill vial is useful and no preservative is necessary, but rubbing alcohol helps to preserve the spider. A hospital stay may be recommended, particularly for those with a heart condition or with health problems. A physician may administer a specific antivenin to counteract the venom or calcium gluconate to relieve pain. Calcium gluconate and/or antivenin may be administered to relieve or counteract symptoms.

3.8.8 Scorpions

Basic Information

Only a very small number of the over 1050 known species are dangerous to humans. Most produce a bee-sting like reaction in humans. It is very painful, but not life-threatening. Scorpions are part of the natural environment. Most in the United States are not dangerously harmful; however, it is also important to remember that even a nearly nontoxic species can cause death if the victim has a severe allergic reaction to the venom.

Symptoms

Some components in scorpion venom appear to have no other function than to cause localized pain or discomfort in the victim. In vertebrates, the systemic effects observed after scorpion envenomation are probably the result of the release of massive quantities of catecholamines from the victim's adrenal glands. The scorpion's venom, therefore, is not directly responsible for the severe manifestations we see in some cases. Instead, the neurotoxins induce the victim's own chemical communication system to destroy the victim's homeostatic functions.

Scorpions not considered of any medical importance (typical Southern California Species) normally have venoms that are of low toxicity. These scorpions normally produce a localized reaction similar to that a honeybee sting. They would have to be several feet long before they could produce and inject enough venom into a person to kill them.

The presence of pre-existing medical conditions such as pneumonia, hypertension, and certain heart ailments can turn otherwise normal systemic reactions into life threatening situations. Persons with such conditions are at greater risk of severe envenomation than are healthy persons. Some people are allergic to scorpion venom in the same way that some are allergic to honey bee venom. In such cases, very severe effects, including death, can occur very rapidly and are not related to the toxicity of the venom. Deaths due to envenomation by non-medically important species are usually the result of allergy induced anaphylactic shock.

Envenomations are usually categorized into two or three levels of severity: 1) localized effects, 2) systemic effects, and 3) systemic effects with central nervous system involvement. Localized effects are common to nearly all scorpion stings regardless of the toxicity of the venom. These symptoms are restricted to the site of sting and include intense pain, minor swelling, redness or induration, numbness, tenderness, and tingling. Intense pain normally subsides within one hour, giving way to numbness, tenderness, and tingling at the site of the sting. This normally results in the favoring of an affected limb. These symptoms normally fade after 24 hours.

If you are stung by a scorpion, call the occupational nurse 1-866-893-2514 and try to note the description of the scorpion

Prevention

When entering an area that has the potential to contain scorpions, the following PPE is recommended: long pants, long sleeved shirts with collars, hard hat with brim, leather work gloves and leather work boots. Reaching into enclosures or recesses without prior visual inspection is not recommended. Thoroughly inspect each area before accessing.

3.8.9 Ticks

Every year employees are exposed to tick bites at work and at home putting them at risk of illness. Ticks typically are in wooded areas, bushes, tall grass, and brush. Ticks are black, black and red, or brown and can be up to one-quarter inch in size.

In some geographic areas exposure is not easily avoided. Wear tightly woven light-colored clothing with long sleeves and pant legs tucked into boots; spray **only outside** of clothing with permethrin or permanone and spray skin with only DEET; and check yourself frequently for ticks.

Where site conditions warrant (vegetation above knee height, tick endemic area) or when tasks warrant (e.g., having to sit/kneel in vegetation) that diminish the effectiveness of the other controls mentioned above, bug-out suits or Tyvek® shall be used. Bug-out suits are more breathable than Tyvek®.

Take precautions to avoid exposure by including pre-planning measures for biological hazards prior to starting field work. Obtain preventative equipment such as repellants, protective clothing and tick removal kits. Use the buddy system and perform tick inspections prior to entering the field vehicle. If ticks were not planned to be encountered and are observed, do not continue field work until these controls can be implemented.

See Tick Fact Sheet, **Attachment 5**, attached to this SSHP for further precautions and controls to implement when ticks are present. Information includes the procedure for submitting a removed tick for testing.

Be aware of the symptoms of Lyme disease or Rocky Mountain spotted fever (RMSF).

- **Lyme—**A rash might appear that looks like a bullseye with a small welt in the center.
- **RMSF—**A rash of red spots under the skin 3 to 10 days after the tick bite.

In both RMSF and Lyme disease, chills, fever, headache, fatigue, stiff neck, and bone pain may develop. If symptoms appear, again contact the occupational nurse at 1-866-893-2514. For more detailed information go to H&S website or contact the program HSM.

SECTION 4

Staff Organization, Qualifications and Responsibilities

4.1 Client

Client Contact
Bryan Beck
NAVFAC Mid-Atlantic
Code: OPCEV
6506 Hampton Blvd
Norfolk, Virginia 23508-1278
Direct: (757) 322-4734
Fax: (757) 322-4805
bryan.k.beck@navy.mil

Base Contact
Robert Lowder
Camp Lejeune – EMD
Building 12
MCB Camp Lejeune, NC 28542-0004
Direct (910) 451-9607
Fax: (910) 451-5997
robert.a.lowder@usmc.mil

4.2 CH2M HILL

- Program Manager: Doug Dronfield
- PM: Keri Hallberg
- Program HSM: Michael Goldman
- Corporate MR Safety and QC Officer: Dan Young
- SUXOS: To Be Determined (TBD)
- SSC: Clif White

The PM is responsible for providing adequate resources (budget and staff) for project-specific implementation of the HSSE management process. The PM has overall management responsibility for the tasks listed below. The PM may explicitly delegate specific tasks to other staff, as described in sections that follow, but retains ultimate responsibility for completion of the following in accordance with this SOP:

- Include standard terms and conditions, and contract-specific health, safety, security, and environmental (HSSE) roles and responsibilities in contract and subcontract agreements (including flow-down requirements to lower-tier subcontractors).

- Select safe and competent subcontractors by:
  - Obtaining, reviewing and accepting or rejecting subcontractor pre-qualification questionnaires.
  - Ensuring that acceptable certificates of insurance, including CH2M HILL as named additional insured, are secured as a condition of subcontract award.
  - Including HSSE submittals checklist in subcontract agreements, and ensuring that appropriate site-specific safety procedures, training and medical monitoring records are reviewed and accepted prior to the start of subcontractor's field operations.
- Maintain copies of subcontracts and subcontractor certificates of insurance (including CH2M HILL as named additional insured), bond, contractor's license, training and medical monitoring records, and site-specific safety procedures in the project file accessible to site personnel.
- Provide oversight of subcontractor HSSE practices per the site-specific safety plan.
- Manage the site and interfacing with third parties in a manner consistent with our contract and subcontract agreements and the applicable standard of reasonable care.
- Ensure that the overall, job-specific, HSSE goals are fully and continuously implemented.

The Program HSM is responsible for:

- Review and accept or reject subcontractor pre-qualification questionnaires that fall outside the performance range delegated to the Contracts Administrator (KA).
- Review and accept or reject subcontractor training records and site-specific safety procedures prior to start of subcontractor's field operations.
- Support the oversight of subcontractor (and lower-tier subcontractors) HSSE practices and interfaces with onsite third parties per the site-specific safety plan.

The SSC is responsible for verifying that the project is conducted in a safe manner including the following specific obligations:

- Verify this SSHP is current and amended when project activities or conditions change.
- Verify CH2M HILL site personnel and subcontractor personnel read the SSHP and sign **Attachment 1**, *Employee Sign-Off Form,* prior to commencing field activities.
- Verify CH2M HILL site personnel and subcontractor personnel have completed any required specialty training.
- Verify compliance with the requirements of this SSHP and applicable subcontractor SSHP(s).
- Act as the project "Hazard Communication Coordinator" and perform the responsibilities outlined in the SSHP.

- Act as the project "Emergency Response Coordinator" and perform the responsibilities outlined in the SSHP
- Post Occupational Safety and Health Administration (OSHA) job-site poster; the poster is required at sites where project field offices, trailers, or equipment-storage boxes are established.
- Verify that safety meetings are conducted and documented in the project file initially and as needed throughout the course of the project (e.g., as tasks or hazards change).
- Verify that project HSSE forms and permits are being used as outlined in the SSHP.
- Perform oversight and/or assessments of subcontractor HSSE practices per the SSHP and verify that project activity self-assessment checklists, **Attachment 6**, are being used as outlined in the SSHP.
- Verify that project files available to site personnel include copies of executed subcontracts and subcontractor certificates of insurance (including CH2M HILL as named additional insured), bond, contractors license, training and medical monitoring records, and site-specific safety procedures prior to start of subcontractor's field operations.
- Manage the site and interfacing with third parties in a manner consistent with our contract/subcontract agreements and the applicable standard of reasonable care.
- Coordinate with the Program HSM regarding CH2M HILL and subcontractor operational performance, and 3rd party interfaces.
- Ensure that the overall, job-specific, HSSE goals are fully and continuously implemented.

The training required for the SSC is as follows:

- SSC-Initial and SSC-Construction
- First Aid and CPR
- Relevant Competent Person Courses (e.g., excavation, confined space, scaffold, fall protection).

The SSC is responsible for contacting the SUXOS and PM. In general, the PM will contact the client. The HSM should be contacted as appropriate.

4.2.1 CH2M HILL Subcontractors

(Reference CH2M HILL SOP HSE-215, Contracts and Subcontracts)

- Surveying Subcontractor: Lanier Surveying
- Subcontractor Contact Name: Brent Lanier
- Telephone: 910-340-6868

- Vegetation clearance subcontractor: East Coast Land Improvement
- Subcontractor Contact Name: Dwight Lanier

- Telephone: 910-325-9086

- DGM subcontractor: NAVEA
- Subcontractor Contact Name: Karen Lemley
- Telephone: 910-325-9086

- Utility location subcontractor: Accumark
- Subcontractor Contact Name: Craig Martin
- Telephone: 804-550-7740

The subcontractors listed above are required to submit their own SSHP. Other plans, such as Lead or Asbestos Abatement Compliance plans may be required as well. Subcontractors are responsible for the HSSE procedures specific to their work, and are required to submit their plans to CH2M HILL for review before the start of field work.

CH2M HILL should continuously endeavor to observe subcontractors' safety performance and adherence to their Accident Prevention Plan and AHAs. This endeavor should be reasonable, and include observing for hazards or unsafe practices that are both readily observable and occur in common work areas. CH2M HILL is not responsible for exhaustive observation for hazards and unsafe practices. Self-assessment checklists contained in **Attachment 6** are to be used by CH2M HILL personnel to review subcontractor performance. CH2M HILL oversight does not relieve subcontractors of their responsibility for effective implementation and compliance with the established plan(s).

HSSE related communications with CH2M HILL subcontractors should be conducted as follows:

- Brief subcontractors on the provisions of this plan, and require them to sign the Employee Signoff Form included in **Attachment 1**.

- Request subcontractor(s) to brief project team on the hazards and precautions related to their work.

- When apparent non-compliance/unsafe conditions or practices are observed, notify the subcontractor safety representative and require corrective action – the subcontractor is responsible for determining and implementing necessary controls and corrective actions.

- When repeat non-compliance/unsafe conditions are observed, notify the subcontractor safety representative and stop affected work until adequate corrective measures are implemented.

- When an apparent imminent danger exists, immediately remove all affected CH2M HILL employees and subcontractors, notify subcontractor safety representative, and stop affected work until adequate corrective measures are implemented. Notify the PM and HSM as appropriate.

- Document all oral HSSE related communications in project field logbook, daily reports, or other records.

4.3 UXO Safety Officer

- Name: TBD
- Company/Office: TBD
- Cellular Number: TBD

The UXOSO is responsible for implementing all MEC-related and general safety components. The UXOSO will verify compliance with all HSSE requirements. The UXOSO will report independently of project management to the CH2M HILL Corporate MR Safety and QC Officer. The UXOSO will implement the approved safety programs in compliance with all Department of Defense (DoD), federal, state, and local statutes and codes; analyze operational risks, hazards, and safety requirements; enforce personnel limits and safety exclusion zones (EZs) for MEC clearance operations, transportation, storage, and destruction; and conduct safety inspections to ensure compliance with safety codes. The UXOSO shall be onsite for the duration of project activity and share in the responsibility to:

- Make safety integral to each MR operation by promoting worker involvement in the work planning and hazard identification process.
- Implement the approved explosive safety programs.
- Analyze MEC and explosive operational risk and hazards.
- Enforce personnel limits and MEC-related EZs.
- Maintain active and visible involvement using open communication with employees regarding safety items on the project.
- Verify that the SSHP and AHAs are current and are amended when project activities or conditions change.
- Verify that the workforce is trained and qualified in accordance with the SSHP.
- Conduct HSSE orientation, safety briefings, etc., for all team members prior to entering the project work areas.
- Serve as the project "Hazard Communication Coordinator" and perform the responsibilities outlined in the SSHP.
- Serve as the project "Emergency Response Coordinator" and perform the responsibilities outlined in the SSHP.
- Perform weekly project activity self-assessment checklists to confirm ongoing project activities are in compliance with HSSE practices and procedures during the course of the project. Complete the applicable checklists depending on the work being performed at the time of the weekly assessment.
- Conduct and prepare reports of daily safety inspections of UXO work processes, site conditions, and equipment conditions and submit them to SUXOS.
- Coordinate with the SUXOS and PM regarding subcontractor operational performance and third-party interfaces.

- Verify appropriate PPE use, availability, and training.
- Conduct daily safety briefings for project personnel on MEC-related operations.
- Conduct accident investigations, including root cause analysis.
- Maintain HSSE records and documentation.
- Deliver field HSSE training as needed based on project-specific hazards and activities.
- Ensure that programs are effectively functioning to prevent and control hazards on the project.
- Provide HSSE inputs into Daily QC Reports.
- Prepare safety hazard analyses for definable features of work.

4.4 Senior UXO Supervisor

Name: TBD
Company/Office: TBD
Cellular Number: TBD

The SUXOS is responsible for the execution of all onsite activities in the EZ. The SUXOS will be responsible for overseeing scheduling and ensuring that field activities are performed in accordance with the specified plans. The SUXOS will be familiar with all aspects of H&S as related to MEC and will coordinate with the UXOSO to ensure H&S of site personnel, the public and the environment. The SUXOS reports directly to the Project Manager and is responsible for:

- Directly controlling the operations of all field teams performing MR activities.
- Monitoring the MR field teams daily performance.
- Assisting the MR field teams in achieving maximum operational safety and efficiency.
- Implementing the approved work plans in the field.
- Supervising all MR teams on the project.
- Temporarily stopping work to correct an unsafe condition or procedure.

4.5 UXO Quality Control

- Name: TBD
- Company/Office: TBD
- Cellular Number: TBD

The UXOQC is responsible for:

- Ensuring that the overall QC procedures and objectives of the project are met.

- Reviewing and ensuring that the Quality Control Plan (QCP) addresses all project-specific QC needs and that all appropriate QC requirements are addressed.
- Implementing the MEC-specific sections of the QC Program for all MR-related evolutions.
- Conducting QC inspections of all MEC and explosives operations for compliance with established procedures.
- Directing and approving all corrective actions to ensure that all MR-related work complies with contractual requirements.
- Temporarily stopping work to correct an unsafe condition or procedure.
- Reporting independently of project management to the Corporate MR Safety and QC Officer.
- Exceeding the requirements of the Department of Defense Explosive Safety Board (DDESB)-approved *UXO Personnel Training and Experience Hierarchy.*

4.6 UXO Technician III

UXO Technician III personnel report directly to the SUXOS and are responsible for:

- The safety and efficiency of their assigned field team.
- Temporarily stopping work in order to bring an unsafe condition or procedure to the attention of the SUXOS.
- Exceeding the requirements of the DDESB-approved *UXO Personnel Training and Experience Hierarchy.*

SECTION 5

Training

Prior to commencement of site activities, the PM will ensure that all employees engaged in hazardous waste operations are informed of the nature and degree of exposure to chemical and physical hazards that are likely to result from participation in site operations. The PM will accomplish this by ensuring that all personnel entering the site have received the appropriate OSHA and site-specific training prior to participation in site activities.

5.1 General Training

5.1.1 Hazardous Waste Operations Training

All employees engaging in hazardous waste operations or emergency response shall receive appropriate training as required by 29 CFR 1910.120 and 29 CFR 1926.65. At a minimum, the training shall have consisted of instruction in the topics outlined in the 29 CFR 1910.120 and 29 CFR 1926.65. Personnel who have not met these training requirements shall not be allowed to engage in hazardous waste operations or emergency response activities.

Initial Training

General site workers engaged in hazardous waste operations shall, at the time of job assignment, have received a minimum of 40 hours of initial HSSE training for hazardous waste site operations, unless otherwise noted in the above-referenced standards.

Employees who may be exposed to health hazards or hazardous substances at treatment, storage, and disposal (TSD) operations shall receive a minimum of 24 hours of initial training to enable the employee to perform their assigned duties and functions in a safe and healthful manner.

Employees engaged in emergency response operations shall be trained to the level of required competence in accordance with 29 CFR 1910.120.

Three-Day Actual Field Experience

General site workers for hazardous waste operations shall have received three days of actual experience (on-the-job training) under the direct supervision of a trained, qualified supervisor and shall be documented. If the field experience has not already been received and documented at a similar site, this supervised experience shall be accomplished and documented at the beginning of the assignment of the project.

Refresher Training

General site workers and TSD workers shall receive 8-hours of refresher training annually (within the previous 12-month period) to maintain qualifications for fieldwork. Employees engaged in emergency response operations shall receive annual refresher training of

sufficient content and duration to maintain their competencies or shall demonstrate competency in those areas at least annually.

Eight-Hour Supervisory Training

Onsite management or supervisors who will be directly responsible for, or supervise employees engaged in hazardous waste site operations, will have received at least 8 hours of additional specialized training on managing such operations. Employees designated as SSC Hazardous Waste (SSC HW) employees are considered 8-hour HAZWOPER Site Safety Supervisor trained.

The employees listed meet state and federal hazardous waste operations requirements for 40-hour initial training, 3-day on-the-job experience, and 8-hour annual refresher training. Employees designated "SSC" have completed a 12-hour site SSC course, and have documented requisite field experience. An SSC with a level designation (D, C, B) equal to or greater than the level of protection being used must be present during all tasks performed in exclusion or decontamination zones. Employees designated "FA-CPR" are currently certified by the American Red Cross, or equivalent, in first aid and CPR. At least one FA-CPR designated employee must be present during all tasks performed in exclusion or decontamination zones. The employees listed below are currently active in a medical surveillance program that meets state and federal regulatory requirements for hazardous waste operations. Certain tasks (e.g., confined-space entry) and contaminants (e.g., lead) may require additional training and medical monitoring.

Pregnant employees are to be informed of and are to follow the procedures in CH2M HILLCH2M HILL- SOP HSE-120, *Reproductive Health*, including obtaining a physician's statement of the employee's ability to perform hazardous activities before being assigned fieldwork.

Employee Name	Office	Responsibility	SSC/FA-CPR
TBD		SSC	

5.2 MEC Training

All UXO-qualified personnel performing work that involves decisions of safety and condition of MEC must be graduates of one of the following schools:

- U.S. Army Bomb Disposal School, Aberdeen Proving Ground, Maryland
- U.S. Naval EOD School, Indian Head, Maryland
- U.S. Naval EOD School, Eglin Air Force Base, Florida

All UXO-qualified personnel will meet or exceed the minimum requirements established and verified by the U.S. Army Engineering and Support Center, Huntsville.

TABLE 5-1
UXO Personnel Training and Experience Hierarchy
Phase I MEC RCRA Facility Investigation, UCC-Woodbine

Position Description	Training Required [1, 2, 3]	Minimum Years of EOD/UXO Experience [4]	Special Requirements
UXOSO	1,2	8 years	Experience in all phases of UXO remediation and applicable safety standards
UXO QC Specialist	1,2	8 years	Experience in all phases of UXO remediation and the transportation, handling and storage of ordnance and explosives materials
SUXOX	1,2	10 years	Significant experience in all aspects of UXO remediation. Five years experience in supervisory positions.
UXO Technician III	1, 2, or 3	8 years	Prior military EOD and/or commercial UXO experience
UXO Technician II	1, 2	N/A	Prior military EOD experience
	Or 3	3 years	Experience in UXO remediation/range clearance operations. Plus specific project/ordnance training
UXO Technician I	1, 2 or 3	0	Successfully completed approved course of instruction appropriate to this skill level
UXO Sweep Personnel	Equipment and site-specific training	N/A	Equipment and site-specific training. (Experience at this position is not required for UXO Technician I certification).

Notes:
[1] Graduate of the Army Bomb Disposal School at Aberdeen, Maryland
[2] Graduate of the Naval EOD School
[3] Graduate of a DoD-certified UXO Training Program
[4] For computational purposes, 1 year is equal to 1,740 hours
This is the minimum experience requirement for designation. This is not an automatic designation, but reserved for those that have demonstrated the requisite knowledge, maturity, judgment and are recommended by the contractor for recognition at the specified skill level.

5.3 Hazard Communication Training

All employees onsite will receive Hazard Communication training detailing the hazards of the product, appropriate protective measures to prevent exposure to the product, as well as safe procedures for storage and handling of the product and response to emergencies. A copy of the hazard communication (HAZCOM)-specific training document is located in **Attachment 7**. The location of the Material Safety Data Sheets (MSDSs) for this site will be in the field office trailer, and all personnel will be made aware of that fact. This training will occur as part of the initial mobilization training at the site.

5.4 Visitors

All visitors to areas where MEC is potentially present must receive, at a minimum, a briefing on site conditions, hazards, and emergency response procedures. The SUXOS or SSC will generally be the one providing the visitor briefing. Visitors are not allowed in the MEC EZ while MEC operations are being conducted. Visitors must always stay on established roadways and delineated pathways, unless they have a UXO-qualified escort with them. All visitors will make appropriate entries in the Visitor's Log.

5.5 Training Documentation

Copies of all training certifications and medical screening will be kept on file at the work site for the duration of site activities.

SECTION 6

Personal Protective Equipment

(Reference CH2M HILL- SOP HSE-117, Personal Protective Equipment)

6.1 Required PPE

- PPE must be worn by employees when actual or potential hazards exist and engineering controls or administrative practices cannot adequately control those hazards.
- A PPE assessment has been conducted by the HSM based on project tasks (see PPE specifications below). Verification and certification of assigned PPE by task is completed by the HSM or designee.
- Employees must be trained to properly wear and maintain the PPE.
- In work areas where actual or potential hazards are present at any time, PPE must be worn by employees working or walking through the area.
- Areas requiring PPE should be posted or employees must be informed of the requirements in an equivalent manner.
- PPE must be inspected prior to use and after any occurrence to identify any deterioration or damage.
- PPE must be maintained in a clean and reliable condition.
- Damaged PPE shall not be used and must either be repaired or discarded.
- PPE shall not be modified, tampered with, or repaired beyond routine maintenance.

The table below outlines PPE to be used according to task based on project-specific hazard assessment. If a task other than the tasks described in this table needs to be performed, contact the HSM so this table can be updated.

Project-Specific PPE Requirements [a]

Task	Level	Body	Head	Respirator [b]
General site entry Surveying Observation of material loading for offsite disposal	D	Work clothes; safety toed leather work boots and gloves	Hardhat [c] Safety glasses with side shields Ear protection [d]	None required
Geoprobe boring Soil sampling	Modified D	Work clothes or cotton coveralls **Boots:** Safety-toe, chemical-resistant boots OR Safety -toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile and outer chemical-resistant nitrile gloves.	Hardhat [c] Safety glasses with side shields Ear protection [d]	None required

Task	Level	Body	Head	Respirator [b]
Work near vehicular traffic ways or earth moving equipment. Surveying	All	Appropriate level of American National Standard Institute (ANSI)/ISEA 107-2004 high-visibility safety vests.	Work near vehicular traffic ways or earth moving equipment.	
Equipment decontamination if using pressure washer	Modified D with splash protection	**Coveralls:** Tyvek® **Boots:** 16-inch-high steel-toed rubber boots **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Splash shield [c] over safety glasses with side shields or splash goggles Ear protection [d]	None required.
Tasks requiring upgrade	C	**Coveralls:** Tyvek® **Boots:** Safety -toe, chemical-resistant boots OR Safety -toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile and outer chemical-resistant nitrile gloves.	Hardhat [c] Splash shield [c] Ear protection [d] Spectacle inserts	APR, full face, MSA Ultratwin or equivalent; with GME-H cartridges or equivalent[e].

Reasons for Upgrading or Downgrading Level of Protection

Upgrade[f]	Downgrade
Request from individual performing tasks.	New information indicating that situation is less hazardous than originally thought.
Change in work tasks that will increase contact or potential contact with hazardous materials.	Change in site conditions that decrease the hazard.
Occurrence or likely occurrence of gas or vapor emission.	Change in work task that will reduce contact with hazardous materials.
Known or suspected presence of dermal hazards.	
Instrument action levels (Section 5) exceeded.	

[a] Modifications are as indicated. CH2M HILL will provide PPE only to CH2M HILL employees.
[b] No facial hair that would interfere with respirator fit is permitted.
[c] Hardhat and splash-shield areas are to be determined by the SSC.
[d] Ear protection should be worn when conversations cannot be held at distances of 3 feet or less without shouting.
[e] See cartridge change-out schedule in Section 4.2.
[f] Performing a task that requires an upgrade to a higher level of protection (e.g., Level D to Level C) is permitted only when the PPE requirements have been approved by the HSM, and an SSC qualified at that level is present.
APR = air-purifying respirator

6.2 PPE Certification

I certify that the PPE requirements listed in the table above for the associated tasks are based upon the project-specific hazard assessment I performed.

Michael Goldman CIH, CSP	June 9, 2009	June 9, 2009
Name	Date of Certification	Date(s) of Project Hazard Assessment

6.3 Respiratory Protection

(Reference CH2M HILL SOP HSE-121, Respiratory Protection)

- Respirator users must have completed appropriate respirator training within the past 12 months. Level C training is required for air-purifying respirators (APR) use.
- Respirator users must complete the respirator medical monitoring protocol and been approved for the specific type of respirator to be used.
- Tight-fitting facepiece respirator (negative or positive pressure) users must have passed an appropriate fit test within past 12 months.
- Respirator use shall be limited to those activities identified in this plan. If site conditions change that alters the effectiveness of the specified respiratory protection, the HSM shall be notified to amend the written plan.
- Tight-fitting facepiece respirator users shall be clean-shaven and shall perform a user seal check before each use.
- Canisters/cartridges shall be replaced according to the change-out schedule specified in this plan. Respirator users shall notify the SSC or HSM of any detection of vapor or gas breakthrough. The SSC shall report any breakthrough events to the HSM for schedule upgrade.
- Respirators in regular use shall be inspected before each use and during cleaning
- Respirators in regular use shall be cleaned and disinfected as often as necessary to ensure they are maintained in a clean and sanitary condition.
- Respirators shall be properly stored to protect against contamination and deformation.
- Field repair of respirators shall be limited to routine maintenance. Defective respirators shall be removed from service.

Respirator Change-Out Schedule

Contaminant	Change-Out Schedule
Arsenic	End-of-service life or end of shift (whichever occurs first)
Cobalt	End-of-service life or end of shift (whichever occurs first)
Iron	End-of-service life or end of shift (whichever occurs first)
Manganese	End-of-service life or end of shift (whichever occurs first)
Thallium	End-of-service life or end of shift (whichever occurs first)

SECTION 7

Medical Surveillance

7.1 Medical Surveillance Program

(Reference CH2M HILL SOP HSE-113, Medical Surveillance Program)

Medical surveillance of employees will be conducted in accordance with the requirements of OSHA 29 CFR 1910.120(f), 29 CFR 1910.134(b)(10) and other established guidelines. Personnel to be included in the Medical Surveillance Program will be those who perform hazardous waste operations that may potentially expose the worker to hazardous substances or other significant H&S threats. As required by 1910.120(f), project personnel will participate in an employer-sponsored Medical Surveillance Program.

A baseline health assessment will be conducted prior to participating in site operations and annually thereafter to determine the worker's ability to perform hazardous waste operations in a safe and healthful manner. The PM will ensure that all health assessments address the site-specific health hazards to which workers may be exposed.

The designated physician will perform the medical assessments specified in this section and review medical examination results to determine each worker's ability to perform his assigned hazardous waste duties. The physician will also be responsible for determining if supplemental or follow-up examinations are required and for maintaining medical and exposure records in accordance with OSHA 29 CFR 1910.120(d).

The purposes of the Medical Surveillance Program are to:

- Assess the individual's health status prior to participation in hazardous waste operations
- Determine the individual's ability to perform work assignments requiring the use of PPE and clothing
- Establish baseline data for comparison to future medical data in order to provide a means of monitoring a worker's health status
- Establish facilities and procedures for emergency and non-emergency medical treatment
- Establish procedures for maintenance and storage of medical and exposure records.

7.2 Physician's Statement

The results of this examination will be made available to the employee and a written physician's statement will be sent to CH2M HILL. A copy of the physician's statement will be kept in each employee's file at the project site for the duration of site operations. The physician's statement will include the following:

- The physician's opinion regarding any conditions that would place the employee at an increased risk from working in hazardous waste operations
- The physician's recommended limitations upon the employee's assigned work, if any
- A statement that the employee has been informed by the physician of the results of the examination and any conditions that may require further examination or treatment.

7.3 Supplemental Examination

A site worker will undergo a supplemental examination if they have been injured; received health impairment; developed signs or symptoms from possible over-exposure; or received a documentable over-exposure without the use of respiratory protection. The contents of this examination will be based upon the type of injury, illness, signs or symptoms of exposure involved and will be determined by the physician. Prior to reassignment to site activities, the physician will certify that the employee is fit to return to work. If necessary, the physician will specify in writing any activity restrictions or additional tests, which may be required.

7.4 Follow-up Health Assessments

During any pre-assignment, annual examination, or supplemental examination, if a condition is detected that requires follow-up tests, the physician will notify CH2M HILL and the employee as to the nature of the follow-up health assessment. The physician will determine the schedule and content of the follow-up health assessment. A statement outlining the employee's fitness for work will be provided to CH2M HILL and the employee upon conclusion of the follow-up health assessment.

7.5 Record Keeping

CH2M HILL will retain and maintain all physician statements, exposure records, and associated information for employees involved in hazardous waste operations. These records will be kept at the project site for the duration of site operations. When the site work is complete, CH2M HILL will retain the records. Examining physicians will be responsible for maintaining records related to laboratory and other tests for each employee examined. All records, whether maintained by CH2M HILL or by the examining physician, will be kept on file for a period of 30 years beyond an employee's termination in accordance with OSHA 29 CFR 1910.20(d).

SECTION 8

Exposure Monitoring/Air Sampling Program

8.1 Air Monitoring Specifications

(Reference CH2M HILL SOP HSE-207, Exposure Monitoring for Airborne Chemical Hazards)

Instrument	Tasks	Action Levels[a]	Action to be Taken when Action Level reached	Frequency [b]	Calibration
FID: OVA model 128 or equivalent	DPT drilling IDW management	<1 parts per million (ppm) 1 to 10 ppm > 10 ppm	Level D Level C.: Evacuate Work area and contact HSM	Initially and periodically during task	Daily
CGI: MSA model 260 or 261 or equivalent	DPT drilling IDW management	0-10% : 10-25% LEL: >25% LEL:	No explosion hazard Potential explosion hazard Explosion hazard; evacuate or vent	Continuous during advancement of boring	Daily
O_2Meter: MSA model 260 or 261 or equivalent	DPT drilling IDW management	>25%[c] O_2: 20.9%[c] O_2: <19.5%[c] O_2:	Explosion hazard; evacuate or vent Normal O_2 O_2 deficient; vent or use SCBA	Continuous during advancement of boring	Daily

[a] Action levels apply to sustained breathing-zone measurements above background.
[b] The exact frequency of monitoring depends on field conditions and is to be determined by the SSC; generally, every 5 to 15 minutes if acceptable; more frequently may be appropriate. Monitoring results shall be recorded. Documentation should include instrument and calibration information, time, measurement results, personnel monitored, and place/location where measurement is taken (e.g., "Breathing Zone/MW-3", "at surface/SB-2", etc.).
[c] If the measured percent of O_2 is less than 10, an accurate LEL reading will not be obtained. Percent LEL and percent O_2 action levels apply only to ambient working atmospheres, and not to confined-space entry. More-stringent percent LEL and O_2 action levels are required for confined-space entry .
[d]Noise monitoring and audiometric testing also required.
CGI = combustible gas indicator; LEL = lowest effect level; OVA = organic vapor analyzer

8.2 Calibration Specifications

(Refer to the respective manufacturer's instructions for proper instrument-maintenance procedures)

Instrument	Gas	Span	Reading	Method
Flame Ionization Detector (FID): OVA	100 ppm methane	3.0 $\pm$ 1.5	100 ppm	1.5 lpm reg T-tubing
FID: TVA 1000	100 ppm methane	NA	100 ppm	2.5 lpm reg T-tubing
CGI: MSA 260, 261, 360, or 361	0.75% pentane	N/A	50% LEL $\pm$ 5% LEL	1.5 lpm reg direct tubing

8.3 Air Sampling

Sampling, in addition to real-time monitoring, may be required by other OSHA regulations where there may be exposure to certain contaminants. Air sampling typically is required when site contaminants include lead, cadmium, arsenic, asbestos, and certain volatile organic compounds. Contact the HSM immediately if these contaminants are encountered.

8.3.1 Method Description

Not recommended at this time

8.3.2 Personnel and Areas

Results must be sent immediately to the HSM. Regulations may require reporting to monitored personnel. Results reported to:

HSM: Michael Goldman/ATL
Other: Max Bertram/KNX

SECTION 9

Heat and Cold Stress

9.1 Temperature Extremes

Each employee is responsible for the following:

- Recognizing the symptoms of heat or cold stress
- Taking appropriate precautionary measures to minimize their risk of exposure to temperature extremes
- Communicating any concerns regarding heat and cold stress to the SSC or UXOSO

9.1.1 Heat Stress

General

Physical fitness influences a person's ability to perform work under heat loads. At a given level of work, the more fit a person is, the less the physiological strain, the lower the heart rate, the lower the body temperature (indicates less retrained body heat—a rise in internal temperature precipitates heat injury), and the more efficient the sweating mechanism.

Acclimatization is the degree to which a worker's body has physiologically adjusted or acclimatized to working under hot conditions. Acclimatization affects their ability to do work. Acclimatized individuals sweat sooner and more profusely than unacclimatized individuals. Acclimatization occurs gradually over 1 to 2 weeks of continuous exposure, but it can be lost in as little as 3 days in a cooler environment.

Dehydration reduces body water volume. This reduces the body's sweating capacity and directly affects its ability to dissipate excess heat.

The ability of a body to dissipate heat depends on the ratio of its surface area to its mass (surface area/weight). **Heat dissipation** is a function of surface area, while heat production depends on body mass. Therefore, overweight individuals (those with a low ratio) are more susceptible to heat-related illnesses because they produce more heat per unit of surface area than if they were thinner. Monitor these persons carefully if heat stress is likely.

When wearing **impermeable clothing**, the weight of an individual is not as important in determining the ability to dissipate excess heat because the primary heat dissipation mechanism, evaporation of sweat, is ineffective.

Symptoms and Treatments of Heat Stress

	Heat Syncope	Heat Rash	Heat Cramps	Heat Exhaustion	Heat Stroke
Signs and Symptoms	Sluggishness or fainting while standing erect or immobile in heat.	Profuse tiny raised red blister-like vesicles on affected areas, along with prickling sensations during heat exposure.	Painful spasms in muscles used during work (arms, legs, or abdomen); onset during or after work hours.	Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or flushed; may faint on standing; rapid thready pulse and low blood pressure; oral temperature normal or low	Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature.
Treatment	Remove to cooler area. Rest lying down. Increase fluid intake. Recovery usually is prompt and complete.	Use mild drying lotions and powders, and keep skin clean for drying skin and preventing infection.	Remove to cooler area. Rest lying down. Increase fluid intake.	Remove to cooler area. Rest lying down, with head in low position. Administer fluids by mouth. Seek medical attention.	Cool rapidly by soaking in cool–but not cold–water. Call ambulance, and get medical attention immediately!

Precautions

- Drink 16 ounces of water before beginning work. Disposable cups and water maintained at 50°F to 60°F should be available. Under severe conditions, drink 1 to 2 cups every 20 minutes, for a total of 1 to 2 gallons per day. Do not use alcohol in place of water or other nonalcoholic fluids. Decrease your intake of coffee and caffeinated soft drinks during working hours.
- Acclimate yourself by slowly increasing workloads (e.g., do not begin with extremely demanding activities).
- Use cooling devices, such as cooling vests, to aid natural body ventilation. These devices add weight, so their use should be balanced against efficiency.
- Use mobile showers or hose-down facilities to reduce body temperature and cool protective clothing.
- Conduct field activities in the early morning or evening and rotate shifts of workers, if possible.
- Avoid direct sun whenever possible, which can decrease physical efficiency and increase the probability of heat stress. Take regular breaks in a cool, shaded area. Use a wide-brim hat or an umbrella when working under direct sun for extended periods.
- Provide adequate shelter/shade to protect personnel against radiant heat (sun, flames, hot metal).

- Maintain good hygiene standards by frequently changing clothing and showering.
- Observe one another for signs of heat stress. Persons who experience signs of heat syncope, heat rash, or heat cramps should consult the SSC or UXOSO to avoid progression of heat-related illness.

Thermal Stress Monitoring

- The following procedures should be considered when the ambient air temperature exceeds 70°F, the relative humidity is high (greater than 50 percent), or when the workers exhibit symptoms of heat stress.
- The heart rate should be measured by the radial pulse for 30 seconds, as early as possible in the resting period.
- The heart rate at the beginning of the rest period should not exceed 110 bpm, or 20 bpm above resting pulse.
- If the heart rate is higher, the next work period should be shortened by 33 percent, while the length of the rest period stays the same.
- If the pulse rate still exceeds 110 beats per minute at the beginning of the next rest period, the following work cycle should be further shortened by 33 percent.
- Continue this procedure until the rate is maintained below 110 bpm, or 20 bpm above resting pulse.
- Alternately, the oral temperature can be measured before the workers have something to drink.
- If the oral temperature exceeds 99.6°F at the beginning of the rest period, the following work cycle should be shortened by 33 percent.
- Continue this procedure until the oral temperature is maintained below 99.6°F. While an accurate indication of heat stress, oral temperature is difficult to measure in the field.

9.1.2 Cold

General

- Low ambient temperatures increase the heat lost from the body to the environment by radiation and convection. In cases where the worker is standing on frozen ground, the heat loss is also due to conduction.
- Wet skin and clothing, whether because of water or perspiration, may conduct heat away from the body through evaporative heat loss and conduction. Thus, the body cools suddenly when chemical protective clothing is removed if the clothing underneath is perspiration soaked.
- Movement of air across the skin reduces the insulating layer of still air just at the skin's surface. Reducing this insulating layer of air increases heat loss by convection.

- Non-insulating materials in contact or near-contact with the skin, such as boots constructed with a metal toe or shank, conduct heat rapidly away from the body.
- Certain common drugs, such as alcohol, caffeine, or nicotine, may exacerbate the effects of cold, especially on the extremities. These chemicals reduce the blood flow to peripheral parts of the body, which are already high-risk areas because of their large surface area to volume ratios. These substances may also aggravate an already hypothermic condition.

Precautions

- Be aware of the symptoms of cold-related disorders, and wear proper, layered clothing for the anticipated fieldwork. Appropriate rain gear is a must in wet weather.
- Consider monitoring the work conditions and adjusting the work schedule using guidelines developed by the U.S. Army (wind-chill index) and the National Safety Council (NSC).
- Wind-chill index (below) is used to estimate the combined effect of wind and low air temperatures on exposed skin. The wind-chill index does not take into account the body part that is exposed, the level of activity, or the amount or type of clothing worn. For those reasons, it should only be used as a guideline to warn workers when they are in a situation that can cause cold-related illnesses.
- *NSC Guidelines for Work and Warm-Up Schedules* can be used with the wind-chill index to estimate work and warm-up schedules for fieldwork. The guidelines are not absolute; workers should be monitored for symptoms of cold-related illnesses. If symptoms are not observed, the work duration can be increased.
- Persons who experience initial signs of immersion foot, frostbite, and/or hypothermia should report it immediately to the SUXOS, SSC, and PM to avoid progression of cold-related illness.
- Observe one another for initial signs of cold-related disorders.
- Obtain and review weather forecast – be aware of predicted weather systems along with sudden drops in temperature, increase in winds, and precipitation.

Symptoms and Treatment of Cold Stress

	Immersion (Trench) Foot	Frostbite	Hypothermia
Signs and Symptoms	Feet discolored and painful; infection and swelling present.	Blanched, white, waxy skin, but tissue resilient; tissue cold and pale.	Shivering, apathy, sleepiness; rapid drop in body temperature; glassy stare; slow pulse; slow respiration.
Treatment	Seek medical treatment immediately.	Remove victim to a warm place. Re-warm area quickly in warm–but not hot–water. Have victim drink warm fluids, but not coffee or alcohol. Do not break blisters. Elevate the injured area, and get medical attention.	Remove victim to a warm place. Have victim drink warm fluids, but not coffee or alcohol. Get medical attention.

SECTION 10

Standard Operating Procedures

This section provides safe work practices and control measures used to reduce or eliminate potential hazards. These practices and controls are to be implemented by the party in control of either the site or the particular hazard. Team members must remain aware of the hazards affecting them regardless of who is responsible for controlling the hazards. Project team members who do not understand any of these provisions should contact the SUXOS, SSC, or UXOSO for clarification. Each person onsite is required to follow these rules and regulations.

10.1 Standard Work Practices

Using common sense and following safe practices can reduce hazards due to normal site activities. Personnel must keep the following prudent guidelines in mind when conducting field activities:

- Hazard assessment is a continuous process. Personnel must be aware of their surroundings and constantly be aware of the UXO, chemical, and physical hazards that are or may be present.
- The number of personnel in the EZ will be the minimum number necessary to perform work tasks in a safe and efficient manner.
- All personnel working within the EZ will adhere to the "Buddy System" at all times. No individual will ever be left alone inside of an EZ.
- All personnel will be familiar with the physical characteristics of each site, including wind direction, site access, and the location of communication devices and safety/emergency equipment.
- Eating, drinking and smoking will only be allowed in designated areas.
- Detection or appearance of unusual liquids, odors, or discolored soil could indicate the presence of contaminants and shall be reported to the SUXOS, SSC, or UXOSO immediately.
- Site personnel are to report any other unusual or potentially hazardous condition to the SUXOS, SSC, or UXOSO for investigation and/or corrective action.

All personnel onsite will be required to follow the safe work practices contained in this program as they relate to the hazards encountered during site activities. All site personnel will be required to read, understand and comply with the provisions of this SSHP. If new tasks or hazards are identified during site operations that pose additional hazards, the SSHP will be amended by the HSM to include additional safe work practices and other control methods as needed.

10.2 General Standards of Practice

The following procedures outline the basic requirements for compliance with applicable sections of OSHA regulations and the requirements of USACE Manual EM 385-1-1. More detailed information and interpretations are located in the referenced CH2M HILL Corporate HSE SOP. If there are any discrepancies between these procedures and the regulatory guidance, the more stringent of the requirements will be observed. All discrepancies must be immediately brought to the attention of the SUXOS, SSC, or UXOSO.

10.2.1 Munitions and Explosives of Concern

(Reference CH2M HILL SOP HSE-610, Explosives Usage and MR)

- Only UXO-qualified personnel shall perform MR procedures. Non-UXO personnel may be used to perform MR-related procedures when supervised by a UXO Technician III.
- All personnel engaged in field operations shall be thoroughly trained and capable of recognizing the specific hazards related to the procedures being performed.
- To ensure that these procedures are performed to standards, all field personnel shall be under the direct supervision of a UXO Technician III.
- Every effort shall be made to identify a suspect MEC item. Under no circumstances will any MEC be moved in an attempt to make a positive identification. The MEC item shall be visually examined for markings and other external features such as shape, size, and external fittings.
- If an unknown MEC item is encountered, the Corporate MR Safety and QC Officer will be notified immediately.
- The following are additional considerations for the safe handling of MEC items:
  - Prior to any action being performed on ordnance, all fusing shall be positively identified. This identification will consist of fuze type by function, condition (armed or unarmed), and physical state/condition of the fuze (e.g., burned, broken, parts exposed or sheared).
  - A projectile containing a base-detonating (BD) fuze is to be considered armed if the round has been fired.
  - Arming wires and pop-out pins on unarmed fuzes should be secured prior to any movement.
  - Do not depress plungers, turn vanes, rotate spindles, or move levers, setting rings, or other external fittings on MEC items. Such actions may arm or activate the MEC.
  - Do not attempt to remove any fuzes from the MEC. Do not dismantle or strip components from any MEC item unless the item is included in the scope of work.
  - UXO personnel are not authorized to inert any MEC item found onsite unless it is a part of the scope of work.
  - MEC items shall not be taken from the site as souvenirs or training aids.

- If suspect chemical warfare materiel (CWM) is encountered during site activities, all work shall immediately cease. Project personnel shall withdraw along cleared paths upwind from the discovery. A team consisting of two personnel shall secure the area to prevent unauthorized access. Personnel should position themselves as far upwind as possible while still maintaining security of the area. The local Point of Contact (POC) designated in the Work Plan Addendum shall be immediately notified.
- Avoid inhalation and skin contact with smoke, fumes, and vapors of explosives and other related materials.
- Consider MEC items that have been exposed to fire and detonation as extremely hazardous. Chemical and physical changes may have occurred to the contents, which might render them more sensitive than in their original state.
- Do not rely on the color coding of MEC for positive identification. Munitions with incomplete or improper color codes have been encountered.
- Avoid approaching the forward area of a MEC item until it can be determined whether the item contains a shaped charge. The explosive jet, which is formed during detonation, can be lethal at great distances. Assume that all shaped-charge munitions contain a piezoelectric (PZ) fusing system until identified. PZ is extremely sensitive, can function at the slightest physical change, and remains hazardous for an indefinite period.

10.2.2 Hazard Communication Program

(Reference CH2M HILL SOP HSE-107, Hazard Communication)

The SSC or UXOSO is to perform the following:

- Complete an inventory of chemicals brought onsite using **Attachment 8**.
- Confirm that an inventory of chemicals brought onsite by all team subcontractors is available.
- Request or confirm locations of MSDS from the client, contractors, and subcontractors for chemicals to which project personnel potentially are exposed.
- Before or as the chemicals arrive onsite, obtain an MSDS for each hazardous chemical.
- Label chemical containers with the identity of the chemical and hazard warnings, and store properly.
- Give project personnel required chemical-specific HAZCOM training using **Attachment 7**.
- Store all materials properly, giving consideration to compatibility, quantity limits, secondary containment, fire prevention, and environmental conditions.

10.2.3 Drum Handling

- Ensure that personnel are trained in proper lifting and moving techniques to prevent back injuries.
- Provide equipment to keep the operator removed from the drums to lessen the likelihood of injury. Such equipment might include: a drum grappler attached to a hydraulic excavator; a small front-end loader, which can be either loaded manually or equipped with a bucket sling; a rough terrain forklift; Roller conveyor equipped with solid rollers; drum carts designed specifically for drum handling.
- Make sure the vehicle selected has sufficient rated load capacity to handle the anticipated loads, and make sure the vehicle can operate smoothly on the available road surface.
- Ensure there are Plexiglas cab shields on equipment such as loaders and backhoes when handling drums containing potentially explosive materials.
- Equipment cabs should be supplied with fire extinguishers, and should be air-conditioned to increase operator efficiency.
- Supply operators with appropriate respiratory protective equipment when needed.
- Ensure that drums are secure and are not in the operator's view of the roadway.
- Prior to handling, all personnel should be warned about hazards of handling.
- Throughout handling, personnel should be alert for information leading to the identity of new hazards. Exercise extreme caution in handling drums that are not intact and tightly sealed.
- Before moving anything, determine the most appropriate sequence in which the various drums and other containers should be moved (i.e., small containers may have to be removed first to permit heavy equipment to enter and move the drums.)
- Overpack drums and an adequate volume of absorbent should be kept near areas where minor spills may occur.

SECTION 11

Site Control

11.1 Site-Control Procedures

(Reference CH2M HILL SOP HSE-218, Hazardous Waste Operations)

- The SSC or UXOSO will conduct a site safety briefing before starting field activities or as tasks and site conditions change.
- Topics for briefing on site safety: general discussion of SSHP, site-specific hazards, locations of work zones, PPE requirements, equipment, special procedures, emergencies.
- The SSC or UXOSO records attendance at safety briefings in a logbook and documents the topics discussed.
- Post the OSHA job-site poster in a central and conspicuous location in accordance with CH2M HILL Core Standard, *OSHA Postings*.
- Establish support, decontamination, and exclusion zones. Delineate with flags or cones as appropriate. Support zone should be upwind of the site. Use access control at entry and exit from each work zone.
- Establish onsite communication consisting of the following:
  - Line-of-sight and hand signals
  - Air horn
  - Two-way radio or cellular telephone if available
- Establish offsite communication.
- Establish and maintain the "buddy system."
- The SSC or UXOSO is to conduct periodic inspections of work practices to determine the effectiveness of this plan. Deficiencies are to be noted, reported to the HSM, and corrected.

11.2 HAZWOPER Compliance Plan

(Reference CH2M HILL SOP HSE-220, Written Plans and HSE-218 Hazardous Waste Operations)

Certain parts of the site work are covered by state or federal HAZWOPER standards and therefore require training and medical monitoring. Anticipated HAZWOPER tasks might occur consecutively or concurrently with respect to non-Hazwoper tasks. This section outlines procedures to be followed when approved activities specified do not require 24- or 40-hour training. Non- HAZWOPER-trained personnel also must be trained in accordance with all other state and federal OSHA requirements.

- When non- HAZWOPER-trained personnel are at risk of exposure, the SSC must post the exclusion zone and inform non- HAZWOPER-trained personnel of the:
  - Nature of the existing contamination and its locations
  - Limitations of their access
  - Emergency action plan for the site
- When exposure is possible, non- HAZWOPER-trained personnel must be removed from the site until it can be demonstrated that there is no longer a potential for exposure to HSSE hazards.

SECTION 12

Personal Hygiene and Decontamination

12.1 Personal Hygiene

Adequate sanitation facilities will be provided in the administrative area and at each work site to ensure proper personal hygiene. Site sanitation will be established and maintained in accordance with OSHA 29 CFR 1910.120(n).

12.2 Decontamination Specifications

(Reference CH2M HILL SOP HSE-218, Hazardous Waste Operations)

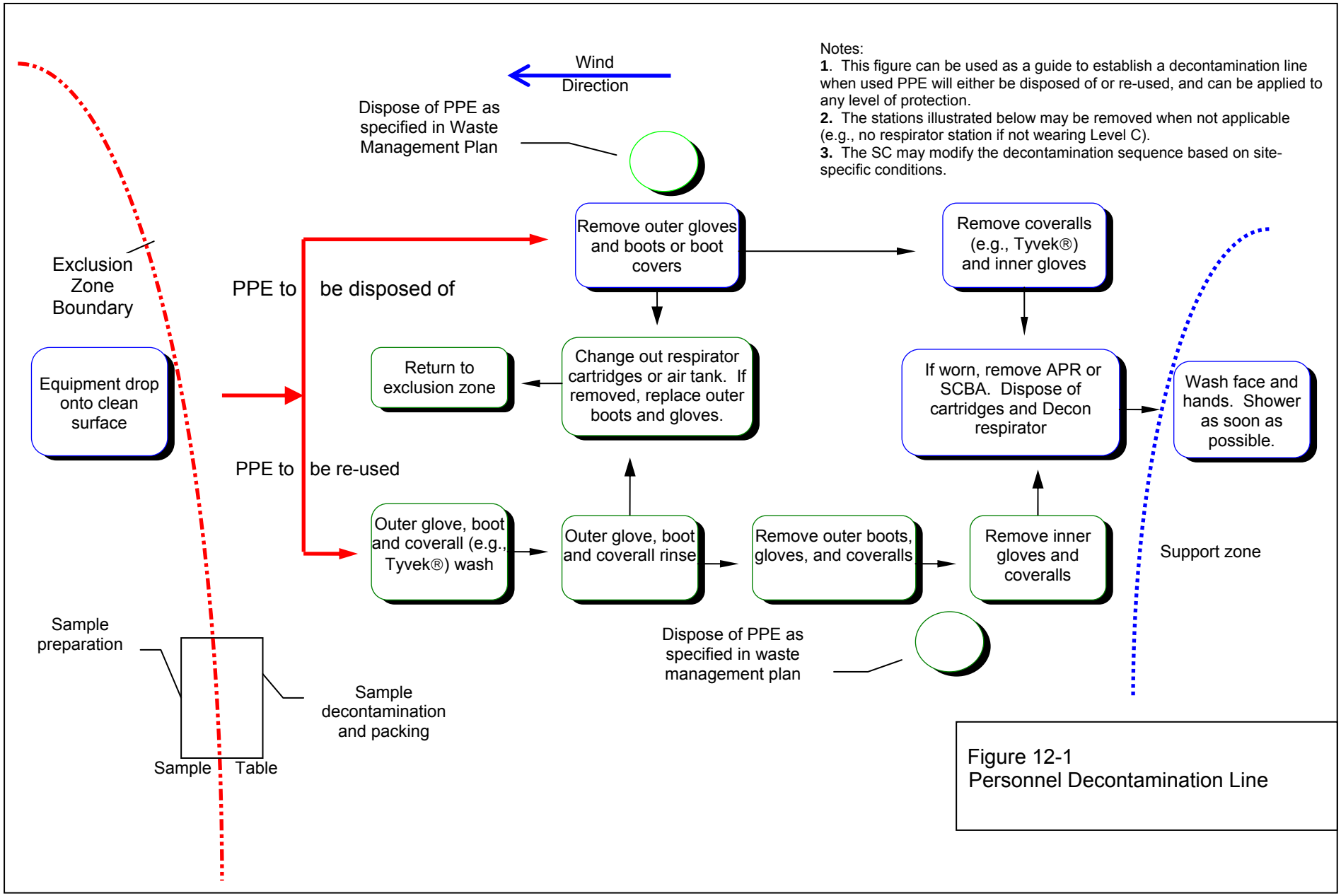
The SSC must establish and monitor the decontamination procedures and their effectiveness. Decontamination procedures found to be ineffective will be modified by the SSC. The SSC must ensure that procedures are established for disposing of materials generated on the site.

Personnel	Sample Equipment	Heavy Equipment
• Boot wash/rinse • Glove wash/rinse • Outer-glove removal • Body-suit removal • Inner-glove removal • Respirator removal • Hand wash/rinse • Face wash/rinse • Shower as soon as possible • Dispose of PPE in municipal trash, or contain for disposal • Dispose of personnel rinse water to facility or sanitary sewer, or contain for offsite disposal	• Wash/rinse equipment • Solvent-rinse equipment • Contain solvent waste for offsite disposal	• Power wash • Steam clean • Dispose of equipment rinse water to facility or sanitary sewer, or contain for offsite disposal

12.3 Diagram of Personnel-Decontamination Line

No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones. The SSC should establish areas for eating, drinking, and smoking. Contact lenses are not permitted in exclusion or decontamination zones.

Figure 12-1 illustrates a conceptual establishment of work zones, including the decontamination line. Work zones are to be modified by the SSC to accommodate task-specific requirements.



Notes:
1. This figure can be used as a guide to establish a decontamination line when used PPE will either be disposed of or re-used, and can be applied to any level of protection.
2. The stations illustrated below may be removed when not applicable (e.g., no respirator station if not wearing Level C).
3. The SC may modify the decontamination sequence based on site-specific conditions.

Figure 12-1
Personnel Decontamination Line

SECTION 13

Emergency Equipment and First Aid

13.1 Emergency Equipment and Supplies

Table 13-1 lists the emergency equipment that will be kept onsite, along with the locations where the equipment will be kept.

TABLE 13-1
Emergency Equipment List and Locations

Emergency Equipment and Supplies	Location
20-class (or two 10-class) A,B,C fire extinguisher	Support Zone/Drill Rig
First aid kit	Support Zone
Eye Wash	Support Zone
Emergency Shower	Support Zone
Potable water	Support Zone
Bloodborne pathogen kit	Support Zone
Additional equipment (specify)	Support Zone

13.2 Medical and First Aid Requirements

Prior to starting site work, the SUXOS, SSC, or UXOSO will arrange with the local medical facility and emergency response personnel to provide prompt medical attention in the event of an accident. The SUXOS, SSC, or UXOSO will identify an area or areas of the project site where aerial medical support can land, if required, and a method of marking that area for identification by the medical team.

13.2.1 First Aid and CPR Training

A minimum of two fully qualified First Aid and CPR-trained individuals will be in the EZ when work is being performed. These individuals will hold certifications in first aid and CPR from the American Heart Association or from an organization with equivalent training. The certificates shall state the date of issue and the length of validity. The qualified individuals will be identified to all personnel onsite during the morning safety briefing.

13.2.2 First Aid Kits

First aid kits will be provided at a minimum in the ratio of 1 for every 25 people onsite. There will be one first aid kit for each individual team conducting operations within the exclusion area. The first aid kits will be type III, 16-unit first aid kit that meets ANSI Z308.1-1998 standards. First aid kits will be easily accessible to all workers, protected from the weather, and each item maintained sterile. The locations will be clearly marked and distributed as appropriate throughout the site.

SECTION 14

Emergency Response and Contingency Procedures

14.1 General

The frequency and severity of emergency situations can be dramatically reduced through proper implementation of the SSHP. However, if an emergency does occur, quick, decisive action will be required since delays in minutes can create or escalate life-threatening situations. In an emergency situation, site personnel involved in emergency response and rescue must be prepared to respond immediately and all required equipment must be on hand, in proper working order, and ready to use. To ensure rapid, effective response to a site emergency, the procedures and contingency plans outlined in this section will be implemented prior to and during the conduct of any site activities involving exposure to HSSE hazards.

14.2 Pre-Emergency Planning

The Emergency Response Coordinator (ERC) performs the applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with CH2M HILL onsite parties, the facility, and local emergency-service providers as appropriate.

- Review the facility emergency and contingency plans where applicable.
- Determine what onsite communication equipment is available (e.g., two-way radio, air horn).
- Determine what offsite communication equipment is needed (e.g., nearest telephone, cell phone).
- Confirm and post emergency telephone numbers, evacuation routes, assembly areas, and route to hospital; communicate the information to onsite personnel.
- Field Trailers: Post “Exit” signs above exit doors, and post “Fire Extinguisher” signs above locations of extinguishers. Keep areas near exits and extinguishers clear.
- Review changed site conditions, onsite operations, and personnel availability in relation to emergency response procedures.
- Where appropriate and acceptable to the client, inform emergency room and ambulance and emergency response teams of anticipated types of site emergencies.
- Designate one vehicle as the emergency vehicle; place hospital directions and map inside; keep keys in ignition during field activities.

- Inventory and check site emergency equipment, supplies, and potable water.
- Communicate emergency procedures for personnel injury, exposures, fires, explosions, and releases.
- Rehearse the Emergency Response Plan (ERP) before site activities begin, including driving route to hospital. Drills should take place periodically but no less than once a year.
- Brief new workers on the ERP.
- The ERC will evaluate emergency response actions and initiate appropriate follow-up actions.

14.3 Personnel and Lines of Authority

- In case of an emergency, the UXOSO or ERC will implement an Incident Command System (ICS) to handle the emergency.
- The UXOSO or ERC will assume command of the incident and act as the Incident Commander (IC) until relieved by outside response agencies if required.
- The SUXOS or ERC will assume the responsibility for operations, which will carry out the ERP as directed by the IC.
- The SUXOS or ERC will assume the role of Site Security, determine the requirements for controlling access to, and egress from the site as required.
- All other personnel will assemble in the designated staging areas and provide assistance as required to assist in the response, mitigation and recovery of the emergency.

14.4 Emergency Recognition and Site Evacuation

14.4.1 Incident Response

In fires, explosions, or chemical releases, actions to be taken include the following:

- Notify appropriate response personnel.
- Shut down CH2M HILL operations and evacuate the immediate work area.
- Account for personnel at the designated assembly area(s).
- Assess the need for site evacuation, and evacuate the site as warranted.
- Implement HSE-111, *Incident Notification, Reporting and Investigation*.
- Notify and submit reports to clients as required in contract.

Small fires or spills posing minimal safety or health hazards may be controlled with onsite spill kits or fire extinguishers without evacuating the site. When in doubt evacuate. Follow the incident reporting procedures in **Section 14.5**.

14.4.2 Emergency Medical Treatment

Emergency medical treatment is needed when there is a life-threatening injury (such as severe bleeding, loss of consciousness, breathing/heart has stopped). When in doubt if an injury is life-threatening or not, treat it as needing emergency medical treatment.

- Notify 911 or other appropriate emergency response authorities as listed in Emergency Contacts at the front of this SSHP.
- The ERC will assume charge during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room.
- Prevent further injury, perform decontamination (if applicable) where feasible; lifesaving and first aid or medical treatment takes priority.
- Initiate first aid and CPR where feasible.
- Notify supervisor and if the injured person is a CH2M HILL employee, the supervisor will call the occupational nurse at 1-866-893-2514 and make other notifications as required by HSE SOP-111, *Incident Notification, Reporting and Investigation*.
- Make certain that the injured person is accompanied to the emergency room.
- Follow the Serious Incident Reporting process in HSE SOP-111, *Incident Notification,* Reporting and Investigation, and complete incident report forms in **Attachment 9**.
- Notify and submit reports to client as required in contract.

14.4.3 Evacuation

- Evacuation routes, assembly areas, and severe weather shelters (and alternative routes and assembly areas) are to be specified on the site map.
- Evacuation route(s) and assembly area(s) will be designated by the ERC or designee before work begins.
- Personnel will assemble at the assembly area(s) upon hearing the emergency signal for evacuation.
- The ERC and a "buddy" will remain on the site after the site has been evacuated (if safe) to assist local responders and advise them of the nature and location of the incident.
- The ERC will account for all personnel in the onsite assembly area.
- A designated person will account for personnel at alternate assembly area(s).
- The ERC will follow the incident reporting procedures in Section 9.7

14.4.4 Emergency Recognition

All personnel entering the EZs will be fully aware of the hazards associated with the project site, the designated EZs, and hazardous materials. All teams will have communication devices with them at all times while in the area. Immediate notification will be made by the fastest means available of any emergency situation.

14.4.5 Evacuation Signals

Audible warnings will be used to alert all project personnel. **Table 14-1** lists the evacuation signals that will be used onsite.

TABLE 14-1
Evacuation Signals

Signal	Meaning
Grasping throat with hand	Emergency. Help me.
Thumbs up	OK, understood.
Grasping buddy's wrist	Leave area now.
Continuous sounding of horn	Emergency; leave site now.

14.4.6 Reporting Areas

Evacuation areas and areas of refuge will be determined based on operational aspects at the project site. Detailed information on evacuation and assembly areas see **Section 15**.

14.4.7 Decontamination and First Aid

The recognized emergency decontamination procedure is to remove contaminated clothing and flush with copious amounts of water. This technique will remove gross contamination from the body and allow emergency care without cross-contamination. Personnel trained in first aid and CPR will be onsite, along with appropriate first aid kits. See **Sections 12 and 13** for specific requirements, equipment, and personnel training.

14.5 Incident Notification and Reporting

(Reference CH2M HILL SOP HSE-111, Incident Notification, Reporting and Investigation)

- If you are injured at work, notify the SSC, UXOSO, and PM immediately. Contact the Injury Management/Return-to-Work toll free number (for U.S. and Puerto Rico) 1-866-893-2514. All PMs must contact their Human Resources Representative and complete the employee injury/illness in the Incident Report Form (IRF) in the HITS database within 24 hours of the incident.
- Immediately notify the PM, ERC, and/or HSM for any project incident (fire, spill/ release, injury/illness, near miss, property damage, or security-related).
- Report any **serious incidents** (life-threatening injury/illness, death, kidnap/missing person, terrorism, property damage greater than $200,000, significant environmental release) **immediately** to your ERC, PM, or HSM. The Serious Incident Reporting number is 720-286-4911.
- For serious incidents, the Corporate Legal Department will determine who completes the IRF.

- For CH2M HILL subcontractor incidents, immediately notify the ERC and HSM to complete and submit an IRF.
- The HSM will inform the PM of any environmental incidents.
- Evaluation and follow-up of the IRF will be completed by the type of incident by the HSM and PM. The Business Group (BG) HSSE Lead will review all BG incidents and modify as required.
- Incident Investigations must be initiated and completed as soon as possible but no later than 72 hours after the incident.

14.5.1 Investigation Requirements

The ERC/UXOSO shall proceed to the scene of the incident, take charge of the situation to prevent further injury or damage, and arrange first aid or medical treatment for the injured. The ERC/UXOSO shall ensure that no equipment, material, or other evidence of the incident is removed unless essential to prevent further injury or damage. The PM will also carry out an initial investigation of the incident.

The cause of loss and near loss incidents are similar, so by identifying and correcting the causes of near loss incidents, future loss incidents may be prevented. The following is the Loss/Near Loss Investigation Process:

- Gather all relevant facts, focusing on fact-finding, not fault-finding.
- Answer the "who, what, when, where, and how" questions.
- Put facts together into a probable scenario.
- Determine incident root cause(s), which are basic causes on why an unsafe act/condition existed.
- Develop and implement solutions, matching all identified root causes with solutions.
- Communicate incident as a lesson learned to all project personnel.
- Follow up on implemented corrective active action to confirm solution is appropriate.

The ERC/UXOSO shall perform an incident investigation, as soon as practical after the incident, for all loss and near loss incidents that occur on the project. Loss incident investigations shall be performed in accordance with corporate policy. The following forms must be completed:

- Incident Report Form (**Attachment 9**)
- Root Cause Analysis Form (**Attachment 10**)

Provide a description of the event and the sequence of events and actions that took place prior to the incident. Start with the incident event and work backwards in time through all of the preceding events that directly contributed to the accident.

The ERC/UXOSO will maintain copies of all incident reports and root cause analysis for the MR group to assist in program review, incident accident trends and future training

requirements. The MR Safety QC Officer will evaluate the ERC/UXOSO investigation report and ensure that the report adequately addresses the facts and circumstances of the incident, the causes, and recommended corrective actions.

14.5.2 Analysis

The accident analysis is essential if all causes of the incident are to be identified for the correct remedial actions to be taken to prevent the same and similar type of incident from recurring. The investigation team will consist of the ERC/UXOSO, PM, and applicable project staff. The Root Cause Analysis Form (**Attachment 10**) must be completed for all loss incidents and near loss incidents. This form must be submitted to the investigation team for review.

The ERC/UXOSO must use the Root Cause Analysis Flow Chart (**Attachment 10**) to assist in identifying the root cause(s) of a loss. Any loss may have one or more root causes and contributing factors. The root cause is the primary or immediate cause of the incident, while a contributing factor is a condition or event that contributes to the incident happening, but is not the primary cause of the incident. Root causes and contributing factors that relate to the person involved in the loss, his or her peers, or the supervisor should be referred to as "personal factors." Causes that pertain to the system within which the loss or injury occurred should be referred to as "job factors."

Personal Factors

- Lack of skill or knowledge
- Correct way takes more time and/or requires more effort
- Short-cutting standard procedures is positively reinforced or tolerated
- Person thinks there is no personal benefit to always doing the job according to standards

Job Factors

- Lack of or inadequate operational procedures or work standards
- Inadequate communication of expectations regarding procedures or standards
- Inadequate tools or equipment

The root cause(s) could be any one or a combination of these seven possibilities or some other uncontrollable factor. In the vast majority of losses, the root cause is very much related to one or more of these seven factors. Uncontrollable factors should be used rarely and only after a thorough review eliminates all seven other factors.

14.5.3 Corrective Actions

Include all corrective actions taken or those that should be taken to prevent recurrence of the incident. Include the specific actions to be taken, the employer and personnel responsible for implementing the actions, and a time frame for completion. Be sure the corrective actions address the causes.

Once the investigation report has been completed, the PM shall hold a review meeting to discuss the incident and provide recommendations. The SUXOS shall be assigned to carry out the recommendations and shall inform the ERC/UXOSO upon successful implementation of all recommended actions.

14.6 Non-emergency Injuries and Illnesses

If there is a non-emergency injury or illness that requires medical care, call 800-756-1130 to discuss the incident with an occupational nurse *before* transporting the individual to a medical care facility.

The Occupational Injury Nurse will provide guidance on appropriate treatment options (triage). If instructed to visit a medical facility by the Occupational Nurse, the Supervisor is responsible for instructing the injured employee to take a copy of the *CH2M HILL Initial Medical Treatment Form* with them to the physician, clinic or hospital. Appropriate treatment details are handled by the Occupational Injury Nurse, and Workers Compensation Groups. Nurse communicates and troubleshoots with and for employee through full recovery.

14.7 Emergency Contacts

24-hour CH2M HILL Serious Incident Reporting Contact/Pager – 720-286-4911		
If injured on the job, notify your supervisor and then call 1-866-893-2514 to contact CH2M HILL'S Occupational Nurse		
Hospital ER (On-Base)#: Onslow County ER (Off-Base)#: Ambulance (On-Base)#: Ambulance (Public) #: LEPC (Poison Control) #:	(910) 451-4840 (910) 451-4841 (910) 451-4842 (910) 577-2240 (910) 451-3004 (910) 451-3005 (910) 451-9111 (800) 222-1222	**CH2M HILL- Medical Consultant** WorkCare Dr. Peter Greaney M.D. 300 S. Harbor Blvd, Suite 600 Anaheim , CA 92805 800-455-6155 714-978-7488
Fire/Spill Emergency – Base Fire Response #:	911 or (910) 451-9111	**CH2M HILL Director Security Operations** **Thomas Horton/DEN** 720/273-3100 (cell) or 720/286-0022 (office)
Security & Police – Base Security #: Base Range Control#	911 or (910) 451-2555 (910) 451-1236	**Responsible HSM** Name: Michael Goldman/ATL Phone: (770) 604-9182 x54133 Cell: 770/331-3127
On-Scene Coordinator Name: Phone:	 Fire Chief (910) 451-5815	**Human Resources:** Name: John Monark/COR Phone: (303) 771-0900
Utilities Emergency Water Gas: EMD Electric	 Contact Base	**Worker's Compensation:** Contact Business Group HR dept. to have form completed or contact Jennifer Rindahl after hours: (720)891-5382
Safety Coordinator (SSC) Name: Phone:	 TBD	**Media Inquiries Corporate Strategic Communications** Name: John Corsi Phone: (720) 286-2087
Project Manager Name: Phone: Cell: 704-975-9381	 Keri Hallberg 704-543-3260	**Automobile Accidents** Rental: Linda Anderson/COR 720/286-2401 CH2M HILL owned vehicle: Linda George 720-286-2057
FedEx Dangerous Goods Shipping **Phone:**	 **800/238-5355**	**CH2M HILL Dangerous Goods Shipping** Phone: 800/255-3924
Facility Alarms: TBD		Evacuation Assembly Area(s): TBD

Directions to Local Hospital

Local Hospital

Facility/Site Evacuation Route(s): follow main roads towards access gates and off the Base

Route to Hospital: (Refer to Figure)

Directions to **Onslow County Memorial Hospital** from Site UXO-06

Head Northeast on Gonzalez Blvd.

Take a right on McHugh Blvd

Turn left on Sneads Ferry Rd

Merge right onto Holcomb Boulevard and follow for approximately 5 miles

Turn left at NC 24 and follow for approximately 2 miles.

Turn right on Western Blvd and follow for approx. 1.3 miles until you reach the hospital at **317 Western Blvd.**

SECTION 15

Emergency Response Plan

15.1 Operations

During the development of this SSHP, attention was given to identifying potential HSSE hazards associated with the conduct of site activities. Once identified, these hazards were assessed to determine the risk that they could result in an emergency situation. Contingency plans for responding to potential emergency situations have been developed and are included in this section. The potential emergencies that may result during the conduct of site activities are as follows:

- Injury or illness
- Fire and/or explosion
- Inclement weather

15.2 Pre-emergency Planning

See **Section 14.2**

15.3 Personnel Roles, Lines of Authority and Communication

See **Section 14.3**

15.4 Emergency Recognition and Prevention

All personnel entering the EZs will be fully aware of the hazards associated with the project site, the designated EZs, and the hazardous materials/explosive storage areas. All teams will have communication devices with them at all times while in the area.

15.4.1 Injury or Illness

In the event of an emergency involving personal injury or illness, immediate response will be key in preventing further injury or illness and providing comfort to the affected party. When EZ personnel are injured or overcome by illness, the following procedure will be followed:

- Upon notification of the occurrence and the nature of the injury or illness, the ERC/UXOSO will, if deemed necessary, summon emergency personnel.
- EZ personnel will transport the victim to the rally point using the stretcher.
- The ERC/UXOSO will assess the severity of the injury or illness and, if necessary, direct the EZ personnel to provide immediate life support.

- If immediate life support is not required or once the victim is stabilized, transport the victim to the appropriate medical facility for further attention.

The following actions should be taken to obtain assistance in a major medical emergency:

- **Call (911) immediately if a major injury or life threatening injury occurs and request assistance.**
- State the nature of the emergency and specific location of the injured person.
- Perform decontamination in accordance with project procedures, if the injured person will not be harmed.

15.4.2 Fires

The person who first detects smoke or fire will immediately notify the ERC/UXOSO or SUXOS by the fastest means available.

Fire Extinguishers

The occurrence of a fire onsite can present a serious threat to all site personnel, the environment, and the general public. To ensure an immediate, aggressive response, dry-chemical-type fire extinguishers will be available at each work site. Dry-chemical fire extinguishers will also be provided at any other site location where flammable materials may present a fire risk, such as the petroleum, oil, and lubricant (POL) storage area. Additionally, a fire extinguisher that is rated at least 2A:10B:C will be located with each piece of heavy equipment and in each site vehicle. The ERC/UXOSO will inspect fire extinguishers weekly and record the results.

Small Fires

A small fire is defined as a fire that can be extinguished with a 4A:20B:C-type fire extinguisher. In the event of a small fire, site personnel will take the following actions:

- Evacuate all unnecessary personnel from the immediate area to an upwind location.
- Extinguish the fire using portable fire extinguishers or by smothering from an upwind location.
- Request emergency response assistance (fire, ambulance, police), as needed.
- Do not attempt to extinguish a fire, even a small one, involving explosives.
- Notify the ERC/UXOSO.

Large Fires

In the event of a large fire or small fire that cannot be extinguished, the following actions will be taken:

- Evacuate all unnecessary personnel from the site to an upwind location;
- Notify emergency response services (fire, police, ambulance, hospital), as needed.

- If it can be done safely, the ERC/UXOSO will direct personnel to move vital equipment/supplies from the fire path.
- The ERC/UXOSO will order the appropriate level of protective clothing to be worn by personnel fighting the fire.
- To the extent possible and with available resources, fight the fire from an upwind location.
- At no time will attempts be made to extinguish a fire involving explosives.
- Notify the site authority.

15.4.3 Explosion

If a detonation is heard or seen that has not been previously announced with an audible warning, report it immediately to the ERC/UXOSO or SUXOS by the fastest means available. In the event of an explosion, all nonessential personnel will evacuate and help secure the site; the ERC/UXOSO will request the required support equipment and personnel and ensure proper authorities are notified. It is essential that the site be evacuated and that no one is allowed to re-enter, except to possibly save a life, until at least 30 minutes or longer if necessary after the explosion. The ERC/UXOSO will determine what actions, if any, are appropriate.

15.4.4 Inclement Weather

Sudden inclement weather can rapidly encroach upon field personnel. Preparedness and caution are the best defenses. Field crew members performing work outdoors should carry clothing appropriate for inclement weather. Personnel are to take heed of the weather forecast for the day and pay attention for signs of changing weather that indicate an impending storm. Signs include towering thunderheads, darkening skies, or a sudden increase in wind. If stormy weather ensues, field personnel should discontinue work and seek shelter until the storm has passed.

Protective measures during a lightning storm include seeking shelter; avoiding projecting above the surrounding landscape (don't stand on a hilltop--seek low areas); staying away from open water, metal equipment, railroad tracks, wire fences, and metal pipes; and positioning people several yards apart. Some other general precautions include:

- Know where to go and how long it will take to get there. If possible, take refuge in a large building or vehicle. Do not go into a shed in an open area.
- The inclination to see trees as enormous umbrellas is the most frequent and most deadly mistake. Do not go under a large tree that is standing alone. Likewise, avoid poles, antennae and towers.
- If the area is wide open, go to a valley or ravine, but be aware of flash flooding.
- If you are caught in a level open area during an electrical storm and you feel your hair stand on end, drop to your knees, bend forward and put your hands on your knees or crouch. The idea is to make yourself less vulnerable by being as low to the ground as

possible and taking up as little ground space as possible. Lying down is dangerous, since the wet earth can conduct electricity. Do not touch the ground with your hands.

- Do not use telephones during electrical storms, except in the case of emergency

Remember that lightning may strike several miles from the parent cloud, so work should be stopped/restarted accordingly. The lightning safety recommendation is 30-30: Seek refuge when thunder sounds within 30 seconds after a lightning flash; and do not resume activity until 30 minutes after the last thunder clap.

- High winds can cause unsafe conditions, and activities should be halted until wind dies down. High winds can also knock over trees, so walking through forested areas during high-wind situations should be avoided. If winds increase, seek shelter or evacuate the area. Proper body protection should be worn in case the winds hit suddenly, because body temperature can decrease rapidly.

15.4.5 Other Unanticipated Hazards

If other unanticipated hazards are encountered, immediately report them to the SSC or UXOSO by the fastest means available and take measures to prevent others from being exposed to the hazards until further instructions or directions are received.

15.5 Safe Distances and Places of Refuge

The SSC or UXOSO will identify daily the safe distances and areas of refuge based on the types and hazards of site activities for the day. This information will be announced at the morning safety briefing and annotated on the site maps, which the teams will have in their vehicles.

All personnel operating in the EZ must be aware of their required safety distances and areas of refuge in case of an emergency. The optimum place of evacuation and refuge is the field office trailer; however, due to having multiple teams working in the exclusion area, it may not be feasible to have all team members report there.

The SSC or UXOSO will determine the safe EZ distances for emergencies involving explosives or MEC and communicate the information over the radio to all teams.

15.6 Site Security and Control

The SSC or SUXOS will secure the site and prevent entry by non-essential personnel. The SSC or UXOSO will initiate personnel accountability with the site sign in and visitor roster to account for all personnel. As soon as accountability is completed, the SSC or SUXOS will be notified.

If local law enforcement is involved in the emergency response, site security will be turned over to the on-scene supervisor with a briefing by the SSC or UXOSO of the situation and current security in place.

15.7 Evacuation Routes and Procedures

See **Section 14.4.3**

15.8 Decontamination

See **Section 14.4.7**

15.9 Emergency Medical Treatment and First Aid

See **Section 14.4.2**

15.10 Emergency Alerting and Response Procedures

All teams within the exclusion areas will have communications with the SSC or UXOSO. There will be an audible warning device available to warn personnel of an emergency onsite, which will be immediately followed by directions over the radio. To prevent confusion, all personnel should restrict their use of the radio during the initial period of the emergency.

Emergency response procedures include all steps to be taken for notifying, evaluating, reacting to, documenting and following up on a given emergency situation. To ensure all necessary elements are covered, the procedural steps outlined in this paragraph will be implemented for each emergency, regardless of its nature.

15.10.1 Notification

Once the SSC or UXOSO has been informed of the emergency, the SSC or UXOSO will alert site personnel to the presence of the emergency by radios. This will be done in order to:

- Notify personnel and to get their attention.
- Stop all work activity as required.
- Lower noise levels in order to speed and simplify communication.
- Begin emergency and/or evacuation procedures.
- Begin site log of all emergency procedures and communications.

If onsite personnel or offsite emergency personnel are to enter the site in response to the emergency, the SSC or UXOSO will, to the extent possible, notify the response personnel about the nature of the emergency, including the following information:

- What happened and when it happened.
- Where onsite the emergency situation occurred.
- Who is involved and, if possible, the cause of the emergency.
- Extent of damage and what hazards may be involved.
- What actions should be taken.

15.10.2 Assessing the Emergency

Available information related to the emergency and the onsite response capabilities should be evaluated and the following information obtained to the best extent possible:

- What happened
- Type of incident
- Casualties involved
- Victims (number, location and condition)
- Treatment required
- Missing personnel
- Cause of incident
- Extent of damage to structures, equipment and terrain
- What could happen from this point
- Potential for fire or explosion
- Location of all personnel in relation to hazardous areas
- Potential for emergency affecting the general public or the environment
- What can be done to remediate the situation
- Equipment and personnel needed for rescue and hazard mitigation
- Number of uninjured personnel available for response
- Resources available onsite
- Resources available from offsite response groups and agencies
- Time needed for offsite response resources to reach the site
- Hazards involved in rescue and response

15.10.3 Rescue and Response Actions

Based on the information collected during the emergency assessment, the general actions listed below will be taken, with some actions being conducted concurrently. No one will attempt emergency response/rescue until the situation has been assessed and the appropriate response outlined by the SSC or UXOSO.

Enforce the Buddy System

- Allow no one to enter a hazardous area without a partner.
- Personnel in the EZ should be in line-of-sight or in communication with the SSC, UXOSO, or their designee.

Survey Casualties

- Locate all victims and assess their condition
- Determine resources needed for stabilization and transport
- Assess existing and potential hazards and determine
  - Whether and how to respond
  - The need for evacuation of site personnel and off-site population
  - The resources needed for evacuation and response

Request Aid

- Contact the required offsite/onsite personnel or facilities, such as ambulance, fire department, and police.

Allocate Resources

- Allocate onsite personnel and equipment to rescue and initiate incident response operations.
- Control the site.
- Assist in bringing the hazardous situation under complete or temporary control and use measures to prevent the spread of the emergency (e.g., control fire, secure site).

Extricate

- Remove or assist victims from the area.

Stabilize

- Administer any medical procedures that are necessary before the victims can be moved.
- Stabilize or permanently fix the hazardous condition.
- Attend to what caused the emergency and anything damaged or endangered by the emergency (e.g., drums, tanks).

Transport

- Use either onsite or offsite assets.
- Log casualties.
- Record who, time, destination and condition upon transport.

Evacuate

- Move site personnel to the rally point, a safe distance upwind of the incident.
- Monitor the incident for significant changes; the hazards may diminish, permitting personnel to re-enter the site, or hazards may increase and require public evacuation.

Casualty Tracking

- Record disposition, condition and location.

15.11 Critique and Follow-Up

15.11.1 Post Emergency Follow-Up

Before normal site activities can resume, the site and personnel must be prepared and equipped to handle another emergency. It is also imperative that all federal, state and local regulatory agencies be notified of the emergency. Therefore, the following activities must be conducted prior to re-start of site activities:

- Notify all appropriate governmental agencies as required (i.e., OSHA must be notified if there have been any fatalities or three or more personnel hospitalized).
- Restock and clean all equipment and supplies used or damaged in the emergency.
- Conduct an accident investigation to determine the cause of the emergency and what preventive measures could be taken to ensure the emergency does not occur again.
- Complete the CH2M HILL accident or insurance forms.
- Review and revise, as needed, the site operational procedures, and if necessary, update the SSHP to reflect the new procedures.
- Re-start site activities.

15.11.2 Documentation

Documentation related to the emergency will be recorded in an accurate, authentic, and complete fashion. A log should have been started immediately after initial notification. All other documentation shall be recorded as soon as possible after the emergency to ensure it is recorded while the events are vivid in the minds of the personnel involved. The information recorded will include:

- Chronological record of events
- Listing of the personnel involved, including personnel onsite, site personnel who responded, personnel in charge, and offsite groups or agencies that responded
- Listing of the actions taken to minimize the effects of or mitigate the emergency
- Assessment of the potential exposures received by site personnel and the surrounding public
- Recording of the injuries or illnesses that occurred as a result of the emergency

After the emergency is over and the site has been restored to operations, the ERC/UXOSO and SUXOS and field team members will hold a formal critique of their response actions, document lessons learned, time lines and identify good behaviors and deficiencies that can be corrected. This information will be utilized to refine the ERP and for the accident/ incident investigation team.

15.12 PPE and Emergency Equipment

The emergency equipment that will be onsite is displayed on Table 13-1. Emergency equipment available for use during normal operations. The team support vehicle will be designated as an emergency vehicle. All emergency equipment will be maintained in proper working order and inspected by the ERC/UXOSO at least weekly to ensure completeness and proper working order. The results of the inspection will be documented on the Safety Inspection Control Log. In the event that any of the disposable items are utilized, the SUXOS or ERC will ensure they are replaced immediately. Site operations will not be conducted if the required emergency equipment is not available and in working condition onsite.

SECTION 16

Emergency Response Teams

No Emergency Response Teams (ERT) will be required for this project site.

SECTION 17

Confined Space Entry

No confined spaces have been identified on this project site.

SECTION 18

Logs, Reports and Recordkeeping

18.1 Self-assessment Checklists

The SSC or UXOSO is responsible for completing the CH2M HILL self-assessment checklists for each covered activity at least weekly. All sections marked "NO" will be explained in the comments section, and the date that the corrective action was completed will be annotated when done. These documents will be maintained as part of the project file and returned to the PM, along with all other HSSE documents and records, at the completion of the project.

18.2 Daily Safety Inspection Logs

The SSC or UXOSO will perform daily site inspections to ensure that project activities are being performed in accordance with the SSHP. Any HSSE deficiencies observed during the daily site inspection will be corrected immediately or that specific work operation will be suspended until it is in compliance with the SSHP requirements. Results of these inspections will be documented daily in the field logbook. Any HSSE deficiency or noncompliant observation will be discussed during the next day's safety meeting.

The SSC or UXOSO will also perform weekly HSSE inspections to confirm specific project activities are performed in compliance with the SSHP's hazard control procedures. All deficiencies and corrective actions, along with the date they were taken or required to be taken will be documented in the self-assessment checklists at the time of the inspection. The UXOSO or SSC will confirm that all deficiencies are closed out with appropriate corrective actions. Copies of these inspection checklists will be maintained on file at the project location.

18.3 Reports and Forms

18.3.1 Visitor's Log

The Visitor's Log will be maintained by the SUXOS. The log will document the visitor's name, company name, date, time, and reason for visit. There will also be documentation that the visitor was given a visitor safety briefing by the SUXOS or UXOSO prior to being permitted to enter the EZ of the site.

18.3.2 Medical Surveillance Records and Certifications

A copy of the Physician Statement from a licensed physician who is certified in Occupational Medicine by the American Board of Preventive Medicine regarding the current annual HAZWOPER physical examination will be maintained in the personnel folder with the other HAZWOPER certificates.

18.3.3 Incident Reporting Forms

The CH2M HILL HITS are required to be submitted for any accident or incident occurring onsite or involving any CH2M HILL employee, subcontractor, equipment or property.

SECTION 19

Approval

This SSHP has been written for use by CH2M HILL only. CH2M HILL claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. The plan is written for the specific site conditions, purposes, dates, and personnel specified, and must be amended if those conditions change.

19.1 Original Plan

Written By: David Seed _____ Date: June 15, 2009

Approved By: Dan Young_____ Date: June 24, 2009

Approved By: Michael Goldman _____ Date: June 22, 2009

19.2 Revisions

Revisions Made By: _____ Date: _____

Revisions to Plan: _____ Date: _____

Revisions Approved By: _____ Date: _____

19.3 Attachments

1. Employee Signoff Form - Site Safety and Health Plan
2. Task Specific Activity Hazard Analyses (AHAs)
3. Pre-Task Safety Plan Form
4. Safe Work Observation Form
5. Tick Fact Sheet
6. HSSE Self Assessment Checklist-Drilling
7. HAZCOM Specific Training Forms
8. Chemical Inventory/Register Form
9. Incident Report Form
10. Root Cause Analysis Form/Flow Chart

CH2M HILL Health and Safety Plan

Attachment 1

Health and Safety Plan Employee Sign-off Form

EMPLOYEE SIGNOFF FORM

Health and Safety Plan

The CH2M HILL project employees and subcontractors listed below have been provided with a copy of this HSP, have read and understood it, and agree to abide by its provisions.

Project Name: CTO-0011 Focused Site Inspection Site UXO-06 BPEA **Project Number:** 377812

EMPLOYEE NAME (Please print)	**EMPLOYEE SIGNATURE**	**COMPANY**	**DATE**

CH2M HILL Health and Safety Plan

Attachment 2

AHAs

TASK ORDER 011 MCB CAMP LEJEUNE

ACTIVITY HAZARD ANALYSIS – Mobilization/Site Preparation

Task Breakdown	Potential Hazards	Critical Safety Practices	Personal Protective Clothing and Equipment
Mobilization/Site Preparation	Manual Lifting	CH2M HILL personnel must notify supervisors or safety representatives of preexisting medical conditions that may be aggravated or re-injured by lifting activities. When lifting objects, lift using knees not back. For repetitive lifting tasks, the use of lifting braces/supports may be considered. If heavy equipment isn't available to have someone assist with the lift— especially for heavy (> 40lbs.) or awkward loads. Use heavy equipment to transfer heavy or awkward loads wherever possible. Plan storage and staging to minimize lifting or carrying distances. Make sure the path of travel is clear prior to the lift. Avoid carrying heavy objects above shoulder level. Do not climb on objects not designed for access by personnel without proper fall protection.	Standard Level D PPE * * Work clothes, reflective vests/ high visibility clothing, hard hat, safety glasses and sturdy hard toed work boots, hand and hearing protection, as dictated by task.
	Slips, Trips, Falls	Be aware of poor footing, potential slipping/tripping hazards in the work area, such as wet/steep slopes, stumps/roots, unprotected holes, ditches, rip rap, utilities, ground protrusions. Observe, mark and avoid these identified site areas. Use sturdy, hard toe work boots with sufficient ankle support. Institute and maintain good housekeeping practices.	Standard Level D PPE *
	Noise	Personnel exposed to loud working environments shall wear hearing protection.	Standard Level D PPE *
	High Ambient Temperature	Provide fluids to prevent worker dehydration. Monitor for heat stress in accordance with HSP (maintain use of buddy system). Institute a proper work-break regiment to avoid heat stress symptoms and overexertion.	Standard Level D PPE (light colored/weight, breathable clothing)
	Fire Prevention	Use only metal safety cans for storage and transfer of fuel. Secure flammable storage lock-up (vented) for flammable/combustible material storage. Use funnels and nozzles during fueling operations. Appropriately sized, easily accessible ABC fire extinguisher in work area. Review and be cognizant of MCB LEJUENE Fire Prevention Procedures and Requirements	Standard Level D PPE *
	Visible Lighting	Perform tasks in daylight hours whenever possible. If dawn, dusk or dark work is to be performed portable lighting must be provided to sufficient illuminate work area(s). Do not enter poorly lit areas without first providing portable illumination.	Standard Level D PPE *

TASK ORDER 011 MCB CAMP LEJEUNE

ACTIVITY HAZARD ANALYSIS – Mobilization/Site Preparation

Task Breakdown	Potential Hazards	Critical Safety Practices	Personal Protective Clothing and Equipment
Mobilization/Site Preparation (continued)	Biological	Observe areas for presence of stinging or biting or stinging insects and nests such as spiders (widows/recluse), bee/wasp hives, fire ants mounds etc. Prior to starting field activities, notify supervisors of known allergies to stinging insects and location and quantity of antidote in the event the employee becomes incapacitated as a result of an insect bite. Observe work area for presence of snakes (cottonmouth as primary, copperhead and rattlers as secondary). Observe wetland/creek, river areas for presence of alligators (nests, eggs) Frequently check body and clothing for ticks, chiggers, spiders. Protect yourself from and avoid exposure to blood bourn pathogens when administering first aid. Exposure to some insect and reptile biological hazards may be temperature dependant.	Standard Level D PPE *
	Cuts & Abrasions	Wear long sleeve clothing and proper PPE (eye protection, hard hats, leather gloves, sturdy hard toe boots) when traversing through wooded areas.	Standard Level D PPE *
	Struck/pinched	Wear reflective warning vests or high visibility clothing in traffic areas or around operating heavy equipment. Isolate equipment swing areas from workers, fixed objects or other equipment. Make/maintain eye contact with heavy equipment and haul truck operators before approaching. Do not approach equipment or haul trucks from rear or from blind spot of operator. Understand and review hand signals. Designate one person to provide hand signals to equipment and haul truck operators. Ensure equipment and haul trucks have operable back-up alarms. Avoid positioning between fixed objects and operating equipment.	Standard Level D PPE *

TASK ORDER 011 MCB CAMP LEJEUNE

ACTIVITY HAZARD ANALYSIS – Mobilization/Site Preparation

Task Breakdown	Potential Hazards	Critical Safety Practices	Personal Protective Clothing and Equipment
Mobilization/Site Preparation (continued)	Biological	Observe areas for presence of stinging or biting or stinging insects and nests such as spiders (widows/recluse), bee/wasp hives, fire ants mounds etc. Frequently check body and clothing for ticks, chiggers, spiders. Prior to starting field activities, notify supervisors of known allergies to stinging insects and location and quantity of antidote in the event the employee becomes incapacitated as a result of an insect bite. Observe work area for presence of snakes (cottonmouth as primary, copperhead and rattlers as secondary). Observe wetland/creek, river areas for presence of alligators (nests, eggs) Protect yourself from and avoid exposure to blood bourn pathogens when administering first aid. Consider utilizing insect repellent. For personnel sensitive to skin rashes, consider the use of products with lower s DEET concentrations such as “children’s cutters” or “skin so soft” products.	Standard Level D PPE *

TASK ORDER 011 MCB CAMP LEJEUNE

ACTIVITY HAZARD ANALYSIS – Mobilization/Site Preparation

Task Breakdown	Potential Hazards	Critical Safety Practices	Personal Protective Clothing and Equipment
Mobilization/Site Preparation (continued)	Electric Hazards	If/when electrical extension cords are required to complete work, extension cords must be: - Equipped with third-wire grounding. - Covered, elevated, or protected from damage when passing through work areas. - Protected from pinching if routed through doorways. - Not fastened with staples, hung from nails, or suspended with wire. - Extension cords and electrical power tools, must have ground fault circuit interrupters (GFCIs) installed. - Rated to handle the voltage/amperage of equipment. Power tools will be inspected prior to use, and damaged tools will be tagged and removed from service. Do not set power tools down in muddy or wet areas which may damage the tool and/or or create a potential for electric shock. Only qualified personnel are permitted to work on unprotected energized electrical systems. Do not access electrical wiring or systems unless qualified to do so. All electrical wiring and equipment must be considered energized until hazardous energy control procedures (i.e. lock-out/tag-out) are implemented. Maintain proper separation between Power Transmission Lines and over overhead utilities. See Electric Safety section in HSP for references to proper separation between operating equipment and power transmission lines/overhead utilities. Do not swing excavator boom toward overhead utilities. Be cognizant of the positions of existing utility pole guy wires and transformers.	Standard Level D PPE *

TASK ORDER 011 MCB CAMP LEJEUNE

ACTIVITY HAZARD ANALYSIS – Mobilization/Site Preparation

Task Breakdown	Potential Hazards	Critical Safety Practices	Personal Protective Clothing and Equipment
Mobilization/Site Preparation (continued)	Heavy Equipment	Seat belts or other restraint system shall be used by heavy equipment operators. Perform daily maintenance and inspections on operating equipment. Keep documentation on site. Use caution around pressurized lines/hoses. Inspect hoses daily for cuts, abrasions and wear. Ensure equipment has operable back-up alarms. Equipment shall only be operated by personnel qualified by prior training or experience, or when in training under the guidance and supervision of a designated person. Ensure that a stable ground surface is available for the operation of heavy equipment. No one shall be allowed to walk under or in front of suspended loads (excavator/loader bucket). Loads shall not be lifted over ground personnel. Equipment operators shall not leave the cab of the equipment while they are lifting/controlling a load unless the load has been delivered to its intended transport location or the load has been fully secured (no potential for rolling onto or crushing ground personnel) and the equipment and controls are fully secured/disengaged and equipment is “de-energized”.	Standard Level D PPE *
	Other	Always using a seat belt while driving on military/government facilities. Always observe posted speed limits, traffic signs and signals. Never using a cell phone or two way radio while driving on military/government facilities. Violating these rules may result in loss of military/government facility driving privileges. Drive 5 mph when driving past troops on maneuvers. If drive past troops on maneuvers could interrupt their activities, vehicle drivers are to bring vehicles to a complete stop in a safe location and yield to troop activities. Shut down operations in heavy rain, wind and/or lightning. At first sight of lightning, operations shall be stopped and only resumed when conditions permit. The lightning safety recommendation is 30-30: Seek refuge when thunder sounds within 30 seconds after a lightning flash; and do not resume activity until 30 minutes after the last thunder clap. Buddy System maintained for all phases of work. Base or local Emergency Dispatch numbers programmed into cellular phones. Have hospital route maps readily available. Report all conditions which may create accidents, injury, illness or property damage to supervisors immediately.	NA

	PRINT	SIGNATURE	
Supervisor Name:	_____	_____	**Date/Time:**_____
Safety Officer Name:	_____	_____	**Date/Time:**_____
Site Personnel:	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
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	_____	_____	**Date/Time:**_____

TASK ORDER 011 MCB CAMP LEJEUNE

ACTIVITY HAZARD ANALYSIS –Sampling

Task Breakdown	Potential Hazards	Critical Safety Practices	Personal Protective Clothing and Equipment
Sampling	Chemical Exposure	Review contaminants of concern for the project and consult project specific HSP for proper dermal and respiratory protection. All personnel performing this task shall be trained in accordance with 29CFR1910.120/29CFR1926.65 and be deemed “fit for duty” and cleared to wear a respirator by a licensed occupation physician. Follow PPE and action monitoring level requirements identified in the sections 5.0 and 6.0 of the HSP. Do not allow dermal contact or incidental ingestion of contaminated materials. Do not kneel or step in soil cuttings or drilling fluids. Exercise good hygiene practices. Always wash hands and then face before eating, drinking, smoking and leaving site. Only eat, drink, smoke or chew tobacco in designated areas that that are not subject to Hazwoper regulated operations. Practice “no hand-face” contact at all times. Caution should be exercised when filling bottles containing acid or base preservatives. Both liquid and vapor phases of acid can cause severe burns. Following sample collection, sample container lids should be tightened securely to prevent any leaks, and the containers should be rinsed with clean water to ensure that they are free of chemical constituents. Follow appropriate sampling equipment decontamination procedures.	Modified Level D_1 or D_2 PPE or as required by HSP * (See Skeet requirements) * D: Work clothes, reflective vests, hard hat, safety glasses and sturdy hard toed work boots, hearing and hand protection as necessary for task. D_1 : D + hand protection (inner and outer chemical resistant gloves) D_2: D_1+ chemical resistant suits and boot covers, face protection (as needed)
	Slips, Trips, Falls	Institute and maintain good housekeeping practices. Be aware areas of poor footing, potential slipping/tripping hazards in the work area. Identify and avoid these areas and unprotected holes, ditches, rip rap, utilities, curbing or ground protrusions. Use sturdy hard toe work boots with sufficient ankle support.	Modified Level D_1 or D_2 PPE or as required by HSP *
	High Ambient Temperature	Provide fluids to prevent worker dehydration. Monitor for heat stress in accordance with HSP (maintain use of buddy system). Institute a proper work-break regiment to avoid heat stress symptoms and overexertion.	Modified Level D_1 or D_2 PPE or as required by HSP * (light colored/weight, breathable clothing)

TASK ORDER 011 MCB CAMP LEJEUNE

ACTIVITY HAZARD ANALYSIS –Sampling

Task Breakdown	Potential Hazards	Critical Safety Practices	Personal Protective Clothing and Equipment
Sampling (cont.)	Manual Lifting	CH2M HILL personnel must notify supervisors or safety representatives of preexisting medical conditions that may be aggravated or re-injured by lifting activities. When lifting objects, lift using knees not back. For repetitive lifting tasks, the use of lifting braces/supports may be considered. If heavy equipment isn't available to have someone assist with the lift— especially for heavy (> 40lbs.) or awkward loads. Use heavy equipment to transfer heavy or awkward loads wherever possible. Plan storage and staging to minimize lifting or carrying distances. Make sure the path of travel is clear prior to the lift. Avoid carrying heavy objects above shoulder level.	Modified Level D_1 or D_2 PPE or as required by HSP *
	Biological	Observe ground surfaces especially in wet or grassy areas for evidence and presence of snakes (poisonous). Observe ground surfaces or surrounding vegetation or structures for presence fire ants, spiders, bee/wasp hives rabid animals etc. Check body and clothing for ticks, chiggers, spiders. Observe areas for presence of stinging insects. Prior to starting field activities, notify supervisors of known allergies to stinging insects and location of antidotes. Avoid exposure to blood bourne pathogens Consider utilizing insect repellent. For personnel sensitive to skin rashes, consider the use of products with lower s DEET concentrations such as "children's cutters" or "skin so soft" products.	Modified Level D_1 or D_2 PPE or as required by HSP *
	Fire Prevention	Use only metal safety cans for storage and transfer of fuel. Maintain flammable/combustible materials in flammable lock-up (vented) when not in use. Use funnels and nozzles during fueling operations. Allow warm engine parts (small engines) to cool before refueling. Appropriately sized, easily accessible ABC fire extinguisher in work area. Review and be cognizant of any MCB Lejeune Fire Prevention Procedures and Requirements	Modified Level D_1 or D_2 PPE or as required by HSP *
	Cuts & Abrasions	Wear long sleeve clothing and proper PPE (eye protection, hard hats, leather gloves, sturdy hard toe boots) when traversing through wooded areas.	
	Visible Lighting	Perform tasks in daylight hours whenever possible. If not, provide sufficient work environment lighting for the work condition.	Modified Level D_1 or D_2 PPE or as required by HSP *

TASK ORDER 011 MCB CAMP LEJEUNE

ACTIVITY HAZARD ANALYSIS –Sampling

Task Breakdown	Potential Hazards	Critical Safety Practices	Personal Protective Clothing and Equipment
Sampling (cont.)	Electrical	If/when electrical extension cords are required to complete work, extension cords must be: - Equipped with third-wire grounding. - Covered, elevated, or protected from damage when passing through work areas. - Protected from pinching if routed through doorways. - Not fastened with staples, hung from nails, or suspended with wire. - Extension cords and electrical power tools, must have ground fault circuit interrupters (GFCIs) installed. - Rated to handle the voltage/amperage of equipment. Do not use care batteries for power sources to sampling equipment.	Modified Level D_1 or D_2 PPE or as required by HSP *
	Other	Always using a seat belt while driving on military/government facilities. Always observe posted speed limits, traffic signs and signals. Never using a cell phone or two way radio while driving on military/government facilities. Violating these rules may result in loss of military/government facility driving privileges. Drive 5 mph when driving past troops on maneuvers. If drive past troops on maneuvers could interrupt their activities, vehicle drivers are to bring vehicles to a complete stop in a safe location and yield to troop activities. Shut down operations in heavy rain, wind and/or lightning. At first sight of lightning, operations shall be stopped and only resumed when conditions permit. The lightning safety recommendation is 30-30: Seek refuge when thunder sounds within 30 seconds after a lightning flash; and do not resume activity until 30 minutes after the last thunder clap. Buddy System maintained for all phases of work. Base or local Emergency Dispatch numbers programmed into cellular phones. Have hospital route maps readily available. Report all conditions which may create accidents, injury, illness or property damage to supervisors immediately.	NA

	PRINT	SIGNATURE	
Supervisor Name:	_____	_____	**Date/Time:**_____
Safety Officer Name:	_____	_____	**Date/Time:**_____
Site Personnel:	_____	_____	**Date/Time:**_____
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	_____	_____	**Date/Time:**_____

TASK ORDER 011 MCB CAMP LEJEUNE

Activity Hazard Analysis – Decontamination Activities

Task Breakdown	Potential Hazards	Critical Safety Practices	Personal Protective Clothing and Equipment
Decontamination Activities	Electrical	If/when electrical extension cords are required to complete work, extension cords must be: - Equipped with third-wire grounding. - Covered, elevated, or protected from damage when passing through work areas. - Protected from pinching if routed through doorways. - Not fastened with staples, hung from nails, or suspended with wire. - Extension cords and electrical power tools, must have ground fault circuit interrupters (GFCIs) installed. - Rated to handle the voltage/amperage of equipment. Keep extension cords and other electrical components for getting wet during decontamination operations. Do not use care batteries for power sources. Where electrical or energized equipment must becleaned or accessed by personnel, Review and implement all applicable components of CH2MHILL SOP # HSE&Q-310, Lock Out Tag Out, except where other requirements may be more stringent.	Modified Level D_2 PPE or as required by HSP * D_2: Work clothes, hard hat, safety glasses with face shield and sturdy hard toed work boots, hearing and hand protection (inner and outer chemical resistant gloves) chemical & liquid resistant suits and over boots or hard toe chemical and liquid resistant boots Note: Level C or Level B maybe required where decontamination activities must occur in Confined Space Situations. Contact the HSM before utilizing Level C or B PPE.
	Slips, Trips, Falls	Be aware of poor footing, potential slipping/tripping hazards in the work area (i.e. wet/muddy areas or slopes, unprotected holes, ditches, rip rap, utilities or other ground protrusions). Identify and avoid these areas. Wear sturdy hard toe work boots with sufficient ankle support (preferably leather). Watch foot placement while working on wet surfaces. If necessary create slip resistant surfaces to stand on in wet areas during decontamination operations. Good housekeeping must be maintained at all times in all project work areas. Common paths of travel should be established and kept free from the accumulation of materials.	Modified Level D_2 PPE or as required by HSP *
	Visible Lighting	Perform tasks in daylight hours whenever possible. If not, provide sufficient work environment lighting for the work condition.	Modified Level D_2 PPE or as required by HSP *
	Noise	Personnel exposed to loud working environments shall wear hearing protection unless otherwise directed (proximal to heavy equipment).	Modified Level D_2 PPE or as required by HSP *

TASK ORDER 011 MCB CAMP LEJEUNE

Activity Hazard Analysis – Decontamination Activities

Task Breakdown	Potential Hazards	Critical Safety Practices	Personal Protective Clothing and Equipment
Decontamination Activities (cont)	Fire Prevention	Use only metal safety cans for storage and transfer of fuel. Use funnels and nozzles during fueling operations. Allow warm engine parts (small engines) to cool before refueling. Appropriately sized, easily accessible ABC fire extinguisher in work area. Review and be cognizant of any MCB Lejeune Fire Prevention Procedures and Requirements	Modified Level D_2 PPE or as required by HSP *
	High Ambient Temperature	Provide fluids to prevent worker dehydration. Monitor for heat stress in accordance with HSP (maintain use of buddy system). Institute a proper work-break regiment to avoid heat stress symptoms and overexertion in PPE.	Modified Level D_2 PPE or as required by HSP * (light colored/weight, breathable clothing)
	Noise	Personnel exposed to loud working environments shall wear hearing protection unless otherwise directed (proximal to heavy equipment).	Modified Level D_2 PPE or as required by HSP *
	Biological	Observe ground surfaces especially in wet or grassy areas for evidence and presence of snakes (poisonous). Observe ground surfaces or surrounding vegetation or structures for presence fire ants, spiders, bee/wasp hives rabid animals etc. Check body and clothing for ticks, chiggers, spiders. Observe areas for presence of stinging insects. Prior to starting field activities, notify supervisors of known allergies to stinging insects and location of antidotes. Avoid exposure to blood bourne pathogens Consider utilizing insect repellent. For personnel sensitive to skin rashes, consider the use of products with lower s DEET concentrations such as “children’s cutters” or “skin so soft” products.	Modified Level D_2 PPE or as required by HSP *

TASK ORDER 011 MCB CAMP LEJEUNE

Activity Hazard Analysis – Decontamination Activities

Task Breakdown	Potential Hazards	Critical Safety Practices	Personal Protective Clothing and Equipment
Decontamination Activities (cont)	Chemical Exposure	Review contaminants of concern for the project and consult project specific HSP for proper dermal and respiratory protection. All personnel performing this task shall be trained in accordance with 29CFR1910.120/29CFR1926.65 and be deemed “fit for duty” and cleared to wear a respirator by a licensed occupation physician. Follow PPE and action monitoring level requirements identified in the sections 5.0 and 6.0 of the HSP. Do not allow dermal contact or incidental ingestion of contaminated materials. Do not kneel or step in soil cuttings or drilling fluids. Exercise good hygiene practices. Always wash hands and then face before eating, drinking, smoking and leaving site. Only eat, drink, smoke or chew tobacco in designated areas that that are not subject to Hazwoper regulated operations. Practice “no hand-face” contact at all times.	Modified Level D_2 PPE or as required by HSP *
	Manual Lifting	JV I personnel must notify supervisors or safety representatives of preexisting medical conditions that may be aggravated or re-injured by lifting activities. When lifting objects, lift using knees not back. For repetitive lifting tasks, the use of lifting braces/supports may be considered. If heavy equipment isn’t available to have someone assist with the lift— especially for heavy (> 40lbs.) or awkward loads. Use heavy equipment to transfer heavy or awkward loads wherever possible. Plan storage and staging to minimize lifting or carrying distances. Make sure the path of travel is clear prior to the lift. Avoid carrying heavy objects above shoulder level.	Modified Level D_2 PPE or as required by HSP *

TASK ORDER 011 MCB CAMP LEJEUNE

Activity Hazard Analysis – Decontamination Activities

Task Breakdown	Potential Hazards	Critical Safety Practices	Personal Protective Clothing and Equipment
Decontamination Activities (cont)	Other	Always using a seat belt while driving on military/government facilities. Always observe posted speed limits, traffic signs and signals. Never using a cell phone or two way radio while driving on military/government facilities. Violating these rules may result in loss of military/government facility driving privileges. Drive 5 mph when driving past troops on maneuvers. If drive past troops on maneuvers could interrupt their activities, vehicle drivers are to bring vehicles to a complete stop in a safe location and yield to troop activities. Shut down operations in heavy rain, wind and/or lightning. At first sight of lightning, operations shall be stopped and only resumed when conditions permit. The lightning safety recommendation is 30-30: Seek refuge when thunder sounds within 30 seconds after a lightning flash; and do not resume activity until 30 minutes after the last thunder clap. Buddy System maintained for all phases of work. Base or local Emergency Dispatch numbers programmed into cellular phones. Have hospital route maps readily available. Report all conditions which may create accidents, injury, illness or property damage to supervisors immediately.	NA

EQUIPMENT REQUIRED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
Pressure Washing Equipment Fire extinguisher Decon. materials Eye wash (small portable type) Misc hand Tools	Visual Inspections of designated work areas identify and address hazardous conditions. Equipment inspections and maintenance. Hand Tool Inspections	Review AHA with all task personnel and site specific HSP for new site personnel. Current training and medical surveillance requirements in accordance with 29CFR1910.120/29CFR1926.65. Review operations/safety manuals for all equipment utilized. Behavior Based Loss Prevention Training and 1st Aid/CPR (supervisors).

	PRINT	SIGNATURE	
Supervisor Name:	_____	_____	**Date/Time:**_____
Safety Officer Name:	_____	_____	**Date/Time:**_____
Site Personnel:	_____	_____	**Date/Time:**_____
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CH2M HILL Health and Safety Plan

Attachment 3

PTSP

CH2MHILL

Pre-Task Safety Plan (PTSP)

Project: _____ Location: _____Date:_____

Supervisor: _____ Job Activity:_____
_____

Task Personnel:
_____
_____
_____
_____

List Tasks:

_____
_____
_____
_____

Tools/Equipment Required for Tasks (ladders, scaffolds, fall protection, cranes/rigging, heavy equipment, power tools):

_____
_____
_____

Potential H&S Hazards, including chemical, physical, safety, biological and environmental (check all that apply):

__ Chemical burns/contact	__ Trench, excavations, cave-ins	__ Ergonomics
__ Pressurized lines/equipment	__ Overexertion	__ Chemical splash
__ Thermal burns	__ Pinch points	__ Poisonous plants/insects
__ Electrical	__ Cuts/abrasions	__ Eye hazards/flying projectile
__ Weather conditions	__ Spills	__ Inhalation hazard
__ Heights/fall > 6 feet	__ Overhead Electrical hazards	__ Heat/cold stress
__ Noise	__ Elevated loads	__ Water/drowning hazard
__ Explosion/fire	__ Slips, trip and falls	__ Heavy equipment
__ Radiation	__ Manual lifting	__ Aerial lifts/platforms
__ Confined space entry	__ Welding/cutting	__ Demolition

Other Potential Hazards (Describe):

_____
_____
_____
_____

Hazard Control Measures (Check All That Apply):			
PPE __ Thermal/lined __ Eye __ Dermal/hand __ Hearing __ Respiratory __ Reflective vests __ Flotation device	Protective Systems __ Sloping __ Shoring __ Trench box __ Barricades __ Competent person __ Locate buried utilities __ Daily inspections	Fire Protection __ Fire extinguishers __ Fire watch __ Non-spark tools __ Grounding/bonding __ Intrinsically safe equipment	Electrical __ Lockout/tagout __ Grounded __ Panels covered __ GFCI/extension cords __ Power tools/cord inspected
Fall Protection __ Harness/lanyards __ Adequate anchorage __ Guardrail system __ Covered opening __ Fixed barricades __ Warning system	Air Monitoring __ PID/FID __ Detector tubes __ Radiation __ Personnel sampling __ LEL/O2 __ Other	Proper Equipment __ Aerial lift/ladders/scaffolds __ Forklift/heavy equipment __ Backup alarms __ Hand/power tools __ Crane with current inspection __ Proper rigging __ Operator qualified	Welding & Cutting __ Cylinders secured/capped __ Cylinders separated/upright __ Flash-back arrestors __ No cylinders in CSE __ Flame retardant clothing __ Appropriate goggles
Confined Space Entry __ Isolation __ Air monitoring __ Trained personnel __ Permit completed __ Rescue	Medical/ER __ First-aid kit __ Eye wash __ FA-CPR trained personnel __ Route to hospital	Heat/Cold Stress __ Work/rest regime __ Rest area __ Liquids available __ Monitoring __ Training	Vehicle/Traffic __ Traffic control __ Barricades __ Flags __ Signs
Permits __ Hot work __ Confined space __ Lockout/tagout __ Excavation __ Demolition __ Energized work	Demolition __ Pre-demolition survey __ Structure condition __ Isolate area/utilities __ Competent person __ Hazmat present	Inspections: __ Ladders/aerial lifts __ Lanyards/harness __ Scaffolds __ Heavy equipment __ Cranes and rigging	Training: __ Hazwaste __ Construction __ Competent person __ Task-specific (THA) __ Hazcom
Field Notes:_____ _____ _____ _____			

Name (Print): _____

Signature:_____ Date:_____

CH2M HILL Health and Safety Plan

Attachment 4

SBO

CH2MHILL

Safe Work Observation Form		
Project:	Observer:	Date:
Position/Title of worker observed:	Background Information/ comments:	
Task/Observation Observed:		

Identify and reinforce safe work practices/behaviors

Identify and improve on at-risk practices/acts

Identify and improve on practices, conditions, controls, and compliance that eliminate or reduce hazards

Proactive PM support facilitates eliminating/reducing hazards (do you have what you need?)

Positive, corrective, cooperative, collaborative feedback/recommendations

Actions & Behaviors	Safe	At-Risk	Observations/Comments
Current & accurate Pre-Task Planning/Briefing (Project safety plan, STAC, AHA, PTSP, tailgate briefing, etc., as needed)			**Positive Observations/Safe Work Practices:**
Properly trained/qualified/experienced			
Tools/equipment available and adequate			
Proper use of tools			**Questionable Activity/Unsafe Condition Observed:**
Barricades/work zone control			
Housekeeping			
Communication			
Work Approach/Habits			
Attitude			
Focus/attentiveness			**Observer's Corrective Actions/Comments:**
Pace			
Uncomfortable/unsafe position			
Inconvenient/unsafe location			
Position/Line of fire			
Apparel (hair, loose clothing, jewelry)			
Repetitive motion			**Observed Worker's Corrective Actions/Comments:**
Other…			

CH2M HILL Health and Safety Plan

Attachment 5

Tick Fact Sheet

Tick-Borne Pathogens

There are six tick-borne pathogens that present a significant field hazard, and in some areas account for more than half of our serious field incidents. These procedures should be applied during any field activity where vegetation is present.

Hazard Control

The methods for controlling exposure to ticks include, in order of most-preferred to least:

- Avoiding tick habitats and ceasing operations in heavily infested areas
- Reducing tick abundance through habitat disruption or application of acracide
- Personal protection through use of repellants and protective clothing
- Frequent tick inspections and proper hygiene

Vaccinations are not available and preventative antibiotic treatment after a bite is generally not recommended.

Avoidance and Reduction of Ticks

To the extent practical, tick habitats should be avoided. In areas with significant tick infestation, consider stopping work and withdrawing from area until adequate tick population control can be achieved. Stopping and withdrawing should be considered as seriously as entering an area without proper energy control or with elevated airborne contaminants – tickborne pathogens present risk of serious illness!

In areas where significant population density or infestation exists, tick reduction should be considered. Tick reduction can be achieved by disrupting tick habitats and/or direct population reduction through the use of tick-toxic pesticides (Damminix, Dursban, Sevin, etc.).

Habitat disruption may include only simple vegetative maintenance such as removing leaf litter and trimming grass and brush. Tick populations can be reduced between 72 and 100% when leaf litter alone is removed. In more heavily infested areas, habitat disruption may include grubbing, tree trimming or removal, and pesticide application (Damminix, Dursban, Sevin, etc.). This approach is practical in smaller, localized areas or perimeter areas that require occasional access. Habitat controls are to be implemented with appropriate health and safety controls, in compliance with applicable environmental requirements, and may be best left to the property owner or tenant, or licensed pesticide vendor. Caution should be exercised when using chemical repellents or pesticides in or around areas where environmental or industrial media samples will be collected for analysis.

Personal Protection

After other prevention and controls are implemented, personal protection is still necessary in controlling exposure to ticks. Personal protection must include all of the following steps:

- So that ticks may be seen on your clothing wear light-colored clothing. Full-body New Tyvek (paper-like disposable coveralls) may also be used.
- To prevent ticks from getting underneath clothing tuck pant legs into socks or tape to boots.
- Wear long-sleeved shirts, a hat, and high boots.
- Apply DEET repellent to exposed skin or clothing per product label.
- Apply permethrin repellent to the outside of boots and clothing before wearing, per product label.
- Frequently check for ticks and remove from clothing.
- Where site conditions warrant (vegetation above knee height, tick endemic area) or when tasks warrant (e.g., having to sit/kneel in vegetation) that diminish the effectiveness of the other controls mentioned above, bug-out suits (obtained from MKE warehouse)/Tyvek shall be used. Bug-out suits are more breathable than Tyvek.
- At the end of the day search your entire body for ticks (particularly groin, armpits, neck and head) and shower.
- To prevent pathogen transmission through mucous membranes or broken/cut skin, wash or disinfect hands and/or wear surgical-style nitrile gloves anytime ticks are handled.

Pregnant individuals and individuals using prescription medications should consult with their physician and/or pharmacists before using chemical repellents. Because human health effects may not be fully known, use of chemical repellents should be kept to a minimum frequency and quantity. Always follow manufacturers' use instructions and precautions. Wash hands after handling, applying, or removing protective gear and clothing. Avoid hand-to-face contact, eating, drinking, smoking, etc. when applying or using repellents. Remove and wash clothes per repellent product label. Chemical repellents should not be used on infants and children.

Vaccinations are generally not available for tick-borne pathogens. Although production of the LYMErix™ lyme disease vaccination has been ceased, vaccination may still be considered under specific circumstances and with concurrence from the consulting physician. Preventative antibiotic treatment in non-ill individuals who have had a recent tick bite is recommended in specific cases only.

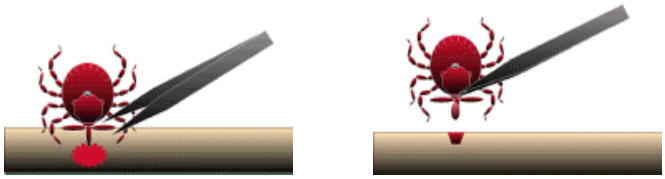
Tick Check

A tick check should be performed after field survey before entering the field vehicle (you do not want to infest your field vehicle with ticks). Have your field partner check your back; the backs of your legs, arms, and neck; and your hairline. Shake off clothing as thorough as possible before entering the vehicle. Once the field day is complete, repeat this procedure and perform a thorough self check.

If a tick has embedded itself into the skin, remove the tick as described below. After removal, preserve the specimen in a small air tight bag; date the bag and freeze it. Contact the occupational nurse (1-866-893-2514) and instructions will be given on how to monitor for symptoms of Lymes disease for 45 days. If symptoms appear, then the tick will be sent to Clongen Laboratories, LLC located in Germantown, Maryland for analysis. The laboratory will have results within 1-3 days. A tick testing submission form (attached) should be properly completed and submitted with the tick. If no symptoms appear the tick can be discarded.

Tick Removal

- Use fine-tipped tweezers or shield your fingers with a tissue, paper towel, or nitrile gloves.
- Grasp the tick as close to the skin surface as possible and pull upward with steady, even pressure. Do not twist or jerk the tick; this may cause the mouthparts to break off and remain in the skin. (If this happens, remove mouthparts with tweezers. Consult your healthcare provider if infection occurs.)



- Do not squeeze, crush, or puncture the body of the tick because its fluids (saliva, hemolymph, gut contents) may contain infectious organisms. Releasing these organisms to the outside of the tick's body or into the bite area may increase the chance of infectious organism transmission.
- Do not handle the tick with bare hands because infectious agents may enter through mucous membranes or breaks in the skin. This precaution is particularly directed to individuals who remove ticks from domestic animals with unprotected fingers. Children, elderly persons, and immunocompromised persons may be at greater risk of infection and should avoid this procedure.

- After removing the tick, thoroughly disinfect the bite site and wash your hands with soap and water.
- You may wish to save the tick for identification in case you become ill. Your doctor can use the information to assist in making an accurate diagnosis. Place the tick in a plastic bag and put it in your freezer. Write the date of the bite on a piece of paper with a pencil and place it in the bag.

Note: Folklore remedies such as petroleum jelly or hot matches do little to encourage a tick to detach from skin. In fact, they may make matters worse by irritating the tick and stimulating it to release additional saliva, increasing the chances of transmitting the pathogen. These methods of tick removal should be avoided. In addition, a number of tick removal devices have been marketed, but none are better than a plain set of fine tipped tweezers.

First-Aid and Medical Treatment

Tick bites should always be treated with first-aid. Clean and wash hands and disinfect the bite site after removing embedded tick. Consult a healthcare professional if infection or symptoms and effects of tick-borne illnesses are develop.

Medical treatment for tick-borne infections include antibiotics and other medical interventions. Diagnosis of specific illness involves both clinical and laboratory confirmations. Preventative antibiotic treatment in non-ill individuals who have had a recent tick bite is recommended in specific cases only.

Previously infected individuals are not conferred immunity – re-infection from future tick bites can occur even after a person has contracted a tick-borne disease.

Hazard Recognition

An important step in controlling tick related hazards is understanding how to identify ticks, their habitats, their geographical locations, and signs & symptoms of tick-borne illnesses.

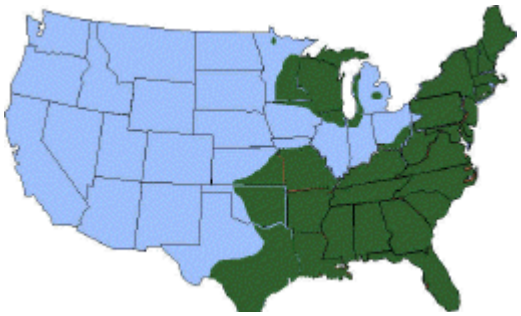
Tick Identification

There are five varieties of hard-bodied ticks that have been associated with tick-borne pathogens. These tick varieties include:

- Deer (Black Legged) Tick (eastern and pacific varieties)
- Lone Star Tick
- Dog Tick
- Rocky Mountain Wood Tick

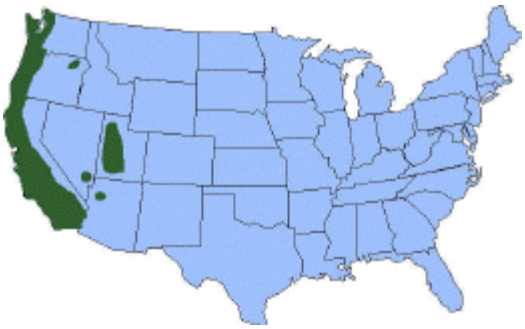
These varieties and their geographical locations are illustrated on the following page.

Deer Tick



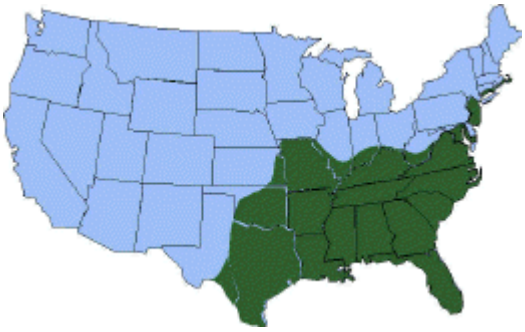
Distribution of Deer Tick (dark green)

From Left: adult female, adult male, nymph, and larvae Deer Tick (cm scale)



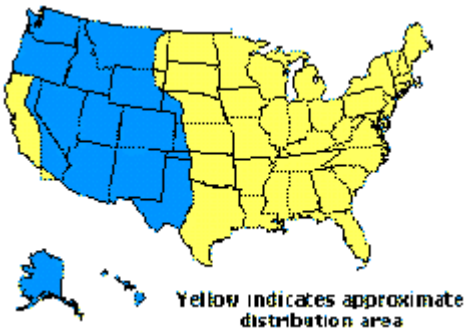
Distribution of Pacific Deer Tick (dark green)

Lone Star Tick

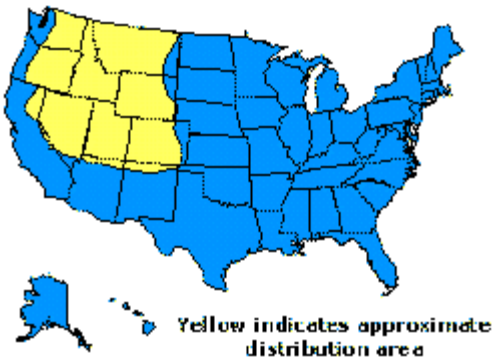


Distribution of Lone Star Tick (Green)

Dog Tick



Rocky Mountain Wood Tick



Tick Habitat

In eastern states, ticks are associated with deciduous forest and habitat containing leaf litter. Leaf litter provides a moist cover from wind, snow, and other elements. In the north-central states, is generally found in heavily wooded areas often surrounded by broad tracts of land cleared for agriculture. On the Pacific Coast, the bacteria are transmitted to humans by the western black-legged (deer) tick and habitats are more diverse. Here, ticks have been found in habitats with forest, north coastal scrub, high brush, and open grasslands. Coastal tick populations thrive in areas of high rainfall, but ticks are also found at inland locations.

Illnesses and Signs & Symptoms

There are six notifiable tick-borne pathogens that cause human illness in the United States. These pathogens may be transmitted during a tick bite – normally hours after attachment. The illnesses, presented in approximate order of most common to least, include:

- Lyme (bacteria)
- RMSF (bacteria)
- Ehrlichiosis (bacteria)
- STARI (Southern Tick-Associated Rash Illness) (bacteria)
- Tularemia (Rabbit Fever) (bacteria)
- Babesia (protozoan parasite)

Symptoms will vary based on the illness, and may develop in infected individuals typically between 3 and 30 days after transmission. Some infected individuals will not become ill or may develop only mild symptoms. These illnesses present with some or all of the following signs & symptoms: fever, headache, muscle aches, stiff neck, joint aches, nausea, vomiting, abdominal pain, diarrhea, malaise, weakness, small solid, ring-like, or spotted rashes. The bite site may be red, swollen, or develop ulceration or lesions. A variety of long-term symptoms may result when untreated, including debilitating effects and death.

CH2M HILL Health and Safety Plan

Attachment 6

HS&E Self-Assessment Checklist-Drilling

CH2MHILL

HS&E Self-Assessment Checklist – DRILLING

This checklist shall be used by CH2M HILL personnel only and shall be completed at the frequency specified in the project's written safety plan.

This checklist is to be used at locations where: 1) CH2M HILL employees are potentially exposed to drilling hazards, 2) CH2M HILL staff are providing support function related to drilling activities, and/or 3) CH2M HILL oversight of a drilling subcontractor is required.

Safety Coordinator may consult with drilling subcontractors when completing this checklist, but shall not direct the means and methods of drilling operations nor direct the details of corrective actions. Drilling subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Items considered to be imminently dangerous (possibility of serious injury or death) shall be corrected immediately, or all exposed personnel shall be removed from the hazard until corrected.

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposures to drilling hazards (complete Section 1).

☐ Evaluate CH2M HILL support functions related to drilling activities (complete Section 2)

☐ Evaluate a CH2M HILL subcontractor's compliance with drilling safety requirements (complete entire checklist).

Subcontractors Name: _____

Check "Yes" if an assessment item is complete/correct.

Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the drilling subcontractor. Section 3 must be completed for all items checked "No."

Check "N/A" if an item is not applicable.

Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in SOP HSE-35.

	Yes	No	N/A	N/O
SECTION 1 - SAFE WORK PRACTICES (4.1)				
1. Personnel cleared during rig startup	☐	☐	☐	☐
Personnel clear of rotating parts	☐	☐	☐	☐
Personnel not positioned under hoisted loads	☐	☐	☐	☐
4. Loose clothing and jewelry removed	☐	☐	☐	☐
5. Smoking is prohibited around drilling operation	☐	☐	☐	☐
6. Personnel wearing appropriate personal protective equipment (PPE), per written plan	☐	☐	☐	☐
7. Personnel instructed not to approach equipment that has become electrically energized	☐	☐	☐	☐
SECTION 2 - SUPPORT FUNCTIONS (4.2)				
FORMS/PERMITS (4.2.1)				
8. Driller license/certification obtained	☐	☐	☐	☐
9. Well development/abandonment notifications and logs submitted and in project files	☐	☐	☐	☐
10. Water withdrawal permit obtained, where required	☐	☐	☐	☐
11. Dig permit obtained, where required	☐	☐	☐	☐
UTILITY LOCATING (4.2.2)				
12. Location of underground utilities and structures identified	☐	☐	☐	☐
WASTE MANAGEMENT (4.2.3)				
13. Drill cuttings and purge water managed and disposed properly	☐	☐	☐	☐
DRILLING AT HAZARDOUS WASTE SITES (4.2.4)				
14. Waste disposed of according to project's written safety plan				
15. Appropriate decontamination procedures being followed, per project's written safety plan	☐	☐	☐	☐
DRILLING AT ORDNANCE EXPLOSIVES (OE)/UNEXPLODED ORDNANCE (UXO) SITES (4.2.5)	☐	☐	☐	☐
16. OE plan prepared and approved	☐	☐	☐	☐
17. OE/UXO avoidance provided, routes and boundaries cleared and marked	☐	☐	☐	☐
18. Initial pilot hole established by UXO technician with hand auger	☐	☐	☐	☐
19. Personnel remain inside cleared areas	☐	☐	☐	☐
SECTION 3 - DRILLING SAFETY REQUIREMENTS (4.3)				
GENERAL (4.3.1)				
20. Only authorized personnel operating drill rigs	☐	☐	☐	☐
21. Daily safety briefing/meeting conducted with crew	☐	☐	☐	☐
22. Daily inspection of drill rig and equipment conducted before use	☐	☐	☐	☐

	Yes	No	N/A	N/O
DRILL RIG PLACEMENT (4.3.2)				
23. Location of underground utilities and structures identified				
24. Safe clearance distance maintained from overhead power lines	☐	☐	☐	☐
25. Drilling pad established, when necessary	☐	☐	☐	☐
26. Drill rig leveled and stabilized	☐	☐	☐	☐
27. Additional precautions taken when drilling in confined areas	☐	☐	☐	☐
DRILL RIG TRAVEL (4.3.3)				
28. Rig shut down and mast lowered and secured prior to rig movement	☐	☐	☐	☐
29. Tools and equipment secured prior to rig movement	☐	☐	☐	☐
30. Only personnel seated in cab are riding on rig during movement	☐	☐	☐	☐
31. Safe clearance distance maintained while traveling under overhead power lines	☐	☐	☐	☐
32. Backup alarm or spotter used when backing rig	☐	☐	☐	☐
DRILL RIG OPERATION (4.3.4)				
33. Kill switch clearly identified and operational	☐	☐	☐	☐
34. All machine guards are in place	☐	☐	☐	☐
35. Rig ropes not wrapped around body parts	☐	☐	☐	☐
36. Pressurized lines and hoses secured from whipping hazards	☐	☐	☐	☐
37. Drill operation stopped during inclement weather	☐	☐	☐	☐
38. Air monitoring conducted per written safety plan for hazardous atmospheres	☐	☐	☐	☐
39. Rig placed in neutral when operator not at controls	☐	☐	☐	☐
DRILL RIG SITE CLOSURE (4.3.5)				
40. Ground openings/holes filled or barricaded	☐	☐	☐	☐
41. Equipment and tools properly stored	☐	☐	☐	☐
42. All vehicles locked and keys removed	☐	☐	☐	☐
DRILL RIG MAINTENANCE (4.3.6)				
28. Defective components repaired immediately	☐	☐	☐	☐
29. Lockout/tagout procedures used prior to maintenance	☐	☐	☐	☐
30. Cathead in clean, sound condition	☐	☐	☐	☐
31. Drill rig ropes in clean, sound condition	☐	☐	☐	☐
32. Fall protection used for fall exposures of 6 feet (U.S.) 1.5 meters (Australia) or greater	☐	☐	☐	☐
33. Rig in neutral and augers stopped rotating before cleaning	☐	☐	☐	☐
34. Good housekeeping maintained on and around rig	☐	☐	☐	☐

SECTION 4

Complete this section for all items checked "No" in previous sections. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

Auditor: _____ Project Manager: _____

CH2M HILL Health and Safety Plan

Attachment 7

HAZCOM specific Training Forms

CH2MHILL

CHEMICAL-SPECIFIC TRAINING FORM

Refer to SOP HSE-107 Attachment 1 for instructions on completing this form.

Location:	Project # :
HCC:	Trainer:

TRAINING PARTICIPANTS:

NAME	SIGNATURE	NAME	SIGNATURE

REGULATED PRODUCTS/TASKS COVERED BY THIS TRAINING:

The HCC shall use the product MSDS to provide the following information concerning each of the products listed above.

- ☐ Physical and health hazards
- ☐ Control measures that can be used to provide protection (including appropriate work practices, emergency procedures, and personal protective equipment to be used)
- ☐ Methods and observations used to detect the presence or release of the regulated product in the workplace (including periodic monitoring, continuous monitoring devices, visual appearance or odor of regulated product when being released, etc.)

Training participants shall have the opportunity to ask questions concerning these products and, upon completion of this training, will understand the product hazards and appropriate control measures available for their protection.

Copies of MSDSs, chemical inventories, and CH2M HILL's written hazard communication program shall be made available for employee review in the facility/project hazard communication file.

CH2M HILL Health and Safety Plan

Attachment 8

Chemical Inventory/Register Form

CH2MHILL

CHEMICAL INVENTORY/REGISTER FORM

Refer to SOP HSE-107, Attachment 1, for instructions on completing this form.

Location: _____

HCC: _____

☐ Office ☐ Warehouse ☐ Laboratory ☐ Project: _____

Project No.: _____

Regulated Product	Location	Container labeled (✓if yes)	MSDS available (✓if yes)

MSDS for the listed products will be maintained at: _____

CH2M HILL Health and Safety Plan

Attachment 9

Incident Report Form

HITS Incident Report Hardcopy (Phase 1 – Initial Entry)
Rev. 1, 12/03/2007

Phase 1 – Initial Entry

Type of Incident (May select more than one)

- ☐ Injury/Illness
- ☐ Property Damage
- ☐ Spill/Release
- ☐ Environment/Permit
- ☐ Near Miss
- ☐ Other

General Information Section

Preparer's Name: _____ **Preparer's Phone Number:** _____

Date of Incident: _____ **Time of Incident**: _____ AM / PM

What Business Group is accountable for this incident: _____

What Business Group SubGroup is accountable for this incident: _____

What CH2M HILL Company is accountable for this incident: _____

Where did the Incident occur?

- ☐ United States, Geographic Region: _____
- ☐ Canada, Province/Territory: _____
- ☐ International, County: _____

Location of Incident?

- ☐ Company Premises, CH2M HILL Office (use 3 letter office code if available): _____
- ☐ Project, Project name: _____
- ☐ In Transit

Traveling from: _____

Traveling to: _____

- ☐ At Home
- ☐ Other, Specify: _____

Describe the incident:

_____

_____

Describe how this event could have been prevented:

_____

_____

Provide Witness Information:

Name: _____ Phone: _____

Name: _____ Phone: _____

Name: _____ Phone: _____

Personnel Notified of Incident (Provide name, date and time):

CH2M HILL Personnel: _____

Client Personnel: _____

Additional Comments:

_____

_____

Injury/Illness Section **[Complete only if Injury/Illness Incident type selected]**

Who was injured?

- ☐ CH2M HILL Employee or CH2M HILL Temp Employee
- ☐ Subcontractor to CH2M HILL (Non-LLC Joint Venture Project)
- ☐ LLC Joint Venture Partner Employee
- ☐ LLC Joint Venture Project Subcontractor/Contractor
- ☐ Other

Name of Injured: _____ **Job Title:** _____

Employer Name: _____ **Supervisor of Employee:** _____

Complete for CH2M HILL Employee Injuries

Business Group of Injured Employee: _____

Has the employee called the Injury Management Administrator (1-800-756-1130)?

☐ Yes ☐ No ☐ Not Sure

Has the injured employee's supervisor been notified of this incident?

☐ Yes ☐ No ☐ Not Sure

Complete for Non-CH2M HILL Employee Injuries

Has the project safety coordinator been notified of this incident?

☐ Yes ☐ No ☐ Not Sure

Project Safety Coordinator: _____

Body Part Affected: _____

Injury/Illness (Result): _____

Describe treatment provided (if medication provided, identify whether over-the-counter or prescription): _____

_____

Describe any work restriction prescribed (include dates and number of days): _____

_____

Physician/Health Care Provider Information

Name: _____ Phone: _____

Was treatment provided away from the worksite?

- ☐ No
- ☐ Yes

Facility Name: _____

Address: _____

City: _____ Phone Number: _____

Was injured treated in an emergency room?

☐ No ☐ Yes

Was injured hospitalized overnight as an in-patient?

☐ No ☐ Yes

General Information Environmental Section **[Complete only if Environment/Permit or Spill/Release Incident type selected]**

Who had control of the area during the incident?

- ☐ CH2M HILL, Company: _____
- ☐ Subcontractor, Company: _____
- ☐ Joint Venture Partner/Contractor/Subcontractor, Company: _____
- ☐ Other, Company: _____

Relationship to CH2M HILL: _____

Property Damage Section **[Complete only if Property Damage Incident type selected]**

Property Damaged: _____

Property Owner: _____

Damage Description: _____

Estimated US Dollar Amount: _____

Spill or Release Section **[Complete only if Spill/Release Incident type selected]**

Substance: _____

Estimated Quantity: _____

Did the spill/release move off the property?: _____

Spill/Release From: _____

Spill/Release To: _____

Environment/Permit Section **[Complete only if Environment/Permit Incident type selected]**

Describe Environmental or Permit Issue: _____

Permit Type: _____

Permitted Level or Criteria (e.g., discharge limit): _____

Permit Name and Number (e.g., NPDES No. ST1234): _____

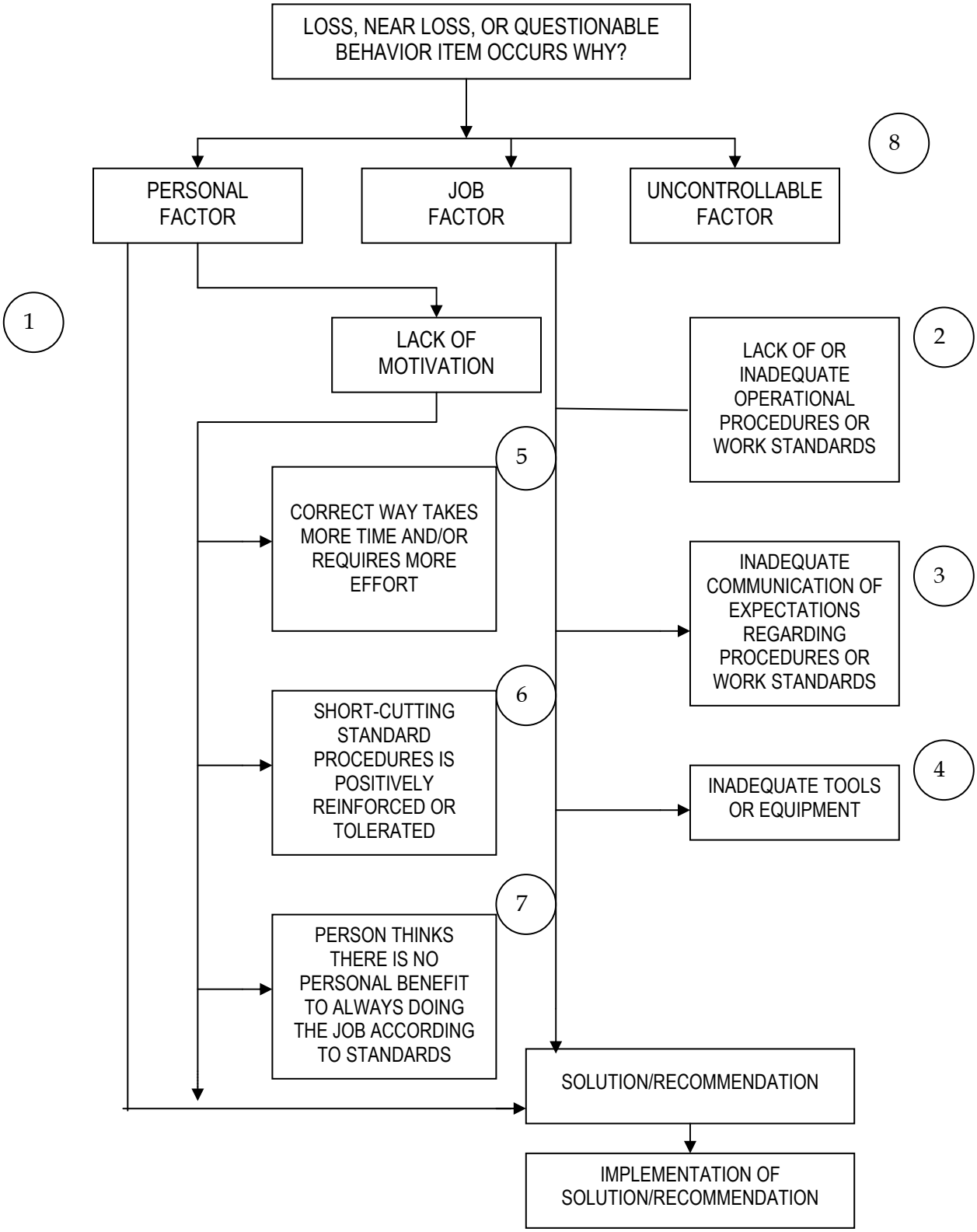
Substance and Estimated Quantity: _____

Duration of Permit Exceedence: _____

CH2M HILL Health and Safety Plan

Attachment 10

Root Cause Analysis Form/Flow Chart


LOSS, NEAR LOSS, OR QUESTIONABLE BEHAVIOR ITEM OCCURS WHY?
8
PERSONAL FACTOR
JOB FACTOR
UNCONTROLLABLE FACTOR
1
LACK OF MOTIVATION
2
LACK OF OR INADEQUATE OPERATIONAL PROCEDURES OR WORK STANDARDS
5
CORRECT WAY TAKES MORE TIME AND/OR REQUIRES MORE EFFORT
3
INADEQUATE COMMUNICATION OF EXPECTATIONS REGARDING PROCEDURES OR WORK STANDARDS
6
SHORT-CUTTING STANDARD PROCEDURES IS POSITIVELY REINFORCED OR TOLERATED
4
INADEQUATE TOOLS OR EQUIPMENT
7
PERSON THINKS THERE IS NO PERSONAL BENEFIT TO ALWAYS DOING THE JOB ACCORDING TO STANDARDS
SOLUTION/RECOMMENDATION
IMPLEMENTATION OF SOLUTION/RECOMMENDATION

CH2M HILL Health and Safety Plan

Attachment 10

Root Cause Analysis Form

Root Cause Analysis (RCA)

Root Cause Categories (RCC): Select the RCC numbered below that applies for the root cause (RC) and/or contributing factor (CF) in the first column, then describe the specific root cause and corrective actions in each column.

Lack of skill or knowledge

Lack of or inadequate operational procedures or work standards

Inadequate communication of expectations regarding procedures or work standards

Inadequate tools or equipment

Correct way takes more time and/or requires more effort

Short-cutting standard procedures is positively reinforced or tolerated

Person thinks there is no personal benefit to always doing the job according to standards

RCC #	Root Cause(s)	Corrective Actions	RC[1]	CF[2]	Due Date	Completion Date	Date Verified

[1] RC = Root Cause; [2] CF = Contributing Factors (check which applies)

Investigation Team Members

Name	Job Title	Date

Results of Solution Verification and Validation

Reviewed By

Name	Job Title	Date

Attachment D-2
Corporate Health, Safety, Security, and Environment Policy

CH2MHILL

HSSE Target Zero World-Class Performance

Health, Safety, Security, and Environment Policy

Protection of people and the environment is a CH2M HILL core value. It is our vision to create a culture within CH2M HILL that empowers employees to drive this value into all global operations and achieve excellence in health, safety, security, and environment (HSSE) performance. CH2M HILL deploys an integrated, enterprise-wide behavior-based HSSE management system to fulfill our mission and the expectations of our clients, staff, and communities based on the following principles:

- We require all management and supervisory personnel to provide the leadership and resources to inspire and empower our employees to take responsibility for their actions and for the actions of their fellow employees to create a safe, healthy, secure, and environmentally-responsible workplace.
- We provide value to clients by tailoring HSSE processes to customer needs and requiring all CH2M HILL employees and subcontractors to deliver projects with agility, personal service, and responsiveness and in compliance with HSSE requirements and company standards to achieve health, safety, security, and pollution prevention excellence. Our performance will aspire to influence others and continually redefine world-class HSSE excellence.
- We systematically evaluate our design engineering and physical work environment to verify safe and secure work conditions and practices are established, consistently followed, and timely corrected.
- We continually assess and improve our HSSE program to achieve and maintain world-class performance by setting and reviewing objectives and targets, reporting performance metrics, and routinely reviewing our progress.
- We care about the safety and security of every CH2M HILL employee and expect all employees to embrace our culture, share our core value for the protection of people and the environment, understand their obligations, actively participate, take responsibility, and "walk the talk" on and off the job.

The undersigned pledge our leadership, commitment, and accountability for making this policy a reality at CH2M HILL.

Dated the 2nd day of September 2008.

Ralph R. Peterson, Chairman of the Board & Chief Executive Officer

Robert C. Allen, Senior Vice President & Chief Human Resources Officer

Garry M. Higdem, President, Energy & Chemicals

Mark A. Lasswell, President & Chief Executive, Civil Infrastructure

Thomas G. Searle, President & Chief Executive, International

Bob C. Card, Chairman, CH2M HILL International

Lee A. McIntire, President & Chief Operating Officer; President & Chief Executive, Energy

Don S. Evans, Vice Chair, Board of Directors; Chief Marketing Officer

Catherine Santee, Senior Vice President & Chief Financial Officer

Michael E. McKelvy, President & Chief Executive, Industrial

Nancy R. Tuor, President & Chief Executive, Federal

Jacqueline Rast, President & Chief Executive, CPE

Keith Christopher, Senior Vice President, Health, Safety, Security, and Environment

Appendix E
MEC Removal Standard Operating Procedures

The selected subcontractor's munitions and explosives of concern (MEC) removal standard operating procedure (SOP) will be provided in this Appendix upon completion of the procurement process.