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FINAL REMEDIAL INVESTIGATION WORK PLAN FOR UXO 20 SAFETY THERMAL TREATMENT POINT NSWC INDIAN HEAD MD
11/1/2012
CH2M HILL

Final

Remedial Investigation Work Plan
for
UXO 20 - Safety Thermal Treatment Point

Naval Support Facility Indian Head
Indian Head, Maryland

Contract Task Order 0012

November 2012

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Washington

Under the

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

Prepared by

CH2MHILL

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Executive Summary

CH2M HILL has been contracted by the Department of the Navy (Navy), Naval Facilities Engineering Command (NAVFAC) Washington to conduct a Remedial Investigation (RI) for UXO 20 - Safety Thermal Treatment Point (STTP), at the Naval Support Facility Indian Head, Indian Head, Maryland. This Work Plan was prepared under the Navy's Comprehensive Long-Term Environmental Action Navy Contract N62470-08-D-1000, Contract Task Order 0012.

UXO 20 (STTP) is located on a peninsula on the Main Installation at the end of Old Burn Point Way (Malcolm Pirnie, 2005). The peninsula is man-made and was constructed of sand, fill material, rocket motor casings, empty cartridges, and coal fly ash between approximately 1940 and 1942. The peninsula was set up for two separate uses: (1) a primary burn area, located from the tip of the peninsula to approximately 150 feet inland, which was used for open burning (OB) of munitions (cartridge-actuated devices [CADs] and propellant-actuated devices [PADs]); and (2) a secondary burn area, which covered the remainder of the peninsula and was used for munitions testing, including deflagration-to-detonation testing, and pierce testing. UXO 20 is 0.97 acre in area and encompasses the southern part (primary burn area) and spits (sediment deposition areas) of the peninsula.

From 1942 to 1988, OB on the ground surface or in an open top, steel thermal treatment vessel occurred on a weekly basis in the primary burn area. Until the 1950s, propellants including CAD and PAD items were burned at a rate of 40 to 50 pounds per week. Water or solvent wet wastes with oil were burned in 55-gallon drums. In 1954, burning of propellants moved to Strauss Avenue Thermal Treatment Point. The burning of up to 25,000 pounds per year of less-sensitive explosives, other pyrotechnics (for example, squibs, igniters, caps, black powder) and difficult–to-burn ordnance materials continued through 1988. The peninsula was reportedly used for OB/open detonation and testing of projectiles, bulk propellant, demolition charges, CAD and PAD primers, less-sensitive explosives, high explosives, and other pyrotechnics using in-ground pits.

The Preliminary Assessment report stated that a site characterization was conducted in 1993 to evaluate whether a clean closure of the range was feasible under the Resource Conservation and Recovery Act (Malcolm Pirnie, 2005). The results from the soil and groundwater samples indicated that detected concentrations of explosives and metals within the soil and groundwater were at levels that would prohibit closure without further investigation. Although sediment was not sampled, the potential nature of past releases, presence of contamination in soil and groundwater, and transport mechanisms suggest it could have been affected by contaminant migration and discharge.

In 2012, the Navy provided written documentation that indicated 96 drums of ash/residue and solvent contaminated surface soil were removed from the site in 1988 (Navy, 1988). It was estimated that the soil excavation spanned a 40-foot -diameter area to a depth of 1 foot below ground surface based on visual observation; the subsurface soil was not disturbed. The location of soil removal, backfill efforts, and quantification of contaminant concentrations are unknown.

The site was recommended for RI for munitions and explosives of concern (MEC) and for munitions constituents (MC) (in soil and groundwater) in the Site Inspection report (CH2M HILL, 2010). MEC is defined as specific military munitions that may pose unique explosive risks, including unexploded ordnance (UXO), discarded military munitions, and MC. MC are defined as any material originating from UXO, discarded military munitions, or other military munitions, including explosive and non-explosive materials, and emissions, degradation, or breakdown elements of such ordnance or munitions. Potentially hazardous chemicals that originate from MC include explosives and breakdown products such as trinitrotoluene (TNT), 1,3,5-trinitroperhydro-1,3,5-triazine (RDX), and octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX); pyrotechnics/propellants/incendiaries such as perchlorate; and metals.

The objective of the RI is to define the nature and extent of MEC and MC at UXO 20 (excluding the shoreline and shallow water). The MEC objective will be accomplished as described in the following steps:

- Step 1: Remove MEC, material potentially presenting an explosive hazard, and metal from the land surface in order to minimize interference with the geophysical survey equipment used in Step 2.
- Step 2: Conduct a DGM survey
- Step 3: Intrusively investigate a percentage of anomalies identified in Step 2. (Note: The scope of Step 3 will not be included in this Work Plan until a better understanding of the density and distribution of the subsurface anomalies is obtained in order to make a reasonable estimate of the work to be performed. Details of Step 3 will be developed after Steps 1 and 2 are completed, and included as an addendum to this work plan.)

For MC, fieldwork will consist of the following steps:

- Step 1: Collect up to 5 *in situ* groundwater samples using direct-push technology, 23 discrete surface soil samples, 23 discrete subsurface soil samples, 4 sediment samples, and 1 multi-incremental (SMI) surface soil sample. The discrete surface soil, subsurface soil, sediment, and groundwater samples will be analyzed for target analyte list metals (total and dissolved for groundwater), target compound list volatile organic compounds, target compound list semivolatile organic compounds, and explosives (including pentaerythritol tetranitrate [PETN], nitroguanidine, nitrocellulose, nitroglycerine, and perchlorate). Surface soil, subsurface soil, and sediment samples will also be analyzed for pH and total organic carbon. Groundwater samples will also be analyzed for hardness. The SMI surface soil sample will be analyzed for target analyte list metals and explosives (including PETN, nitroguanidine, nitrocellulose, nitroglycerine, and perchlorate).
- Step 2: Install and sample four permanent monitoring wells; locations will be based on the results of Step 1.
- Step 3: Evaluate whether contaminant concentrations attributable to releases from the site present unacceptable risk to human health or the environment and, therefore, whether the site warrants action to mitigate or control the unacceptable risk.

The RI investigation methods, findings, and recommendations will be presented in an RI report for the Indian Head Installation Restoration Team to review. The report will provide the basis for making the following management decisions for the site:

- Determine if additional sampling is required to fully characterize the nature and extent of detected chemical constituents in surface soil, subsurface soil, sediment, and groundwater
- Assess if any interim remedial measures are warranted prior to completing the Feasibility Study or if sufficient data exist to conduct a Feasibility Study without additional investigation

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Abbreviations and Acronyms

AHA	Activity Hazard Analysis
CAD	cartridge-actuated device
DGM	digital geophysical mapping
DQO	data quality objective
ECP	entry control point
EPA	U.S. Environmental Protection Agency
ESQD	explosive safety quantity – distance
ESS	Explosives Safety Submission
EZ	exclusion zone
GPS	global positioning system
GSV	geophysical system verification
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HSP	Health and Safety Plan
IAS	Initial Assessment Study
IHIRT	Indian Head Installation Restoration Team
IVS	instrument verification strip
m	meter(s)
MC	munitions constituents
MDAS	material documented as safe
MEC	munitions and explosives of concern
MPPEH	material potentially presenting an explosive hazard
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NSF-IH	Naval Support Facility Indian Head
OB	open burning
OD	open detonation
PA	Preliminary Assessment
PAD	propellant-actuated device
PETN	pentaerythritol tetranitrate
RCRA	Resource Conservation and Recovery Act
RDX	1,3,5-trinitroperhydro-1,3,5-triazine
RI	Remedial Investigation
SI	Site Inspection
STTP	Safety Thermal Treatment Point
TNT	trinitrotoluene
UFP-SAP	Uniform Federal Policy–Sampling and Analysis Plan
UXO	unexploded ordnance

SECTION 1

Introduction

Naval Support Facility Indian Head (NSF-IH) is in the process of investigating closed ranges following the Comprehensive Environmental Response, Compensation and Liability Act investigation process. As part of this process, a Preliminary Assessment (PA) and Site Inspection (SI) were completed in 2005 and 2010, respectively (Malcolm Pirnie, 2005; CH2M HILL, 2010). Both the PA and SI recommended that a Remedial Investigation (RI) be performed for both munitions and explosives of concern (MEC) and munitions constituents (MC).

This Work Plan presents the objectives, scope, and procedures for conducting an RI at UXO 20 - Safety Thermal Treatment Point (STTP), at NSF-IH in Indian Head, Maryland. This document was prepared under the Department of the Navy (Navy), Naval Facilities Engineering Command (NAVFAC) Washington Comprehensive Long-term Environmental Action Navy 1000, Contract Number N62470-08-D-1000, Contract Task Order 0012.

1.1 Base Setting

NSF-IH is a Navy facility in northwestern Charles County, Maryland, approximately 25 miles southwest of Washington, DC. The facility consists of two tracts of land: the Main Installation on the Cornwallis Neck Peninsula, and the Stump Neck Annex, across Mattawoman Creek (Figure 1). The Main Installation contains approximately 2,500 acres and is bounded by the Potomac River to the northwest, west, and south; Mattawoman Creek to the south and east; and the town of Indian Head to the northeast. Included as part of the main area are Marsh Island and Thoroughfare Island, which are located in Mattawoman Creek. The Stump Neck Annex contains approximately 1,084 acres and is bounded by Mattawoman Creek to the northeast, the Potomac River to the northwest, and Chicamuxen Creek to the south-southwest. Both the Main Installation (Cornwallis Neck Peninsula) and the Stump Neck Annex are on the National Priorities List. The Main Installation and Stump Neck Annex are separated by Mattawoman Creek (noncontiguous), have separate U.S. Environmental Protection Agency (EPA) identification numbers, and perform dissimilar operations.

1.2 Site Description and Background

The site referred to as UXO 20 STTP, in the PA report (Malcolm Pirnie, 2005) was a 1.6-acre site at the end of Old Burn Point Way on a peninsula that extends southwest from the Main Installation into the confluence of Mattawoman Creek and the Potomac River. The PA report noted that, according to the Initial Assessment Study (IAS) (Fred C. Hart Associates, 1983), it is a man-made peninsula constructed of sand, fill material, rocket motor casings, empty cartridges, and coal fly ash. This information, however, could not be confirmed from the IAS.

The peninsula was built between approximately 1940 and 1942 and was set up for two separate uses: (1) the primary burn area, located from the tip of the peninsula to approximately 150 feet inland, which was used for open burning (OB) of munitions; (cartridge-actuated devices [CADs] and propellant-actuated devices [PADs]); (2) the secondary burn area, which covered the remainder of the peninsula and was used for munitions testing, including deflagration-to-detonation testing and pierce testing. From 1942 to 1988, OB on the ground surface or in an open top, steel thermal treatment vessel occurred on a weekly basis in the primary burn area. Until the 1950s, several types of propellants, including water or solvent wet wastes, were burned at the STTP at a rate of 40 to 50 pounds per week. Water or solvent wet wastes with oil were burned in 55-gallon drums. In 1954, propellant burning operations moved to the Strauss Avenue Thermal Treatment Point. The burning of up to 25,000 pounds per year of less-sensitive explosives, other pyrotechnics, and difficult-to-burn ordnance materials continued through 1988. Additionally, the peninsula was reportedly used for the OB/open detonation (OD) and testing of projectiles, bulk propellant, demolition charges, CADs / PADs, primers, less-sensitive explosives, high explosives, and other pyrotechnics using in-ground pits.

The PA also notes that initially material was burned directly on the ground when the STTP was first constructed, and new soil would be brought in periodically as needed. Onsite burn pans were added in 1980. In a few instances, the steel deflection shield was not able to prevent ejected materials from leaving the area. These incidences were caused primarily by burning nitroglycerine solvents or plastic- bonded explosives in bulk form.

The IAS report, prepared for the Naval Energy and Environmental Support Activity, states that sometime in the late 1970s 5 gallons of waste solvents were spilled on the STTP, reaching surface water. In addition, it was reported that, during the same time period, metal items from the site were occasionally ejected into Mattawoman Creek and the Potomac River during OB. Furthermore, according to written documentation from the Navy, approximately 96 drums of ash/residue and solvent contaminated surface soil were removed from the site in 1988 (Navy, 1988). Based on visual observation, it was estimated that the soil excavation spanned a 40-foot-diameter area to a depth of 1 foot. The subsurface soil was not disturbed. The location of soil removal, backfill efforts, and quantification of contaminant concentrations are unknown.

The STTP was previously designated as Solid Waste Management Unit 20 under the installation’s Resource Conservation and Recovery Act (RCRA) program. In 1993, a study was conducted at the STTP to evaluate whether a clean closure of the range was feasible under RCRA. As part of this site characterization, soil and groundwater samples were collected. The investigation concluded that the detected concentrations of explosives and metals within the soil and groundwater were at levels that would prohibit closure without further investigation. Soil and groundwater samples contained elevated levels of metals, explosives, volatiles, and semivolatiles compared to background samples (Tetra Tech, 2002). Although sediment was not sampled, the potential nature of past releases, presence of contamination in soil and groundwater, and transport mechanisms suggest it could have been affected by contaminant migration and discharge.

Several objects were observed during a June 2003 visual survey of the STTP. These objects included a large, cylindrical steel unit, which was identified as the former burn tank in the primary burn area, as well as a steel deflection screen and miscellaneous explosives testing equipment. A former burn tank was observed during the PA and the November 2008 site visit by CH2M HILL. A free-standing metal frame, a steel deflection screen, and other explosives testing equipment also are located on range.

During the SI, historical aerial photographs from 1943 to 1981 were reviewed. In a June 1943 photograph, an access road is shown leading to a small peninsula along the shoreline, and this peninsula was expanded by October. In a 1950 photograph, four stained areas were visible on the peninsula. A 1951 photo shows a large rectangular stained area near the center of the peninsula, and what was likely an open vertical tank on the north end. In a 1952 photo, another stained area is visible on the south end of the peninsula, and in a 1954 photo, a rectangular light-toned area was also in evidence there; multi-toned material appeared in photos dating from 1956 to 1964, and an evidence of an explosion was visible in a 1961 photo. In photographs from 1972 through 1981, dark-toned material was visible at the southern end of the peninsula. In a 1972 photo, an open tank and a vertical open tank are visible at the north end of the site; the vertical tank remained in photos through 1981 (CH2M HILL, 2010).

On August 2, 2011, NSF-IH informed CH2M HILL that the northern part of the peninsula is active and is currently being used by NSF-IH to test hand grenades. As a result of this information, the boundary of UXO 20 has been adjusted to exclude the northern part where testing is still ongoing and to include the southern part and spits (recent [since the PA] sediment deposition areas) of the peninsula, totaling approximately 0.97 acre (Figure 2). The site boundary has been officially revised in the NSF-IH database. The northern portion of the peninsula (formerly part of UXO 20) will be investigated under a new munition site designation upon closure.

Originally covering 1.3 acres, the area of the range was adjusted to account for a small area of recent sediment deposition on the southern point of the peninsula. However, based on current site conditions and active testing being conducted at the northern portion of the STTP, the site boundary has been revised to only include the southern portion of the peninsula. The current site area, which is the area over which the RI is being conducted, is 0.97 acre. Within the remainder of this document, the following terms apply: (1) UXO 20 (or site) refers to the area in the southern part of the peninsula encompassed by the new site boundary shown in Figure 2; and (2) “peninsula” refers to both the northern and southern parts of the peninsula, synonymous with the old site boundary in the PA.

1.3 Project Objectives

The objective of the RI is to define the nature and extent of MEC and MC at UXO 20 (excluding the shoreline and shallow water). The MEC objective will be accomplished as described in the following steps:

- Step 1: Remove MEC, material potentially presenting an explosive hazard (MPPEH), and metal from the land surface in order to minimize interference with the geophysical survey equipment used in Step 2.
- Step 2: Conduct a digital geophysical mapping (DGM) survey.
- Step 3: Intrusively investigate a percentage of anomalies identified in Step 2. (Note: The scope of Step 3 will not be included in this Work Plan until a better understanding of the density and distribution of the subsurface anomalies is obtained in order to make a reasonable estimate of the work to be performed. Details of Step 3 will be developed after Steps 1 and 2 are completed, and included as an addendum to this Work Plan.)
- For MC, fieldwork will consist of the following steps:
- Step 1: Collect up to 5 *in situ* groundwater samples using direct-push technology, 23 discrete surface soil samples, 23 discrete subsurface soil samples, 4 sediment samples, and 1 multi-incremental surface soil sample. The discrete surface soil, subsurface soil, sediment, and groundwater samples will be analyzed for target analyte list metals (total and dissolved for groundwater), target compound list volatile organic compounds, target compound list semivolatile organic compounds, and explosives (including pentaerythritol tetranitrate [PETN], nitroguanidine, nitrocellulose, nitroglycerine, and perchlorate). Surface soil, subsurface soil, and sediment samples will also be analyzed for pH and total organic carbon. Groundwater samples will also be analyzed for hardness. The multi-incremental surface soil sample will be analyzed for target analyte list metals and explosives (including PETN, nitroguanidine, nitrocellulose, nitroglycerine, and perchlorate).
- Step 2: Install and sample four permanent monitoring wells; locations will be based on the results of Step 1.
- Step 3: Evaluate whether contaminant concentrations attributable to releases from the site present unacceptable risk to human health or the environment and, therefore, whether the site warrants action to mitigate or control the unacceptable risk.

These objectives will be accomplished through the investigation approaches for MEC and MC outlined in Sections 2 and 3, respectively. The RI investigation methods, findings, and recommendations will be presented in an RI report for the Indian Head Installation Restoration Team (IHIRT) to review. The report will provide the basis for making the following management decisions for the site:

- Determine if additional sampling is required to fully characterize the nature and extent of detected chemical constituents in surface soil, subsurface soil, sediment, and groundwater
- Assess if any interim remedial measures are warranted before completing the Feasibility Study or if sufficient data exist to conduct a Feasibility Study without additional investigation

1.4 Project Organization

CH2M HILL will perform the RI with support from the Navy. The project organization chart is shown on Figure 3.

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1.5 Work Plan Organization

The remainder of this Work Plan is divided into the following sections:

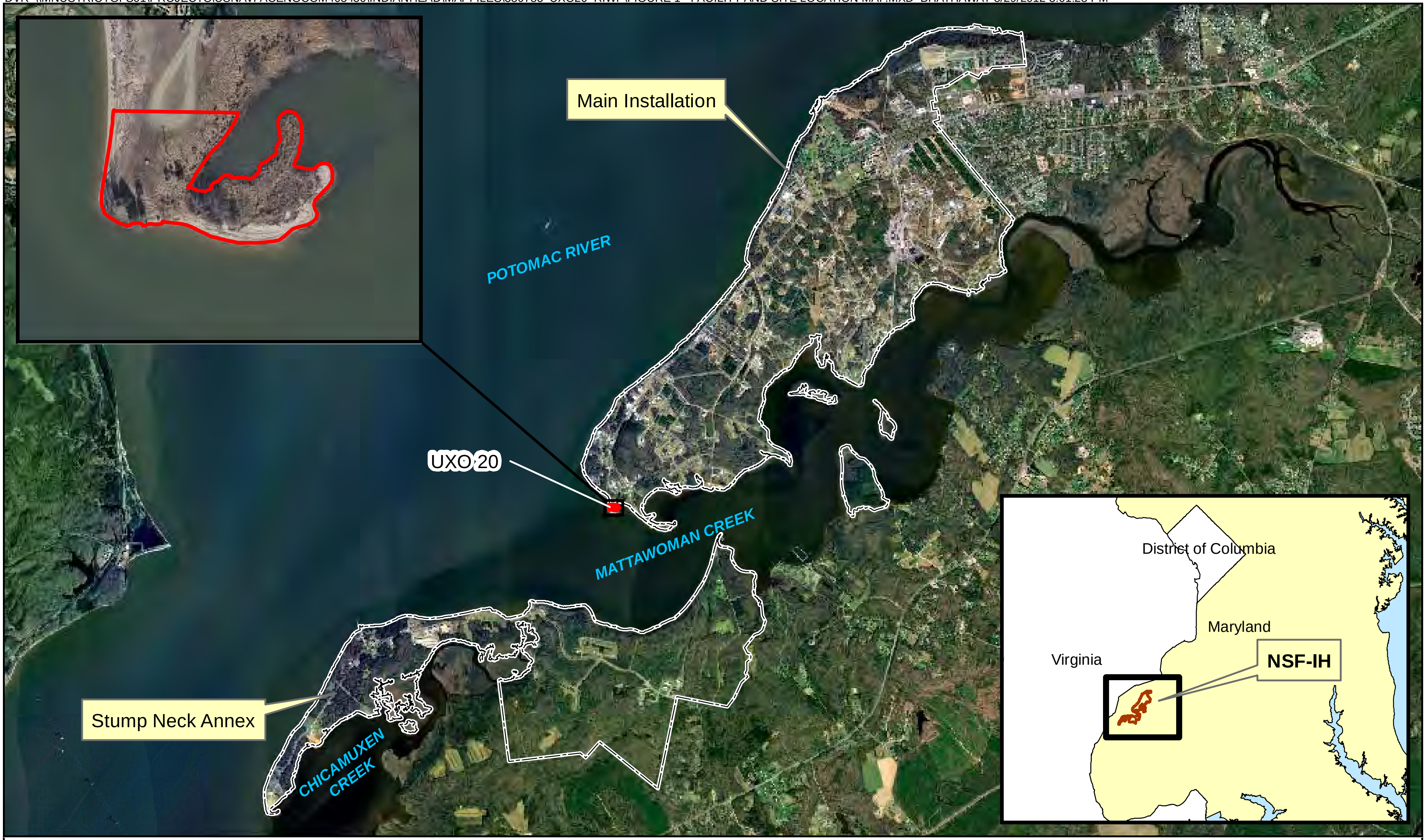
Section 2—Munitions and Explosives of Concern Investigation; describes procedures for implementing the MEC investigation.

Section 3—Munitions Constituents Investigation; describes procedures for implementing the MC investigation.

Section 4—References; lists all documents cited in this Work Plan.

Figures are provided at the end of each section. Appendices follow the References section. Several plans have been prepared in support of this RI and are provided as Appendix A (Accident Prevention Plan), Appendix B (Geophysical Investigation Plan), Appendix C (Project Quality Control Plan), Appendix D (Health and Safety Plan [HSP]), Appendix E, CH2M HILL's standard operating procedures for field methodologies), and Appendix F (Uniform Federal Policy-Sampling and Analysis Plan [UFP-SAP] for the UXO 20 – STTP RI).

DVR \\MNUSTRICTGFS01\PROJECTS\USNAVFACENGCOM405450\INDIANHEAD\MAPFILES\380785_UXO20_RIWP\FIGURE 1 - FACILITY AND SITE LOCATION MAP.MXD BHATHAWAY 8/29/2012 3:01:28 PM



Legend

UXO 20 Site Boundary

Installation Boundary

Imagery Source: Google Earth Pro

Figure 1
Facility and Site Location Map
Remedial Investigation Work Plan for UXO 20
NSF-IH, Indian Head, Maryland

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DVR \\MNUSTRICTGFS01\PROJECTS\USNAVFACENGCOM405450\INDIANHEAD\MAPFILES\380785_UXO20_RIWP\FIGURE 2 - P1 RI INVESTIGATION AREA.MXD BHATHAWAY 9/27/2012 8:33:01 AM

Legend

UXO 20 Site Boundary (0.97 acre)

100% DGM Survey (0.75 acre)

Note: The RI will be conducted over the entire site; however, the DGM survey will only be conducted on the portion of the site that is believed to be viable for the site crew and equipment to traverse.

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S

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Feet

Figure 2
RI Investigation Area
Remedial Investigation Work Plan for UXO 20
NSF-IH, Indian Head, Maryland

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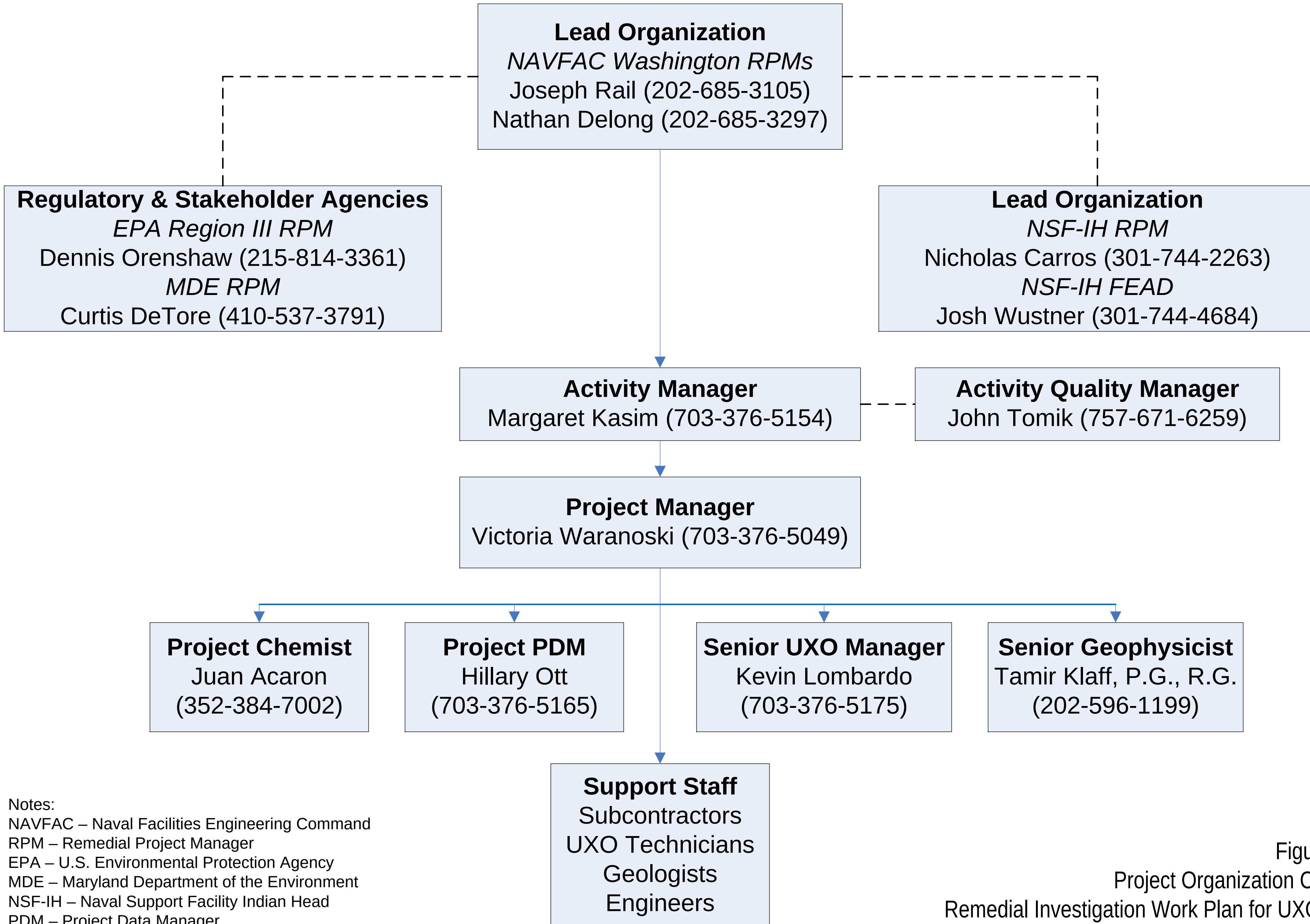

Notes:
NAVFAC – Naval Facilities Engineering Command
RPM – Remedial Project Manager
EPA – U.S. Environmental Protection Agency
MDE – Maryland Department of the Environment
NSF-IH – Naval Support Facility Indian Head
PDM – Project Data Manager
UXO – unexploded ordnance

Line of Authority
Line of Communication

Figure 3
Project Organization Chart
Remedial Investigation Work Plan for UXO 20
NSF-IH, Indian Head, Maryland

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SECTION 2

Munitions and Explosives of Concern Investigation

Figure 4 shows the sequence of the events to implement MEC activities at UXO 20. The activities are discussed in this section in the order in which they appear in the figure. Controls (identified by Activity Hazard Analysis [AHA] in the HSP) will be implemented to reduce risks to project personnel, the public, and the environment. Section 6.2 of the Explosives Safety Submission (ESS; CH2M HILL, 2012) describes the setup of exclusion zones (EZs) to protect nonessential personnel from any adverse effects generated from a potential explosion site (blast overpressure and fragmentation hazards). CH2M HILL's unexploded ordnance (UXO) personnel will ensure that the EZs and explosive safety quantity - distance (ESQD) arcs have established entry control points (ECPs) with barricades to control access. The ECPs are shown on Figures C-1 and C-2 of the ESS. When the EZs and ESQD arcs are in effect, access to these areas will be limited to personnel essential to the operation and authorized visitors. As noted in Section 6.1 of the ESS, a spotter will monitor Mattawoman Creek and the Potomac River for potential waterway traffic transiting UXO 20 ESQD arcs during explosive operations.

Because of the potential presence of munitions at this site, anomaly avoidance procedures will be followed during all work activities: vegetation clearing, setup of support areas, MEC/MPPEH and non-MEC clearing and removal, DGM survey, and anomaly excavation. Before any of the work outlined below is performed, the DGM survey boundary will be marked with a hand-held global positioning system (GPS) instrument. The areas will be staked out by CH2M HILL using anomaly avoidance procedures. Appendix D provides CH2M HILL's AHA for oversight during the survey, MEC and non-MEC clearing and recovery, and DGM. The HSP (including the AHAs) in Appendix D will be revised for anomaly excavation before performing the work, and will be included in the addendum to this Work Plan. Appendix E provides CH2M HILL's standard operating procedure for anomaly avoidance.

2.1 Field Activities

Figure 4 depicts the field activities process for the site preparation, removal of burn containment equipment, and DGM survey. Field activities for anomaly excavation will be included in the addendum to this Work Plan.

2.1.1 Site Preparation

Site Visit

CH2M HILL and its subcontractors will conduct a site visit to assess site conditions and determine if there are any site-specific issues, such as equipment needs, scheduling concerns, access issues, overhead utilities, and Base coordination, to address before mobilization begins.

Work and Safety Permit Approval and Base Access

A Comprehensive Work Approval Process Permit will be completed by NSF-IH. This will provide a centralized process for a comprehensive review of all planned projects and activities related to the facility. It further requires that all aspects and impacts of a project are considered, thereby facilitating appropriate planning and timely implementation without negatively affecting other projects or Base activities. NSF-IH will provide CH2M HILL with a signed copy of the Comprehensive Work Approval Process before field mobilization occurs.

Access to NSF-IH is controlled by NSF-IH security services. The subcontractors will have the option to enroll in RAPIDGate to obtain gate passes in accordance with NSF-IH requirements. Working hours at NSF-IH and at UXO 20 are from 7:00 a.m. to 4:30 p.m. Monday through Friday. NSF-IH will perform equipment and vehicle safety checks on the first day of field work.

Mobilization/Demobilization

Before mobilization, CH2M HILL field personnel will review this Work Plan and the ESS to ensure that the work is executed and health and safety protocols are adhered to as outlined herein. Mobilization includes coordination with the Navy, stakeout of investigative areas, and site orientation for the field staff. Utility clearance will not be performed because the munitions investigation activities do not entail intrusive activities. Demobilization will consist of ensuring that the site is left in the same condition as it was before mobilization, except for the vegetation and MEC/non-MEC items removed during preparation for DGM activities.

Boundary Survey

CH2M HILL will conduct a survey to establish the boundary for UXO 20. A GPS unit will be used to survey the site boundary. Wooden stakes will be placed, using anomaly avoidance procedures, along the boundary at corners and boundary turning points. No work will be conducted along the shoreline or in the shallow water.

Vegetation Reduction

CH2M HILL's subcontractor will perform vegetation reduction, supported by anomaly avoidance procedures where necessary, to perform the DGM survey. Vegetation reduction will consist of cutting brush and trees smaller than 6 inches in diameter to within 6 inches of the ground surface and removing downed trees along DGM transects. Vegetation reduction will be kept to a minimum to minimize any disturbance to the ground and avoid erosion. Signs of stressed vegetation will be documented in the field log book. All cleared vegetation will be mulched (as necessary) and left onsite.

Surface Removal of MEC/MPPEH and Other Metal Items

During detector-aided visual surface removal activities of the DGM survey area, a UXO team will remove MEC and MPPEH items as well as metal debris that is 2 inches by 2 inches or larger. The location of each item will be recorded photographically and surveyed with a GPS as possible and documented in the field log book. All items recovered during this activity will be evaluated and segregated as MEC, MPPEH, scrap metal, or general refuse. Recovered MEC and MPPEH will be assessed and their explosives safety status documented as either material documented as safe (MDAS) or material documented as an explosive hazard in accordance with NAVSEA Ordnance Pamphlet, paragraph 13-15 (NAVSEA, 2011) and Sections 6.3 and 6.4 of the ESS (CH2M HILL, 2012). MDAS is MPPEH that has been assessed and documented as not presenting an explosive hazard and for which the chain of custody has been established and maintained. Material documented as an explosive hazard is MPPEH that cannot be documented as MDAS, that has been assessed and documented as to the maximum explosive hazards the material is known or suspected to present, and for which the chain of custody has been established and maintained. All recovered MEC classified as unsafe-to-move will be blown in place. All recovered MEC classified as safe-to-move may be blown in place or moved within the site boundary for the purpose of conducting the disposal operation away from inhabited buildings, structures, roadways, or shoreline.

2.1.2 Removal of Burn Containment Equipment

Identification and Documentation of Items

Before beginning the identification and documentation of MEC items, the UXO technician will test the GPS equipment to ensure that it is functioning as designed. The location of each item will be recorded photographically and surveyed with a GPS as possible and documented in the field log book.

100 percent Visual Inspection

Burn containment equipment to be removed consists of the former burn tank, steel deflection shield, and part of a burn tank. In addition, a concrete block will also be removed. On September 21, 2011, CH2M HILL and the Navy observed that the former burn tank has an open bottom. As a result, debris observed inside the former burn tank will not be cleared before removal of the item. Before removal of the burn containment equipment, the following steps will be taken:

- Step 1: Visually inspect the exterior and interior surfaces of each aboveground item for the presence of explosive hazards. If explosive hazards are observed, remove hazards with solvents and cotton cloth rags and decontaminate the surface using either solvents such as an acetone, or hot soapy water. UXO personnel may confirm the surface is free of visible hazards using an explosive detection/identification field test kit. The field kit may be Expray (or equivalent substitute) and will test for various explosives and nitrate residues. The visible inspection, Expray testing, and decontamination process will be repeated until the entire surface is declared free of explosive hazards.

- Step 2: Once the aboveground surface is declared to be free of explosive hazards, the item will be lifted off the ground, with a crane or suitable substitute lifting equipment, to enable a full visual inspection of belowground surface not inspected in Step 1. The belowground surface contact areas will be visually inspected and washed with water to remove soil particles that may be adhered to the item. As stated in Step 1, the item will be inspected for explosives hazards and decontaminated until surfaces are free of explosive hazards.

  During the use of mechanized equipment, essential personnel will be protected from the blast overpressure for the primary maximum credible event. Operators will be provided blast overpressure protection by maintaining a minimum 5-foot (K24) separation distance from the burning containment equipment, based on the maximum credible event (Table 6-1 in the ESS) between the lift points and the operator cab. However, a 4-foot (K18) separation distance is permitted if the operator is provided with 9-decibel hearing attenuation equipment. In addition, fragmentation protection will be provided by placing the equipment operator behind shielding constructed of material with thicknesses not less than those presented for the MEC analogue on the Department of Defense Explosives Safety Board Fragmentation Data Review Form in Appendix B of the ESS. During item-lifting operations, nonessential personnel and the public will remain a minimum of 200 feet away from the lift operations.

- Step 3: Upon 100 percent visual inspection of the item, the item may be certified and verified as MDAS by UXO personnel.
- Step 4: MDAS will be loaded on a flatbed truck, blocked and braced, secured, and moved to an MDAS staging area located outside the site boundary.
- Step 5: MDAS items will be ultimately transported to a smelting company for witness recycling.

2.1.3 Digital Geophysical Mapping Survey

Following the surface removal of MEC/MPPEH and other metal items, a DGM survey will be performed in order to achieve 100 percent coverage of the accessible areas of the site, in accordance with the survey procedures provided in the Geophysical Investigation Plan (Appendix B). The purpose of the DGM survey is to identify metallic items in the subsurface that may be caused by MEC at the site (excluding the shoreline and shallow water). The DGM will be performed over 0.75 acre, excluding the shoreline, shallow water, and inaccessible marshland area (Figure 2).

The DGM survey will be performed using the Geonics EM61-MK2 time domain electromagnetic sensor. This type of metal detector is designed to detect shallow ferrous and non-ferrous metallic objects with very good spatial resolution and with minimal interference from adjacent metallic features and is, therefore, well suited for work close to man-made structures and in areas of dense subsurface metallic debris.

The EM61-MK2's transmitter generates a pulsed primary magnetic field, which then induces eddy currents in nearby metallic objects. The decay of the eddy currents produces a secondary magnetic field that is measured as a voltage in millivolts by the receiver coil of the instrument. The EM61-MK2 offers the ability to measure secondary eddy currents at four distinct time intervals. By taking measurements at relatively long times after the start of the decay, the current induced in the ground has fully dissipated, and only the current in the metal is producing a secondary field. Assuming accurate data positioning, target resolution of approximately 0.5 meter (m) can be expected.

Positioning for the DGM surveys will be provided by a real-time kinematic GPS when possible and by wheel fiducial positioning techniques where remaining tree canopies or other tall obstacles will limit the use of GPS methods. The fiducial method is accomplished using a specialized odometer counter wheel on the EM61-MK2 that triggers the instrument to record once for every 0.1 m of ground covered. Lines will be collected in a similar method to the GPS surveys. To assist in positioning the data, additional tape measures will be laid out perpendicular to the survey direction at 7.6m (25-foot) intervals within the grid. A fiducial mark will be recorded in the data each time the center of the EM61-MK2 trigger wheel crosses a fiducial line.

A geophysical system verification (GSV) will be performed as part of the process for validating the DGM system used during the geophysical mapping. The GSV is a physics-based, presumptively selected technology process in which signal strength and sensor performance are compared to known response curves of industry standard objects to verify DGM systems before and during site surveys. The GSV process is designed to provide initial verification of the proposed DGM system using an instrument verification strip (IVS), followed by a blind seeding program for continued verification throughout the field operations.

CH2M HILL's quality control geophysicist will perform a quality control check to make sure that the system meets project data quality objectives (DQOs) and is considered validated and appropriate for use at the site through observation of the IVS activities and an independent analysis of the IVS results. Details concerning the GSV are provided as an attachment to Appendix B.

The subcontractor will divided the DGM area into control grids on 30-m (98-foot) centers that will provide location control throughout the operation to manage the collection of geophysical data. Grids will be collected by laying measuring tapes along the two edges perpendicular to the survey direction. Non-metallic marker items will be used to denote lines every 0.75m (2.5 feet), which will be travelled in alternating directions during the survey. The grids will be digitally mapped using the EM61-MK2 either through direct connection with a real-time kinematic GPS or using odometer or fiducial positioning methods. The GPS rover unit will receive base station corrections in real time via a radio modem from the base station located over a known point near the IVS, which will be located on the golf course south of UXO 11.

2.2 Data Quality Objectives

DQOs are pre-established goals that help monitor and assess the progress of the project. They provide the benchmarks against which the quality of fieldwork and the quality of resulting analytical data are evaluated.

DQOs specify the data type, quality, quantity, and how data are used to support project decisions. Data gathered during the MEC investigation will be used to assess the types and locations of MEC at the site.

The site-specific DQOs presented below were developed following the seven-step process outlined in EPA's *Data Quality Objectives Process for Hazardous Waste Site Investigations* (EPA, 2000).

2.2.1 Step 1: State the Problem

The site has been used for OB/OD of waste pyrotechnics, solvents, projectiles, CADs/ PADs; primers, less-sensitive explosives, high explosives, and single-base, double-base, and composite propellants. Facility operations may have resulted in munitions being released into the environment. The nature and extent of potential MEC at UXO 20 are unknown.

2.2.2 Step 2: Identify the Decision

The objective of the MEC portion of the RI is to define the nature and extent of MEC at the site (excluding the shoreline and shallow water), which will aid in site management decisions by the IHIRT. If munitions items are observed on the surface, the type and function will be documented and GPS coordinates will be recorded. A geophysical survey will be conducted to detect anomalies in the subsurface. Anomaly excavation will be conducted to define the nature and extent of MEC present at the site. The collected information will be used by the IHIRT to evaluate current site conditions and assess future action alternatives.

2.2.3 Step 3: Identify Inputs to the Decision

Current information on the site consists of data collected during the RCRA investigation, PA, SI, and site visits conducted on November 25, 2008 and April 22, 2009. Geophysical data collected during the RI will be used to identify areas for anomaly excavation and characterization. The anomaly excavation and characterization during the RI will be used to define the nature and extent of MEC at the site.

2.2.4 Step 4: Define the Boundaries of the Study

Figure 2 shows the proposed DGM survey boundary, which covers approximately 0.75 acre. The area to the east of the peninsula is excluded from the DGM survey boundary because it is a marshland and would be unacceptable for access during the DGM survey. The boundary of the anomaly excavation(s) will be determined based on the results of the survey. The actual extent of the area to be investigated will be decided in the field, based on accessibility.

2.2.5 Step 5: Develop a Decision Rule

Following collection of the geophysical data, the following decisions will be made:

- If anomalies are not identified, anomaly excavation will not be required and no further action will be recommended for munitions
- If anomalies are identified, anomaly excavation and characterization will be conducted to characterize the sources of the DGM anomalies through intrusive confirmation and identification of the individual anomalies.

2.2.6 Step 6: Specify Limits on Decision Errors

Decision errors are minimal because the geophysical survey will be performed in the field with equipment that will be validated before use and data will be collected as the survey is performed.

2.2.7 Step 7: Optimize the Design

This investigation is part of an overall stepwise approach to data collection that is designed to ensure that all appropriate data are collected for management decisions by the IHIRT. The data collection and evaluation process presented in this Work Plan are part of the optimization process.

2.3 Documentation

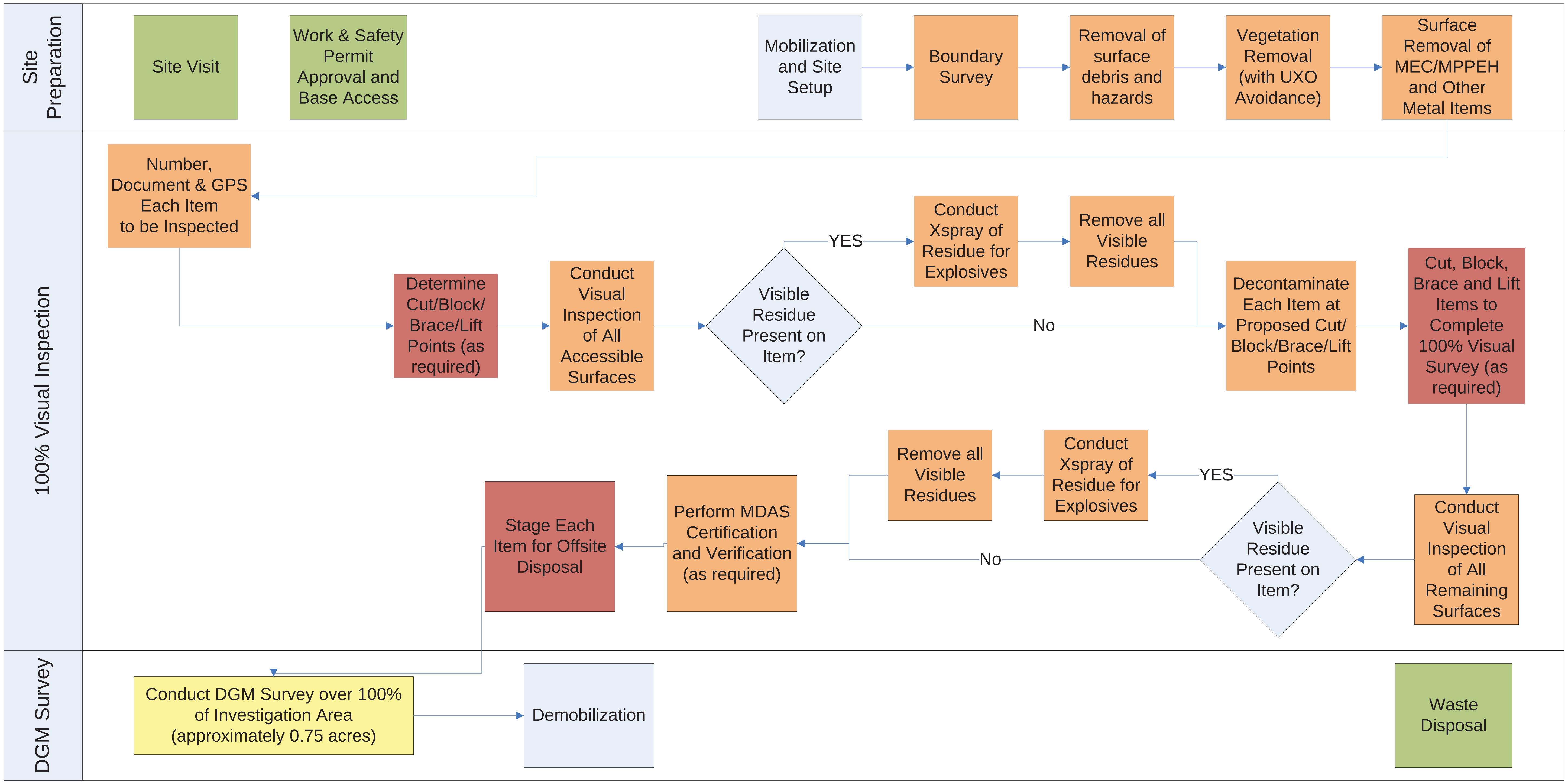
All field information will be documented in a handheld portable data assistant device and/or field notebook in accordance with the standard operating procedure, *Preparing Field Log Books,* in Appendix E. The data will be downloaded on a daily basis to a field computer. At the end of the project, the data will be uploaded into the NAVFAC munitions database in Navy Installation Restoration Information Solution.

2.4 Data Evaluation

Information gained and data collected will be used by the IHIRT to make a management decision on the path forward for MEC at this site. The data also will be used to create figures and maps for the RI report.

2.5 MEC Management and Contingency Plan

Figure 4 shows the flowchart for site setup, vegetation reduction and removal, and MEC/MPPEH and non-MEC handling during surface clearing before the DGM survey. The handling and management of MEC/MPPEH and non-MEC will be performed in accordance with the final ESS (CH2M HILL, 2012). Surface clearing and recovering of MEC/MPPEH and non–MEC items will be performed by CH2M HILL's subcontractor under the oversight of CH2M HILL.



Notes:
1. Green shaded items will occur prior to mobilization and after demobilization.
2. Orange shaded items indicate task to be completed by CH2M HILL UXO personnel.
3. Red shaded items indicate task to be completed by crane subcontractor.
4. Yellow shaded items indicate task to be completed by DGM subcontractor.
5. All tasks will be conducted with oversight by CH2M HILL.

Acronyms:
UXO – unexploded ordnance
MEC – munitions and explosives of concern
MPPEH - material potentially presenting an explosive hazard
GPS – global positioning system
MDAS – material documented as safe
DGM – digital geophysical mapping

FIGURE 4
Sequence of Events for MEC Investigation
Remedial Investigation Work Plan for UXO 20
NSF-IH, Indian Head, Maryland

CH2MHILL

SECTION 3

Munitions Constituents Investigation

Because of the collection of environmental media, the format for presenting information on the sampling and analysis protocol will follow the UFP-SAP (IDQTF, 2005). The UFP-SAP is provided in Appendix F. The UFP-SAP contains the Field Sampling Plan, the Quality Assurance Project Plan, and the Investigation-Derived Waste Management Plan. The HSP is provided in Appendix D.

3.1 Field Sampling Plan

Refer to Worksheets 10, 11, and 17 in the UFP-SAP for information regarding the Field Sampling Plan for the site. Anomaly avoidance will be conducted by a UXO technician during field activities because of the presence of MEC.

3.2 Quality Assurance Project Plan

Refer to Worksheets 12, 15, 19, 20, 23, 24, 25, 26, 27, 28, 29, 30, 34, 35, and 36 in the UFP-SAP for information regarding the Quality Assurance Project Plan for the site.

3.3 Investigation-derived Waste Management Plan

Refer to Worksheet 14 in the UFP-SAP for information regarding the Investigation-Derived Waste Management Plan for the site.

3.4 Reporting

An RI report will be prepared, which will summarize the background, objectives, methods, and results of both the MEC and MC investigations. It will also include recommendations for the site. The IHIRT will use the information in the RI report to make a management decision for the path forward for UXO 20.

SECTION 4

References

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Appendix A
Accident Prevention Plan

Final

Accident Prevention Plan
UXO 20

Naval Support Facility
Indian Head, Maryland

Contract Task Order 0012

November 2012

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Washington

Under the

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

Prepared by

CH2MHILL

Chantilly, Virginia

Contents

Acronyms and Abbreviations

APP	Accident Prevention Plan
CFR	Code of Federal Regulation
CLEAN	Comprehensive Long-term Environmental Action Navy
CPR	cardiopulmonary resuscitation
CSP	Certified Safety Professional
EM	Engineering Manual
H&S	health and safety
HS&E	Health, Safety and Environment
HSM	Health & Safety Manager
HSP	Health and Safety Plan
MEC	munitions and explosives of concern
OSHA	Occupational Safety and Health Administration
PPE	personal protective equipment
RHSM	Regional Health and Safety Manager
SHSO	Site Health and Safety Officer
SOP	standard operating procedure
SWO	Safe Work Observation form
UXO	unexploded ordnance

SECTION 1

Signature Sheets

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____

Mark Orman CSP, CHMM, ARM

SECTION 2

Background Information

Background information for this project is detailed in the Health and Safety Plan (HSP), Section 1.1, Introduction, as well as the project-specific Work Plan, of which this Accident Prevention Plan (APP) and HSP are integral components.

SECTION 3

Statement of Safety and Health Policy

3.1 Objective

The objective of this APP is to provide a safe work place for all employees by developing and administering an overall Health, Safety and Environment (HS&E) program. This APP establishes written policies and procedures that serve as vehicles through which the program will be implemented.

3.2 Purpose

The purpose of this APP, in conjunction with the project HSP, is to define the policies, procedures, and requirements that must be implemented for the Navy's Comprehensive Long-term Environmental Action Navy (CLEAN) Program projects and to also establish the responsibilities and requirements for managers, supervisors, employees, and subcontractors who may participate in the execution of CLEAN projects. It is the intent of this APP and HSP to address applicable requirements set forth by 29 Code of Federal Regulations (CFR) 191029 and 29 CFR 1926; Engineering Manual (EM) 385 1-1, Appendix A; and CH2M HILL policies and procedures incorporated by reference, herein.

3.3 CH2MHILL Goals

The goal of the CH2M HILL HS&E program is to eliminate workplace accidents, gain worker acceptance through cooperation and training, and provide our clients with a responsible, well-trained, safety-oriented work force.

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.** Projects will be conducted in a manner that minimizes the probability of near-misses, injury, illness, and equipment/property damage.

3.4 Primary HS&E Program Functions

The primary functions of the HS&E program are to:

- Define the health and safety (H&S) responsibilities of CH2M HILL personnel
- Administer the medical surveillance program
- Prepare the site safety plans
- Provide safety training/maintain training records
- Provide safety procedures and protocols to be used at project sites, shops, and offices
- Conduct accident investigations and maintain records
- Verify Occupational Safety and Health Administration (OSHA) compliance under 29 CFR 1910, 29 CFR 1926, and EM 385 1-1, as applicable, to executable contract work
- Provide guidance and assistance with preparation of safety protocols for specific tasks
- Promote safety and health consciousness within the company
- Designate the functional organization of safety committees to serve corporate and project-specific H&S program needs

3.5 Safety Organization and Responsibility

For CH2M HILL, the safety and protection of employees, clients, and the community is the first priority. This concern for safety is not restricted to field operations but extends to laboratories, offices, and treatment facilities. If an activity or condition is unsafe, the task will not proceed until the situation is corrected.

The **Program Manager** is the primary operational safety official for the Navy CLEAN Program at CH2M HILL and has overall responsibility for ensuring that program participants adhere to the H&S policies and procedures.

The **Health and Safety Manager** (HSM) administers the safety program for CH2M HILL and reports directly to the Program Manager with regard to CLEAN program matters. The HSM, or designee, is responsible for supporting and assisting program personnel in executing the HS&E policies and procedures. The HSM also maintains secondary reporting to the Deputy Program Manager.

The **Site Health and Safety Officer** (SHSO) is responsible for administration and enforcement of the safety procedures and protocols on project sites. The SHSO is the primary safety official at the working level. The responsibility for safety is delegated and shared by project managers, alternate site safety officers, and subcontractors' supervisors. At a minimum, the SHSO must perform, or otherwise supervise the performance of, the following:

- Motivate employees and supervisors of subcontractors to adhere to CH2M HILL's safety policy in each work situation.
- Schedule, organize, and lead preparatory phase meetings in advance of all activities relevant to definable features of work and have a working knowledge of the safe procedure for all jobs and tasks under their supervision. When in doubt, seek assistance before initiating a task. Safely is the only acceptable manner in which to perform the task. If the task cannot be accomplished safely, it will not be attempted.
- 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 so that everyone knows the correct procedure for safely accomplishing required tasks. New employees will not be allowed to perform any work until required training is completed.
- Immediately correct unsafe conditions that involve CH2M HILL employees or subcontractors.
- Ensure that employees are outfitted with and wear personal protective equipment (PPE) as specified by this plan, the HSP, EM 385-1-1, and other CH2M HILL procedures.
- Set a good safety example.
- Obtain the cooperation of employees and subcontractors. Subcontractor safety performance records will be verified before contract award and will be continually monitored during operations.
- Report all accidents, near-misses, and property damage in accordance with the Incident Management and Reporting procedure.

Every employee, regardless of job title, shares the responsibility for safety and should report any unsafe work condition without fear of reprisal. It is imperative that employees observe the following minimum requirements in order to achieve a safe and healthy workplace:

- Each employee must be familiar with this APP and the general safety rules herein.
- Each employee will practice safe procedures and follow all safety rules and regulations for the successful completion of any job task.
- All employees will wear the PPE required for the job or task as specified by this plan, EM 385-1-1, and other CH2M HILL procedures.

- The employee will notify the immediate supervisor of any potential hazard or unsafe work practice that could result in injury or destruction of property.
- The employee will report all accidents to an immediate supervisor regardless of whether injury or property damage resulted. This includes all near-misses (accidents without injury or damage). This requirement serves to bring unsafe conditions to the attention of management.
- Each employee will be subject to contraband search for safety purposes and for the safety of fellow employees.
- Violations of published safety policies and procedures may be cause for disciplinary actions up to and including dismissal.
- All employees who are taking prescribed medications that could affect work performance or might alter the manner in which they could be treated in an emergency will so advise their supervisor before beginning work.

3.6 Regulator Compliance Policy

CH2M HILL's policy is to comply with all federal, state, local, and client regulations. It is the responsibility of all personnel to perform all work in full compliance with appropriate regulations. H&S personnel will immediately bring any condition regarding safety and health compliance to the attention of supervisory operating personnel.

CH2M HILL will endeavor to ensure regulatory compliance by all of its subcontractors, including, safety records, OSHA training, and medical surveillance, as applicable.

3.7 CH2M HILL Medical Surveillance

All employees who perform work at hazardous waste sites or perform emergency response will be subject to the CH2M HILL medical surveillance program. This program conforms to the requirements established by 29 CFR 1910.120/1926.65 (f) Medical Surveillance, and is titled standard operating procedure (SOP) HSE-113, *Medical Surveillance*.

3.8 CH2M HILL Position Statement on Modified Work

CH2M HILL will attempt to eliminate all accidents through strict compliance with OSHA regulations and CH2M HILL H&S procedures, as well as supervisor and employee safety training, safety audits, and constant attention to safety. Should an employee be injured or become ill in the course of and arising from his or her employment, CH2M HILL will attempt to provide modified work. Modified work ("light duty") will be made available in order to bring the injured employee back to the work environment, for the benefit of the employee and the company, whenever medically appropriate.

Employees are expected to return to modified work when medically capable. The work assigned to the injured employee will meet the restrictions set forth by the treating and/or company physician. Examples of modified work include but are not limited to office work and light shop work.

3.9 Field Safety Inspections

Weekly safety inspections will be made of the work area/workers and documented on Safe Work Observation forms (SWOs). The inspection will be made by the Site Superintendent/ Supervisor, Field Team Lead (hereinafter defined as the individual responsible for site operations), and/or the SHSO, or other designated CH2M HILL representative. These inspections are in addition to the daily inspections to be held by these individuals and designated crew leaders. Discrepancies found during inspections will be corrected as soon as practicable. Serious safety violations will be corrected immediately. Inspection records (SWOs) will be maintained in project files, and sent to the regional HS&E manager for tracking.

Additionally, the CH2M HILL HSM or designated representative may make periodic unannounced inspections of work sites at their own discretion or at the request of an employee, supervisor, manager, or client.

3.10 First Aid

Each facility and work location must be evaluated as to the potential requirement for medical emergencies. At a minimum, an industrial first-aid kit will be provided. An adequate number of employees with current certification in first aid and cardiopulmonary resuscitation (CPR) will be maintained on the project sites.

The SSHO will ensure that emergency medical attention is readily available. For emergency response and remediation operations, the SSHO will establish the requirement for medical emergency response and identify an emergency medical facility with chemical contamination trauma capability. If site conditions require, an emergency medical technician and/or the availability of ambulance service on site will be subcontracted.

Medical support requirements are also defined by section 9.2.6 of this APP.

3.11 Review of Health and Safety Statistics

A designated representative from CH2M HILL will review and tabulate safety statistics as necessary:

- Workers' Compensation Experience Modification Ratings
- OSHA 300A forms

3.12 Specific Written Safety Procedures/Permits

To provide a safe work place and communicate specific work requirements for regulatory compliance, specific tasks are incorporated by reference to this procedure. These procedures deal with specific areas such as confined space, hot work, lock out /tag out, etc.

All CH2M HILL personnel who may be subject to these procedures will receive appropriate training and will be held accountable for compliance with procedure requirements.

3.13 State, OSHA, and Other Regulations

Where state regulations differ from federal regulation cited in this plan, the more-stringent regulation will apply.

3.14 Changes

Any user of this plan is welcome to recommend changes. Changes normally result from finding errors, regulatory changes, equipment modification, new equipment purchases, and changes to operation procedures or site conditions. The format for making a recommended change is:

Submit a written recommendation to the CH2M HILL HSM via your immediate supervisor (overall CH2M HILL Project Manager). The CH2M HILL HSM will review the recommendation.

After review, the CH2M HILL HSM will decide if the suggestions should be included as an amendment or new procedure in this plan. Changes to this plan will be distributed immediately upon approval.

SECTION 4

Responsibilities and Lines of Authorities

Any CH2M HILL onsite employee has the authority to intervene and suspend work in the interest of safety policy compliance; however, following intervention, the SHSO must be contacted immediately. The SHSO will contact the Project Manager and the Regional Health and Safety Manager (RHSM).

- Mark Orman CH2M HILL RHSM
- Victoria Waranoski CH2M HILL Project Manager
- To be determined CH2M HILL SHSO

Safety responsibilities, accountability, and lines of authority are further discussed in Section 3.2 of the HSP, Project Safety Responsibilities.

4.1 Employee Competency

Employee competency, as defined by 29 CFR 1926.32(f) and for areas of executable contract work for which an employee has responsibility, shall be established by the appropriate employer only. Competency shall be determined by the employee's training, total work experience, professional certification, and/or educational degrees. It is the opinion of CH2MHILL HILL that the professionals listed above are competent in their areas of expertise with regard to the management, field execution of the contract work, or in the implementation of CH2M HILL site-specific or program H&S requirements, as applicable. Executable onsite contract work, for which there is a requirement for a competent person to oversee, will not be conducted unless a competent person is available onsite.

Employee training records are available at corporate offices and by electronic means and are maintained on the project site. Depending on the size of the project crew and because of work crew dynamics and scheduling, provision of hard copies of employee records within the content of this APP or HSP would be impractical, but must be maintained onsite and will be provided to government officials for verification upon request.

In addition to the requirements above, the CH2M HILL HSM is a Certified Safety Professional (CSP) and meets established qualification and training criteria requirements and exhibits sufficient knowledge in health, safety and/or industrial hygiene matters to act as the responsible program official in the oversight of the CH2M HILL HS&E program.

4.2 Pre-task Safety and Health Analysis

Requirements for completing the pre-task safety and health analysis for performing onsite work must be, at a minimum, in accordance with sections 10.1 and 10.2 of the HSP.

4.3 Lines of Authority

Safety responsibilities, accountability, and lines of authority are discussed in Section 3.2 of the HSP and sections 3.5, 4.0 and 4.5 of this APP. The CH2M HILL chain of command and incident reporting process for this project are discussed in sections 10.3 and 10.7 of the HSP.

4.4 Non-compliance with Safety Requirements

All project personnel have the authority to stop work if it is their judgment that serious injury could result from continued activity. The individual responsible for site operations or the SHSO must be notified immediately if this becomes necessary. To protect the health and safety of all personnel, employees who knowingly disregard safety policies/procedures may be subject to disciplinary actions up to and including termination.

4.5 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 and procedures in each work environment. A first-line supervisor, for these purposes, is defined as that person designated to give immediate onsite supervision to personnel involved in a task.

All managers and supervisors will have complete knowledge of the safe procedure for all jobs and tasks under their supervision. When in doubt, they will seek assistance of the HSM, or other authorized program safety professional, before initiating a task. Safely is the only acceptable manner in which to perform the task. If the task cannot be accomplished safely, it will not be attempted.

Managers and 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 so 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, which involve CH2M HILL employees or contractors.
- Ensure that the employees are outfitted with and wear PPE as specified by this APP, the HSP, other CH2M HILL procedures, or as directed by the HSM, Project Manager, or SSHO.
- Set a good safety example.
- Obtain the cooperation of employees and contractors.
- Provide a safe work environment for employees and contractors.
- Confirm contractor safety performance records have been verified before contract award and monitor contractor performance during operations.
- Report all accidents, near-misses and property damage in accordance with the incident management and reporting procedure.
- Establish a safety culture, using the elements of the CH2M HILL Safety Improvement Process, which promotes awareness, encourages participation and recognizes excellence.

4.6 CH2M HILL Employee Responsibility Requirements

Each employee is responsible for his or her personal safety as well as the safety of others in the area and is expected to participate fully in the ***Safety Improvement Process,*** particularly the loss prevention observation process. The employee must use all equipment provided in an appropriate and responsible manner as directed by the SSHO. All CH2M HILL personnel will follow the policies set forth in the HSP. Site personnel concerned with any aspect of H&S will bring the concern to the attention of the Project Manager or SSHO. All project personnel have the authority to stop work, if it is their judgment that serious injury could result from continued activity. The individual responsible for site operations or the SSHO will be notified immediately if this becomes necessary. Personnel who knowingly disregard safety policies/procedures may be subject to disciplinary actions in accordance with their employer's established procedure.

SECTION 5

Subcontractors and Suppliers

5.1 Subcontractor/Supplier Coordination and Control

CH2M HILL subcontractors should be screened for safety performance and compliance with federal alcohol and drug testing requirements before being awarded any contract for site work. CH2M HILL subcontractors will comply with the requirements for site safety as outlined in CH2M HILL's H&S procedures.

Full identification of all subcontractors that are or may be required to successfully execute this contract may not be fully detailed at the time that H&S documents are prepared for submission or implementation. Because of the potentially dynamic and evolving nature of contract requirements and resultant project scheduling at many points during the project evolution, only partial identification of potential subcontractors who may be selected for our projects is likely. To this end, continuously updating and amending this APP or the HSP with potentially selected, newly selected, or approved subcontractors would not be practical or cost-effective for all parties concerned.

CH2M HILL maintains an extensive and detailed process for subcontractor procurement, with the Federal Acquisition Regulations as the primary driver. Subcontractor selection is based on scope of work pricing, qualifications, safety performance, and best-value evaluations

5.2 Subcontractor/Supplier Safety Responsibilities

All subcontractor employees are subject to the same training and medical surveillance requirements as CH2M HILL 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 29 CFR 1910.120. All subcontractor personnel will be required to sign in daily and be required to attend a daily meeting discussing operations and safety issues. All CH2M HILL employees and subcontractors will jointly complete a Pre-Task Safety Plan or individually complete a Safety Task Analysis Card before starting work at the site. Subcontractors will submit Activity Hazard Analyses for their work activities to the CH2M HILL SHSO or HSM for review before starting work. The subcontractor reports directly to the CH2M HILL Project Manager. The CH2M HILL Project Manager may designate subcontractor reportability to the CH2M HILL individual responsible for site operations. All incidents involving subcontractor employees will be reported to the CH2M HILL individual responsible for site operations, and a copy of the subcontractor's injury/illness report will be submitted to the CH2M HILL Project Manager and HSM, as soon as possible, but no later than 24 hours after an incident.

CH2M HILL subcontractors are required to sign off on and comply with all requirements of the CH2M HILL Site-Specific HSP, which includes this APP. Plans to address specific hazards may be added to the APP during the course of work. CH2M HILL subcontractors will be required to sign off on and comply with any such supplemental plans. Subcontractors not in compliance will be immediately dismissed from the site. Subcontractors will only be allowed on munitions and explosives of concern (MEC) sites when supervised by the appropriate unexploded ordnance (UXO) technical crew.

Suppliers delivering various materials to the project site or providing equipment and equipment maintenance will comply with all rules and regulations specified by the owner. Supplier personnel will not be permitted into contaminated areas unless their training and medical surveillance is in accordance with 29 CFR 1910.120. Contractors will not ride on tractors, forklifts, or similar vehicles unless specific seats are provided. They will follow facility hot work rules if hot work is required for vehicle or equipment maintenance. Operators of mobile equipment onsite must observe all traffic rules such as speed limits and the rights-of-way of pedestrians. Suppliers will only be allowed on MEC sites when supervised by the appropriate UXO technical crew.

SECTION 6

Training

CH2M HILL engages in environmental remediation, construction, and other services, and endeavors to comply with the numerous H&S safety training requirements mandated by governmental agencies, clients, and internal policies.

Personnel will be provided with sufficient training to execute their jobs in a safe and healthy manner.

Direct supervisors are responsible for identifying the training requirements of a task and making sure that employees have the necessary training to complete the task safely. H&S personnel will assist with this identification and training.

Designated CH2M HILL personnel and/or electronic databases will facilitate maintenance of training records and applicable experience documentation. If an employee is found to lack sufficient training or experience to perform an assigned task, every effort will be made to provide the employee with the necessary training, or the employee will be replaced by an alternate who has the proper training and experience.

Employee training records are available at corporate offices and by electronic mean, and are maintained on the project site. Depending on the size of the project crew, provision of hard copies of employee records within the content of this APP or HSP would be impractical, but must be maintained onsite and will be provided to government officials for verification upon request.

6.1 Safety Indoctrination Subjects

Outlines of the site safety orientation for CH2M HILL and subcontractor personnel and visitors are provided in Section s1.0, 2.0, 4.0, and 9.0 of the HSP.

General topics of the site safety orientation for CH2MHILL and subcontractor personnel and visitors are listed below:

- MEC safety, staying with and obeying the UXO technicians
- NSF-IH safety rules: Areas where cell phones and radio transmissions are not allowed, facility speed limits, other Base-specific safety requirements
- Boating safety for working on water
- Vegetation clearance safety, including detailed discussion of chain saw operation safety, tree felling and limbing safety, machete safety, and brush cutting safety
- Biological controls (poison ivy is still a risk even if the leaves are gone), ticks, bees, wasps, feral dogs, mosquito bites
- Cold stress
- Chemical hazards expected, and on which sites

6.2 Mandatory Training and Certifications

Mandatory training and certifications are discussed in Sections 3.1 (CH2M HILL Employee Medical Surveillance and Training) and 3.3 (Field Team Chain of Command and Communication Procedures) of the HSP.

All personnel entering an exclusion zone will be trained in the provisions of this APP and will be required to sign the plan. All personnel entering a MEC exclusion zone will be supervised by a UXO technician and will be required to review and sign the MEC Management and Contingency Plan. UXO technicians are required to have training and certifications as stated in the MEC Management and Contingency Plan.

6.3 Supervisory and Employee Safety Meetings

The CH2M HILL SHSO will conduct daily safety meetings at the start of each work shift for onsite personnel and will require subcontractors to follow similar meeting procedures or participate in the CH2M HILL daily safety meetings.

SECTION 7

Safety and Health Inspections

The CH2M HILL Project Manager, the individual responsible for site operations, and/or the SSHO are required to perform site inspections using the designated checklists included herein by reference or are contained in referenced SOPs. The inspection will be made by the Project Manager, the individual responsible for site operations, and/or the SSHO, or another designated CH2M HILL representative. Discrepancies found during inspections will be corrected as soon as practicable and documented in the Loss Prevention Observation form (**Attachment 5** of the HSP). Serious inconsistencies will be corrected immediately. Inspections that identify imminent danger or immediately dangerous to life and health situations will require that work be stopped immediately and personnel are removed from the work area until the situation is abated, corrected, or controlled to a non-hazardous condition.

The individual responsible for site operations or SSHO is responsible for conducting and preparing reports of daily inspections of work processes, site conditions, and equipment conditions and submitting them for the project record, as necessary. Corrective actions resulting from discrepancies identified in inspections processes will be reviewed with the Project Manager and implemented, as necessary. Copies of these reports are maintained on file at the project locations.

The CH2M HILL HSM or designated representative may periodically conduct site visits and perform site safety assessments. Additionally, the CH2M HILL HSM or designated representative may make periodic unannounced inspections of work sites at their own discretion or at the request of an employee, supervisor, manager, or client. Any discrepancies that are identified as part of these inspection processes will be addressed with the Project Manager overall, or may be corrected in the field if minor in nature.

As required, CH2M HILL's safety equipment will comply with the appropriate requirements of OSHA, the National Institute for Occupational Safety and Health, American National Standards Institute, ASTM International (formerly the American Society for Testing and Materials [ASTM]), and U.S. Coast Guard or other recognized certification organizations.

SECTION 8

Accident Reporting and Investigation

8.1 Accident Investigation

All accidents, injuries, illnesses, and near-misses will be investigated by the SSHO or other authorized H&S program designate. Upon completion of such investigations, investigation reports shall be provided to the Project Manager for review and circulation to CH2M HILL program stakeholders (HSM, Program/Deputy Program Manager, and other potential CH2M HILL stakeholder interests).

The CH2M HILL HSM or authorized designee will investigate all incidents and accidents. Such accidents include, but may not be limited to, the following:

- A fatal injury
- A hospitalization of three or more people resulting from a single occurrence
- A weight-handling equipment incident
- A permanent total disability
- A permanent partial disability
- Property damage
- Spill
- Near-miss

The CH2MHILL HSM also requests that a specific written accident investigation be conducted in case of an unusual or serious injury or accident. In general, accident, injury, illness and property damage incidents will be investigated in accordance with the requirements in section 10.4 of the HSP.

8.2 Exposure Data (Man-hours Worked)

The CH2M HILL HSM, with assistance from designated CH2M HILL personnel, tracks and maintains incident records in accordance with federal reporting requirements (OSHA 300 Log), as applicable to the incident.

8.3 Accident Investigations, Reports, and Logs

Incident investigations for CH2M HILL shall be in accordance with Section 10.4 of the HSP. The CH2M HILL HSM or designee conducts accident/incident investigations. Incident investigation reports are completed by the SSHO or other authorized designee and will be reviewed and acknowledged by the Project Manager. The report must be submitted to the Project Manager and HSM, as soon as possible, but no longer than within 24 hours of the incident.

8.4 Immediate Notification of Major Incidents

CH2M HILL will immediately notify the Base contact/Navy Remedial Project Manager /Facilities Engineering and Acquisition Division of any major incident, including injury, fire, equipment/ property damage and environmental incident. A full report will be provided within 48 hours. Procedures to be followed in response to any project incident are detailed in Section 9.7, Incident Notification and Reporting, of the HSP.

SECTION 9

Plans Required by the Safety Manual

9.1 Layout Plans

Site layout plans, drawings, or sketches are included in the project-specific Work Plan, of which this APP and HSP are integral components.

9.2 Emergency Response Plans

The emergency response preparedness and procedures are provided in Section 9.0 of the HSP.

9.2.1 Procedures and Tests

The project team intends to verify that emergency response processes are in place and capable of being executed before field assignments begin. Pre-emergency planning procedures for this project are discussed in Section 9.1 of the HSP. However, because response to medical or fire emergencies will be by government facility installation personnel or even by outside public responders, it may be impractical and disruptive to the "primary mission" of these responders to perform procedural response testing. When this happens, the designated responsible party shall verify that emergency services are available for response, that contact information is appropriate, and that responders know how to access anticipated work areas.

9.2.2 Spill Plans

Spill prevention shall be conducted in accordance with the information identified in Section 7.0 of the HSP, Project Hazards - Spill Containment Procedures.

9.2.3 Firefighting Plan

CH2M HILL personnel are not considered firefighting organizations. Only "small fires" that are containable by the use of first-response fire protection equipment may be controlled by CH2M HILL personnel. All other responses shall be considered "fire fighting" measures and shall be conducted by facility provided or public agency firefighting teams.

Fire prevention measures and first-response fire protection equipment shall be in accordance with the information in Section 2.1.4,Project Hazards – Fire Prevention, and Section 9.2, Emergency Equipment and Supplies, of the HSP.

9.2.4 Posting of Emergency Telephone Numbers

Emergency contact numbers appropriate to project operations are included on page 5 of the HSP and referred to as the Emergency Contact List. Where temporary construction facilities are established at the project site, this Emergency Contact List shall be posted in a conspicuous location. Where temporary construction facilities are not allowed or provided, the list shall be available for quick reference by the individual(s) responsible for site operations and its location shall also be made known to other site personnel.

9.2.5 Man overboard / Abandon Ship

Not Applicable

9.2.6 Medical Support

Medical support shall be in accordance with section 9.4 of the HSP. The location of and direction to medical support facilities shall be posted in a conspicuous location where temporary construction facilities are established at the project site. Where temporary construction facilities are not allowed or provided, the list shall be available for quick reference by the individual(s) responsible for site operations and its location shall also be made known to other site other personnel.

In addition, the project shall be outfitted with first aid kits of suitable size and quality (contents) to meet H&S requirements for onsite first aid or CPR response. Personnel protective devices shall be provided such that universal precautions against bloodborne pathogens can be exercised while administering CPR or first aid. Eye wash stations, either portable or stationary, will be available.

An effective means of communication to summon transportation of injured workers to medical treatment facilities is required. Communication devices shall be tested in the area of use to assure functionality.

When a medical facility or physician is not accessible within 5 minutes of an injury to a group of two or more employees for the treatment of injuries, at least two employees on each shift shall be qualified to administer first aid and CPR.

9.3 Plan for Prevention of Alcohol and Drug Abuse

The CH2M HILL substance abuse program is in accordance with Section 2.2.3 of the HSP and the CH2M HILL Drug Free Workplace SOP.

9.4 Site Sanitation Plan

Toilet facilities on construction sites shall be provided as follows:

Minimum Toilet Facilities at Construction Sites

Number of Personnel	Number of Toilets
20 or fewer	1
20 or greater	1 toilet seat and 1 urinal per 40 workers
Greater than 200	1 toilet seat and 1 urinal per 50 workers.

The above requirements do not apply to mobile crews or to normally unattended work locations if employees working at these locations have transportation immediately available to nearby toilet facilities. Separate toilet rooms for each sex need not be provided if toilet rooms can only be occupied by one person at a time, can be locked from the inside, and contain at least one toilet seat.

Toilet facilities shall be constructed so that the occupants are protected against weather and falling objects; all cracks shall be sealed, and the door shall be tight-fitting, self-closing, and capable of being latched. Adequate ventilation shall be provided and all windows and vents shall be screened. Toilet facilities shall be constructed so that the interior is lighted. Provisions for routinely servicing and cleaning all toilets and disposing of the sewage shall be established before placing toilet facilities into operation. The method of sewage disposal and the placement location selected shall be in accordance with federal, state, and local health regulations.

Washing facilities shall be provided at toilet facilities and as needed to maintain healthful and sanitary conditions. Each washing facility shall be maintained in a sanitary condition and provided with water (either hot and cold running water or tepid running water), soap, and individual means of drying. If it is not practical to provide running water, hand sanitizers may be used as a substitute. Washing facilities shall be located close to the worksite.

Trash and garbage generated by site activities will be disposed in the facility’s dumpsters.

9.5 Access and Haul Road Plan

The site access road is included in the project-specific Work Plan as applicable, of which this APP and the HSP are integral components.

9.6 Respiratory Protection Plan

Not Applicable

9.7 Hazard Control Program

The CH2M HILL hazard control program is defined by the entire contents of the HSP and this APP, as well as documents included by reference.

9.8 Hazard Communication Program

Site-specific hazard communication information is provided in Section 2.2.5 of the HSP, Project Hazards – Hazard Communication. Hazard communication awareness training can be accomplished by using the chemical-specific training & project-specific chemical product hazard communication forms contained in **Attachment 3** of the HSP. Material Safety Data Sheet information associated with this project is not included herein, for submission, due to the volume of information necessary. It is the intent of the project to compile this information for inclusion in the hardcopy version of the HSP used for implementation on the project site.

9.9 Process Safety Management

Not Applicable

9.10 Lead Abatement Plan

Not Applicable

9.11 Asbestos Abatement Plan

Not Applicable

9.12 Radiation Safety Program

The radiation exposure control measures shall be conducted in accordance with the information identified in Section 2.4, Project Hazards – Radiological Hazards and Controls, and Section 5, Air Monitoring, of the HSP as applicable.

9.13 Abrasive Blasting

Not Applicable

9.14 Heat/Cold Stress Monitoring Program

The heat/cold stress monitoring program shall be conducted in accordance with the information identified in sections 2.2.8 and 2.2.9 of the HSP, Project Hazards - Heat Stress Monitoring and Cold Stress Monitoring, respectively, as applicable.

9.15 Crystalline Silica Monitoring Plan

Not Applicable

9.16 Night Operations Lighting Plan

No night operations will be conducted for the execution of this project. However, project visible lighting requirements shall be in accordance with the information provided in Section 2.1.7 of the HSP, Project Hazards - Visible Lighting.

9.17 Fire Prevention Plan

Fire prevention shall be conducted in accordance with the information identified in Section 2.1.4 of the HSP, Project Hazards - Fire Prevention.

9.18 Wild Land Fire Management Plan

Not Applicable

9.19 Hazardous Energy Control Plan

This program establishes lockout practices of energy sources that could cause injury to personnel involved at the work site. The lock out program covers all employees and outside contractors affected by the cleaning, repairing, servicing, and adjusting of prime movers, machinery, and equipment. Only authorized employees will perform such work.

- Authorized employees will be instructed in lock out/tag out procedures by their supervisor. Each new or transferred employee will be instructed by the supervisor in lock out procedures. A sufficient number of tags and padlocks will be supplied. During each phase of construction, a representative from CH2M HILL will be present while the electrical supervisor begins the lock out/tag out process.
- All equipment will be locked out to protect against accidental or inadvertent operation when such operation could cause injury to personnel. Do not attempt to operate any switch, valve, or other energy-isolating device bearing a lock.
- Documented inspections will be made periodically by supervisors to ensure that each procedure is being properly followed. The SSHO will make sure these inspections are being performed and keep on record the inspection reports on the job site. The inspection must include a review addressing the employee’s responsibilities. Documentation is to include the date of the inspection, equipment on which the procedure was being utilized, the employees involved, and the person performing the inspection.
- Authorized employees will be certain as to which switch, valve, or other energy- isolating devices apply to the equipment being locked out. More than one energy source may be involved. Any questionable identification of sources will be cleared through the supervisors.
- To begin the lock out process, use the following items as a guide. If for any reason the following items are in question, contact your immediate supervisor before moving forward. If more than one individual is required to lock out equipment, each person will place his own personal lock on the energy-isolating device(s). One authorized individual and a competent person from the prime contractor (CH2M HILL), with the knowledge of the crew, may lock out equipment for the whole crew. In such cases, it is the responsibility of the individual to carry out all steps of the lock out procedure and inform the crew when it is safe to work on the equipment. Additionally, the authorized individual will not remove a crew lock until it has been verified that all individuals are clear and a prime contractor competent person is present.
  - Notify all affected employees that a lock out is required.
  - If the equipment is operating, shut it down by the normal stopping procedure.
  - Operate the switch, valve, or other energy-isolating devices so that the energy source(s) is disconnected or isolated from the equipment.
  - Stored energy, such as capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure, must also be dissipated or restrained by methods such as grounding, repositioning, blocking, or bleeding down.
  - Lock out energy-isolating devices with an assigned individual lock. A second lock will be used if possible by the superintendent.

  - After ensuring that no personnel are exposed and as a check on having disconnected the energy sources, operate the push button or other normal operating controls to make certain the equipment will not operate. CAUTION: Return operating controls to the neutral position after the test.
  - Attach a completed accident prevention tag and/or sign on the controls of the machine. The identification tag and/or sign will be coordinated with the electrical contractor and the prime contractor. A CH2M HILL representative will then familiarize the facility personnel affected by this operation with the identification of these tags or signs and the procedures under which the contractors will be working, and the point of contact of the electrical supervisor.
  - The equipment is now locked out.
- To restore equipment to service, use the following items as a guide. If for any reason the following items are in question, contact your immediate supervisor before moving forward.
  - When the job is complete and equipment is ready for testing or normal service, check the equipment area to see that no one is exposed.
  - When equipment is clear, remove all locks. The energy-isolating devices may be operated to restore energy to the equipment. There must be a supervisor from the electrical contractor and the prime contractor present.
- The included checklist for lock out training is a minimum requirement to provide to new employees. The supervisors must sign, date, and retain in their own records this information. The supervisor must also delivery a copy of this training to the Site Safety Officer.
  - Explain the significance of why a machine is locked or tagged out.
  - Explain what an employee is to do (and not do) when encountering a tag or lock on a switch or device he or she wants to operate.
  - Explain the importance of notification of affected employees.
  - Show the employee the location of all locks, tags, and lock out devices.
  - Explain how to recognize the applicable hazardous energy sources.
  - Explain the type(s) and magnitude of energy to be isolated on the machinery and how to control that energy.
  - Explain the proper sequence of locking out.
- All utility outages will follow the contract specifications, EM 385-1-1 and OSHA standards. The contractors will follow the requirements above as well as the following:
  - The contractor will supply the required tags and/or locks for each utility outage.
  - PWC utility outages will be coordinated with PWC Utilities, the contractor, and sub-contractor.
  - Interior building/ facility utility outages will be coordinated with Facility Manager, the contractor, and subcontractor.
  - A preparatory meeting will be held before all electrical work and utility outages; this meeting will also cover any safety issues that may pertain to the scope of work. The Activity Hazard Analysis will be reviewed and any additional concerns will be annotated on this form.

In addition, hazardous energy control activities shall be in accordance with the information identified in Section 3.0 of the HSP, Project Hazards – Lock-Out/Tag-Out.

9.20 Critical Lift Plan

Not Applicable

9.21 Contingency for Severe Weather Plan

Not Applicable

9.22 Float Plan

Not Applicable

9.23 Site-specific Fall Protection and Prevention Plan

Not Applicable

9.24 Demolition Plan

Not Applicable

9.25 Excavation/Trenching Plan

Not Applicable

9.26 Emergency Rescue (Tunneling)

Not Applicable

9.27 Underground Construction Fire Prevention and Protection Plan

Not Applicable

9.28 Compressed Air Plan

Not Applicable

9.29 Formwork Shoring and Removal Plan

Not Applicable

9.30 Precast Concrete Plan

Not Applicable

9.31 Lift Slab Plans

Not Applicable

9.32 Steel Erection Plans

Not Applicable

9.33 Site Safety and Health Plan (Hazardous Waste Operations and Emergency Response)

A site-specific HSP for hazardous waste operations and emergency response is a comprehensive document contained in sections 1.0-11.0 of the HSP and its attachments.

9.34 Blasting Safety Plan

Not Applicable

9.35 Diving Plan

Not Applicable

9.36 Confined Space Program

Not Applicable

SECTION 10
Risk Management Process

Project-specific hazards and hazard control measures are identified in Section 2 of the HSP. A detailed Activity Hazard Analysis for each major phase of work is included in **Attachment 5** of the HSP.

Appendix B
Geophysical Investigation Plan

Final

Geophysical Investigation Plan
for
UXO 20

Naval Support Facility Indian Head
Indian Head, Maryland

Contract Task Order 0012

November 2012

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Washington

Under the

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

Prepared by

CH2MHILL

Chantilly, Virginia

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Activity Manager

Date

Contents

Tables (located at the end of the plan)

Figures (located at the end of the plan)

Attachment

Acronyms and Abbreviations

cm	centimeter(s)
DGM	digital geophysical mapping
DQO	data quality objective
GIP	Geophysical Investigation Plan
GPS	global positioning system
GSV	geophysical system verification
HSP	Health and Safety Plan
In	inch(es)
m	meter(s)
MEC	munitions and explosives of concern
MPC	measurement performance criterion
MPPEH	material potentially presenting an explosive hazard
MRP	Munitions Response Program
NSF-IH	Naval Support Facility, Indian Head
QC	quality control
RTK	real-time kinematic
SUXOS	Senior UXO Supervisor
UXO	unexploded ordnance

SECTION 1

Geophysical Operations Overview

This Geophysical Investigation Plan (GIP) describes the equipment, approach, methods, operational procedures, and quality control (QC) methods to be used in performing the geophysical investigation at UXO 20, Naval Support Facility, Indian Head (NSF-IH), Indian Head, Maryland. NSF-IH is a Navy facility in northwestern Charles County, Maryland, located approximately 25 miles southwest of Washington, DC. Background information on the site can be found in Section 1 of the Remedial Investigation Work Plan, herein referred to as the work plan.

Additional topics covered in this GIP include the following: safety issues; geophysical data quality objectives (DQOs); site description; anticipated munitions and explosives of concern (MEC) types, quantities, compositions, and depths; physical site conditions; adverse geophysical conditions; site utilities and manmade features that may negatively affect the geophysical operation; data acquisition and reporting; and geophysical program QC requirements.

The geophysical instruments used during digital geophysical mapping (DGM) will be operated by the DGM subcontractor. Geophysical support during non-DGM operations (such as clearing locations for the placement of survey stakes) will involve the use of analog instruments that do not have data storage capabilities. These instruments are typically used to detect near-surface or subsurface metallic items in real time by emitting an audible tone or providing a visual indicator of response amplitude when in the presence of an item. These analog instruments will be operated by an unexploded ordnance (UXO) Technician II or III.

1.1 Safety Issues

Project personnel are required to adhere to the project Health and Safety Plan (HSP), presented in Appendix D of the work plan. A surface visual inspection will be performed at UXO 20 by UXO technicians before DGM begins in order to identify and remove potential MEC items and material potentially presenting an explosive hazard (MPPEH), munitions debris, and non-munitions-related surface metal from the DGM area. The visual inspection will be conducted in accordance with Section 2 of the work plan.

DGM survey personnel will not access areas beyond the established DGM perimeter and associated access routes, unless otherwise directed by the Senior UXO Supervisor (SUXOS) or UXO technicians. If a potential MEC/MPPEH item is observed at the surface, DGM personnel will retreat to the designated rally point and immediately inform the SUXOS. The SUXOS will report the finding to the NSF-IH contact (Nicholas Carros, 301-744-2263) and will subsequently contact the CH2M HILL Project Manager. The NSF-IH contact will coordinate further actions related to the item using NSF-IH resources.

1.2 DGM Personnel Qualifications

DGM operations will be led by a qualified munitions response geophysicist, and data collection and associated field tasks will be conducted by personnel experienced in the operation of the applicable instruments. Onsite DGM personnel will have documented proof of completion of the 40-hour Occupational Safety and Health Administration Hazardous Waste Operations and Emergency Response training, as well as annual 8-hour refreshers and required medical monitoring physical exams. At least two DGM team members will be qualified to administer first aid and cardiopulmonary resuscitation; this typically is met by one certification from the DGM subcontractor and one certification from the CH2M HILL oversight staff.

1.3 Investigation Area

The DGM area at UXO 20 is presented as Figure 2 in the work plan. The DGM area will be divided into control grids on 30-meter (m) centers that will provide location control throughout the operation. The corners of the grids will be physically marked onsite using either a real-time kinematic global positioning system (RTK-GPS) or conventional land surveying equipment.

The difference between the DGM boundary and site boundary in Figure 2 of the work plan is due to the exclusion of the southernmost spit from the DGM area because it was concluded during previous site visits that the marshland in this area would be inaccessible for land-based DGM.

SECTION 2

Background

2.1 Site History

A description of the site history is provided in Section 1 of the work plan.

2.2 Anticipated MEC Types, Composition, and Quantities

The types, composition, and quantities of potential MEC items at UXO 20 are not known. Information on the types of materials associated with the historic open burn/open detonation activities is provided in the work plan.

2.3 Anticipated Depth of MEC Items

The depth of potential MEC items at UXO 20 is not known. However, the anticipated depths range from near surface to several feet below ground surface.

2.4 Vegetation and Topography

The DGM survey area is situated on the southern portion of the peninsula that extends southwest of the main NSF-IH facility into the confluence of the Mattawoman Creek and the Potomac River. The area is relatively flat and open and is bordered by a tree line along the north side. A marshland covers most of the eastern end of the peninsula but is not included in the DGM survey area.

2.5 Geologic Conditions

A description of the composition of the peninsula is provided in the work plan.

2.6 Shallow Groundwater Conditions

A description of the anticipated shallow groundwater conditions at the site is provided in the Uniform Federal Policy Sampling and Analysis Plan (Appendix F of the work plan).

2.7 Adverse Geophysical Conditions

There are no adverse geophysical conditions present at UXO 20.

2.8 Site Utilities

CH2M HILL will review available underground utility maps from NSF-IH to evaluate whether utilities are present within the DGM area at UXO 20. However, because of the relatively remote location of the site, underground utilities are not expected within the DGM area.

2.9 Manmade Features Potentially Affecting Geophysical Operations

The former burn chamber and steel deflection shield are present at UXO 20 and will be removed before performing DGM.

2.10 Site-specific Dynamic Events

In the event of severe weather or an emergency at NSF-IH, DGM personnel will follow the procedures in the project HSP. Site-specific dynamic events (such as unusually strong winds or harsh weather conditions) that may negatively affect the DGM survey operations at the site are not anticipated. Although it is possible that weather conditions may temporarily interfere with operations at during the DGM, no significant weather-related delays or impacts on the geophysical instruments are expected.

2.11 Overall Site Accessibility and Impediments

The site is accessible via paved and dirt roads, and access impediments are not anticipated.

2.12 Potential Worker Hazards

No potential worker hazards are anticipated at the site other than those associated with conducting DGM and associated field tasks. These hazards are described in the project HSP.

SECTION 3
Geophysical Investigation

The geophysical system verification (GSV) process will be used to validate the DGM system to be used at UXO 20. The GSV Work Plan is provided as an attachment to this GIP.

3.1 DGM DQOs

The primary objective of the DGM is to identify subsurface metal indicative of potential MEC and MPPEH. DQOs specific to the DGM are provided in the GSV Work Plan. Achievement of the DQOs will be verified by the CH2M HILL Project/QC geophysicist.

3.1.1 General Geophysical System Functioning

DGM Systems Positioning

The DQO for DGM systems positioning is that the coordinates being obtained from the positioning systems are at a sufficient accuracy to allow for appropriate relocation of MEC items for intrusive investigation. The measurement performance criterion (MPC) for this is that the positional error of the system at known locations will not exceed 10 centimeters (cm) (4 inches [in]). This will be evaluated by ensuring that, on a daily basis, the geophysical system being used passes QC Test # 2, Record Sensor Positions, as outlined in Section 3.4.1.

DGM System Data Repeatability

The DQO for DGM systems data repeatability is that the systems respond consistently from the beginning to the end of an operation. The MPC for this is that the response to a standardized item will not vary more than ±20 percent. This will be evaluated by ensuring that, on a daily basis, the geophysical system being used passes QC Test # 5, *Static Background and Static Spike,* as outlined in Section 3.4.1. Results of QC Test # 6, *Repeat Data*, will also be qualitatively[1] reviewed for repeatability.

3.1.2 DGM Surveys

Down Line Data Density

The DQO for downline (along each survey transect) data density is to have sufficient data collected along each transect to detect MEC items. The MPC for this is that at least 98 percent of possible sensor readings are captured along each transect at 0.7 feet (0.213 m) or less. In addition, any transect (or portion thereof) containing a data gap of 2 feet or greater does not meet the DQO. This will be evaluated by verifying that all of the DGM data collected and used for anomaly selection meet this standard.

Survey Coverage (Lane Spacing)

The DQO for lane spacing is to maintain appropriate lane spacing to provide 100 percent coverage of accessible portions of the survey area. The MPC for this is that the lane spacing is no greater than 1 m (the width of the EM61-MK2 system), with an intended lane spacing of 0.75 m. This will be evaluated by verifying that all of the DGM data collected and used for anomaly selection meet this standard, except at locations where trees or other obstructions prohibit such spacing.

Positioning Accuracy

The DQO for horizontal positioning accuracy is that positioning of detected anomalies is accurate enough to allow for effective reacquisition of the anomaly. The MPC for this is that a selected anomaly must be within 1 m

[1] Comparisons are qualitative because sources of error, including horizontal orientation of the instrument, system bounce, item orientation, and actual item distance from system transmitter and receiver coils, can cause high variability in signal response. Quantitative validation of the system response to an ISO is performed during QC Test #5 (Static Background and Static Spike), described in Section 3.4.1).

of each blind seed. Any anomaly that is selected farther outside than 1 m from a point directly above the blind seed will not be considered to be a detection of that item. This will be evaluated by verifying that all blind seeds have an anomaly location selected within this standard or can be otherwise explained.

3.2 Geophysical Instrumentation

3.2.1 Analog Geophysical Instruments

The Schonstedt GA-52Cx magnetometer will be used during non-DGM operations where a geophysical instrument is needed. The Schonstedt GA-52Cx fluxgate gradiometer is a handheld analog magnetometer that detects ferrous objects and ferromagnetic minerals. The instrument provides an audible signal representing the magnitude and direction of the local magnetic field. The operator sweeps the instrument back and forth in the area of interest and monitors the change in pitch of the sound emanating from the instrument. The change in pitch represents the response to a secondary magnetic field produced by a ferrous metallic item. This instrument will only be used in areas where ferrous MEC items are considered likely to be present.

In cases where non-ferrous MEC items may be present, the White's XLT will be used. The White's XLT is an electromagnetic metal detector that uses a transmitter coil to establish a localized electromagnetic field that induces eddy currents in nearby conductive materials. A collocated receiver coil measures the eddy current response, and the system provides an audible tone and visual display of the response magnitude. The operator sweeps the instrument back and forth in the area of interest and monitors the change in pitch of the sound emanating from the instrument.

3.2.2 DGM Instrument

The EM61-MK2 will be used to perform the DGM at UXO 20. 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. The EM61-MK2 system to be used at the site will be consist an air-cored, 1m by 0.5m coil, a digital data recorder, batteries, and processing electronics. The EM61-MK2's transmitter generates a pulsed primary magnetic field, which then induces eddy currents in nearby metallic objects. The receiver coil measures these eddy currents at four distinct time intervals. Secondary voltages induced in the receiver coil are measured in millivolts.

Positioning of the EM61-MK2 data will be performed either through direct connection with an RTK GPS or using odometer or fiducial positioning methods. Odometer methods use a procedure wherein a measuring device (for example, wheel-based) is used to calculate the distance traveled along a linear transect. Using this approach, a series of survey lanes are established over a grid. Flags are placed at the beginning and end of each lane, and an operator walks down the lane while sensor readings are collected when triggered by the odometer system at a pre-defined interval (for example, every 20 cm). As the operator walks past the starting and ending points in the survey lane, the operator stops the data collection. By assuming the operator walked in a straight line, the total distance recorded by the odometer system is compared to the known distance travel and the down-line position for each of the data points is adjusted accordingly.

Fiducial methods use a time-marking procedure to determine the spatial location of the collected data. Similar to the odometer approach, a series of survey lanes are established over a grid. Flags are placed at the beginning and end of each lane, and at equal distances along the transect (for example, every 10 m). An operator walks down the lane while the data logger collects sensor readings at a prescribed sampling. As the operator walks past the starting, fiducial, and end lines in the survey lane, the operator presses a button on the data logger that places a fiducial time mark in the data stream. By assuming the operator walked in a straight line at a constant velocity, the location of each data point can be calculated.

3.3 Data Acquisition, Processing and Reporting

3.3.1 Data Coverage

DGM will be performed across UXO 20 in order to achieve 100-percent coverage of the accessible portions of the DGM area. DGM will be performed using an intended lane spacing of 0.75 m. Inaccessible areas will be documented by DGM personnel.

3.3.2 Field Data Sheets

Information to be recorded in the Munitions Response Program (MRP) Enterprise System field devices will include the following:

- Site ID
- Grid ID (or other identifier of surveyed area)
- Field team leader name
- Field team members' names
- Date of data collection
- Instrument used
- Positioning method used
- Instrument serial numbers
- File names in data recorders
- Data collection sampling rate
- Line numbers, survey direction, fiducial locations, start and end points
- Weather conditions
- Grid conditions
- Terrain conditions
- Cultural conditions
- Survey area sketch
- Associated QC data file names
- Field notes (other)

3.3.3 Data Processing

Instrument-specific software will be used for initial data processing, and the output will be imported into Geosoft Oasis Montaj for additional processing, anomaly selections, quality assurance/QC, and presentation. The general processing steps include the following:

- Positional offset correction
- Sensor bias, background leveling, and/or standardization adjustment
- Sensor drift removal
- Latency or lag correction
- Geophysical noise identification and removal (spatial, temporal, motional, terrain induced)
- Contour level selection with background shading
- Digital filtering and enhancement (low pass, high pass, band pass, convolution, correlation, non-linear, etc.)

3.3.4 Interpretation/Anomaly Selection

The following criteria, supplemented by site- and system-specific criteria established during instrument validation, will be used for selecting anomalies:

- Maximum amplitude of the response with respect to local background conditions
- Lateral extent (footprint) of the area of response
- Three-dimensional shape of the response

- Decay curve characteristics
- Location of the response with respect to the edge of the grid, inaccessible areas, land features, cultural features, or utilities within or adjacent to the grid (field notes and relevant aerial photos and site plans will also be used)

3.3.5 Target Locations

The target analysis process culminates in the creation of target location lists that contain information such as target location and amplitude. The target list will first be generated using an initial anomaly detection threshold consistent with the smallest potential MEC item of concern at the site. This threshold is typically on the order of 2.5 to 3 millivolts when relatively small MEC items (for example, 20-millimeter projectiles) are expected to be present.

Because of the site's history as an open burn/open detonation area, it is possible that existing surface and near-surface conditions will be characterized by a relatively elevated metallic signature. If the review of the DGM data indicates a relatively elevated background metallic signature, the initial anomaly selection threshold may be too low and would subsequently be increased before the target lists are finalized. Increasing the target selection threshold after an initial review of the DGM data would also facilitate prioritization of potential MEC items and provide guidance for conducting potential follow-up investigations at the site.

3.3.6 Grid Maps

With each target list, the DGM subcontractor will also provide a map containing the following information:

- Client
- Project
- Contractor
- Map creator
- Map approver
- Date map was created
- Map file name (full path and file extension)
- Scale
- Grid identification
- Grid corner locations
- Contoured data
- Anomaly locations with unique identification numbers
- North arrow, legend, title block, etc.

3.3.7 Records Management

All files will be made available for QC verification throughout the project in order to verify that the field and data processing procedures presented in this GIP and the work plan are properly followed. All raw data files, final processed data files, hard copies, and field notes will be retained and maintained in the MRP Enterprise System throughout the project.

3.3.8 Final Reports, Maps, and Geophysical Mapping Data

The DGM subcontractor will provide each day's data for QC inspection via the Internet using a file transfer protocol site, electronic mail (email) attachments for small files under 5 megabytes, or digital compact disk within 3 working days after collection. These data are considered to be in raw form. The DGM subcontractor also will provide a digital geo-referenced map in Geosoft format so that results can be registered within the original mission plan survey map.

All geophysical field data will be provided to CH2M HILL in delineated fields as x, y, z, v1, v2, and so forth, where x and y are universal transverse mercator grid plane coordinates in easting (m) and northing (m); z (optional) is elevation in feet; and v1, v2, v3, and so forth are the instrument readings. The last data field will be a time stamp. Each data field will be separated by a comma or tab. No individual file will be larger than 100 megabytes and no longer than 600,000 rows. Each grid will be logically and sequentially named so that the geophysical data files can be easily correlated with the grid name.

Within 45 days of completion of data collection, the processed geophysical field data, final maps, and interpretations will be provided to CH2M HILL. All geophysical data will be accompanied by a report (MRP Enterprise standard report format) documenting the field activities and the processing performed to-date. Information provided by the MRP Enterprise report is summarized in Table 1.

All sensor data will be correlated with navigational data, based on a local "third order" (1:5,000) monument or survey marker. If a suitable control point is not available, a land surveyor will establish a minimum of two new monuments or survey markers with a minimum of third-order accuracy.

3.4 DGM Systems QC

An extensive QC program will be applied to the DGM operations at the site. Figure 1 presents the overall chart of the QC steps.

3.4.1 QC Tests

Each of the DGM systems will be field tested to confirm proper operating conditions. Several basic QC tests will be performed in addition to instrument-specific tests. A description of each QC test, acceptance criteria, and frequency is provided below and summarized in Table 2.

1. **Equipment Warm-up**. Standard warm-up time is at least 5 minutes. Equipment warm-up will be performed at the beginning of daily operations as well as after the instrument has been off for a sufficient amount of time for the electronics to cool. The warm-up period may be increased, as needed, by DGM personnel in the event of unusually cold weather.

2. **Record Sensor Positions**. Positioning accuracy of the final processed data will be demonstrated by operating the equipment over one or more known points. The positional accuracy will be evaluated by calculating the difference between the known location and the displayed position from the DGM system. The sensor position test will be conducted at the beginning of daily operations.

3. **Personnel Test.** This test checks the response of instruments to personnel and their clothing/proximity to the system. The response will be observed in real time for immediate corrective action and subsequently transmitted to the processor, where the instrument response will be evaluated for data spikes that could represent false anomalies. The personnel test will be conducted at the beginning of daily operations.

4. **Vibration Test (Cable Shake).** This test checks the response of the instrument to vibration of the system cables. The response will be observed in real time in the field for immediate corrective action and subsequently transmitted to the processor, where the instrument response will be evaluated for data spikes that could create false anomalies. The vibration test will be conducted at the beginning of daily operations.

5. **Static Background and Static Spike**. Static tests will be performed by positioning the survey equipment near or within the DGM area in an area free of metallic interference. Data will be collected for at least 1 minute. During this time, the instrument will remain stationary and data will be recorded first without a reference item and then with a reference item. The purpose of the static test is to evaluate sensor drift and ambient noise levels. The static background and static spike test will be conducted at the beginning and end of daily operations.

6. **Repeat Data.** This test is performed to evaluate the repeatability of the geophysical data and will be performed after completion of the DGM. At least 2 percent of the DGM area will be resurveyed for this test.

3.4.2 QC Seed Items

QC seed items (refer to the GSV Plan for a description of the item types) will be seeded at least every 0.75 acre. The seed items will have labels identifying them as inert and that also provide a contract reference, point of contact address, phone number, and a unique identifier. CH2M HILL personnel will perform QC seeding using hand tools. The seed locations will first be checked using a hand-held analog geophysical instrument to identify locations that appear to be free of metallic interference. The locations of the seed items will be surveyed using an RTK-GPS or conventional survey equipment. The items will be buried at depths of approximately 6 inches in order to have a sufficiently high signal-to-noise ratio for comparison with published industry standard target values. Detection of the QC seed items will be monitored by CH2M HILL. If a seed item is not detected, the DGM subcontractor will perform a root-cause analysis and develop a corrective action plan that will be approved by CH2M HILL.

3.4.3 QC of DGM Data and Deliverables

Both the DGM subcontractor and CH2M HILL geophysicists will perform QC of geophysical data and data deliverables at each processing stage. Figure 2 shows the processing stages and the associated QC steps. Data will not move to the next stage until they have passed each QC check.

QC checks to be performed on field forms, pre-processed data, and processed data can be found in Table 1.

3.4.4 Corrective Measures

General corrective measures in association with DGM surveying include the following. Additional measures may be implemented to account for specific instrument problems or site-specific conditions.

- Replacement of sensors if they fail to meet instrument check requirements.
- Recollection if QC seed items are not mapped in the DGM data. In the event that a mapped seed item is not selected during data processing, the data may be re-processed in lieu of recollection.

3.5 Analog Geophysical Systems QC

QC of the analog geophysical instruments will be accomplished through daily functional checks before use in the field. Each instrument will be operated over a small ferrous metallic item. If the instrument cannot detect the item, it will be taken out of service until it is repaired or replaced.

Tables

TABLE 1
Processing Documentation Requirements
Geophysical Investigation Plan for UXO 20
NSF-IH, Indian Head, Maryland

Information Type	"Raw" Data Delivery Report	Final Data Delivery Report	Must be in File Headers
Site ID	X	X	X
Geophysical instrument type used	X	X	
Positioning method used	X	X	
Instrument serial numbers (geophysical and positioning)	X	X	
Coordinate system and unit of measure	X	X	
Grid ID (or other identifier of surveyed area)	X	X	X
Date of data collection	X	X	X
Raw data file names associated with delivery	X	X	
Processed data file names associated with delivery	X	X	
Name of Project Geophysicist	X	X	
Name of Site Geophysicist	X	X	
Name of data processor	X	X	
Data processing software used	X	X	
Despiking method and details	X	X	
Sensor drift removal and details	X	X	
Latency/lag correction and details	X	X	
Sensor bias, background leveling and/or standardization adjustment method and details		X	
Portable document format (PDF) document showing graphical results of each field quality control test	X	X	
Geophysical noise identification and removal (spatial, temporal, motional, terrain induced) and details		X	
Other filtering/processing performed and details		X	
Gridding method		X	
Anomaly selection and decision criteria details		X	
Geosoft ".xyz" file for unit of survey being delivered (e.g., grid or area agreed upon with Geophysicist)		X	
Geosoft ".grd" file for unit of survey being delivered		X	
Geosoft ".map" file for unit of survey being delivered		X	
PDF of Geosoft map for unit of survey being delivered		X	
Geosoft ".map" mosaic of all processed data to date		X	
PDF mosaic of Geosoft map of all processed data to date		X	
Other processing comments		X	
Date data processing is completed	X	X	
Data delivery date	X	X	
Scanned copy of field notes and field mobile data collection device notes (if applicable)	X		

TABLE 2
DGM Instruments Standardization Tests and Acceptance Criteria
Geophysical Investigation Plan for UXO 20
NSF-IH, Indian Head, Maryland

Test	Test Description	Acceptance Criteria	Power On	Beginning of Day	Beginning and End of Day	2% of Total Area Surveyed
1	Equipment Warm-up	Equipment specific (typically 5 minutes)	X			
2	Record Sensor Positions	± 4 in (10.2 cm)		X		
3	Personnel Test	Based on instrument used. Personnel, clothing, etc., should have no effect on instrument response.		X		
4	Vibration Test (Cable Shake)	Data profile does not exhibit data spikes .		X		
5	Static Background & Static Spike	± 20% of published standard item response, after background correction			X	
6	Repeat Data	Qualitative comparison of data.				X

Figures

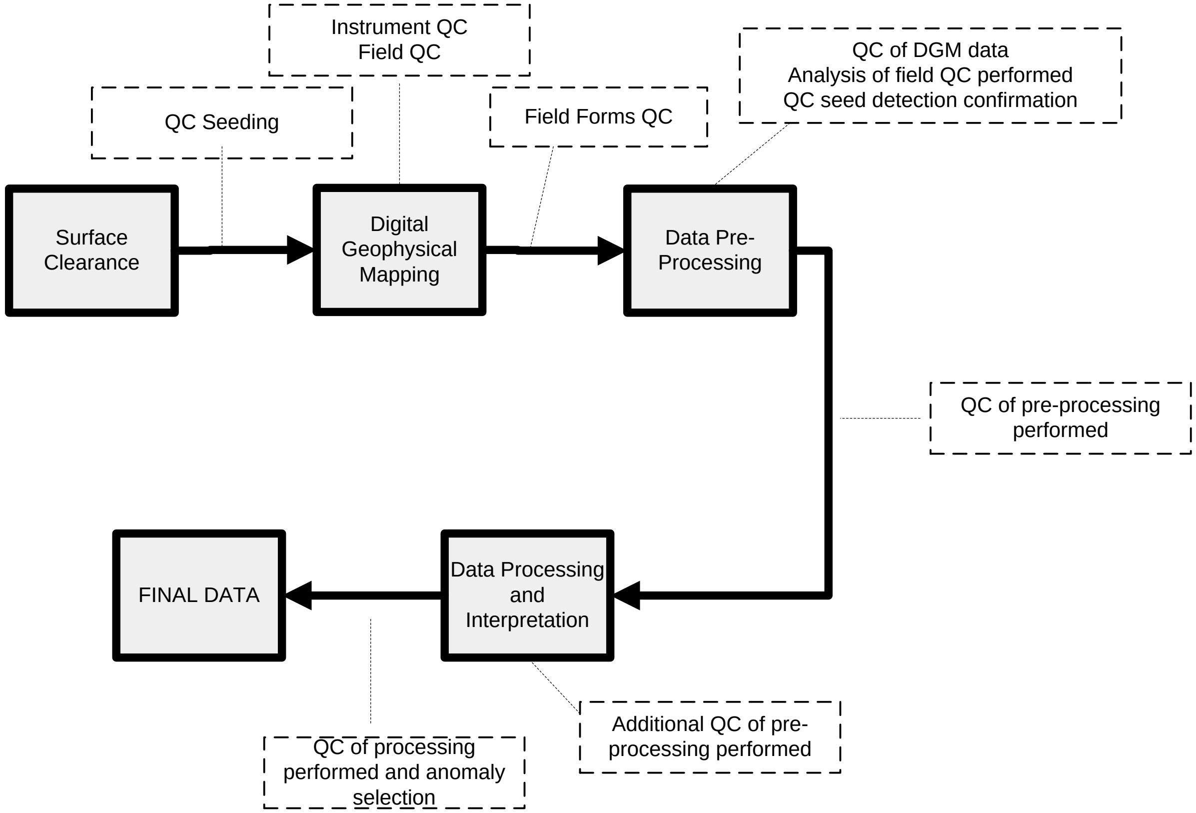

FIGURE 1
Overview of DGM Process QC
Geophysical Investigation Plan for UXO 20
NSF-IH, Indian Head, Maryland
CH2MHILL

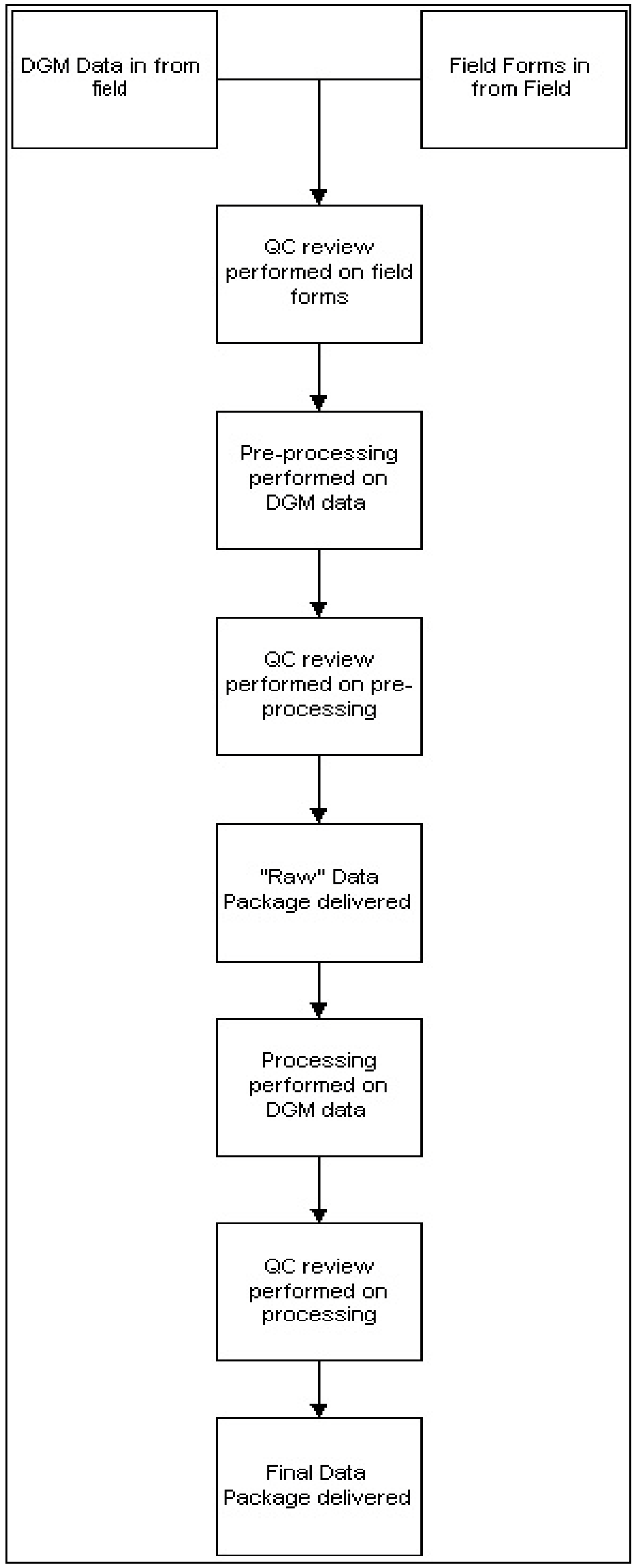

FIGURE 2
QC of DGM Data - Process Flowpath
Geophysical Investigation Plan for UXO 20
NSF-IH, Indian Head, Maryland

CH2MHILL

Attachment
Geophysical System Verification Work Plan for UXO 20

Geophysical System Verification Work Plan for UXO 20

Naval Support Facility Indian Head
Indian Head, Maryland

Contract Task Order 0012

October 2012

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Washington

Under the

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

Prepared by

CH2MHILL

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Contents

Acronyms and Abbreviations

cm	centimeter
DGM	digital geophysical mapping
DQO	data quality objective
GSV	geophysical system verification
in	inch
ISO	industry standard objectives
IVS	instrument verification strip
m	meters
MEC	munitions and explosives of concern
MPPEH	material potentially presenting an explosive hazard
NRL	Naval Research Laboratory
QC	quality control
UXO	unexploded ordnance

SECTION 1

Geophysical System Verification

Geophysical system verification (GSV) is a physics-based, presumptively selected technology process in which signal strength and sensor performance are compared to known response curves of industry standard objects (ISOs) to verify digital geophysical mapping (DGM) systems before and during site surveys. The GSV process is designed to perform initial verification of the DGM system using an instrument verification strip (IVS), followed by a blind seeding program for continued verification throughout the field operations.

1.1 Instrument Verification Strip

The initial phase of the geophysical investigation to locate potential munitions and explosives of concern (MEC) and material potentially presenting an explosive hazard (MPPEH) at UXO 20 will be verification of the presumptively selected DGM system using an IVS.

1.1.1 Personnel and Qualifications

The following individuals will be involved in the IVS process:

- CH2M HILL Quality Control (QC) Geophysicist
- CH2M HILL/subcontractor DGM Site Geophysicist
- CH2M HILL/subcontractor Field Geophysicist or Geophysical Technician
- CH2M HILL/subcontractor Data Processor

DGM personnel involved in performance of the IVS and the production geophysical surveys will meet the following qualifications:

- **QC Geophysicist:** will have a degree in geophysics, geology or a closely related field, and have a minimum of 5 years of relevant geophysical experience, including MEC and MPPEH projects. This individual will be capable of overseeing all facets of DGM and data analysis at multiple MEC and MPPEH project/program sites.
- **Site Geophysicist:** will have relevant geophysical experience, including proven record of successfully executing DGM at MEC and MPPEH project sites. This individual will be capable of managing multiple DGM teams, operating and maintaining required equipment, ensuring field team compliance to project health and safety requirements, maintaining effective communication and daily data flow, and performing and overseeing field QC measures.
- **Field Geophysicist:** will have relevant geophysical experience, including DGM at MEC and MPPEH projects. This individual will be capable of leading a DGM team and will provide oversight and training, as needed, to geophysical technicians. This individual will also be capable of operating and maintaining required equipment, following project health and safety requirements, maintaining effective communication and daily data flow, and successfully performing field QC measures.
- **Geophysical Technician::** will have received training on the proper use and maintenance of relevant field equipment. This individual will operate under the guidance of the Field Geophysicist (or higher) and will be capable of following project health and safety requirements, maintaining effective communication and daily data flow, and successfully performing field QC measures.
- **Geophysical Data Processor:** will have relevant data processing experience and be trained in the proper use of software platforms required to processing geophysical data related to MEC and MPPEH projects. This individual will be capable of concurrently supporting multiple projects and will be capable of maintaining effective and timely communication with the QC and Site Geophysicists.

1.1.2 DGM System

The presumptively selected system to be used for DGM at UXO 20 will be the Geonics, Ltd. EM61-MK2 time domain electromagnetic metal detector, with positioning provided by real-time kinematic- global positioning system or odometer/fiducial methods. This system and positioning methods are discussed in the UXO 20 Geophysical Investigation Plan, to which this plan is an appendix.

1.1.3 Location and Length of IVS

An existing IVS established during previous DGM at the Naval Support Facility, Indian Head may be used for the investigation at UXO 20, unless the DGM team decides that constructing a new IVS closer to UXO 20 will result in overall increased project efficiency. The location of the existing IVS is shown as Figure 1 of this GSV plan, and the IVS endpoint and seed information is provided in Table 1.

The following sections present the information needing for setting up a new IVS. Sections relevant to establishing a new IVS may be skipped if it is decided that the existing IVS can be effectively used.

1.1.4 Industry Standard Objects

The ISOs (Figure 2) to be used in the IVS are 1 inch (in) (2.54 centimeters [cm]) by 4 in (10.16 cm) steel pipes (part number 44615K466) from the McMaster-Carr on-line catalog (http://www.mcmaster.com/):

Shape: Straight nipple, threaded at both ends
Schedule: 40
Pipe Size: 1 in (1.315-in outer diameter)
Length: 4 in
Finish: Black welded steel

Instrument response curves for this ISO have been developed by the Naval Research Laboratory (NRL). These response curves demonstrate their standard response under their best orientation and worst orientation at multiple distances from the instrument's bottom transmit/receive coil. The best orientation would be perpendicular to the EM61-MK2 instrument plane to cause the highest peak amplitude response. The worst orientation would be parallel to the instrument plane and perpendicular to the direction of travel to cause the lowest peak amplitude response. (NRL/MR/6110--09-9183 – provided as Figure 3).

1.1.5 IVS Procedures

The QC and Site Geophysicists (refer to Section 1.1.1) will be responsible for oversight and proper construction of the IVS. The IVS process flow chart is presented as Figure 4 and is numbered in accordance with the steps in Table 1.

1. An IVS area will be selected with preference for the following (although none of the conditions are vital for IVS success):
    (a) Terrain, geology and vegetation similar to the DGM area
    (b) Geophysical noise conditions similar to those expected for the DGM area
    (c) Sufficient space to perform necessary IVS tests, maneuver equipment, and to allow for adequate separation (at least 3 m) between ISOs in order to avoid ambiguities in data evaluation.
    (d) Readily accessible to DGM personnel
    (e) Proximity to the actual DGM area (if not within the area)
2. A "background" DGM survey will be performed using the geophysical instrument to be validated over the IVS and for DGM production. This step will allow background geophysical conditions to be recorded, will assist in evaluating the suitability of the proposed IVS location (for example, few existing anomalies), and will provide guidance for the eventual placement of the ISOs so that they are not buried near existing

subsurface anomalies. The background survey data will be processed and provided to the CH2M HILL QC Geophysicist for approval.

3. Following verification that the IVS area is clear of subsurface anomalies (or that existing anomalies can be avoided during seeding), two ISO items will be buried vertically at depths of approximately 3 and 7 times their diameter (10 cm and 23 cm, respectively). A plan view of the generalized IVS setup is presented as Figure 5.

   Depth measurements for the ISOs are referenced to the center of mass of the item. The project personnel will bury the ISOs to the appropriate depths for seed items. The background survey results will be used as a guideline to maximize the distance between the ISOs and other subsurface anomalies. In addition, unexploded ordnance (UXO)-qualified personnel will conduct an anomaly avoidance survey to ensure that intrusive activities are not performed on top of or near existing subsurface anomalies. The depth, orientation, and azimuth will be recorded by the project personnel as precisely as possible.

4. Real-time kinematic-global positioning system or conventional total station survey equipment will be used to record the center of each ISO and the IVS endpoints. The holes will be backfilled with soil, and a polyvinyl chloride surveyor's flag or 6-inch wooden survey stake will be used to mark the ISO locations and IVS endpoints.

5. As part of the GSV, the DGM team will collect data along the IVS while mimicking the procedures to be followed during DGM production. At the IVS, data will be collected along the specific transects depicted in Table 2 and Figure 6. The DGM data from the IVS will be processed and interpreted by the data processor. The results will be provided within 12 hours of completion of data collection to the QC Geophysicist for approval.

6. If the data quality objectives (DQOs) have not been met, the QC Geophysicist will inform the Site Geophysicist and data processor. The project team will discuss whether modifications to the instruments or field procedures can be made to meet the DQOs.

7. If the DQOs cannot be met for the IVS, the project team will discuss additional possible resolutions (that is, modification of a DQO) before completing the IVS process.

8. The IVS process is complete after the survey has met the initial (or modified) DQOs and the QC Geophysicist has approved the results.

1.1.6 DQOs

The DQOs for use with the IVS are presented in Table 3. The geophysical system will not be used for DGM production until it has met these DQOs or until the project team has identified reasons for not meeting a DQO and implemented the necessary corrective action.

DGM production DQOs will be achieved through the ISO blind seeding program and other QC tests, as discussed in the Geophysical Investigation Plan. The IVS DQOs, measurement performance criteria, and test methods are summarized in Table 1 and discussed in detail in the following subsections.

General System Verification

DGM System Positioning

The DQO for DGM system positioning refers to the accuracy of the positional data for use in re-acquiring potential MEC and MPPEH items for intrusive investigation. The performance criterion is that the positional error at known control points will not exceed 25 cm (9.8 in). This accuracy will be evaluated during the IVS process by determining whether the geophysical anomalies representing the ISO seeds in the IVS data are located within 25 cm (9.8 in) from the surveyed locations from the IVS construction.

DGM System Munitions Detection

The DQO for munitions detection refers to the ability of the system to detect munitions items within industry standards. This ability is demonstrated through a physics-based, presumptive selection process in which signal strength and sensor performance are compared to published, industry-accepted responses. For example, this process is intended to demonstrate that the maximum EM61-MK2 amplitude response over a standard item falls within the NRL sensor response curve for that item (refer to Figure 3). Once it has been determined that the system responds comparably to this item, cross-correlation of industry experience with detection of munitions items can be assumed. In other words, depth and orientation of detectable munitions items with the EM61-MK2 under test scenarios[1] and at other project sites can be assumed.

A qualitative evaluation of instrument response will also be performed at the IVS because minor variations in the instrument coil height as it passes over an item and slight deviations along the IVS transect can significantly affect the amplitude of the instrument response. This evaluation will be conducted using a spike test (Section 1.1.7) and by evaluating whether the geophysical instrument responds within a specific threshold. The distance from the coil and orientation of the reference item for the spike test can be controlled.

Data Handling

This DQO refers to the handling of data and stipulates that all data must be delivered in a timely manner and in a useable format. Because of the need for rapid feedback during IVS operations, the performance criterion for data handling during IVS activities will require that raw data and preliminary results be delivered to the QC Geophysicist within 12 hours of completion of data collection. Final processed IVS data shall be delivered to the QC Geophysicist within 3 working days after completion of data collection.

1.1.7 Quality Control

Achievement of the DQOs will be verified by the QC Geophysicist. The selected IVS area, the construction of the IVS, and the documentation and survey locations will be verified during oversight of the IVS process. Geophysical standard operating procedures will be included as an addendum to this GSV Work Plan by the DGM subcontractor and will be reviewed by the QC Geophysicist as part of the overall project controls.

The QC tests presented in Table 4 and in the following subsections will be conducted on the selected geophysical system being used at the IVS:

1. **Equipment Warm-up**. Standard warm-up time is at least 5 minutes. Equipment warm-up will be performed at the beginning of daily operations as well as after the instrument has been off for a sufficient amount of time for the electronics to cool. The warm-up period may be increased, as needed, by DGM personnel in the event of unusually cold weather.

2. **Record Sensor Positions**. Positioning accuracy of the final processed data will be demonstrated by operating the equipment over one or more known points. The positional accuracy will be evaluated by calculating the difference between the known location and the displayed position from the DGM system. The sensor position test will be conducted at the beginning of daily operations.

3. **Personnel Test.** This test checks the response of instruments to personnel and their clothing/proximity to the system. The response will be observed in real time for immediate corrective action and subsequently transmitted to the processor, where the instrument response will be evaluated for data spikes that would potentially represent false anomalies. The personnel test will be conducted at the beginning of daily operations.

4. **Vibration Test (Cable Shake).** This test checks the response of the instrument to vibration of the system cables. The response will be observed in real time in the field for immediate corrective action and

[1] NRL/MR/6110--08-9155 (EM61-MK2 Response of Standard Munitions Items), Final Report for the Evaluation of UXO Detection Technology at the Standardized UXO Test Sites Aberdeen and Yuma Proving Grounds, Standardized UXO Technology Demonstration Site Program, SERDP, November 2007. Demonstrator scoring results: http://aec.army.mil/usaec/technology/uxo01f.html

subsequently transmitted to the processor, where the instrument response will be evaluated for data spikes that could create false anomalies. The vibration test will be conducted at the beginning of daily operations.

5. **Static Background and Static Spike**. Static tests will be performed by positioning the survey equipment near or within the DGM area in an area free of metallic interference. Data will be collected for at least 1 minute. During this time, the instrument will remain stationary, and data will be recorded first without a reference item and then with a reference item. The purpose of the static test is to evaluate sensor drift and ambient noise levels. The static background and static spike test will be conducted at the beginning and end of daily operations.

   The ISO can be placed above or below the EM61-MK2 transmitter coil as long as the precise distance is measured from the center of mass of the item to the horizontal plane of the coil (top of coil if item placed above coil, bottom of coil if item placed below), as illustrated in Figure 7.

1.1.8 Data Analysis and Interpretation

All data collected at the IVS test strip will be post-processed and analyzed. Instrument-specific data processing standard operating procedures will be included as an addendum to this Work Plan by the data processor.

1.1.9 IVS Data Evaluation

The QC Geophysicist will evaluate the IVS data and approve the selected geophysical system for use during DGM once the DQOs are met.

SECTION 2

Blind Seeding

As a part of the GSV process, additional ISOs will be used as blind QC seeds within the DGM area in order to provide ongoing verification that the DGM system is properly functioning and that the munitions detection and positioning DQOs are consistently met.

2.1 Seeds Placement

Seed items will be buried vertically at a depth of approximately 6 to 12 inches below ground surface. The depth will be measured to the center of mass of the item, as shown in Figure 8. Final burial depths will be recorded in field notes.

The QC Geophysicist will be responsible for verifying that each QC seed is labeled with a unique identifier. These labels can constitute paint pen markings or weather-resistant labels secured to the seed item.

The QC seed item locations will not be shared with DGM personnel or data processors until after final results have been presented to the QC Geophysicist.

2.2 Validation

The QC Geophysicist will overlay the locations of the QC seed items onto daily DGM data and verify that the munitions detection and positioning DQOs are continuing to be met. A comprehensive root-cause analysis will be performed and a corrective action identified and implemented pending approval of the QC Geophysicist.

SECTION 3

Reporting

The IVS results will be submitted as a technical memorandum. The memorandum will include a summary of the IVS operations, an as-built map of the IVS plot, and a discussion of the IVS results. Results of the QC seed evaluation will be provided as part of the Site Inspection report.

Tables

TABLE 1

Existing IVS Survey Coordinates

Geophysical Investigation Verification Work Plan for UXO 20

NSF-IH, Indian Head, Maryland

Point ID	Easting (m)	Northing (m)	Item Depth (cm)	Item Orientation	Description
IVS-south	310026.127	4274413.953	N/A	N/A	IVS northern end point
IVS-1	310023.621	4274417.842	11.2	Horizontal, perpendicular to line direction	Seed Item
IVS-2	310021.226	4274421.671	17	Horizontal, perpendicular to line direction	Seed Item
IVS-3	310016.609	4274429.046	23.4	Horizontal, perpendicular to line direction	Seed Item
IVS-north	310015.528	4274430.801	N/A	N/A	IVS southern end point

Coordinate system: North American Datum 1983 Universal Transverse Mercator Zone 18 North (m = meters)

TABLE 2

IVS Transects Descriptions and Purpose

Geophysical Investigation Verification Work Plan for UXO 20

NSF-IH, Indian Head, Maryland

Transect	Description	Purpose
A	offset by 0.75m	Demonstrate horizontal drop off of item response
B	directly over center of strip	Verify response vs. established response curves
C	offset by 0.37m (1/2 intended lane separation) from center of strip	Demonstrate horizontal drop off of item response
D	offset by 0.75m (on opposite side of strip from Transect A)	Demonstrate horizontal drop off of item response
E	offset by ~3m from strip	Measure background noise

TABLE 3
Project Data Quality Objectives
Geophysical Investigation Verification Work Plan for UXO 20
NSF-IH, Indian Head, Maryland

Data Quality Objective	Measurement Performance Criteria	Test Method During IVS
General System Verification		
DGM System Positioning. Accurate coordinates are being obtained from DGM positioning systems.	Positional error of ISO seeds will not exceed 25 cm (9.8 in).	Results of IVS DGM survey vs. IVS seed locations will be evaluated to ensure compliance.
DGM System Munitions Detection. DGM system response is within industry standards for detection.	Response to ISO is comparable to published or calculated results for that item. Response to standardized item will not vary more than ±20%of expected value in static test.	Results of IVS surveys over seed items in strip will be qualitatively reviewed. Results of static test will be quantitatively reviewed to ensure compliance.
Data Handling		
All data must be delivered in a timely manner and in a useable format.	IVS data is completed and delivered within 12 hours.	Evaluate based on actual delivery of data

[1] NRL/MR/6110--09-9183 (Provided as Figure 6)

TABLE 4
Geophysical Instrument Standardization Tests and Acceptance Criteria
Geophysical Investigation Verification Work Plan for UXO 20
NSF-IH, Indian Head, Maryland

Test	Test Description	Acceptance Criteria	Power on	Beginning of day	Beginning and end of day
1	Equipment Warm-up	Equipment specific (typically 5 minutes)	X		
2	Record Sensor Positions	+/- 4 in (10.2 cm)		X	
3	Personnel Test	Based on instrument used. Personnel, clothing, etc., should have no effect on instrument response.		X	
4	Vibration Test (Cable Shake)	Data profile does not exhibit data spikes.		X	
5	Static Background & Static Spike	+/- 20% of standard item response, after background correction			X

Figures

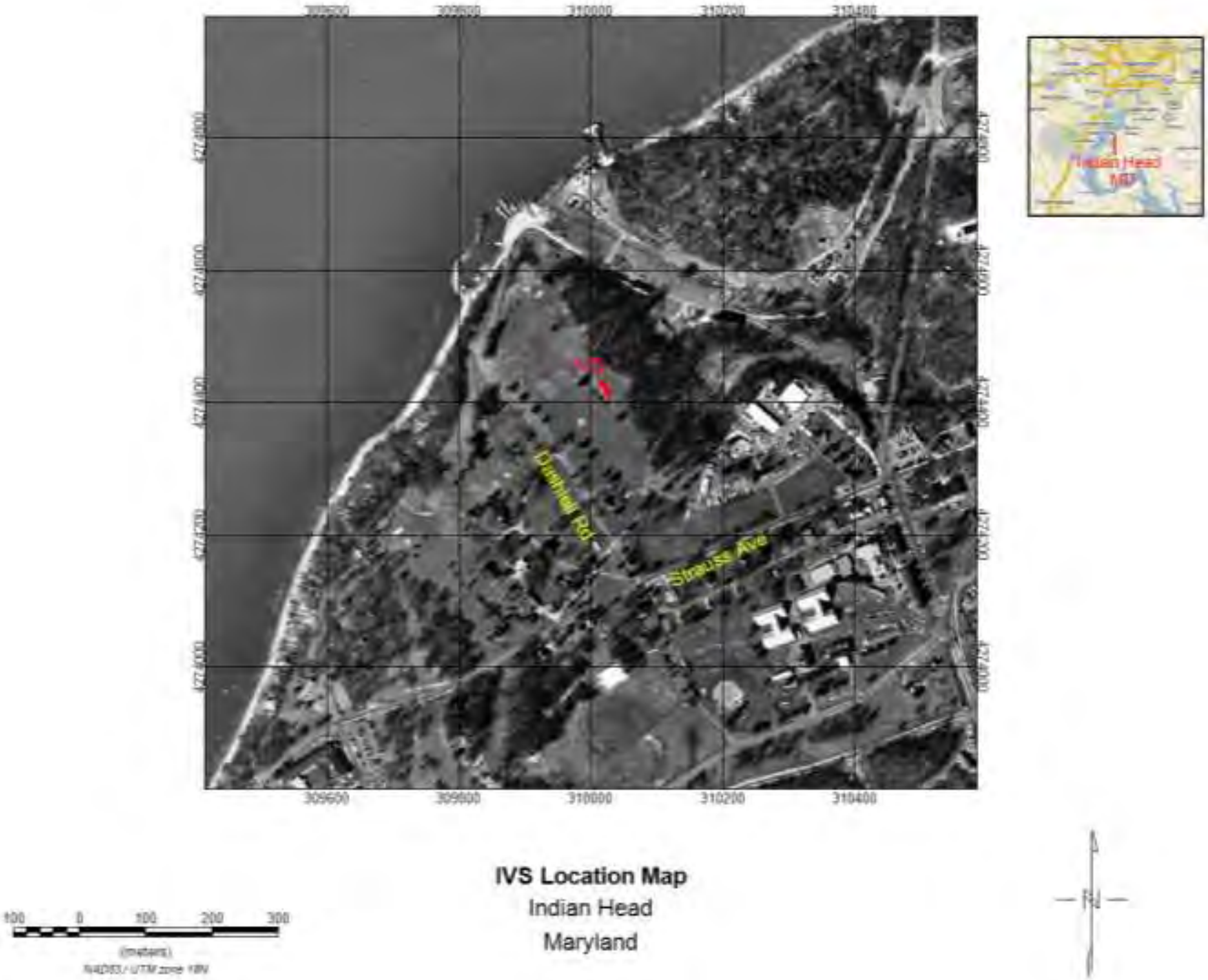

FIGURE 1
Existing IVS Location Map
Geophysical System Verification Work Plan for UXO 20
NSF-IH, Indian Head, Maryland

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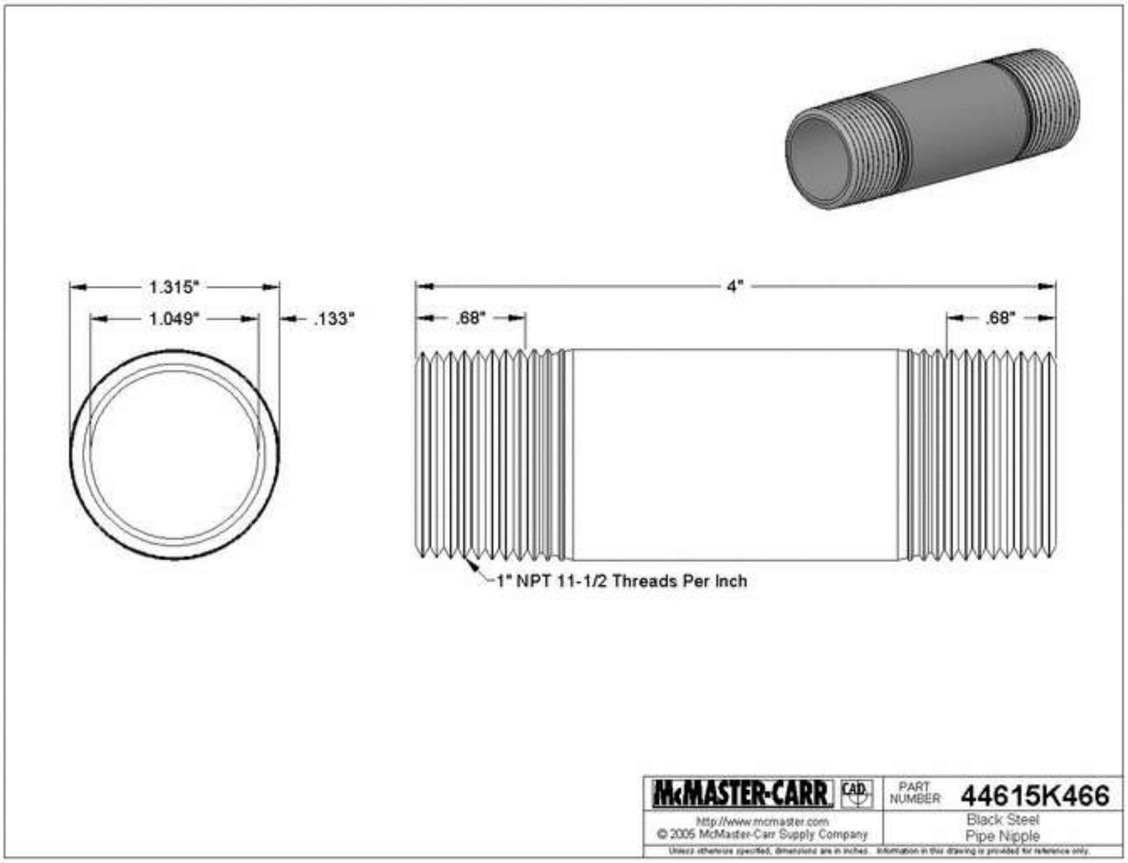

FIGURE 2
Industry Standard Object
Geophysical System Verification Work Plan for UXO 20
NSF-IH, Indian Head, Maryland

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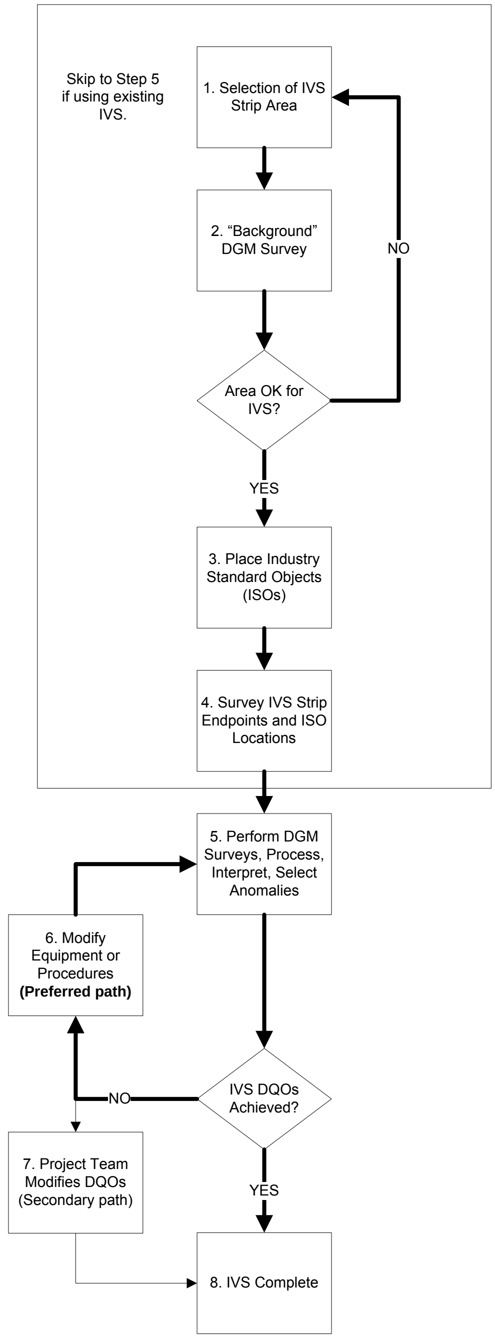

FIGURE 3
IVS Process
Geophysical System Verification Work Plan for UXO 20
NSF-IH, Indian Head, Maryland

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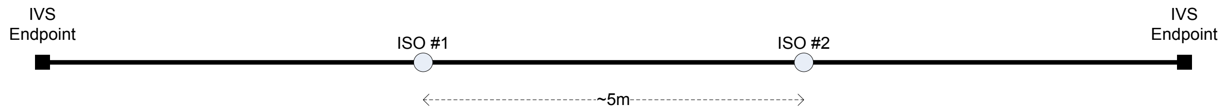

FIGURE 4
IVS Strip
Geophysical System Verification Work Plan for UXO 20
NSF-IH, Indian Head, Maryland

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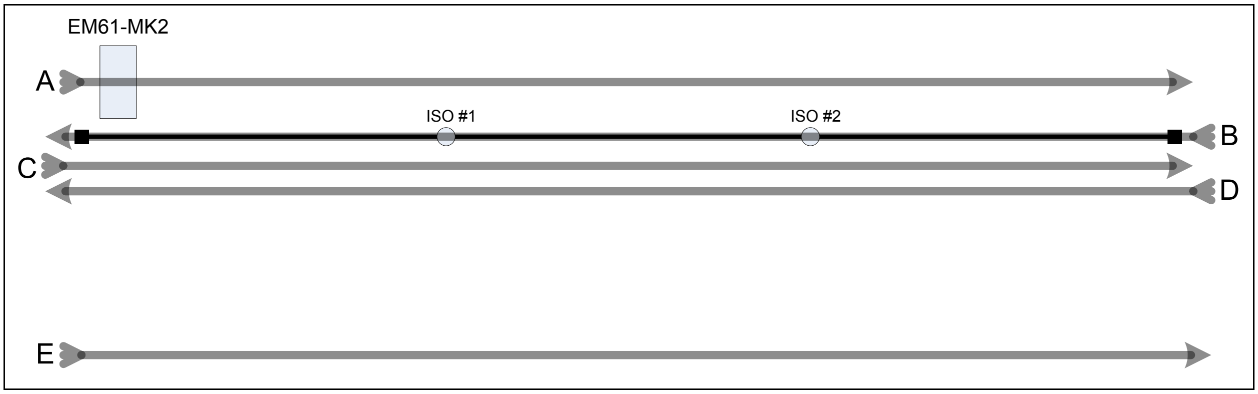

FIGURE 5
IVS Transects
Geophysical System Verification Work Plan for UXO 20
NSF-IH, Indian Head, Maryland

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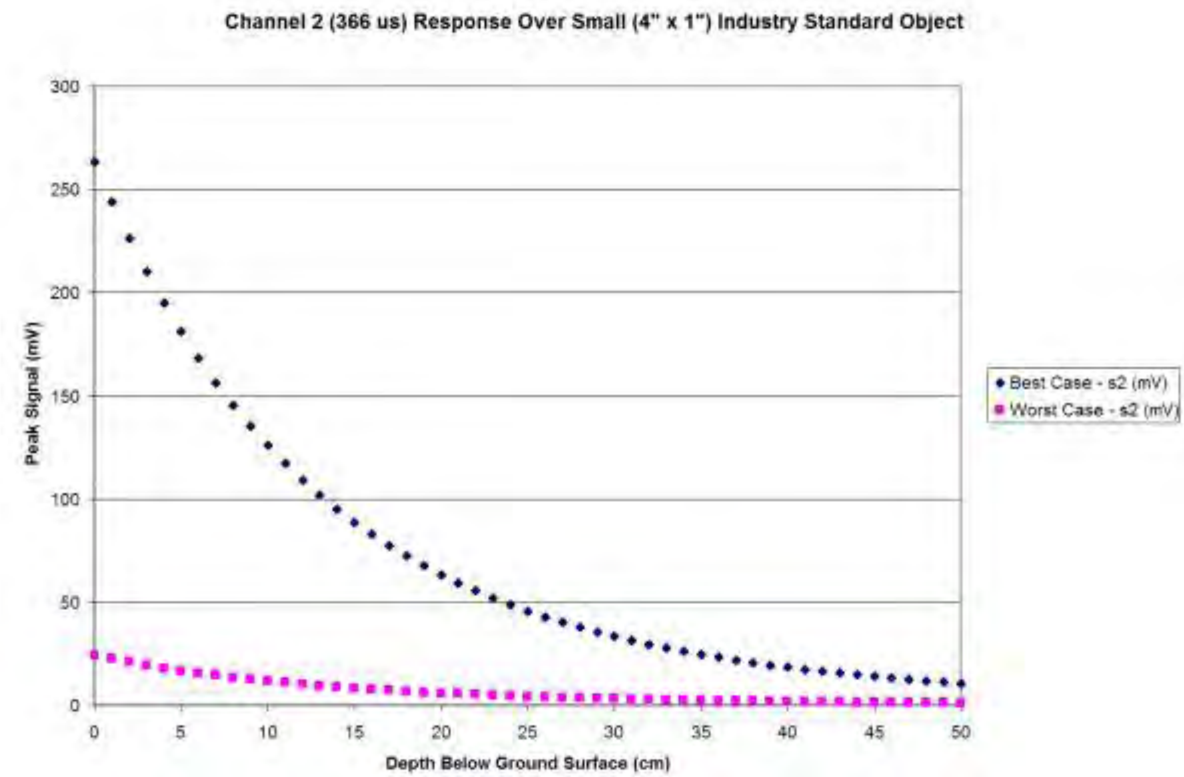

Reference: NRL/MR/6110-09-9183

FIGURE 6
NRL results for Small (4 inch x 1 inch) ISO Tested under EM61-MK2 Bottom Coil
Geophysical System Verification Work Plan for UXO 20
NSF-IH, Indian Head, Maryland

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FIGURE 7
Example Spike Test Setup
Geophysical System Verification Work Plan for UXO 20
NSF-IH, Indian Head, Maryland

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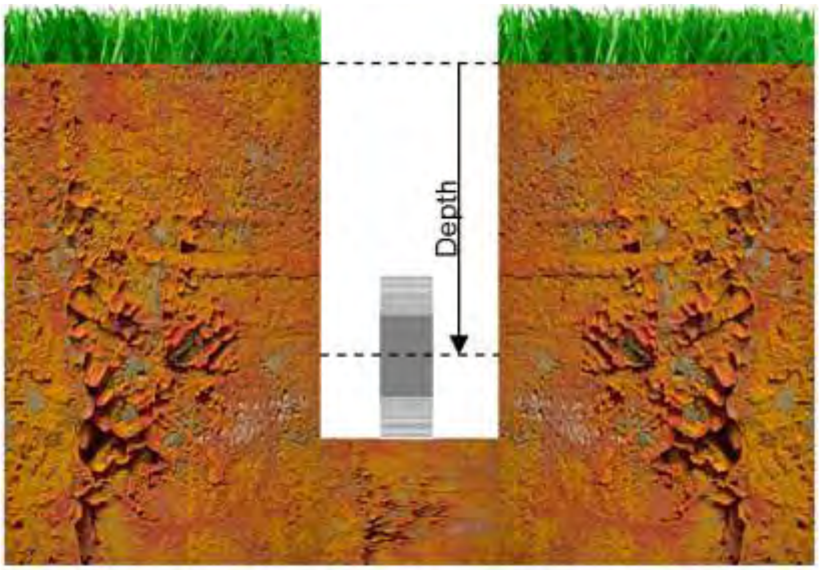

FIGURE 8
QC Seed Burial Illustration
Geophysical System Verification Work Plan for UXO 20
NSF-IH, Indian Head, Maryland

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Appendix C
Project Quality Control Plan

Final

Quality Control Plan
for
UXO 20

Naval Support Facility Indian Head
Indian Head, Maryland

Contract Task Order 0012

November 2012

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Washington

Under the

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

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Activity Manager

Date

Contents

Tables

Attachments

Acronyms and Abbreviations

CAP	Corrective Action Plan
CAR	Corrective Action Request
CFR	Code of Federal Regulations
DDESB	Department of Defense Explosives Safety Board
DFOW	definable feature of work
DGM	digital geophysical mapping
DoD	Department of Defense
ECP	Entry Control Point
ESQD	Explosive Safety Quantity-Distance
ESS	Explosives Safety Submission
FCR	Field Change Request
FTL	field team leader
GIP	Geophysical Investigation Plan
GIS	geographic information system
HSP	Health and Safety Plan
IVS	instrument verification strip
MDAS	material documented as safe
MDEH	material documented as an explosive hazard
MEC	munitions and explosives of concern
MPPEH	material potentially presenting an explosive hazard
MR	munitions response
MRP	Munitions Response Program
Navy	Department of the Navy
NCR	Nonconformance Report
OSHA	Occupational Safety and Health Administration
PM	Project Manager
QA	quality assurance
QC	quality control
QCP	Quality Control Plan
SOP	Standard Operating Procedure
SSHP	Site Safety and Health Plan
SUXOS	Senior Unexploded Ordnance Supervisor
TP	Technical Paper
UXO	unexploded ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist

SECTION 1
Introduction

This Quality Control Plan (QCP) describes the quality control (QC) approach and procedures for the Remedial Investigation for Safety Thermal Treatment Point – Unexploded Ordnance (UXO) 20 at Naval Support Facility, Indian Head in Indian Head, Maryland. The requirements and systems established in this QCP are relevant and applicable to project work performed by CH2M HILL and its subcontractors. The UXO-related QC forms (Forms 1b through 9b) referenced throughout this section are presented in the attachment to this plan.

SECTION 2

Quality Control Organization and Responsibilities

This section identifies key project team members and lists the quality assurance (QA)/QC responsibilities associated with each position and describes communication procedures that will be followed throughout the project.

2.1 Project Team Members

The organizational structure and responsibilities of the project team (refer to Figure 3 of the Work Plan) are designed to provide project QC for the site. Those positions with primary QC responsibilities are described in the following paragraphs.

2.1.1 Project Management

The Activity Manager, Margaret Kasim, provides overall project quality management and implementation on the project and is the primary contact for QC elements of the project. She has responsibility for identifying quality problems and initiates, recommends, and/or provides corrective measures to those problems, and conducts internal and external audits to monitor processes and systems in accordance with the Work Plan. She verifies implementation of corrective measures and conducts senior-level review of contract deliverables, monitors activities at the work sites, and coordinates with the Project Manager (PM), Site Manager, and Unexploded Ordnance Quality Control Specialist (UXOQCS) to establish the needs and priorities of QC activities.

The PM, Victoria Waranoski, is responsible for overall project activities, including cost control, schedule control, and technical quality. In addition, the PM develops the Work Plan and monitors project activities to ensure compliance with project objectives and scope. The PM also communicates with the Activity Manager, Department of the Navy (Navy), regulators, and the CH2M HILL team regarding project progress.

The PM has the 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 QC review team to coordinate review efforts, address review comments, and adjudicate technical issues.

2.1.2 Quality Manager

The quality manager for this project is Mr. John Tomik. Mr. Tomik has significant experience in the various technical aspects of a complex project. He is responsible for evaluating the technical merit of the work planning documents before field activities begin. Mr. Tomik will assist the PM in selecting an internal QC review team.

2.1.3 UXO Quality Control Specialist

The UXOQCS for this project is Mr. Keith Schucker. The UXOQCS is responsible for implementing and administering this QCP and communicating the onsite QC program policies, objectives, and procedures to the project personnel and subcontractors during project meetings and informal discussions. The UXOQCS will have the same minimum qualifications as a UXO Technician III, as outlined in Department of Defense Explosives Safety Board (DDESB) Technical Paper (TP) 18. Onsite technical personnel will assist the UXOQCS in monitoring, controlling, and documenting the quality of the field activities. Documentation related to the control of project quality, including audits and equipment check results, will be reviewed or prepared by the UXOQCS. The UXOQCS responsibilities include the following:

- Developing, assessing the effectiveness of, and maintaining this QCP and related procedures
- Reviewing and approving the qualifications of proposed technical staff and subcontractors
- Planning and ensuring the performance of preparatory, initial, follow-up, and completion audits for each definable feature of work (DFOW) as described in Table 1

- Identifying quality problems and verifying that appropriate corrective actions are implemented
- Ensuring that the requisite QC records, including submittals, are generated and retained as prescribed in this QCP
- Performing QC audits, as necessary, and surveillance
- Following the responsibilities specific to munitions response (MR) operations

In addition, the UXOQCS will coordinate with the PM and will report to the corporate MR Safety and Quality Manager if quality or safety issues are not resolved to his satisfaction by the project team. The UXOQCS has authority to enforce the procedures defined in this QCP. He has the authority to stop work to ensure project activities comply with specifications of this QCP, the contract, and the project. This authority applies equally to all project activities, whether performed by CH2M HILL or its subcontractors.

2.1.4 Senior UXO Supervisor

The Senior Unexploded Ordnance Supervisor (SUXOS) is the onsite representative for the project who is responsible for planning, coordinating, and supervising all contractor and subcontractor activities related to the Interim Munitions and Explosives of Concern (MEC) Surface Removal work. The SUXOS helps to ensure that the activities comply with regulations, Department of Defense (DoD) directives, and any other relevant local, state, and federal statutes and codes. The SUXOS will work closely with the PM and will supervise all aspects of the MEC removal fieldwork.

2.1.5 Corporate Munitions Response Safety and Quality Manager

The corporate MR Safety and Quality Manager for this project is Dr. George DeMetropolis. He oversees safety and quality for MR operations. He serves as the point of contact for the UXOQCS for any MR health- or safety-related issues, and may conduct MR-related project audits. He is also responsible for investigating MR-related accidents should any occur during the course of the project.

2.1.6 Field Team Leader

The field team leader (FTL) for this project is Mr. Keith Schucker. The FTL reports to the PM and is responsible for coordinating field efforts, providing and maintaining field equipment and materials, providing shipping and packing materials, and accurately completing the daily diaries. As the lead field representative, the FTL is also responsible for consistently implementing QC measures at the site and for performing field activities in accordance with approved work plans, policies, and field procedures.

2.1.7 Quality Control Geophysicist

Mr. Tamir Klaff will serve as the Project QC Geophysicist. He will be responsible for the ultimate quality of the digital geophysical mapping (DGM) survey data and review and acceptance of the data.

2.1.8 Data Manager

The UXOQCS is responsible for compiling, organizing, updating, and maintaining all hard copy and electronic QC data files for the project. The UXOQCS may utilize a Data Manager to work with the PM and UXOQCS to setup and maintain logs and records of field QC inspections, audits, reports, and meetings for the project files. The UXOQCS, or Data Manager, will also ensure that project field-generated documents such as Field Change Requests (FCRs), Nonconformance Reports (NCRs), Root Cause Analyses, and Corrective Action Requests (CARs) are reviewed and approved before implementation. The UXOQCS and the Data Manager will work together to establish and maintain the project field QC file.

2.2 Project Communication

At the beginning of the project 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.

Before field activity begins, a project team meeting will be held to review the concept, assumptions, objectives of the field approach, and the project objectives. During the field investigation phase of the project, the field teams, including the UXOQCS and UXO Safety Officer (if those functions are not being served by the same person) will meet daily to review the status of the project and to discuss technical and safety issues. When necessary, other meetings will be scheduled as necessary to resolve problems.

All official communications with the Navy will be channeled through the CH2M HILL PM, who will be informed on a daily basis of field activities being conducted.

2.2.1 Quality Control Meetings

Prior to initiation of field activities, a meeting will be held with the field operations management team. The Activity Manager, UXOQCS, PM, SUXOS, Quality Manager, FTL, QC Geophysicist, MEC support subcontractor representative, and Data Manager will attend the QC meetings as appropriate. The purpose of this meeting will be to discuss QC-related issues. The content of the meeting will be recorded by the Data Manager, reviewed and approved by the UXOQCS, and placed in the project QC file.

2.3 Personnel Qualifications and Training

All project staff members will be qualified to perform their assigned jobs in accordance with the terms outlined in the Contract and by the project plans. Specific qualifications and training required for UXO-qualified personnel are stated as follows and in the Work Plan.

2.3.1 Qualification and Training for UXO Personnel

UXO-qualified personnel assigned to the positions of UXO Technician I, UXO Technician II, UXO Technician III, UXO Safety Officer, UXOQCS, or SUXOS will be qualified and certified in accordance with DDESB TP 18 and terms outlined by United States Department of Labor Employment Standards Administration Wage Hour Division for UXO Personnel.

2.3.2 UXO Training Documentation

Before the investigation, the UXOQCS will obtain copies of on-the-job training letters and certifications, as necessary to complete the personnel qualification file for each project person. This information will be maintained in the project files. Records of site-specific and routine training for personnel and visitors, as required by these project plans, will also be maintained in the project files.

2.3.3 Safety and Health Training

Safety and health training requirements for onsite project personnel have been established in accordance with Occupational Safety and Health Administration (OSHA) requirements for hazardous site workers (29 *Code of Federal Regulations* [CFR] 1910.120) and are specified in the Site Safety and Health Plan (SSHP). The project Health and Safety Plan (HSP) is provided in Appendix D of this Work Plan.

2.4 Submittal Management

Submittals include deliverables generated by the CH2M HILL team and may involve submittals generated by subcontractors. The PM is responsible for the overall management and control of project submittals, as well as scheduling and tracking each submittal. The PM will establish and maintain a project submittal schedule that reflects the draft, draft final, and final deliverable status. The PM is also responsible for establishing and maintaining a project file so that project documents may be retained and controlled appropriately. Document submittal activities have been incorporated into the project schedule. The PM will monitor the progress of project submittals and update the submittal schedule on a regular basis.

The Activity Manager is responsible for ensuring, through detailed review, that field QC submittals, as well as the materials and work they represent, are compliant with applicable contractual specifications and project plans.

2.4.1 Review of SOPs and Activity Hazard Analyses

During the preparatory phase for each DFOW, as discussed on Table 1, the UXOQCS will ensure that the DFOWs are in accordance with the Work Plan requirements and request clarification whenever necessary. The primary purpose of this review is to identify and resolve potential conflicts before initiating work operations. To minimize schedule impacts, QC checks will be performed as early in the process as practical to allow sufficient time for evaluation and response formulation. The Activity Manager will verify that work plans and Standard Operating Procedures (SOPs): (1) have been approved by their appropriate authority for implementation of a particular DFOW; (2) are clear and complete; and (3) are executable and practical. Furthermore, these checks will include identifying discrepancies between the Work Plan and industry standards and assessing and verifying site conditions and constraints.

2.4.2 Review and Approval of Submittals

Before delivery, project submittals will be reviewed and approved by appropriate members of the CH2M HILL team. Submittal reviews will be delegated by the PM, and the review team will typically include the Activity Manager, Senior Technical Consultant, and PM. Reviewer signatures are required on each submittal. Technical documents (reports, plans, and/or SOPs) will be first reviewed by the PM and qualified technical staff. Before submittal, the document will be submitted to the Activity Manager for review and approval.

2.4.3 Transmittal to Client

Document submittals will be accomplished as specified in the Work Plan.

2.4.4 QC Document Review and Submittal

The QC file will be maintained by the UXOQCS on behalf of the Activity Manager and is an integral component of the project file. FCRs, NCRs, CARs, Corrective Action Plans (CAPs), and other field-generated reports will be reviewed and accepted by the Activity Manager before submittal to the Navy. The UXOQCS, with as-needed support from the Data Manager will be responsible for maintaining this QC-related information and keeping it current. QC documentation requirements include the following:

- Technical information will not be replaced or revised without receipt of a properly authorized FCR, change order or other approved revision.

Copies of purchase orders or subcontracts requiring inspection will be provided to the Activity Manager by the PM.

SECTION 3

Definable Features of Work and the Three-Phase Control Process

MR-related QC will be monitored through the DFOWs, identified in Table 1, using a three-phase control process.

3.1 Definable Features of Work

The DFOWs for this project are divided into activities related to planning, field operations, and final project reports and closeout:

1. **Planning**

- Pre-Mobilization Activities: System setup for geographic information system (GIS), document management and control, data management, and subcontracting
- Preparing Work Plan

2. **Field Operations**

- Site Preparation: Mobilization
- DGM survey
- Demobilization

3. **Final Project Reports and Closeout**

- Preparing GIS maps
- Draft and Final Reports: preparing and obtaining approval
- Data archiving and project closeout

3.2 Three Phases of Control

The UXOQCS is responsible for ensuring that the three-phase control process, including the Preparatory Phase, Initial Phase, and Follow-up Phase, is implemented for each DFOW listed in this QCP, regardless of whether it is performed by CH2M HILL or CH2M HILL's subcontractors.

3.2.1 Preparatory Phase

The Preparatory Phase culminates with the planning and design process leading up to actual field activities. Successful completion of the Preparatory Phase verifies that the project delivery, QC, and safety plans have been completed. The following actions will be performed as applicable for each DFOW:

1. Confirm that the appropriate technical procedures are incorporated into the project Work Plan and review procedures.
2. Confirm that adequate testing is called for to ensure quality delivery.
3. Ensure equipment testing procedures are in place, with control limits and frequency, for each piece of equipment.
4. Confirm qualifications/training of personnel and verify that roles/responsibilities are well-defined and communicated.
5. Confirm that the site HSP adequately address the work operations and that applicable safety requirements have been incorporated into the plan.
6. Discuss methods to be employed during the field activities.

7. Confirm that any required permits and other regulatory requirements are met.
8. Verify that lessons learned during previous similar work have been incorporated as appropriate into the project procedures to prevent recurrence of past problems.

Project personnel must correct or resolve discrepancies between existing conditions and the approved plans and procedures identified by the UXOQCS and the team during the Preparatory Phase. The UXOQCS or designee must verify that unsatisfactory and nonconforming conditions have been corrected prior to granting approval to begin work.

Results of the activity are to be documented in the Preparatory Inspection Checklist (Form 1b) specific for the DFOW and summarized in the Weekly QC Report.

3.2.2 Initial Phase

The Initial Phase occurs at the startup of field activities associated with a specific DFOW. The Initial Phase confirms that this QCP, other applicable Work Plan sections, and procedures are being effectively implemented and the desired results are being achieved.

During the Initial Phase, the initial segment of the DFOW is observed and inspected to ensure that the work complies with contract and Work Plan requirements. The Initial Phase should be repeated if acceptable levels of specified quality are not met. The following tasks shall be performed for each DFOW:

1. Establish the quality of work required to properly deliver the project in accordance with contractual requirements. The UXOQC will ensure that the field teams are aware of expectations associated with the field methods established under the Preparatory Phase by observing the initial work activities and interacting with the PM, Activity Manager, and responsible subcontractors' supervisors.
2. Resolve conflicts. The UXOQC will guide the PM and responsible supervisor(s) in resolving conflicts. Should conflicts arise in establishing the baseline quality for the DFOW, the responsibility to resolve the conflict falls to the PM.
3. Verify with the Health and Safety Manager that the site HSP was developed to ensure that the identified hazards adequately address field conditions. Confirm that applicable safety requirements are being implemented during field activities.

Upon completion of Initial Phase activities, the results are to be documented in the Initial Phase Inspection Checklist (Form 2b) and the QC logbook and summarized in the Weekly QC Report. Should results be unsatisfactory, the Initial Phase will be rescheduled and performed again.

3.2.3 Follow-up Phase

Completion of the Initial Phase of QC activity leads directly into the Follow-up Phase, which addresses the routine day-to-day activities at the site. Inspection and audit activities associated with each DFOW are described in Table 1 and are to be scheduled as indicated on Form 5b. Specific tasks associated with the Follow-up Phase include:

1. Inspection of the work activity to ensure work complies with the contract and Work Plan.
2. Evaluation and confirmation that the quality of work is being maintained at least at the level established during the Initial Phase.
3. Evaluation and confirmation that required testing is being performed in accordance with procedures established during the Preparatory Phase and confirmed during the Initial Phase.
4. Confirmation that nonconforming work is being corrected promptly and in accordance with the direction provided by the UXOQC.

To conduct and document these inspections, the UXOQC is to generate the Follow-up Phase Inspection Checklist (Form 3b). The Follow-up Phase inspections will be performed daily or as otherwise identified in this QCP until the completion of each DFOW.

The UXOQC is responsible for onsite monitoring of the practices and operations taking place and verifying continued compliance with the specifications and requirements of the contract, project, and approved project plans and procedures. The UXOQC is also responsible for verifying that a daily health and safety inspection is performed and documented, as prescribed in the HSP (refer to Appendix D). Discrepancies between site practices and approved plans and procedures are to be resolved, and corrective actions for unsatisfactory and nonconforming conditions or practices are to be verified by the UXOQCS or a designee prior to granting approval to continue work. Follow-up Phase inspection results are to be documented in the QC logbook and summarized in the Weekly QC Report.

Additional Audits

Additional audits performed on the same DFOW may be required at the discretion of the UXOQC. Additional preparatory and initial audits are generally warranted under any of the following conditions: unsatisfactory work, changes in key personnel, resumption of work after a substantial period of inactivity (such as 2 weeks or more), or changes to the project scope of work and specifications.

Final Acceptance Audit

Upon conclusion of the DFOW and prior to closeout, the Final Acceptance Inspection must be performed to verify that project requirements relevant to the work are satisfied. Outstanding and nonconforming items are to be documented on the Final Inspection Checklist (Form 4b). Resolution of each item must be noted on the checklist. Contractor acceptance and closeout of each DFOW is a prerequisite to project closeout.

SECTION 4

Audit Procedures

The UXOQC is responsible for verifying compliance with this QCP through audits and surveillance. Each DFOW auditing procedure and responsibility is presented in Table 1 at the end of this plan. The UXOQC or a designee is to inspect and audit the quality of work being performed for the DFOW. The UXOQC or a designee is to verify that procedures conform to applicable specifications stated in this Work Plan or other applicable guidance. Identified deficiencies are to be communicated to the responsible individual and documented in the QC logbook and Weekly QC Report. Corrective actions are to be verified by the UXOQC and recorded in the Weekly QC Report.

4.1 Pass or Failure Criteria

The QC methods used will ensure conformance with the project specifications and achieve the overall contract objectives. In cases where QC inspections indicate nonconformance, specific actions resulting from a specific QC concern or failure have been developed. Table 2 defines the QC Methods to be used and the specific pass or fail criteria. QC failure is defined as non-conformance with (1) provisions of the Work Plan and the Explosives Safety Submission (ESS), and (2) industry standards. Except where clearly defined, the responsibility for assessing whether a QC failure is considered major (for example, has the potential to jeopardize the health and safety of personnel, jeopardize the environment, or compromise project requirements) or minor (such as results from using improper methods in which a field team or field team member is conducting the work or sweep) lies with the UXOQCS.

Nonconformance with process or procedural requirements will be addressed by the UXOQCS with the appropriate team leader (for example, MEC Support subcontractor UXO team leader or survey crew leader). If nonconformance affects safety or overall product quality, work will cease until an appropriate resolution is identified and implemented, and the SUXOS/Site Manager will be notified. Once the UXOQCS, appropriate team leader, and SUXOS/Site Manager are satisfied with the suggested corrective action, the action will be implemented and documented.

If the failure directly affects product quality, or is otherwise determined by the UXOQCS to require a follow-up action, an NCR will be prepared and submitted to the subcontractor. The NCR will include a detailed written description of the nonconformance item and required follow-up actions, developed and signed by the UXOQCS. A copy of the completed form will be provided to the subcontractor responsible for the nonconformance as notification of the failure. In response, the contractor will provide a plan for corrective action for the failure and complete the corrective action. Once the corrective action has been completed, it will be documented on the form and, if approved, will be signed by the UXOQCS and Construction Manager. These signatures will indicate that the failed work has been corrected, accepted, and the NCR will be closed. A copy of the NCR and any relevant attachments will be placed in the project QC file, along with Follow-up Phase Inspection documents for that DFOW.

If the failure of process or procedure occurs more than once a CAR will be prepared. The CAR will specify whether a CAP is needed. The UXOQCS will meet with the appropriate team leader and members to determine the corrective course of action. During follow-up QC inspections, the UXOQCS will ensure and document in the UXOQCS Log Book and the QC Report that agreed-upon corrective actions have been implemented.

SECTION 5

Corrective and Preventive Action Procedures

Corrective and preventive action procedures are designed to prevent quality problems and to facilitate process improvements, as well as identify, document, and track deficiencies until corrective action has been verified.

5.1 Preventive Measures

While the entire QC program is directed toward problem prevention, certain elements of the program have greater potential to be proactive. The primary tool for problem prevention on this project is discussed in Three Phases of Control (Section 3.2). Should these preventive measures fail, tracking and communicating deficiencies provide a mechanism for preventing their recurrence.

5.2 Continual Improvement

Project team members at all levels are encouraged to provide recommendations for improvements in established work processes and techniques. The intent is to identify activities that are compliant but can be performed more efficiently or cost-effectively. Typical quality improvement recommendations consist of identifying an existing practice that should be improved and/or recommending an alternate practice that provides a benefit without compromising prescribed standards of quality. Project personnel are to bring their recommendations to the attention of project management or the QC staff through verbal or written means. However, deviations from established protocols are not to be implemented without prior written approval by the PM and concurrence of the UXOQCS. Where a staff-initiated recommendation results in a tangible benefit to the project, public acknowledgment is to be given by the PM.

5.3 Deficiency Identification and Resolution

While deficiency identification and resolution occurs primarily at the operational level, QC audits provide a backup mechanism to address problems that either are not identified or cannot be resolved at the operational level. Through implementation of the audit program prescribed in this QCP, the QC staff is responsible for verifying that deficiencies are identified, documented as prescribed herein, and corrected in a timely manner. Deficiencies identified by the QC staff are to be corrected by the operational staff and documented by the QC staff.

5.4 Corrective Action Request

A CAR (Form 6b) can be issued by any member of the project staff, including CH2M HILL and subcontractor employees. If the individual issuing the CAR is also responsible for correcting the problem, he or she should do so and document the results on Part B of the CAR (Form 6b). Otherwise, the CAR should be forwarded to the PM, who is then responsible for evaluating the validity of the request, formulating a resolution and prevention strategy, assigning personnel and resources, and specifying and enforcing a schedule for corrective actions. Once a corrective action has been completed, the CAR and supporting information are to be forwarded to the UXOQCS for closure. Sufficient information is to be provided to allow the QC reviewer to verify the effectiveness of the corrective actions.

In addition to observing actual work operations, CARs are to be reviewed during follow-up QC audits. The purposes of this review are as follows: to ensure that established protocols are implemented properly; to verify that corrective action commitments are met; to ensure that corrective actions are effective in resolving problems; to identify trends within and among similar work units; and to facilitate system root cause analysis of larger problems. The QC staff should pay particular attention to work units that generate either an unusually large or unusually small number of CARs.

The UXOQCS will determine whether a written CAP (Form 7b) is necessary, based on whether any of the following are met: the CAR priority is high; deficiency requires a rigorous corrective action planning process to identify similar work product or activities affected by the deficiency; or deficiency requires extensive resources and planning to correct the deficiency and to prevent recurrence. The CAP is developed by a PM designee and approved and signed by the PM. The CAP is to indicate whether it is submitted for informational purposes or for review and approval. In either event, the operational staff is encouraged to discuss the corrective action strategy with the QC staff throughout the process. The CAP form is included at the attachment to this QCP.

5.5 Deficiency and Corrective Action Tracking

Each CAR must be given a unique identification number and tracked until corrective actions have been taken and documented in Part B of the form and the CAR is submitted to the UXOQCS or a designee for verification and closure.

5.6 Lessons Learned and Other Documentation

The lessons learned through the deficiency management process are documented on CARs and CAPs. CARs should be cited in the Weekly QC Report. Minor deficiencies identified during a QC audit that are readily correctable and can be verified in the field are to be documented in the QC logbook and Weekly QC Report without initiating a CAR. Deficiencies that cannot be readily corrected are to be documented by the QC staff on a CAR and in the Weekly QC Report. Copies of CARs are to be referenced in and attached to the Weekly QC Report. CAPs will also be attached to Weekly QC Reports to document the final outcome of the deficiency. Similar or related deficiencies may be addressed on a single CAP.

SECTION 6

Records Generated

6.1 Onsite Project File

The UXOQCS will establish and maintain an onsite project file in accordance with the CH2M HILL corporate quality procedures for document control. Part of the file will be in paper format and part in digital format. The onsite files will be maintained in the project field office or designated field vehicle and on the UXOQCS's laptop computer. The purpose of these files is to maintain a complete set of all documents, reports, certifications, and other records that provide information on project plans, contractual agreements, and project activities.

The CH2M HILL Munitions Response Program (MRP) Enterprise, which consists of a mobile field data collection device used to collect form-based information of DGM operations and a centralized desktop interface and database, will be the repository for most of the information collected by the field team (for example, daily reports). This database will contain information that can be easily presented and delivered through automated report production, which reduces the amount of actual paper in the files. The database will be backed up daily and stored in an offsite location. The files (in either paper or digital format) will include copies of the following:

- Qualifications and training records of all site personnel
- Submittals
- Schedule and progress reports
- Survey records
- Conversation logs
- Meeting minutes and agenda
- Audit logs and schedules
- Photo documentation
- Site maps
- Equipment-check records
- Nonconformance and corrective action reports
- Daily work activity summary reports, which may include:
  - Weekly QC Report
  - Daily Health and Safety Report
  - Daily Report (including activity log)(Form 8b)
  - Daily DGM team logs (field data sheets)
  - Reports on any emergency response actions (Explosive Ordnance Disposal personnel will handle emergencies on this project)
  - Equipment check records
  - Incident reports
  - Confirmation that documents have been reviewed and approved (Form 9b)

As the project activities progress, the UXOQC will monitor the usefulness of the project filing system for information retrieval. If additional file sections are needed, the UXOQCS will expand the initial filing structure to include additional sections.

6.2 Weekly QC Report

The UXOQCS is responsible for preparing and submitting the Weekly QC Report to the PM for the project file. The report and any attachments are to be submitted to the PM on the first workday following the dates covered by the report.

The Weekly QC Report is to provide an overview of QC activities performed each day, including those performed by subcontractors. The report must present an accurate and complete picture of QC activities by reporting both conforming and deficient conditions, and the reports should be precise, factual, legible, and objective. Copies of supporting documentation, such as checklists and surveillance reports, are to be attached.

A field QC log is to be maintained by the UXOQCS to document details of field activities during QC monitoring activities. At the end of each day, copies of the log entries (Form 8b) are to be attached to the Weekly QC Report. The information in the field QC log provides backup information and is intended to serve as a phone log and memory aid in the preparation of the Weekly QC Report and for addressing follow-up questions.

Copies of Weekly QC Reports with attachments and field QC logs no longer in use are to be maintained in the project QC file. Upon project closeout, all QC logs are to be included in the project QC file.

SECTION 7
Testing and Maintenance

Testing and maintenance of equipment such as geophysical instruments, radios, cell phones, vehicles and machinery will be performed in accordance with the manufacturer's specifications, this Work Plan, and all applicable SOPs. Geophysical detection equipment will be tested daily, as specified in the Geophysical Investigation Plan (GIP).

Test results must be documented by the individual performing the test. Testing and maintenance records associated with measuring and testing equipment must be generated by the individual performing the activity. Documentation for testing and maintenance of equipment is to be made available to the client upon request.

The UXOQCS is responsible for ensuring that the tests are performed and that the results are summarized and provided with the Weekly QC Report. To track each failing test for future retesting, the failing test must be noted on the deficiency log. Resolution of the failing test is complete when retesting is performed and the corrective action is verified on the deficiency log.

SECTION 8

Digital Geophysical Mapping Systems Quality Control

A QC program will be applied to the DGM operations at the site. Program elements include DGM instruments QC, QC seed items, QC of DGM data and deliverables, and analog geophysical systems QC. QC program details are provided in the GIP included as Appendix B.

SECTION 9

Forms

The QC forms are provided in the Attachment to this QCP.

Tables

TABLE 1
Definable Features of Work Auditing Procedures and Responsibilities
Munitions Investigation Work Plan UXO 20
NSF-IH, Indian Head, Maryland

Definable Feature of Work with Auditable Function	Responsible Person(s)[1]	Audit Procedure[2]	Quality Control (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	Once	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	Verify appropriate measures are in place to manage and control project documents.	PP	Once	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, QC Geophysicist	Verify appropriate measures are in place to manage and control project data.	PP	Once	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, UXOQCSM	Verify subcontractor qualifications, training, and licenses.	PP/IP	Once	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	Verify technical and operational approaches have been agreed on by the project team.	PP/IP	Once	Technical and operational approaches have been agreed on by project team and incorporated into the Work Plan.	Do not proceed with field activities until criterion is passed
Geophysical System Verification (GSV) Work Plan preparation and approval (Project Planning)	Project Manager	Verify GSV Work Plan has been prepared and approved.	PP/IP	Once	GSV Work Plan has been approved by the Department of the Navy (Navy).	Do not proceed with field activities until criterion is passed.
Work Plan (Mobilization)	Project Manager	Verify Work Plan has been prepared and approved.	PP/IP	Once	Work Plan has been approved by Navy.	Do not proceed with field activities (excluding site mobilization) until criterion is passed.
Field Operations						
Site preparation (Mobilization)	UXOQCSM	Verify local agencies are coordinated.	PP/IP	Once	Local agencies are coordinated.	Do not proceed with field activities until criterion is passed.
Site preparation (Mobilization)	UXOQCSM	Verify equipment has been inspected and tested.	PP/IP	Each occurrence	Equipment passes inspection and testing.	Proceed only with activities for which equipment has passed inspection and testing.
Site preparation (Mobilization)	UXOQCSM	Verify communications and other logistical support is coordinated.	PP/IP	Once	Communications and other logistical support are coordinated.	Do not proceed with field activities until criterion is passed.
Site preparation (Mobilization)	UXOQCSM	Verify emergency services have been coordinated.	PP/IP	Once	Emergency services are coordinated.	Do not proceed with field activities until criterion is passed.
Site preparation (Mobilization)	UXOQCSM	Verify site-specific training is performed and acknowledged.	PP/IP	Once	Site-specific training is performed and acknowledged	Do not proceed with field activities until criterion is passed.
GSV Execution (Mobilization)	QC Geophysicist	Verify DQOs established in Work Plan have been accomplished.	PP/IP	Once	DQOs identified in GSV Work Plan have been achieved	Continue with GSV until DQOs are achieved.
DGM Survey	QC Geophysicist	Verify DGM Survey conducted IAW GIP and GSV Work Plan:	IP/FP	Once/Daily	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	QC Geophysicist	Check results of QC tests performed as specified in GIP	FP	Each occurrence	QC tests must pass IAW standards determined during the GSV 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.

TABLE 1
Definable Features of Work Auditing Procedures and Responsibilities
Munitions Investigation Work Plan for Land Sites UXO 6, 9, 11, 20, and 30; and Water Site UXO 27
NSF-IH, Indian Head, Maryland

Definable Feature of Work with Auditable Function	Responsible Person(s)1	Audit Procedure2	QC Phase3	Freq. of Audit	Pass/Fail Criteria	Action if Failure Occurs
DGM Survey	QC Geophysicist	Confirm that DGM survey DQOs established are being met.	FP	Each occurrence	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	QC Geophysicist	Verify data checks specified in GIP	FP	Each occurrence	Data checks must pass in accordance with standards determined during the GSV 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.
Demobilization	Field Supervisor	Verify facilities-support infrastructures are dismantled and shipped to appropriate location and area is returned to original condition.	FP	Once	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
Field Operations	PM	Verify field site is returned to original condition	FP	Once	Field site is returned to original condition	Ensure field site is returned to original condition
Final Project Reports and Close-out	PM	Verify tabulation of all MEC, MD, and other material recovered during the removal actions are accurate and complete	IP	Once	Tabulation of all MEC, MD, and other material recovered during the removal actions are accurate and complete	Ensure tabulation of all MEC, MD, and other material recovered during the removal actions are accurate and complete
Final Project Reports and Close-out	AM	Verify Final Report has been approved	IP	Once	Final Report has been approved	Take appropriate actions to ensure document get approved
Final Project Reports and Close-out	AM	Verify data back-up systems are in place	IP	Once	Data back-up systems are in place	Ensure data back-up systems are in place
Final Project Reports and Close-out	AM	Verify purchase orders have been closed out	IP	Once	Purchase orders have been closed out	Ensure purchase orders are closed out

Notes:
AM = Activity Manager
DGM = digital geophysical mapping
DQO = data quality objective
GIP = Geophysical Investigation Plan
GSV = Geophysical System Verification
IAW = in accordance with
MD = munitions debris
MEC = munitions and explosives of concern
Navy = Department of the Navy
PM = Project Manager
QC = Quality Control
SOP = Standard Operating Procedure
UXOQCS = Unexploded Ordnance Quality Control Specialist

QC Phase
PP = Preparatory Phase
IP = Initial Phase
FP = Follow-up Phase

[1] The responsible person (if other than the UXOQCSM) is the individual with whom the UXOQCSM 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.

TABLE 2
QC Methods and Pass/Fail Criteria
Quality Control Plan for UXO 20
NSF-IH, Indian Head, Maryland

Operation	Peer Oversight	Inspection	Audit	Pass/Fail
Site Preparation Entry Control Points (ECPs)	x	Conforms to Work Plan and or SOPs	Locations of ECPs	In accordance with Work Plan criteria and the ESS
Instrument Verification Strip (IVS) placement and Equipment Acceptance	x	Conforms to Work Plan and or SOPs	Checkout and, operation of geophysical instruments (including documentation)	100 percent detection and selection of MEC, material potentially presenting an explosive hazard (MPPEH), and other metal items with one dimension greater than 2 inches
Land Survey (for example, GPS)	X	Conforms to Contractor's SOPs	Professional license verification, equipment check-out against known control monument for vertical and horizontal accuracy	Site boundaries achieve centimeter tolerance for traverse closure
Vegetation Reduction	X	Conforms to Contractor's SOPs	Training records in accordance with DDESB personnel requirements (DDESB, 2004). Avoidance provided by UXO Technicians. Personal protective equipment in accordance with the HSP.	Brush cut to no more than 6 inches above surface; trees greater than 6 inches in diameter remain
Surface Removal	X	Surface Evaluation Program	All work performed in accordance with ESS and Work Plan.	Pass = 0 MEC/MPPEH, or metal items with any one dimension greater than 2 inches; Fail = 1 MEC/MPPEH, or metal item with any one dimension greater than 2 inches Fail = rework of 50-foot x 50-foot grid and repeat QC process.
MPPEH Processing	x	Conforms to Contractor's SOPs	MPPEH/material documented as an explosive hazard (MDEH) is in accordance with Work Plan. Material documented as safe (MDAS) and MDEH are properly documented and a chain of custody is in place. 100 percent verification of demilitarization methods to achieve a determination of releasable to a recycler	100 percent of all MDAS has been properly assessed and documented as safe. Re-inspect and document any discrepant material. Visual Inspection of all surface areas, demilitarization in accordance with DoD Instruction 4140.62
MEC Detonation	x	Conforms to Contractor's SOPs	100 percent oversight during explosive operations set-up, execution, and post-investigation	Explosive main charge fails to detonate, or fragments are thrown beyond Explosive Safety Quantity-Distance (ESQD) arcs

Attachment
QC Forms

Form 1a: Field Change Documentation

Date: ____________

Page _______ **of** ________

Project:

Project No.:

Applicable Document:

Change Description:

Reason for change:

Recommended disposition:

Impact on present and completed work:

Final disposition (MCB Camp Lejeune only)

Request by:

CH2M HILL Project Manager: ____ Date:______________

Approvals:

Navy Remedial Project Manager: ______________________________________ Date:______________

FORM 1b

Preparatory Inspection Checklist
(Part I)

Contract No.:

Date: ___________

TITLE AND NO. OF TECHNICAL SECTION: ______________________________________

____

____

____

A. Planned Attendees:

	Name	Position	Company
1)			
2)			
3)			
4)			
5)			
6)			
7)			
8)			
9)			
10)			
11)			

B. Submittals required to begin work:

	Item	Submittal No.	Action Code
1)			
2)			
3)			
4)			
5)			
6)			
7)			
8)			

I hereby certify that, to the best of my knowledge and belief, the above required materials delivered to the job site are the same as those submitted and approved.

____

Contractor Quality Control Systems Manager

FORM 1b (Continued)

Preparatory Inspection Checklist
(Part I)

Contract No.:

Date: ____________

C. Equipment to be used in executing work:

1) ______________________________
2) ______________________________
3) ______________________________
4) ______________________________
5) ______________________________

D. Work areas examined to ascertain that all preliminary work has been completed:

____
____

E. Methods and procedures for performing Quality Control, including specific testing requirements:

____
____

The above methods and procedures have been identified from the project plans and will be performed as specified for the Definable Feature of Work.

____
Contractor Quality Control Systems Manager

FORM 1b (Continued)

Preparatory Inspection Checklist
(Part II)

A. Persons in attendance: See Meeting Attendance Sheet (attached)

B. Because of mutual understanding developed during review of preparatory outline and Contract Requirements: (Contract items not specifically covered during the preparatory inspection conference are assumed to be in strict conformance with the contract requirements.)

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The items noted above constitute a memorandum of mutual understanding and will be performed as planned and specified.

______________________________ ______________________________
MEC QCS Technical Representative

Form 2a: Corrective Action Request Form

Originator: ____ Date: _______

Person responsible for replying: ____

Description of problem and when identified: _____________________________________

____

<u>Sequence of Corrective Action (CA):</u> (Note, if no responsible person is identified, submit this form directly to the Project Manager)

State date, person, and action planned:

____

____

____

____

____

CA initially approved by: __________________________________ Date: _____________

Follow-up date: ____

Final CA approval by: _____________________________________ Date: _____________

Information copies to:

Responsible person:____

Field Team Leader:____

Project Manager: ____

FORM 2b

Initial Phase Check List

Contract No.:

Date: ___________

Title and No. of Technical Section: ____

____

____

Description and Location of Work Inspected: ____

A. Key Personnel Present:

Name	Position	Company

B. Materials being used are in strict compliance with the contract plans and specifications: Yes ___ No ____

If not, explain: ____

____

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____

C. Procedures and/or work methods witnessed are in strict compliance with the contract specifications: Yes No ___

If not, explain: ____

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D. Workmanship is acceptable: Yes ____ No ____

State where improvement is needed: ____

____

____

____

E. Workmanship is free of safety violations: Yes ____ No ____

If no, corrective action taken: ____

____

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MEC QCS

FORM 3b

FOLLOW-UP CHECKLIST

Date:
Contractor:
Contract No:

Y=YES; N=NO; SEE REMARKS BLANK=NOT APPLICABLE	
WORK COMPLIES WITH CONTRACT AS APPROVED IN INITIAL PHASE	

IDENTIFY DEFINABLE FEATURE OF WORK, LOCATION, AND LIST PERSONNEL PRESENT

TESTING PERFORMED & WHO PERFORMED TEST (Include number of samples and/or tests taken)

QA Representative________________________ **Date** _________________

MEC QCS________________________________ **Date** _________________

FORM 4b

Final Inspection Checklist
(Part I)

DATE: ____________

CONTRACT NO.:____

Project / Area of Inspection: ____

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A. DEFINABLE FEATURES OF WORK: ______________________ Status of Inspection:

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I hereby certify, that to the best of my knowledge and belief, that the work inspected is complete and all materials and equipment used and work performed were completed in accordance with plans submitted and approved.

____

CONTRACTOR QUALITY CONTROL SYSTEMS MANAGER

B. Final Acceptance is Approved, Subject to the Correction of the Punchlist Items Below:

____

____

____

____

____

FORM 4b (Continued)

Final Inspection Checklist
(Part I)

DATE:______________________

CONTRACT NO.:

A. Persons in Attendance: See Meeting Attendance Sheet (attached)

B. Resolution of Punch-list Items:

The items noted above constitute a memorandum of mutual understanding and work has been performed as planned and specified.

MEC QCS

TECHNICAL REPRESENTATIVE

FORM 4b (Continued)

Final Inspection Checklist
(Part II)

MEETING ATTENDANCE LIST

Meeting:		**Date:**
Name	**Organization**	**Phone Number**

FORM 5b

INSPECTION SCHEDULE AND TRACKING FORM

Project:	**Project Manager:**	**MEC QCS:**

Reference Number	Definable Feature of Work	**Preparatory**		**Initial**		**Follow-Up**		**Completion**		
		Date Planned	Actual Date	Date Planned	Actual Date	Planned Begin/End	Actual Dates	Planned Begin/End	Actual Dates	Status

FORM 6b

CORRECTIVE ACTION REQUEST

(1)Page 7 of 2

(2)CAR #:	(3)PRIORITY: ☐HIGH ☐NORMAL	(4)DATE PREPARED:

PART A: NOTICE OF DEFICIENCY

(5)PROJECT:	
(6)PROJECT MANAGER:	(7)MEC QCS:
(8)WORK UNIT:	(9)WORK UNIT MANAGER:
(10)ISSUED TO (INDIVIDUAL & ORGANIZATION):	
(11)REQUIREMENT & REFERENCE:	
(12)PROBLEM DESCRIPTION & LOCATION: (4)CAP REQUIRED? ☐YES ☐NO (14)RESPONSE DUE:	
(15)ISSUED BY (PRINTED NAME & TITLE): SIGNATURE: DATE:	(16)MANAGEMENT CONCURRENCE:

Form 6B (continued)
CORRECTIVE ACTION REQUEST

PART B: CORRECTIVE ACTION

(17) PROPOSED CORRECTIVE ACTION/ACTION TAKEN: NOTE: SUPPORTING DOCUMENTATION MUST BE LISTED ON THE BACK OF THIS FORM AND ATTACHED.	
(18) PART B COMPLETED BY (NAME & TITLE): SIGNATURE: DATE:	(19) QC CONCURRENCE:

PART C: CORRECTIVE ACTION VERIFICATION

(20) CAR VERIFICATION AND CLOSE-OUT: (CHECK ONLY ONE & EXPLAIN STIPULATIONS, IF ANY) ☐ APPROVED FOR CLOSURE WITHOUT STIPULATIONS ☐ APPROVED FOR CLOSURE WITH FOLLOWING STIPULATIONS COMMENTS/STIPULATIONS: (21) CLOSED BY (PRINTED NAME & TITLE): SIGNATURE: DATE:

Form 6B (continued)
CORRECTIVE ACTION REQUEST

CORRECTIVE ACTION REQUEST (CAR) INSTRUCTION SHEET

(1) **MEC QCS**: Verify that the total number of pages includes all attachments.

(2) **MEC QCS**: Fill in CAR number from CAR log.

(3) **MEC QCS**: Fill in appropriate priority category. **High** priority indicates resolution of deficiency requires expediting corrective action plan and correction of deficient conditions noted in the CAR and extraordinary resources may be required due to the deficiency's impact on continuing operations. **Normal** priority indicates that the deficiency resolution process may be accomplished without further impacting continuing operations.

(4) **CAR Requestor**: Fill in date CAR is initiated.

(5) **CAR Requestor**: Identify project name, number, CTO, and WAD.

(6) **CAR Requestor**: Identify Project Manager

(7) **CAR Requestor**: Identify CQC System Manager.

(8) **CAR Requestor**: Identify project organization, group, or discrete work environment where deficiency was first discovered.

(9) **CAR Requestor**: Identify line manager responsible for work unit where deficiency was discovered.

(10) **MEC QCS**: Identify responsible manager designated to resolve deficiency (this may not be work unit manager).

(11) **CAR Requestor**: Identify source of requirement violated in contract, work planning document, procedure, instruction, etc; use exact reference to page and, when applicable, paragraph.

(12) **CAR Requestor**: Identify problem as it relates to requirement previously stated. Identify location of work activities impacted by deficiency.

(4) **MEC QCS**: Identify if Corrective Action Plan (CAP) is required. CAP is typically required where one or more of the following conditions apply: CAR priority is **High**; deficiency requires a rigorous corrective action planning process to identify similar work product or activities affected by the deficiency; or deficiency requires extensive resources and planning to correct the deficiency and to prevent future recurrence.

(14) **MEC QCS**: Identify date by which proposed corrective action is due to QC for concurrence.

Form 6B (continued)
CORRECTIVE ACTION REQUEST

(15) **MEC QCS**: Sign and date CAR and forward to responsible manager identified in (10) above.

(16) **Responsible Manager**: Initial to acknowledge receipt of CAR.

(17) **Responsible Manager**: Complete corrective action plan and identify date of correction. Typical corrective action response will include statement regarding how the condition occurred, what the extent of the problem is (if not readily apparent by the problem description statement in [12]), methods to be used to correct the condition, and actions to be taken to prevent the condition from recurring. If a CAP is required, refer to CAP only in this section.

(18) **Responsible Manager**: Sign and date corrective action response.

(19) **MEC QCS**: Initial to identify concurrence with corrective action response from responsible manager.

(20) **MEC QCS**: Check appropriate block to identify if corrective action process is complete so that CAR may be closed. Add close-out comments relevant to block checked.

(21) **MEC QCS**: Indicate document closeout by signing and dating.

FORM 7b

CORRECTIVE ACTION PLAN

Attach clarifications and additional information as needed. Identify attached material in appropriate section of this form.

PART A: TO BE COMPLETED BY PROJECT MANAGER OR DESIGNEE

(1)PROJECT:		
(2)PROJECT MANAGER:	(3)MEC QCS:	
(4)CAR NO(S) AND DATE(S) ISSUED:		
(5)DEFICIENCY DESCRIPTION AND LOCATION:		
(6)PLANNED ACTIONS	(7)ASSIGNED RESPONSIBILITY	(8) COMPLETION DUE DATE
(9)PROJECT MANAGER SIGNATURE:		DATE:

PART B: TO BE COMPLETED BY MEC QCS OR DESIGNEE

(10)CAP REVIEWED BY:	DATE:
(11)REVIEWER COMMENTS:	
(12)CAP DISPOSITION: (CHECK ONLY ONE AND EXPLAIN STIPULATIONS, IF ANY) ☐ APPROVED WITHOUT STIPULATIONS ☐ APPROVED WITH STIPULATIONS ☐ APPROVAL DELAYED, FURTHER PLANNING REQUIRED COMMENTS:	
(4)MEC QCS SIGNATURE:	DATE:

FORM 8b

DAILY QUALITY CONTROL REPORT

Contract No.: __________

Date: ________________Task Order No.:________Report No:_______

LOCATION OF WORK: ____
DESCRIPTION: ____________ ____
WEATHER: (CLEAR) (FOG) (P.CLOUDY) (RAIN) (WINDY)
TEMPERATURE: MIN °F MAX °F

1. Work performed today:

____

____

2. Work performed today by CH2MHILL subcontractor(s):

____

____

3. Preparatory Phase Inspections performed today (include personnel present, specification section, drawings, plans, and submittals required for definable feature of work):

____

____

4. Initial phase Inspections performed today (include personnel present, workmanship standard established, material certifications/test are completed, plans and drawings are reviewed):

____

____

5. Follow-up Phase Inspections performed today (include locations, feature of work and level of compliance with plans and procedures):

____

____

____

6. List tests performed, samples collected, and results received:

____

____

____

7. Verbal instructions received (instructions given by Government representative and actions taken):

____

____

____

8. Non-conformances/deficiencies reported:

____

____

____

9. Site safety monitoring activities performed today:

____

____

10. Remarks:

____

____

____

____

CERTIFICATION: *I certify that the above report is complete and correct and that I, or my representative, have inspected all work identified on this report performed by CH2M HILL and our subcontractor(s) and have determined to the best of my knowledge and belief that noted work activities are in compliance with the plans and specifications, except as may be noted above.*

MEC QCS (or designee) Signature: ____

Form 9b

Document Release and Review

Client:	Author:								Submittal Register Item No.:		Date:
Document Title:									Revision:	D.O.#	WAD#

Reviewer (*print*)	Reviewer initial & date	Technical	Project Manager	CQC System Mgr.	Health & Safety	Editorial	Chemistry	Construction	Reviewer Comments Resolved (*Signature & Date*)
Same as Technical Reviewer Above		X	Topic outline with objectives for each section submitted prior to Rev. A						

Program Reviewer's Acceptance for Document Submittal	Signature	Yes	No
1) A 4025 (as applicable) prepared and submitted with document?			
2) Technical Conclusions adequately supported by text and data?			
3) Tables and Figures are in the proper format and checked and approved?			
4) The Table of Contents consistent with text information?			
5) Technical Reviewers are qualified and accepted by Technical Manager?			
6) A document Distribution List been prepared and submitted with document?			

Approval: ______________________________
Project Manager

Approval: ______________________________
MEC QCS

Recommended
4025 Code ______________

Appendix D
Health and Safety Plan

Final

Health and Safety Plan
Indian Head UXO 20

Naval Support Facility
Indian Head, Maryland

Contract Task Order 0012

November 2012

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Washington

Under the

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

Prepared by

CH2MHILL

Chantilly, Virginia

Contents

Attachments

Acronyms and Abbreviations

°C	degree Celsius
°F	degree Fahrenheit
μg/m^3	microgram per cubic meter
A/D	Assembly/Disassembly
ACGIH	American Conference of Governmental Industrial Hygienists
AHA	Activity Hazard Analysis
AL	action level
ANSI	American National Standards Institute
APP	Accident Prevention Plan
APR	air-purifying respirator
ARI	Automotive Rental, Inc.
ARRA	American Recovery and Reinvestment Act
bpm	beat per minute
CAD/PAD	Cartridge Actuated Device/Propellant Actuated Device
CFR	Code of Federal Regulations
CGI	combustible gas indicator
CLEAN	Comprehensive Long-term Environmental Action – Navy
CM	Construction Manager
COC	contaminant of concern
CPR	cardiopulmonary resuscitation
CSE	confined space entry
CTO	Contract Task Order
dBA	decibel, A-weighted
DEET	N,N-diethyl-meta-toluamide
DEHP	bis-(2-ethylhexyl)phthalate
DGM	digital geophysical mapping
DOT	Department of Transportation
EM	Environmental Manager
EME	earthmoving equipment
EOD	Explosive Ordnance Disposal
ERC	Emergency Response Coordinator
ES	Environmental Services
ESBG	Environmental Services Business Group
ESS	Explosives Safety Submission
eV	electron volt
EZ	exclusion zone
FA	first aid
FID	flame ionization detector
FWSO	Firm Wide Security Operations
GFCI	Ground Fault Circuit Interrupter
GPS	global positioning system
H&S	health and safety
HAZWOPER	hazardous waste operations and emergency response

HCC	Hazard Characteristic Code
HEPA	high-efficiency particulate air
HITS	Hours and Incident Tracking System
HMX	cyclotetramethylene-tetranitramine
HR	Human Resources
HSE	Health, Safety, and the Environment
HSM	Health and Safety Manager
HSP	Health and Safety Plan
HSSE	Health, Safety, Security, and the Environment
IDLH	immediately dangerous to life and health
IHDIVNAVSURFAWARCEN	Indian Head Division Naval Surface Warfare Center
IMRTW	Injury Management/Return To Work
IRF	Incident Report Form
ISEA	International Safety Equipment Association
KA	Contract Administrator
kV	kilovolt
LEL	lower exposure limit
LID	Legal Insurance Department
lpm	liter per minute
lx	lux
MC	munitions constituents
MEC	munitions and explosives of concern
mg/kg	milligram per kilogram
mg/m^3	milligram per cubic meter
MPPEH	material potentially presenting an explosive hazard
MR	munitions response
MRS	munitions response site
MSDS	Material Safety Data Sheet
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NPCS	non-permit confined space
NPDES	National Pollutant Discharge Elimination System
NRR	noise reduction rating
NSC	National Safety Council
NSF-IH	Naval Support Facility Indian Head
OB/OD	open burning/open detonation
OMI	Office of the Medical Investigator
ORE	Opportunity Risk Evaluation
OSHA	Occupational Safety and Health Administration
PAPR	powered air-purifying respirator
PCB	polychlorinated biphenyl
PDA	personal digital assistant
PEL	permissible exposure limit
PETN	pentaerythritol tetranitrate
PFD	personal flotation device
PID	photoionization detector
PIM	potentially infectious material
PIP	photoionization potential

PM	Project Manager
POV	personally owned vehicle
PPE	personal protective equipment
ppm	part per million
PRCS	permit-required confined space
PTSP	Pre-task Safety Plan
RDX	cyclotrimethylenetrinitramine
REL	recommended exposure limit
REM	Responsible Environmental Manager
RHSM	Responsible Health and Safety Manager
RI	Remedial Investigation
RMSF	Rocky Mountain Spotted Fever
SAR	supplied-air respirator
SBO	Safe Behavior Observation
SC	Safety Coordinator
SCBA	self-contained breathing apparatus
SOP	Standard Operating Procedure
SPA	safety program assistant
SPF	sun protection factor
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
STAC	Safety and Training Advisory Committee
STS	standard threshold shift
SXOS	Senior Unexploded Ordnance Supervisor
TBD	to be determined
TLV	Threshold Limit Value
TM	Task Manager
TNT	trinitrotoluene
TSD	treatment, storage, and disposal
TSDF	treatment, storage, and disposal facility
U.S.	United States
UL	Underwriters Laboratory
USEPA	United States Environmental Protection Agency
UV	ultraviolet
UXO	Unexploded Ordnance
UXOSO	Unexploded Ordnance Safety Officer
VO	Virtual Office
VOC	volatile organic compound

Approval

This site-specific Health and Safety Plan (HSP) 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 and identified scope(s) of work and must be amended if those conditions or scope(s) of work change.

By approving this HSP, the Responsible Health and Safety Manager (RHSM) certifies that the personal protective equipment (PPE) has been selected based on the project-specific hazard assessment.

Original Plan

RHSM Approval: Mark Orman **Date**: 16 May 2011

Field Operations Manager Approval: **Date:**

Revisions

Revisions Made By: Carl Woods per e-mail from Vicki Waranoski **Date: 9/15/12**

Description of Revisions to Plan:

In summary, we are going to the site, doing vegetation clearing, deconning these large former burn chambers (either with hot soapy water or acetone on rags), lifting the large items with crane or other suitable equipment, putting them on a flat bed truck for disposal, disposing of munitions and explosives of concern (MEC)/material potentially presenting an explosive hazard (MPPEH), and conducting digital geophysical mapping (DGM) surveys.

Revisions Approved By: Carl Woods **Date: 9/15/12**

---

1 Introduction

Health, Safety, and Environment Policy Commitment

Protection of people and the environment is a CH2M HILL core value. It is our vision to create a culture that empowers employees to drive this value into all global operations and achieve excellence in health, safety, and environment (HSE) performance.
CH2M HILL deploys an integrated, enterprise-wide behavior based HSE 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 their fellow employees to prevent injuries, illnesses, and adverse environmental impacts, and create a safe, healthy, and environmentally-responsible workplace.
- We provide value to clients by tailoring HSE processes to customer needs and requiring CH2M HILL employees and subcontractors to deliver projects that identify HSE requirements and commit to compliance with applicable HSE laws and regulations, company standards, and external requirements.
- We are committed to pollution prevention in conjunction with our Sustainability Policy and by offering our clients sustainable solutions.
- We aspire to continually improve our performance and influence others to redefine world-class HSE excellence.
- We evaluate our design engineering and physical work environment to verify safe work conditions and practices are established, followed, and corrected as needed.
- We assess and continually improve our HSE program to achieve and maintain world-class performance by setting and reviewing objectives and targets, reporting performance metrics, and routinely evaluating our program.
- We expect all employees to embrace our Target Zero 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 5th day of April, 2012

Lee McIntire
Chief Executive Officer

John Madia
Chief Human Resources Officer

Mike Lucki
Chief Financial Officer

Margaret McLean
Chief Legal Officer

Mike McKelvy
President, Government, Environment, and Infrastructure Division

Bob Card
President, Energy, Water and Facilities Division

Jacqueline Rast
President, International Division

Fred Brune
Chief Administrative Officer

Gene Lupia
President, Delivery Excellence

Brad Barber
Director, Health, Safety, and Environment

1.1 CH2M HILL Policy and Commitment

1.1.1 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; and
- 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, cost reduction, and job performance, and are crucial to our success.

1.1.2 Health and Safety Commitment

CH2M HILL has embraced a philosophy for health and safety (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. Also, 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 also 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 of its operations; to the protection of the general public whenever it comes in contact with the Company's work; and to 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 CH2M HILL's safety program depends on the full cooperation and participation of each employee.

CH2M HILL management extends its full commitment to H&S excellence.

1.1.3 Project-Specific Health, Safety, and the Environment Goals

All management and employees are to strive to meet the project-specific Health, Safety, and the Environment (HSE) goals outlined as follows. The team will be successful only if everyone makes a concerted effort to accomplish these goals. The goals allow the project to stay focused on optimizing the H&S of all project personnel and, therefore, making the project a great success.

The Project has established 11 specific goals and objectives:

- Create an injury-free environment;
- Have zero injuries or incidents;
- Provide management leadership for HSE by communicating performance expectations, reviewing and tracking performance, and leading by example;
- Ensure effective implementation of the Health and Safety Plan (HSP) through education, delegation, and team work;
- Ensure 100 percent participation in HSE compliance;

- Continuously improve our safety performance;
- Maintain free and open lines of communication;
- Make a personal commitment to safety as a value;
- Focus safety improvements on high-risk groups;
- Continue strong employee involvement initiatives; and
- Achieve H&S excellence

2 Applicability

This HSP applies to:

- All CH2M HILL staff, including subcontractors and tiered subcontractors of CH2M HILL working on the site; and
- All visitors to the construction site in the custody of CH2M HILL (including visitors from the Client, the Government, the public, and other staff of any CH2M HILL company).

This HSP does not apply to the third-party contractors, their workers, their subcontractors, their visitors, or any other persons not under the direct control or custody of CH2M HILL.

This HSP defines the procedures and requirements for the H&S of CH2M HILL staff and visitors when they are physically on the work site. The work site includes the project area (as defined by the contract documents) and the project offices, trailers, and facilities thereon.

This HSP will be kept onsite during field activities and will be reviewed as necessary. The HSP will be amended or revised as project activities or conditions change or when supplemental information becomes available. The HSP adopts, by reference, the Enterprise-wide Core Standards and Standard Operating Procedures (SOPs), as appropriate. In addition, the HSP may adopt procedures from the project Work Plan and any governing regulations. If there is a contradiction between this HSP and any governing regulation, the more stringent and protective requirement will apply.

All CH2M HILL staff and subcontractors must sign the employee sign-off form included in this document as Attachment 1 to acknowledge review of this document. Copies of the signature page will be maintained onsite by the Safety Coordinator (SC).

3 General Project Information

3.1 Project Information and Background

Project Number: Comprehensive Long-term Environmental Action – Navy (CLEAN) 1000 CTO-012, 380785

Client: Naval Facilities Engineering Command (NAVFAC) Washington

Project/Site Name: Naval Support Facility Indian Head (NSF-IH), UXO Site 20 Safety Thermal Treatment Point.

Site Address: Indian Head, Maryland

CH2M HILL Project Manager (PM): Victoria Waranoski

CH2M HILL Office: Chantilly, VA

DATE HSP Prepared: 6/6/2012

Date(s) of Site Work: Summer/Fall 2012

3.2 Site Background and Setting

Safety Thermal Treatment Point (Unexploded Ordnance [UXO] 20)

Site UXO 20 is a 1.6-acre site located at the end of a peninsula that extends southwest from the Main Installation into Mattawoman Creek. It was reportedly used for open burning/open detonation (OB/OD) and testing of projectiles, bulk propellant, bulk high explosives, demolition charges, Cartridge Actuated Devices/Propellant Actuated Devices (CADs/PADs), primers, less sensitive explosives, and various other pyrotechnics. It operated from the late 1940s to 1988. Soil and groundwater samples showed elevated levels of explosives and metals (1996 Draft Closure and Post Closure Plans for the Safety Thermal Treatment Point). Because munitions constituents (MC) (trinitrotoluene [TNT], cyclotrimethylenetrinitramine [RDX], Composition A, Composition B, Composition C, torpex, pentaerythritol tetranitrate [PETN], dynamite, nitrocellulose, cordite, perchlorate, metals) was detected, this site moving forward to a Remedial Investigation (RI). An RI is scoped. The objective of the RI is to verify the nature and extent of munitions and explosives of concern (MEC).

The Explosives Safety Submission (ESS) is for non-intrusive activities in support of an interim removal action (IRA) and digital geophysical mapping (DGM) at UXO 20, Safety Thermal Treatment Point, at NSF-IH in Indian Head, Maryland. This ESS was prepared by CH2M HILL under the Department of the Navy (Navy), NAVFAC Washington CLEAN, Contract Number N62470-08-D-1000, Contract Task Order (CTO) 0012.

NSF-IH is a Navy facility in northwestern Charles County, Maryland, approximately 25 miles south of Washington DC. The facility consists of two tracts of land: the Main Installation on the Cornwallis Neck Peninsula, and the Stump Neck Annex, across Mattawoman Creek. UXO 20 is located in the southwest portion of the Main Installation.

See Site Map for work area.

3.3 Description of Tasks

Refer to project documents (i.e., Work Plan) for detailed task information. Tasks other than those listed below require an approved amendment or revision to this plan before tasks begin. Refer to the “Site Control” section of this HSP for procedures related to “clean” tasks that do not involve hazardous waste operations and emergency response (HAZWOPER).

3.3.1 HAZWOPER-regulated Tasks

- Boundary Survey
- Vegetation Clearance
- Surface Removal of MEC/material potentially presenting an explosive hazard (MPPEH)
- DGM Surveys
- Removal of Burn Containment Equipment

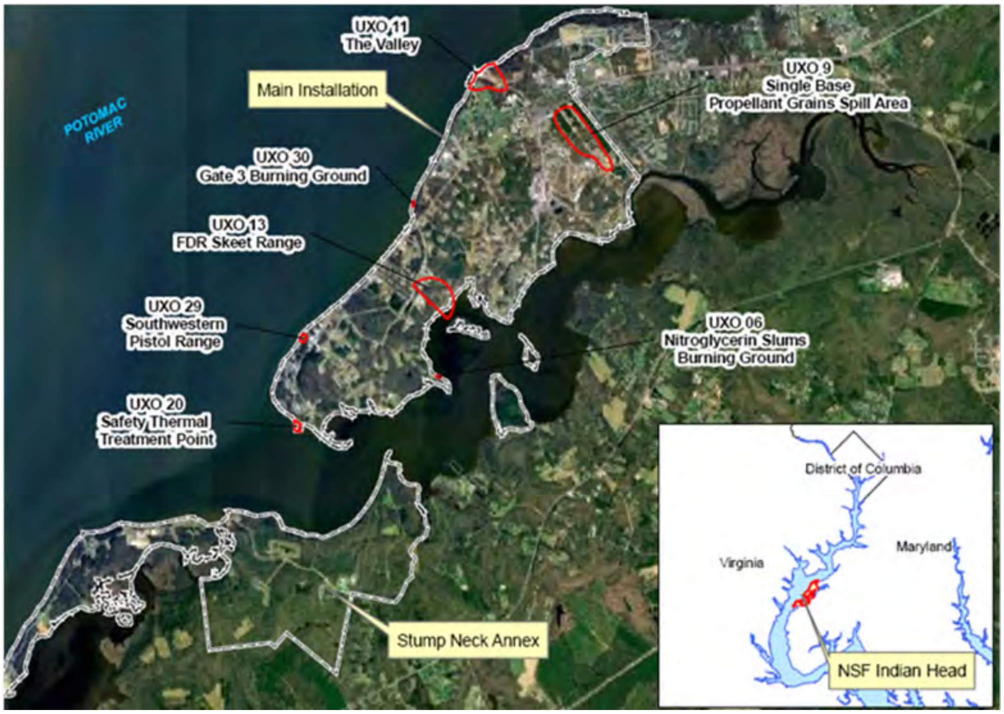
3.3.2 Non-HAZWOPER-regulated Tasks

Under specific circumstances, the training and medical monitoring requirements of federal or state HAZWOPER regulations are not applicable. It must be demonstrated that the tasks can be performed without the possibility of exposure in order to use non-HAZWOPER-trained personnel. **Contact the Responsible Health and Safety Manager (RHSM) prior to using non-HAZWOPER-trained personnel for the following tasks when working on a regulated hazardous waste site.**

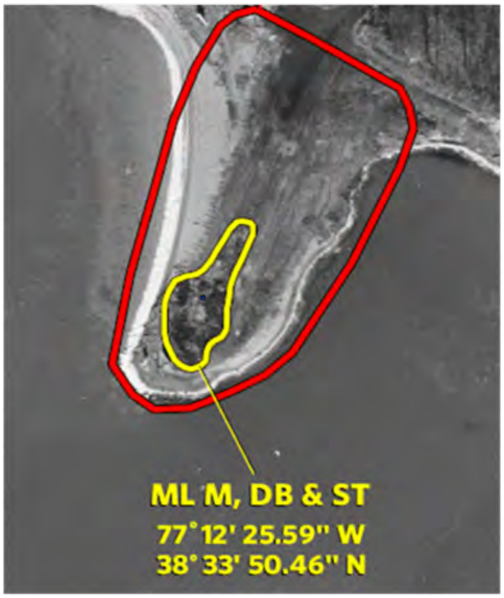
TASKS	CONTROLS
• Utility Survey/Site Walks (non-intrusive)	• Brief on hazards, limits of access, and emergency procedures. • Post areas of contamination as appropriate. • Perform air sampling/monitoring as specified in this HSP.

Site Map

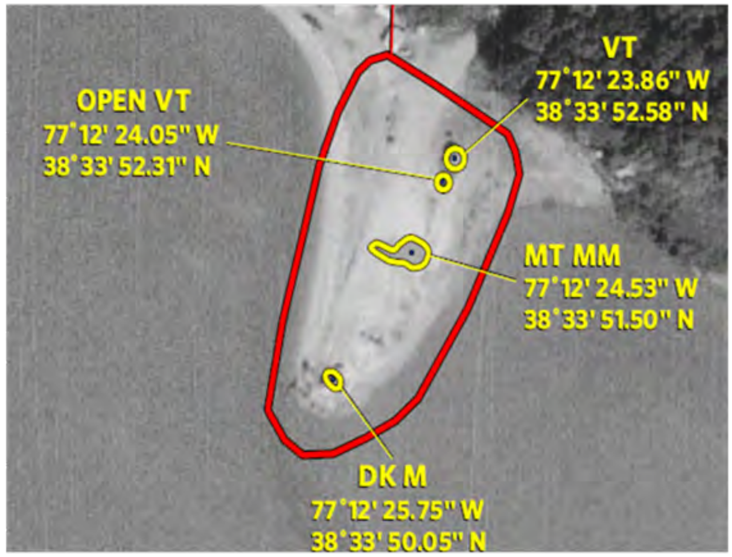
Site Location



Aerial Photos



February 7, 1962



September 23, 1972

4 Project Organization and Responsibilities

4.1 Client

Contact Name: Mr. Joe Rail, Remedial PM Phone: 202-685-3105 Facility Contact Name: Mr. Nicholas Carros, Remedial Program Manager Phone: 301-744-2263

4.2 CH2M HILL

4.2.1 Project Manager

PM Name: Victoria Waranoski, Job Title: PM CH2M HILL Office: WDC Telephone Number: 703-376-5049 Cellular Number: 571-480-2018

The PM is responsible for providing adequate resources (budget and staff) for project-specific implementation of the HSE 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 document:

- Incorporate standard terms and conditions, and contract-specific HSE roles and responsibilities in contract and subcontract agreements (including flow-down requirements to lower-tier subcontractors).
- Select safe and competent subcontractors by:
- Choosing potential subcontractors based on technical ability and HSE performance;
  - Implementing the subcontractor prequalification process;
  - Ensuring that acceptable certificates of insurance, including CH2M HILL as named additional insured, are secured as a condition of subcontract award; and
  - Ensuring HSE submittals, subcontract agreements, and appropriate site-specific safety procedures are in place and accepted prior field mobilization.
- Ensure copies of training and medical monitoring records, and site-specific safety procedures are being maintained in the project file accessible to site personnel.
- Provide oversight of subcontractor HSE practices per the site-specific safety plans and procedures.
- Manage the site and interfacing with third parties in a manner consistent with the contract and subcontract agreements and the applicable standard of reasonable care.
- Ensure that the overall, job-specific, HSE goals are fully and continuously implemented.
- Provide visible support and motivation for HSE programs, rules, procedures, processes, and training, leading by example and encouraging CH2M HILL employees to take ownership of HSE issues.
- Intervene or stop work when an unsafe condition or behavior is observed, and/or when an environmentally compromising condition is encountered.
- Make available to and require CH2M HILL employees to complete required HSE training within established timelines and provide project numbers for such training.

- Consistently and even-handedly enforce HSE rules, procedures, and requirements at the office and/or on project work sites.
- Promptly report all work-related HSE incidents or near misses.
- Wear any required personal protective equipment (PPE).
- Ensure CH2M HILL employees complete required HSE training within established timelines.
- Conduct, cooperate, or assist with HSE incident investigations.
- Consult with the Human Resources (HR) Delivery Partner before taking any disciplinary action (other than verbal counseling) associated with CH2M HILL Policy 203 and/or HSE programs rules, procedures, processes, and training.

4.2.2 CH2M HILL Responsible Health and Safety Manager

RHSM Name: Mark Orman
Job Title: RHSM
CH2M HILL Office: MKE
Telephone Number: 414-847-0597
Cellular Number: 414-712-4138

The RHSM is responsible for the following:

- Review and evaluate subcontractor HSE performance using the pre-qualification process;
- Approve HSP and its revisions as well as Activity Hazard Analyses (AHA);
- Review and evaluate subcontractor site-specific safety procedures for adequacy prior to start of subcontractor's field operations;
- Support the oversight (or SC's direct oversight) of subcontractor and tiered subcontractor HSE practices;
- Permit upgrades/downgrades in respiratory protection after reviewing analytical data;
- Conduct audits as determined by project schedule and coordination with PM; and
- Participate in incident investigations, lessons learned, loss/near loss reporting.

4.2.3 CH2M HILL Project Environmental Manager

Environmental Manager (EM) Name: Nancy Ballantyne
CH2M HILL Office: DEN
Telephone Number: 720-286-5561
Cellular Number: 303-885-9954

The Project EM is responsible for the following:

- Provide environmental program support in areas such as training, auditing, planning, permit tracking, and subcontractor oversight as needed or as specified in the project environmental plan;
- Review and evaluate qualifications for subcontractors with a history of environmental non-compliance and for waste transportation and disposal subcontractors;
- Evaluate any spills, releases, or environmental permit incidents for appropriate follow-up actions, notifications, and recordkeeping requirements; and
- Provide environmental compliance and environmental management expertise and advice to the project team as needed during the course of the project.

4.2.4 CH2M HILL Safety Coordinator

SC Name: To be determined (TBD) Job Title: CH2M HILL Office: Telephone Number: Cellular Number:

The SC is responsible for verifying that the project is conducted in a safe manner including the following specific obligations:

- Verify this HSP is current and amended when project activities or conditions change;
- Verify CH2M HILL site personnel and subcontractor personnel read the HSP and sign the Employee Sign-Off Form, prior to commencing field activities;
- Verify CH2M HILL site personnel have completed any required specialty training (for example, fall protection, confined space entry [CSE], among others) and medical surveillance as identified in this HSP;
- 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, contractor's license, training and medical monitoring records, and accepted site-specific safety procedures prior to start of subcontractor's field operations;
- Act as the project "Hazard Communication Coordinator" and perform the responsibilities outlined in the HSP;
- Act as the project "Emergency Response Coordinator" (ERC) and perform the responsibilities outlined in the HSP;
- Post the 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;
- Hold and/or verify that safety meetings are conducted and documented in the project file initially and as needed throughout the course of the project (as tasks or hazards change);
- Verify that project H&S forms and permits are being used as outlined this HSP;
- Perform oversight and assessments of subcontractor HSE practices per the site-specific safety plan and verify that project activity self-assessment checklists are being used as outlined this HSP;
- Coordinate with the RHSM regarding CH2M HILL and subcontractor operational performance, and third-party interfaces;
- Verify appropriate PPE use, availability, and training;
- Ensure that the overall, job-specific, HSE goals are fully and continuously implemented;
- Conduct accident investigations including root cause analysis;
- Calibrate and conduct air monitoring in accordance with the HSP; maintain all air monitoring records in project file;
- Maintain HSE records and documentation;
- Facilitate OSHA or other government agency inspections including accompanying inspector and providing all necessary documentation and follow-up;
- Deliver field HSE training as needed based on project-specific hazards and activities;
- Contact the RHSM and PM in the event of an incident;

- When an apparent imminent danger exists, immediately remove all affected CH2M HILL employees and subcontractors, notify subcontractor safety representative, stop affected work until adequate corrective measures are implemented, and notify the PM and RHSM as appropriate; and
- Document all oral H&S-related communications in project field logbook, daily reports, or other records

4.3 CH2M HILL Subcontractors

(Reference CH2M HILL SOP HSE-215, *Contracts and Subcontracts)*

Subcontractor: Boundary Survey/DGM Mapping & Survey - TBD Subcontractor Contact Name: Telephone:
Subcontractor: Vegetation Clearance - TBD Subcontractor Contact Name: Telephone:
Subcontractor: Munitions - TBD Subcontractor Contact Name: Telephone:
Subcontractor: Removal of Burn Containment Equipment - TBD Subcontractor Contact Name: Telephone:

Subcontractors must comply with the following activities, and are responsible to:

- Comply with all local, state, and federal safety standards;
- Comply with project and owner safety requirements;
- Actively participate in the project safety program and either hold or attend and participate in all required safety meetings;
- Provide a qualified safety representative to interface with CH2M HILL;
- Maintain safety equipment and PPE for their employees;
- Maintain and replace safety protection systems damaged or removed by the subcontractor's operations;
- Notify the SC of any accident, injury, or incident immediately and submit reports to CH2M HILL within 24 hours;
- Install contractually required general conditions for safety (for example, handrail, fencing, fall protection systems, floor opening covers);
- Conduct and document weekly safety inspections of project-specific tasks and associated work areas;
- Conduct site-specific and job-specific training for all subcontractor employees, including review of the CH2M HILL HSP, subcontractor HSPs, and subcontractor AHAs and sign appropriate sign-off forms; and
- Determine and implement necessary controls and corrective actions to correct unsafe conditions.

The previously listed subcontractors listed may be required to submit their own site-specific HSP and other plans such as lead or asbestos abatement compliance plans. Subcontractors are responsible for the H&S procedures specific to their work, and are required to submit their plans to CH2M HILL for review and acceptance before the start of field work.

Subcontractors are also required to prepare AHAs before beginning each activity posing hazards to their personnel. The AHA will identify the principle steps of the activity, potential H&S hazards for each step and recommended control measures for each identified hazard. In addition, a listing of the equipment to be used to perform the activity, inspection requirements, and training requirements for the safe operation of the equipment listed must be identified.

4.4 Employee Responsibilities

All personnel are assigned responsibility for safe and healthy operations. This concept is the foundation for involving all employees in identifying hazards and providing solutions. For any operation, individuals have full authority to stop work and initiate immediate corrective action or control. In addition, each worker has a right and responsibility to report unsafe conditions or practices. This right represents a significant facet of worker empowerment and program ownership. Through shared values and a belief that all accidents are preventable, our employees accept personal responsibility for working safely.

Each employee is responsible for the following performance objectives:

- Perform work in a safe manner and produce quality results;
- Perform work in accordance with company policies, and report injuries, illnesses, and unsafe conditions;
- Complete work without injury, illness, or property damage;
- Report all incidents immediately to supervisor, and file proper forms with a HR representative;
- Report all hazardous conditions and/or hazardous activities immediately to supervisor for corrective action; and
- Complete an HSE orientation prior to being authorized to enter the project work areas.

4.4.1 Employee Authority

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

4.5 Client Contractors

(Reference CH2M HILL SOP HSE-215, *Contracts, Subcontracts and HSE Management Practices*)

Contractor:	None anticipated
Contact Name:	____________________
Telephone:	____________________
Contractor Task(s):	____________________
Contractor:	____________________
Contact Name:	____________________
Telephone:	____________________
Contractor Task(s):	____________________

This HSP does not cover contractors that are contracted directly to the client or the owner. CH2M HILL is not responsible for the H&S or means and methods of the contractor's work, and we must never assume such responsibility through our actions (such as advising on H&S issues). In addition to these instructions, CH2M HILL team members should review contractor safety plans so that we remain aware of appropriate precautions that apply to us. Self-assessment checklists are to be used by the SC and CH2M HILL team members to review the contractor's performance only as it pertains to evaluating CH2M HILL exposure and safety. The RHSM is the only person who is authorized to comment on or approve contractor safety procedures.

H&S-related communications with contractors should be conducted as follows:

- Request the contractor to brief CH2M HILL team members on the precautions related to the contractor's work;
- When an apparent contractor non-compliance or unsafe condition or practice poses a risk to CH2M HILL team members:
  - Notify the contractor safety representative;
  - Request that the contractor determine and implement corrective actions;
  - If necessary, stop affected CH2M HILL work until contractor corrects the condition or practice; and
  - Notify the client, PM, and RHSM as appropriate.

If apparent contractor non-compliance or unsafe conditions or practices are observed, inform the contractor safety representative (CH2M HILL's obligation is limited strictly to informing the contractor of the observation; the contractor is solely responsible for determining and implementing necessary controls and corrective actions).

If an apparent imminent danger is observed, immediately warn the contractor employee(s) in danger and notify the contractor safety representative (CH2M HILL's obligation is limited strictly to immediately warning the affected individual(s) and informing the contractor of the observation; the contractor is solely responsible for determining and implementing necessary controls and corrective actions).

All verbal H&S-related communications will be documented in project field logbook, daily reports, or other records.

5 Standards of Conduct

All individuals associated with this project must work injury-free and drug-free and must comply with the following standards of conduct, the HSP, and the safety requirements of CH2M HILL. Commonly accepted standards of conduct help maintain good relationships between people. They promote responsibility and self-development. Misunderstandings, frictions, and disciplinary action can be avoided by refraining from thoughtless or wrongful acts.

5.1 Standards of Conduct Violations

All individuals associated with this project are expected to behave in a professional manner. Violations of the standards of conduct would include, but not be limited to:

- 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 construction clothing or bringing the necessary tools; or
- Violation of any other commonly accepted reasonable rule of responsible personal conduct.

5.2 Disciplinary Actions

The Environmental Services Business Group (ESBG) employees, employees working on ESBG projects, and subcontractor employees are subject to disciplinary action for not following HSE rules and requirements. Potential disciplinary action is equally applicable to all employees including management and supervision. Disciplinary action may include denial of access to the worksite, warnings, reprimands, and other actions up to and including termination depending on the specific circumstances.

5.3 Subcontractor Safety Performance

CH2M HILL should continuously endeavor to observe subcontractors' safety performance and adherence to their plans 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. CH2M HILL oversight does not relieve subcontractors of their responsibility for effective implementation and compliance with the established plan(s).

5.3.1 Observed Hazard Form

When apparent non-compliance or unsafe conditions or practices are observed, notify the subcontractor's supervisor or safety representative verbally, and document using the Observed Hazard Form, included as an attachment to this HSP, and require corrective action.

If necessary, stop subcontractor's work using the Stop Work Order Form until corrective actions is implemented for observed serious hazards or conditions. Update the Observed Hazard Form to document corrective actions have been taken. The subcontractor is responsible for determining and implementing necessary controls and corrective actions.

5.3.2 Stop Work Order

CH2M HILL has the authority, as specified in the contract, and the responsibility to stop work in the event any CH2M HILL employee observes unsafe conditions or failure of the subcontractor to adhere to its safe-work practices. This authority and action does not in any way relieve the subcontractor of its responsibilities for the means and methods of the work or, therefore, of any corrective actions. Failure to comply with safe work practices can be the basis for restriction or removal of the subcontractor staff from the job site, termination of the subcontract, restriction from future work, or all three.

When an apparent imminent danger is observed, immediately stop work and alert all affected individuals. Remove all affected CH2M HILL employees and subcontractor staff from the danger, notify the subcontractor's supervisor or safety representative, and do not allow work to resume until adequate corrective measures are implemented. Notify the PM, Contract Administrator (KA) and RHSM.

When repeated non-compliance or unsafe conditions are observed, notify the subcontractor's supervisor or safety representative and stop affected work by completing and delivering the Stop Work Order Form (attached to this HSP) until adequate corrective measures are implemented. Consult the KA to determine what the contract dictates for actions to pursue in event of subcontractor non-compliance including work stoppage, back charges, progress payments, removal of subcontractor manager, monetary penalties, or termination of subcontractor for cause.

5.4 Incentive Program

Each project is encouraged to implement a safety incentive program that rewards workers for exhibiting exemplary safety behaviors. Actions that qualify are those that go above and beyond what is expected. Actions that will be rewarded include spotting and correcting a hazard, bringing a hazard to the attention of your foreman, telling your foreman about an incident, coming up with a safer way to get the work done, or stopping a crew member from doing something unsafe. The program will operate throughout the project, covering all workers. The incentive program will be communicated to all employees during the project employee orientation and project safety meetings.

5.5 Reporting Unsafe Conditions/Practices

Responsibility for effective H&S management extends to all levels of the project and requires good communication between employees, supervisors, and management. Accident prevention requires a pro-active policy on near misses, close calls, unsafe conditions, and unsafe practices. All personnel must report any situation, practice, or condition that might jeopardize the safety of our projects. All unsafe conditions or unsafe practices will be corrected immediately. CH2M HILL has zero tolerance of unsafe conditions or unsafe practices.

No employee or supervisor will be disciplined for reporting unsafe conditions or practices. Individuals involved in reporting the unsafe conditions or practices will remain anonymous.

The following reporting procedures will be followed by all project employees:

- Upon detection of any unsafe condition or practice, the responsible employee will attempt to safely correct the condition;
- The unsafe condition or practice will be brought to the attention of the worker's direct supervisor, unless the unsafe condition or practice involves the employee's direct supervisor. If so, the SC needs to be notified at once by the responsible employee;
- Either the responsible employee or responsible employee's direct supervisor is responsible for immediately reporting the unsafe condition or practice to the SC;
- The SC will act promptly to correct the unsafe condition or practice; and
- Details of the incident or situation will be recorded by the SC in the field logbook or use the Observed Hazard Form if subcontractor was involved.

6 Safety Planning and Change Management

6.1 Daily Safety Meetings and Pre-task Safety Plans

Daily safety meetings are to be held with all project personnel in attendance to review the hazards posed and required HSE procedures and AHAs that apply for each day's project activities. The Pre-task Safety Plans (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 as an attachment to this HSP, 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 HSE procedures, as identified in the HSP and AHA. The use of PTSPs promotes worker participation in the hazard recognition and control process while reinforcing the task-specific hazard and required HSE procedures with the crew each day.

6.2 Change Management

This HSP addresses all known activities and associated hazards. As work progresses, if significant changes are identified which could affect H&S at the site, coordinate with the RHSM to determine whether a HSP update is necessary.

The following are examples of changes that may require a revision to the plan:

- Change in CH2M HILL staff;
- New subcontractor to perform work;
- New chemicals brought to site for use;
- Change in scope or addition of new tasks;
- Change in contaminants of concern (COCs) or change in concentrations of COCs; and
- New hazards or hazards not previously identified that are not addressed in this HSP.

6.3 Agency Inspection Guidance

(Reference CH2M HILL SOP HSE-201, *Agency Inspections and Communications*)

Agency inspections (e.g., OSHA, United States Environmental Protection Agency [USEPA], and other regulatory agencies) are on the rise. CH2M HILL implements safety and environmental programs in order to ensure safety to workers, the public, and the environment. This plan addresses things like labeling containers, completing the hazard communication training using the attachments to this HSP, listing training requirements and PPE requirements, and addressing project-specific hazards. Field personnel need to contact the RHSM to update this plan if hazards are encountered that are not addressed.

SOP HSE-201 addresses agency inspections in detail, and the attached **Target Zero Bulletin on Agency Inspections** provides a good summary of the inspection process and what to do if an agency such as OSHA or USEPA shows up at the site. It is critical to make immediate notification to the RHSM if an inspector arrives (and EM if it is environmental-related); they can help facilitate and make additional notifications.

Review the Target Zero Bulletin and keep it with your HSP/Environmental Plan. Make it a topic at a safety meeting and keep it readily available in the event of an inspection.

PROJECT HSE Change Management Form			
Project Task:	**MEC cleanup, MC investigation**	Project/Task Manager (TM):	
Project Number:	**380785**	Project Name: **Indian Head Safety Thermal Treatment Point Investigation**	
	Evaluation Checklist	Yes	No
1.	Has the CH2M HILL staff listed in the original HSP changed?		
2.	Has a new subcontractor been added to the project?		
3.	Is any chemical or product to be used that is not listed in Attachment 2 of the plan?		
4.	Have additional tasks been added which were not originally addressed in the "Project Information" section of this HSP?		
5.	Have new contaminants or higher than anticipated levels of original contaminants been encountered?		
6.	Has other safety, equipment, activity or environmental hazards been encountered that are not addressed in this HSP?		

If the answer is "YES" to the questions above, HSP revision may be needed. For questions 2-6, contact RHSM prior to continuing work. In addition to contacting the RHSM, the following actions can be taken for questions 1-3:

- Confirm that staff's medical and training status is current – check training records at: http://www.int.ch2m.com/hands (or contact your regional safety program assistant [SPA]), and confirm subcontractor qualifications.
- Confirm with the project RHSM that subcontractor safety performance has been reviewed and is acceptable.
- Confirm with the RHSM that subcontractor safety procedures, plans, and/or AHAs have been reviewed and are acceptable.
- Add the new chemical or product information to the Chemical Inventory Form, inform the RHSM, and ensure that personnel handling the chemical or product have been trained, and that training is documented using the Chemical-Specific Training Form included as an attachment to this HSP. Add the Material Safety Data Sheet(s) (MSDS) for chemicals handled or used at the project to this HSP. AHAs may need to be developed or amended to account for new chemicals. The RHSM will review the AHAs prior to the chemical use.

7 Project Hazard Analysis

An H&S risk analysis (Table 1) has been performed for each task. In the order listed below, the RHSM considers the various methods for mitigating the hazards. Employees are trained on this hierarchy of controls during their hazardous waste training and reminded of them throughout the execution of projects:

- Elimination of the hazards (use remote sampling methodology to avoid going into a confined space);
- Substitution (reduce exposure to vapors by using of a geoprobe instead of test pitting);
- Engineering controls (ventilate a confined space to improve air quality);
- Warnings (establish exclusion zones [EZs] to keep untrained people away from hazardous waste work);
- Administrative controls (implement a work-rest schedule to reduce chance of heat stress); or
- Use of PPE (use of respirators when action levels [ALs] are exceeded).

The hazard controls and safe work practices are summarized in the following sections of this HSP:

- General hazards and controls;
- Project-specific hazards and controls;
- Physical hazards and controls;
- Biological hazards and controls; and
- COCs

7.1 Activity Hazard Analysis

An AHA defines the activity being performed, the hazards posed and control measures required to perform the work safely. Workers are briefed on the AHA before doing the work and their input is solicited prior, during, and after the performance of work to further identify the hazards posed and control measures required. The AHA will identify the work tasks required to perform each activity, along with potential HSE hazards and recommended control measures for each hazard. In addition, a listing of the equipment to be used to perform the activity, inspection requirements and training requirements for the safe operation of the equipment listed must be identified. The following hazard controls and applicable CH2M HILL core standards and SOPs should be used as a basis for preparing AHAs.

AHAs must be prepared for CH2M HILL activities and included as an attachment to this HSP.

7.2 Subcontractor Activity Hazard Analysis

CH2M HILL subcontractors are required to provide AHAs specific to their scope of work on the project for acceptance by CH2M HILL. Each subcontractor will submit AHAs for their field activities, as defined in their scope of work, along with their project-specific safety plan and/or procedures. Additions or changes in field activities, equipment, tools, or material used to perform work or hazards not addressed in existing AHAs requires either a new AHA to be prepared or an existing AHA to be revised.

TABLE 1
General Activity Hazard Analysis

Potential Hazard	Boundary survey with UXO tech	Removal of Burn Containment Equipment	Surface Removal of MEC/MPPEH	Vegetation Clearance	DGM Survey
Biological Hazards	X	X	X	X	X
Chainsaws				X	
Chemical Hazard	X	X	X	X	X
Drilling					
Demolition					
Drum Handling/Sampling					
Earthmoving/Heavy Equipment		X			
Field Vehicles	X	X	X	X	X
Fire Prevention	X	X	X	X	X
Forklifts		X			
Hand & Power Tools	X	X	X	X	X
Haul Truck Operation		X			
Knife Use				X	
Manual Lifting	X	X	X	X	X
MEC/MMPEH	X	X	X	X	X
Noise		X	X	X	
Pressurized Lines/Equipment		X	X		
Ultraviolet (UV) Light exposure (sunburn)	X	X	X	X	X
Utilities (underground/overhead)		X	X		
Working around Material Handling Equipment		X	X	X	
Working near water					

8 General Hazards and Controls

This section provides safe work practices and control measures used to reduce or eliminate potential hazards. It is a summarized list of requirements. Always consult the appropriate CH2M HILL SOP to ensure all requirements are implemented.

8.1 Bloodborne Pathogens

(Reference CH2M HILL SOP HSE-202, *Bloodborne Pathogens*)

Exposure to bloodborne pathogens may occur when rendering first aid (FA) or cardiopulmonary resuscitation (CPR), or when coming into contact with landfill waste or waste streams containing potentially infectious material (PIM).

Employees trained in first-aid/CPR or those exposed to PIM must complete CH2M HILL's 1-hour bloodborne pathogens computer-based training module annually. When performing first-aid/CPR the following will apply:

- 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;
- 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; and
- If necessary, decontaminate all potentially contaminated equipment and surfaces with chlorine bleach as soon as possible. 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.

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); and
- Administering post-exposure prophylaxis.

8.2 Chemical Storage

The following are general guidelines for storing chemicals and other hazardous materials:

- Keep acids away from bases;
- Keep oxidizers (nitric acid, nitrates, peroxides, chlorates) and organics away from inorganic reducing agents (metals);
- Keep flammables and corrosives in appropriate storage cabinets;
- Do not store paper or other combustibles near flammables;
- Use secondary containment and lipped shelving that is secured; and
- Have a fire suppression system available.

8.2.1 Storage of Flammable/Combustible Liquids

- Only approved containers and portable tanks will be used for storage and handling of flammable and combustible liquids.
- Approved safety cans will be used for the handling and use of flammable liquids in quantities of 5 gallons (19 liters) or less. Do not use plastic gas cans.

- For quantities of 1 gallon (3.78 liters) or less, the original container may be used for storage and use of flammable liquids.
- Flammable or combustible liquids will not be stored in areas used for stairways or normally used for the passage of people.

8.2.2 Indoor Storage of Flammable/Combustible Liquids

- No more than 25 gallons (95 liters) of flammable or combustible liquids will be stored in a room outside of an approved storage cabinet.
- Quantities of flammable and combustible liquids in excess of 25 gallons (95 liters) will be stored in an acceptable or approved cabinet.
- Cabinets will be conspicuously lettered: "FLAMMABLE: KEEP FIRE AWAY."
- Not more than 60 gallons (228 liters) of flammable or 120 gallons (456 liters) of combustible liquids will be stored in any one storage cabinet. Not more than three such cabinets may be located in a single storage area.

8.2.3 Outside Storage of Flammable/Combustible Liquids

- Storage of containers (not more than 60 gallons [228 liters] each) will not exceed 1,100 gallons (4,180 liters) in any one area. No area will be within 20 feet (6.1 meters) of any building.
- Storage areas will be graded to divert spills away from buildings and surrounded by an earthen dike.
- Storage areas may not be located near a storm drain. Overflow and spills must be diverted away from storm drains or surface waters.
- Storage areas will be free from weeds, debris, and other combustible materials.
- Outdoor portable tanks will be provided with emergency vent devices and will not be closer than 20 feet (6.1 meters) to any building.
- Signs indicating no smoking will be posted around the storage area.

8.2.4 Storage of Hazardous Waste

- All facilities storing ignitable and combustible liquids and hazardous wastes must be designed, constructed, maintained, and operated to minimize the possibility of a fire, explosion, or any release of hazardous constituents.
- Flammable wastes should be stored more than 50 feet from the property line.

8.2.5 Storage of Chemical Injection Chemicals/Materials

- When chemical injection remediation technologies are being used at a site, the following storage guidelines must be followed:
- Some injection chemicals, such as strong oxidizers, may have stringent storage requirements per local or National Fire Codes. Verify that appropriate storage provisions are in place prior to starting work.
- **NOTE**: Counties and cities may have requirements specific to storing these chemicals. Also, storage and use of certain chemicals such as potassium permanganate and hydrogen peroxide may be subject to the new Chemical Facility Anti-Terrorism Standards of the Department of Homeland Security – the applicability depends on the chemical, quantity/concentration, and type of facility. Please contact the project EM to determine whether chemicals are subject to these standards.
- Injection chemicals must be stored in a designated, secured area with spill prevention capabilities. Review MSDS or other information to determine potential incompatible materials. Incompatible materials will not be stored together. Ensure all containers are labeled.

8.3 Driving Safety

(Reference CH2M HILL HSE Policy 205, Distracted Driving – Wireless Devices, Vehicle Safety Core Standard)

All CH2M HILL employees are prohibited from using Wireless Devices while operating a Motor Vehicle when conducting company business regardless of the location or vehicle ownership and whether or not during regular working hours.

All CH2M HILL contractors and subcontractors are prohibited from using Wireless Devices while operating a CH2M HILL- or CH2M HILL-client-owned, leased, or rented Motor Vehicle, or while operating any other Motor Vehicle on the project site.

- Prohibited use includes the following:
- Dialing or speed dialing
- Using a hands-free or voice recognition (blue tooth) device to dial or speed dial
- Engaging in conversation or listening to a conversation using a Wireless Device
- Checking e-mails or surfing the internet using a Wireless Device
- Texting or e-mailing (reading, sending, or screening) with a Wireless Device
- Programming or entering coordinates into a global positioning system (GPS) device (following directions by a GPS is permitted)
- Using a Wireless Device for voice recording or dictation
- Employees, contractors, and subcontractors who need to use a wireless device must pull off the road to a safe location, with the vehicle securely stopped and emergency flashers on, or wait until they reach their destination.
- Avoid distractions from mobile phones, smartphones, voice recognition systems, personal digital assistant (PDAs), notebook, tablets (or similar devices), or laptops, by turning off or silencing the wireless devices before operating a motor vehicle.

Follow the following guidelines when operating a vehicle:

- Obey speed limits; be aware of blind spots or other hazards associated with low visibility. Practice defensive driving techniques, such as leaving plenty of room between your vehicle and the one ahead of you;
- Do no drive while drowsy. Drowsiness can occur at any time, but is most likely after 18 hours or more without sleep;
- Maintain focus on driving. Eating, drinking, smoking, adjusting controls can divert attention from the road. Take the time to park and perform these tasks when parked rather than while driving; and
- Ensure vehicle drivers are familiar with the safe operation of vehicles of the type and size to be operated. Large vehicles such as full size vans and pick-ups have different vision challenges and handling characteristics than smaller vehicles.

8.4 Electrical Safety

(Reference CH2M HILL SOP HSE-206, *Electrical Safety*)

Below are the hazard controls and safe work practices to follow when using electrical tools, extension cords, and/or other electrical-powered equipment or when exposed to electrical hazards. Ensure the requirements of the referenced SOP are followed:

- Only qualified personnel are permitted to work on unprotected energized electrical systems;
- Only authorized personnel are permitted to enter high-voltage areas;

- CH2M HILL employees who might from time to time work in an environment influenced by the presence of electrical energy must complete Awareness Level Electrical Safety Training located on the CH2M HILL Virtual Office (VO);
- Do not tamper with electrical wiring and equipment unless qualified to do so. All electrical wiring and equipment must be considered energized until lockout/tagout procedures are implemented;
- Inspect electrical equipment, power tools, and extension cords for damage prior to use. Do not use defective electrical equipment, remove from service;
- CH2M HILL has selected Ground Fault Circuit Interrupters (GFCIs) as the standard method for protecting employees from the hazards associated with electric shock;
  - GFCIs will be used on all 120-volt, single phase 15 and 20-amphere receptacle outlets which are not part of the permanent wiring of the building or structure.
- An assured equipment grounding conductor program may be required under the following scenarios:
  - GFCIs cannot be utilized;
  - Client requires such a program to be implemented; or
  - Business Group decides to implement program in addition to GFCI protection.
- Extension cords must be equipped with third-wire grounding. Cords passing through work areas must be covered, elevated or protected from damage. Cords should not be routed through doorways unless protected from pinching. Cords should not be fastened with staples, hung from nails, or suspended with wire;
- Electrical power tools and equipment must be effectively grounded or double-insulated and Underwriters Laboratory (UL) approved;
- Operate and maintain electric power tools and equipment according to manufacturers' instructions;
- Maintain safe clearance distances between overhead power lines and any electrical conducting material unless the power lines have been de-energized and grounded, or where insulating barriers have been installed to prevent physical contact. Maintain at least 10 feet (3 meters) from overhead power lines for voltages of 50 kilovolts (kV) or less, and 10 feet (3 meters) plus 0.4 inches (1.0 centimeter) for every 1 kV over 50 kV;
- Temporary lights will not be suspended by their electric cord unless designed for suspension. Lights will be protected from accidental contact or breakage; and
- Protect all electrical equipment, tools, switches, and outlets from environmental elements.

8.5 Field Vehicles

- Field vehicles may be personal vehicles, rental vehicles, fleet vehicles, or project vehicles.
- Maintain a FA kit, bloodborne pathogen kit, and fire extinguisher in the field vehicle at all times.
- Utilize a rotary beacon on vehicle if working adjacent to active roadway.
- Familiarize yourself with rental vehicle features prior to operating the vehicle:
  - Vision Fields and Blind Spots
  - Vehicle Size
  - Mirror adjustments
  - Seat adjustments
  - Cruise control features, if offered
  - Pre-program radio stations and GPS, if equipped

- Always wear seatbelt while operating vehicle.
- Adjust headrest to proper position.
- Tie down loose items if utilizing a van or pick-up truck.
- 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.
- Ensure back-up alarms are functioning, if equipped. Before backing a vehicle, take a walk around the vehicle to identify obstructions or hazards. Use a spotter when necessary to back into or out of an area.
- See the Vehicle Accident Guidance attached to this HSP, if a vehicle incident is experienced in a rental or fleet vehicle.

8.6 Fire Prevention

(Reference CH2M HILL SOP HSE-403, *Hazardous Material Handling*)

Follow the fire prevention and control procedures listed as follows.

8.6.1 Fire Extinguishers and General Fire Prevention Practices

- Fire extinguishers will be provided so that the travel distance from any work area to the nearest extinguisher is less than 100 feet (30.5 meters). When 5 gallons (19 liters) or more of a flammable or combustible liquid is being used, an extinguisher must be within 50 feet (15.2 meters). Extinguishers must:
  - be maintained in a fully charged and operable condition;
  - be visually inspected each month; and
  - 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 (3 meters) from any building.
- Solvent waste and oily rags must be kept in a fire resistant, covered container until removed from the site.
- Keep areas neat. Housekeeping is important.

8.6.2 Dispensing of Flammable/Combustible Liquids

- Areas in which flammable or combustible liquids are dispensed in quantities greater than 5 gallons (22.7 liters) (will be separated from other operations by at least 25 feet (7.6 meters).
- Drainage away from storm drains or surface waters or other means of containment will be provided to control spills.
- Adequate natural or mechanical ventilation will be provided to maintain the concentration of flammable vapor at or below 10 percent of the lower flammable limit.
- Dispensing of flammable liquids from one container to another will be done only when containers are electrically interconnected (bonded).
- Dispensing flammable or combustible liquids by means of air pressure on the container or portable tanks is prohibited.
- Dispensing devices and nozzles for flammable liquids will be of an approved type.

8.7 General Practices and Housekeeping

The following are general requirements applicable to all portions of the work:

- 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, or other devices to be used;
- Specific areas should be designated for the proper storage of materials;
- Tools, equipment, materials, and supplies will 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 will be removed at regular intervals;
- All spills will be quickly cleaned up; oil and grease will be cleaned from walking and working surfaces;
- Review the safety requirements of each job you are assigned to with your supervisor. 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 supervisor immediately;
- Report emergencies, occupational illnesses, injuries, vehicle accidents, and near misses immediately;
- 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 supervisor;
- 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; and
- Check the work area to determine what problems or hazards may exist.

8.8 Hazard Communication

(Reference CH2M HILL SOPs HSE-107, *Hazard Communication* and HSE-403, *Hazardous Material Handling*)

The hazard communication coordinator is to perform the following:

- Complete an inventory of chemicals brought on site by CH2M HILL using the chemical inventory form included as an attachment to this HSP;
- Confirm that an inventory of chemicals brought on site by CH2M HILL subcontractors is available;
- Request or confirm locations of MSDSs from the client, contractors, and subcontractors for chemicals to which CH2M HILL employees potentially are exposed;
- Before or as the chemicals arrive on site, obtain an MSDS for each hazardous chemical and include on the chemical inventory sheet (attached to this HSP) and add the MSDS to the MSDS attachment section of this HSP;
- Label chemical containers with the identity of the chemical and with hazard warnings, and store properly;
- Give employees required chemical-specific HAZCOM training using the chemical-specific training form included as an attachment to this HSP; and
- Store all materials properly, giving consideration to compatibility, quantity limits, secondary containment, fire prevention, and environmental conditions.

8.9 Knife Use

Open-bladed knives (for example, box cutters, utility knives, pocket knives, machetes, and multi-purpose tools with fixed blades such as a Leatherman) are prohibited at worksites except where the following three conditions are met:

- The open-bladed knife is determined to be the best tool for the job;
- An approved AHA or written procedure is in place that covers the necessary safety precautions (work practices, PPE, and training); and
- Knife users have been trained and follow the AHA.

8.10 Lighting

Lighting will be evaluated when conducting work inside buildings, confined spaces, or other areas/instances where supplemental light may be needed (e.g., work before sunrise or after sunset). A light meter can be used to evaluate the adequacy of lighting. The following are common requirements for lighting and the conditions/type of work being performed:

- While work is in progress outside construction areas will have at least 33 lux (lx);
- Construction work conducted inside buildings should be provided with at least 55 lx light;
- The means of egress will be illuminated with emergency and non-emergency lighting to provide a minimum 11 lx measured at the floor. Egress illumination will 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.

8.11 Manual Lifting

(Reference CH2M HILL SOP HSE-112, *Manual Lifting*)

Back injuries are the leading cause of disabling work and most back injuries are the result of improper lifting techniques or overexertion. Use the following to mitigate the hazards associated with lifting:

- When possible, the task should be modified to minimize manual lifting hazards;
- Lifting of loads weighing more than 40 pounds (18 kilograms) will be evaluated by the SC using the Lifting Evaluation Form contained in SOP HSE-112;
- Using mechanical lifting devices is the preferred means of lifting heavy objects such as forklifts; cranes, hoists, and rigging; hand trucks; and trolleys;
- Personnel will seek assistance when performing manual lifting tasks that appear beyond their physical capabilities;
- In general, the following steps must be practiced when planning and performing manual lifts: Assess the situation before you lift; ensure good lifting and body positioning practices; ensure good carrying and setting down practices; and
- All CH2M HILL workers must have training in proper manual lifting training either through the New Employee Orientation or through Manual Lifting module located on the VO.

8.12 Personal Hygiene

Good hygiene is essential for personal health and to reduce the potential of cross-contamination when working on a hazardous waste site. Implement the following:

- Keep hands away from nose, mouth, and eyes during work;
- Keep areas of broken skin (chapped, burned, etc.) covered; and
- Wash hands with soap and water prior to eating, smoking, or applying cosmetics.

8.13 Personal Security

Follow the guidelines below for personal security measures. The RHSM and Firm-Wide Security Office can be contacted if additional, specific measures are needed (e.g., such as evaluating the needs for security service).

General Safety and Security Guidelines

CH2M HILL Corporate Security Department recommends the following guidelines for workers in the United States (U.S.):

- Stay alert and be aware of your surroundings. Avoid pre-occupations with mobile devices, while in an unfamiliar area.
- Whenever possible use the buddy system with another employee or client or subcontractor employee.
- Trust your intuition; if a situation appears strange or wrong, it probably is.
- Be confident in your walk or stride; do not give the appearance you are new in town.
- Avoid carrying and displaying large sums of cash.
- If you sense or see dangerous situations along your route, change your route and depart the area quickly. If you feel that you are being followed, go to the nearest police station or safe location and file a complaint with the police. Provide a description of the person, their vehicle, license plate number and any other useful information.
- Only walk short distances that are safe and secure while visiting an unfamiliar city or location.

- Take host approved transportation for long distances.
- “Fight or Flight?” Leaving the possible or dangerous area is always better than staying to fight.
- Always report suspicious activity to the nearest local law enforcement agency.
- Locate emergency exits in your hotel or where you are staying to ensure you know where to go in case of a fire or a natural or man-made disaster.
- Secure your electronic devices when left in your room or take them with you if you are not able to secure them properly.
- If you feel your life is in danger, call 911. Be sure to speak clearly, concisely and give the dispatcher a good description of where you are physically located.

Operating or Riding in Vehicles

- When waiting for public transportation or a taxi, remain in a store or restaurant as long as possible before catching your ride and never wait by yourself in an isolated area.
- Approach your vehicle with keys firmly in your hand and ready to unlock the car.
- Quickly check your car before entering it to determine damage or presence of an intruder.
- Vulnerable times can be stopping to find your keys to enter your vehicle or stepping out of your vehicle in an isolated area. Be aware of your surroundings before you perform these activities.
- Always keep your doors locked during transit and when the vehicle is parked.
- Never leave your vehicle unlocked, even when to performing a quick task such as checking in a hotel, getting gas or going picking up food.
- If confronted by an individual inside a vehicle pointing a weapon at you, run the opposite way from where the vehicle is facing and scream as loud as you can. This evasive action will probably cause the individual to drive away.
- If an individual in a passing car points at your tires or engine to indicate a malfunction, only pull over in a well-lit and populated gas or rest stop. Never pull over in an isolated or dimly lit area. You may have a malfunction or the passing motorist may be attempting to rob you.
- Always park your vehicle is a well-lit and secure area. If your vehicle is parked in a dimly lit or isolated area in a parking garage; ask an attendant or friend to accompany you to your vehicle.
- Secure your valuables in the trunk, or place them out of sight or cover them with a blanket or coat if there is no secure storage area in the vehicle. The would-be-perpetrator likes to see what to steal and not knowing what you have concealed will normally prevent a break in.

Riding in a Taxi

- Have your host or a designated travel agent suggest or reserve a reputable taxi service for you during your stay.
- Only use a taxi service that was vetted for safety and reliability.
- If possible, place luggage, laptop and personal belongings inside the taxi.
- When you first enter the taxi, check the driver photo identification card, normally located on the driver’s visor with the driver to ensure they match.

Walking

- If you experience automotive trouble, remain inside the locked vehicle and call for assistance.

- If you can’t reach assistance via a mobile phone, only walk for help in a safe area facing the traffic.
- If while walking, you are shadowed or followed by a vehicle, run back in the direction of your vehicle and enter the vehicle if possible. File a police report on the incident as soon as practicable.
- Be aware of your surroundings and those around you while walking and do not be distracted by using electronic devices.
- Regularly change your route if you are walking to and from meetings or conferences and choose only well-lit areas to walk in at night.
- If walking long distances, identify a “safe house, shop, store or restaurant” to duck into if confronted by a perpetrator.

Jogging or Running

- Always jog or run in an area that is safe, secure, and used for exercising.
- Avoid running along busy roads or highways.
- If you chose to venture out on a jog or run, check the route by vehicle prior to beginning to exercise.
- Let the host or a friend know when you leave, when you plan to return, and the route you will take during exercising.
- Take a photo identification and mobile phone with you for emergencies.
- Avoid physically over-extending yourself since reflexes and decision-making ability can be impaired.

Clothing and Jewelry

- Dress to blend in with locals, maintain a low profile and avoid drawing attention to yourself.
- Travel with inexpensive clothing and jewelry.
- Avoid wearing CH2M HILL distinctive clothing or using CH2M HILL logos on luggage or laptops.

Emergency Numbers and Information

- Leave your itinerary and emergency contact numbers where you can be reached with family members and only those that have a need to know.
- Pre-program emergency numbers in the mobile device you are traveling with.
- Carry a list of current medications and specific doses in your purse or wallet.
- Record medical emergency information on a document that can be readily available if you are unable to speak or unconscious.
- Have a photo copy of your driver’s license, passport, and credit card information separately in case your wallet or purse is stolen.

8.14 Shipping and Transportation of Hazardous Materials

(Reference CH2M HILL SOP HSE-417, *Hazardous Materials Transportation*)

The U.S. Department of Transportation (DOT) has specific regulations governing shipping of hazardous materials (also called dangerous goods). Chemicals brought to the site might be defined as hazardous materials by the U.S. DOT. Hazardous wastes that may be shipped offsite are also defined as hazardous materials by U.S. DOT. Other wastes may also be U.S. DOT hazardous materials. To confirm whether a material or a waste is a U.S. DOT hazardous material, check with the ESBG Waste Coordinator (Lisa Schwan/ATL), the project EM, or the CH2M HILL Dangerous Goods Shipping Coordinators (John Blasco/BAO or Rob Strehlow/MKW).

All staff who affect shipment of hazardous materials, including receiving hazardous materials, preparing profiles or manifests, packaging hazardous wastes, labeling, or transporting hazardous materials by road, are called HazMat employees (note CH2M HILL cannot transport hazardous wastes by public road). HazMat employees must receive CH2M HILL online training in shipping dangerous goods. CH2M HILL's online Dangerous Goods Shipping course can be found on the CH2M HILL Health, Safety, Security, and the Environment (HSSE) website.

All hazardous materials that are shipped (e.g., via Federal Express) or are transported by road must be properly identified, labeled, packed, and documented by trained staff. If the material is a product that is being shipped (e.g., calibration gas), use the HazMat ShipRight tool on the CH2M HILL VO (under Company Resources – Online Shipping). Contact the Dangerous Goods Shipping coordinators, the ESBG Waste Coordinator or the project EM for additional information.

49 CFR 172 requires that all hazmat employees be aware of potential transportation security concerns. Hazardous materials security is addressed in CH2M HILL's Hazardous Materials SOP (HSE-403). The following points are provided as an overview of security measures to increase awareness of this important matter:

- It is essential that each employee understand the security risks involved with transporting hazardous materials;
- All transporters of hazardous materials must be prequalified by a Contracts Administrator who evaluate the carrier's safety rating, security measures, and employee screening procedures;
- When shipping hazardous materials, check driver credentials and ask about shipping details;
- When receiving a hazardous materials shipment, inspect packages for signs of tampering or damage to the contents. Verify the drivers and company information on the form with the driver; and
- If there is suspicious or unusual behavior (e.g., driver without credentials, evasive answers) or any discrepancies identified, do not offer or accept the shipment, and immediately notify the PM or the RHSM.

Employees responsible for shipping hazard materials must also review the CH2M HILL Transportation Security Plan (HSE-417 Appendix A).

8.15 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.

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; and
- Arrival at work under the influence of legal or illegal drugs or alcohol.

Drug and/or alcohol testing is applicable under CH2M HILL Constructors, Inc. and munitions response (MR) projects performed in the U.S. 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 VO.

9 Project-specific Hazard Controls

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 work or the particular hazard. Each person onsite is required to abide by the hazard controls. Consult the appropriate CH2M HILL SOP to ensure all requirements are implemented. CH2M HILL employees and subcontractors must remain aware of the hazards affecting them regardless of who is responsible for controlling the hazards. CH2M HILL employees and subcontractors who do not understand any of these provisions should contact the RHSM for clarification.

9.1 Arsenic

(Reference CH2M HILL, SOP HSE-501, *Arsenic*)

<u>Exposure levels are not anticipated to reach AL or above; this section is provided for informational purposed in the unlikely event that elevated levels are detected.</u> Arsenic is considered a "Confirmed Human Carcinogen." CH2M HILL is required to control employee exposure to arsenic when exposures are at or above 5.0 micrograms per cubic meter ($\mu g/m^3$), or if there is the possibility of skin or eye irritation from arsenic. The elements of the CH2M HILL arsenic program include the following:

- Exposure monitoring;
- Methods of control, including PPE and respirators;
- Medical surveillance;
- Training on hazards of arsenic and control measures (includes project-specific training and the computer-based training on CH2M HILL's VO, *Arsenic Exposure);* and
- Recordkeeping requirements.

If air monitoring indicates there is potential exposure at the AL concentrations, notify the RHSM to ensure the above have been adequately addressed. Full implantation of SOP HSE-501, Arsenic, will be required. Other exposure control measures include:

- Do not enter regulated work areas unless training, medical monitoring, and PPE requirements established by the competent person have been met;
- Do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in regulated areas;
- Avoid skin and eye contact with liquid and particulate arsenic or arsenic trichloride;
- Respiratory protection and other exposure controls selection will be based on the most recent exposure monitoring results obtained from the competent person; and
- Review the fact sheet included as an attachment to this HSP.

9.2 Cadmium

(Reference CH2M HILL SOP HSE-504, *Cadmium*)

<u>Exposure levels are not anticipated to reach AL or above; this section is provided for informational purposed in the unlikely event that elevated levels are detected.</u> Cadmium is considered a "Suspected Human Carcinogen." CH2M HILL is required to control employee workplace exposure to cadmium when personal exposure is at or above 2.5 $\mu g/m^3$ by implementing a program that meets the requirements of the OSHA Cadmium standard, 29 Code of Federal Regulations (CFR) 1926.1127. The elements of the CH2M HILL cadmium program include the following:

- Exposure monitoring;
- Methods of control, including PPE and respirators;
- Medical surveillance;
- Training on hazards of cadmium and control measures (includes project-specific training and the computer-based training on CH2M HILL's VO, *Cadmium);* and
- Recordkeeping requirements.

If air monitoring indicates there is potential exposure at the AL concentrations above, notify the RHSM to ensure the above have been adequately addressed. Other exposure control measures include:

- Do not enter regulated work areas unless training, medical monitoring, and PPE requirements established by the competent person have been met;
- Do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in regulated areas;
- Respiratory protection and other exposure controls selection will be based on the most recent exposure monitoring results obtained from the competent person; and
- Review the fact sheet included as an attachment to this HSP.

9.3 Chainsaws

(Reference CH2M HILL SOP HSE-210, *Hand and Power Tools*)

Below are the hazard controls and safe work practices to follow when working around or operating chainsaws. Ensure the requirements in the referenced SOP are followed.

9.3.1 Equipment

Only chainsaws equipped with a spark arrestor and fully functioning chain brake or "safety chain" will be used. The following safety equipment will be readily available while operating a chainsaw:

- Chainsaw operator's manual;
- Fully stocked FA kit;
- Multipurpose fire extinguisher;
- Grounded extension cord approved for outdoor use and GFCI for electrical-powered chainsaws;
- Approved safety gasoline container and funnel or flexible nozzle for refueling gasoline-powered chainsaws; and
- Sledge hammer and non-metallic wedges when necessary to prevent pinching of the chain.

9.3.2 Personal Protective Equipment Requirements

The following PPE will be worn while operating chainsaws:

- Safety glasses with side shields and face shield to prevent injury from wood chips, sawdust, or other flying objects;
- Hard hat with properly fitted suspension to prevent head injury from falling debris;
- Steel-toed safety shoes or boots to prevent foot injury from falling objects and accidental contact with the moving chain;
- Hearing protection to prevent permanent damage to hearing. Ear muffs or plugs will have a decibel noise reduction rating (NRR) assigned to them. The higher the rating, the greater the protection offered;
- Non-leather, fabric work gloves to prevent hand injury from abrasions, splinters and cuts;

- Clothing that is well-fitted and free of loose edges that could become entangled in the saw; and
- Protective chaps or leggings that cover the area from the groin to about 2 inches (5.08 centimeters) above the ankles should be used. These chaps are made from synthetic fabrics that are designed to prevent the running saw chain from coming in contact with your legs.

9.3.3 Safe Operation

The following safe operation guidelines will be followed regardless of the purpose for using a chainsaw:

- Inspect the chainsaw prior to use;
- Chainsaws will be held firmly with both hands, with thumbs and fingers encircling both chain saw handles;
- Stand slightly to the left side of the saw, out of the plane of the cutting chain and guide bar to reduce the risk of injury in the event of a kickback;
- Position saw so that it is between the waist and mid-chest level. Overreaching or cutting above the mid-chest height will be avoided;
- Maintain a full throttle setting while cutting. Chainsaws are designed to be run at full speed;
- Always be aware of what is in the saw's downward path after the cut;
- Do not attempt to cut material that is larger than the guide bar of the saw;
- Avoid cuts that will cause the chainsaw to jam. Always cut into the compression wood first until the cut starts to close; then cut from the other side toward the compression cut;
- Use a non-metallic wedge to prevent the compression cut jamming on the blade;
- Chainsaws are designed to feed themselves into the wood and require only light pressure to cut efficiently. If extra force is required to keep cutting, the chain requires sharpening. Additional signs of a dull chain include a saw that is cutting crooked, results in fine sawdust instead of chips, or the smell of burnt wood. Do not use a dull chain;
- Bystanders and helpers will be kept at a safe distance from operation;
- Do not operate a chainsaw when fatigued; take frequent breaks;
- Work slowly; don't rush; and
- A fire extinguisher will be present at all times when operating the chainsaw in forest or brushy areas.

9.3.4 Refueling the Engine

The fuel for gasoline-powered chainsaws will be mixed in accordance with the manufacturer's recommendations as outlined in the chainsaw operator's manual. Fuel will be stored and transported in an approved safety container. The following precautions should also be followed:

- The engine will be shut off and allowed to cool before refueling; never refuel a hot engine;
- A fire extinguisher will be present during fueling and refueling;
- Smoking around fueling or refueling operations will be prohibited; and
- A funnel or a flexible nozzle will be used to avoid spilling fuel on the engine.

9.4 Confined Space Entry Activities

(Reference CH2M HILL, SOP HSE-203, *Confined Space Entry*)

A confined space is defined as a space that has all of the following characteristics:

- Large enough to allow personnel to enter the space with their entire body;
- Limited openings for entry and exit; and

- Not designed for continuous human occupancy;

Examples of possible confined spaces include underground vaults, pipelines, ducts, tunnels, storage tanks, sewers, process vessels, and pits.

The following requirements apply when entering a permit-required confined space (PRCS), an Alternate Procedure Confined Space, or a PRCS reclassified as a non-permit confined space (NPCS). Ensure the requirements in the referenced SOP are followed.

- Entrants, Attendants, and the Entry Supervisor will have successfully completed CSE training.
- The appropriate CSE permit will be completed as outlined in CH2M HILL SOP HSE-203, *Confined Space Entry*.
- The completed permit or certificate will be posted for review near the space entrance point.
- The Entry Supervisor will conduct a pre-entry briefing with all Authorized Entrants and Attendants prior to entry in accordance with SOP HSE-203.
- Entrants and Attendants will verify that the Entry Supervisor has authorized entry and that all requirements of the permit or certificate have been satisfied prior to each entry.
- Atmospheric monitoring for oxygen, combustible gases, and potential toxic air contaminants will be conducted at the frequency provided on the permit or certificate. Entry will not be permitted if an atmospheric hazard is detected above acceptable safe levels. Atmospheric monitoring will be performed in accordance with the Site Monitoring Section of this HSP and SOP HSE-203.
- Entrants will evacuate the space upon orders of the Attendant or Entry Supervisor, when an alarm is sounded, or when a prohibited condition or dangerous situation is recognized.
- Entrants and Attendants will inform the Entry Supervisor of any hazards confronted or created in the space, or any problems encountered during entry. The Entry Supervisor will inform the owner of such issues.
- The Entry Supervisor will provide a copy of the canceled permit or certificate to the SC for review and maintain it in the project file.
- Complete the self-assessment checklist for CSE whenever entries are being performed.

9.5 Cranes

(Reference CH2M HILL SOP HSE-303, *Cranes*)

The following are the hazard controls and safe work practices to follow when working around or operating cranes. Ensure the requirements in the referenced SOP are followed.

- Crane operators are prohibited from using any wireless device while operating a crane. Equipment must be stopped before using devices such as two way radios or cell phones.
- Cranes will be operated by a certified crane operator. After November 10, 2014, only operators possessing a certificate from a nationally accredited testing organization, an audited employer training program, or U.S. military or state-issuing agency will be authorized to operate cranes.
- The crane’s operations manual and load chart specifically designed for the crane will be in the crane at all times.
- The crane must have a current annual inspection to include load test certification (within the last 12 months) that meets all state and federal safety standards. Documentation of this inspection must be available for review.
- A competent person will inspect the crane daily to ensure it is in safe operating condition. The daily crane inspection log provided within the crane manufacturer’s operations manual will be used. See also the requirements for monthly inspections, among others, in SOP HSE-303.

- All rigging equipment must be inspected by a competent person prior to use for signs of excessive wear; equipment found to be damaged will be tagged and removed from service.
- A qualified and competent Assembly/Disassembly (A/D) Director will be assigned when cranes must be assembled onsite. The A/D Director is responsible for ensuring the crane is assembled and disassembled according to manufacturer requirements; performing training for the A/D crew; and ensuring sufficient ground conditions exist for crane placement; among other responsibilities (see SOP HSE-303).
- The A/D process must comply with requirements in HSE-303, including having an AHA for the task.
- A critical lift plan will be prepared when the lift is estimated to be greater than 75 percent of the crane capacity or when two cranes will be used to make a lift.
- A pre-lift meeting will be conducted to include all parties involved in that day's crane operation.
- Only one qualified person will be designated to signal the crane operator. This person will be thoroughly familiar with the American National Standards Institute (ANSI) standard method of hand signals and an illustration of these signals will be posted at the job site.
- No personnel will be permitted under the load at any time.
- Tag lines will be attached to every load being made by the crane.
- The swing radius of the rear rotating superstructure (counterweight) of the crane will be barricaded and no entrance allowed.
- Suspended loads will not pass over workers or occupied buildings at any time.
- Complete the self-assessment checklist for crane-suspended personnel platforms whenever they are being used.
- CH2M HILL employees exposed to hazards posed by crane operations must be trained in hazards awareness and control procedures. See requirements for training in HSE-303.

Power Line Safety

It must be determined whether equipment operations including A/D, positioning, and crane operation (including traveling with a load) will occur in proximity to power lines within 20 feet (6.1 meters) for line voltage up to 350 kV, and within 50 feet (15.2 meters) for line voltage between 350 kV to 1,000 kV. For power lines over 1,000 kV, the distance must be determined by the utility/operator or qualified registered professional engineer in electrical power transmission and distribution.

If equipment operations are within proximity of aforementioned distances to power lines, one of the following options must be implemented to prevent encroachment and electrocution:

- **Option 1**: Deenergize and ground the power. Confirm from the utility/operator that the power line has been deenergized and visibly grounded at the worksite
- **Option 2**: If the voltage is not determined, ensure that no part of the equipment, load line, or load (including rigging and lifting accessories), gets closer than 20 feet (6.1 meters) by:
  - Conduct a planning meeting with the operator and other workers in the area to review the actions that will be taken to prevent encroachment and electrocution. Training requirements for working around energized power lines are described in Section 6.0, Training.
  - Use non-conductive tag lines.
  - Erect and maintain an elevated warning line, barricade or line of signs in view of the operator, either with flags or other high-visibility markings at 20 feet (1.6 meters) from the power line. A spotter must be used when the operator does not have clear line of sight to the elevated warning line.

– To prevent encroachment, the operator can use a proximity alarm, or position a dedicated spotter with visual aids to demarcate the encroachment and constant communication access to the operator.

If the line voltage can be determined, and if any part of the equipment, line load or load (including rigging and lifting accessories) would encroach within that specified distance listed in Table 1, then the requirements listed in Option 2 must be implemented.

TABLE 1
Minimum Clearance Distances

Voltage (nominal, kV, alternating current)	**Minimum Clearance – Feet (meters)**
Up to 50	10
Over 50 to 200	15
Over 200 to 350	20
Over 350 to 500	25
Over 500 to 750	35
Over 750 to 1,000	45
Over 1,000	Established by the utility owner/operator or by a qualified registered professional engineer in electrical power transmission and distribution

For equipment traveling within 20 feet (6.1 meters), under or near power lines without a load, the clearance distances described in Table 2 must be maintained and the following actions implemented.

- A dedicated spotter is assigned during equipment travel, positioned to effectively gauge the clearance distance, and is in continuous communication with the operator.
- During equipment travel, the boom/mast and support system are sufficiently lowered to ensure clearance distances are maintained, along with taking into consideration of the effects of speed and terrain.

TABLE 2
Minimum Clearance Distances While Traveling With No Load

Voltage (nominal, kV, alternating current)	**Minimum Clearance – Feet (meters)**
Up to 0.75	4
Over 0.75 to 50	6
Over 50 to 345	10
Over 345 to 750	16
Over 750 to 1,000	20
Over 1,000	Established by the utility owner/operator or by a qualified registered professional engineer in electrical power transmission and distribution

9.6 Demolition

(Reference CH2M HILL SOP HSE-305, *Demolition*)

This section is applicable to all forms of demolition. Demolition is defined as the removal or dismantling of structures or equipment by disassembly.

An engineering survey will be completed prior to start of demolition operations. The survey will determine the condition of the structure framing, floors, and walls; the presence of asbestos, polychlorinated biphenyls (PCBs), lead paint, or other regulated hazardous substances; the presence of hazardous materials in tanks, pipes, and equipment; and the possibility of unplanned collapse of any portion of the structure. Any adjacent structure where personnel may be exposed will also be similarly evaluated. The survey will be conducted by a competent person and a written record of the survey findings will be maintained at the project site.

The demolition contractor working on this project will provide CH2M HILL with a demolition safety plan prior to the start of work. CH2M HILL will use this plan to verify that the subcontractor is implementing the necessary safety precautions during this activity. In addition, the following safety precautions will be implemented by CH2M HILL personnel. The following are the hazard controls and safe work practices to follow when working around or performing demolition. Ensure the requirements in the referenced SOP are followed.

- Appropriate warning and instructional safety signs will be conspicuously posted where necessary.
- Fugitive dust must be controlled during demolition by using water spray or other methods.
- Remain a safe distance from the demolition zone to reduce exposure to fragmentation of glass, steel, masonry, and other debris during demolition operations.
- Do not enter the demolition zone unless completely necessary, and only after the competent person has assessed the condition of the structure and has authorized entry.
- Follow all requirements established by the competent person. The competent person will inform personnel of the areas that are safe to enter and the areas where entry is prohibited. When possible, the competent person should escort CH2M HILL personnel while in the demolition zone.
- All demolition activities that may affect the integrity of the structure or safety of personnel must cease until personnel have exited the demolition zone.
- During the course of demolition, work areas, passageways, stairs, ladders, and exits will be kept free of demolition debris.
- Stay as clear as possible of all hoisting operations. Loads will not be hoisted overhead of personnel
- Proper control measures will be in place before welding or cutting on surfaces covered by coatings containing flammable or hazardous materials such as lead, cadmium, zinc, etc. Highly flammable or toxic coatings may require stripping of the coating a sufficient distance from the area to be heated. Welding and cutting will be performed in accordance with the provisions of OSHA 1926, Subpart J, “Welding and Cutting.” Follow “Welding and Cutting” SOP HSE-314.

9.7 Drilling Safety

(Reference CH2M HILL SOP HSE-204, *Drilling*)

The following are the hazard controls and safe work practices to follow when working around or performing drilling. Ensure the requirements in the referenced SOP are followed.

- 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 10 feet (3 meters) between mast and overhead lines (<50 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 (cable tool, air rotary, hollow-stem auger, etc.).
- Do not wear loose-fitting clothing, watches, etc., 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.
- Use the drilling self-assessment checklist attached to this HSP to evaluate drilling operations.

9.8 Drum Handling

The following are the hazard controls and safe work practices to follow when overseeing the movement of drums or when handling drums.

- Ensure that personnel are trained in proper lifting and moving techniques to prevent back injuries.
- Ensure drum bungs/lids are secured and drums are labeled prior to moving.
- 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 appropriately designed Plexiglas cab shields on loaders, backhoes, etc., 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.
- Before moving anything, determine the most appropriate sequence in which the various drums and other containers should be moved (e.g. 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.

9.9 Drum Sampling Safety

Personnel are permitted to handle and/or sample drums containing certain types of waste (drilling waste, investigation-derived waste, waste from known sources) only. Handling or sampling drums with unknown contents requires a plan revision or amendment approved by the RHSM. The following control measures will be taken when sampling drums:

- Minimize transportation of drums.
- Sample only labeled drums or drums from a known waste stream.
- Do not sample bulging or swollen drums. Contact the RHSM.
- If drums contain, or potentially contain, flammable materials, use non-sparking tools to open.
- Use the proper tools to open and seal drums.
- Reseal bung holes or plugs whenever possible.
- Avoid mixing incompatible drum contents.
- Sample drums without leaning over the drum opening.
- Transfer/sample the content of drums using a method that minimizes contact with material.
- Use the PPE and perform air monitoring as specified in the PPE and Site Monitoring sections of this HSP.
- Have a spill kit accessible during sampling activities.
- If transferring/sampling drums containing flammable or combustible liquids, drums and liquid transfer equipment should be grounded and bonded to reduce the potential of a static discharge.

9.10 Earthmoving Equipment

(Reference CH2M HILL, SOP HSE-306, *Earthmoving Equipment*)

The following are the hazard controls and safe work practices to follow when working around or operating heavy equipment. Ensure the requirements in the referenced SOP are followed.

- CH2M HILL authorizes only those employees qualified by training or previous experience to operate material handling equipment.
- CH2M HILL employees must be evaluated prior to operating earthmoving equipment (EME) by a CH2M HILL EME operator evaluation designated person. This evaluation will be documented according to SOP HSE-306, Earthmoving Equipment.
- Equipment must be checked at the beginning of each shift to ensure the equipment is in safe operating condition and free of apparent damage. The check should include: service brakes, parking brakes, emergency brakes, tires, horn, back-up alarm, steering mechanism, coupling devices, seat belts and operating controls. All defects will be corrected before the equipment is placed in service. Documentation of this inspection must be maintained onsite at all times (use the EME Inspection form if operated by CH2M HILL).
- Equipment must be on a stable foundation such as solid ground or cribbing; outriggers are to be fully extended.
- Equipment must not be used to lift personnel; loads must not be lifted over the heads of personnel.
- Equipment, or parts thereof, which are suspended must be substantially blocked or cribbed to prevent shifting before personnel are permitted to work under or between them. All controls will be in a neutral position, with the motors stopped and brakes set.

- Equipment which is operating in reverse must have a reverse signal alarm distinguishable from the surrounding noise or a signal person when the operators view is obstructed.
- When equipment is used near energized powerlines, the closest part of the equipment must be at least 10 feet (3 meters) from the powerlines less than 50 kV. Provide an additional 4 feet (1.2 meters) for every 10 kV over 50 kV. A person must be designated to observe clearances and give timely warning for all operations where it is difficult for the operator to maintain the desired clearance by visual means. All overhead powerlines must be considered to be an energized until the electrical utility authorities indicate that it is not an energized line and it has been visibly grounded.
- Underground utility lines must be located before excavation begins; refer to the Utilities (underground) section.
- Operators loading and unloading from vehicles are responsible for seeing that vehicle drivers are in the vehicle cab or in a safe area.
- The parking brake will be set whenever equipment is parked; wheels must be chocked when parked on inclines.
- When not in operation, the blade or bucket must be blocked or grounded; the master clutch must be disengaged when the operator leaves the cab. When equipment is unattended, power must be shut off, brakes set, blades or buckets landed and shift lever in neutral.

9.11 Excavation Activities

(Reference CH2M HILL SOP HSE-307, *Excavation and Trenching Safety*)

The requirements in this section will be followed whenever excavation is being performed. Refer to the Earthmoving Equipment section and SOP for additional requirements applicable to operating/oversight of EME. The following are the hazard controls and safe work practices to follow when working around or performing excavation. Ensure the requirements in the referenced SOP are followed.

- If the project site is suspected of MEC contamination, requirements of the *Explosives Usage and Munitions Response* SOP HSE-610 will be followed. MECs include UXO, discarded military munitions, materials that present a potential explosive hazard, chemical warfare materials, MC, and contaminated soil or groundwater. "Down-hole" avoidance support may be required to prevent accidental contact with UXO. Safety requirements will be based on the risk assessment identified within the MR (safety) Opportunity Risk Evaluation (ORE).
- Do not enter the excavations unless completely necessary, and only after the excavation competent person has completed their daily inspection and has authorized entry. An inspection will be conducted by the competent person prior to the start of work, as needed throughout the shift, after every rainstorm, and after any hazard increasing occurrence. Documentation of the inspection must be maintained onsite at all times.
- Follow all excavation entry requirements established by the excavation competent person and any excavation permit being used.
- Sloping, benching, shoring, shielding, or other protective systems are required to protect personnel from cave-ins except when the excavation is made entirely in stable rock or is less than 5 feet deep (1.5 meters) and there is no indication of possible cave-in, as determined by the excavation competent person. Protective systems for excavations deeper than 20 feet (6.1 meters) must be designed or approved by a registered professional engineer.
- Trenches greater than 4 feet (1.2 meters) deep will be provided with a ladder, stairway, or ramp positioned so that the maximum lateral travel distance is no more than 25 feet (7.6 meters).
- The atmosphere of excavations greater than 4 feet (1.2 meters) deep will be tested prior to entry when a hazardous atmosphere exists or could reasonably be expected to exist, such as excavating landfills,

hazardous waste dumps; or areas containing sewer or gas utility systems, petroleum distillates, or areas where hazardous substances are stored nearby.

- Spoil piles, material, and equipment must be kept at least 2 feet (61 centimeters) from the edge of the excavation, or a retaining device must be used to prevent the material from falling into the excavation.
- Excavations will not be entered when:
  - Protective systems are damaged or unstable;
  - Objects or structures above the work location may become unstable and fall into the excavation;
  - The potential for a hazardous atmosphere exists, unless the air has been tested and found to be at safe levels; or
  - Accumulated water exists in the excavation, unless precautions have been taken to prevent excavation cave-in.
- The excavation self-assessment checklist will be used to evaluate excavations prior to entry.

9.12 Forklift Operations

(Reference CH2M HILL, SOP HSE-309, *Forklifts*)

The following are the hazard controls and safe work practices to follow when working around or operating forklifts. Ensure the requirements in the referenced SOP are followed.

- A rated lifting capacity must be posted in a location readily visible to the operator.
- A forklift truck must not be used to elevate employees unless a platform with guardrails, a back guard, and a kill switch is provided on the vehicle. When guardrails are not possible, fall arrest protection is required.
- The subcontractor operating the forklift must post and enforce a set of operating rules for forklift trucks.
- Only certified forklift operators will operate forklifts.
- Stunt driving and horseplay are prohibited.
- Employees must not ride on the forks.
- Employees must never be permitted under the forks (unless forks are blocked).
- The driver must inspect the forklift once a shift and document this inspection.
- The operator must look in the direction of travel and must not move the vehicle until all persons are clear of the vehicle.
- Forks must be carried as low as possible.
- The operator must lower the forks, shut off the engine, and set the brakes (or block the wheels) before leaving the forklift operator’s position unless maintenance or safety inspections require the forklift to be running.
- Trucks must be blocked and have brakes set when forklifts are driven onto their beds.
- Extreme care must be taken when tilting elevated loads.
- Every forklift must have operable brakes capable of safely stopping it when fully loaded.
- Forklifts must have parking brakes and an operable horn.
- When the operator is exposed to possible falling objects, industrial trucks must be equipped with overhead protection (canopy).

- If using certified CH2M HILL forklift operators—forklifts must be inspected and documented daily using the forklift inspection form.

9.13 Groundwater Sampling/Water Level Measurements

Below are the hazard controls and safe work practices to follow when personnel or subcontractors are performing groundwater sampling and/or water level measurements.

- Full coolers are heavy. Plan in advance to have two people available at the end of the sampling effort to load full coolers into vehicles. If two people won't be available use several smaller coolers instead of fewer large ones.
- Wear the appropriate PPE when sampling, including safety glasses, nitrile gloves, and steel toe boots (see PPE section of this HSP).
- Monitor headspace of wells prior to sampling to minimize any vapor inhalation (refer to the "Site Monitoring" section of this HSP).
- Use caution when opening well lids. Wells may contain poisonous spiders and hornet or wasp nests.
- Use the appropriate lifting procedures (see CH2M HILL SOP HSE-112) when unloading equipment and sampling at each well.
- Avoid sharp edges on well casings.
- If dermal contact occurs with groundwater or the acid used in sample preservation, immediately wash all affected skin thoroughly with soap and water.
- Avoid eating and drinking on site and during sampling.
- Use ear plugs during sampling if sampling involves a generator.
- Containerize all purge water and transport to the appropriate storage area.
- Use two people to transport full coolers/containers whenever possible. If two people are not available use a dolly to move coolers. If the coolers weigh more than 40 pounds Attachment 1 of the HSE-112, *Manual Lifting,* will be completed by the SC. If the coolers weigh more than 50 pounds they should never be lifted by one person.

9.14 Hand and Power Tools

(Reference CH2M HILL, SOP HSE-210, *Hand and Power Tools*)

The following are the hazard controls and safe work practices to follow when personnel or subcontractors are using hand and power tools. Ensure the requirements in the referenced SOP are followed.

- Tools will be inspected prior to use and damaged tools will be tagged and removed from service.
- Hand tools will be used for their intended use and operated in accordance with manufacturer's instructions and design limitations;
- Maintain all hand and power tools in a safe condition.
- Use PPE (such as gloves, safety glasses, earplugs, and face shields) when exposed to a hazard from a tool.
- Do not carry or lower a power tool by its cord or hose.
- Portable power tools will be plugged into GFCI protected outlets; and
- Portable power tools will be UL listed and have a three-wire grounded plug or be double insulated.
- Disconnect tools from energy sources when they are not in use, before servicing and cleaning them, and when changing accessories (such as blades, bits, and cutters).

- Safety guards on tools must remain installed while the tool is in use and must be promptly replaced after repair or maintenance has been performed.
- Store tools properly in a place where they will not be damaged or come in contact with hazardous materials.
- If a cordless tool is connected to its recharge unit, both pieces of equipment must conform strictly with electrical standards and manufacturer's specifications.
- Tools used in an explosive environment must be rated for work in that environment (that is, intrinsically safe, spark-proof, etc.).
- Working with manual and pistol-grip hand tools may involve highly repetitive movement, extended elevation, constrained postures, and/or awkward positioning of body members (for example, hand, wrist, arm, shoulder, neck, etc.). Consider alternative tool designs, improved posture, the selection of appropriate materials, changing work organization, and sequencing to prevent muscular, skeletal, repetitive motion, and cumulative trauma stressors.

Machine Guarding

- Ensure that all machine guards are in place to prevent contact with drive lines, belts, chains, pinch points or any other sources of mechanical injury.
- Unplugging jammed equipment will only be performed when equipment has been shut down, all sources of energy have been isolated and equipment has been locked/tagged and tested.
- Maintenance and repair of equipment that results in the removal of guards or would otherwise put anyone at risk requires lockout of that equipment prior to work.

9.15 Haul Trucks

Below are the hazard controls and safe work practices to follow when working around or operating haul trucks.

- Haul truck operators should be familiar with their equipment and inspect all equipment before use.
- Haul truck operators should ensure all persons are clear before operating truck or equipment. Before moving operators should sound horn or alarm, all equipment should be equipped with a working back up alarm.
- Haulage trucks or equipment with restricted visibility should be equipped with devices that eliminate blind spots.
- Employees should stay off haul roads. When approaching a haul area, employees should make eye contact and communicate their intentions directly with the equipment operator.
- If possible minimize steep grades on haul roads.
- Where grades are steep provide signage indicating the actual grade as well as measures for a runaway truck.
- Trucks are to be operated within the manufacturer's recommendations (for example- retarder charts indicate the combination of loads, grades and speeds that should not be exceeded if the truck's retarder is to work properly – to ensure the truck does not descend grade at speeds greater than listed).
- Haul roads should be well lit, sufficiently wide (at least 50 percent of the width of the equipment on both sides of road) and equipped with reflectors to indicate access points.
- Haul roads should have adequate right-of-way signs indicating haul directions.

9.16 Hexavalent Chromium Exposure

(Reference the CH2M HILL SOP HSE-513, *Hexavalent Chromium - Chromium VI*)

Exposure levels are not anticipated to reach AL or above; this section is provided for informational purposed in the unlikely event that elevated levels are detected. The OSHA permissible exposure limit (PEL) and American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) for Hexavalent Chromium VI is 5 $\mu g/m^3$ (insoluble) and 1 $\mu g/m^3$ (soluble) with an AL of 2.5 $\mu g/m^3$for insoluble and 0.5 $\mu g/m^3$ for soluble. Hexavalent Chromium is considered a Human Carcinogen.

The precautions listed as follows will be followed when exposed to Hexavalent Chromium:

- Exposure assessments must be performed for workers who may be exposed to Hexavalent Chromium above the AL.
- Avoid exposure by inhalation, skin and eye contact with fume, liquid and/or particulate Hexavalent Chromium.
- Respiratory protection and other exposure controls selection will be based on the most recent exposure monitoring results obtained from the competent person.
- Do not enter regulated work areas unless training, medical monitoring, and PPE requirements established by the competent person have been met.
- Do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in regulated areas.
- Review the fact sheet included as an attachment to this HSP.

9.17 Knife Use

Open-bladed knives (for example, box cutters, utility knives, pocket knives, machetes, and multi-purpose tools with fixed blades such as a Leatherman) are prohibited at worksites except where the following three conditions are met:

- The open-bladed knife is determined to be the best tool for the job;
- An approved AHA or written procedure is in place that covers the necessary safety precautions (work practices, PPE, and training); and
- Knife users have been trained and follow the AHA.

9.18 Lead

(Reference CH2M HILL SOP HSE-508, *Lead*)

Exposure levels are not anticipated to reach AL or above; this section is provided for informational purposed in the unlikely event that elevated levels are detected. CH2M HILL is required to control employee exposure to lead when exposures are at or above 30 $\mu g/m^3$ by implementing a program that meets the requirements of the OSHA Lead standard, 29 CFR 1910.1025 and 29 CFR 1926.62. The elements of the CH2M HILL lead program include the following:

- Exposure monitoring;
- Methods of control, including PPE and respirators;
- Medical surveillance;
- Training on hazards of lead and control measures (includes project-specific training and the computer-based training on CH2M HILL's VO, *Lead Exposure Training);* and
- Record keeping requirements.

If air monitoring indicates there is potential exposure at the AL concentrations above, notify the RHSM to ensure the above have been adequately addressed. Other exposure control measures include:

- Do not enter regulated work areas unless training, medical monitoring, and PPE requirements established by the competent person have been met;
- Do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in regulated areas;
- Respiratory protection and other exposure controls selection will be based on the most recent exposure monitoring results obtained from the competent person; and
- Review the fact sheet included as an attachment to this HSP.

9.19 Manual Lifting

(Reference CH2M HILL SOP HSE-112, *Manual Lifting*)

Back injuries are the leading cause of disabling work and most back injuries are the result of improper lifting techniques or overexertion. Use the following to mitigate the hazards associated with lifting:

- When possible, the task should be modified to minimize manual lifting hazards;
- Lifting of loads weighing more than 40 pounds (18 kilograms) will be evaluated by the SC using the Lifting Evaluation Form contained in SOP HSE-112;
- Using mechanical lifting devices is the preferred means of lifting heavy objects such as forklifts; cranes, hoists, and rigging; hand trucks; and trolleys;
- Personnel will seek assistance when performing manual lifting tasks that appear beyond their physical capabilities;
- In general, the following steps must be practiced when planning and performing manual lifts: Assess the situation before you lift; ensure good lifting and body positioning practices; ensure good carrying and setting down practices; and
- All CH2M HILL workers must have training in proper manual lifting training either through the New Employee Orientation or through Manual Lifting module located on the VO.

9.20 Munitions and Explosives of Concern and/or Material Potentially Presenting an Explosive Hazard

9.20.1 Hazard Identification

The nature of activities on this project will result in the potential of encountering MEC and MPPEH items that have been fired, disposed, or abandoned, but may still represent a hazard. Non-UXO trained personnel will avoid all contact with MEC/MPPEH. .

9.20.2 Hazard Mitigation/Prevention

All field personnel will be given munitions recognition training prior to working on the site. The training will be verified by signature on the site training form. Personnel will be instructed to be alert for MEC/MPPEH. The following general precautions concerning suspect MEC will be observed at all times:

- Suspect MEC item(s) WILL NOT be touched or moved regardless of the markings or apparent condition. Only UXO trained personnel are allowed to handle MEC/MPPEH.
- Radios or cellular phones WILL NOT be used in the vicinity of suspect MEC items.
- Areas where the ground cannot be seen WILL NOT be traveled across without escort.
- Vehicles WILL NOT be driven into suspected MEC areas; clearly marked lanes will be used.

- Matches, cigarettes, lighters, or other flame-producing devices WILL NOT be carried on to a munitions response site (MRS).
- Color codes WILL NOT be relied upon for positive identification of MEC items or their contents.
- Suspect MEC items will be approached from the side whenever possible; approaching the front or rear areas will be avoided.
- Personnel will always assume that a MEC item contains a live charge until it can be determined otherwise.
- EME Operations within an EZ will be performed under the supervision of a UXO technician III
- EME will not be used to excavate soils within 12 inches of an anomaly.
- Anomaly investigation personnel are not permitted to enter an excavation greater than 4 feet in depth. If an investigation needs to be performed in an excavation deeper than 4 feet, operations at that work area will be halted and the Site Safety and Health Officer (SSHO) will be notified. If further investigation is warranted, the SSHO will notify the Health and Safety Manager (HSM) to determine the appropriate safety measures (e.g. sloping, shoring, etc.) to be implemented. The implementation of excavation safety provisions will require an amendment to this Accident Prevention Plan (APP)/HSP.
- When anomaly investigation personnel must be in the area of EME:
  - Sufficient separation between ground support personnel and operating EME must be maintained.
  - Wear reflective vests or high visibility clothing to promote visibility of ground personnel by equipment operators.
  - Isolate equipment swing areas from workers, fixed objects or other equipment. Ground personnel will avoid positioning themselves between fixed object and operating equipment.
  - Make/maintain eye contact with operators before approaching equipment. Do not approach equipment from rear or from blind spot of operator. Stay out of the swing radius of operating heavy equipment.
  - Suspended loads will not be passed over ground personnel and ground personnel will not walk under or in front of suspended loads.

The following actions will be taken if munitions are found:

- Personnel who are not UXO-qualified will note the area of concern, and leave the immediate vicinity. They WILL NOT touch, move, or otherwise disturb the item.
- Personnel should not be misled by markings on the munitions item stating or indicating that the item is a practice bomb or inert. Even practice bombs may have explosive charges that are used to mark/spot the point of impact, or the item could be incorrectly marked.
- Immediately upon locating any suspect MEC, the Senior Unexploded Ordnance Supervisor (SUXOS) and Unexploded Ordnance Safety Officer (UXOSO) will be notified. In turn, the SUXOS will notify the PM who will then provide required notifications to the client.
- Operations in the immediate area of the suspect MEC will be halted and the appropriate procedures (as described below) will be implemented.

Removal and disposal of MEC is part of this scope of work and will be undertaken by a MEC support contractor under the oversight of CH2M HILL UXO qualified personnel. MEC will be consolidated, demilitarized, and disposed of in accordance with procedures outline in the approved Work Plan and ESS.

When MEC is detected and identified as potentially loaded with explosives, chemicals, propellant or pyrotechnics, or when a buried object is exposed and cannot be identified as non-MEC, the MEC support contractor will coordinate with the CH2M HILL SUXOS for assistance. The location of the object will be marked with a yellow survey marker flag and all investigation activities at that location will cease. The MEC support contractor will maintain site access control and ensure personnel safety until Navy Explosive Ordnance Disposal (EOD) Personnel arrive and take control of the site. The contractor must supply the GPS coordinates for each item upon arrival of the Emergency Response Team. The GPS positions must also be noted in the final report. The contractor will allow the Government EOD personnel sufficient time to complete field evaluation, render safe, recover and dispose of MEC, per incident, when MEC that cannot be identified is detected.

9.20.3 MEC Avoidance Activities

MEC avoidance is required for several of the activities required by this scope of work. MEC avoidance activities may include visual observation of the ground surface by a UXO technician prior to and during non-intrusive tasks. When the ground is obstructed and as required, a UXO technician may augment the visual inspection with a handheld magnetometer (Schonstedt Ga-52Cx, White XLT, or equivalent). The SOP for MEC Avoidance will be followed.

9.21 Pressure Washing Operations

The following are the hazard controls and safe work practices to follow when working around or performing pressure washing.

- Only trained, authorized personnel may operate the high-pressure washer.
- Follow manufacturer's safety and operating instructions.
- Inspect pressure washer before use and confirm deadman trigger is fully operational
- The wand must always be pointed at the work area.
- The trigger should never be tied down
- Never point the wand at yourself or another worker.
- The wand must be at least 42 inches (1.1 meter) from the trigger to the tip and utilize greater than 10 degree tips.
- The operator must maintain good footing.
- Non-operators must remain a safe distance from the operator.
- No unauthorized attachment may be made to the unit.
- Do not modify the wand.
- All leaks or malfunctioning equipment must be repaired immediately or the unit taken out-of-service.
- Polycoated Tyvek or equivalent, 16-inch-high steel-toed rubber boots, safety glasses, hard hat with face shield, and inner and outer nitrile gloves will be worn, at a minimum.

9.22 Utilities (underground)

An assessment for underground utilities must be conducted where there is a potential to contact underground utilities or similar subsurface obstructions during intrusive activities. Intrusive activities include excavation, trenching, drilling, hand augering, soil sampling, or similar activities.

The assessment must be conducted <u>before any intrusive subsurface activity</u> and must include at least the following elements:

1. A background and records assessment of known utilities or other subsurface obstructions.
2. Contacting and using the designated local utility locating service.

3. Conducting an independent field survey to identify, locate, and mark potential underground utilities or subsurface obstructions. *Note: This is independent of, and in addition to, any utility survey conducted by the designated local utility locating service above.*
4. A visual survey of the area to validate the chosen location.

When any of these steps identifies an underground utility within 5 feet (1.5 meters) of intrusive work, then non-aggressive means must be used to physically locate the utility before a drill rig, backhoe, excavator or other aggressive method is used.

Aggressive methods are never allowed within 2 feet of an identified high risk utility (see the following paragraph).

Any deviation from these requirements must be approved by the RHSM and the PM.

Background and Records Assessment of Known Utilities

Identify any client- or location-specific permit and/or procedural requirements (e.g., dig permit or intrusive work permit) for subsurface activities. For military installations, contact the Base Civil Engineer and obtain the appropriate form to begin the clearance process.

Obtain available utility diagrams and/or as-built drawings for the facility.

Review locations of possible subsurface utilities including sanitary and storm sewers, electrical lines, water supply lines, natural gas lines, fuel tanks and lines, communication lines, lighting protection systems, etc. Note: Use caution in relying on as-built drawings as they are rarely 100 percent accurate.

Request that a facility contact with knowledge of utility locations review and approve proposed locations of intrusive work.

Designated Local Utility Locating Service

Contact your designated local utility locating service (e.g., Dig-Safe, Blue Stake, One Call) to identify and mark the location of utilities. Call 811 in the U.S. or go to www.call811.com to identify the appropriate local service group. Contacting the local utility locating service is a legal requirement in most jurisdictions.

Independent Field Survey (Utility Locate)

The organization conducting the intrusive work (CH2M HILL or subcontractor) will arrange for an independent field survey to identify, locate, and mark any potential subsurface utilities in the work area. This survey is in addition to any utility survey conducted by the designated local utility locating service.

The independent field survey provider will determine the most appropriate instrumentation/technique or combinations of instrumentation/techniques to identify subsurface utilities based on their experience and expertise, types of utilities anticipated to be present, and specific site conditions.

A CH2M HILL or subcontractor representative must be present during the independent field survey to observe the utility locate and verify that the work area and utilities have been properly identified and marked. If there is any question that the survey was not performed adequately or the individual was not qualified, then arrangements must be made to obtain a qualified utility locate service to re-survey the area. Obtain documentation of the survey and clearances in writing and signed by the party conducting the clearance. Maintain all documentation in the project file.

If the site owner (military installation or client) can provide the independent field survey, CH2M HILL or the subcontractor will ensure that the survey includes:

- Physically walking the area to verify the work location and identify, locate, and mark underground utility locations:
- Having qualified staff available and instrumentation to conduct the locate;

- Agreeing to document the survey and clearances in writing.
- Should any of the above criteria not be met, CH2M HILL or subcontractor must arrange for an alternate independent utility locate service to perform the survey.
- The markings from utility surveys must be protected and preserved until the markings are no longer required. If the utility location markings are destroyed or removed before intrusive work commences or is completed, the PM, SC, or designee must notify the independent utility locate service or the designated local utility locating service to resurvey and remark the area.

Visual Assessment before and during Intrusive Activities

Perform a "360 degree" assessment. Walk the area and inspect for utility-related items such as valve caps, previous linear cuts, patchwork in pavement, hydrants, manholes, utility vaults, drains, and vent risers in and around the dig area.

The visual survey will include all surface landmarks, including manholes, previous liner cuts, patchwork in pavement, pad-mounted transformers, utility poles with risers, storm sewer drains, utility vaults, and fire hydrants.

If any unanticipated items are found, conduct further research before initiating intrusive activities and implement any actions needed to avoid striking the utility or obstruction.

Subsurface Activities within 5 feet of an Underground Utility or if there is Uncertainty

When aggressive intrusive activities will be conducted within 5 feet (1.5 meters) of an underground utility or when there is uncertainty about utility locations, locations must be physically verified by non-aggressive means such as air or water knifing, hand digging, or human powered hand augering. Non-conductive tools must be used if electrical hazards may be present. If intrusive activities are within 5 feet (1.5 meters) and parallel to a marked existing utility, the utility location must be exposed and verified by non-aggressive methods every 100 feet (30.5 meters). Check to see if the utility can be isolated during intrusive work.

Intrusive Activities within 2 feet of an Underground Utility

Use non-aggressive methods (hand digging, vacuum excavation, etc.) to perform intrusive activities within 2 feet of a high risk utility (i.e., a utility that cannot be de-energized or would cause significant impacts to repair/replace). Hazardous utilities will be de-energized whenever possible.

Spotter

A spotter will be used to monitor for signs of utilities during advancement of intrusive work (e.g., sudden change in advancement of auger or split spoon, presence of pea gravel or sand in soils, presence of concrete or other debris in soils, refusal of auger or excavating equipment). If any suspicious conditions are encountered stop work immediately and contact the PM or RHSM to evaluate the situation. The spotter must have a method to alert an operator to stop the intrusive activity (e.g., air horn, hand signals).

9.23 Utilities (overhead)

Proximity to Power Lines

No work is to be conducted within 50 feet (15.2 meters) 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 (15.2 meters) 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 (Meters)
0-50	10 (3.0)
51-100	12 (3.7)
101-200	15 (4.6)
201-300	20 (6.1)
301-500	25 (7.6)
501-750	35 (10.7)
751-1,000	45 (13.7)

(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.

9.24 Welding and Cutting

(Reference CH2M HILL, SOP-314, *Welding and Cutting*)

The following are the hazard controls and safe work practices to follow when working around or performing welding and cutting. Ensure the requirements in the referenced SOP are followed.

- Workers designated to operate welding and cutting equipment will have been properly instructed and qualified to operate such equipment.
- Before welding or cutting is permitted, the area will be inspected by the individual responsible for authorizing the welding or cutting operation. The authorization, preferably in the form of a written permit, will detail precautions to be taken before work is to begin.
- Suitable fire extinguishing equipment will be immediately available in the work area.
- Flame-resistant blankets will be used to control sparks produced by welding and cutting operations from traveling to lower levels or adjacent surfaces.
- If the valve on a fuel-gas cylinder is found to leak around the valve stem, the valve will be closed and the gland nut tightened. If this does not stop the leak, the cylinder is to be tagged and removed from service.
- Nothing should be placed on top of a cylinder or manifold that will damage it or interfere with the quick closing of the valve.
- Flow gages and regulators will be inspected prior to use and removed from cylinders when not in use.

- Hoses, leads, and cables will be not be routed through doorways and walkways unless covered, elevated, or protected from damage. Where hoses, leads, and cables pass through wall openings, adequate protection will be provided to prevent damage.
- Flash arresters will be installed at the torch handle.
- Arc welding electrodes will not be struck against compressed gas cylinders to strike an arc.
- All arc welding or cutting operations will be shielded by noncombustible or flame resistant screens to protect employees or other persons in the vicinity from the direct rays of the arc.
- Proper ventilation will be provided so as to maintain the level of contaminants in the breathing zone of welders below applicable PELs.
- Minimum PPE includes the following:
  - Safety-toed shoes or boots, hard hats, and safety glasses
  - Body protection (such as gloves, coveralls, or Tyvek) when chemical hazards exist
  - Hearing protection when working in close proximity to loud equipment and machinery
  - Protective clothing and gloves to prevent burns
  - Suitable eye protective equipment for the type of welding or cutting performed
  - Opaque screens to block arc flash from arc welding and cutting operations
  - Mechanical ventilation systems for welding and cutting operations conducted in enclosed or confined spaces
  - Air monitoring or sampling equipment to evaluate airborne concentrations of welding and cutting contaminants
  - Respiratory protection when airborne concentrations of contaminants exceed regulatory limits

9.24.1 Compressed Gas Cylinders

- Cylinders being transported, moved, or stored will have valve protection caps installed. When transported by motor vehicle, hoisted, or carried, cylinders will be in the vertical position.
- Oxygen cylinders in storage will be separated from fuel-gas cylinders or combustible materials by a minimum of 20 feet (6.1 meters) or by a noncombustible barrier at least 5 feet (1.5 meters) high having a fire resistant rating of at least one half hour.
- Inside of buildings, cylinders will be stored in well-ventilated, dry locations at least 20 feet (6.1 meters) from highly combustible materials. Cylinders should be stored in definitely assigned places away from elevators, stairs, or gangways. Assigned storage areas will be located where cylinders will not be knocked over or damaged.
- During use, cylinders will be kept far enough away from the actual welding and cutting operations to prevent sparks, hot slag, or flames from reaching them. When impractical, fire resistant shields will be provided.
- Cylinders containing oxygen or fuel-gas will not be taken into confined spaces.
- If cylinders are frozen, warm (not boiling) water will be used to thaw them.

9.24.2 Welding and Cutting Equipment

- Fuel-gas and oxygen hoses will be easily distinguishable from each other and will not be interchangeable between fuel-gas and oxygen.
- Hoses will be inspected at the beginning of each shift. Defective hoses will be removed from service.

- Hose couplings will be designed to be disconnected with a rotary motion, not by straight pull.
- Torches will be inspected at the beginning of each shift for leaking valves, connections, and couplings. Defective torches will be removed from service.
- Torches will be ignited with friction lighters, not open flames or hot work.

9.24.3 Arc Welding and Cutting

- Only manual electrode holders that are designed for arc welding or cutting and are capable of safely handling the maximum rated current will be used.
- Only cable that is free from repair or splices for a minimum distance of 10 feet (3 meters) from the cable's attachment to the electrode holder will be used.
- Any current-carrying part that arc welders or cutters grip in their hand, as well as the outer surfaces of the jaws of the holder, will be fully insulated against the maximum voltage encountered to ground.
- The frames of arc welding or cutting machines will be grounded. Grounding circuits, other than by means of the structure, will be checked to ensure that the circuit between the ground and the grounded power conductor has resistance low enough to permit sufficient current flow to cause the fuse or circuit breaker to interrupt the current.
- When electrode holders are left unattended, the electrode will be removed and the holder placed where it cannot harm employees.
- Hot electrode holders will not be dipped in water to cool them.
- When welding or cutting is stopped for any appreciable length of time, or before the welding or cutting machine is moved, the power will be shut off.
- Before starting welding or cutting operations, all connections to the machine will be checked.

9.24.4 Toxic Fumes and Gases

- General mechanical or local exhaust ventilation will be provided when welding or cutting in a confined space.
- Contaminated air exhausted from the work area will be discharged into the open air or otherwise clear of the intake air.
- Other employees exposed to the same atmosphere as the welder or cutter will be protected in the same manner as the welder or cutter.
- In enclosed spaces, all surfaces covered with toxic preservative coatings will be stripped to a distance of at least four inches from the area to be heated, or the worker will be protected with an air-line respirator.
- Welding or cutting in an enclosed space will be performed with local exhaust ventilation or air-line respirators when the following metal bases, fillers, or coatings are involved: lead, cadmium, mercury, zinc, stainless steel, or beryllium.
- Employees welding or cutting in the open air and who are exposed to the metals noted above will be protected with filter-type respirators; however, when working with beryllium, the employee will be protected with an air-line respirator.

9.24.5 Fire Prevention

- When the potential for an explosive atmosphere exists in the immediate area of welding or cutting operations, air monitoring instruments will be used to verify that no explosive atmosphere is present before or during welding or cutting operations.
- When welding or cutting on walls, floors, or ceilings, the same precautions will be taken on the opposite side as for the welding or cutting side.

- Whenever openings or cracks in the floor, walls, or doorways cannot be closed, precautions will be taken to prevent combustible materials in other areas from coming in contact with sparks.
- To prevent fire in enclosed spaces, the gas supply to the torch will be shut off at some point outside the enclosed space whenever the torch is not in use or is left unattended.
- Drums or hollow structures that have contained toxic or flammable substances will be filled with water or thoroughly cleaned, ventilated, and tested before welding or cutting on them.
- Before heat is applied to a drum, container, or structure, a vent or opening will be provided to release built-up pressure during the application of heat.
- Before welding or cutting on any surface covered by a preservative coating whose flammability is unknown, a competent person will test to determine its flammability.
- Preservative coatings will be considered highly flammable when scrapings burn rapidly.
- When preservative coatings are determined to be highly flammable, they will be stripped from the area to be heated.

9.25 Working Around Material Handling Equipment

When CH2M HILL personnel are exposed to material handling equipment, the following safe work practices/ hazard controls will be implemented:

- Never approach operating equipment from the rear. Always make positive contact with the operator, and confirm that the operator has stopped the motion of the equipment.
- Never approach the side of operating equipment; remain outside of the swing and turning radius.
- Maintain distance from pinch points of operating equipment.
- Never turn your back on any operating equipment.
- Never climb onto operating equipment or operate contractor/subcontractor equipment.
- Never ride contractor/subcontractor equipment unless it is designed to accommodate passengers and equipped with firmly attached passenger seat.
- Never work or walk under a suspended load.
- Never use equipment as a personnel lift; do not ride excavator buckets or crane hooks.
- Always stay alert and maintain a safe distance from operating equipment, especially equipment on cross slopes and unstable terrain.

9.26 Working Over Water

If any activities pose a risk to drowning implement the following during the activity:

- Fall protection should be provided to prevent personnel from falling into water. Where fall protection systems are not provided and the danger of drowning exists, U.S. Coast Guard-approved personal flotation devices (PFDs), or a life jacket, will be worn.
- Provide employees with an approved (U.S. Coast Guard for U.S. operations) life jacket or buoyant work vest.
  - Employees should inspect life jackets or work vests daily before use for defects. Do not use defective jackets or vests.
- Post ring buoys with at least 90 feet (27.4 meters) of 3/8-inch solid-braid polypropylene (or equal) line next to the work area. If the work area is large, post extra buoys 200 feet (61 meters) or less from each other.

- Provide at least one life saving skiff, immediately available at locations where employees are working over or adjacent to water.
  - Ensure the skiff is in the water and capable of being launched by one person and is equipped with both motor and oars.
- Designate at least one employee on site to respond to water emergencies and operate the skiff at times when there are employees above water.
  - If the designated skiff operator is not within visual range of the water, provide him or her with a radio or provide some form of communication to inform them of an emergency.
  - Designated employee should be able to reach a victim in the water within three to four minutes.
- Ensure at least one employee trained in CPR and FA is on site during work activities.

10 Physical Hazards and Controls

Physical hazards include exposure to temperature extremes, sun, noise, and radiation. If you encounter a physical hazard that has not been identified in this plan, contact the RHSM so that a revision to this plan can be made.

10.1 Noise

(Reference CH2M HILL SOP HSE-108, *Hearing Conservation*)

CH2M HILL is required to control employee exposure to occupational noise levels of 85 decibels, A-weighted (dBA), and above by implementing a hearing conservation program that meets the requirements of the OSHA Occupational Noise Exposure standard, 29 CFR 1910.95. A noise assessment may be conducted by the RHSM or designee based on potential to emit noise above 85 dBA and also considering the frequency and duration of the task.

- Areas or equipment emitting noise at or above 90 dBA will 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 RHSM will evaluate appropriate controls measures and work practices for employees who have experienced a standard threshold shift (STS) in their hearing.
- Employees who are exposed at or above the AL of 85 dBA are required to complete the online Noise Training Module located on CH2M HILL's VO.
- 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.

10.2 Ultraviolet Radiation (sun exposure)

Health effects regarding 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. Implement the following controls to avoid sunburn.

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 (SPF). Most dermatologists advocate SPF 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.
- No sunscreen provides 100 percent protection against UV radiation. Other precautions must be taken to avoid overexposure.

10.3 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 (see following sections); and
- Communicating any concerns regarding heat and cold stress to their supervisor or SC.

10.3.1 Heat

Heat-related illnesses are caused by more than just temperature and humidity factors.

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 un-acclimatized 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.

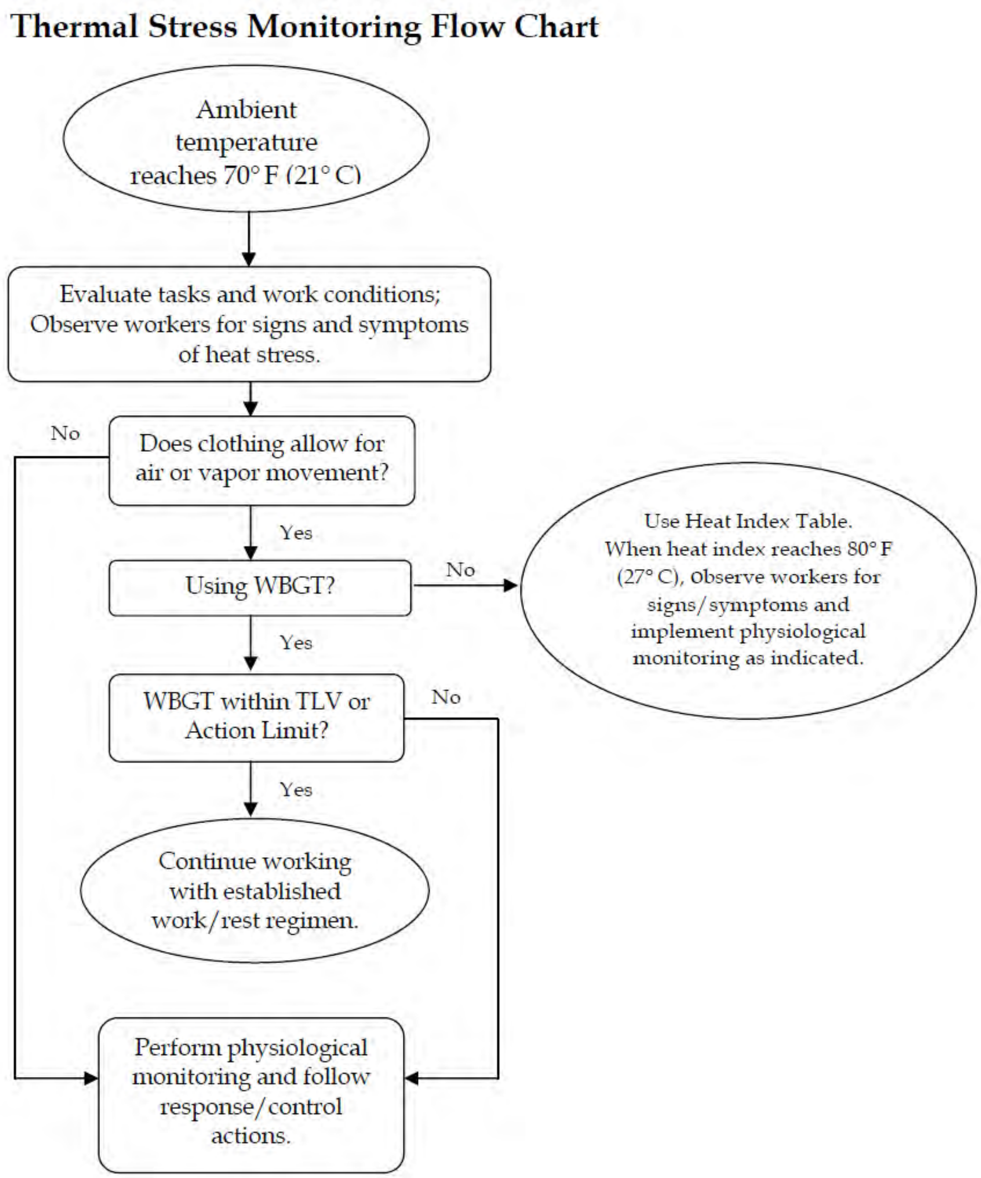
SYMPTOMS AND TREATMENT OF HEAT STRESS					
	Heat Syncope	**Heat Rash**	**Heat Cramps**	**Heat Exhaustion**	**Heat Stroke**
Signs and Symptoms	Sluggishness or fainting while standing erect or immobile in heat.	Profuse tiny raised red blister-like vesicles on affected areas, along with prickling sensations 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) (10 degrees Celsius [°C]) to 60°F F (15.6°C) should be available. Under severe conditions, drink 1 to 2 cups every 20 minutes, for a total of 1 to 2 gallons (7.5 liters) per day. Remind employees to drink water throughout their work shift.
- 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 to site work conditions by slowly increasing workloads; for example, do not begin site work with extremely demanding activities. Closely monitor employees during their first 14 days of work in the field.

- Supervisors and SCs must continually observe employees throughout the work shift for signs and symptoms of heat stress or illness. Employees must monitor themselves for heat stress as well as observe their co-workers.
- Effective communication must be maintained with employees throughout the work shift either by voice, observation, or electronic device.
- 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 shade to protect personnel against radiant heat (sun, flames, hot metal).
- Use portable fans for convection cooling or in extreme heat conditions, an air-conditioned rest area when needed.
- In hot weather, rotate shifts of workers.
- Maintain good hygiene standards by frequent changes of clothing and showering. Clothing should be permitted to dry during rest periods. Persons who notice skin problems should consult medical personnel.
- Brief employees initially before the project work begins and routinely as part of the daily safety briefing, on the signs and symptoms, of heat-relatedness illnesses, precautions to measures and emergency procedures to follow as described in this plan.
- Observe one another for signs of heat stress. PREVENTION and communication is key.

Thermal Stress Monitoring



Thermal Stress Monitoring – Permeable or Impermeable Clothing

When **permeable work clothes** are worn (street clothes or clothing ensembles over street clothes), regularly observe workers for signs and symptoms of heat stress and implement physiological monitoring as indicated in the following paragraph. This should start when the heat index reaches 80°F (27°C) [see Heat Index Table as follows], or sooner if workers exhibit symptoms of heat stress indicated in the table above. These heat index values were devised for shady, light wind conditions; exposure to full sunshine can increase the values by up to 15°F (8°C). Also, strong winds, particularly with very hot, dry air, can be extremely hazardous.

When wearing **impermeable clothing** (e.g., clothing doesn't allow for air or water vapor movement such as Tyvek), physiological monitoring as described below will be conducted when the ambient temperature reaches 70°F (21°C) or sooner when climatic conditions may present greater risk of heat stress combined with wearing unique variations of impermeable clothing, or workers exhibit symptoms of heat stress

Heat Index

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	126	130					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Streuous Activity

Caution Extreme Caution Danger Extreme Danger

Heat Index	Possible Heat Disorders	Minimum Frequency of Physiological Monitoring
80°F - 90°F (27°C - 32°C)	Fatigue possible with prolonged exposure and/or physical activity	Conduct initial monitoring as baseline and observe workers for signs of heat stress and implement physiological monitoring if warranted.
90°F - 105°F (32°C - 41°C)	Sunstroke, heat cramps, or heat exhaustion possible with prolonged exposure and/or physical activity	Conduct initial monitoring as baseline, then at least every hour, or sooner, if signs of heat stress are observed.
105°F - 130°F (41°C - 54°C)	Sunstroke, heat cramps, or heat exhaustion likely, and heat stroke possible with prolonged exposure and/or physical activity.	Conduct initial monitoring as baseline, then every 30 minutes or sooner if signs of heat stress are observed.
130°F or Higher (54°C or Higher)	Heat/Sunstroke highly likely with continued exposure.	Conduct initial monitoring as baseline, then every 15 minutes or sooner if signs of heat stress are observed.

Source: National Weather Service

Physiological Monitoring and Associated Actions

For employees wearing permeable clothing, follow the minimum frequency of physiological monitoring listed in the Heat Index Table.

For employees wearing impermeable clothing, physiological monitoring should begin initially at a 15-minute interval, then if the employee's heart rate or body temperature is within acceptable limits, conduct the subsequent physiological monitoring at 30 minutes, and follow the established regimen protocol described as follows.

The following physiological monitoring protocol below, using either radial pulse or aural temperature, will occur when the heat index is 80°F or greater (or when personnel exhibit signs of heat stress), the following will be performed:

- The sustained heart rate during the work cycle should remain below 180 beats per minute (bpm) minus the individual's age (e.g. 180 – 35 year old person = 145 bpm). The sustained heart rate can be estimated by measuring the heart rate at the radial pulse for 30 seconds as quickly as possible prior to starting the rest period.
- The heart rate after a 1-minute rest period should not exceed 120 bpm.
- If the heart rate is higher than 120 bpm after the FIRST minute into the rest period, 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 120 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 120 bpm after the FIRST minute into the rest period.

Alternately, the body temperature can be measured, either oral or aural (ear), before the workers have something to drink.

- If the oral or aural temperature exceeds 99.6°F (37.6°F) at the beginning of the rest period, the following work cycle should be shortened by 33 percent.
- Continue this procedure until the oral or aural (ear) temperature is maintained below 99.6°F (37.6°C). While an accurate indication of heat stress, oral temperature is difficult to measure in the field, however, a digital aural (aural) thermometer is easy to obtain and inexpensive to purchase.
- Use the form attached to this HSP to track workers' measurements and actions taken.

Procedures for when Heat Illness Symptoms are Experienced

- **Always** contact the RHSM when any heat illness related symptom is experienced so that controls can be evaluated and modified, if needed.
- In the case of cramps, reduce activity, increase fluid intake, move to shade until recovered.
- In the case of all other heat-related symptoms (fainting, heat rash, heat exhaustion), and if the worker is a CH2M HILL worker, contact the occupational physician at 1-866-893-2514 and immediate supervisor.
- In the case of heat stroke symptoms, call 911, have a designee give location and directions to ambulance service if needed, follow precautions under the emergency medical treatment of this HSP.
- Follow the Incident Notification, Reporting, and Investigation section of this HSP.

10.3.2 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).
- The wind-chill index (as follows) 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.
- Persons who experience initial signs of immersion foot, frostbite, and/or hypothermia should report it immediately to their supervisor/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.

Wind Chill Chart

Temperature (ºF)

Wind (mph) / Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

Wind Chill (ºF) = $35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$

Where, T= Air Temperature (ºF) V= Wind Speed (mph)

Effective 11/01/01

10.4 Radiological Hazards

Refer to CH2M HILL's Core Standard, Radiological Control and Radiological Controls Manual for additional requirements.

Hazards	Controls
None Known	None Required

11 Biological Hazards and Controls

Biological hazards are everywhere and change with the region and season. If you encounter a biological hazard that has not been identified in this plan, contact the RHSM so that a revision to this plan can be made. Whether it is contact with a poisonous plant, a poisonous snake, or a bug bite, do not take bites or stings lightly. If there is a chance of an allergic reaction or infection, or to seek medical advice on how to properly care for the injury, contact the occupational nurse at 1-866-893-2514.

11.1 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 a buddy. If you are stung, contact the occupational nurse at 1-866-893-2514. If a stinger is present, remove it carefully with tweezers. Wash and disinfect the wound, cover it, and apply ice. Watch for an allergic reaction if you have never been stung before. Call 911 if the reaction is severe.

11.2 Mosquito Bites

Due to the recent detection of the West Nile Virus in the southwestern U.S. 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; and
- 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.

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 project RHSM with questions, and immediately report any suspicious symptoms to your supervisor, PM, and contact the occupational nurse at 1-866-893-2514.

11.3 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 the following images). 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 urishol 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 Zanfel, Tecnu, or another product designed for removing urushiol. If you do not have Zanfel or 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.

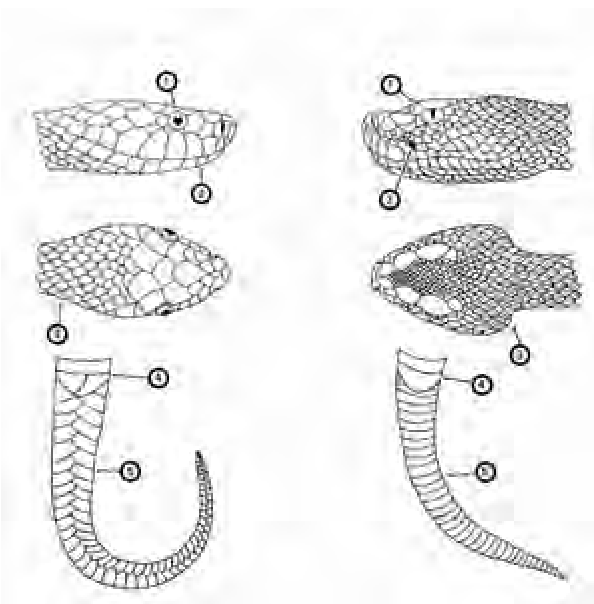
If you do come into contact with one of these poisonous plants and a reaction develops, contact your supervisor and the occupational nurse 1-866-893-2514.

11.4 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 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. The following is a guide to identifying poisonous snakes from non-poisonous snakes.

Identification of Poisonous Snakes

Major Identification Features Non-venomous Snake	Major Identification Features Venomous Snake
1. Round pupils 2. No sensing pit 3. Head slightly wider than neck 4. Divided anal plate 5. Double row of scales on the underside of the tail	1. Elliptical pupils 2. Sensing pit between eye and nostril 3. Head much wider than neck 4. Single anal plate 5. Single scales on the underside of the tail



11.5 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 (6.4 millimeters) 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 (vegetation above knee height, tick endemic area) or when tasks (e.g., having to sit or kneel in vegetation) diminish the effectiveness of the other controls mentioned above, bug-out suits (check with your local or regional warehouse) or Tyvek will 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. Avoid habitats where possible, reduce the abundance through habitat disruption or application of acracide. If these controls aren't feasible, contact your local or regional warehouse for 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 attached to this HSP for further precautions and controls to implement when ticks are present. If bitten by a tick, follow the removal procedures found in the tick fact sheet, and call the occupational nurse at 1-866-893-2514.

Be aware of the symptoms of Lyme disease or Rocky Mountain Spotted Fever (RMSF). Lyme disease is a rash that might appear that looks like a bullseye with a small welt in the center. RMSF is 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.

Be sure to complete an Incident Report (either use the Hours and Incident Tracking System [HITS] system on the VO) if you do come in contact with a tick.

12 Contaminants of Concern

The following table summarizes the potential COCs and their occupational exposure limit and signs and symptoms of exposure. The table also includes the maximum concentration of each COC and the associated location and media that was sampled (groundwater, soil boring, surface soil). These concentrations were used to determine engineering and administrative controls described in the "Project-Specific Hazard Controls" section of this HSP, as well as PPE and site monitoring requirements.

COCs					
Contaminant	**Location and Maximum[a] Concentration (ppm)**	**Exposure Limit[b]**	**IDLH[c]**	**Symptoms and Effects of Exposure**	**PIP[d] (eV)**
Acetone	GW: SB: SS:	250 ppm	2,500 ppm	Irritation to eyes, nose, throat; headache, dizziness, central nervous system depression; dermatitis	9.69
Arsenic	GW: 35.9 SB: SS: 16.5	0.01 mg/m^3	5 Ca	Ulceration of nasal septum, respiratory irritation, dermatitis, gastrointestinal disturbances, peripheral neuropathy, hyperpigmentation	NA
Barium	GW: SB: SS: 1,550	0.5 mg/m^3 as barium chloride	50 mg/m3	irritation eyes, skin, upper respiratory system; skin burns; gastroenteritis; muscle spasm; slow pulse, extrasystoles; hypokalemia	NA
Beryllium	GW: 0.0019 SB: SS: 0.35	0.0005 mg/m^3	4 mg/m3	Berylliosis (chronic exposure): anorexia, weight loss, lassitude (weakness, exhaustion), chest pain, cough, clubbing of fingers, cyanosis, pulmonary insufficiency; irritation eyes; dermatitis; [potential occupational carcinogen]	NA
Dynamite - Nitroglycerine	GW: SB: SS:1.6	0.1 mg/m3	75 mg/m3	Throbbing headache; dizziness; nausea, vomiting	NL
HMX	GW: 0.0011 SB: SS: 13				NA
TNT	GW: 0.84 SB: SS: 13	0.5 mg/m^3	500 mg/m^3	Irritation skin, mucous membrane; liver damage, jaundice	10.59
Cadmium	GW: 0.0054 SB: SS: 14.8	0.005 mg/m^3	9 Ca	Pulmonary edema, coughing, chest tightness/pain, headache, chills, muscle aches, nausea, vomiting, diarrhea, difficulty breathing, loss of sense of smell, emphysema, mild anemia	NA
Chromium (as Cr(II) & Cr(III))	GW: 0.212 SB: SS: 101	0.5 mg/m3	25	Irritated eyes, sensitization dermatitis, histologic fibrosis of lungs	NA
Bis-(2-ethylhexyl)phthalate (DEHP, DOP)	GW: 0.005 SB: SS:	5 mg/m3	5,000 Ca	Eye and mucous membrane irritant	UK

COCs					
Contaminant	**Location and Maximum[a] Concentration (ppm)**	**Exposure Limit[b]**	**IDLH[c]**	**Symptoms and Effects of Exposure**	**PIP[d] (eV)**
Lead	GW: 5.11 SB: SS: 1,010	0.05 mg/m^3	100	Weakness lassitude, facial pallor, pal eye, weight loss, malnutrition, abdominal pain, constipation, anemia, gingival lead line, tremors, paralysis of wrist and ankles, encephalopathy, kidney disease, irritated eyes, hypertension	NA
Manganese	GW: 0.825 SB: SS: 485	1 mg/m^3	500 mg/m^3	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
Mercury	GW: 0.022 SB: SS: 174	0.05 mg/m^3	10	Skin and eye irritation, cough, chest pain, difficult breathing, bronchitis, pneumontitis, tremors, insomnia, irritability, indecision, headache, fatigue, weakness, GI disturbance	NA

Footnotes:

[a] Specify sample-designation and media: SB (Soil Boring), A (Air), D (Drums), GW (Groundwater), L (Lagoon), TK (Tank), SS (Surface Soil), SL (Sludge), SW (Surface Water).
[b] Appropriate value of PEL, recommended exposure limit (REL), or 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; NA = Not applicable; UK = Unknown.
eV = electron volt
HMX = cyclotetramethylene-tetranitramine
mg/kg = milligram per kilogram
mg/m^3 = milligram per cubic meter
ppm = part per million

Potential Routes of Exposure		
Dermal: Contact with contaminated media. This route of exposure is minimized through use of engineering controls, administrative controls and proper use of PPE.	**Inhalation:** Vapors and contaminated particulates. This route of exposure is minimized through use of engineering controls, administrative controls and proper use of respiratory protection when other forms of control do not reduce the potential for exposure.	**Other:** Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

13 Site Monitoring

(Reference CH2M HILL SOP HSE-207, *Exposure Monitoring for Airborne Chemical Hazards*)

When performing site monitoring, record all the information, such as in a field logbook. Note date and time, describe monitoring location (for example, in breathing zone, at source and site location), and what the reading is. If any ALs are reached, note it in the field logbook and note the action taken.

Exposure records (air sampling) must be preserved for the duration of employment plus 30 years. Ensure that copies of the field log book are maintained in the project file.

Copies of all project exposure records (e.g., copies of field logbook pages where air monitoring readings are recorded and associated calibration) will be sent to the regional SPA for retention and maintained in the project files.

13.1 Direct Reading Monitoring Specifications

Instrument	Tasks	ALs[a]	Action to be Taken when AL Reached	Frequency [b]	Calibration
Toxic Gas Monitor: MultiRAE Plus with 10.6 eV lamp (VOCs, O_2, LEL, CO, H_2S)	Geoprobe soil, sediment and groundwater sampling	0-1 ppm 1-5 ppm	Level D Level C – notify HSM prior	Initially, periodically, and at end of task	Daily
CGI: MSA model 260 or 261 or equivalent	Geoprobe soil, sediment and groundwater sampling	0-10% : >10% LEL:	No explosion hazard Explosion hazard; evacuate or vent	Initially, periodically, and at end of task	Daily
O_2 Meter: MSA model 260 or 261 or equivalent	Geoprobe soil, sediment and groundwater sampling	>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	Initially, periodically, and at end of task	Daily
Dust Monitor: DataRAM or equivalent	Intrusive/soil disturbance	<1.5 mg/m^3 >1.5 mg/m^3	Level D Level C	Initially, periodically, and at end of task	Zero Daily
Nose-Level Monitor [d]	Equipment use	<85 dBA 85-120 dBA 120 dBA	No action required Hearing protection required Stop; re-evaluate	Initially and periodically during task	Daily

[a] ALs apply to sustained breathing-zone measurements above background.
[b] The exact frequency of monitoring depends on field conditions and is TBD by the SC; generally, every 5 to 15 minutes if acceptable; more frequently may be appropriate.
[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 ALs apply only to ambient working atmospheres, and not to confined-space entry. More-stringent percent LEL and O_2 ALs are required for confined-space entry.
[d] Noise monitoring and audiometric testing also required.

CGI = combustible gas indicator
LEL = lower exposure limit
SCBA = self-contained breathing apparatus
VOC = volatile organic compound

13.2 Calibration Specifications

(Refer to the respective manufacturer's instructions for proper instrument-maintenance procedures)

Instrument	Gas	Span	Reading	Method
Dust Monitor: DataRAM	Dust-free air	Not applicable	0.00 mg/m^3 in "Measure" mode	Dust-free area OR Z-bag with HEPA filter
MultiRae or equivalent	H_2S	CF = 25	25 ppm	1.5 lpm reg
	CO	CF = 50	50 ppm	T-tubing
	LEL	CF = 50	50%	
	O_2	CF = 20.9	20.9%	
	100 ppm isobutylene	CF = 100	100 ppm	

Notes:
HEPA = high-efficiency particulate air
lpm = liter per minute

Calibrate air monitoring equipment daily (or prior to use) in accordance with the instrument's instructions. Document the calibration in the field logbook (or equivalent) and include the following information:

- Instrument name
- Serial Number
- Owner of instrument (for example, CH2M HILL, HAZCO)
- Calibration gas (including type and lot number)
- Type of regulator (for example, 1.5 lpm)
- Type of tubing (for example, direct or T-tubing)
- Ambient weather condition (for example, temperature and wind direction)
- Calibration/instrument readings
- Operator's name and signature
- Date and time

13.3 Integrated Personal 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 VOCs. Contact the RHSM immediately if these contaminants are encountered.

Method Description

None

Personnel and Areas

Results must be sent immediately to the RHSM. Regulations may require reporting to monitored personnel. Results reported to:

RHSM: NA
Other: NA

14 Personal Protective Equipment

(Reference CH2M HILL- SOP HSE-117, *Personal Protective Equipment*)

14.1 Required Personal Protective Equipment

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 RHSM based on project tasks (see PPE specifications below). Verification and certification of assigned PPE by task is completed by the RHSM that approved this plan. Items that need to be followed when using any form of PPE are as follows:

- 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 will not be used and must either be repaired or discarded; and
- PPE will 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 RHSM so this table can be updated.

Project-Specific Personal Protective Equipment Requirements[a]

Task	Level	Body	Head	Respirator [b]
Site entry	D	Work clothes; safety toed leather work boots and gloves	Hardhat [c] Safety glasses with side shields Ear protection [d]	None required
All other site tasks	Modified D	Work clothes or cotton coveralls *Tyvek for protection from poisonous plant as necessary **Boots:** Safety-toe, chemical-resistant boots OR Safety -toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves. OR SC to determine body protection based on potential contact with site contaminants. If outer layer of personal clothing cannot be kept clean, then outer cotton coveralls or uncoated Tyvek coveralls will be worn. (Polycoated Tyvek when there is potential to contact contaminated groundwater or free liquids from drums.)	Hardhat [c] Safety glasses with side shields Ear protection [d]	None required

Project-Specific Personal Protective Equipment Requirements[a]

Task	Level	Body	Head	Respirator [b]
Work near vehicular traffic ways or EME.	All	Appropriate level of ANSI/ISEA 107-2004 high-visibility safety vests.	Work near vehicular traffic ways or EME.	
Equipment decontamination if using pressure washer	Modified D with splash protection	**Coveralls:** Polycoated 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.
Upgrade	C	**Coveralls:** Polycoated Tyvek **Boots:** Safety -toe, chemical-resistant boots OR Safety -toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Splash shield [c] Ear protection [d] Spectacle inserts	APR, full face, MSA Ultratwin or equivalent; [GMC-H] [e].

Reasons for Upgrading or Downgrading Level of Protection (with approval of the RHSM)

Upgrade[f]	Downgrade
• Request from individual performing tasks. • Change in work tasks that will increase contact or potential contact with hazardous materials. • Occurrence or likely occurrence of gas or vapor emission. • Known or suspected presence of dermal hazards. • Instrument ALs in the “Site Monitoring” section exceeded.	• New information indicating that situation is less hazardous than originally thought. • Change in site conditions that decrease the hazard. • Change in work task that will reduce contact with hazardous materials.

[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 TBD by the SC.
[d] Ear protection should be worn when conversations cannot be held at distances of 3 feet (1 meter) or less without shouting.
[e] See cartridge change-out schedule.
[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 RHSM, and an SC qualified at that level is present.
ISEA = International Safety Equipment Association

14.2 Respiratory Protection

(Reference CH2M HILL SOP HSE-121, *Respiratory Protection*)

Implement the following when using respiratory protection:

- Respirator users must have completed appropriate respirator training within the past 12 months. Level C training is required for air-purifying respirators (APRs) use and Level B training is required for supplied-air respirators (SARs) and SCBA use. Specific training is required for the use of powered air-purifying respirators (PAPRs).
- 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 will be limited to those activities identified in this plan. If site conditions change that alters the effectiveness of the specified respiratory protection, the RHSM will be notified to amend the written plan.
- Tight-fitting facepiece respirator users will be clean-shaven and will perform a user seal check before each use.
- Canisters/cartridges will be replaced according to the change-out schedule specified in this plan. Respirator users will notify the SC or RHSM of any detection of vapor or gas breakthrough. The SC will report any breakthrough events to the RHSM for schedule upgrade.
- Respirators in regular use will be inspected before each use and during cleaning
- Respirators in regular use will be cleaned and disinfected as often as necessary to ensure they are maintained in a clean and sanitary condition.
- Respirators will be properly stored to protect against contamination and deformation.
- Field repair of respirators will be limited to routine maintenance. Defective respirators will be removed from service.
- When breathing air is supplied by cylinder or compressor, the SC or RHSM will verify the air meets Grade D air specifications.
- The SC or designee will complete the H&S Self-Assessment Checklist – Respiratory Protection included in as attachment to this plan to verify compliance with CH2M HILL's respiratory protection program.

Respirator Change-Out Schedule

Contaminant	Change-Out Schedule
All	End-of-service life or end of shift (whichever occurs first)

15 Worker Training and Qualification

15.1 CH2M HILL Worker Training

(Reference CH2M HILL SOP HSE-110, *Training*)

15.1.1 Hazardous Waste Operations Training

All employees engaging in HAZWOPER will receive appropriate training as required by 29 CFR 1910.120 and 29 CFR 1926.65. At a minimum, the training will have consisted of instruction in the topics outlined in 29 CFR 1910.120 and 29 CFR 1926.65. Personnel who have not met these training requirements will not be allowed to engage in HAZWOPER.

Initial Training

General site workers engaged in hazardous waste operations will, at the time of job assignment, have received a minimum of 40 hours of initial H&S 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 will 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 will 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 will have received 3 days of actual experience (on-the-job training) under the direct supervision of a trained, qualified supervisor and will be documented. If the field experience has not already been received and documented at a similar site, this supervised experience will be accomplished and documented at the beginning of the assignment of the project.

Refresher Training

General site workers and TSD workers will receive 8 hours of refresher training annually (within the previous 12-month period) to maintain qualifications for fieldwork. Employees engaged in emergency response operations will receive annual refresher training of sufficient content and duration to maintain their competencies or will demonstrate competency in those areas at least annually.

Eight-Hour Supervisory Training

On site 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 SC – Hazardous Waste are considered 8-hour HAZWOPER Site Safety Supervisor trained.

15.1.2 First Aid and Cardiopulmonary Resuscitation

FA and CPR training consistent with the requirements of a nationally recognized organization such as the American Red Cross Association or NSC will be administered by a certified trainer. A minimum of two personnel per active field operation will have FA and CPR training. Bloodborne pathogen training located on CH2M HILL's VO is also required for those designated as FA and CPR trained.

15.1.3 Safety Coordinator Training

SCs are trained to implement the HSE program on CH2M HILL field projects. A qualified SC is required to be identified in the site-specific HSP for CH2M HILL field projects. SCs must also meet the requirements of the worker category appropriate to the type of field project (construction or hazardous waste). In addition, the SCs will have completed additional safety training required by the specific work activity on the project that qualifies them to implement the HSE program (for example, fall protection, excavation).

15.1.4 Site-Specific Training

Prior to commencement of field activities, all field personnel assigned to the project will have completed site-specific training that will address the contents of applicable HSPs, including the activities, procedures, monitoring, and equipment used in the site operations. Site-specific training will also include site and facility layout, potential hazards, risks associated with identified emergency response actions, and available emergency services. This training allows field workers to clarify anything they do not understand and to reinforce their responsibilities regarding safety and work operations for their particular activity.

15.1.5 Project-Specific Training Requirements

Project-specific training for this project includes:

- HSPs/AHAs

16 Medical Surveillance and Qualification

All site workers participating in HAZWOPER will maintain an adequate medical surveillance program in accordance with 29 CFR 1910.120 or 29 CFR 1926.65 and other applicable OSHA standards. Documentation of employee medical qualification (e.g., physician's written opinion) will be maintained in the project files and made available for inspection.

16.1 Hazardous Waste Operations and Emergency Response

CH2M HILL personnel expected to participate in onsite HAZWOPER are required to have a current medical qualification for performing this work. Medical qualification will consist of a qualified physician's written opinion regarding fitness for duty at a hazardous waste site, including any recommended limitations on the employee's assigned work. The physician's written opinion will state whether the employee has any detected medical conditions that would place the employee at increased risk of material impairment of the employee's health from work in HAZWOPER, or from respirator use.

16.2 Job or Site-Specific Medical Surveillance

Due to the nature of hazards for a particular job or work site, specialized medical surveillance may be necessary. This surveillance could include biological monitoring for specific compounds, or specialized medical examinations.

Site-specific medical surveillance includes:

16.3 Respirator User Qualification

Personnel required to wear respirators must have a current medical qualification to wear respirators. Medical qualification will consist of a qualified physician's written opinion regarding the employee's ability to safely wear a respirator in accordance with 29 CFR 1910.134.

16.4 Hearing Conservation

Personnel working in hazardous waste operations or operations that fall under 29 CFR 1910.95 and exposed to noise levels in excess of the 85-dBA time-weighted average will be included in a hearing conservation program that includes annual audiometric testing.

17 Site-Control Plan

17.1 Site-Control Procedures

(Reference CH2M HILL SOP HSE-218, *Hazardous Waste Operations)*

- The SC will implement site control procedures.
- The SC will conduct a site safety briefing (see as follows) before starting field activities or as tasks and site conditions change.
- Topics for briefing on site safety: general discussion of HSP, site-specific hazards, locations of work zones, PPE requirements, equipment, special procedures, emergencies.
- The SC 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, contamination reduction, and EZs. 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.”
- Initial air monitoring is conducted by the SC in appropriate level of protection.
- The SC is to conduct periodic inspections of work practices to determine the effectiveness of this plan. Deficiencies are to be noted, reported to the RHSM, and corrected.

17.2 HAZWOPER Compliance Plan

(Reference CH2M HILL SOP 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 listed in the “General Project Information” section of this HSP might occur consecutively or concurrently with respect to non-HAZWOPER tasks (also specified in the “General Project Information” section).

This section outlines procedures to be followed when approved the approved non-HAZWOPER activities 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.

- In many cases, air sampling, in addition to real-time monitoring, must confirm that there is no exposure to gases or vapors before non-HAZWOPER-trained personnel are allowed on the site, or while non-HAZWOPER-trained staff is working in proximity to HAZWOPER activities. Other data (e.g., soil) also must document that there is no potential for exposure. The RHSM must approve the interpretation of these data.
- When non-HAZWOPER-trained personnel are at risk of exposure, the SC must post the EZ 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

- Periodic air monitoring with direct-reading instruments conducted during regulated tasks also should be used to ensure that non-HAZWOPER-trained personnel (e.g., in an adjacent area) are not exposed to airborne contaminants.
- 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 H&S hazards.
- Remediation treatment system start-ups: Once a treatment system begins to pump and treat contaminated media, the site is, for the purposes of applying the HAZWOPER standard, considered a treatment, storage, and disposal facility (TSDF). Therefore, once the system begins operation, only HAZWOPER-trained personnel (minimum of 24 hours of training) will be permitted to enter the site. All non-HAZWOPER-trained personnel must not enter the TSDF area of the site.

18 Decontamination

(Reference CH2M HILL SOP HSE-218, *Hazardous Waste Operations*)

The SC must establish and monitor the decontamination procedures and their effectiveness. Decontamination procedures found to be ineffective will be modified by the SC. The SC must ensure that procedures are established for disposing of materials generated on the site.

18.1 Decontamination Specifications

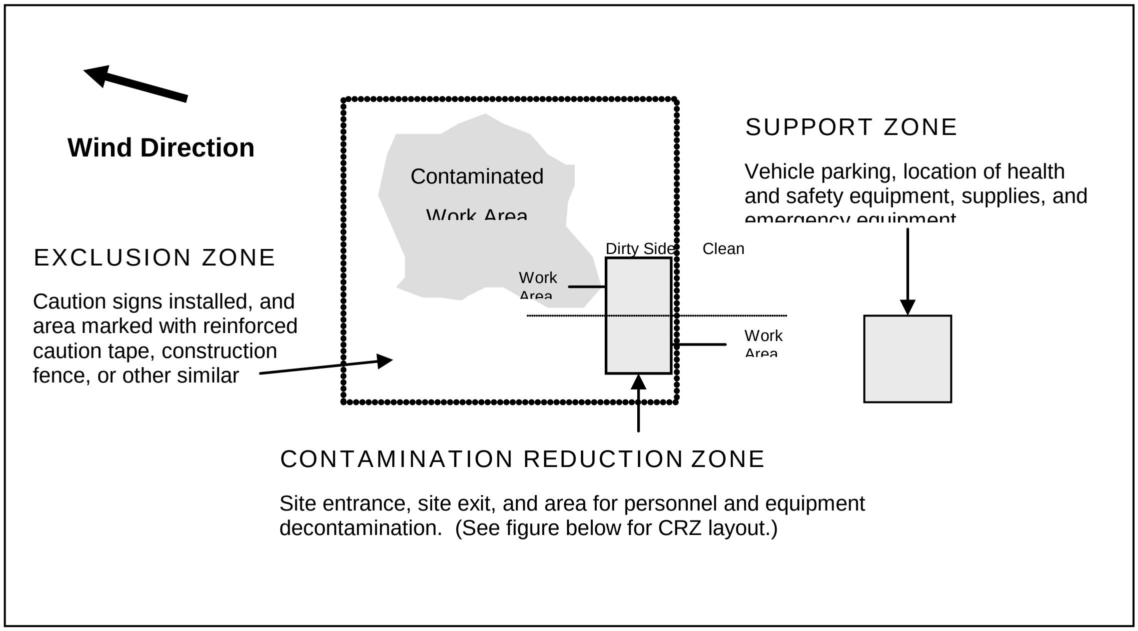
Personnel	Sample Equipment	Heavy Equipment
• Boot wash/rinse • Glove wash/rinse • Outer-glove removal • Body-suit removal • Inner-glove removal • Respirator removal • Hand wash/rinse • Face wash/rinse • Shower as soon as possible • Dispose of PPE in municipal trash, or contain for disposal • Dispose 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

18.2 Diagram of Personnel-Decontamination Line

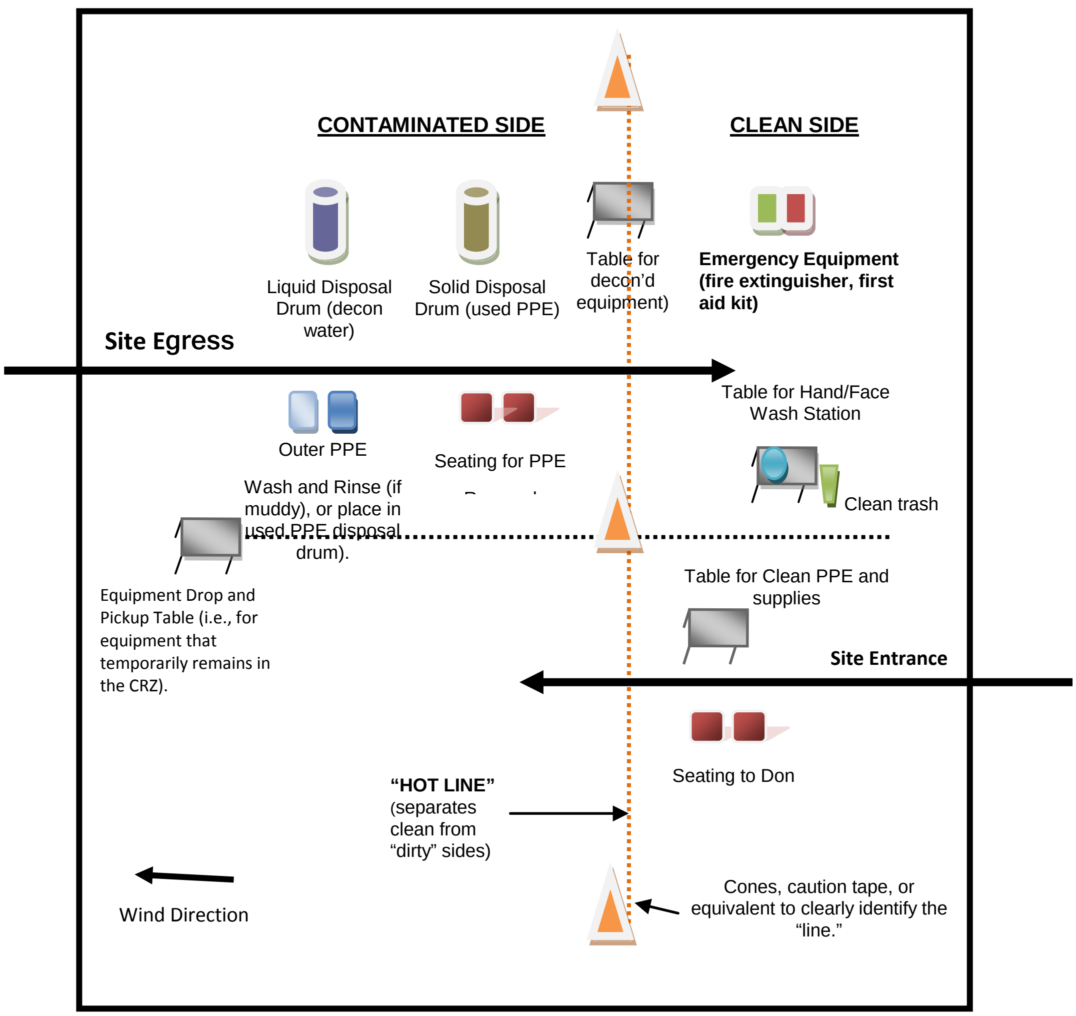
No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones. The SC should establish areas for eating, drinking, and smoking.

The following figure illustrates a conceptual establishment of work zones, including the decontamination line. Work zones are to be modified by the SC to accommodate task-specific requirements.

Work Area - Set up appropriately based on wind direction



Typical Contamination Reduction Zone



19 Emergency Response Plan

(Reference CH2M HILL SOP HSE-106, *Emergency Planning*)

19.1 Pre-Emergency Planning

- The ERC, typically the SC or designee, 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. Pre-Emergency Planning activities performed by the ERC include:
- 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 the "Emergency Contacts" page and route to the hospital located in this section in project trailer(s) and keep a copy in field vehicles along with evacuation routes and assembly areas. Communicate the information to onsite personnel and keep it updated.
- 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 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 emergency response plan.
- The ERC will evaluate emergency response actions and initiate appropriate follow-up actions.

19.2 Emergency Equipment and Supplies

The ERC should mark the locations of emergency equipment on the site map and post the map.

Emergency Equipment and Supplies	Location
20 (or two 10) class A,B,C fire extinguisher	Vehicle
FA kit	Vehicle
Eye Wash	Vehicle
Potable water	Vehicle
Bloodborne-pathogen kit	Vehicle
Cell Phone	FTL/SSC

19.3 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 the "Incident Notification, Reporting, and Investigation" section of this HSP.

19.4 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 the "Emergency Contacts" page located in this section.
- 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 FA or medical treatment takes priority.
- Initiate FA 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 using the HITS system on the VO or if not feasible, use the hard copy forms provided as an attachment to this HSP.
- Notify and submit reports to client as required in contract.

19.5 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 the "Incident Notification, Reporting and Investigation" section of this HSP.

19.6 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.

19.7 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.

Emergency Contacts

24-hour CH2M HILL Injury Reporting– 1-866-893-2514

24-hour CH2M HILL Serious Incident Reporting Contact – 720-286-4911

Medical Emergency – 911 **Facility Medical Response #:** 301-744-4333 (if in restricted area, use red call boxes-no cell phone usage in restricted area **Local Ambulance #:**	**CH2M HILL- Medical Consultant** WorkCare Dr. Peter Greaney M.D. 300 S. Harbor Blvd, Suite 600 Anaheim , CA 92805 800-455-6155/866-893-2514 714-978-7488
Fire/Spill Emergency – 911 **Facility Fire Response #:** 301-744-4333 **Local Fire Dept #:**911	**CH2M HILL Director – HSSE** Andy Strickland/DEN 720-480-0685 (cell) or 720-286-2393 (office)
Security & Police – 911 **Facility Security #:** 301-744-4333 (if in restricted area, use red call boxes-no cell phone usage in restricted area **Local Police #:** 911	**CH2M HILL RHSM** Name: Mark Orman Phone: 414-847-0597
Utilities Emergency Phone Numbers On base: Contact Nick Carros, NSF-IH Phone: 301-744-2253	**CH2M HILL HR Department** Phone: Employee Connect toll-free number 1-877-586-4411 (U.S. and Canada)
CH2M HILL PM Name: Victoria Waranoski Phone: 703/376-5049	**CH2M HILL Worker's Compensation:** Contact Business Group HR dept. to have form completed or contact Jennifer Rindahl after hours: (720)891-5382
CH2M HILL SC Name: TBD Phone:	**Media Inquiries Corporate Strategic Communications** Name: John Corsi Phone: 720-286-2087
CH2M HILL Project EM Name: Hope Wilson Phone: +1 678-530-4226	**Automobile Accidents** Rental: Jennifer Rindahl/DEN: 720-286-2449 CH2M HILL-owned vehicle: Linda George/DEN: 720-286-2057 See attachment Vehicle Accident Guidance
Federal Express Dangerous Goods Shipping Phone: 800-238-5355	**CHEMTEL (hazardous material spills)** Phone: 800-255-3924
Facility Alarms: Since CH2M HILL personnel will not always be working in close proximity to each other, hand signals, voice commands, air horns, and two-way radios will comprise the mechanisms to alert site personnel of an emergency. All onsite contractors must read and sign the "Hazard Control Briefing for Environmental Division Visitors (Indian Head Division Naval Surface Warfare Center (IHDIVNAVSURFAWARCEN)"and attend the "Pre-construction Safety Briefing" from the Safety Department prior to commencing work.	Evacuation Assembly Area(s): In the event that the site must be evacuated, all personnel will immediately stop activities and report to a safe place of refuge at the support zone area. The safe place of refuge may also serve as the telephone communication point, as communication with emergency response agencies may be necessary. A telephone communication point and safe place of refuge will be determined prior to the commencement of site activities at each site.
Facility/Site Evacuation Route(s): TBD before start of work	

Directions to Local Hospital

Local Hospital **Hospital Phone#:** 301-609-4000

Civista Medical Center

701 East Charles St., LaPlata MD 20646

Start at : Indian Head, MD

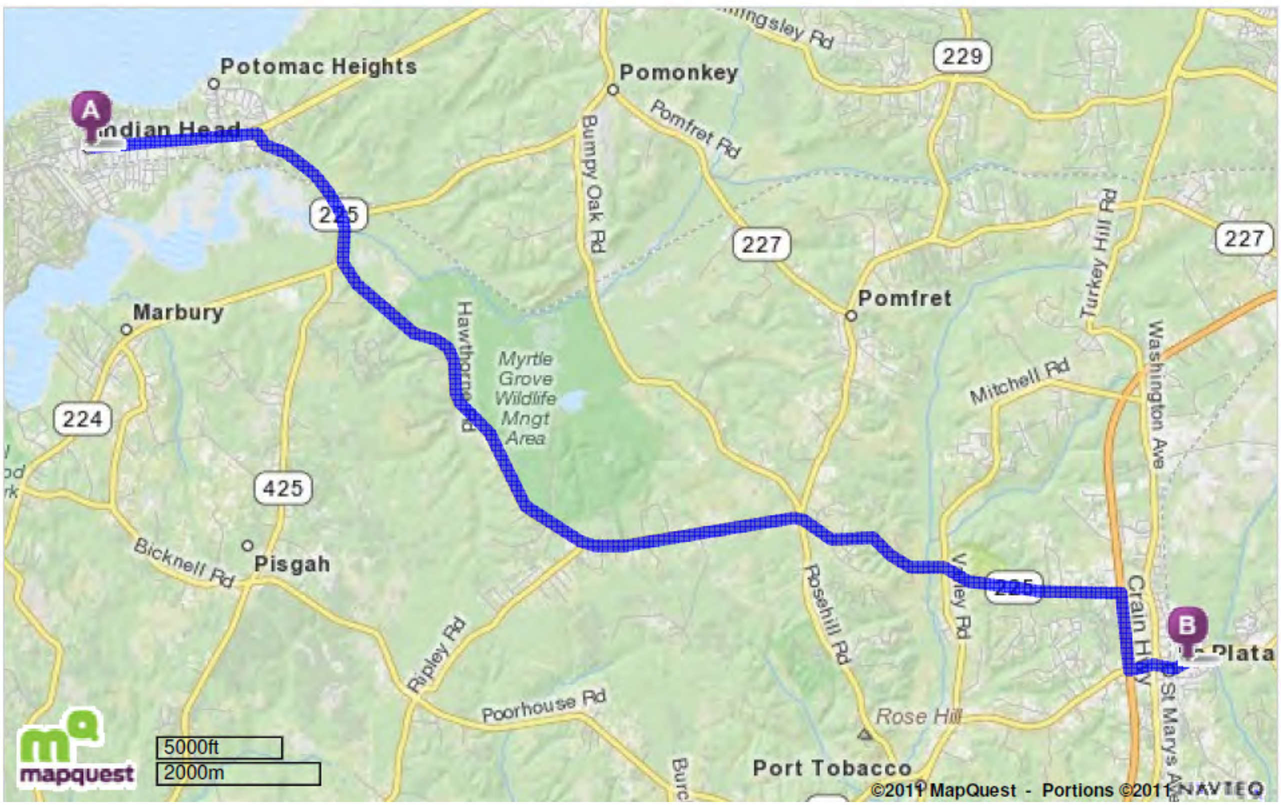
1) Go EAST on Indian Head Highway/MD-210 N toward Strauss Ave. Go 1.5 Miles.

2) Turn Right onto Hawthorn Road/MD-225. Go 10.6 Miles.

3) Turn Right on Crain Highway/U.S.-301 S/Blue Star Memorial Highway. Go 0.7 Mile

4) Turn Left onto Md-6. Go 0.6 Mile

5) 701 Charles Street is on the Right.



20 Spill Containment Procedures

CH2M HILL and subcontractor personnel working at the project site will be knowledgeable of the potential health, safety and environmental concerns associated with petroleum and other hazardous substances that could potentially be released at the project site.

The following is a list of criteria that must be addressed in CH2M HILL's or the subcontractor's plans in the event of a spill or release. In the event of a large quantity spill notify emergency services. Personnel discovering a spill will (only if safe to do so):

- Stop the spill immediately (if possible) or note source. If unsafe conditions exist, then leave the area, call emergency services, inform nearby personnel, notify the site supervisors, and initiate incident reporting process. The SC will be notified immediately.
- Extinguish sources of ignition (e.g., flames, sparks, hot surfaces, cigarettes, etc.)
- Clear personnel from the spill location and barricade the area.
- Utilize available spill control equipment in an effort to ensure that fires, explosions, and releases do not occur, recur, or spread.
- Use sorbent materials to control the spill at the source.
- Construct a temporary containment dike of sorbent materials, cinder blocks, bricks or other suitable materials to help contain the spill.
- Attempt to identify the character, exact source, amount, and extent of the released materials. Identification of the spilled material should be made as soon as possible so that the appropriate cleanup procedure can be identified.
- Assess possible hazards to human health or the environment as a result of the release, fire or explosion.
- A Spill Report will be completed, including a description of the event, root causes, and corrective actions.

21 Inspections

21.1 Management Health, Safety, Security, and the Environment Inspections

The Management Inspection Checklist (attached to this plan) is intended to facilitate PM leadership, provide an opportunity for PM's to mentor field staff on HSE and identify any big picture actions that need to be addressed. Observations that would improve global HSE program should also be included on the form. This Checklist does NOT take the place of a formal HSE audit. The PM will:

- Complete one checklist per month during field work when visiting the site. The PM may delegate completion to the task lead, field team leader, or Construction Manager (CM) if the project is short duration and a visit is not planned for.
- Complete applicable sections of the checklist (can by typed or hand-written). Address issues with the field team, taking the opportunity to mentor staff by identifying the "root cause" of observation (e.g., why are Safe Behavior Observations [SBOs] not being completed, had this hazard been noted by any other team members?).
- Send completed form to Project Delivery Manager, Sector HSE Lead, and RHSM for tracking and review. Original should be kept in the project files.

21.2 Project Activity Self-Assessment Checklists

In addition to the hazard controls specified in this document, Project Activity Self-Assessment Checklists are contained as an attachment to this HSP. The Project-Activity Self–Assessment Checklists are based upon minimum regulatory compliance and some site-specific requirements may be more stringent. The objective of the self-assessment process is to identify gaps in project safety performance, and prompt for corrective actions in addressing these gaps. The self-assessment checklists, including documented corrective actions, will be made part of the permanent project records and maintained by the SC.

The self-assessment checklists will also be used by the SC in evaluating the subcontractors and any client contractors' compliance on site.

The self-assessment checklists for the following tasks and exposures are required when the task or exposure is initiated and weekly thereafter while the task or exposure is taking place. The checklists will be completed by the SC or other CH2M HILL representative and maintained in project files.

- Chainsaw Self-Assessment Checklist
- Drilling
- Forklifts
- EME
- Hand and Power Tools
- Manual Lifting
- PPE

21.3 Safe Behavior Observations

SBOs will be conducted by SC 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. The SC or designee will perform at least one SBO each week for tasks/operations addressed in the project-specific HSP or

AHA. The SC or designee will complete the SBO form (attached to this HSP) for the task/operation being observed and submit them weekly to the regional point of contact.

22 Incident Notification, Reporting, and Investigation

(Reference CH2M HILL SOP HSE-111, *Incident Notification, Reporting and Investigation*)

22.1 General Information

This section applies to the following:

- All injuries involving employees, third parties, or members of the public
- Damage to property or equipment
- Interruptions to work or public service (e.g., hitting a utility)
- Incidents which attract negative media coverage
- Near misses
- Spills, leaks, or regulatory violations
- Motor vehicle accidents

Documentation, including incident reports, investigation, analysis and corrective measure taken, will be kept by the SC and maintained onsite for the duration of the project.

22.2 Section Definitions

Incident: an undesired event which results or could have resulted in loss through injury, damage to assets or environmental harm. This includes all of the definitions below.

Accident: an incident involving actual loss through injury, damage to assets, or environmental harm.

Near Miss: an unsafe act or incident which, in other circumstances, could have resulted in loss through injury, damage to assets, or environmental harm.

Serious Incident:

- All fatalities including contractors, subcontractors, third parties, or members of the public
- Kidnap/Missing Person
- Event that involves a fire, explosion, or property damage that requires a site evacuation or is estimated to result in greater than $ 500,000 in damage.
- Acts or threats of terrorism
- Spill or release of hazardous materials or substances that involves a significant threat of imminent harm to site workers, neighboring facilities, the community, or the environment.

22.3 Reporting Requirements

All employees and subcontractors' employees will immediately report any incident (including "near misses," as defined in the previous section) in which they are involved or witness to their supervisor.

The CH2M HILL or Subcontractor supervisor, upon receiving an incident report, will inform his immediate superior and the CH2M HILL SC.

The SC will immediately report the following information to the RHSM and PM by phone and e-mail:

- Project Name/Site Manager
- Date and time of incident
- Description of incident
- Extent of known injuries/damage
- Level of medical attention

- Preliminary root cause/corrective actions

The SC will complete an entry into the HITS database system located on CH2M HILL's VO (or if VO not available, use the hard copy Incident Report Form [IRF] and Root Cause Analysis Form and forward it to the RHSM) within 24 hours and finalize those forms within 3 calendar days.

The CH2M HILL team will comply with all applicable statutory incident reporting requirements such as those to OSHA and the police.

22.4 HITS System and Incident Report Form

It is the policy of CH2M HILL to maintain a HITS entry and/or IRF for all work-related injuries and illnesses sustained by its employees in accordance with recordkeeping and insurance requirements. A HITS entry and/or IRF will also be maintained for other incidents (property damage, fire or explosion, spill, release, potential violation, and near misses) as part of our loss prevention and risk reduction initiative.

22.5 Injury Management/Return-to-Work (for CH2M HILL Staff Only)

(Reference CH2M HILL, SOP HSSE-124, Injury Management/Return-to-Work)

22.5.1 Background

The Injury Management Program has been established to provide orderly, effective and timely medical treatment and return-to-work transition for an employee who sustains a work-related injury or illness. It also provides guidance and assistance with obtaining appropriate treatment to aid recovery, keep supervisors informed of employee status, and to quickly report and investigate work-related injury/illnesses to prevent recurrence.

To implement the Injury Management/Return-to-Work (IMRTW) Program successfully, supervisors and/or SC should:

- Ensure employees are informed of the IMRTW Program.
- Become familiar with the Notification Process (detailed as follows).
- Post the IMRTW Notification Poster.

22.5.2 The Injury Management/Return-to-Work Notification Process:

- Employee informs their Supervisor.
- Employee calls the Injury Management Program toll free number 1-866-893-2514 immediately and speaks with the Occupational Injury Nurse. This number is operable 24 hours per day, 7 days a week.
- Supervisor ensures employee immediately calls the Injury Management Program number. Supervisor makes the call with the injured worker or for the injured worker if needed.
- Nurse assists employee with obtaining appropriate medical treatment, as necessary schedules clinic visit for employee (calls ahead, and assists with any necessary follow up treatment) with the supervisor or SC accompany the employee if a clinic visit is necessary to ensure that employees receive appropriate and timely care.
- Supervisor/SC completes the HITS entry or IRF immediately (within 24 hours) and forwards it to the PM and RHSM.
- Nurse notifies appropriate CH2M HILL staff by e-mail (supervisor, H&S, HR, and Workers' Compensation).
- Nurse communicates and coordinates with and for employee on treatment through recovery.

- Supervisor ensures suitable duties are identified and available for injured/ill workers who are determined to be medically fit to return to work on transitional duty (temporary and progressive).
- Supervisor ensures medical limitations prescribed (if any) by physician are followed until the worker is released to full duty.

22.6 Serious Incident Reporting Requirements

(Reference CH2M HILL SOP HSE-111, *Incident Reporting, Notification and Investigation*)

The Serious Incident Reporting Requirements ensures timely notification and allows for positive control over flow of information so that the incident is handled effectively, efficiently, and in conjunction with appropriate corporate entities. This standard notification process integrates HSSE and Firm Wide Security Operations (FWSO) requirements for the consistent reporting of and managing of serious events throughout our operations.

22.6.1 Serious Incident Determination

The following are general criteria for determining whether an incident on CH2M HILL-owned or -managed facilities or program sites is considered serious and must be immediately reported up to Group President level through the reporting/notification process:

- Work related death, or life threatening injury or illness of a CH2M HILL employee, subcontractor, or member of the public
- Kidnap/missing person
- Acts or threats of terrorism
- Event that involves a fire, explosion, or property damage that requires a site evacuation or is estimated to result in greater than $ 500,000 in damage.
- Spill or release of hazardous materials or substances that involves a significant threat of imminent harm to site workers, neighboring facilities, the community or the environment.

22.6.2 Serious Incident Reporting

If an incident meets the "Serious Incident" criteria, the PM is to immediately contact the Crisis Manager at 720-286-4911, then follow the standard incident reporting procedure.

For all serious incidents this standard reporting process is implemented immediately so as to ultimately achieve notification to the Business Group President within 2 hours of incident onset or discovery, and notification to appropriate corporate Crisis Management Support Team.

ESBG U.S. Operations
Incident Reporting Flow Diagram

Direct Reporting Responsibility

Informational Reporting

Incident:

- Injury or illness
- Hazardous substance exposure
- Damage to property
- Fire or explosion
- Spill, release, potential violation, or permit exceedance

If incident is an **injury** to U.S. or Puerto Rico based CH2M HILL personnel contact the Occupational Health Nurse at 866/893-2514. Outside the U.S., the supervisor must notify the HR representative.

The Ops Leader is responsible for completing the Incident Report Form (IRF) in **HITS** when there is an injury to a CH2M HILL employee. The PM, CM or SC is responsible for completing the IRF for all other incidents. ***The IRF/HITS must be completed within 24 hours of the incident and does not replace the required immediate PM and RHSM***

Incident

Ensure that Emergency Responders have been notified as necessary

Employee or Subcontractor

Provide immediate notification.

Supervisor – Construction Manager - Safety Coordinator

Provide immediate notification by phone and e-mail to PM <u>and</u> RHSM. In addition, for spills, NOVs, and permit issues you may also call the EM.

CRISIS MANAGER:

<u>**If**</u> the incident meets the "**Serious Incident**" criteria, contact the Crisis Manager **(720 286 4911)**

Third Party – Incidents outside of our contractual obligations do not need to be communicated, unless they are serious and/or may affect CH2M HILL. The RHSM will determine the level of communication necessary for third party incidents.

Serious Incident:

- **Work related death, or life threatening injury or illness of a CH2M HILL employee, subcontractor, or member of the public**
- **Kidnap/missing person**
- **Acts or threats of terrorism**
- **Event that involves a fire, explosion, or property damage that requires a site evacuation or is estimated to result in greater than $ 500,000 U.S. in damage.**
- **Spill or release of hazardous materials or substances that involves a significant threat of imminent harm to site workers, neighboring facilities, the community or the environment.**

Responsible HSM (RHSM)

Immediately notify the Sector <u>OR</u> Client Program HSE Manager, immediately notify the Responsible Environmental Manager (EM) for <u>spills, NOVs, and permit issues</u>, and direct the incident investigation.

Client Program HSE Manager

Notify Sector HSM, and coordinate communication and incident investigations.

Immediate notification to the Sector HSM is not required for some minor incidents. Follow the program or sector protocol.

Sector HSE Manager

Coordinate communication, direct significant incident investigations, notify Sector EM for spills, NOVs, & permit issues.

HSSE Director

Provide decision-making assistance or direction for incident resolution.

Project Manager

Provide notification to the Sector <u>OR</u> Program Project Delivery (PD) or Operations (Ops) Manager or designee. Notification is based on program or sector specific criteria.

Immediate notification to the PD/Ops Manager is not required for some minor incidents. Follow the program or sector protocol.

Sector or Program PD/Ops Manager

Notify Client Program Manager <u>OR</u> Sector Director, provide guidance and follow the incident through to resolution.

Client Program Manager

Notify Sector Director; provide decision-making assistance or direction for incident resolution.

Keep unnecessary communication of serious incidents to a minimum

Sector Director

Provide decision-making assistance or direction for incident resolution.

ES U.S. Operations Director/ Executive Leadership Team

Provide decision-making assistance, direction for incident resolution, and make higher level notifications as necessary

Post-emergency incident communications regarding serious incidents at a CH2M HILL office or project (regardless of the party involved) shall be considered sensitive in nature and must be controlled in a confidential manner.

22.7 Incident Root Cause 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 SC (with support from RHSM), appropriate subcontractor personnel as necessary, the PM, and the responsible supervisor. More participants may be involved as needed to complete the investigation.

The Root Cause Analysis Form must be completed for all Loss Incidents and Near Loss Incidents. This form must be submitted to the investigation team for review.

For minor losses or near losses, the information may be gathered by the supervisor or other personnel immediately following the loss. Based on the complexity of the situation, this information may be all that is necessary to enable the investigation team to analyze the loss, determine the root cause, and develop recommendations. More complex situations may require the investigation team to revisit the loss site or re-interview key witnesses to obtain answers to questions that may arise during the investigation process.

Photographs or videotapes of the scene and damaged equipment should be taken from all sides and from various distances. This point is especially important when the investigation team will not be able to review the loss scene.

The investigation team must use the Root Cause Analysis Flow Chart 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.”

22.7.1 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

22.7.2 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.

22.7.3 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 timeframe for completion. Be sure the corrective actions address the causes.

Once the investigation report has been completed, the PM will hold a review meeting to discuss the incident and provide recommendations. The responsible supervisors will be assigned to carry out the recommendations, and will inform the SC upon successful implementation of all recommended actions.

- The RHSM will inform the Responsible Environmental Manager (REM) of any environmental incidents.
- Evaluation and follow-up of the IRF will be completed by the type of incident by the RHSM, REM, or FWSO. The Business Group HSE Lead will review all Business Group 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.

23 Records and Reports

An organized project filing system is essential for good documentation and recordkeeping. There are many benefits to an organized filing system:

- Other CH2M HILL employees can easily and quickly find documents
- Records are readily available for review
- Records may be needed during OSHA investigations, audits, or other legal matters
- Records may be needed on short notice in case of an accident, illness or other emergency
- Systematic recordkeeping aids in overall project organization

The project filing system will be established at the beginning of the project and maintained throughout all phases of construction and archived in accordance with CH2M HILL's Records Retention Policy. The information contained in the filing system will be updated regularly and/or as specified in this document. The PM and SC are responsible for collecting documentation, including subcontractor documentation, and maintaining a complete and organized filing system.

The following are examples of records that must be maintained as the project progresses:

- Exposure records includes air monitoring data (including calibration records), MSDSs, exposure modeling results.
- Physical hazard exposure records include noise, ionizing radiation, non-ionizing radiation, vibration, and lasers exposure assessments and measurements.
- Respiratory Fit Test Records
- Training Records
- Injury/illness reports and investigations
- Federal or State Agency Inspection Records
- Other Records
  - Ergonomic evaluations
  - HSE audits and assessments
  - Project-Specific HSE Plans
  - CSE Permits
  - Equipment inspections
  - Equipment maintenance
  - SBOs
  - Self-Assessment Checklists

Employee Signoff Form – Health and Safety Plan

EMPLOYEE SIGNOFF FORM

Health and Safety Plan

The CH2M HILL project employees and subcontractors listed as follows have been provided with a copy of this HSP, have read and understood it, and agree to abide by its provisions.

Project Name: Indian Head Site 20 **Project Number:**

EMPLOYEE NAME (Please print)	EMPLOYEE SIGNATURE	COMPANY	DATE

Chemical Inventory/Register Form

CH2MHILL

CHEMICAL INVENTORY/REGISTER FORM

Refer to SOP HSE-107, Attachment 1, for instructions on completing this form.

Location:
Hazard Characteristic Code (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 3

Chemical-Specific Training Form

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 will 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 PPE 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 will 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 will be made available for employee review in the facility/project hazard communication file.

CH2M HILL Health and Safety Plan

Attachment 4

Project Activity Self-Assessment Checklists/Permits/Forms

Chainsaw Self-Assessment Checklist
Drilling
Forklifts
EME
Hand and Power Tools
Manual Lifting
PPE

CH2M HILL Health and Safety Plan

Attachment 5

Behavior Based Loss Prevention System Forms

Activity Hazard Analysis

Pre-task Safety Plans

Safe Behavior Observation

Incident Report and Investigation

(use electronic form when possible)

HITS

ACTIVITY HAZARD ANALYSIS

Activity:	**Date**:
	Project Name:
Description of the work:	**Site Supervisor**:
	Site Safety Officer:
	Review for latest use: Before the job is performed

Work Activity Sequence (Identify the principal steps involved and the sequence of work activities)	**Potential H&S Hazards** (Analyze each principal step for potential hazards)	**Hazard Controls** (Develop specific controls for each potential hazard)

ACTIVITY HAZARD ANALYSIS

Work Activity Sequence (Identify the principal steps involved and the sequence of work activities)	**Potential H&S Hazards** (Analyze each principal step for potential hazards)	**Hazard Controls** (Develop specific controls for each potential hazard)

Equipment to be used (List equipment to be used in the work activity)	**Inspection Requirements** (List inspection requirements for the work activity)	**Training Requirements** (List training requirements including hazard communication)

ACTIVITY HAZARD ANALYSIS

	PRINT NAME	SIGNATURE	
Supervisor Name:	________________________	________________________	Date/Time:____________________
Safety Officer Name:	________________________	________________________	Date/Time:____________________
Employee Name(s):	________________________	________________________	Date/Time:____________________
	________________________	________________________	Date/Time:____________________
	________________________	________________________	Date/Time:____________________
	________________________	________________________	Date/Time:____________________
	________________________	________________________	Date/Time:____________________
	________________________	________________________	Date/Time:____________________
	________________________	________________________	Date/Time:____________________
	________________________	________________________	Date/Time:____________________
	________________________	________________________	Date/Time:____________________

CH2MHILL

PTSP and Safety Meeting Sign-in Sheet

Project:______________________________ Location: ________________ Date:_________________

Supervisor: ___________________________________ Job Activity:____

____

Attendees: Print Name Sign Name

____
____
____
____
____
____
____
____

List Tasks and verify that applicable AHAs have been reviewed:

____
____
____
___

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
__ CSE	__ Welding/cutting	__ Demolition
__Underground Utilities	__ Security	__ Poor communications

Other Potential Hazards (Describe):

____
____
____
___

Hazard Control Measures (Check All That Apply):

PPE
__ Thermal/lined
__ Eye
__ Dermal/hand
__ Hearing
__ Respiratory
__ Reflective vests
__ Flotation device
__ Hard Hat

Protective Systems
__ Sloping
__ Shoring
__ Trench box
__ Barricades
__ Competent person
__ Locate buried utilities
__ Daily inspections
__ Entry Permits/notification

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
__ Overhead line clearance
__ Underground utils ID'd

Fall Protection
__ Harness/lanyards
__ Adequate anchorage
__ Guardrail system
__ Covered opening
__ Fixed barricades
__ Warning system

Air Monitoring
__ Photoionization detector (PID)/flame ionization detector (FID)
__ Detector tubes
__ Radiation
__ Personnel sampling
__ LEL/O_2
__ No visible dust
__ 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

CSE
__ Isolation
__ Air monitoring
__ Trained personnel
__ Permit completed
__ Rescue

Medical/Emergency Response
__ 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
__ Drill rigs/geoprobe rigs
__ Cranes and rigging
__ Utilities marked

Training:
__ Hazwaste (current)
__ Construction
__ Competent person
__ Task-specific
__ FA/CPR
__ Confined Space
__ Hazcom

Underground Utilities
__Dig alert called
__3rd Party locater
__As-builts reviewed
__Interview site staff
__Client review
__soft locate necessary?

Incident Communications
__Work stops until cleared by TM/CM
__Immediate calls to TM/CM
__Client notification
__24-hour notification setup
__Clear communications

AHA' s
__reviewed and approved by HSM
__on site and current
__applicable for this day's work
__Communication and incident processes included?

Field Notes (including observations from prior day, etc.):

____
_
____
____
__

Name (Print): ________________________________

Signature:________________________________ Date:__________________

CH2MHILL

Safe Behavior Observation Form		
☐Federal or ☐Commercial Sector (check one)	☐Construction or ☐Consulting (check one)	
Project Number:	Client/Program:	
Project Name:	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, Safety and Training Advisory Committee [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…			

For Environmental Services (ES) Federal Sector projects please e-mail completed forms to: CH2M HILL ES FED Safe Behavior Observation

HITS Incident Report Hardcopy (Phase 1 – Initial Entry)

Phase 1 – Initial Entry

Type of Incident (May select more than one)

☐ Injury/Illness	☐ Spill/Release	☐ Near Miss
☐ Property Damage	☐ Environment/Permit	☐ 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?

- ☐ U.S., 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 SC been notified of this incident?

☐ Yes ☐ No ☐ Not Sure

Project SC: ______________________________

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 U.S. 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., National Pollutant Discharge Elimination System [NPDES] No. ST1234):

____

Substance and Estimated Quantity: ______________________________

Duration of Permit Exceedence: ______________________________

HSSE	Lessons Learned [Date] ESBG LL-11-xx
Subject	**[Insert Descriptive Name of Lessons Learned]**
CH2M HILL Project?	[Yes or No]
Situation	[Describe incident or situation that occurred in general terms. Try to be brief and avoid unnecessary details such as names of people or projects, Business Groups, divisions, dates, location, etc.]
Lessons Learned ***(Recommendations and Comments)***	• Bullet out any lessons learned, recommendations or other important "take away" information that would benefit others. Tie the recommendations to the incident or event, and avoid including information that is not directly tied to the event.
Submitted By	[Name/Office Location/Phone]
Additional Information Contact	[Name/Office Location/Phone]
Keywords/Categories	[Insert any keywords or incident categories that would aid in a search for this lessons learned]

Send completed Lessons Learned to the ESBG HSSE Director for posting and distribution. Please include a recommended distribution list.

CH2M HILL Health and Safety Plan

Attachment 6

Material Safety Data Sheets

CH2M HILL HEALTH AND SAFETY PLAN

Attachment 7

Tick Fact Sheet

Tick-Borne Pathogens — A Fact Sheet

Most of us have heard of Lyme disease or RMSF, but there are actually six notifiable tick-borne pathogens that present a significant field hazard. In some areas, these account for more than half of our serious field incidents. The following procedures should be applied during any field activity—even in places that are predominantly paved with bordering vegetation.

Hazard Recognition

An important step in controlling tick related hazards is understanding how to identify ticks, their habitats, their geographical locations, and signs and symptoms of tick-borne illnesses.

Tick Identification

There are five varieties of hard-bodied ticks that have been associated with tick-borne pathogens. These 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.

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. For this region, 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.

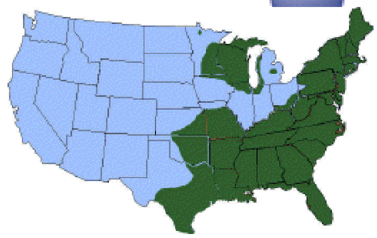
Illnesses and Signs and Symptoms

There are six notifiable tick-borne pathogens that cause human illness in the U.S.. 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)

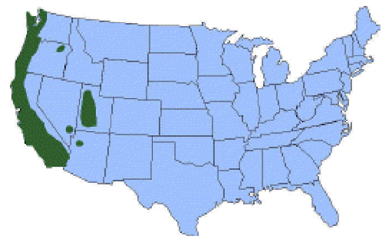
Symptoms will vary based on the illness, and may develop in infected individuals typically between 3 and 30 days after transmission. Some infected individuals will not become ill or may develop only mild symptoms. These illnesses present with some or all of the following signs and symptoms: fever, headache, 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. For Lyme disease, the bite area will sometimes resemble a target pattern. A variety of long-term symptoms may result if the illness is left untreated, including debilitating effects and death.

Deer Tick



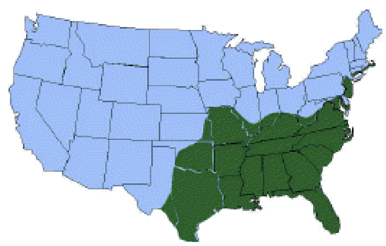
Distribution of Deer Tick (dark green)

From Left: adult female, adult male, nymph, and larvae Deer Tick (centimeters

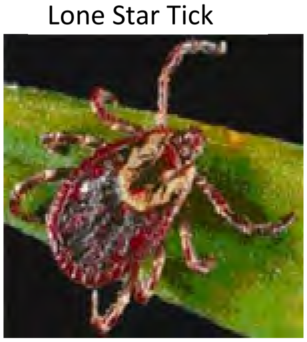


Distribution of Pacific Deer Tick (dark green)

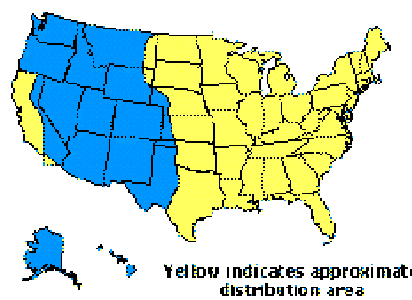
Lone Star Tick



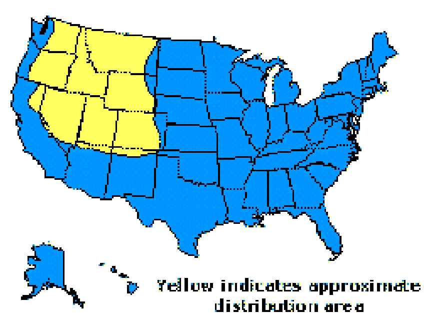
Distribution of Lone Star Tick (Green)



Dog Tick



Rocky Mountain Wood Tick



Hazard Control

The methods for controlling exposure to ticks include, in order of most- to least-preferred:

- 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—tick-borne 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 by between 72 and 100 percent 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 H&S controls, in compliance with applicable environmental requirements, and may be best left to the property owner or tenant or to a 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 to control exposure to ticks. Personal protection must include all of the following steps:

- So that ticks may be easily seen, 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
- 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 any time 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 situations such as hand-to-face contact, eating, drinking, and smoking when applying or using repellents.

Remove and wash clothes in accordance with the 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.

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 in the following list.

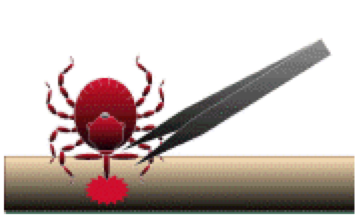
Tick Removal

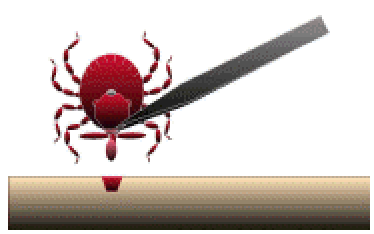
1. Use the tick removal kit obtained through the CH2M HILL Milwaukee warehouse, or a fine-tipped tweezers or shield your fingers with a tissue, paper towel, or nitrile gloves.

Tick Bites\Tick Remover.pdf

2. 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.

3. Avoid squeezing, crushing or puncturing 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.

4. 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.

5. After removing the tick, thoroughly disinfect the bite site and wash your hands with soap and water.

6. Should you wish to save the tick for identification, place it in a plastic bag, with the date of the tick bite, and place in your freezer. It may be used at a later date to assist a physician with making an accurate diagnosis (if you become ill).

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. Individuals previously infected with Lyme disease does not confer immunity—re-infection from future tick bites can occur even after a person has contracted a tick-borne disease.

The employee should contact the IMRTW provider, WorkCare, using the toll-free number 866-893-2514 to report the tick bite. WorkCare will follow-up with each CH2M HILL employee who reports a tick bite and is at risk of developing Lyme disease by monitoring for symptoms up to 45 days, and will refer the employee to a medical provider for evaluation and treatment as necessary.

Vehicle Accident Guidance—ESBG

Remember that if you a renting a non-CH2M HILL owned vehicle (short-term rental) in the U.S., you should carry the insurance card from the state where your driver's license is issued.

If you operate a fleet vehicle, carry the insurance card where the vehicle is registered.

Please see link below to print out an insurance card (for **CH2M HILL employees** only). The page shows state-specific restrictions and the definitions of hired, owned, etc., vehicles.

https://communities.int.ch2m.com/legal/insurance/Shared%20Documents/AutoID_Cards.aspx?PageView=Shared

For ALL Vehicles if you are in an accident:

1. If you are injured, call 911 for emergency medical treatment or 1-866-893-2514 to contact the CH2M HILL Occupational Nurse/Physician for minor injuries. If you feel you have not been injured, contact the RHSM for guidance on whether calling the CH2M HILL Occupation Nurse/Physician is applicable.

2. **Call the Police--**For any vehicle accident/damage, it is recommended that the local police (or site security/emergency services if working on a client site that provides such services) be called to determine if a report needs to be filed. In some instances, a report may not be required (during accident alerts, or in public parking lots). Document that the authorities were called and follow up with any guidance they give you. State requirements vary. If a report is filed, obtain a copy.

3. Notify Supervisor, (and PM/RHSM if working on a project site)

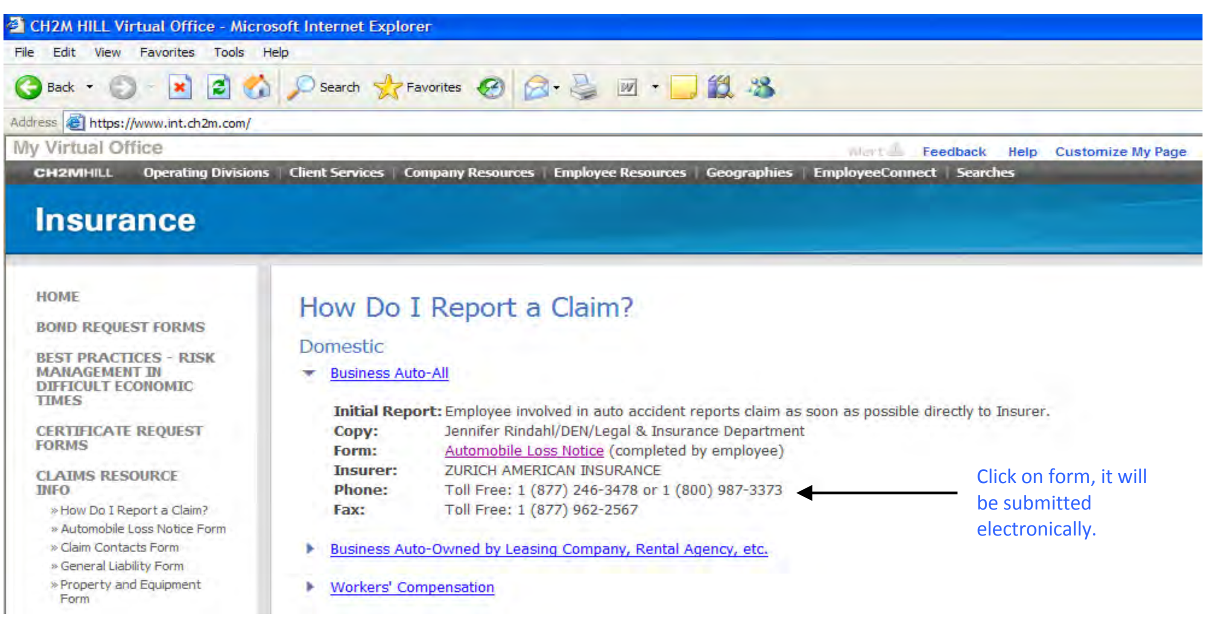
4. Complete a HITS report on the VO.

Additional Steps for FLEET VEHICLES:

Definition: These are vehicles rented for greater than 90 days or rentals that are leased (either through Automotive Rental, Inc.[ARI] or leases from other companies [older fleet vehicles]).

Report the accident to the following:

1. Fill out and Auto Loss Notice on the VO (click "Company Resources," then "Corporate Groups," then "Insurance"). See the following screen shot:



Click on form, it will be submitted electronically.

2. Contact Zurich (1-877-246-3478 or 1-800-987-3373).

3. Contact Linda George/DEN at 720-286-2057.

Note: If you are an ES employee that happens to use an Office of the Medical Investigator (**OMI**) **vehicle** on a project and get into an accident, you must also contact Michelle Garlington/DEN (720-286-4273).

<u>Additional Steps for RENTALS:</u>

1. Fill out and Auto Loss Notice on the VO (click "Company Resources," then "Corporate Groups," then "Insurance"). See previous screen shot.

2. Call 1-800-VISA-911 (**only** if the car has been **rented for less than 31 days**—they provide some additional physical damage coverage in this time period).

3. Call Zurich (1-877-246-3478 or 1-800-987-3373).

4. Call the rental company (Budget, National, Enterprise, etc.).

5. Call Jennifer Rindahl/DEN at 720-286-2449.

<u>For Personally Owned Vehicles (POVs):</u>

CH2M HILL does not provide auto insurance for POVs, it is responsibility of the owner. If you are in a vehicle accident conducting company business, contact the police as above, supervisor, and 911 or CH2M HILL's occupational nurse/physician as previously stated. Complete a HITS report. Refer to the Employee Handbook/Policies, assistance for meeting personal insurance deductibles (up to $500) is available with proof of insurance and deductible.

If using your POV for extended project use, notify the PM to make sure a rental car is not needed. Check your insurance policy for guidance on using the POV for business use.

<u>Additional Resources:</u>

Business Auto Insurance Manual

https://www.int.ch2m.com/webuploads/newsgenerator/travel/news/business_auto_manual[1].pdf

Claims Resource Manual

https://www.int.ch2m.com/intrnl/voffice/corp/insurance/InsHome.asp

Attachment 8

Observed Hazard Form

CH2MHILL

OBSERVED HAZARD FORM

Name/Company of Observer (*optional*):

Date reported**:**____________________

Time reported**:**______________________

Contractor/s performing unsafe act or creating unsafe condition**:**

1. ____

2. ____

3. ____

Unsafe Act or Condition**:**

____
____
____
____
____
____
____
____
____
____

Location of Unsafe Act or Condition**:**

Name of CH2M HILL Representative:

Corrective Actions Taken**:** Date**:** ____________

- ____ ____________________Injury or illness
- Hazardous substance exposure
- Damage to property

Project Safety Committee Evaluation**:** Date**:** ____________

____
____
____
____
____

Stop Work Order Form

CH2MHILL

Stop Work Order

REPORT PREPARED BY:

Name:	**Title:**	**Signature:**	**Date:**

ISSUE OF NONPERFORMANCE:

Description:	Date of Nonperformance: ________________

SUBCONTRACTOR SIGNATURE OF NOTIFICATION:

Name:	**Title:**	**Signature:**	**Date:**

***** Corrective action is to be taken immediately. Note below the action taken, sign and return to CCI.* Work may not resume until authorization is granted by CH2M HILL Constructors, Inc. Representative,***

SUBCONTRACTOR'S CORRECTIVE ACTION

Description:	Date of Nonperformance: ________________

SUBCONTRACTOR SIGNATURE OF CORRECTION

Name:	**Title:**	**Signature:**	**Date:**

CH2M HILL HEALTH AND SAFETY PLAN

Attachment 10

Agency Inspection Target Zero Bulletin

TARGET ZERO Bulletin

Subject: HSSE Agency Inspections (OSHA, USEPA, DOT, State Health Department)

Do you know what YOU would do if an agency inspector arrived at your site unannounced?

Recently, a State OSHA inspector made an unannounced visit to one of our Federal project sites. OSHA, USEPA, and authorized state or local agencies have authority to inspect any facility that is subject to health, safety, and environmental legislation. Inspections may be announced or unannounced. This particular inspector indicated that the project was targeted for an inspection because the work was funded by the American Recovery and Reinvestment Act (ARRA).

Enterprise SOP HSE-201, *Agency Inspections and Communications,* describes the responsibilities, procedures, and requirements associated with inspections conducted by external regulatory agencies, as well as the methods for communicating information to key individuals. This Target Zero Bulletin is a brief summary of what to do in the event of an agency inspection at your site. Refer to the SOP for more specific guidance.

Notification of Inspections

- If the inspection is an announced regulatory agency inspection, the PM should notify the RHSM and REM well in advance of the inspection.
- If an unannounced agency inspector visits one of our projects, Field personnel must immediately notify the project ERC. Typically the ERC is the SC.
- The ERC must immediately notify the RHSM/REM, as appropriate, of unannounced inspections, or designate someone to call the RHSM/REM. The RHSM/REMs can provide guidance to the field staff and PM.

Inspector Credential Verification

- Upon arrival, the ERC must request the inspector to provide official credentials. Record the inspector's name and office phone number or obtain the inspector's business card.
- The inspector will sign the visitors log and be given a site-specific health, safety, and environmental protection briefing.
- The inspector will meet any site access requirements associated with security clearances, specialized training, and medical monitoring. The CH2M HILL representative will verify that the inspector possesses these requirements; access will only be granted to those areas where appropriate access requirements are met. Some inspectors have the authority to gain access to any work area at any time, such as an inspector with a search warrant. In these cases, we can stop work operations as necessary to protect the safety of the inspector(s).

Opening Conference

- The CH2M HILL PM, ERC, RHSM, or REM, and the inspector will determine attendees for the opening conference. The RHSM (for OSHA and other worker H&S inspections) or REM (for environmental inspections) will join the opening conference via conference call.
- The inspector will inform CH2M HILL of the purpose of the inspection and provide a copy of the complaint, if applicable.
- The inspector will outline the scope of the inspection, including employee interviews conducted in private, physical inspection of the workplace and records, possible referrals, discrimination complaints, and the closing conference(s).

Requests for OSHA Logs

- An OSHA inspector may request to review the project OSHA Injury/Illness log, better known as the OSHA 300 Log. Contact your RHSM for assistance in obtaining the OSHA 300 Log.

- Field projects with a continuous duration of 1 year or longer are considered to be separate establishments and are required to maintain an OSHA 300 log specific to the project. The project OSHA 300 log should be maintained onsite and kept current.
- Recordable injuries and illnesses sustained on field projects less than 1 year in duration are maintained on the CH2M HILL office log where the injured employee is based.

The Inspection

- The scope of the inspection will be limited to that indicated by the inspector in the opening conference. The inspector will be escorted to relevant areas only. The ERC or other designated by the RHSM or REM must accompany the inspector during the inspection.
- Ensure that the inspection is limited to the scope that the inspector disclosed during the opening conference. The ERC should always take notes which identify: areas inspected, machinery or equipment and materials examined, employees or other persons interviewed, and photographs taken by the inspector.
- The inspector will observe safety, health, and environmental conditions and practices and document the inspection process. The inspector may also take photos and instrument readings, examine records, collect air samples, measure noise levels, survey existing engineering controls, and monitor employee exposure to toxic vapors, gases, and dusts.
- CH2M HILL should gather duplicate information (photographs, readings, samples) in the same manner and condition as the inspector. If the equipment needed to take duplicate samples is not onsite, ask the inspector if the sampling can wait until the equipment is available. If samples are taken, request a description of the tests that the agency intends to perform on the samples and request results as soon as they are available.
- Employees may be questioned during the inspection tour. The employee can refuse to speak to an inspector, can speak to the inspector with a company representative (including management) present, or can speak to the inspector privately. It is CH2M HILL policy that employees who wish to speak to the inspector are not discriminated against, intimidated, or otherwise mistreated for exercising their rights during compliance inspections.
- Copies of documents should not be provided to the inspector without the approval of the RHSM or REM or Legal Insurance Department (LID). **DO NOT** voluntarily release documents. Respond only to inspection team requests.
- During the course of the inspection, the inspector may point out violations. For each violation, the CH2M HILL representative should ask the inspector to discuss possible corrective action. Where possible, violations detected by the inspector should be corrected immediately and noted by the inspector as corrected.
- For those items which cannot be corrected immediately, an action plan will be formulated for timely correction. In any instance, employees exposed to hazards will be removed from the area.

Closing Conference

After the inspection, a closing conference is normally held as follows:

- The CH2M HILL PM, ERC, RHSM, or REM will be involved via conference call in the closing conference, at a minimum;
- The inspector will describe the apparent violations found during the inspection and other pertinent issues as deemed necessary by the inspector. CH2M HILL will be advised of their rights to participate in any subsequent conferences, meetings or discussions. Any unusual circumstances noted during the closing conference will be documented by the ERC;
- The inspector will discuss violations observed during the inspection and indicate for which violations a citation and a proposed penalty may be issued or recommended;
- The ERC will request receipts for all samples and approved documents photocopied by the inspector, request a photocopy of the inspector's photograph log, and request a copy of the final inspection report; and
- Any documentation from an agency inspection must be transmitted immediately to the RHSM or REM, and LID.

Unannounced regulatory agency inspections may happen at any time on our projects -

Get your RHSM/REM and PM involved immediately if an Inspector arrives.

CH2M HILL HEALTH AND SAFETY PLAN

Attachment 11

Completed CH2M HILL AHAs

Appendix E
Standard Operating Procedures

MRP – SOP – 0001

MUNITIONS RESPONSE PROGRAM (MRP)

STANDARD OPERATING PROCEDURE (SOP)

SURFACE MUNITIONS AND EXPLOSIVES OF CONCERN (MEC)

& SUBSURFACE ANOMALY AVOIDANCE

1.0 OBJECTIVE:

Provide safe procedures to avoid Munitions and Explosives or Concern (MEC) during visitor/personnel escort, land survey, vegetation reduction, sediment sampling, soil boring, drilling, direct push technology-core sampling, or other environmental or construction activities conducted in an environment where the presence of MEC is suspected.

2.0 PURPOSE:

This SOP provides guidance for avoiding surface MEC (e.g., Unexploded Ordnance (UXO), Discarded Military Munitions (DMM)), Material Potentially Presenting an Explosive Hazard (MPPEH), and subsurface anomalies.

3.0 APPLICABILITY:

This SOP applies MEC avoidance procedures per Department of Army Engineering Pamphlet (EP) 75-1-2 Munitions and Explosives of Concern Support During Hazardous Toxic and Radioactive Waste (HTRW) and Construction Activities.

4.0 TECHNCIAL GUIDANCE:

This SOP lists processes and procedures that comply with the following sources:

- DOD 6055.09-M, Ammunition and Explosives Safety Standards, February 2008
- USN Environmental Restoration Program (MRP Chapter 12) August 2006
- NAVSEA OP 5Volume 1, Ammunition and Explosives Safety Ashore, July 2009;
- NOSSA Instruction 8023.11(series), Standard Operating Procedure Development
- USAF Manual 91-201, Explosive Safety Standards, November 2008
- DA Pamphlet 385-64, Ammunition and Explosives Safety Standards, October, 8, 2008
- DA Field Manual (FM) 21-16, Unexploded Ordnance (UXO) Procedures, August, 1994
- DA Engineering Manual (EM) 1110-1-4009, Military Munitions Response Actions, June, 2007
- DA Engineering Pamphlet (EP) 1110-1-18, Military Munitions Response Process, April 2006
- DA Engineering Manual (EM) 385-1-97, Explosives, Health and Safety, September 2008
- **Note: Electronic copies for the sources listed above are available via CH2M HILL SUXOS Laptop Computer**

5.0 SOP VALIDATION RECORD:

SOP Title: MEC Anomaly Avoidance .... Work Instruction Identification/ SOP: # MRP-SOP-0001

Author: K. Lombardo Date: December 1, 2009................. Revision Date: 02/16/2012

Review: G. DeMetropolis, Date: February 16, 2012 .... Approval; J. Bowles

Validation Date: December 14, 2009 .... Process Observer: Kevin Lombardo, December 14, 2009

6.0 HAZARDOUS MATERIALS:

Hazardous Chemicals: None; Product Name: N/A; Material Safety Data Sheets: N/A; Health Hazards: N/A

7.0 EMERGENCY RESPONSE INFORMATION

Work Site Name (location) address/building # Street):

____

Nearest intersection (cross streets) or entrance gate:

____

Safe Area Rally Point (gate/building or intersection) Note: Rally Point should be upwind of work location:

____

UXO Qualified Technician Incident Commander: (name) ____________________

Personnel Injury or Medical Distress:

1. Summon Emergency Medical Services (EMS)
2. Administer Fist Aid and/or CPR
3. Notify Project Manager
4. PM implements CH2M HILL SOP 111, Incident Notification, Reporting, and Investigations.

Fire:

1. Evacuate personnel from the Munitions Response Site and Area to safe rally point
2. Notify Fire Department of "Work site Name," fire location, and personnel safe rally point
3. Obtain head count, ensuring all personnel are present and or accounted for.
4. Notify Project Manager
5. PM implements CH2M HILL SOP 111, Incident Notification, Reporting, and Investigations.

(Fire/Rescue radio call sign): ______________________ **Phone #** ______________________

Medical Services radio call sign: ___________________ **Phone #** ______________________

Range Control radio call sign: _____________________ **Phone #** ______________________

Project Manager POC: ____________________________ **Phone #** ______________________

Identify local disaster warning system (radio, PA, phone, other):________________________
Flag(s): ____
Warning Bells/Horns/Sirens/Lights/Strobes: ____
Public Address System: ____
Weather Radio Channel: ____
Other: ____

8.0 PERSONNEL ROLES AND RESPONSIBILITY

Note: Roles and responsibilities are dependent upon work plan direction; one or all roles and responsibilities may be applicable.

1. Project/Construction Manager (P/CM): Provides the necessary resources and personnel to safely and efficiently accomplish the scope of work. Ensures CH2M HILL unexploded ordnance (UXO) personnel shall be qualified in accordance with:
   - OPNAVINST 8020.14/MCO P8020.11 (series).
   - And are certified to perform the job assigned and that the certification is current. Contractors who perform those duties described in NAVSEA OP5, paragraph 2-3 involving ammunition and explosives shall comply with NAVMED P117 Article 15-107.
   - Prior to site operations, CH2M HILL will verify training, medical qualification statements by physicians, and conformance to substance abuse testing and reporting programs.
   - Shall confirm active explosive certification program conformance for personnel compliance to requirements for UXO personnel identified IAW DDESB Technical Paper (TP) 18, and monitors these personnel for conformance to the Bureau of Alcohol, Tobacco, Firearms, and Explosives, Safe Explosives Act 2003 Certification requirements for "Employee Possessor," and or "Responsible Person."
2. Senior UXO Supervisors or Unexploded Ordnance Technician III or II: Supervises the operational resources necessary to implement, and accomplish this procedure and requirements set forth within the Work, Health, Safety, Quality and Accident Prevention Plans. May stop work at anytime to prevent accidents, remedy unsafe conditions, stop an unsafe act, or question the safety of a process or procedure or

observe non conformance to this SOP and/or plans. Provides a Site Specific Tailgate Safety Briefing to include MEC, construction, industrial, environmental, and natural safety hazard awareness. Provides the plan of day. As applicable provides a Hazardous Materials briefing for items used, consumed, or required for this SOP. Brief personnel on communications, security, emergency/medical response, evacuation, rally points, IAW with project instructors, and plans. Also, informs personnel to prevent disclosure of classified work, site observations, or information.

3. Non-UXO Qualified Personnel are obligated to follow guidance within this SOP, Work, Health and Safety and Accident Prevention Plans.

9.0 PRE-OPERATIONAL CHECK LIST

1. ( ) CH2M HILL Inc. Safety Risk Evaluation (SRE) and Explosives Safety Submission Determination (ESSD) (Navy Projects)	2. ( ) Project Task/Work/ Instructions
3. ( ) Work Plan/Accident Prevention Plan/ Health and Safety Plan	4. ( ) Personal Protective Equipment (PPE) IAW Safety Plan
5. ( ) Emergency P.O.C List	6. ( ) Directions and map to hospital
7. ( ) Communications (2 methods)	8. ( ) First aid/Fire Extinguisher/- (GPS/compasses optional)

10.0 ANOMALY DETECTION EQUIPMENT (as required by project instruction)

( ) Ferrous Metal Detector (Schonstedt GA 52CX or Ferex 4.021 MK 26 Mod 0 or equivalent), with extra batteries, carry case, & instruction manual (as required by project instructions)

( ) All Metals Detector (White Spectrum XLT or equivalent) with extra battery, carry case, & instruction manual (as required by project instructions)

( ) Down-hole Instrument Direct Push Technology – Schonstedt MG 230 Gradiometer maximum 2.12-inch "Outside Diameter" (OD) Probe Head - Extra batteries and instruction manual (as required by project instructions)

11.0 EXPLOSIVE ORDNANCE RECONNAISSANCE EQUIPMENT

WARNING

Direct physical contact with or movement of MEC or MPPEH is not authorized.

( ) Tape Measure, ruler, pen/paper, item for scale perspective (e.g. dollar bill),

( ) Camera (digital), with spare batteries (as required by project instructions)

( ) Small dry erase white board and dry erase marker for photograph item number, date, time, location, and description.

12.0 GENERAL INFORMATION	
CATEGORY **Surface MEC/Anomaly Avoidance**	**DIRECTIONS** **(S)** = Safety, **(O)** = Operations, **(Q) =** Quality Control
Note: (o) PM shall obtain MISS Utilities Check and or local Dig (intrusive) permits prior to intrusive actions (such as use of direct push technology, drilling, and use of hand augers) **(WARNING)** **Fire: (s)** Do not attempt to fight a fire, evacuate area, move upwind or crosswind to safe rally point, notify fire department. **Wildlife: (s)** Aggressive/defensive – Avoid wildlife –withdraw from area **Hunters: (s)** Withdraw from area, retreat to vehicle, contact project authority **CWM: (s)** Evacuate upwind to safe rally point, mark area on map, contact PM **Severe Weather (lighting, winds, and storms): (s)** Evacuate to vehicle, follow PM guidance	
13.0 SAFETY	
Munitions Response Group Safety Manager	George DeMetropolis/SDO Telephone (Office): (619) 687 – 0120, Ext. 37239 Telephone (Cellular): (619) 564 – 9627
Safety Plan, Accident Prevention Plan and Activity Hazard Analysis	(s) All field personnel require reading, compliance, and acknowledging they understand and comprehend the safety information contained within these plans, SOP and AHA; attesting through signature and date
Visitors access to work location	(s) All visitors (contract/transient/witness) require a safety briefing, wearing of PPE IAW site specific safety plan, and conformance to UXO Technician instructions.
Safety Meeting:	(s) Each morning – Project Personnel shall participate in a tailgate safety briefing, discussing the operational activities (plan of the day), MEC/HTRW hazards/risks, safety controls, and emergency procedures; daily weather forecast, work activity OSHA PPE

	level, insect/poisonous plant avoidance, and heat/cold stress prevention. Personnel shall sign and date, the safety briefing acknowledgment form; confirming individual participation, understanding, and comprehension prior to operations. Personnel who do not participate in the safety briefing or, understand, or comprehend the safety briefing may not access work areas.
Safety Pre-field operations check list	(s) ( ) First Aid Kit (serviceable and supplies within shelf life) (s) ( ) Fire Extinguisher 10BC (or greater) (charged/indicator green) (s) ( ) Water (minimum 1 liter per person) (s) ( ) Cell phone/identified alternate land line location/or two/way Radio (s) ( ) Identification of wind direction, and rally points (s) ( ) PPE IAW Activity Hazard Analysis (s) ( ) Vehicles unlocked; keys in announced location (s) ( ) Insect repellant/sun screen (available)
Equipment Check-out: 1) Schonstedt – GA52CX magnetometer or equivalent 2) White's (E series) Spectrum model XLT Metal Detector or equivalent 3) Schonstedt gradiometer MG 230 for Down-hole or underwater search or equivalent 4) Forster Ferex 4.021 models K,L, & W or MK 26 MOD 0 magnetometer for down-hole or underwater search or equivalent	(o) Assemble/inspect, IAW manufacture instructions (o) Test geophysical instruments against a known source (ferrous or non-ferrous) for instrument response. (o) Source (ferrous) Schedule 40, 2-inch x 5-inch steel pipe or equivalent (q) Pass/Fail - instrument shall detect source on surface at 12-inches above item/fail non-detect - replace instrument (o) Source on surface (non-ferrous) ¾-inch x 6-inch Brass Pipe nipple (aka) couple fitting or equivalent (q) Pass/Fail - instrument shall detect source on surface at 6-inches above item/fail non-detect - replace instrument

	(q) Name of individual recording geophysical instrument source test results by instrument manufacturer with: type, model, serial number, by the date of daily equipment check. Record results for pass/fail source test with remarks. Reject and replace geophysical instrument that does not pass quality control source test.
14.0 SITE ACCESS	
WARNING: UXO Technician(s) shall not make physical contact with MEC, or commercial explosives. UXO Technicians assigned to implement this SOP shall not intentionally move MEC or explosives, incendiaries, smokes, propellants, or commercial explosives. **NOTE:** If MEC, to include Unexploded Ordnance (UXO), Discarded Military Munitions, (DMM) or Material Potentially Presenting an Explosive Hazard (MPPEH) are encountered, the UXO Technician shall respond IAW 3R training, avoid such items, and notify Project Manger IAW site-specific project instructions.	(o) Implement 3R (R, R, R) process, and procedures. (o) Recognize MEC, UXO, DMM, and or MPPEH; offset mark anomaly location with flag, ribbon, paint, stakes, other location identifier (o) Retreat from MEC location and avoid MEC location (o) Report & record MEC location in logbook and contact Project Manager IAW project instructions to request additional guidance. **Note:** MR Safety may instruct UXO Qualified Technician to perform a zero contact Explosive Ordnance Reconnaissance of the item requesting information for type by function, condition, filler, and nomenclature (if visually possible), supported by photographs of the item.
15.0 EXPLOSIVE ORDNANCE RECONNAISSANCE (EOR)	
EXPLOSIVE ORDNANCE RECONNAISSANCE Reconnaissance involving the investigation, detection, location, marking, initial identification, and reporting of suspected MPPEH in order to determine future action	
EOR Method UXO Qualified Technician is required prior to performing an Explosive Ordnance Reconnaissance to review Department of the Army, Field Manual (FM) 21-16, Unexploded Ordnance (UXO) Procedures, August 1994 – A copy can be obtained from:	(o) Use general Explosive Ordnance Disposal (EOD) safety precautions until munition type, fuzing , condition, and filler are identified (o) Upon identification, of type by function, fuzing, and condition use general EOD safety precautions for the category of munition (e.g.

WWW.UXOINFO.COM or from CH2M HILL MR Operations, Kevin Lombardo/WDC	Rocket; avoid approach to the front and rear of item, etc). (s) Approach Unexploded Ordnance (UXO) 45^0 to the rear (s) Do not cast shadows over UXO fuze (s) Remain cognizant to avoid dispensed wires, filaments, or other items that could initiate movement (s) Remain cognizant of Electromagnetic Hazardous Radiation, to Ordnance (HERO) precautions.
Information Recovery	(o) Photograph item from each vantage point. Identify each photograph with item name, view (side, front, rear, etc.), and distance from camera to item, (f-stop & shutter speed and film speed if applicable). It is required that a photograph log be kept for each item. Use a ruler in photo to demonstrate perspective of the item. (o) Close-up photograph fuze, markings, nose, tail, and or markings
16.0 PERSONNEL ESCORT	
Personnel Escort A minimum of one UXO qualified Technician(II) shall escort non-UXO qualified site personnel conducting access to a Munitions Response Area or Site The UXO qualified person shall visually search the surface of walking paths, roads, and parking areas to locate, mark, and avoid MEC during walking, driving, or setting-up equipment.	(o) Establish a wind streamer of tape/ribbon (flag) within/near the project site to observe wind direction. (o) A UXO Technician shall visually search the surface area, for MEC/HTRW to avoid such items. The UXO Technician may augment the visual search with the application of a geophysical instrument to detect surface/subsurface ferrous and or non-ferrous anomaly sources for the purpose of anomaly avoidance (o/s) When escorting non-qualified UXO personnel, a UXO Technician shall lead, and non-UXO qualified personnel shall follow along a path identified by the UXO Technician. (o) The UXO Technician shall identify surface hazards (MPPEH) and avoid such hazards. The location of a hazard requires, the UXO Technician to communicate the location to non-UXO qualified persons for avoidance around the item. (s) Communication can be by hand signals (pointing), or marking with flags, tape, ribbon, paint, stakes, or other means identified during a safety briefing.

	(s) Essential Personnel Limits - MR Escorts are a minimum of one UXO qualified Technician II or above, to no more than six (6) non-qualified persons. (s) Non UXO qualified personnel shall not approach and avoid a marked MPPEH or HTRW hazard.

17.0 MEC AVOIDANCE SUPPORT

LAND SURVEY, SEDIMENT SAMPLING, GROUNDWATER COLLECTION, ENDANGERED SPECIES SAMPLING/MONITORING

Applicable to Visitors, Land Survey, Sediment Sampling, Groundwater Collection, Endangered Species Sampling/Monitoring

WARNING: Subsurface intrusive acts could initiate MEC, through physical contact, movement, or shock.	(o) A UXO Technician shall search each intrusive point from the surface with a magnetometer and or all metals detector in accordance with the instruments manufactures instructions, to locate ferrous and/or non-ferrous subsurface anomalies. Location of such subsurface anomalies requires the placement of an offset marker (pin flag a minimum of 12-inches) to the north of the greatest signal strength for the anomaly. (s) For land survey and sampling activities where detection of an anomaly occurs, an alternative location free of ferrous and non-ferrous anomalies is required to proceed with intrusive activities. (q) The UXO Technician shall note within the daily logbook the rejection of the primary location and selection of the alternative location, with a written description of direction and feet/inches for the offset location from the primary point.

NOTE:

Personnel performing subsurface intrusive activities for the purpose of land survey and environmental sampling require a UXO Technician to search the subsurface with either or both (dependent on MEC site-specific history) a magnetometer and/or all metals detector to confirm the subsurface is free of ferrous and or non-ferrous anomalies.

A UXO Technician shall mark the boundaries /limits for ingress/egress access from a safe area (i.e.: road) to the work activity location or provide escort to and from the work activity location.

18.0 VEGETATION REDUCTION MEC AVOIDANCE (MANUAL/MECHANICAL)

WARNING: DO not apply vegetation cutting	(o) A UXO Technician shall escort vegetation reduction personnel, perform a visual and/or magnetometer and/or all metals detection instrument search of surface

<table>
<tr><td>closer than six-inches to ground surface.

Vegetation reduction actions that occur less than six-inches above ground surface, may result in movement, or shock to MEC, resulting in an unintentional detonation or functioning as designed of the item.</td><td>access routes, walking paths, and vegetation reduction locations for MEC/HTRW and or obstruction hazards.

(o) The UXO Technician shall operate a magnetometer and or all metals detection instrument to locate surface anomalies with potential to be a hazard to vegetation reduction crews.

(o) The UXO Technician shall perform a visual surveillance of the surface to locate surface hazards (MEC, HTRW) or obstructions to equipment, mark the location and instruct vegetation reduction crews to avoid the location.

(s) The UXO Technician shall remain away from the immediate operating radius of powered equipment and remain alert for flying debris

(s) The UXO Technician shall wear high visibility outerwear, use hearing, and eye protection, and avoid swing radius of powered equipment.</td></tr>
<tr><td colspan="2">Warning :

Personnel performing vegetation reduction activities shall not operate equipment closer than 6-inches to the ground thus, all brush cutting equipment (chain saws, weed whackers, string trimmers, brush cutters, bush hogs, hydro-ax, or debarking equipment) shall operate six-inches or greater above ground.</td></tr>
<tr><td colspan="2">19.0 MEC AVOIDANCE (DOWN HOLE)</td></tr>
<tr><td>WARNING:

When applying MEC avoidance procedures for drilling or the use of direct push technology, the steel mass of drill rigs and direct push technology DPT power plants will influence gradiometers, and magnetometer reporting instruments. Thus, drill rigs and DPT equipment shall be withdrawn a minimum of ten feet from intrusive points while performing down-hole avoidance search.</td><td>(o) Prior to drilling, the UXO Technician will conduct a visual reconnaissance of access paths and drilling area. The reconnaissance will include locating the designated sampling or drilling location(s) ensuring that the locations do not have surface MEC, or MPPEH, and magnetometers or all metal detection search do not indicate the presence of subsurface anomalies. If detection of subsurface anomalies occurs, at the sampling point, the sampling point is abandoned. Once the designated sampling point has been determined free of anomalies, an access route for the sampling crew's vehicles is searched. The access path requires twice the width of the widest vehicle and marking along the sides with flags, ribbon, engineer tape, stakes, or equivalent to define limits.

(s) If an observation of MEC or MPPEH should occur, the UXO Technician shall mark the item, avoid it, and notify the PM for either military EOD or UXO Contractor</td></tr>
</table>

	support. (o) A UXO Technician will clear each work site for drilling/DPT and clearly mark the safe to walk, and drill or DPT, boundaries. Each drill/DPT safe area will be large enough to accommodate the drilling equipment and provide a work area for the crews. As a minimum, the safe area will be a rectangle, with a side dimension equal to twice the length of the largest vehicle or piece of equipment for use on site.
NOTE: (p) Drilling and application of DPT may require an ingress route and pad turning radius, twice the width, and length of the mechanical equipment.	
NOTE: MEC may exist within the subsurface up to 30 feet below ground surface, dependent on site-specific history. Refer to project instruction to determine maximum depth for down-hole MEC avoidance support.	
The UXO Technician is required to escort personnel and remain with personnel when sampling/drilling at an MRP or MEC/MPPEH suspect site.	(o) Soil bore holing may be by hand auger, power-auger, drilling, DPT. A UXO Technician will examine, prior to sampling/drilling, the borehole location with a down-hole gradiometer or magnetometer, a minimum of every one (1) foot, to the deepest sampling depth or a maximum of 30 feet below ground surface to ensure avoidance of anomalies, or to depth identified within the project instruction.
WARNING: Drilling equipment may produce injury from snapping cables, pinch points, chain failures or falling booms, derricks, and drill piping. Avoid the immediate operational radius of drillers when supporting efforts.	(o) Drilling down–hole monitoring requires at a minimum of one (1) foot increments of search, during the actual well drilling operation. This will require the withdrawal of the drill rod or augers from the hole and moving the drill rig a minimum of 10 feet or enough feet away from the drill-hole location to prevent the metal in the rig from influencing the magnetometer/gradiometer. (o) The UXO Technician shall perform down-hole monitoring for anomalies at each location identified within the project instruction.
20.0 QUALITY CONTROL	

The QC Manager will be responsible for ensuring this SOP is effectively implemented. Surveillances and/or inspections will be conducted to ensure SOP compliance.	(q) UXOQC personnel shall document nonconforming materials, items or activities in a NCR based on surveillances and/or inspections
21.0 ACTIVITY COMPLETION	
Completion of documentation:	( ) Project site logs to Project Manager ( ) Tail gate safety meeting log to Project Manager ( ) Equipment check-out report to Project Manager ( ) Quality control reports to Project Manager

21.0 EQUIPMENT

ITEM	QUANTITY
Cellular telephone	1
Dow-hole (only) Magnetometer/Gradiometer capable of down-hole operations to 30 feet	1 or (as required by Project instruction)
Magnetometer capable of monitoring to a depth of two-feet below ground surface for ferrous items	1 or (as required by Project instruction)
All metals detector capable of monitoring to a depth of 6-inches below ground surface for non-ferrous items	Optional
Multi colors of marking flags, ribbon, and tape	As determined by SUXOS
Batteries	Two day supply for instruments
First –aid Kit (25 person)	1 within the work area
Water	Minimum 1 liter per person in work area
Camera/Tape Measure/Ruler/Calipers/Paper Pencil	As determined by SUXOS
Hand tools, (hammer, general purpose tools, etc.)	Assorted as determined by SUXOS

MINIMUM PERSONAL PROTECTIVE EQUIPMENT: IAW with Safety Plan and AHA or a minimum of OSHA LEVEL "D"

Coveralls (or long pants, sleeved shirt)

Boots (level “D”) Cover (cap, floppy, skull) Gloves (leather) Safety Eye protection (as required by AHA) Hard hats (when working in an area with a potential for head injury or heavy equipment e.g. drill rig) Because this is a possible HTRW operation, the MR Supervisor will direct the required explosive safety site PPE conditions.
SPECIAL TRAINING AND REFRESHER REQUIREMENTS: UXO Technicians will be qualified at a minimum Level II designation and be graduates of the U.S. Naval School of Explosive Ordnance Disposal or other DOD DEDSB TP 18 approved course or school/course of instruction, Hazard Waste Operations IAW 29CFR 1910.120 (e) & (f) and medical clearance physical authorization to perform work.
WAIVERS, EXEMPTIONS, SPECIFIC AUTHORIZATIONS, OR APPROVED DEVIATIONS THAT APPLY TO THIS OPERATION: None
ACTIVITY HAZARD ANLAYSIS

Safe Work Method Statement/ Job Hazard Analysis

Company Name: **CH2M HILL**	Project Name/#: SOP MRP 0001- MEC Anomaly Avoidance
Work Activity/Task: MEC Anomaly Avoidance	Principal Contractor: **CH2M HILL**
Date: December 09, 2009	Note: Sign off to be provided at Tool Box talk
Prepared by: George DeMetropolis	Supervisor: TBD by project location
Signature:	Safety Coordinator (SC): TBD by project location
All metals detection equipment, metal detection instruments, magnetometry equipment, gradiometers, and military ordnance detection equipment, plant & equipment required: - machinery: maintenance checks provided and recorded by subcontractor or operator: suitably qualified and competent, with health, safety, and environment (HS&E) training	Training Requirements 29 CFR 1910.120 (e) & (f); DDESB TP 18 minimum qualifications for Unexploded Ordnance Technicians; OPNAVINST 8020.14/MCO P8020.11 (series) and are certified to perform the job assigned and certification is current. NAVSEA OP5, paragraph 2-3 involving ammunition and explosives shall comply with NAVMED P117 Article 15-107. Prior to site operations, CH2M HILL will verify training, medical qualification statements by physicians, and conformance to substance abuse testing and reporting programs. CH2M HILL has an active explosive certification program and monitors these personnel for conformance to the Bureau of Alcohol, Tobacco, Firearms, and Explosives, Safe Explosives Act 2003 Certification requirements for "Employee Possessor," and or "Responsible Person." 3R training for non-UXO qualified Personnel. (in addition to those in project's written safety plan: - OHS Construction Induction - Waste Management for waste streams and materials

Job Step	Potential Hazard	Controls
Forms/Permits	Unknown client-specific hazards. MEC Surface/Subsurface	UXO qualified personnel, SOP MR 0001, 3Rs Training for Non-UXO qualified personnel, Metal (ferrous/nonferrous) detection equipment, DA EP 75-1-2. Well driller license, drill rig permit •Well installation or abandonment notification •Dig/drill permit obtained, where required by client facility •Water withdrawal permit obtained, where required
Site Setup	Striking underground utilities, impact with MEC	•Location of underground utilities and installations identified •Daily briefing Avoid Surface and Subsurface MEC through the use of MR SOP 0001 – MEC Anomaly Avoidance
	Striking overhead utilities	•Locate and take appropriate precautions with required distances from power lines •Lower mast and secure during travel

	Physical environmental hazards	•Use of appropriate personal protective equipment (PPE) where required. Safety boots, hard hats, safety glasses and hearing protection are mandatory. Respirators when chemical hazards exist. No loose-fitting clothing, rings, watches, etc.; long hair to be restrained close to the head.
	Dermal or inhalation exposure to contaminants	•Investigate history of area; determine nature and degree of contaminants that could be present •Conduct air monitoring for potential hazardous atmospheres as described in the project's written safety plan. •Use respirators and other PPE as prescribed in the project's written safety plan

Job Step	Potential Hazard	Controls
Site Setup (Continued)	Fire /Explosion	• No smoking around the drill rig – MR SOP-0001 MEC Anomaly Avoidance
	Struck by vehicles	•Follow traffic control plan •Wear high-visibility warning vests
	Drill rig travel	•Ensure stable ground and adequate footing for machinery. Adequate ground preparation to support loads and accommodate waste materials. •Drill rig travel will be conducted with mast secured in its lowered position •Tools and equipment secured prior to rig movement •Only personnel seated in cab are to ride on the rig vehicle •Ensure clearance of overhead power lines •Use alarm or spotter when reversing rig
	Illegal offsite impacts	• Excavation area checked for wetlands, endangered species, cultural/historic resources
	Spread of contamination from contaminated drill cuttings	•Manage cuttings in accordance with all project plans

Drilling Activities	Rotating machinery parts of drill rig MEC- surface/Subsurface – physical contact	•Daily inspection of drill rig & equipment •Ensure appropriate guards are installed or suitable barriers to forewarn personnel of dangers •Personnel clear during set up, clear of rotating parts •Loose clothing, long hair, and jewelry to be safely secured •Hands or feet should not be used to move cuttings away from auger •Rig in neutral and augers stopped rotating before cleaning •Kill switch installed, clearly identified and operational •Rig placed in neutral when operator not at controls •Pressurized lines and hoses secured from whipping hazards Advance Drill/bore hole/DPT in one foot increments applying MR SOP 0001-MEC Anomaly Avoidance Procedures
	Hoisting operations	•Ensure all personnel are clear of operation to a suitable safe distance
	Overturning of drill rig	•Establish drill pad if necessary •Drill rig level and stabilized
	Securing ropes and cables	•Ensure security to stable fixture. Do not wrap around any part of the body. •Drill rig ropes in clean, sound condition

22.0 PROCESS SUPERVISOR'S STATEMENT

I have read and understand this SOP. To the best of my knowledge, the processes described within this SOP can be done in a safe, healthful, and environmentally sound manner. I have made sure that all persons assigned to this process are qualified, have read and understand the requirements of this SOP, and have signed the workers statement for this process. I will ensure the SOP is the most recent revision. If a major change to the SOP is necessary, I will ensure that the processes are stopped until the SOP is revised and approved. If unexpected safety, health, or environmental hazards arise, I will stop activities, until hazards have been controlled, reduced, or eliminated to an acceptable risk level.

SOP MRP 0001 PROCEDURE SUPERVISOR ACKNOWLEDGEMENT

UXO Supervisor's Name (print):	Supervisor's Signature	Organization	Date

23.0 PERSONNEL STATEMENT

I have read this SOP and I have received adequate demonstration of the procedure, training to perform the process and procedure according to requirements, procedure, and guidance identified below. I agree to follow this SOP, unless I identify a hazard, work condition, or compliance issue not addressed within this SOP or encounter a situation, condition, or issue that, I cannot perform according to the SOP. If such a stoppage occurs, I will immediately notify the SUXOS, UXO Technician III, or II. Should the situation, condition, or compliance remain unresolved for greater than 24-hours, I shall contact the Munitions Response Safety Manager (619) 564-9627.

SOP MRP – 0001 - PERSONNEL STATEMENT ACKNOWLEDGEMENT

Personnel Name (print):	Personnel Signature	Organization	Date

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.

Appendix F
UFP-SAP

SAP Worksheet #1—Title and Approval Page

Final

Uniform Federal Policy-Sampling and Analysis Plan
UXO 20 - Safety Thermal Treatment Point
Remedial Investigation

Naval Support Facility Indian Head
Indian Head, Maryland

Contract Task Order 0012

November 2012

Prepared for:

Department of the Navy
Naval Facilities Engineering Command
Washington

Under the

Navy CLEAN 1000 Program
Contract N62470-02-D-1000

Prepared by:

CH2MHILL

Chantilly, Virginia

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Dennis Orenshaw
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Executive Summary

Introduction

CH2M HILL has been contracted by the Department of the Navy (Navy), Naval Facilities Engineering Command (NAVFAC) Washington to conduct a Remedial Investigation (RI) for UXO 20 -Safety Thermal Treatment Point (STTP), at Naval Support Facility Indian Head, Indian Head, Maryland. This Uniform Federal Policy-Sampling and Analysis Plan (UFP-SAP) is designed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, and as amended by the Superfund Amendments and Reauthorization Act of 1986. CH2M HILL prepared this document under the NAVFAC Washington Comprehensive Long-Term Environmental Action Navy 1000 Contract N62470-08-D-1000, Contract Task Order 012, for submittal to NAVFAC Washington; the U.S. Environmental Protection Agency Region III; and the Maryland Department of the Environment.

Background Information

The Preliminary Assessment report for this site reported that the site covered approximately 1.6 acres and was located at the end of Old Burn Point Way, on a peninsula which extends from the Main Installation into the confluence of the Mattawoman Creek and the Potomac River. The peninsula was built between approximately 1940 and 1942 and was set up for two separate uses: (1) a primary burn area, located from the tip of the peninsula to approximately 150 feet inland (UXO 20), was used for open burning (OB) of munitions (cartridge-actuated devices [CADs] and propellant-actuated devices [PADs]); and (2) a secondary burn area, which covered the remainder of the peninsula and was used for munitions testing, including deflagration-to-detonation testing and pierce testing. The peninsula was operated from the late 1940s to 1988. OB was conducted on the ground surface or in an open top, steel burn chamber in the primary burn area. A steel deflection shield was also used to prevent ejected materials from leaving the OB area. UXO 20 was also reportedly used for OB/OD and testing of projectiles, bulk propellant, demolition charges, CADs and PADs primers, less-sensitive explosives, high explosives, and other pyrotechnics using in-ground pits.

Originally covering 1.3 acres, the area of the range were adjusted to account for a small area of recent sediment deposition on the southern point of the peninsula. However, based on current site conditions and active testing being conducted at the northern portion of the STTP, the site boundary has been revised to only include the southern portion of the peninsula. The current site area, which is the area over which the RI is being conducted, is 0.97 acre.

The STTP was previously designated as Solid Waste Management Unit 20 under the installation's Resource Conservation and Recovery Act (RCRA) program. In 1993, a study was conducted at the site to evaluate whether a clean closure of the range was feasible under RCRA. As part of the site characterization, soil and groundwater samples were collected. The investigation concluded that the detected concentrations of explosives and metals within the soil and groundwater were at levels that would prohibit closure without further investigation. Soil and groundwater samples contained elevated levels of metals, explosives, volatiles, and semivolatiles when compared to background[1] samples. Although sediment was not sampled, the potential nature of past releases, presence of contamination in soil and groundwater, and transport mechanisms suggest it could have been affected by contaminant migration and discharge.

[1] Background data set generated for soil, groundwater, freshwater sediments, and biota can be found in the *Background Soil Investigation report for Indian Head and Stump Neck Annex; Naval Surface Warfare Center; Indian Head, Maryland* (Tetra Tech, Inc., 2002)

Proposed RI Activities

For scoping and documentation purposes, the RI has been broken down into two segments: the munitions constituents (MC) investigation and the munitions and explosives of concern (MEC) investigation. MC is defined as any material originating from unexploded ordnance (UXO), discarded military munitions, or other military munitions, including explosive and non-explosive materials, and emissions, degradation, or breakdown elements of such ordnance or munitions. Potentially hazardous chemicals that originate from MC include explosives and breakdown products such as TNT, RDX, and HMX; pyrotechnics/propellants/incendiaries such as perchlorate; and metals. MEC is defined as specific military munitions that may pose unique explosive risks, including UXO, discarded military munitions, and MC.

The goal of the RI is to define the nature and extent of MC and MEC at UXO 20. The MC investigation will focus on the environmental sampling of potentially affected media at UXO 20. This UFP-SAP will serve as the work plan for the MC segment of the RI. The MEC investigation will focus on the identification and confirmation of potential surface and subsurface MEC items at UXO 20. The MEC segment of the RI is being documented under a separate work plan (the *Remedial Investigation Work Plan for UXO 20*) to which the UFP-SAP will be included as an appendix.

Although MC typically include explosives and metals, the past OB/OD activities conducted at the site indicate that volatiles and semivolatiles may have been used at UXO 20, so they have also been included in this investigation. The constituents of potential concern at UXO 20 consist of target analyte list (TAL) metals, target compound list (TCL) volatile organic compounds (VOCs), TCL semivolatile organic compounds (SVOCs), and explosives (including pentaerythritol tetranitrate, nitroguanidine, nitrocellulose, nitroglycerin, and perchlorate) in groundwater, sediment, surface soil, and subsurface soil. Although human and ecological receptors may be exposed to contaminants in the surface water of Mattawoman Creek, the Indian Head Installation Restoration Team concluded that focusing on soil, groundwater and sediment would best represent the contamination most likely attributed from the site, primarily because the dynamic nature of the surface water system and the multiple contributors along the creek. The full list of constituents can be found in Worksheet #15.

The objectives of the MC segment of the RI are:

- Define the nature and extent of TAL metals, TCL VOC, TCL SVOC, and explosives contamination in the surface and subsurface soil, sediment, and shallow groundwater
- Evaluate whether contaminant concentrations attributable to releases from the site present unacceptable risk to human health or the environment and, therefore, whether the site warrants action to mitigate or control the unacceptable risk.

These objectives will be accomplished through the following sampling program, which will be conducted in two phases:

- Phase 1 consists of collecting up to 5 *in situ* groundwater samples using direct-push technology, 23 discrete surface soil samples, 23 discrete subsurface soil samples, 4 sediment samples, and 1 multi-incremental (SMI) soil sample. The discrete soil, sediment, and groundwater samples will be analyzed for TAL metals (total and dissolved for groundwater), TCL VOCs, TCL SVOCs, and explosives. Soil and sediment samples will also be analyzed for pH and total organic carbon to help interpret the data. Groundwater samples will also be analyzed for hardness to help support the ecological risk assessment. The SMI soil sample will be analyzed for TAL metals and explosives. All samples will be collected using anomaly avoidance procedures.
- Phase 2 consists of installing and sampling four permanent monitoring wells; locations will be based on the Phase 1 results.

CH2M HILL prepared this UFP-SAP in accordance with the Navy's UFP-SAP policy guidance to ensure that environmental data collected are scientifically sound, of known and documented quality, and suitable for intended uses. The laboratory information cited in this document is specific to Spectrum Analytical, Inc. in

Tampa, Florida and Warwick, Rhode Island[2], Empirical Laboratories in Nashville, Tennessee[3], and Microbac Laboratories in Marietta, Ohio[4]. These laboratories were selected based on a competitive selection process and will support all laboratory needs for this project. If additional laboratory services are necessary to meet the project objectives, revised SAP worksheets will be submitted to the Navy and regulatory agencies for approval and appended to this UFP-SAP.

UFP-SAP Outline

This UFP-SAP contains 37 worksheets, which are grouped into four areas:

- Project Management (Worksheets #1-16)
- Measurements/Data Acquisition (Worksheets #17-30)
- Assessment Oversight (Worksheets #31-33)
- Data Review (Worksheets #34-37)

All tables are embedded within the worksheets. All figures are included at the end of the document. Field standard operating procedures are provided as Attachment A and the Department of Defense Environmental Laboratory Accreditation Program accreditation letter for all laboratories is provided as Attachment B.

Upon approval of this UFP-SAP by the Navy and the regulators, the field activities will take place.

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[2] http://www.spectrum-analytical.com/
[3] www.empirlabs.com
[4] www.microbac.com

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SAP Worksheets

Figures

Attachments

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Abbreviations and Acronyms

%D	percent difference or drift
%R	percent recovery
%RSD	percent relative standard deviation
°C	degrees Celsius
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
AM	Activity Manager
amu	atomic mass unit
AQ	aqueous
AQM	Activity Quality Manager
bgs	below ground surface
BTAG	Biological Technical Assistance Group
CA	corrective action
CAD	cartridge-actuated device
CCV	continuing calibration verification
CLEAN	Comprehensive Long-Term Environmental Action, Navy
COC	chain of custody
COPC	constituent of potential concern
DGM	digital geophysical mapping
DL	detection limit
DoD	U.S. Department of Defense
DPT	direct-push technology
DQI	data quality indicator
DQO	data quality objectives
EICP	electron ionization current plot
ELAP	Environmental Laboratory Accreditation Program
EPA	U.S. Environmental Protection Agency
ERA	ecological risk assessment
ESS	Explosives Safety Submission
EXPLO	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine, hexahydro-1,3,5-trinitro-1,3,5-triazine, 1,3,5-trinitrobenzene, 1,3-dinitrobenzene, methyl-2,4,6-trinitrophenylnitramine, nitrobenzene, 2,4,6-trinitrotoluene, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, 2,4-dinitrotoluene, 2,6-dinitrotoluene, 2-nitrotoluene, 3-nitrotoluene, 4-nitrotoluene, PETN, nitroguanidine, nitrocellulose, nitroglycerin, and perchlorate
FTL	Field Team Leader
g	gram(s)
GC-MS	gas chromatograph-mass spectrometer
H&S	health and safety
HASP	Health and Safety Plan
HDPE	high-density polyethylene
HHRA	human health risk assessment
HPLC	high-performance liquid chromatography

IAS	Initial Assessment Study
ICAL	initial calibration
ICS	interference check solutions
ICP-MS	inductively coupled plasma-mass spectrometer
ICV	calibration verification
IDW	investigation-derived waste
IHIRT	Indian Head Installation Restoration Team
IR	Installation Restoration
IS	internal standard
LCS	laboratory control sample
LOD	limit of detection
LODV	limit of detection verification
LOQ	limit of quantitation
MC	munitions constituents
MCL	maximum contaminant level
MDE	Maryland Department of the Environment
MEC	munitions and explosives of concern
METAL	aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, cyanide, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc
mg/kg	milligrams per kilogram
mL	milliliter
MS/MSD	matrix spike/matrix spike duplicate
N/A	not applicable
NAVFAC	Naval Facilities Engineering Command
Navy	U.S. Department of the Navy
NC	nitrocellulose
NFESC	Naval Facilities Engineering Service Center
NG	nitroglycerin
NSF-IH	Naval Support Facility Indian Head
NOSSA	Naval Ordnance Safety and Security Activity
OB	open burning
OB/OD	open burn/open detonation
ORP	oxidation-reduction potential
PA	Preliminary Assessment
PAD	propellant-actuated device
PAL	project action limits
PDM	Project Data Manager
PDS	post-digestion spike
PETN	pentaerythritol tetranitrate
PID	photoionization detector
PIL	project indicator limit
PM	Project Manager
POC	point of contact
PPE	personal protective equipment
ppm	parts per million
PQL	project quantitation limit

PQO	project quality objectives
QAPP	Quality Assurance Project Plan
QA	quality assurance
QC	quality control
QL	quantitation limit
QSM	Quality Systems Manual
RCRA	Resource Conservation and Recovery Act
RF	response factor
RI	Remedial Investigation
RPD	relative percent difference
RPM	Remedial Project Manager
RRT	relative retention time
RSL	regional screening level
SD	sediment
SI	Site Investigation
SMI	multi-incremental sample
SOP	standard operating procedure
SPCC	System Performance Check Compound
STTP	Safety Thermal Treatment Point
SU	sampling unit
SVOCs	semivolatile organic compounds
TAL	target analyte list
TBD	to be determined
TCL	target compound list
TDBD	top depth bottom depth
TOC	total organic carbon
UFP-SAP	Uniform Federal Policy Sampling Analysis Plan
UXO	unexploded ordnance
VOA	volatile organic analyte
VOC	volatile organic compound

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SAP Worksheet #2—SAP Identifying Information

Site Name/Number: Safety Thermal Treatment Point (STTP)/Unexploded Ordnance (UXO) 20
Operable Unit: Not Applicable (N/A)
Contractor Name: CH2M HILL
Contract Number: N62470-02-D-1000, Task Order 0012
Contract Title: CLEAN 1000

1. **This Uniform Federal Policy Sampling and Analysis Plan (UFP-SAP) was prepared in accordance with the requirements of:**

   Uniform Federal Policy (UFP) for Quality Assurance Project Plans: Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs. Part 1: UFP-QAPP Manual. Version 1. March. (Intergovernmental Data Quality Task Force, 2005)

   Guidance for Quality Assurance Project Plans (QAPPs). EPA QA/G-5 and EPA QA/G-5M (U.S. Environmental Protection Agency [EPA], 2002)

   Guidance on Systematic Planning Using the Data Quality Objectives Process. EPA QA/G-4 (EPA, 2006)

2. **Identify regulatory program:**

   Comprehensive Environmental Response, Compensation, and Liability Act of 1980

3. **This UFP-SAP is specific to:**

   This is a project-specific SAP for the Remedial Investigation (RI) activities at UXO 20.

4. **List dates of scoping sessions that were held:**

Scoping Session	Date
Indian Head Tier I Partnering Meeting	12/1/2010
Indian Head Tier I Partnering Meeting	6/29/2011
Indian Head Tier I Partnering Meeting	8/4/2011

5. **List dates and titles of any UFP-SAP documents written for previous site work that are relevant to the current investigation:**

Title	Date
Preliminary Assessment (Malcolm Pirnie)	2005
Site Inspection Report (CH2M HILL)	2010

6. **List organizational partners (stakeholders) and connection with lead organization:**

   Maryland Department of the Environment (MDE) – regulatory stakeholder

   EPA Region III – regulatory stakeholder

SAP Worksheet #2—SAP Identifying Information (continued)

7. Lead organization (see Worksheet #7 for detailed list of data users):

U.S. Department of the Navy (Navy) – Lead Agency

8. If any required UFP-SAP elements or required information are not applicable to the project or are provided elsewhere, then note the omitted elements and provide an explanation for their exclusion below:

All UFP-SAP elements required for this project are described herein on the 37 UFP-SAP Worksheets. Therefore, the crosswalk table is not necessary for this project.

SAP Worksheet #3—Distribution List

Name of SAP Recipients	Title/Role	Organization	Telephone Number (Optional)	E-mail Address or Mailing Address
Joseph Rail	Remedial Project Manager (RPM)	Naval Facilities Engineering Command (NAVFAC) Washington	202-685-3105	joseph.rail@navy.mil
Nicholas Carros	Installation Restoration (IR) Program Manager	Naval Support Facility Indian Head (NSF-IH)	301-744-2263	nicholas.carros@navy.mil
Dennis Orenshaw	RPM	EPA Region III	215-814-3361	orenshaw.dennis@epamail.epa.gov
Curtis DeTore	RPM	MDE	410-537-3791	cdetore@mde.state.md.us
Margaret Kasim	Activity Manager (AM)	CH2M HILL	703-376-5154	margaret.kasim@ch2m.com
John Tomik	Activity Quality Manager (AQM)	CH2M HILL	757-671-6259	john.tomik@ch2m.com
Victoria Waranoski	Project Manager (PM)	CH2M HILL	703-376-5049	victoria.waranoski@ch2m.com
Ngozi Ibe	UFP-SAP Primary Author	CH2M HILL	703-376-5017	ngozi.ibe@ch2m.com
To be Determined (TBD)	Field Team Leader (FTL)	CH2M HILL	TBD	TBD
TBD	Field Team Member	CH2M HILL	TBD	TBD
TBD	UXO Oversight	CH2M HILL	TBD	TBD
TBD	Utility Locating Subcontractor	TBD	TBD	TBD
TBD	Drilling Subcontractor	TBD	TBD	TBD
TBD	Investigation-Derived Waste (IDW) Subcontractor	TBD	TBD	TBD
John Heyman	PM	Spectrum Analytical Inc.	813-888-9507	jheyman@pelab.com
Mark Gudnason	Quality Assurance (QA) Officer	Spectrum Analytical Inc.	813-888-9507	mgundnason@pelab.com

SAP Worksheet #3—Distribution List (continued)

Name of SAP Recipients	Title/Role	Organization	Telephone Number (Optional)	E-mail Address or Mailing Address
Sonya Gordon	PM	Empirical Laboratories	615-345-1115 ext 238	sgordon@empirlabs.com
Marcia McGinnity	QA Officer	Empirical Laboratories	615-345-1115 ext 232	mmcginnity@empirlabs.com
Kathy Albertson	PM	Microbac Laboratories	800-373-4071	Kathy.Albertson@microbac.com
Wade Delong	QA Officer	Microbac Laboratories	800-373-4071	Wade.Delong@microbac.com
Ward Dickens	Data Validator	CH2M HILL	352-384-7049	ward.dickens@ch2m.com

SAP Worksheet #4—Project Personnel Sign-off Sheet

The personnel listed below acknowledge their receipt, acceptance, and approval for the listed sections of this UFP-SAP for RI activities at UXO 20 – STTP, NSF-IH, Indian Head, Maryland. The signed version of this document becomes a part of the Administrative Record for the NSF-IH, and a copy will be maintained in CH2M HILL's project file.

Organization: Spectrum Analytical Inc.

Name	Title/Role	Telephone Number (optional)	Signature/E-mail Receipt	Date SAP Read
John Heyman	PM	813-888-9507		
Mark Gudnason	QA Officer	813-888-9507		

Organization: Empirical Laboratories

Name	Title/Role	Telephone Number (optional)	Signature/E-mail Receipt	Date SAP Read
Sonya Gordon	PM	615-345-1115 ext 238		
Marcia McGinnity	QA Officer	615-345-1115 ext 232		

Organization: Microbac Laboratories

Name	Title/Role	Telephone Number (optional)	Signature/E-mail Receipt	Date SAP Read
Kathy Albertson	PM	800-373-4071		
Wade Delong	QA Officer	800-373-4071		

Organization: Subcontractors

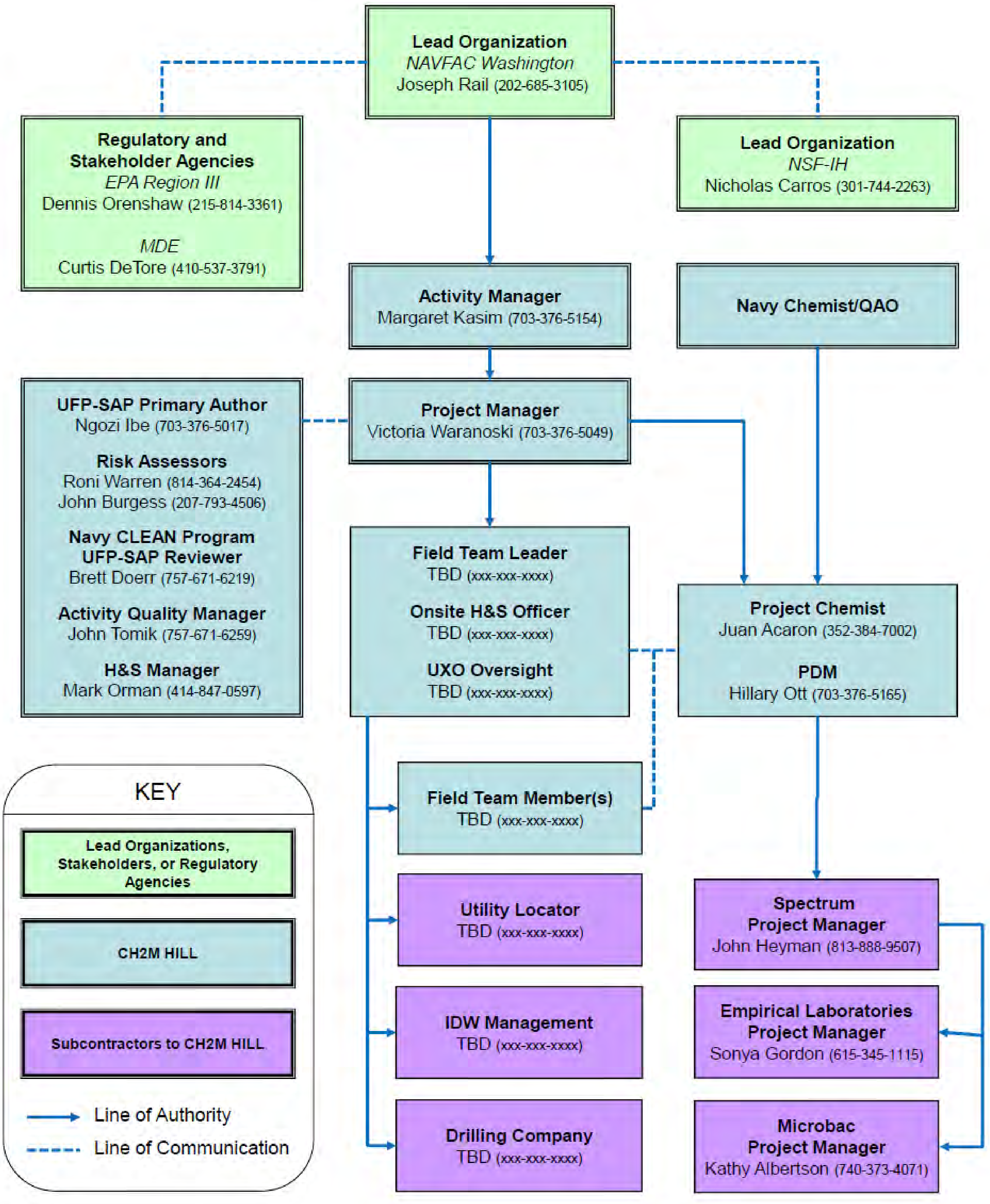
Name	Title/Role	Telephone Number (optional)	Signature/E-mail Receipt	Date SAP Read
TBD	Utility Locating Subcontractor	TBD		
TBD	Drilling Subcontractor	TBD		
TBD	IDW Subcontractor	TBD		

SAP Worksheet #4—Project Personnel Sign-Off Sheet (continued)

Organization: CH2M HILL

Name	Title/Role	Telephone Number (optional)	Signature/E-mail Receipt	Date SAP Read
Margaret Kasim	AM	703-376-5154		
Victoria Waranoski	PM	703-376-5049		
John Tomik	AQM	757-671-6259		
Mark Orman	Health and Safety (H&S) Manager	414-847-0277/414-847-0597		
Roni Warren	Human Health Risk Assessor	814-364-2454		
John Burgess	Ecological Risk Assessor	617-523-2002		
Anita Dodson	Navy Program Chemist	757-671-6218		
Brett Doerr	Navy Comprehensive Long-Term Environmental Action, Navy (CLEAN) Program UFP-SAP Reviewer	757-671-6219		
Juan Acaron	Project Chemist	352-384-7002		
Ngozi Ibe	UFP-SAP Primary Author	703-376-5017		
Hilary Ott	Project Data Manager (PDM)	703-376-5305		
TBD	Onsite H&S Officer	TBD		
TBD	FTL	TBD		
TBD	Field Team Member	TBD		
TBD	UXO Oversight	TBD		

SAP Worksheet #5—Project Organizational Chart



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SAP Worksheet #6—Communication Pathways

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure
Communication with Navy (lead agency)	Navy RPM	Joseph Rail	202-685-3105 joseph.rail@navy.mil	• Primary point of contact (POC) for Navy • Delegates communication to other internal or external points of contact • Notifies EPA and MDE via email within 24 hours of field changes affecting the scope or implementation of the design • Participates in the onboard review discussion • Navy Chemist will have 21 calendar days for UFP-SAP review
Communication with NSF-IH	NSF-IH	Nicholas Carros	301-744-2263 nicholas.carros@navy.mil	• Primary POC for NSF-IH • Delegates communication to other internal or external points of contact • Will be provided with daily reports of all construction activities. If field issues occur that affect the mission of the facility, the IR Program PM or his delegated personal should be notified immediately.
Communication with EPA (regulatory agency)	RPM -EPA	Dennis Orenshaw	215-814-3361 Orenshaw.Dennis@epamail.epa.gov	• Primary POC for EPA • Delegates communication to other internal or external POCs • Has 30 days for UFP-SAP review • Participates in the onboard review discussion
Communication with MDE (regulatory agency)	RPM - MDE	Curtis DeTore	410-537-3791 cdetore@mde.state.md.us	• Primary /secondary POC for MDE • Delegates communication to other internal or external points of contact • Has 30 days for UFP-SAP review • Participates in the onboard review discussion

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure
Communication regarding overall project status and implementation and primary POC with Navy RPM, EPA, and MDE	AM	Margaret Kasim	703-376-5154 Margaret.Kasim@ch2m.com	• Forwards all relevant information and materials about the project to Nate Delong (NAVFAC Washington), Dennis Orenshaw (EPA), and Curtis DeTore (MDE) • Oversees the overall project status
Technical communications for project implementation and data interpretation	AQM	John Tomik	352-335-5877 John.Tomik@ch2m.com	• To be contacted regarding questions/issues encountered in the field, input on data interpretation, as needed • Reviews the data as necessary prior to Indian Head Installation Restoration Team (IHIRT) discussion
Communications regarding project management and implementation of all project phases, and primary POC with Navy RPM	PM	Victoria Waranoski	703-376-5049 victoria.waranoski@ch2m.com	• Forwards all information and materials about the project to Navy RPM on a daily basis • Oversees the overall project status. • Is informed of project status by CH2M HILL project staff. • If field changes occur during construction activities, works with the Navy RPM to communicate field changes to the IHIRT via email within 24 hours

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure
UFP-SAP implementation in the field	CH2M HILL FTL	TBD	TBD	• Facilitates CH2M HILL's internal communication (PM to field team members). • Coordinates schedules and field activities with driller, utility locator, and IDW subcontractors. • Communicates with subcontractors by phone, followed up with e-mail to document decisions and actions. • Documents deviations from the Work Plan in the field log book and notifies PM immediately. • Executes deviations only after PM approval. • Implements project health and safety requirements. • Reports health and safety near misses and incidents to the PM immediately by phone. • Provides daily progress reports/updates to the CH2M HILL PM by phone or email.
Health and Safety (H&S)	Onsite H&S Officer	TBD	TBD	• Responsible for the adherence of team members to the site safety requirements described in the H&S Plan (HASP). • Will report H&S incidents and near losses to PM.

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure
Reporting lab data quality issues	Laboratory QA officer	Mark Gudnason Marcia McGinnity Wade Delong	813-888-9507 mgudnason@pelab.com 615-345-1115 x 232 mmcginnity@empirlabs.com 800-373-4071 Wade.Delong@microbac.com	• Reports all quality assurance/quality control (QA/QC) issues with project field samples to the Project Chemist as soon as identified, not to exceed 24 hours.
Data tracking from collection through upload to database	PDM	Hillary Ott	703-376-5165 Hillary.Ott@ch2m.com	• Tracks data from sample collection through upload to the database, ensuring Work Plan requirements are met by the laboratory and field staffs. • POC for laboratory QA/QC officer. • Reports the lab issues to the PM and Project Chemist within 4 hours.

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure
Management of analytical lab and data validation subs. Analytical corrective actions (CAs)/ release of analytical data	Project Chemist	Juan Acaron	352-384-7002 Juan.Acaron@ch2m.com	• Analytical laboratory CAs will be identified by, or brought to the attention of, the Project Chemist on a daily basis and reported to the PM within 4 hours. • Facilitates resolution on a same-day basis after consulting with the PM and AQM and the Navy Chemist (if changes in the UFP-SAP are warranted) to ensure UFP-SAP requirements are met by the laboratory. • Approves release of analytical data after validation is completed and approved by the Project Chemist within 7 days • Communicates with subcontractor laboratory(ies) and data validator by phone, followed up with e-mail to document decisions and actions. • Informs PM, RPM, and Navy Chemist of any laboratory issues that would cause negative impacts to project delivery or would cause the project data quality objectives (DQOs) to not be met

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SAP Worksheet #7—Personnel Responsibilities Table

Name	Title/Role	Organizational Affiliation	Responsibilities
Joseph Rail	Navy RPM	NAVFAC Washington	Manages all NSF-IH IR Program activities
Dennis Orenshaw	RPM	EPA Region III	Reviews and provides input for EPA on development of the STTP. UXO 20 RI
Curtis DeTore	RPM	MDE	Reviews and provides input for MDE on the STTP, UXO 20 RI
Margaret Kasim	AM	CH2M HILL	Oversees overall project status for all projects implemented at NSF-IH
Victoria Waranoski	PM	CH2M HILL	Manages project, oversees all project activities, and is responsible for all aspects of the work performed under this UFP-SAP
John Tomik	AQM	CH2M HILL	Provides overall technical QC of the field investigation design and implementation; responsible for audits, CA, checks of QA performance
Brett Doerr	Navy CLEAN Program UFP-SAP Reviewer	CH2M HILL	Provides program-level review of UFP-SAP
Anita Dodson	Navy CLEAN Program Chemist	CH2M HILL	Provides SAP delivery support and program-level review of UFP-SAP
Roni Warren	Human Health Risk Assessor	CH2M HILL	Provides human health risk assessment (HHRA) oversight for STTP, UXO 20
John Burgess	Ecological Risk Assessor	CH2M HILL	Provides ecological risk assessment (ERA) oversight for the STTP, UXO 20
Juan Acaron	Project Chemist	CH2M HILL	Coordinates laboratory and data validation subcontracts and oversees performance of laboratory and data validation
Hillary Ott	PDM	CH2M HILL	Provides sample tracking, data management, and communication with laboratory
Ngozi Ibe	Primary Author	CH2M HILL	Works with PM, chemist and senior consultants to draft UFP-SAP document; coordinates with geographic information system, health and safety, and publications staffs

SAP Worksheet #7—Personnel Responsibilities and Qualifications Table (continued)

Name	Title/Role	Organizational Affiliation	Responsibilities
Mark Orman	H&S Manager	CH2M HILL	Develops and approves project HASPs
TBD	FTL	CH2M HILL	Supervises field implementation of the UFP-SAP
TBD	UXO Oversight	CH2M HILL	Provides UXO oversight during implementation of the UFP-SAP
John Heyman	Laboratory PM	Spectrum Analytical Inc.	Manages sample tracking and maintains good communication with Project Chemist and PDM
Mark Gudnason	Laboratory QA Officer	Spectrum Analytical Inc.	Responsible for audits, CAs, checks of QA performance within the laboratory
Sonya Gordon	Laboratory PM	Empirical Laboratories	Manages sample tracking and maintains good communication with Project Chemist and PDM
Marcia McGinnity	Laboratory QA Officer	Empirical Laboratories	Responsible for audits, CAs, checks of QA performance within the laboratory
Kathy Albertson	Laboratory PM	Microbac Laboratories	Manages sample tracking and maintains good communication with Project Chemist and PDM
Wade Delong	Laboratory QA Officer	Microbac Laboratories	Responsible for audits, CAs, checks of QA performance within the laboratory
Ward Dickens	Data Validator	CH2M HILL	Internal data validation of all analytical laboratory data.
TBD	Utility Locate Subcontractor	TBD	Performs utility location
TBD	Drilling Subcontractor	TBD	Performs direct-push technology (DPT) drilling to facilitate sample collection
TBD	IDW Subcontractor	TBD	Responsible for manifesting, transporting, and disposing of IDW

SAP Worksheet #8—Special Personnel Training Requirements Table

Project Function	Specialized Training By Title or Description of Course	Training Provider	Training Date	Personnel / Groups Receiving Training	Personnel Titles / Organizational Affiliation	Location of Training Records / Certificates
STTP RI	UXO Safety Training	Registered training organization	Subcontractor specific	UXO Technician	UXO Technician	Subcontractor human resources department

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SAP Worksheet #9—Project Scoping Session Participants Sheet

Project Name: UXO 20 - STTP RI **Projected Date(s) of Sampling:** Fall 2012 **PM:** Victoria Waranoski – CH2M HILL	**Site Name:** UXO 20 - STTP **Site Location:** NSF-IH, Indian Head, Maryland

Date of Session: December 01, 2010

Scoping Session Purpose: Obtain IHIRT buy-in on RI approach

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Joseph Rail	Navy RPM	NAVFAC Washington	202-685-3105	joseph.rail@navy.mil	Navy RPM
Nathan Delong	Navy RPM	NAVFAC Washington	202-685-3297	Nathan.delong@mavy.mil	Navy RPM
Nicholas Carros	Navy RPM	NAVFAC Washington	301-744-2263	nicholas.carros@navy.mil	Navy RPM
Dennis Orenshaw	RPM	EPA Region 3	215-814-3361	orenshaw.dennis@epamail.epa.gov	Regulator
Curtis DeTore	RPM	MDE	410-537-3791	cdetore@mde.state.md.us	Regulator
Margaret Kasim	AM/PM	CH2M HILL	703-376-5154	margaret.kasim@ch2m.com	AM/PM
Victoria Waranoski	Staff Engineer	CH2M HILL	703-376-5049	victoria.waranoski@ch2m.com	Primary Author
John Tomik	AQM	CH2M HILL	757-671-6259	john.tomik@ch2m.com	Senior Consultant
Scott Nesbitt	N/A	Tetra Tech	N/A	N/A	N/A

Comments/Decisions

The Site Investigation (SI) report recommended an RI for munitions and explosives of concern (MEC) and munitions constituents (MC) in soil and groundwater for UXO 20. The proposed MEC investigation was as follows:

- Phase I – clear vegetation, collect wipe samples, identify/global positioning system /document items on land, remove metal debris and stockpile, stage MEC items, and conduct digital geophysical mapping (DGM) survey.
- Phase II – verify the presence of MEC at percentage of land areas where anomalies are identified in Phase I.

The proposed MC investigation was as follows:

- Phase I – utility clearance, anomaly avoidance, advance up to 20 boreholes via DPT and collect *in situ* groundwater samples, perform multi-incremental sampling for soil, and analyze samples for full suite of parameters.

SAP Worksheet #9—Project Scoping Session Participants Sheet (continued)

- Phase II – install up to four permanent monitoring wells, implement anomaly avoidance, and analyze samples for full suite.

Action Items

No action items were created during the scoping session.

Consensus Decisions

The IHIRT agreed to the proposed approach as described above and made the following decisions:

- Add sediment sampling to the investigation.
- Do not sample surface water
- Do not analyze for the full suite of parameters; analyze only for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, and explosives (including pentaerythritol tetranitrate, nitroguanidine, nitrocellulose, nitroglycerin, and perchlorate).

Project Name: UXO 20 - STTP RI **Projected Date(s) of Sampling:** Fall 2011 **PM:** Victoria Waranoski – CH2M HILL	**Site Name:** UXO 20 - STTP **Site Location:** NSF-IH, Indian Head, Maryland
Date of Session: June 29, 2011 **Scoping Session Purpose:** Obtain IHIRT buy-in on RI approach	

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Joseph Rail	Navy RPM	NAVFAC Washington	202-685-3105	joseph.rail@navy.mil	Navy RPM
Nathan Delong	Navy RPM	NAVFAC Washington	202-685-3297	Nathan.delong@mavy.mil	Navy RPM
Nicholas Carros	Navy RPM	NAVFAC Washington	301-744-2263	nicholas.carros@navy.mil	Navy RPM
Dennis Orenshaw	RPM	EPA Region 3	215-814-3361	orenshaw.dennis@epamail.epa.gov	Regulator
Curtis DeTore	RPM	MDE	410-537-3791	cdetore@mde.state.md.us	Regulator
Margaret Kasim	AM/PM	CH2M HILL	703-376-5154	margaret.kasim@ch2m.com	AM/PM
Victoria Waranoski	Staff Engineer	CH2M HILL	703-376-5049	victoria.waranoski@ch2m.com	Primary Author
John Tomik	AQM	CH2M HILL	757-671-6259	john.tomik@ch2m.com	Senior Consultant

SAP Worksheet #9—Project Scoping Session Participants Sheet (continued)

Project Name: UXO 20 - STTP RI **Projected Date(s) of Sampling:** Fall 2011 **PM:** Victoria Waranoski – CH2M HILL			**Site Name:** UXO 20 - STTP **Site Location:** NSF-IH, Indian Head, Maryland		
Date of Session: June 29, 2011 **Scoping Session Purpose:** Obtain IHIRT buy-in on RI approach					
Name	**Title**	**Affiliation**	**Phone #**	**E-mail Address**	**Project Role**
Brian Reisch	N/A	NAVFAC Washington	N/A	N/A	N/A
Scott Nesbitt	N/A	Tetra Tech	N/A	N/A	N/A

Comments/Decisions

CH2M HILL informed the IHIRT that the northern portion of UXO 20 is active, based on information provided from NSF-IH. Testing of hand grenades is conducted for 1 week every 2 months. the IHIRT discussed the MC sampling approach., which would not likely change because of the active/non-active status of the site. The MEC discussion has been postponed to a future date.

The IHIRT discussed the current site boundary, which did not encompass the entire peninsula; it excludes the soil/sediment deposition areas to the east of the site. The MC sampling approach was modified as follows:

- Surface soil, subsurface soil, and *in situ* groundwater samples will be added to the eastern portion of the peninsula that is outside of the current site boundary.
- Because of current direction and groundwater flow direction, the proposed sediment samples along the southern shoreline will not likely provide useful information. The sediment sampling along the southern shoreline will be moved to the eastern shoreline.
- The eight proposed multi-incremental sampling units (SUs) will be revised to five units: SU1, SU2, and SU3 will remain the same; SU4, SU5, SU6, SU7, and SU8 will be combined as one unit, SU4; and the land to the east of the peninsula outside the current site boundary will become SU5.

Action Items

An action item was generated for the Navy to check into the path forward for UXO 20.

Consensus Decisions

The IHIRT has revised the MC sampling plan approach as discussed above. CH2M HILL will stop work on UXO 20 until a path forward has been selected by the Navy.

SAP Worksheet #9—Project Scoping Session Participants Sheet (continued)

Project Name: UXO 20 - STTP RI **Projected Date(s) of Sampling:** Fall 2011 **PM:** Victoria Waranoski – CH2M HILL	**Site Name:** UXO 20 - STTP **Site Location:** NSF-IH, Indian Head, Maryland
Date of Session: August 3, 2011 **Scoping Session Purpose:** Obtain IHIRT buy-in on RI approach	

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Scott Nesbitt	N/A	Tetra Tech	N/A	N/A	N/A

Comments/Decisions

- CH2M HILL informed the IHIRT that the Navy uses the northern portion of UXO 20 for testing of hand grenades 1 week approximately every 2 months. The southern portion of the site, where the historical open burn/open detonation (OB/OD) took place, is inactive.
- The IHIRT discussed and agreed to the boundary of the area that should be investigated as part of the RI. This area will consist of the southern portion of the peninsula and the two spits to the east. The length of the southern portion will be 150 feet from the tip of the peninsula inland.
- The IHIRT agreed to the following sampling approach: Discrete sampling will only be conducted in the southern portion of the peninsula and not the spits to the east. Sampling locations will concentrate around the burn areas and will spread out over the remainder of the site.
- Multi-incremental Sampling (SMI) – It consists of collecting surface (0 to 2 inches below ground surface [bgs]) soil samples only in the spits. If the results are “hot”(i.e., exceed the project action limits [PALs]), discrete sampling will be conducted. If the results are not “hot”(i.e., do not exceed the PALs), the spits will be closed out with no further investigation. In addition, if the discrete surface soil sampling results in the southern portion show no contamination but the subsurface soil results show contamination, the IHIRT will evaluate the next step for the spits because this will not justify no further investigation for the subsurface in the SMI sampling area.

SAP Worksheet #9—Project Scoping Session Participants Sheet (continued)

- DGM – DGM will be conducted in the southern portion of the peninsula and the north spit. The south spit will not be included because this area is not part of the original construction, but rather was created from sedimentation processes.

  Because UXO 20 is located in an area highly susceptible to erosion, it was noted that the MEC investigation should minimize vegetation removal. It was also suggested that CH2M HILL consider using a handheld equipment to perform the DGM survey in the north spit to protect existing vegetation. MDE asked how the soil inside the steel burn chamber will be handled, assuming that the bottom of the chamber is open. CH2M HILL responded that if the bottom is open, the soil inside the chamber will be sampled as part of the discrete sampling. If the bottom is closed, discrete soil samples will be collected below the chamber after it has been removed.

Action Items

No action items were created during the scoping session.

Consensus Decisions

CH2M HILL will incorporate the changes agreed upon by the IHIRT in the Explosives Safety Submission (ESS) and RI work plan.

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SAP Worksheet #10—Problem Definition

Location and Description

NSF-IH is a Navy facility located in northwestern Charles County, Maryland, approximately 25 miles southwest of Washington, DC. The facility consists of two tracts of land: the Main Installation on the Cornwallis Neck Peninsula and the Stump Neck Annex located across Mattawoman Creek (Figure 1). The Main Installation contains approximately 2,500 acres and is bounded by the Potomac River to the northwest, west, and south; Mattawoman Creek to the south and east; and the town of Indian Head to the northeast. The Stump Neck Annex contains approximately 1,084 acres and is bounded by Mattawoman Creek to the northeast, the Potomac River to the northwest, and Chicamuxen Creek to the south-southwest.

The site referred to as UXO 20, Safety Thermal Treatment Point, in the Preliminary Assessment (PA) report (Malcolm Pirnie, 2005) was a 1.6-acre site at the end of Old Burn Point Way on a peninsula that extends southwest from the Main Installation into the confluence of Mattawoman Creek and the Potomac River. The PA report noted that according to the Initial Assessment Study (IAS) (Fred C. Hart Associates, 1983), it is a man-made peninsula constructed of sand, fill material, rocket motor casings, empty cartridges, and coal fly ash. This information, however, could not be confirmed from the IAS. On August 2, 2011, NSF-IH informed CH2M HILL that the northern part of the peninsula is active and is currently being used by NSF-IH to test hand grenades. As a result of this information, the boundary of UXO 20 has been adjusted to exclude the northern part where testing is still ongoing and to include the southern part and spits (recent [since the PA] sediment deposition areas) of the peninsula, totaling approximately 0.97 acre (Figure 2). Within the remainder of this UFP-SAP, the following terms apply: (1) UXO 20 (or site) refers to the area in the southern part of the peninsula encompassed by the new site boundary shown in Figure 2; and (2) “peninsula” refers to both the northern and southern parts of the peninsula, synonymous with the old site boundary in the PA. The site boundary has been officially revised in the NSF-IH database. The northern portion of the peninsula (formerly part of UXO 20) will be investigated under a new munition site designation upon closure.

History

The following information is summarized from the PA. The peninsula was built between approximately 1940 and 1942 and was set up for two separate uses: (1) a primary burn area, located from the tip of the peninsula to approximately 150 feet inland (UXO 20), was used for open burning (OB) of munitions (cartridge-actuated devices [CADs] and propellant-actuated devices [PADs]); and (2) a secondary burn area, which covered the remainder of the peninsula and was used for munitions testing, including deflagration-to-detonation testing and pierce testing. The peninsula was operated from the late 1940s to 1988.

From 1942 to 1988, OB on the ground surface or in an open top, steel thermal treatment vessel occurred on a weekly basis in the primary burn area. Until the 1950s, propellants including CAD and PAD items were burned at a rate of 40 to 50 pounds per week. Water or solvent wet wastes with oil were burned in 55-gallon drums. In 1954, propellant burning operations were moved to the Strauss Avenue Thermal Treatment Point. The burning of up to 25,000 pounds per year of less-sensitive explosives, other pyrotechnics (for example, squibs, igniters, caps, black powder) and difficult–to-burn ordnance materials continued through 1988. The peninsula was reportedly used for OB/OD and testing of projectiles, bulk propellant, demolition charges, CADs and PADs primers, less-sensitive explosives, high explosives, and other pyrotechnics using in-ground pits.

SAP Worksheet #10—Problem Definition (continued)

The PA also notes that initially material was burned directly on the ground, and new soil would be brought in as needed. In 1980, burn pans were used, but the steel deflection shield could not completely prevent ejected materials from leaving the OB area. These incidences were caused mostly by burning nitroglycerin solvents or plastic-bonded explosives in bulk form. Although ejected materials occasionally left the OB area, most ordnance items would not have penetrated the ground because no firing of munitions occurred. The northern portion of the peninsula remains operational and is used for OD approximately 1 week every 2 months.

Geology, Hydrogeology and Hydrology

The peninsula is man-made and constructed of sand, fill material, rocket motor casings, empty cartridges, and coal fly ash. Because the peninsula is man-made and extends into the Mattawoman Creek-Potomac River confluence, the surficial water table is expected to be directly connected to these surface water bodies. The groundwater table at the site ranges from just beneath the surface to 5 feet bgs. The nearest potable well, #15, is located upgradient and approximately 1,000 feet east of the peninsula, and was constructed in the lower Patapsco aquifer.

The peninsula is flat, with an elevation of 5 feet above mean sea level, sloping towards Mattawoman Creek and the Potomac River. A wetland covering approximately 1.25 acres lies northeast of the peninsula, but is not within the site boundary. Surface water runoff occurs in the direction of the Potomac River and Mattawoman Creek. The peninsula is located within a 100-year floodplain and is likely tidally influenced.

Previous Investigations

The PA reports that the IAS reported that sometime in the late 1970s, 5 gallons of waste solvents were spilled on the STTP, reaching surface water. In addition, it was reported that during the same time period, metal items from the site were occasionally ejected into Mattawoman Creek and the Potomac River during OB. As documented in the PA, the peninsula was previously designated as Solid Waste Management Unit 20 under the installation's Resource Conservation and Recovery Act (RCRA) program. In 1993, a characterization study was conducted at the site to evaluate whether a clean closure of the range was feasible under RCRA. As part of the site characterization, soil and groundwater samples were collected from the southernmost tip on the peninsula where the OB/OD operations occurred.

According to written documentation from the Navy, approximately 96 drums of ash/residue and solvent contaminated surface soil were removed from the site in 1988 (Navy, 1988). Based on visual observation, it was estimated that the soil excavation spanned a 40-foot diameter area to a depth of 1 foot. The subsurface soil was not disturbed. The location of soil removal, backfill efforts, and quantification of contaminant concentrations are unknown.

The RCRA Characterization Study results indicated that soil samples contained elevated concentrations of metals, explosives, volatiles, and semivolatiles when compared to background[5] concentrations. The highest concentration of metals occurred near the steel burn tank. Metals concentrations detected at levels at least five times higher than the background concentrations were barium (1,550 milligrams per kilogram [mg/kg]), cadmium (14.8 mg/kg), chromium (101 mg/kg), lead (1,010 mg/kg), mercury (174 mg/kg), and nickel (70.1 mg/kg). Although we do not know if cyanide was used at UXO 20, cyanide was analyzed for and detected during the characterization study. Cyanide was detected in 3 of 8 soil samples and 2 of 3 *in situ* groundwater samples. Based on this data, cyanide will be analyzed as part of the RI effort. The explosives most commonly occurring onsite at elevated levels were

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[5] Background data set generated for soil, groundwater, freshwater sediments, and biota can be found in the *Background Soil Investigation report for Indian Head and Stump Neck Annex; Naval Surface Warfare Center; Indian Head, Maryland* (Tetra tech, Inc., 2002)

SAP Worksheet #10—Problem Definition (continued)

Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) (13 mg/kg), 2,4-dinitrotoluene (6.0 mg/kg), and nitroglycerin (NG) (180 mg/kg). Groundwater samples contained elevated concentrations of metals, explosives, volatiles, and semivolatiles when compared to backgrounds concentrations. The highest concentrations of metals occurred near the former burn tank. Metals detected at the highest concentrations included lead (5,110 micrograms per liter [µg/L]), mercury (22 µg/L), beryllium (1.9 µg/L) and cadmium (5.4 µg/L). Two explosives were detected in groundwater samples, HMX (1.1 µg/L) and trinitrotoluene (0.84 µg/L). Based on the results of the investigation, it was concluded that the detected concentrations of metals and explosives in soil and groundwater were at concentrations that would prohibit closure of the peninsula without further investigation.

A visual survey was conducted in June 2003 in support of the PA. The PA report noted that evidence of explosives or MEC was not observed. However, a large cylindrical unit (former burn tank), a free-standing metal frame, a steel deflection shield, and miscellaneous explosives testing equipment were observed. The former burn tank and steel deflection shield are located in the primary burn area. The former burn tank, which is approximately 8 feet high and 10 feet in diameter, was used to minimize ash and debris emissions during burning. The steel deflection shield is approximately 15 feet high and 15 feet wide and is believed to have been used to block flying debris from the burn tank from reaching the Potomac River and Mattawoman Creek. Because facility activities may have resulted in munitions being released into the environment, the PA recommended an SI for MEC and an RI for MC.

In 2008, 2009, and 2010, the Navy and CH2M HILL conducted several site visits, and observed the same items observed during the PA visual survey. In 2010, an SI was completed for MEC, but consisted only of an aerial photographic analysis (CH2M HILL, 2010). Removal and staging of surface metal items to perform a DGM was not approved by Naval Ordnance Safety and Security Activity (NOSSA) to be done under an Explosive Safety Determination Request, so the DGM was not performed as a part of the SI. According to NOSSA, surface items may be contaminated with explosives and equipment that would come in contact with these items would present explosive conditions, so removal of the surface items had to be done under an ESS. The aerial photographic analysis consisted of a review of historical aerial photographs from 1943 to 1981. The analysis provided documentation of the expansion of the peninsula and evidence of the OB/OD activities at the southern end of the peninsula. The photos indicated visibly stained areas and dark-toned material at the southern end of the peninsula within the new site boundary. The SI recommended an RI for MEC.

Conceptual Site Model

The following subsections define the key aspects of the site's conceptual model of contaminant sources, release and transport mechanisms, and potential receptors (Figure 3).

Potential Sources and Releases of Contamination

The primary potential source of contamination at the site is from OB of CADs and PADs on a weekly basis from 1942 and 1988. OB occurred on the ground surface or in an open-top, steel thermal treatment vessel. In addition, water or solvent wet wastes with oil were burned in 55-gallon drums. Deterioration of material in and on the ground surface from the OB/OD activities may also provide a potential source of contamination at the site. A secondary source of contamination is munitions testing, including deflagration-to-detonation testing and pierce testing in the northern part of the peninsula, which is topographically upgradient of the site.

SAP Worksheet #10—Problem Definition (continued)

Potential Migration Pathways

- Precipitation infiltration may provide for contaminant mobility into the subsurface soil and into the shallow or surficial groundwater aquifer, which may then transport contaminants to Mattawoman Creek.
- Contaminants sorbed to surface soil may be mobilized during extended periods of precipitation or storm surges that may cover the site and erode and transport the surface soil to Mattawoman Creek.

Exposures and Receptors

Human Health

Currently, the site is downgradient of an active range. It is on the tip of a peninsula at the confluence of Mattawoman Creek and the Potomac River. The site may be accessed by people on the site or by people using the creek and the river recreationally. Future site use is expected to remain the same as current site use; however, it is possible, although unlikely, that the site could be developed for additional munitions use, other industrial use, or residential use. Currently, groundwater beneath the site is not used as a potable water supply. Although unlikely, groundwater could be used as a potential future potable water supply.

- Current human health exposure scenario:
  - Authorized Navy personnel (adult military and civilian site workers), adult visitors/adult contractors, adult maintenance workers, adult, adolescent, and child recreational river users/trespassers exposed to constituents of potential concern (COPCs) in surface soil through incidental ingestion and dermal contact, and inhalation of particulate and volatile emissions from surface soil
  - Authorized Navy personnel (adult military and civilian) and/or adult contractors (will not be evaluated separately from authorized Navy personnel because their exposure would be the same or lower) who perform maintenance activities along the shoreline, and adult, adolescent, and child recreational river users/trespassers exposed to COPCs in sediment and surface water through incidental ingestion and dermal contact
- Future human health exposure scenarios:
  - Authorized Navy personnel (adult military and civilian site workers), adult visitors/adult contractors, adult construction workers, adult, adolescent, and child recreational river users/trespassers, and adult and child residents exposed to COPCs in surface and subsurface soil through incidental ingestion and dermal contact, and inhalation of particulate and volatile emissions from soil
  - Authorized Navy personnel (adult military and civilian) and/or adult contractors (will not be evaluated separately from authorized Navy personnel because their exposure would be the same or lower) who perform maintenance activities along the shoreline, and adult, adolescent, and child recreational river users exposed to COPCs in sediment and surface water through incidental ingestion and dermal contact
  - Authorized Navy personnel (adult military and civilian site workers), adult visitors/adult contractors (will not be evaluated separately from authorized Navy personnel because their exposure would be the same or lower), and adult and child residents exposed to COPCs in groundwater used as a potable water supply through ingestion, dermal contact, and inhalation of volatiles while showering, and adult construction workers exposed to COPCs in groundwater during excavation and construction activities through dermal contact and inhalation of volatiles

SAP Worksheet #10—Problem Definition (continued)

Ecological

Potential exposure pathways for ecological receptors include direct exposure to contaminants in surface soils and surface sediments and indirect exposure to contaminants in groundwater through groundwater discharge to Mattawoman Creek. Upper-trophic-level receptors could also be exposed through uptake via the food chain for bioaccumulative contaminants. Organisms might be exposed to chemicals present at the site through the following exposure routes:

- Direct contact with surface soil and shallow subsurface soil
- Direct contact with sediment
- Direct contact with sediment pore water in the groundwater/surface water transition zone
- Direct contact with surface water at the point of groundwater discharge
- Incidental ingestion of soil
- Incidental ingestion of sediment
- Ingestion of surface water
- Root uptake by plants
- Food chain exposure for upper-trophic-level receptors

The main portion of the site consists of old field habitat interspersed with metal structures used for historical site activities. There are some mature hardwood stands surrounding the open field areas and most of the eastern part of the peninsula is forested. The shoreline varies from rocky areas with exposed rubble used in construction of the peninsula on the eastern side, to sandy, beach areas devoid of vegetation, on the western and southern sides of the peninsula.

The site provides potential refuge and foraging habitats for some mammals and avian species. Potential terrestrial ecological receptors include soil invertebrates, terrestrial plants, birds, mammals, and reptiles. Potential aquatic receptors include benthic invertebrates, aquatic plants, amphibians, fish, and reptiles, and semi-aquatic birds, mammals, and reptiles. Soil invertebrates could be exposed to contaminants in soil through dermal contact and ingestion. Terrestrial plants could be exposed to contaminants in soil through root uptake. Benthic invertebrates, amphibians, and reptiles could be exposed to contaminants in sediment and sediment pore water through dermal contact and ingestion. Aquatic plants could be exposed to contaminants in sediment through root uptake. Terrestrial birds, mammals, and reptiles could be exposed to contaminants through bioaccumulation in the food chain and through incidental ingestion of surface soil. Semi-aquatic birds, mammals, and reptiles could be exposed to contaminants through bioaccumulation in the aquatic food chain and through incidental ingestion of surface sediment. Aquatic receptors could also potentially be indirectly exposed to contaminants in groundwater through ingestion of and direct contact with surface water after discharge of groundwater to surface water.

Problem Definition

The site has been used for OB/OD of waste pyrotechnics, solvents, projectiles, CADs, PADs, primers, less-sensitive explosives, high explosives, and single-base, double-base, and composite propellants. Facility activities may have resulted in MCs being released into the environment and contaminating the soil, groundwater, surface water, and sediment through direct deposit, infiltration, erosion, and overland flow. Although human and ecological receptors may be exposed to contaminants in the surface water of Mattawoman Creek, the IHIRT concluded that focusing on soil, groundwater, and sediment would best represent the contamination most likely attributed from the site, primarily because the dynamic nature of the surface water system and the multiple contributors along the creek. Previous sampling of the soil and groundwater indicated elevated concentrations of metals, explosives, volatiles, and semivolatiles when compared to background samples; however, an HHRA or ERA has not been completed, nor has the nature and extent been sufficiently delineated.

SAP Worksheet #10—Problem Definition (continued)

This UFP-SAP is in support of the MC component of the RI. The MEC investigation, which will be performed in accordance with a Navy- and regulator-approved work plan and a NOSSA-approved ESS, will be conducted before the MC investigation. The MEC investigation will include removal of MEC and non-MEC items on the surface of the site and a DGM survey, which will enable the environmental samples to be collected.

Environmental Questions to be answered by this Project

The environmental questions/problems to be addressed by the MC component of the RI are:

1. What is the nature and extent of contamination in the surface soil and subsurface soil?

   Twenty-three discrete surface and subsurface soil samples will be collected from the locations shown on Figure 4. The discrete samples have been distributed across the site, which is the primary burn area, located from the tip of the peninsula and the area 150 feet inland. The sampling density is biased around the known OB/OD location, where the former burn chamber and steel deflection shield are located.

   One SMI soil sample will be composited from 30 to 100 plug locations as shown on Figure 5. The SMI sample will be collected from the 0- to 2-inch (approximately) surface interval on the area of the site believed to have been formed by erosion from the historical terrestrial area and sedimentation/deposition in the area to be sampled. The proposed plug locations are distributed in a grid such that there is soil collected from across this portion of the site. . The SMI sample is being collected to determine the presence or absence of contamination that may have been transported over time as erosion and sedimentation occurred. This sample will not be used in the risk assessment but will be used in the initial risk screening process.

   Based on the results of the MEC investigation and anomaly avoidance, the proposed environmental sample locations may be revised in the field. If MEC-related item(s) are identified during the MEC investigation, the environmental sample locations will be redistributed and relocated around the identified item(s) to sample the media in the immediate vicinity. This effort will determine if the MEC-related item(s) generated a release to the environment while ensuring the objectives of the MC investigation are met.

   The discrete soil samples, collected from the primary burn area where the potential source area is located, will be analyzed for TAL metals, TCL VOCs and SVOCs, explosives (including pentaerythritol tetranitrate [PETN], NG, nitrocellulose [NC], nitroguanidine, and perchlorate), pH, and total organic carbon (TOC), as detailed in Worksheet #18. The SMI sample, collected from the spits where no potential source areas have been identified, will be analyzed for TAL metals and explosives (including PETN, NG, NC, nitroguanidine, and perchlorate), as detailed in Worksheet #18. The analytical results of the discrete sampling will be used to evaluate the nature and extent of site-related constituents in the surface soil and subsurface soil. The analytical results of the SMI sampling will be used to assess the presence or absence of site-related constituents in the spits. If the SMI sample indicates that contamination may be present in the spits, discrete sampling will be conducted in this area.

2. What is the nature and extent of contamination in the sediment?

   Four sediment samples will be collected from the locations shown on Figure 4. Samples will be collected along the western and eastern shorelines because these areas are subject to less turbulence and scouring than the sediments along the southern shoreline, and therefore, are best representative of potential contaminant discharge from the site.

   The sediment samples will be analyzed for TAL metals, TCL VOCs and SVOCs, explosives (including PETN, NG, NC, nitroguanidine, and perchlorate), pH, and TOC, as detailed in Worksheet #18. The analytical results will be used to evaluate the nature and extent of site-related constituents in the sediment.

SAP Worksheet #10—Problem Definition (continued)

3. What is the nature and extent of contamination in the shallow groundwater?

   Five *in situ* shallow groundwater samples will be collected from the locations shown on Figure 4. The locations were selected based on an even distribution across the site, including one location at the former burn chamber.

   The groundwater samples will be analyzed for TAL metals (total and dissolved), TCL VOCs and SVOCs, explosives (including PETN, NG, NC, nitroguanidine, and perchlorate), and hardness), as detailed in Worksheet #18. The analytical results will be used to evaluate the nature and extent of site-related constituents in the shallow groundwater.

4. Do the concentrations of constituents detected in the surface soil, subsurface soil, sediment, or groundwater and attributable to the site present unacceptable human health or ecological risk?

   The analytical data collected during the RI will be used to conduct a baseline HHRA and ERA to assess whether the concentrations of constituents detected in the surface soil, subsurface soil, sediment, or shallow groundwater present potentially unacceptable human health risk, ecological risk, or both.

   The baseline HHRA will follow current EPA risk assessment methodology and will consist of the following components, as well as a section summarizing the results of the HHRA:

   - Data evaluation/hazard identification – Data will be screened against human health risk-based criteria (i.e., current EPA regional screening levels [RSLs]), and ecological risk-based criteria (i.e., EPA ecological soil screening levels, and Region III Biological Technical Assistance Group [BTAG] surface soil screening values); COPCs will be identified as those constituents that exceed the risk-based criteria.
   - Exposure assessment – receptors, exposure pathways, exposure parameters (ingestion rate), and exposure point concentrations will be identified.
   - Toxicity assessment – Toxicity values for the COPCs identified in the data evaluation will be identified.
   - Risk characterization – The previous steps will be combined to estimate potential risks to receptors.
   - Uncertainty evaluation – Sources of uncertainty in the risk assessment will be identified, and potential effects on calculated risk will be determined.

   A screening-level ERA (Steps 1 and 2) and, if warranted, the first step of the baseline ERA (Step 3A) will be prepared for UXO 20 in general accordance with the Navy and EPA guidance.

5. Do the constituent concentrations in the surface soil, subsurface soil, sediment, or shallow groundwater warrant further investigation and/or action?

   The results of the MEC and MC investigations and subsequent risk assessment will be used to make the determination for further investigation and/or action in accordance with the project quality objective (PQO) statements in Worksheet #11.

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SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements

This section presents the PQOs for the UXO 20 RI in the format specified by the UFP-SAP guidance.

Who will use the data?

The data will be used by the IHIRT (Navy, EPA Region III, MDE) to make decisions about the path forward for UXO 20. CH2M HILL will use the data to prepare an RI report, which will document the field activities, analytical results, nature and extent of contamination, and baseline HHRA and ERA results.

Within each organization, the data may be used by human health risk assessors, ecological risk assessors, and/or PMs. Other technical disciplines within each organization may use the data as well. Chemists will use the data to evaluate overall data quality with respect to subcontracted laboratories. Geologists and hydrogeologists may use the data to gain better understanding of subsurface soil quality and fill unit groundwater conditions contributing to contaminant fate and transport mechanisms. Engineers may use the data in designing removal actions or remedial systems in the future, if warranted.

Analytical data for IDW will be collected to characterize the borehole cuttings and other materials generated during the field sampling event. CH2M HILL and the IDW disposal contractor will use the data to classify the materials and select the appropriate methods for transportation and offsite disposal/treatment.

What are the Project Action Limits (PALs)?

HHRA—Concentrations of constituents detected in the surface soil, subsurface soil, and sediment and shallow groundwater samples collected during the UXO 20 RI field event will be compared to the current EPA RSLs to identify COPCs. The concentrations of constituents detected in groundwater also will be compared to the EPA maximum contaminant levels (MCLs)[6]. The concentrations of constituents detected in soil will be compared to residential soil RSLs. The concentrations of constituents detected in sediment will be compared to 10 times the residential soil RSLs. The concentrations of constituents detected in groundwater will be compared to the tap water RSLs. The RSLs for noncarcinogenic constituents will be divided by 10 to account for exposure to more than one constituent that affects the same target organ. The adjusted RSLs will be the PALs for the human health risk-based screening of analytical data to identify the COPCs used to assess potential risks to human health (see Worksheet #15). If constituent concentrations exceed the RSL (modified and/or adjusted as described above), the constituent will be identified as a COPC for the site.

ERA— The concentrations of constituents detected in soil will be screened against EPA ecological soil screening levels, where available, and Region III BTAG surface soil screening values for chemicals without ecological soil screening levels. The screening values that will be used to evaluate potential ecological risks from chemicals in sediment were derived from the following sources: *EPA Region III Freshwater Sediment Screening Benchmarks (EPA, 2005); National Oceanic and Atmospheric Administration Screening Quick Reference Tables* (Buchmann, 2008); and *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-associated Biota: 1997 Revision* (Jones et al., 1997). The concentrations of constituents detected in groundwater will be compared to the

[6] Although shallow groundwater is not considered a suitable drinking water source under current land use conditions, it may be considered a potential future drinking water source. The Comprehensive Environmental Response, Compensation, and Liability Act of 1980identifies MCLs as criteria protective of human health for potential drinking water sources. Therefore, MCLs are appropriate for use as PALs for groundwater.

SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements (continued)

Region III BTAG freshwater criteria as a conservative estimate because there is a potential exposure pathway for aquatic organisms if groundwater discharges directly to the Mattawoman Creek or to sediment pore water.

The screening values stated above will be used as ecological PALs, or “ecological target quantitation limits” (QLs) for the laboratory chemical analysis (see Worksheet #15).

What will the data be used for?

The data will be used to answer the following questions, as described in Worksheet #10:

- What is the nature and extent of contamination in the surface soil and subsurface soil?
- What is the nature and extent of contamination in the sediment?
- What is the nature and extent of contamination in the shallow groundwater?
- Do the concentrations of constituents detected in the surface soil, subsurface soil, sediment, or shallow groundwater present unacceptable human health or ecological risk?
- Do the constituent concentrations in the surface soil, subsurface soil, sediment, or shallow groundwater warrant further investigation and/or action?

What types of data are needed (matrix, target analytes, analytical groups, field screening, onsite analytical or offsite laboratory techniques, sampling techniques)?

This UFP-SAP provides details for the collection and analyses of surface soil, subsurface soil, sediment, and shallow groundwater samples in support of an RI. Worksheet #17 presents detailed information on the types of data needed for this project. All samples will be analyzed by an offsite laboratory. All samples will be collected in accordance with the NSF-IH master plans (Tetra Tech, 2009) and the standard operating procedures (SOPs) listed on Worksheet #21 and presented in Attachment A. Because of the past activities potentially related to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 and associated with the site (all potential types of waste disposed), a focused range of constituent analyses is warranted as follows:

- **Surface soil and subsurface soil** samples will be analyzed for TCL VOCs and SVOCs, total TAL metals, explosives (including PETN, NG, NC, nitroguanidine, and perchlorate), pH, and TOC.
- **SMI soil** sample will be analyzed for total TAL metals and explosives (including PETN, NG, NC, nitroguanidine, and perchlorate).
- **Sediment** samples will be analyzed for TCL VOCs and SVOCs, total TAL metals, explosives (including PETN, NG, NC, nitroguanidine, and perchlorate), pH, and TOC.
- **Groundwater** samples will be analyzed for TCL VOCs and SVOCs, total and dissolved TAL metals, explosives (including PETN, NG, NC, nitroguanidine, and perchlorate), and hardness.

SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements (continued)

How "good" do the data need to be in order to support the environmental decision?

The data will be of the quality and quantity required to meet the project objective of determining the nature and extent of site-related constituents in surface soil, subsurface soil, sediment, and groundwater and the associated human health and ecological risks. Additional information associated with the precision, bias, sensitivity, representativeness and comparability of the data is provided in this worksheet and in Worksheets #12, #15, #19, #20, #24, and #28.

How will data be used when the laboratory-specific limits of detection are greater than the PALs?

Worksheet #15 presents analytical methodology and limits. In addition to listing the particular analytes, PALs, and limits, it also identifies where limits of detection (LODs) are greater than PALs. Although this information was considered when planning the analytical protocol for the site and may lead to some uncertainty, it does not prevent conclusions from being drawn with respect to the objectives of the RI, for the following reasons:

1. The samples collected are being analyzed for constituent groups, not specific analytes. This is because the site is in the RI phase, where the primary objective is to identify the nature and extent of contamination. In this case, analyzing for analyte groups is appropriate for satisfying this objective, as well as making decisions about whether further investigation and/or action is warranted. Even if a particular analyte has an LOD greater than a screening level, there are sufficient other analytes in the same constituent group that would likely be detected in the event of a release and whose LODs are less than the screening values. Therefore, decisions about further investigation and/or action at the site can be made with sufficient confidence.
2. Even though some LODs are greater than their respective PALs, detection limits (DLs) are closer to and may be less than the applicable PALs. The laboratory instrumentation would likely detect a constituent if present at a concentration greater than its detection limit; such a result would be reported as estimated because it is less than the limit of quantitation (LOQ).

How much data should be collected (number of samples for each analytical group, matrix, and concentration)?

Detailed information on data collection is provided in Worksheet #17. The quantities and types of QA/QC samples are detailed in Worksheet #20.

Where, when, and how should the data be collected/generated?

- Detailed information on when the data will be collected is provided in Worksheet #16.
- Detailed information on where and how the data will be collected is provided in Worksheets #14 and #17.
- All sampling will be performed in general accordance with the procedures described in the NSF-IH master plans (Tetra Tech, 2009) and the SOPs listed on Worksheet #21.

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

- The CH2M HILL field team will collect the samples during the field sampling event.

SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements (continued)

- The samples will be shipped via overnight courier to [Spectrum Analytical; Empirical Laboratories; Microbac Laboratories]
- All chemical data generated will be submitted to CH2M HILL. Once received and reviewed by CH2M HILL, all chemical data will be validated.
- Field data, such as field screening results (photoionization detector [PID] readings) and field observations will also be collected by CH2M HILL during the field sampling event. These data are qualitative and semi-quantitative (screening-level) in nature and, therefore, will not undergo third-party validation; however, all chemical data will be validated by CH2M HILL.
- All chemical and field data will be presented in an RI report, which will be submitted to the Navy as a preliminary draft for review before distribution to EPA and MDE for review and approval. The final approved report will be placed in the Administrative Record and will be publicly available.

How will the data be archived?

Data will be archived in accordance with Navy CLEAN contractual requirements. The analytical data will be loaded to the Navy IR Information System database.

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

- If MEC-related item(s) are identified during the MEC investigation, then the environmental sample locations will be redistributed and relocated around the identified item(s) to sample the media in the immediate vicinity.

The following PQOs are shown in the flow chart presented in Figure 6.

- If the concentrations of detected constituents do not exceed human health and/or ecological screening levels, then the RI report[7] will be prepared with a recommendation of 'No Further Investigation' for MC[8] in soil, sediment, and/or groundwater.
- If the concentrations of detected constituents exceed human health and/or ecological screening levels and the nature and extent of contamination have been sufficiently delineated, then an HHRA and screening ERA will be conducted[9].
- If the concentrations of detected constituents exceed human health and/or ecological screening levels and the nature and extent of contamination have not been sufficiently delineated, then the existing data will be used to propose additional sampling needs to the IHIRT in order to sufficiently delineate the nature and extent of contamination. Additional samples will be collected.
- If no potentially unacceptable risk associated with site-specific soil, sediment, and/or groundwater is identified during the HHRA and screening ERA, and detected constituents are less than the

[7] The results of the MEC investigation, documented under a separate work plan, will be taken into account in the RI report and any subsequent action(s) or remedial alternatives generated in a Feasibility Study.

[8] MC constituents at UXO 20 comprise TAL metals, TCL VOCs, TCL SVOCs, and explosives (including PETN, nitroguanidine, NC, NG, and perchlorate.

[9] The HHRA and screening ERA will not be conducted for the SMI soil sample, which is being collected from the 0 to 2 inch surface soil interval; however, the SMI soil sample results will be used in the human health and ecological risk screening to determine the presence or absence of MC contamination in the spits.

SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements (continued)

background[10] levels, then the RI report will be prepared with a recommendation of 'No Further Investigation' for MC in soil, sediment, and/or groundwater.

- If potentially unacceptable risk associated with site-specific soil, sediment, and/or groundwater is identified during the HHRA and screening ERA, but detected constituents are less than the background levels, then the RI report will be prepared with a recommendation of 'No Further Investigation' for MCs in soil, sediment, and/or groundwater.
- If potentially unacceptable risk associated with the site-specific soil, sediment, and/or groundwater is identified during the HHRA and screening ERA, and detected constituents are greater than the background levels, the RI report will be prepared with a recommendation for a Feasibility Study to evaluate remedial alternatives for MC in soil, sediment, and/or groundwater.

[10] The comparison of data to background levels is a secondary evaluation criteria to support risk management decisions. Background values are not used to eliminate COCs during the risk evaluation.

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SAP Worksheet #12-1–Measurement Performance Criteria Table - Field QC Samples

Matrix: Groundwater
Analytical Group: METAL, FMETAL[1]
Concentration Level: Low (SW-846 6020A, 7470A, 9012B)

QC Sample[2]	Analytical Group[3]	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Field Duplicate	METAL, FMETAL	One per 10 field samples	Precision	%RPD ≤20%	S & A
Equipment Rinsate Blank	METAL, FMETAL	One per day	Bias / Contamination	Same as method blank. Refer to Worksheet #28-1.	S
Temperature Blank	METAL, FMETAL	One per cooler	Accuracy / Representativeness	≤ 6°C	S

[1] Cyanide is not part of the FMETAL analysis group.
2Matrix spike/matrix spike duplicate (MS/MSD) is described on Worksheet #28.
[3] If information varies within an analytical group, separate by individual analyte.

RPD = relative percent difference
°C = degrees Celsius

SAP Worksheet #12-2–Measurement Performance Criteria Table - Field QC Samples

Matrix: Groundwater
Analytical Group: VOC
Concentration Level: Low (SW-846 8260C)

QC Sample[1]	Analytical Group[2]	Frequency	DQIs	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Field Duplicate	VOC	One per 10 field samples	Precision	%RPD ≤20%	S & A
Equipment Rinsate Blank	VOC	One per day	Bias / Contamination	Same as method blank. Refer to Worksheet #28-2.	S
Trip Blank	VOC	One per cooler	Bias / Contamination	Same as method blank.	S & A
Temperature Blank	VOC	One per cooler	Accuracy / Representativeness	≤ 6°C	S

[1] MS/MSD is described on Worksheet #28.
[2] If information varies within an analytical group, separate by individual analyte.

SAP Worksheet #12-3–Measurement Performance Criteria Table - Field QC Samples

Matrix: Groundwater
Analytical Group: SVOC
Concentration Level: Low (SW-846 8270D), SIM (SW-846 8270D-SIM)

QC Sample[1]	Analytical Group[2]	Frequency	DQIs	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Field Duplicate	SVOC	One per 10 field samples	Precision	%RPD ≤20%	S & A
Equipment Rinsate Blank	SVOC	One per day	Bias / Contamination	Same as method blank. Refer to Worksheet #28-3.	S
Temperature Blank	SVOC	One per cooler	Accuracy / Representativeness	≤ 6°C	S

[1] MS/MSD is described on Worksheet #28.
[2] If information varies within an analytical group, separate by individual analyte.

SAP Worksheet #12-4–Measurement Performance Criteria Table - Field QC Samples

Matrix: Groundwater
Analytical Group: EXPLO
Concentration Level: Low (USATHAMA/353.2/353.3, SW-846 8330B, SW-846 6850)

QC Sample[1]	Analytical Group[2]	Frequency	DQIs	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Field Duplicate	EXPLO	One per 10 field samples	Precision	%RPD ≤20%	S & A
Equipment Rinsate Blank	EXPLO	One per day	Bias / Contamination	Same as method blank. Refer to Worksheet #28-4.	S
Temperature Blank	EXPLO	One per cooler	Accuracy / Representativeness	≤ 6°C	S

[1] MS/MSD is described on Worksheet #28.
[2] If information varies within an analytical group, separate by individual analyte.

SAP Worksheet #12-5–Measurement Performance Criteria Table - Field QC Samples

Matrix: Groundwater
Analytical Group: WCHEM
Concentration Level: Low (Hardness)

QC Sample	Analytical Group[1]	Frequency	DQIs	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Temperature Blank	WCHEM	One per cooler	Accuracy / Representativeness	≤ 6°C	S

[1]If information varies within an analytical group, separate by individual analyte.

SAP Worksheet #12-6–Measurement Performance Criteria Table - Field QC Samples

Matrix: Sediment, Surface Soil, Subsurface Soil, and Multi-Incremental Soil

Analytical Group: METAL

Concentration Level: Low (SW-846 6020A, 7471A, 9012B)

QC Sample[1]	Analytical Group[2]	Frequency	DQIs	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Field Duplicate	METAL	One per 10 discrete field samples	Precision	%RPD ≤30%	S & A
Field Triplicate	METAL	One set of three per 10 multi-incremental field samples	Precision	%RSD ≤30% (advisory)	S & A
Equipment Rinsate Blank	METAL	One per day	Bias / Contamination	Same as method blank. Refer to Worksheet #28-5.	S
Temperature Blank	METAL	One per cooler	Accuracy / Representativeness	≤ 6°C	S

[1] MS/MSD is described on Worksheet #28.

[2] If information varies within an analytical group, separate by individual analyte.

SAP Worksheet #12-7–Measurement Performance Criteria Table - Field QC Samples

Matrix: Discrete Sample for Sediment, Surface Soil, and Subsurface Soil

Analytical Group: VOC

Concentration Level: Low (SW-846 8260C)

QC Sample[1]	Analytical Group[2]	Frequency	DQIs	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Field Duplicate	VOC	One per 10 field samples	Precision	%RPD ≤30%	S & A
Equipment Rinsate Blank	VOC	One per day	Bias / Contamination	Same as method blank. Refer to Worksheet #28-6.	S
Trip Blank	VOC	One per cooler	Bias / Contamination	Same as method blank.	S & A
Temperature Blank	VOC	One per cooler	Accuracy / Representativeness	≤ 6°C	S

[1] MS/MSD is described on Worksheet #28.

[2] If information varies within an analytical group, separate by individual analyte.

SAP Worksheet #12-8–Measurement Performance Criteria Table

Matrix: Discrete Sample for Sediment, Surface Soil, and Subsurface Soil

Analytical Group: SVOC

Concentration Level: Low (SW-846 8270D), SIM (SW-846 8270D-SIM)

QC Sample[1]	Analytical Group[2]	Frequency	DQIs	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Field Duplicate	SVOC	One per 10 field samples	Precision	%RPD ≤30%	S & A
Equipment Rinsate Blank	SVOC	One per day	Bias / Contamination	Same as method blank. Refer to Worksheet #28-7.	S
Temperature Blank	SVOC	One per cooler	Accuracy / Representativeness	≤ 6°C	S

[1] MS/MSD is described on Worksheet #28.

[2] If information varies within an analytical group, separate by individual analyte.

SAP Worksheet #12-9–Measurement Performance Criteria Table - Field QC Samples

Matrix: Sediment, Surface Soil, Subsurface Soil, and Multi-Incremental Soil
Analytical Group: EXPLO
Concentration Level: Low (USATHAMA/353.2/353.3, SW-846 8330B, SW-846 6850)

QC Sample[1]	Analytical Group[2]	Frequency	DQIs	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Field Duplicate	EXPLOSIVES	One per 10 discrete field samples	Precision	%RPD ≤20%	S & A
Field Triplicate	EXPLOSIVES	One set of three per 10 multi-incremental field samples	Precision	%RSD ≤20% (advisory)	S & A
Equipment Rinsate Blank	EXPLOSIVES	One per day	Bias / Contamination	Same as method blank. Refer to Worksheet #28-8.	S
Temperature Blank	EXPLOSIVES	One per cooler	Accuracy / Representativeness	≤ 6°C	S

[1] MS/MSD is described on Worksheet #28.
[2] If information varies within an analytical group, separate by individual analyte.

SAP Worksheet #12-10–Measurement Performance Criteria Table - Field QC Samples

Matrix: Discrete Sample for Sediment, Surface Soil, and Subsurface Soil

Analytical Group: WCHEM

Concentration Level: Low (SW-846 9045C and Lloyd Kahn)

QC Sample	Analytical Group[1]	Frequency	DQIs	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Temperature Blank	WCHEM	One per cooler	Accuracy / Representativeness	≤ 6°C	S

[1]If information varies within an analytical group, separate by individual analyte.

SAP Worksheet #13—Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (originating organization, report title and date)	Data Generator(s) (originating organization, data types, data generation / collection dates)	How Data Will Be Used	Limitations on Data Use
N/A	N/A	N/A	N/A	N/A

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SAP Worksheet #14—Summary of Project Tasks

Project Logistics

In general, work will be performed in Level D personal protective equipment (PPE), which includes hard hat, safety glasses, and safety-toed boots, and hearing protection. Optional PPE includes the use of Tyvek coveralls. Upgrades to higher levels of PPE are discussed in the HASP, provided as Appendix D of the RI work plan.

Sampling activities are expected to be performed during normal working hours, except under specific arrangement with NSF-IH for after-hours or weekend activities. A portion of UXO 20 lies within the Strauss Avenue Safety Thermal Treatment Plant Work Restriction Arc and may be under additional work restrictions.

Project Tasks

Applicable SOPs for project tasks outlined in this section are listed on Worksheet #21 and provided in Attachment A.

- **Utility Clearance**
  - Utility clearance will be performed at each sample location before any intrusive activity begins, in accordance with the SOP *Locating and Clearing Underground Utilities* provided in Attachment A.
- **Anomaly Avoidance**
  - Anomaly avoidance will be performed during field activities using the SOP *Explosives Usage and Munitions Response* located in Attachment A.
  - UXO technicians will be present during environmental sampling. They will provide the field team with guidance to safely obtain samples with optimal locations near the former steel burn chamber and deflection shield, as well as any other identified items of interest.
- **Surface Soil Sampling**

Anomaly avoidance will be performed before the start of sampling by a CH2M HILL UXO technician. CH2M HILL field personnel will collect 23 discrete surface soil samples using a hand trowel from a depth interval of 0 to 6 inches bgs, as specified in Worksheet #17 and shown in Figure 4. In addition, one SMI soil sample will be collected using a hand plug tool from the 0- to 2-inch depth interval, as specified in Worksheet #17 and shown in Figure 5. Sampling protocols will follow the *Soil Sampling* and *Shallow Soil Sampling* SOPs referenced in Worksheet #21. Appropriate QA/QC samples will be collected as specified in Worksheet #20. Soil sample locations will be located using a global positioning system in accordance with the SOP *Global Positioning System*, referenced in Worksheet #21.

- **Subsurface Soil Sampling**

Anomaly avoidance will be performed by a CH2M HILL UXO technician before the start of sampling and at every 1-foot drilling interval to a depth not to exceed 10 feet bgs or when groundwater is encountered. CH2M HILL field personnel will collect 23 discrete subsurface soil samples using a DPT rig in accordance with the *Direct-Push Soil Sample Collection* and *Homogenization of Soil and Sediment Samples* SOPs provided in Attachment A, as specified in Worksheet #17 and shown in Figure 4. Soils will be screened using a PID, and each sample will be collected from 6 inches above the water table, which is assumed to be approximately 5 feet bgs. Sampling protocols will follow the *Soil Sampling, Direct-Push Soil Sampling Collection*, and *Multi RAE Photoionization Detector (PID)* SOPs referenced in Worksheet #21. Appropriate QA/QC samples will be collected as specified in Worksheet #20. Soil sample locations will be located using a global positioning system in accordance with the SOP *Global Positioning System*, referenced in Worksheet #21.

SAP Worksheet #14—Summary of Project Tasks (continued)

- **Sediment Sampling**

Anomaly avoidance will be performed before the start of sampling by a CH2M HILL UXO technician. CH2M HILL field personnel will collect 4 sediment samples from a depth interval of 0 to 6 inches below the sediment surface using a hand trowel, in accordance with the *Direct-Push Soil Sample Collection* and *Homogenization of Soil and Sediment Samples* SOPs provided in Attachment A, as specified in Worksheet #17 and shown in Figure 4. Appropriate QA/QC samples will be collected as specified in Worksheet #20. Sediment sample locations will be located using a global positioning system in accordance with the SOP *Global Positioning System*, referenced in Worksheet #21.

- ***In Situ* Groundwater Sampling**

Anomaly avoidance will be performed by a CH2M HILL UXO technician before the start of sampling and at every 1-foot drilling interval to a depth not to exceed 10 feet bgs or when groundwater is encountered. CH2M HILL field personnel will collect five *in situ* groundwater samples using a DPT rig, as specified in Worksheet #17 and shown in Figure 4. Field parameters (pH, specific conductivity, turbidity, dissolved oxygen, oxidation-reduction potential [ORP], and temperature) will be collected at each point and recorded in the log book. Sampling protocols will be in accordance with the *Direct-Push Groundwater Sample Collection* and *Field Measurement of pH, Specific Conductance, Turbidity, Dissolved Oxygen, ORP, and Temperature Using a Horiba or YSI Water Quality Parameter Meter with Flow-Through Cell* SOPs referenced in Worksheet #21. Appropriate QA/QC samples will be collected as specified in Worksheet #20. Soil sample locations will be located using a global positioning system in accordance with the SOP *Global Positioning System*, referenced in Worksheet #21.

- **Decontamination**

All non-disposable sampling equipment will be decontaminated before sampling activities at each location in accordance with the *Decontamination of Personnel and Equipment* and *Decontamination of Drilling Rigs and Equipment* SOPs located in Attachment A.

- **Waste Management**
  - DPT soil cuttings, purged groundwater, and decontamination rinse water will be placed in metal drums and sampled for waste characterization parameters in accordance with the SOP *Disposal of Waste Fluids and Solids* and *Sampling Contents of Tanks and Drums* located in Attachment A.
  - It is assumed that any remaining sediment that is not sent to the laboratory will be left at the location at which it was collected. Therefore, it is assumed that sediment IDW will not be generated.

- **Quality Control**
  - Implement SOPs for field (Attachment A) and laboratory (Attachment B) activities being performed.
  - QA/QC samples to be collected are outlined on Worksheet #20.

SAP Worksheet #14—Summary of Project Tasks (continued)

- **Analytical Tasks**
  - The laboratory will maintain, test, inspect, and calibrate analytical instruments (Worksheets #24 and #25).
  - The laboratory will process and prepare samples for analysis.
  - The laboratory will analyze environmental samples for various groups of parameters, as shown on Worksheet #18: VOCs, SVOCs, metals, and explosives.
  - The laboratory will provide all sample results in a Level IV data package, which includes all laboratory QC forms and raw data. Please refer to Work sheet #29.
- **Data Management**
  - Attachment A provides guidance on data management steps, such as data requirements and format for field log books and information on chain-of-custody procedures. The CH2M HILL Project PDM is responsible for data tracking and storage and will coordinate archiving and retrieval of data.
- **Procedures for recording data, including guidelines for recording and correcting data.**
  - Project Assessment/Audit (Worksheets #31 and #32)
  - Data Review
    - Data Validation (Worksheets #35 and #36)
    - Data Usability Assessment (Worksheet #37)

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SAP Worksheet #15-1—Reference Limits and Evaluation Table

Matrix: Groundwater and Aqueous (Blanks)

Analytical Group: METAL, FMETAL

Analyte[1,2]	CAS Number	RSLs Tapwater Adjusted, November 2011 (µg/L)	Region III BTAG Freshwater Criteria (µg/L)	Laboratory-specific (µg/L)			Accuracy Control Limit (%R)	Precision Control Limit (% RPD)
				LOQs	LODs	DLs		
Aluminum	7429-90-5	3700	87	100	18.6	9.3	80 - 120	10
Antimony	7440-36-0	1.5	30	10	6.6	3.3	80 - 120	10
Arsenic	7440-38-2	0.045	5	10	6.62	3.31	80 - 120	10
Barium	7440-39-3	730	4	10	0.625	0.22	80 - 120	10
Beryllium	7440-41-7	7.3	0.66	5	0.32	0.12	80 - 120	10
Cadmium	7440-43-9	1.8	0.25	5	1.8	0.72	80 - 120	10
Calcium	7440-70-2	--	116000	100	78	39	80 - 120	10
Chromium	7440-47-3	0.043	85	10	1	0.43	80 - 120	10
Cobalt	7440-48-4	1.1	23	10	0.8	0.37	80 - 120	10
Copper	7440-50-8	150	9	10	8	2.7	80 - 120	10
Iron	7439-89-6	2600	300	50	11.2	5.5	80 - 120	10
Lead	7439-92-1	15	2.5	15	7.5	3.7	80 - 120	10
Magnesium	7439-95-4	--	82000	100	20	9.8	80 - 120	10
Manganese	7439-96-5	88	0.1	10	0.8	0.35	80 - 120	10
Mercury	7439-97-6	1.1	0.019	0.2	0.1	0.037	80 - 120	10
Nickel	7440-02-0	73	52	5	2	0.93	80 - 120	10
Potassium	7440-09-7	--	53000	500	160	71.7	80 - 120	10
Selenium	7782-49-2	18	1	20	9	4.1	80 - 120	10

SAP Worksheet #15-1—Reference Limits and Evaluation Table (continued)

Matrix: Groundwater and Aqueous (Blanks)

Analytical Group: METAL, FMETAL

Analyte[1,2]	CAS Number	RSLs Tapwater Adjusted, November 2011 (µg/L)	Region III BTAG Freshwater Criteria (µg/L)	Laboratory-specific (µg/L)			Accuracy Control Limit (%R)	Precision Control Limit (% RPD)
				LOQs	LODs	DLs		
Silver	7440-22-4	18	3.2	10	1.2	0.52	80 - 120	10
Sodium	7440-23-5	--	680000	400	400	180	80 - 120	10
Thallium	7440-28-0	0.037	0.8	10	9	4.4	80 - 120	10
Vanadium	7440-62-2	18	20	10	1	0.44	80 - 120	10
Zinc	7440-66-6	1100	120	20	8	4	80 - 120	10
Cyanide	57-12-5	73	5	10	3	1	80 - 120	20

1. Filtered cyanide is not analyzed.
2. All metals (except mercury) are analyzed via 6020A.

Shading indicates cells where the LOD is greater than the screening level. Refer to Worksheet #11 section "How good must the data be. "

%R = percent recovery

SAP Worksheet #15-2—Reference Limits and Evaluation Table

Matrix: Groundwater and Aqueous (Blanks)

Analytical Group: VOC

Analyte	CAS Number	RSLs Tapwater Adjusted, November 2011 (µg/L)	Region III BTAG Freshwater Criteria (µg/L)	Laboratory-specific (µg/L)			Accuracy Control Limit (%R)	Precision Control Limit (% RPD)
				LOQs	LODs	DLs		
1,1,1-Trichloroethane	71-55-6	910	11	1	0.4	0.14	65 - 130	20
1,1,2,2-Tetrachloroethane	79-34-5	0.067	610	1	0.3	0.13	65 - 130	20
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	76-13-1	5900	--	1	1	0.23	70 - 130	20
1,1,2-Trichloroethane	79-00-5	0.042	1200	1	0.4	0.2	75 - 125	20
1,1-Dichloroethane	75-34-3	2.4	47	1	0.4	0.15	70 - 135	20
1,1-Dichloroethene	75-35-4	34	25	0.5	0.3	0.19	70 - 130	20
1,2,4-Trichlorobenzene	120-82-1	0.41	24	1	0.8	0.4	65 - 135	20
1,2-Dibromo-3-chloropropane	96-12-8	0.00032	--	2	2	1	50 - 130	20
1,2-Dibromoethane	106-93-4	0.0065	--	1	0.3	0.11	80 - 120	20
1,2-Dichlorobenzene	95-50-1	37	0.7	1	1	0.25	70 - 120	20
1,2-Dichloroethane	107-06-2	0.15	100	1	0.4	0.15	70 - 130	20
1,2-Dichloropropane	78-87-5	0.39	--	1	0.3	0.15	75 - 125	20
1,3-Dichlorobenzene	541-73-1	0.37	150	2	0.3	0.15	75 - 125	20
1,4-Dichlorobenzene	106-46-7	0.43	26	3	0.3	0.15	75 - 125	20
2-Butanone	78-93-3	710	14000	4	4	2	30 - 150	20
2-Hexanone	591-78-6	4.7	99	4	1.2	0.48	55 - 130	20
4-Methyl-2-pentanone	108-10-1	200	170	4	2	1	60 - 135	20

SAP Worksheet #15-2—Reference Limits and Evaluation Table (continued)

Matrix: Groundwater and Aqueous (Blanks)

Analytical Group: VOC

Analyte	CAS Number	RSLs Tapwater Adjusted, November 2011 (µg/L)	Region III BTAG Freshwater Criteria (µg/L)	Laboratory-specific (µg/L)			Accuracy Control Limit (%R)	Precision Control Limit (% RPD)
				LOQs	LODs	DLs		
Acetone	67-64-1	2200	1500	10	2	1.3	40 - 140	20
Benzene	71-43-2	0.41	370	1	0.34	0.17	80 - 120	20
Bromodichloromethane	75-27-4	--	--	1	0.3	0.15	75 - 120	20
Bromoform	75-25-2	8.5	320	1	1	0.19	70 - 130	20
Bromomethane	74-83-9	0.87	--	1	1	0.43	30 - 145	20
Carbon disulfide	75-15-0	100	0.92	1	0.4	0.19	35 - 160	20
Carbon tetrachloride	56-23-5	0.44	13.3	1	0.3	0.14	65 - 140	20
Chlorobenzene	108-90-7	9.1	1.3	1	0.3	0.16	80 - 120	20
Chloroethane	75-00-3	2100	--	1.44	1.44	0.72	60 - 135	20
Chloroform	67-66-3	0.19	1.8	1	0.4	0.16	65 - 135	20
Chloromethane	74-87-3	19	--	1	1	0.32	40 - 125	20
cis-1,2-Dichloroethene	156-59-2	7.3	--	1	0.4	0.19	70 - 125	20
cis-1,3-Dichloropropene	10061-01-5	0.43	--	1	0.8	0.4	70 - 130	20
Cyclohexane	110-82-7	1300	--	1	0.4	0.2	70 - 130	20
Dibromochloromethane	124-48-1	0.15	--	0.3	0.3	0.13	60 - 135	20
Dichlorodifluoromethane (Freon-12)	75-71-8	20	--	1	1	0.17	30 - 155	20
Ethylbenzene	100-41-4	1.5	90	1	0.3	0.22	75 - 125	20
Isopropylbenzene	98-82-8	68	2.6	1	0.4	0.14	75 - 125	20

SAP Worksheet #15-2—Reference Limits and Evaluation Table (continued)

Matrix: Groundwater and Aqueous (Blanks)

Analytical Group: VOC

Analyte	CAS Number	RSLs Tapwater Adjusted, November 2011 (µg/L)	Region III BTAG Freshwater Criteria (µg/L)	Laboratory-specific (µg/L)			Accuracy Control Limit (%R)	Precision Control Limit (% RPD)
				LOQs	LODs	DLs		
m- and p-Xylene	m&pXYLENE	20	--	0.4	0.4	0.23	75 - 130	20
Methyl acetate	79-20-9	3700	--	1	0.6	0.38	70 - 130	20
Methylcyclohexane	108-87-2	--	--	1	1	1	65 - 125	20
Methylene chloride	75-09-2	4.8	98.1	1	0.4	0.27	70 - 130	20
Methyl-tert-butyl ether (MTBE)	1634-04-4	12	11070	5	1.32	0.66	55 - 140	20
o-Xylene	95-47-6	20	--	1	1	0.5	80 - 120	20
Styrene	100-42-5	160	72	1	0.3	0.12	65 - 135	20
Tetrachloroethene	127-18-4	0.11	111	1	0.3	0.21	45 - 150	20
Toluene	108-88-3	--	2	1	0.2	0.14	75 - 120	20
trans-1,2-Dichloroethene	156-60-5	--	970	1	1	0.33	60 - 140	20
trans-1,3-Dichloropropene	10061-02-6	--	--	1	0.6	0.3	55 - 140	20
Trichloroethene	79-01-6	--	21	1	0.3	0.19	70 - 125	20
Trichlorofluoromethane (Freon-11)	75-69-4	130	--	1	0.8	0.4	60 - 145	20
Vinyl chloride	75-01-4	0.016	930	1	1	0.18	50 - 145	20

Shading indicates cells where the LOD is greater than the screening level. Refer to Worksheet #11 section "How good must the data be."

SAP Worksheet #15-3—Reference Limits and Evaluation Table

Matrix: Groundwater and Aqueous (Blanks)

Analytical Group: SVOC

Analyte	CAS Number	Concentration Range	RSLs Tapwater Adjusted, November 2011 (µg/L)	Region III BTAG Freshwater Criteria (µg/L)	Laboratory-specific (µg/L)			Accuracy Control Limit (%R)	Precision Control Limit (% RPD)
					LOQs	LODs	DLs		
1,1-Biphenyl	92-52-4	8270	0.083	14	4	1	0.76	70 - 130	20
2,2'-Oxybis(1-chloropropane)	108-60-1	8270	0.32	--	6.6	6.6	3.3	25 - 130	20
2,4,5-Trichlorophenol	95-95-4	8270	370	--	6.8	6.8	3.4	50 - 110	20
2,4,6-Trichlorophenol	88-06-2	8270	3.7	--	4	1	0.84	50 - 115	20
2,4-Dichlorophenol	120-83-2	8270	11	--	6.2	6.2	3.1	50 - 105	20
2,4-Dimethylphenol	105-67-9	8270	73	--	4.6	4.6	2.3	30 - 110	19
2,4-Dinitrophenol	51-28-5	8270	7.3	--	20	8	5.6	15 - 140	20
2,4-Dinitrotoluene	121-14-2	8270	0.22	--	5.6	5.6	2.8	50 - 120	20
2,6-Dinitrotoluene	606-20-2	8270	3.7	81	5.6	5.6	2.8	50 - 115	20
2-Chloronaphthalene	91-58-7	8270	290	--	5.6	5.6	2.8	50 - 105	20
2-Chlorophenol	95-57-8	8270	18	24	5.8	5.8	2.9	35 - 105	20
2-Methylnaphthalene	91-57-6	8270_SIM	15	4.7	0.05	0.05	0.02	45 - 105	20
2-Methylphenol	95-48-7	8270	180	13	5.2	5.2	2.6	40 - 110	20
2-Nitroaniline	88-74-4	8270	37	--	6	6	3	50 - 115	20
2-Nitrophenol	88-75-5	8270	18	1920	4	1	0.77	40 - 115	20
3,3'-Dichlorobenzidine	91-94-1	8270	0.15	4.5	5.4	5.4	2.7	20 - 110	20
3-Nitroaniline	99-09-2	8270	--	--	5.6	5.6	2.8	20 - 125	20

SAP Worksheet #15-3—Reference Limits and Evaluation Table (continued)

Matrix: Groundwater and Aqueous (Blanks)

Analytical Group: SVOC

Analyte	CAS Number	Concentration Range	RSLs Tapwater Adjusted, November 2011 (µg/L)	Region III BTAG Freshwater Criteria (µg/L)	Laboratory-specific (µg/L)			Accuracy Control Limit (%R)	Precision Control Limit (% RPD)
					LOQs	LODs	DLs		
4,6-Dinitro-2-methylphenol	534-52-1	8270	0.29	--	8	8	4	40 - 130	20
4-Bromophenyl-phenylether	101-55-3	8270	--	1.5	4.6	4.6	2.3	50 - 115	20
4-Chloro-3-methylphenol	59-50-7	8270	370	--	5.4	5.4	2.7	45 - 110	20
4-Chloroaniline	106-47-8	8270	0.34	232	6	6	3	15 - 110	20
4-Chlorophenyl-phenylether	7005-72-3	8270	18	--	5	5	2.5	50 - 110	20
4-Methylphenol	106-44-5	8270	18	543	12.2	12.2	6.1	30 - 110	20
4-Nitroaniline	100-01-6	8270	3.4	--	4	2.6	1.5	35 - 120	20
4-Nitrophenol	100-02-7	8270	0.12	60	8	8	4	0 - 125	20
Acenaphthene	83-32-9	8270_SIM	220	5.8	0.05	0.05	0.02	45 - 110	20
Acenaphthylene	208-96-8	8270_SIM	220	--	0.05	0.05	0.02	50 - 105	20
Acetophenone	98-86-2	8270	370	--	8	8	4	45 - 118	20
Anthracene	120-12-7	8270_SIM	1100	0.012	0.05	0.05	0.02	55 - 110	20
Atrazine	1912-24-9	8270	0.29	1.8	4	1	0.54	70 - 130	19
Benzaldehyde	100-52-7	8270	370	--	4	1	0.49	40 - 100	20
Benzo(a)anthracene	56-55-3	8270_SIM	0.029	0.018	0.05	0.05	0.02	55 - 110	20
Benzo(a)pyrene	50-32-8	8270_SIM	0.0029	0.015	0.05	0.05	0.02	55 - 110	20
Benzo(b)fluoranthene	205-99-2	8270_SIM	0.029	--	0.05	0.05	0.02	45 - 120	20

SAP Worksheet #15-3—Reference Limits and Evaluation Table (continued)

Matrix: Groundwater and Aqueous (Blanks)

Analytical Group: SVOC

Analyte	CAS Number	Concentration Range	RSLs Tapwater Adjusted, November 2011 (µg/L)	Region III BTAG Freshwater Criteria (µg/L)	Laboratory-specific (µg/L)			Accuracy Control Limit (%R)	Precision Control Limit (% RPD)
					LOQs	LODs	DLs		
Benzo(g,h,i)perylene	191-24-2	8270_SIM	110	--	0.05	0.05	0.02	40 - 125	20
Benzo(k)fluoranthene	207-08-9	8270_SIM	0.29	--	0.05	0.05	0.02	45 - 125	20
bis(2-Chloroethoxy)methane	111-91-1	8270	11	--	7	7	3.5	45 - 105	20
bis(2-Chloroethyl)ether	111-44-4	8270	0.012	--	6	6	3	35 - 110	20
bis(2-Ethylhexyl)phthalate	117-81-7	8270	4.8	16	8.8	8.8	4.4	40 - 125	20
Butylbenzylphthalate	85-68-7	8270	35	19	6	6	3	45 - 115	20
Caprolactam	105-60-2	8270	1800	--	8	8	4	70 - 130	59
Carbazole	86-74-8	8270	--	--	6.2	6.2	3.1	50 - 115	20
Chrysene	218-01-9	8270_SIM	2.9	--	0.05	0.05	0.02	55 - 110	20
Dibenz(a,h)anthracene	53-70-3	8270_SIM	0.0029	--	0.05	0.05	0.02	40 - 125	20
Dibenzofuran	132-64-9	8270	3.7	3.7	5.4	5.4	2.7	55 - 105	20
Diethylphthalate	84-66-2	8270	2900	210	5.6	5.6	2.8	40 - 120	20
Dimethyl phthalate	131-11-3	8270	--	--	6	6	3	25 - 125	20
Di-n-butylphthalate	84-74-2	8270	370	19	4	1	0.86	55 - 115	20
Di-n-octylphthalate	117-84-0	8270	4.8	22	4	2.2	1.1	35 - 135	20
Fluoranthene	206-44-0	8270_SIM	150	0.04	0.05	0.05	0.02	55 - 115	20
Fluorene	86-73-7	8270_SIM	150	3	0.05	0.05	0.02	50 - 110	20

SAP Worksheet #15-3—Reference Limits and Evaluation Table (continued)

Matrix: Groundwater and Aqueous (Blanks)

Analytical Group: SVOC

Analyte	CAS Number	Concentration Range	RSLs Tapwater Adjusted, November 2011 (µg/L)	Region III BTAG Freshwater Criteria (µg/L)	Laboratory-specific (µg/L)			Accuracy Control Limit (%R)	Precision Control Limit (% RPD)
					LOQs	LODs	DLs		
Hexachlorobenzene	118-74-1	8270	0.042	0.0003	4	1	0.41	50 - 110	20
Hexachlorobutadiene	87-68-3	8270	0.86	1.3	5	5	2.5	25 - 105	20
Hexachlorocyclopentadiene	77-47-4	8270	22	--	4	1	0.82	13 - 80	20
Hexachloroethane	67-72-1	8270	3.7	12	5.2	5.2	2.6	30 - 95	20
Indeno(1,2,3-cd)pyrene	193-39-5	8270_SIM	0.029	--	0.05	0.05	0.02	45 - 125	20
Isophorone	78-59-1	8270	71	--	7.6	7.6	3.8	50 - 110	20
Naphthalene	91-20-3	8270_SIM	0.14	1.1	0.05	0.05	0.02	40 - 100	20
Nitrobenzene	98-95-3	8270	0.12	--	4	2	1	45 - 110	20
n-Nitroso-di-n-propylamine	621-64-7	8270	0.0096	--	6	6	3	35 - 130	20
n-Nitrosodiphenylamine	86-30-6	8270	14	210	6.8	6.8	3.4	50 - 110	20
Pentachlorophenol	87-86-5	8270	0.17	0.5	10	4	1.4	40 - 115	20
Phenanthrene	85-01-8	8270_SIM	1100	0.4	0.05	0.05	0.02	50 - 115	20
Phenol	108-95-2	8270	1100	4	4	3.4	1.7	0 - 115	20
Pyrene	129-00-0	8270_SIM	110	0.025	0.05	0.05	0.02	50 - 130	20

Shading indicates cells where the LOD is greater than the screening level. Refer to Worksheet #11 section "How good must the data be."

SAP Worksheet #15-4—Reference Limits and Evaluation Table

Matrix: Groundwater and Aqueous (Blanks)

Analytical Group: EXPLO

Analyte[1]	CAS Number	RSLs Tapwater Adjusted, November 2011 (µg/L)	Region III BTAG Freshwater Criteria (µg/L)	Laboratory-specific (µg/L)			Accuracy Control Limit (%R)	Precision Control Limit (% RPD)
				LOQs	LODs	DLs		
1,3,5-Trinitrobenzene	99-35-4	110	--	0.8	0.18	0.1	65 - 140	20
1,3-Dinitrobenzene	99-65-0	0.37	--	0.8	0.28	0.14	45 - 160	20
2,4,6-Trinitrotoluene	118-96-7	1.8	100	0.8	0.34	0.17	50 - 145	20
2,4-Dinitrotoluene	121-14-2	0.22	--	0.8	0.24	0.12	60 - 135	20
2,6-Dinitrotoluene	606-20-2	3.7	81	0.8	0.26	0.13	60 - 135	20
2-Amino-4,6-dinitrotoluene	35572-78-2	7.3	1480	0.8	0.24	0.12	50 - 155	20
2-Nitrotoluene	88-72-2	0.31	--	0.8	0.46	0.23	45 - 135	20
3-Nitrotoluene	99-08-1	0.37	750	0.8	0.48	0.24	50 - 130	20
4-Amino-2,6-dinitrotoluene	19406-51-0	7.3	--	1.44	1.44	0.72	55 - 155	20
4-Nitrotoluene	99-99-0	4.2	1900	0.8	0.44	0.22	50 - 130	20
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	--	--	0.8	0.18	0.11	50 - 160	20
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	479-45-8	--	--	0.8	0.18	0.11	20 - 175	20
Nitrobenzene	98-95-3	0.12	--	0.8	0.32	0.16	50 - 140	20
Nitrocellulose	9004-70-0	11000000	--	1	0.5	0.25	20 - 140	50
Nitroglycerin	55-63-0	0.37	138	3.2	0.75	0.59	50 - 110	20
Nitroguanidine	556-88-7	370	--	8	8	4	50 - 150	40
HMX	2691-41-0	--	--	0.8	0.18	0.097	80 - 115	20
Perchlorate	14797-73-0	2.6	--	0.5	0.2	0.066	80 - 120	15
PETN	78-11-5	7.3	85000	3.2	0.75	0.74	50 - 110	20

1. All EXPLO are reported from Spectrum Analytical with the exception of NC (Microbac) and Perchlorate (Empirical)

Shading indicates cells where the LOD is greater than the screening level. Refer to Worksheet #11 section "How good must the data be."

SAP Worksheet #15-5—Reference Limits and Evaluation Table

Matrix: Sediment, Surface Soil, Subsurface Soil, and Multi-Incremental Sampling Soil

Analytical Group: METAL

Analyte	CAS Number	RSLs Residential Soil Adjusted, November 2011 (mg/kg)	RSLs Residential Soil Adjusted, November 2011 (x10 for SD) (mg/kg)	Region III BTAG Freshwater Sediment Criteria (mg/kg)	Region III BTAG Freshwater Soil Criteria (mg/kg)	Laboratory-specific (mg/kg)			Accuracy Control Limit (%R)	Precision Control Limit (% RPD)
						LOQs	LODs	DLs		
Aluminum	7429-90-5	7700	77000	--	1	10	4.8	1.9	80 - 120	10
Antimony	7440-36-0	3.1	31	2	78	1	0.48	0.24	80 - 120	10
Arsenic	7440-38-2	0.39	3.9	9.8	328	1.05	1.05	0.5	80 - 120	10
Barium	7440-39-3	1500	15000	--	330	0.5	0.35	0.16	80 - 120	10
Beryllium	7440-41-7	16	160	--	40	0.5	0.384	0.16	80 - 120	10
Cadmium	7440-43-9	7	70	0.99	32	0.5	0.1	0.05	80 - 120	10
Calcium	7440-70-2	--	--	--	--	10	7	3.3	80 - 120	10
Chromium	7440-47-3	0.29	2.9	43.4	0.0075	0.5	0.35	0.16	80 - 120	10
Cobalt	7440-48-4	2.3	23	50	13	0.5	0.1	0.05	80 - 120	10
Copper	7440-50-8	310	3100	31.6	15	0.5	0.35	0.16	80 - 120	10
Iron	7439-89-6	5500	55000	20000	12	5	1.8	0.6	80 - 120	10
Lead	7439-92-1	400	4000	35.8	120	0.8	0.8	0.34	80 - 120	10
Magnesium	7439-95-4	--	--	--	--	10	7	2.9	80 - 120	10
Manganese	7439-96-5	180	1800	460	330	0.5	0.35	0.16	80 - 120	10
Mercury	7439-97-6	2.3	23	0.18	0.058	0.02	0.00925	0.0037	80 - 120	10
Nickel	7440-02-0	150	1500	22.7	2	0.5	0.4	0.16	80 - 120	10

SAP Worksheet #15-5—Reference Limits and Evaluation Table (continued)

Matrix: Sediment, Surface Soil, Subsurface Soil, and Multi-Incremental Sampling Soil

Analytical Group: METAL

Analyte[1]	CAS Number	RSLs Residential Soil Adjusted, November 2011 (mg/kg)	RSLs Residential Soil Adjusted, November 2011 (x10 for SD) (mg/kg)	Region III BTAG Freshwater Sediment Criteria (mg/kg)	Region III BTAG Freshwater Soil Criteria (mg/kg)	Laboratory-specific (mg/kg)			Accuracy Control Limit (%R)	Precision Control Limit (% RPD)
						LOQs	LODs	DLs		
Potassium	7440-09-7	--	--	--	--	50	10	5	80 - 120	10
Selenium	7782-49-2	39	390	2	1.8	2	0.9	0.4	80 - 120	10
Silver	7440-22-4	39	390	1	560	0.5	0.35	0.16	75 - 120	10
Sodium	7440-23-5	--	--	--	--	30	20	10	80 - 120	10
Thallium	7440-28-0	0.078	0.78	--	0.001	1	0.72	0.34	80 - 120	10
Vanadium	7440-62-2	39	390	--	0.5	0.5	0.35	0.16	80 - 120	10
Zinc	7440-66-6	2300	23000	121	10	1	0.72	0.33	80 - 120	10
Cyanide	57-12-5	160	1600	0.1	0.005	10	0.08	0.029	75-125	20

1. All metals (except Mercury) are analyzed via 6020.

Shading indicates cells where the LOD is greater than the screening level. Refer to Worksheet #11 section "How good must the data be."

SAP Worksheet #15-6—Reference Limits and Evaluation Table

Matrix: Sediment, Surface Soil, and Subsurface Soil
Analytical Group: VOC

Analyte	CAS Number	RSLs Residential Soil Adjusted, November 2011 (µg/kg)	RSLs Residential Soil Adjusted X 10 for SD, November 2011 (µg/kg)	Region III BTAG Freshwater Sediment Criteria (µg/kg)	Region III BTAG Freshwater Soil Criteria (µg/kg)	Laboratory-specific (µg/kg)			Accuracy Control Limit (%R)	Precision Control Limit (% RPD)
						LOQs	LODs	DLs		
1,1,1-Trichloroethane	71-55-6	640000	640000	30.2	300	2	2	1	70 - 135	30
1,1,2,2-Tetrachloroethane	79-34-5	560	5600	1360	300	2	1	0.59	55 - 130	30
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	76-13-1	910000	910000	--	--	2	1	0.63	70 - 130	30
1,1,2-Trichloroethane	79-00-5	160	1600	1240	300	2	2	0.82	60 - 125	30
1,1-Dichloroethane	75-34-3	3300	33000	--	300	2	1	0.34	75 - 125	30
1,1-Dichloroethene	75-35-4	24000	240000	31	--	2	1	0.34	65 - 135	30
1,2,4-Trichlorobenzene	120-82-1	6200	62000	2100	100	5	1	0.63	65 - 130	30
1,2-Dibromo-3-chloropropane	96-12-8	5.4	54	--	--	5.6	5.6	2.8	40 - 135	30
1,2-Dibromoethane	106-93-4	34	340	--	5000	2	1.64	0.82	70 - 125	30
1,2-Dichlorobenzene	95-50-1	190000	380000	16.5	100	5	1.12	0.56	75 - 120	30
1,2-Dichloroethane	107-06-2	430	4300	--	870000	2	2	1	70 - 135	30
1,2-Dichloropropane	78-87-5	940	9400	--	300	2	1	0.63	70 - 120	30
1,3-Dichlorobenzene	541-73-1	--	--	4430	--	5	0.5	0.45	70 - 125	30
1,4-Dichlorobenzene	106-46-7	2400	24000	599	100	5	1	0.65	70 - 125	30
2-Butanone	78-93-3	2800000	28000000	--	--	10	3	1.4	30 - 160	30
2-Hexanone	591-78-6	21000	210000	--	--	10	1.5	1.3	45 - 145	30
4-Methyl-2-pentanone	108-10-1	530000	3400000	--	100000	10	3.2	1.6	45 - 145	30
Acetone	67-64-1	6100000	61000000	--	--	10	2.6	1.3	20 - 160	30
Benzene	71-43-2	1100	11000	--	100	2	1	0.5	75 - 125	30
Bromodichloromethane	75-27-4	270	2700	--	450000	2	0.75	0.32	70 - 130	30
Bromoform	75-25-2	62000	620000	654	1147000	2	1	0.46	55 - 135	30
Bromomethane	74-83-9	730	7300	--	--	2.4	2.4	1.2	30 - 160	30
Carbon disulfide	75-15-0	82000	740000	0.851	--	3	3	1.5	45 - 160	30
Carbon tetrachloride	56-23-5	610	6100	64.2	300	2	1	0.6	65 - 135	30
Chlorobenzene	108-90-7	29000	290000	8.42	100	2	0.5	0.35	75 - 125	30
Chloroethane	75-00-3	1500000	2100000	--	--	2	2	0.74	40 - 155	30
Chloroform	67-66-3	290	2900	--	300	2	1.08	0.54	70 - 125	30

SAP Worksheet #15-6—Reference Limits and Evaluation Table (continued)

Matrix: Sediment, Surface Soil, and Subsurface Soil
Analytical Group: VOC

Analyte	CAS Number	RSLs Residential Soil Adjusted, November 2011 (µg/kg)	RSLs Residential Soil Adjusted X 10 for SD, November 2011 (µg/kg)	Region III BTAG Freshwater Sediment Criteria (µg/kg)	Region III BTAG Freshwater Soil Criteria (µg/kg)	Laboratory-specific (µg/kg)			Accuracy Control Limit (%R)	Precision Control Limit (% RPD)
						LOQs	LODs	DLs		
Chloromethane	74-87-3	12000	120000	--	--	2	1	0.38	50 - 130	30
cis-1,2-Dichloroethene	156-59-2	16000	160000	--	300	2	1	0.62	65 - 125	30
cis-1,3-Dichloropropene	10061-01-5	1700	17000	--	300	2	1	0.42	70 - 125	30
Cyclohexane	110-82-7	120000	120000	--	100	2	2	1	70 - 130	30
Dibromochloromethane	124-48-1	680	6800	--	--	2	1	0.46	65 - 130	30
Dichlorodifluoromethane (Freon-12)	75-71-8	9400	94000	--	--	2	1.2	0.6	35 - 135	30
Ethylbenzene	100-41-4	5400	54000	1100	100	2	1.38	0.69	75 - 125	30
Isopropylbenzene	98-82-8	210000	270000	86	--	2	1	0.6	75 - 130	30
m- and p-Xylene	m&pXYLENE	59000	390000	--	--	4	1	0.68	80 - 125	30
Methyl acetate	79-20-9	7800000	29000000	--	--	5	4	2	70 - 130	30
Methylcyclohexane	108-87-2	--	--	--	--	2	1	0.43	65 - 125	30
Methylene chloride	75-09-2	11000	110000	--	300	2	0.75	0.43	70 - 130	30
Methyl-tert-butyl ether (MTBE)	1634-04-4	43000	430000	--	--	5	2.4	1.2	55 - 140	30
o-Xylene	95-47-6	69000	430000	--	--	2	0.5	0.35	75 - 125	30
Styrene	100-42-5	630000	870000	559	100	2	0.5	0.28	75 - 125	30
Tetrachloroethene	127-18-4	550	5500	468	300	2	2	0.93	65 - 140	30
Toluene	108-88-3	500000	820000	--	100	2	0.5	0.29	70 - 125	30
trans-1,2-Dichloroethene	156-60-5	15000	150000	1050	300	2	1	0.39	65 - 135	30
trans-1,3-Dichloropropene	10061-02-6	1700	17000	--	300	2	2	1	65 - 125	30
Trichloroethene	79-01-6	440	4400	96.9	300	2	1	0.44	75 - 125	30
Trichlorofluoromethane (Freon-11)	75-69-4	79000	790000	--	--	2	1	0.44	25 - 185	30
Vinyl chloride	75-01-4	60	600	--	300	2	1	0.6	60 - 125	30

µg/kg = micrograms per kilogram

Shading indicates cells where the LOD is greater than the screening level. Refer to Worksheet #11 section "How good must the data be."

SAP Worksheet #15-7—Reference Limits and Evaluation Table

Matrix: Sediment, Surface Soil, and Subsurface Soil

Analytical Group: SVOC

Analyte	CAS Number	Concentration Range	RSLs Residential Soil Adjusted, November 2011 (µg/kg)	RSLs Residential Soil Adjusted (x10 for SD), November 2011 (µg/kg)	Region III BTAG Freshwater Sediment Criteria (µg/kg)	Region III BTAG Freshwater Soil Criteria (µg/kg)	Laboratory-specific (µg/kg)			Accuracy Control Limit (%R)	Precision Control Limit (% RPD)
							LOQs	LODs	DLs		
1,1-Biphenyl	92-52-4	8270	5100	51000	1220	600	270	122	61	60 - 130	30
2,2'-Oxybis(1-chloropropane)	108-60-1	8270	4600	46000	--	--	440	440	220	20 - 115	30
2,4,5-Trichlorophenol	95-95-4	8270	610000	6100000	--	100	267	200	74	50 - 110	30
2,4,6-Trichlorophenol	88-06-2	8270	6100	61000	213	100	267	200	68	45 - 110	30
2,4-Dichlorophenol	120-83-2	8270	18000	180000	117	100	267	150	75	45 - 110	30
2,4-Dimethylphenol	105-67-9	8270	120000	1200000	29	100	267	114	57	30 - 105	30
2,4-Dinitrophenol	51-28-5	8270	12000	120000	--	100	1340	532	220	15 - 130	30
2,4-Dinitrotoluene	121-14-2	8270	1600	16000	41.6	--	270	98	49	50 - 115	30
2,6-Dinitrotoluene	606-20-2	8270	6100	61000	--	--	270	75	50	50 - 110	30
2-Chloronaphthalene	91-58-7	8270	180000	180000	--	--	270	133	66.7	45 - 105	30
2-Chlorophenol	95-57-8	8270	39000	390000	31.2	100	270	138	69	45 - 105	30
2-Methylnaphthalene	91-57-6	8270_SIM	31000	310000	20.2	--	3.33	2.5	1.33	45 - 105	30
2-Methylphenol	95-48-7	8270	310000	3100000	--	100	267	192	96	40 - 105	30
2-Nitroaniline	88-74-4	8270	61000	610000	--	--	270	114	57	45 - 120	30
2-Nitrophenol	88-75-5	8270	39000	390000	--	--	270	200	72	40 - 110	30
3,3'-Dichlorobenzidine	91-94-1	8270	1100	11000	127	--	270	118	59	10 - 130	30
3-Nitroaniline	99-09-2	8270	--	--	--	--	267	200	80	25 - 110	30
4,6-Dinitro-2-methylphenol	534-52-1	8270	490	4900	--	--	532	532	266	30 - 135	30
4-Bromophenyl-phenylether	101-55-3	8270	--	--	1230	--	270	98	49	45 - 115	30
4-Chloro-3-methylphenol	59-50-7	8270	610000	6100000	--	--	270	112	56	45 - 115	30
4-Chloroaniline	106-47-8	8270	2400	24000	--	--	270	126	63	10 - 95	30
4-Chlorophenyl-phenylether	7005-72-3	8270	31000	310000	--	--	270	102	51	45 - 110	30
4-Methylphenol	106-44-5	8270	31000	310000	670	100	270	118	59	40 - 105	30
4-Nitroaniline	100-01-6	8270	24000	240000	--	--	267	200	88	35 - 115	30
4-Nitrophenol	100-02-7	8270	4800	48000	--	100	667	75	53	15 - 140	30
Acenaphthene	83-32-9	8270_SIM	340000	3400000	6.7	100	3.33	2.5	1.33	45 - 110	30
Acenaphthylene	208-96-8	8270_SIM	340000	3400000	5.9	100	3.33	2.5	1.33	45 - 105	30
Acetophenone	98-86-2	8270	780000	2500000	--	--	270	200	100	70 - 130	30
Anthracene	120-12-7	8270_SIM	1700000	17000000	57.2	100	3.33	2.5	1.33	55 - 105	30
Atrazine	1912-24-9	8270	2100	21000	--	--	270	158	79	60 - 130	30
Benzaldehyde	100-52-7	8270	780000	1200000	--	--	270	90	45	60 - 130	30
Benzo(a)anthracene	56-55-3	8270_SIM	150	1500	108	100	3.33	2.5	1.4	50 - 110	30
Benzo(a)pyrene	50-32-8	8270_SIM	15	150	150	100	3.33	2.5	1.8	50 - 110	30
Benzo(b)fluoranthene	205-99-2	8270_SIM	150	1500	--	100	3.33	2.5	1.9	45 - 115	30
Benzo(g,h,i)perylene	191-24-2	8270_SIM	170000	1700000	170	100	6.2	6.2	3.1	40 - 125	30

SAP Worksheet #15-7—Reference Limits and Evaluation Table (continued)

Matrix: Sediment, Surface Soil, and Subsurface Soil
Analytical Group: SVOC

Analyte	CAS Number	Concentration Range	RSLs Residential Soil Adjusted, November 2011 (µg/kg)	RSLs Residential Soil Adjusted (x10 for SD), November 2011 (µg/kg)	Region III BTAG Freshwater Sediment Criteria (µg/kg)	Region III BTAG Freshwater Soil Criteria (µg/kg)	Laboratory-specific (µg/kg)			Accuracy Control Limit (%R)	Precision Control Limit (% RPD)
							LOQs	LODs	DLs		
Benzo(k)fluoranthene	207-08-9	8270_SIM	1500	15000	240	100	3.33	2.5	2.1	45 - 125	30
bis(2-Chloroethoxy)methane	111-91-1	8270	18000	180000	--	--	267	114	57	45 - 110	30
bis(2-Chloroethyl)ether	111-44-4	8270	210	2100	--	--	270	134	67	40 - 105	30
bis(2-Ethylhexyl)phthalate	117-81-7	8270	35000	350000	180	--	270	166	83	45 - 125	30
Butylbenzylphthalate	85-68-7	8270	260000	2600000	10900	--	270	126	63	50 - 125	30
Caprolactam	105-60-2	8270	3100000	31000000	--	--	280	280	140	60 - 130	30
Carbazole	86-74-8	8270	--	--	--	--	270	108	54	45 - 115	30
Chrysene	218-01-9	8270_SIM	15000	150000	166	100	3.33	2.5	1.33	55 - 110	30
Dibenz(a,h)anthracene	53-70-3	8270_SIM	15	150	33	100	5.2	5.2	2.6	40 - 125	30
Dibenzofuran	132-64-9	8270	7800	78000	415	--	270	108	54	50 - 105	30
Diethylphthalate	84-66-2	8270	4900000	49000000	603	1000	270	102	51	50 - 115	30
Dimethyl phthalate	131-11-3	8270	--	--	--	2000	270	118	59	50 - 110	30
Di-n-butylphthalate	84-74-2	8270	610000	6100000	6470	200000	270	88	44	55 - 110	30
Di-n-octylphthalate	117-84-0	8270	35000	350000	--	--	270	116	58	40 - 130	30
Fluoranthene	206-44-0	8270_SIM	230000	2300000	423	100	3.33	2.5	1.33	55 - 115	30
Fluorene	86-73-7	8270_SIM	230000	2300000	77.4	100	3.33	2.5	1.33	50 - 110	30
Hexachlorobenzene	118-74-1	8270	300	3000	20	1000000	267	106	53	45 - 120	30
Hexachlorobutadiene	87-68-3	8270	6100	61000	--	--	270	116	58	40 - 115	30
Hexachlorocyclopentadiene	77-47-4	8270	37000	370000	--	100	667	50	40	24 - 119	30
Hexachloroethane	67-72-1	8270	6100	61000	1027	--	270	100	50	35 - 110	30
Indeno(1,2,3-cd)pyrene	193-39-5	8270_SIM	150	1500	17	100	6	6	3	40 - 120	30
Isophorone	78-59-1	8270	510000	5100000	--	--	270	118	59	45 - 110	30
Naphthalene	91-20-3	8270_SIM	3600	36000	176	100	3.33	2.5	1.4	40 - 105	30
Nitrobenzene	98-95-3	8270	4800	48000	--	400	270	120	60	40 - 115	30
n-Nitroso-di-n-propylamine	621-64-7	8270	69	690	--	--	270	122	61	40 - 115	30
n-Nitrosodiphenylamine	86-30-6	8270	99000	990000	2680	200	267	126	63	50 - 115	30
Pentachlorophenol	87-86-5	8270	890	8900	504	5000	300	300	133	25 - 120	30
Phenanthrene	85-01-8	8270_SIM	1700000	17000000	204	100	3.33	2.5	1.33	50 - 110	30
Phenol	108-95-2	8270	1800000	18000000	420	100	1334	130	65	40 - 100	30
Pyrene	129-00-0	8270_SIM	170000	1700000	195	100	3.33	2.5	1.33	45 - 125	30

Shading indicates cells where the LOD is greater than the criteria. Refer to Worksheet #11 section "How good must the data be."

SAP Worksheet #15-8—Reference Limits and Evaluation Table

Matrix: Sediment, Surface Soil, Subsurface Soil, and Multi-Incremental Sampling Soil
Analytical Group: EXPLO

Analyte[1]	CAS Number	RSLs Residential Soil Adjusted, November 2011 (µg/kg)	RSLs Residential Soil Adjusted (x10 for SD), November 2011 (µg/kg)	Region III BTAG Freshwater Sediment Criteria (µg/kg)	Laboratory-specific (µg/kg)			Accuracy Control Limit (%R)	Precision Control Limit (% RPD)
					LOQs	LODs	DLs		
1,3,5-Trinitrobenzene	99-35-4	220000	2200000	--	100	60	53	75 - 125	12
1,3-Dinitrobenzene	99-65-0	610	6100	--	100	60	38	80 - 160	12
2,4,6-Trinitrotoluene	118-96-7	3600	36000	92	124	124	62	80 - 145	10
2,4-Dinitrotoluene	121-14-2	1600	16000	41.6	100	164	82	80 - 135	9
2,6-Dinitrotoluene	606-20-2	6100	61000	--	100	60	43	55 - 135	13
2-Amino-4,6-dinitrotoluene	35572-78-2	15000	150000	--	400	90	74	50 - 155	13
2-Nitrotoluene	88-72-2	2900	29000	--	400	90	74	45 - 135	11
3-Nitrotoluene	99-08-1	610	6100	--	400	90	87	50 - 130	18
4-Amino-2,6-dinitrotoluene	19406-51-0	15000	150000	--	100	60	50	55 - 155	11
4-Nitrotoluene	99-99-0	24000	240000	4060	400	240	120	50 - 130	16
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	5600	56000	--	100	60	43	50 - 160	13
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	479-45-8	24000	240000	--	150	150	75	20 - 170	12
Nitrobenzene	98-95-3	4800	48000	--	158	158	79	50 - 140	10
Nitrocellulose	9004-70-0	100000000	100000000	--	10000	5000	2500	50 - 110	50
Nitroglycerin	55-63-0	610	6100	--	1600	540	240	50 - 110	13
Nitroguanidine	556-88-7	610000	6100000	--	500	500	250	50 - 150	40
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	380000	3800000	--	100	60	51	80 - 115	12
Perchlorate	14797-73-0	5500	55000	--	5	2	0.6	80 - 120	15
PETN	78-11-5	12000	120000	--	1600	540	240	50 - 110	30

1.All EXPLO are reported from Spectrum Analytical with the exception of NC (Microbac) and Perchlorate (Empirical)

Shading indicates cells where the LOD is greater than the criteria. Refer to Worksheet #11 section "How good must the data be."

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SAP Worksheet #15-9—Reference Limits and Evaluation Table

Matrix: Sediment, Surface Soil, and Subsurface Soil

Analytical Group: WCHEM

Analyte	CAS Number[1]	Project Indicator Limit[2]	Laboratory-specific		
			LOQs	LODs	DLs
pH	PH	N/A	N/A	N/A	N/A
TOC	TOC	N/A	100 (mg/kg)	100 (mg/kg)	38 (mg/kg)

1. This CAS number is contractor-specific.
2. pH and TOC are being analyzed to support the ERA. These wet chemistry analytes influence the bioavailability of some contaminants.
3. There are no screening levels or project indicator limits (PILs) applicable to WCHEM data. These data are considered screening-level data and not definitive, and as such they are being collected for informational purposes; therefore, PILs identified above are achievable limits specific to the subcontracted laboratory.

SAP Worksheet #15-10—Reference Limits and Evaluation Table

Matrix: Groundwater

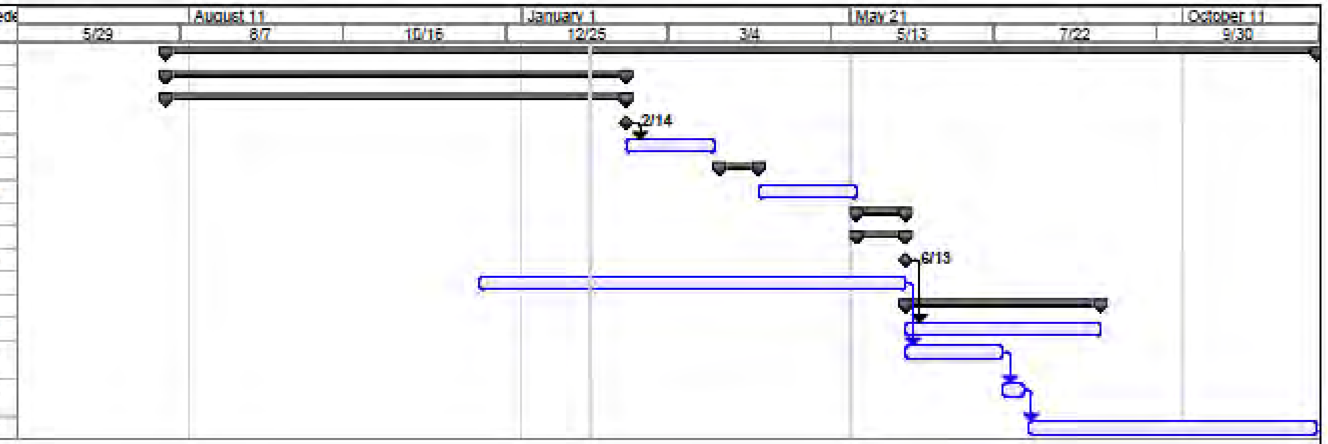
Analytical Group: WCHEM

Analyte	CAS Number[1]	PIL[2]	Laboratory-specific (µg/L)[3]		
			LOQs	LODs	DLs
Hardness	HARD	N/A	N/A	N/A	N/A

1. This CAS number is contractor-specific.
2. Hardness is being analyzed to support the ERA. The screening of some metals is hardness-dependant and needs to be adjusted.
3. There are no screening levels or PILs applicable to WCHEM data. These data are considered screening-level data and not definitive, and as such they are being collected for informational purposes; therefore, PILs identified above are achievable limits specific to the subcontracted laboratory.
4. Laboratory-specific limits are not applicable to hardness in groundwater, which is simply a calculation based on calcium and magnesium results via 6020A.

SAP Worksheet #16—Project Schedule / Timeline Table

ID		Task Name	Duration	Start	Finish	Predecessors
1		**UFP-SAP (380785)**	**355 days**	**Mon 8/1/11**	**Fri 12/7/12**	
2		**Pre-Draft UFP-SAP (UXO 20)**	**142 days**	**Mon 8/1/11**	**Tue 2/14/12**	
3		**Prepare Pre-Draft UFP-SAP**	**142 days**	**Mon 8/1/11**	**Tue 2/14/12**	
16		Submit Pre-Draft UFP-SAP to Navy Chemist	0 days	Tue 2/14/12	Tue 2/14/12	15
17		Navy Chemist review	28 days	Wed 2/15/12	Fri 3/23/12	16
18		**Draft UFP-SAP (UXO 20)**	**13 days**	**Mon 3/26/12**	**Wed 4/11/12**	
25		IHIRT review	30 days	Thu 4/12/12	Wed 5/23/12	24
26		**Final UFP-SAP (UXO 20)**	**15 days**	**Thu 5/24/12**	**Wed 6/13/12**	
27		**Prepare Final UFP-SAP**	**15 days**	**Thu 5/24/12**	**Wed 6/13/12**	
31		Submit Final UFP-SAP	0 days	Wed 6/13/12	Wed 6/13/12	30
32		Bald Eagle Nesting Season	131 days	Wed 12/14/11	Wed 6/13/12	
33		**RI Fieldwork**	**60 days**	**Thu 6/14/12**	**Wed 9/5/12**	
34		Planning	60 days	Thu 6/14/12	Wed 9/5/12	31
35		MEC fieldwork (vegetation clearing, debris removal, DGM survey)	30 days	Thu 6/14/12	Wed 7/25/12	32
36		MC fieldwork (soil, groundwater, sediment sampling)	7 days	Thu 7/26/12	Fri 8/3/12	35
37		Lab Analysis and Data Loading	90 days	Mon 8/6/12	Fri 12/7/12	36



Project: CTO 12 - UXO 20 RI
Date: Mon 1/30/12

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

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SAP Worksheet #17—Sampling Design and Rationale

Matrix	Depth of Samples	Analysis	Method	Number of Samples	Rationale	Sampling Strategy
In Situ Groundwater	TBD (assumed to be approximately 5 feet bgs)	TAL Metals (total and dissolved)	SW-846 6010B, 7470A, 9012B	5	Up to five *in situ* groundwater samples will be collected from the soil boring locations identified in Figure 4. The IHIRT agreed that five evenly distributed *in situ* groundwater samples will sufficiently delineate the groundwater at the site (excluding the spits). Groundwater will be collected in this area because it is believed to be potentially affected by the former OB/OD activities and transport mechanisms described in Worksheet #10. The *in situ* groundwater samples will be analyzed for TAL metals, TCL VOCs, TCL SVOCs, and explosives because these constituents exceeded background concentrations in the 1993 characterization study and relate to the OB/OD activities that were conducted at the site. Total and dissolved metals will be analyzed to determine the ratio of metals present in the dissolved phase versus adsorbed to particulate matter in the groundwater. This data will be used to evaluate the phase distribution and transport of potential contamination, and support the future remedial alternatives if necessary. The *in situ* groundwater sampling analysis will 1) determine the nature and extent of site-related contaminants and, 2) support the decision for the path forward for UXO 20.	This is the MC component of the RI. *In situ* groundwater samples will be collected by implementing standard techniques using DPT. Samples will be taken after the MEC investigation has been completed. The depth of samples is assumed and will be determined in the field.
		TCL VOCs	SW-846 8260B	5		
		TCL SVOCs	SW-846 8270C_SIM	5		
		Nitroaromatics, Nitroamines, PETN	SW-846 8330	5		
		Nitroguanidine	SW-846 8330M	5		
		Nitrocellulose	EPA 353.2M	5		
		Nitroglycerin	SW-846 8332	5		
		Perchlorate	SW-846 6850	5		
		Hardness	Calculation	5		

SAP Worksheet #17—Sampling Design and Rationale (continued)

Matrix	Depth of Samples	Analysis	Method	Number of Samples	Rationale	Sampling Strategy
Discrete Surface Soil	0 to 6 inches bgs	TAL Metals (total only)	SW-846 6010B, 7470A, 9012B	23	Up to 23 discrete surface soil samples will be collected from the soil boring locations identified in Figure 4. The IHIRT agreed that the 23 discrete surface soil samples should be spatially biased around the identified areas of concern such as the former burn chamber and steel deflection shield (i.e., primary burn area), and also distributed across the remainder of the site (excluding the spits). These sample locations will sufficiently delineate the surface soil at the site (excluding the spits). Surface soil will be collected because it is believed to be potentially affected by the former OB/OD activities and transport mechanisms described in Worksheet #10. The discrete surface soil samples will be analyzed for TAL metals, TCL VOCs, TCL SVOCs, and explosives because these constituents exceeded background concentrations in the 1993 characterization study and relate to the OB/OD activities that were conducted at the site. The samples will also be analyzed for pH and TOC to support the data interpretation. The discrete surface soil sampling analysis will determine 1) the nature and extent of site-related contaminants and, 2) support the decision for the path forward for UXO 20.	This is the MC component of the RI. Discrete surface soil samples will be collected by implementing standard techniques using DPT. MEC investigation has been completed.
		TCL VOCs	SW-846 8260B	23		
		TCL SVOCs	SW-846 8270C_SIM	23		
		Nitroaromatics, Nitroamines, PETN	SW-846 8330	23		
		Nitroguanidine	SW-846 8330M	23		
		Nitrocellulose	EPA 353.2M	23		
		Nitroglycerin	SW-846 8332	23		
		Perchlorate	SW-846 6850	23		
		pH	SW-846 9045C/00012	23		
		TOC	Lloyd Kahn/100.0401	23		

SAP Worksheet #17—Sampling Design and Rationale (continued)

Matrix	Depth of Samples	Analysis	Method	Number of Samples	Rationale	Sampling Strategy
SMI Soil	0 to 2 inches bgs	TAL Metals (total only)	SW-846 6010B, 7470A, 9012B	1	One SMI soil sample will be collected from the two spits in the eastern portion of the peninsula. This area is outside the primary burn area and is previously uncharacterized (Figure 5). The IHIRT agreed that one SMI soil sample composited from 30-100 plugs collected from the 0- to 2-inch surface soil interval will sufficiently cover the area. 30-100 plugs is recommended by the SMI SOP to achieve sufficient soil mass for analysis. Soil will be collected because it is unknown if any potential site-related contaminants have been transported during the sedimentation and erosion of the land. The SMI soil sample will be analyzed for TAL metals and explosives because these constituents are believed to be potentially transported from the former OB/OD area. The SMI soil sampling analysis will determine 1) the presence or absence of contamination in this deposited land that is not part of the original peninsula and, 2) support the decision for the path forward for UXO 20.	This is the MC component of the RI. The SMI soil sampling will be conducted using the incremental sampling strategy and approach in general accordance with *Interim Guidance 09-02, Implementation of Incremental Sampling (IS) of Soil for the Military Munitions Response Program* (U.S. Army Corps of Engineers, 2009). Samples will be taken after the MEC investigation has been completed.
		Nitroaromatics, Nitroamines, PETN	SW-846 8330	1		
		Nitroguanidine	SW-846 8330M	1		
		Nitrocellulose	EPA 353.2M	1		
		Nitroglycerin	SW-846 8332	1		
		Perchlorate	SW-846 6850	1		

SAP Worksheet #17—Sampling Design and Rationale (continued)

Matrix	Depth of Samples	Analysis	Method	Number of Samples	Rationale	Sampling Strategy
Discrete Subsurface Soil	TBD (Assumed to be 6-inch bgs to above the water table)	TAL Metals (total only)	SW-846 6010B, 7470A, 9012B	23	Up to 23 discrete subsurface soil samples will be collected from the soil boring locations identified in (Figure 4). The IHIRT agreed that the 23 discrete subsurface soil samples should be spatially biased around the identified areas of concern such as the former burn chamber and steel deflection shield (i.e., primary burn area), and also distributed across the remainder of the site (excluding the spits). These sample locations will sufficiently delineate the subsurface soil at the site (excluding the spits). Subsurface soil will be collected because it is believed to be potentially affected by the former OB/OD activities and transport mechanisms described in Worksheet #10. The discrete subsurface soil samples will be analyzed for TAL metals, TCL VOCs, TCL SVOCs, and explosives because these constituents exceeded background concentrations in the 1993 characterization study and relate to the OB/OD activities that were conducted at the site. The samples will also be analyzed for pH and TOC to support the data interpretation. The discrete subsurface soil sampling analysis will determine 1) the nature and extent of site-related contaminants and, 2) support the decision for the path forward for UXO 20.	This is the MC component of the RI. Discrete subsurface soil samples will be collected by implementing standard techniques using DPT. MEC investigation has been completed.
		TCL VOCs	SW-846 8260B	23		
		TCL SVOCs	SW-846 8270C_SIM	23		
		Nitroaromatics, Nitroamines, PETN	SW-846 8330	23		
		Nitroguanidine	SW-846 8330M	23		
		Nitrocellulose	EPA 353.2M	23		
		Nitroglycerin	SW-846 8332	23		
		Perchlorate	SW-846 6850	23		
		pH	SW-846 9045C/00012	23		
		TOC	Lloyd Kahn/100.0401	23		

SAP Worksheet #17—Sampling Design and Rationale (continued)

Matrix	Depth of Samples	Analysis	Method	Number of Samples	Rationale	Sampling Strategy
Sediment	0 to 6 inches bgs	TAL Metals (total only)	SW-846 6010B, 7470A, 9012B	4	Up to 4 sediment samples will be collected from the soil boring locations identified in Figure 4. This area is uncharacterized The IHIRT agreed that four samples located along the western and eastern shorelines will sufficiently delineate the sediment at the site (excluding the spits). Sediment will not be collected along the southern shoreline because of the currents and groundwater flow in the area. These samples would not be indicative of UXO 20 and would not provide useful data for the RI. Sediment will be collected because it is believed to be potentially affected by the former OB/OD activities and transport mechanisms described in Worksheet #10. The sediment samples will be analyzed for TAL metals, TCL VOCs, TCL SVOCs, and explosives because these constituents exceeded background concentrations in the 1993 characterization study and relate to the OB/OD activities that were conducted at the site. The sediment sampling analysis will determine 1) the nature and extent of site-related contaminants and, 2) support the decision for the path forward for UXO 20.	This is the MC component of the RI. Sediment samples will be collected by implementing standard techniques using DPT. MEC investigation has been completed.
		TCL VOCs	SW-846 8260B	4		
		TCL SVOCs	SW-846 8270C_SIM	4		
		Nitroaromatics, Nitroamines, PETN	SW-846 8330	4		
		Nitroguanidine	SW-846 8330M	4		
		Nitrocellulose	EPA 353.2M	4		
		Nitroglycerin	SW-846 8332	4		
		Perchlorate	SW-846 6850	4		
		pH	SW-846 9045C/00012	4		
		TOC	Lloyd Kahn/100.0401	4		

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SAP Worksheet #18—Sampling Locations and Methods/SOP Requirements Table

Discrete Surface Soil Sampling

Station ID	Sampling ID[1,2]	Matrix	Depth (units)	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference
ISUXO20-	ISUXO20-SS01-0001	Surface Soil (SS)	0 to 6 inches bgs	TCL VOCs, TCL SVOCs, TAL metals, explosives, pH, and TOC (See Worksheet #15)	See Worksheets #14 and #20	Worksheet #14 and Attachment A
ISUXO20-	ISUXO20-SS02-0001					
ISUXO20-	ISUXO20-SS03-0001					
ISUXO20-	ISUXO20-SS04-0001					
ISUXO20-	ISUXO20-SS05-0001					
ISUXO20-	ISUXO20-SS06-0001					
ISUXO20-	ISUXO20-SS07-0001					
ISUXO20-	ISUXO20-SS08-0001					
ISUXO20-	ISUXO20-SS09-0001					
ISUXO20-	ISUXO20-SS10-0001					
ISUXO20-	ISUXO20-SS11-0001					
ISUXO20-	ISUXO20-SS12-0001					
ISUXO2-	ISUXO20-SS13-0001					
ISUXO20-	ISUXO20-SS14-0001					
ISUXO20-	ISUXO20-SS15-0001					
ISUXO20-	ISUXO20-SS16-0001					
ISUXO20-	ISUXO20-SS17-0001					
ISUXO20-	ISUXO20-SS18-0001					
ISUXO20-	ISUXO20-SS19-0001					
ISUXO20-	ISUXO20-SS20-0001					
ISUXO20-	ISUXO20-SS21-0001					
ISUXO20-	ISUXO20-SS22-0001					
ISUXO20-	ISUXO20-SS23-0001					

SAP Worksheet #18—Sampling Locations and Methods/SOP Requirements Table (continued)

SMI Soil Sampling

Station ID	Sampling ID[1,2]	Matrix	Depth (units)	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference
ISUXO20-SMI01	ISUXO20-SMI01-0001	Soil (random incremental sample)	0 to 2 inches bgs	TAL metals and explosives (See Worksheet #15)	See Worksheets #14 and #20	Worksheet #14 and Attachment A

Discrete Subsurface Soil Sampling

Station ID	Sampling ID[1,2]	Matrix	Depth (units)	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference
ISUXO20-SB01	ISUXO20-SB01-TDBD	Subsurface Soil (SB)	TBD (Assumed to be 0.5 feet bgs to above the water table)	TCL VOCs, TCL SVOCs, TAL metals, explosives, pH, and TOC (See Worksheet #15)	See Worksheets #14 and #20	Worksheet #14 and Attachment A
ISUXO20-SB02	ISUXO20-SB02-TDBD					
ISUXO20-SB03	ISUXO20-SB03-TDBD					
ISUXO20-SB04	ISUXO20-SB04-TDBD					
ISUXO20-SB05	ISUXO20-SB05-TDBD					
ISUXO20-SB06	ISUXO20-SB06-TDBD					
ISUXO20-SB07	ISUXO20-SB07-TDBD					
ISUXO20-SB08	ISUXO20-SB08-TDBD					
ISUXO20-SB09	ISUXO20-SB09-TDBD					
ISUXO20-SB10	ISUXO20-SB10-TDBD					
ISUXO20-SB11	ISUXO20-SB11-TDBD					
ISUXO20-SB12	ISUXO20-SB12-TDBD					
ISUXO20-SB13	ISUXO20-SB13-TDBD					

SAP Worksheet #18—Sampling Locations and Methods/SOP Requirements Table (continued)

Station ID	Sampling ID[1,2]	Matrix	Depth (units)	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference
ISUXO20-SB14	ISUXO20-SB14-TDBD					
ISUXO20-SB15	ISUXO20-SB15-TDBD					
ISUXO20-SB16	ISUXO20-SB16-TDBD					
ISUXO20-SB17	ISUXO20-SB17-TDBD					
ISUXO20-SB18	ISUXO20-SB18-TDBD					
ISUXO20-SB19	ISUXO20-SB19-TDBD					
ISUXO20-SB20	ISUXO20-SB20-TDBD					
ISUXO20-SB21	ISUXO20-SB21-TDBD					
ISUXO20-SB22	ISUXO20-SB22-TDBD					
ISUXO20-SB23	ISUXO20-SB23-TDBD					

In Situ Groundwater Sampling

Station ID	Sampling ID[1,2]	Matrix	Depth (units)	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference
ISUXO20-DP01	ISUXO20GP01	*In Situ* Groundwater (GP)	TBD (assumed to be approximately 5 feet bgs)	TCL VOCs, TCL SVOCs, TAL metals, explosives, and hardness (See Worksheet #15)	See Worksheets #14 and #20	Worksheet #14 and Attachment A
ISUXO20-DP02	ISUXO20GP02					
ISUXO20-DP03	ISUXO20GP03					
ISUXO20-DP04	ISUXO20-GP04					
ISUXO20-DP05	ISUXO20-GP05					

SAP Worksheet #18—Sampling Locations and Methods/SOP Requirements Table (continued)

Sediment Sampling

Sampling Location / ID Number	Sampling ID[1,2]	Matrix	Depth (units)	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference
ISUXO20-SD01	ISUXO20-SD01-0001	Sediment (SD)	0 to 6 inches bgs	TCL VOCs, TCL SVOCs, TAL metals, explosives, pH, and TOC (See Worksheet #15)	See Worksheets #14 and #20	Worksheet #14 and Attachment A
ISUXO20-SD02	ISUXO20-SD02-0001					
ISUXO20-SD03	ISUXO20-SD03-0001					
ISUXO20-SD04	ISUXO20-SD04-0001					

QA/QC

Sampling Location / ID Number	Sampling ID[1,2]	Matrix	Depth (units)	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference
ISUXO20-SD01 (Duplicate)	ISUXO20-SD01P-0001	Same as parent sample or Aqueous for blanks	Same as parent sample or NA	TCL VOCs, TCL SVOCs, TAL metals, explosives, pH, and TOC (See Worksheet #15)	See Worksheets #14 and #20	Worksheet #14 and Attachment A
ISUXO20-SB22	ISUXO20-SB22-TDBD-MS					
ISUXO20-SB22	ISUXO20-SB22-TDBD-SD					
ISUXO20-QC	ISUXO20-EB01-MMDDYY					

Notes:

TDBD – top depth bottom depth; refers to the TBD sample depth for discrete subsurface soil samples. The depths are assumed and may be changed based on field observations. It is assumed that discrete subsurface soil samples will be collected continuously until groundwater is encountered.

1. All samples are named in accordance with sample nomenclature scheme for NSF-IH. Sample IDs are in the format ISxxYYnnTDBD – where xx is site number and, YY is the matrix, nn is station number, and TDBD is the top and bottom sampling depth.

2. QA/QC requirements are field duplicate 1 per 10 samples, MS/MSD 1 per 20 samples and equipment blank is 1 per week for each type of equipment. Nomenclature shown above is for example; exact location and frequency will be determined in the field. Duplicate and MS/MSD samples will be taken from the area assumed to be most heavily identified contaminated area, if possible.

SAP Worksheet #19–Analytical SOP Requirements Table

Matrix	Analytical Group	Analytical and Preparation Method / SOP Reference[1]	Containers (number, size, and type)	Sample Volume[2] (units)	Preservation Requirements (chemical, temperature, light-protected)	Maximum Holding Time[3] (preparation / analysis)
GW, AQ	METAL	SW-846 6020A / 100.0003, 100.0110	1 of 250mL HDPE	50mL	HNO_3 to pH < 2, $\leq$ 6 °C but not frozen	6 months
		SW-846 7470A / 00071		100mL		28 days
		SW-846 9012B / 00034	1 of 250mL HDPE	50mL	NaOH to pH > 12, $\leq$ 6 °C but not frozen	14 days
	FMETAL	SW-846 6020A / 100.0003, 100.0110	1 of 250mL HDPE	50mL	HNO_3 to pH < 2, $\leq$ 6 °C but not frozen	6 months
		SW-846 7470A / 00071		100mL		28 days
	VOC	SW-846 8260B / 00039	3 of 40mL VOA vial	40mL	zero-headspace, HCl to pH < 2, $\leq$ 6 °C but not frozen	14 days
	SVOC	SW-846 8270D, SW-846 8270D_SIM / 00033, 00150	2 of 1L amber	500mL	$\leq$ 6 °C but not frozen	7 days / 40 days
	EXPLO	SW-846 8330B / 00076, 00055	2 of 1L amber	750mL	$\leq$ 6 °C but not frozen	7 days / 40 days
		SW-846 8330-NG /	2 of 1L amber	750mL	$\leq$ 6 °C but not frozen	7 days / 40 days
		USATHAMA/353.2/353.3 / KNITRO-C-W	2 of 1L amber	750mL	$\leq$ 6 °C but not frozen	7 days / 40 days
		SW-846 6850 / 239	1 of 250mL HDPE	20mL	Field-filtering with 0.2 µm PTFE membrane filter; Cool to 4°C, headspace in jar, protect from light	28 days
	WCHEM	SM 2340B / N/A	N/A (calculation from metals results; share with metals, above)			

SAP Worksheet #19–Analytical SOP Requirements Table (continued)

Matrix	Analytical Group	Analytical and Preparation Method / SOP Reference[1]	Containers (number, size, and type)	Sample Volume[2] (units)	Preservation Requirements (chemical, temperature, light-protected)	Maximum Holding Time[3] (preparation / analysis)
SD, SS, SB	METAL	SW-846 6020A / 100.0110	1 of 4oz CWM soil jar	2g	≤ 6 °C but not frozen	6 months
		SW-846 7471B / 00071	1 of 4oz CWM soil jar	0.5g		28 days
		SW-846 9012 / 00034		10g		14 days
	VOC	SW-846 8260B / 00039	2 of 40mL VOA vial	5g	D.I. water, ≤ 6 °C but not frozen, freeze upon receipt	48 hours to freeze / 14 days
			1 of 40mL VOA vial	5g	MeOH, ≤ 6 °C but not frozen	14 days
			1 of 2oz CWM soil jar in the event that 40mL VOA vials are not appropriate for sediment	5g	zero-headspace, ≤ 6 °C but not frozen	14 days
	SVOC	SW-846 8270D, SW-846 8270D_SIM / 00033, 00150	1 of 8oz CWM soil jar	30g	≤ 6 °C but not frozen	14 days / 40 days
	EXPLO	SW-846 8330B / 00076, 00055	2 of 4oz CWM soil jar	30g	≤ 6 °C but not frozen	14 days / 40 days
		SW-846 8330-NG / 00076, 00055	1 of 4 oz CWM clear soil jar	30g	≤ 6 °C but not frozen	14 days / 40 days
		USATHAMA/353.2/353.3 / KNITRO-C-S	1 of 4 oz CWM amber soil jar	30g	≤ 6 °C but not frozen	14 days / 40 days
		SW-846 6850 / 239	1 of 2oz CWM soil jar	1g	≤ 6 °C but not frozen	28 days
	WCHEM	pH: SW-846 9045C / 00083	1 of 4oz CWM soil jar	10g	≤ 6 °C but not frozen	ASAP
		TOC: Lloyd Kahn / 100.0410	1 of 4oz CWM soil jar	1g		14 days

SAP Worksheet #19–Analytical SOP Requirements Table (continued)

Matrix	Analytical Group	Analytical and Preparation Method / SOP Reference[1]	Containers (number, size, and type)	Sample Volume[2] (units)	Preservation Requirements (chemical, temperature, light-protected)	Maximum Holding Time[3] (preparation / analysis)
SMI	METAL	SW-846 6020A / 100.0110	2 of 32oz CWM soil jar (Approx. 1 kg of soil)	2g	≤ 6 °C but not frozen	6 months
		SW-846 7471B / 00071		0.5g		28 days
		SW-846 9012 / 00034		10g		14 days
	EXPLO	SW-846 8330B / 00076, 00055		30g		14 days / 40 days
		SW-846 8330-NG / HPLC05		30g		14 days / 40 days
		USATHAMA/353.2/353.3 / KNITRO-C-S		30g		14 days / 40 days
		SW-846 6850 / 239		1g		28 days

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).

[2]Provide the minimum sample volume or mass requirement if it differs from the container volume.

[3]Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted.

CWM = chemical warfare material
g = gram(s)
HDPE = high-density polyethylene
mL = milliliter
VOA = volatile organic analyte

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SAP Worksheet #20–Field Quality Control Sample Summary Table

Matrix	Analytical Group	No. of Sampling Locations[2]	No. of Field Duplicates	No. of Field Triplicates	No. of MS/MSDs[1]	No. of Field Blanks[3]	No. of Equip. Blanks[3]	No. of VOA Trip Blanks[3]	Total No. of Samples to Lab
Phase 1									
GW	METAL	5	1		1		1		9
	FMETAL	5	1		1		1		9
	VOC	5	1		1		1	1	10
	SVOC	5	1		1		1		9
	EXPLO	5	1		1		1		9
	WCHEM (Hardness)	5							5
SS	METAL	23	3		2		3		33
	VOC	23	3		2		3	3	36
	SVOC	23	3		2		3		33
	EXPLO	23	3		2		3		33
	WCHEM (pH and TOC)	23							23
SB	METAL	23	3		2		3		33
	VOC	23	3		2		3	3	36
	SVOC	23	3		2		3		33
	EXPLO	23	3		2		3		33
	WCHEM (pH and TOC)	23							23

SAP Worksheet #20–Field Quality Control Sample Summary Table (continued)

Matrix	Analytical Group	No. of Sampling Locations[2]	No. of Field Duplicates	No. of Field Triplicates	No. of MS/MSDs[1]	No. of Field Blanks[3]	No. of Equip. Blanks[3]	No. of VOA Trip Blanks[3]	Total No. of Samples to Lab
SD	METAL	4	1		1		1		8
	VOC	4	1		1		1	1	9
	SVOC	4	1		1		1		8
	EXPLO	4	1		1		1		8
	WCHEM (pH and TOC)	4	1		1				7
SMI	METAL	1		1	1		1		6
	EXPLO	1		1	1		1		6
Phase 2									
GW	METAL	5	1		1		1		9
	FMETAL	5	1		1		1		9
	VOC	5	1		1		1	1	10
	SVOC	5	1		1		1		9
	EXPLO	5	1		1		1		9

[1]Although the MS/MSD is not typically considered a field QC, it is included here because location determination is often established in the field.

[2]If samples will be collected at different depths at the same location, count each discrete sampling depth as a separate sampling location or station.

[3]The number of equipment blanks, field blanks, and trip blanks is based on a fundamental assumption of the number of sampling days each site will require. It was assumed that the groundwater sampling will occupy 1 day and the soil sampling will occupy a total of 8 days.

SAP Worksheet #21—Project Sampling SOP References Table

Reference Number	Title, Revision Date and / or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP-001	Locating and Clearing Underground Utilities (Last QC and reviewed 05/2011)	CH2M HILL	N/A	N	N/A
SOP-002	Explosives Usage and Munitions Response (Last revised 02/2012)	CH2M HILL	Schonstedt metal detector	N	N/A
SOP-003	Soil Sampling (Last QC and revised 05/2011)	CH2M HILL	Stainless steel, trowel, shovel, scoop, coring device, hand auger, split spoon, sampling tubes, drill rig, sample jars	N	N/A
SOP-004	Direct-Push Soil Sample Collection (Last QC and reviewed 05/2011)	CH2M HILL	Truck rig, sampling rods, acetate liners, sample containers, PPE	N	N/A
SOP-005	Sediment Sampling (Last QC and revised 05/2011)	CH2M HILL	Sample collection device, disposable spoon or spatula, measuring tape, log book, PPE, materials for classifying soils, and sample jars.	N	N/A
SOP-007	Homogenization of Soil and Sediment Samples (Last QC and reviewed 05/2011)	CH2M HILL	Sample containers, stainless steel spoons/spatula/pans	N	N/A
SOP-008	Direct-Push Groundwater Sample Collection (Last QC and reviewed 05/2011)	CH2M HILL	DPT rig, rods, tubing sample containers, PPE	N	N/A
SOP-009	Decontamination of Personnel and Equipment (Last QC and revised 05/2011)	CH2M HILL	Water, detergent, methanol, PPE	Y	Phosphate-free and chlorine-free detergent (such as Detergent 8 or Dishbrite) must be used.

SAP Worksheet #21—Project Sampling SOP References Table (continued)

Reference Number	Title, Revision Date and / or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP-010	Decontamination of Drilling Rigs and Equipment (Last QC and reviewed 05/2011)	CH2M HILL	Steam cleaner, water, buckets, brushed, methanol, detergent	Y	Phosphate-free and chlorine-free detergent (such as Detergent 8 or Dishbrite) must be used.
SOP-011	Equipment Blank and Field Blank Preparation (Last QC and reviewed 05/2011)	CH2M HILL	Lab grade water, DI, sample bottles, PPE	N	N/A
SOP-012	Preparing Field Log Books (Last QC and reviewed 05/2011)	CH2M HILL	Log book and indelible pen	N	N/A
SOP-013	Chain-of-Custody (Last QC and reviewed 05/2011)	CH2M HILL	N/A	N	N/A
SOP-014	Packaging and Shipping Procedures for Low-Concentration Samples (Last QC and reviewed 05/2011)	CH2M HILL	Coolers, clear tape, labels, Ziploc bags, etc.	N	N/A
SOP -015	VOC Sampling – Water (Last QC and reviewed 05/2011)	CH2M HILL	Sample vials and latex gloves	N	N/A
SOP -016	Global Positioning System (Last QC and reviewed 05/2011)	CH2M HILL	Global positioning unit	N	N/A
SOP -017	Disposal of Waste Fluids and Solids (Last QC and reviewed 05/2011)	CH2M HILL	Department of Transportation-approved 55-gallon drum, tools, pain pen	N	N/A
SOP – 018	Sampling Contents of Tanks and Drums (Last QC and reviewed 05/2011)	CH2M HILL	PPE, sampling equipment, tools	N	N/A
SOP – 019	Soil Boring Drilling and Abandonment (Last QC and reviewed 05/2011)	CH2M HILL	Truck-mounted rig, augers, downhole compacting tool, cement, bentonite	N	N/A
SOP – 020	Logging of Soil Borings (Last QC and reviewed 05/2011)	CH2M HILL	Pen, log book, tape measure, spatula, soil classification charts	N	N/A
SOP – 021	Shallow Soil Sampling (Last QC and revised 05/2011)	CH2M HILL	Sample jars, spatula	N	N/A

SAP Worksheet #21—Project Sampling SOP References Table (continued)

Reference Number	Title, Revision Date and / or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP – 022	Soil Boring Sampling – Split Spoon (Last QC and revised 05/2011)	CH2M HILL	Latex gloves, stainless steel pan, log book, spatula, bottleware, decon solutions	N	N/A
SOP-023	Multi RAE Photoionization Detector (PID) (Last QC and reviewed 05/2011)	CH2M HILL	PID	N	N/A
SOP-024	Field Measurement of pH, Specific Conductance, Turbidity, Dissolved Oxygen, ORP, and Temperature Using a Horiba or YSI Water Quality Parameter Meter with Flow-Through Cell (Last QC and reviewed 10/2011)	CH2M HILL	Horiba or YSI Meter	N	N/A

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SAP Worksheet #22—Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maintenance Activity	Testing/ Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference
Horiba U-22	Calibrate probe using Horiba U-22 Auto-Calibration Standard Solution	Check mechanical and electronic parts, verify system continuity, check battery, and clean probes. Calibration check.	Visual inspection	Daily before use, at the end of the day, when unstable readings occur	Stable readings after 3 minutes pH reads 4.0 +/- 3% Conductivity reads 4.49 +/- 3% Turbidity reads 0 +/- 3%	Clean probe with deionized water and calibrate again. Do not use this instrument if unable to calibrate properly.	FTL	SOP-025 in WS #21
Multi RAE PID	Calibrate using ambient air and isobutylene 100 parts per million (ppm) calibration gas	Recharge daily	Visual Inspection	Daily, before use	Ambient air reads 0.0 ppm +/- 3% Isobutylene gas reads 100 ppm +/- 3%	Follow instructions in manual to clean sensor, Do not use this instrument if unable to calibrate properly.	FTL	SOP-024 in WS #21
Schonstedt metal detector	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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SAP Worksheet #23–Analytical SOP References Table

Lab SOP Number	Title, Revision Date, and / or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance to QSM	Modified for Project Work?[1] (y/n)
00010	Initial receipt, Inventory, Preservation Verification, Labeling and Storage, 8/17/11, Rev. 16	N/A	GW, SS, SB, SD, SMI / METAL, FMETAL, WCHEM, SVOC, VOC, EXPLO	NA	Spectrum Analytical-Tampa	N	N
00026	Sample Preparation: Pressurized Fluid Extraction (PFE) Method 3445 and 3545A, 6/28/2011, Rev.22	Definitive	SS, SB, SD / SVOC	NA		N	N
00033	Sample analysis: 8270C and D GC/MS Semi-Volatile Organics, 7/22/2011, Rev.16	Definitive	GW, SS, SB, SD / SVOC	GC-MS		N	N
00034	Sample analysis: Total and Ammenable CN by Colorimetric Automated Techniques, EPA 9012B, 7/25/2011, Rev.14	Definitive	GW, SS, SB, SD, SMI / METAL	Spectrophotometer		N	N
00039	Sample Analysis: GC/MS Volatile Organics (SW-846 8260B), 10/27/11, Rev.19	Definitive	GW, SS, SB, SD / VOC	GC-MS		N	N
00055	Sample Analysis: HPLC Determination of Nitroaromatics and Nitramines ar Mid-Trace Levels - EPA Method 8330 (Explosives), 12/1/2011, Rev.17	Definitive	GW, SS, SB, SD / EXPLO	HPLC		N	N
00071	Sample Analysis: Mercury by CVAA using FIMS 7470/ 7470A & 7471A/ 7471B, 4/7/2011, Rev.12	Definitive	GW, SS, SB, SD, SMI / METAL, FMETAL	CVAA		N	N
00076	Sample Preparation: Extraction of Nitroaromatics and Nitramines by SW-846 Method 8330, 12/1/2011, Rev.15	Definitive	SS, SB, SD, SMI / EXPLO	N/A		N	N
00083	Sample Analysis: pH Determination, Aqueous EPA 150.1, Soil/ Waste 9045C (Electrometric), 4/22/2011, Rev.6	Screening	SS, SB, SD / WCHEM	pH Probe		N	N
00150	Sample Analysis: GC/MS 8270-SIM Semi-Volatile Organics, 10/27/11, Rev. 5	Definitive	GW, SS, SB, SD / SVOC	GC-MS		N	N
20.0003	Logging Workorders and Samples into Omega ME, 11/05/09, Rev. 4	N/A	GW, SS, SB, SD, SMI / METAL, FMETAL, WCHEM	NA	Spectrum Analytical-Rhode Island	N	N
30.0024	Sample and Waste Disposal, 6/12/11, Rev. 9	N/A	GW, SS, SB, SD, SMI / METAL, FMETAL, WCHEM	NA			
100.0110	Determination of Metals in Water and Soils by SW-846 Method 6020A Inductively Coupled Plasma- Mass Sprectrometry (ICP-MS), 4/16/10, Rev. 2	Definitive	GW, SS, SB, SD, SMI / METAL, FMETAL	ICP-MS			
N/A	An SOP is not required for hardness via SM 2340B because it is simply calculated based on the results of Ca and Mg via 6020A.	Screening	GW / WCHEM	N/A			
100.0003	Sample Preparation of Aqueous Samples by Acid Digestion Using SW 846 Methods SW3010/SW3005 for Analysis by ICP/AES or ICP/MS, 2/16/10, Rev. 8	Definitive	GW / METAL, FMETAL	Sample Prep			
100.0410	Lloyd-Kahn TOC in Soil, 12/09/08 Rev.1 (Revisited 1/10/2011)	Screening	SS, SB, SD / WCHEM	TOC Analyzer			
QS10	Laboratory Sample Receiving, Log In and Storage, 9/16/11, Rev. 18	N/A	GW, SS, SB, SD, SMI / EXPLO	NA	Empirical	N	N
QS14	Analytical Laboratory Waste Disposal, 8/31/10, Rev. 6	N/A	GW, SS, SB, SD, SMI / EXPLO	NA			

SAP Worksheet #23–Analytical SOP References Table (continued)

<table>
<tr><th>Lab SOP Number</th><th>Title, Revision Date, and / or Number</th><th>Definitive or Screening Data</th><th>Matrix and Analytical Group</th><th>Instrument</th><th>Organization Performing Analysis</th><th>Variance to QSM</th><th>Modified for Project Work?[1] (y/n)</th></tr>
<tr><td>SOP 239</td><td>Perchlorate in Water, Soil, and Solid Waste Using High Performance Liquid Chromatography/ Electrospray Ionization/ Mass Spectrometry by SW846 Method 6850, 12/2/11, Rev. 8</td><td>Definitive</td><td>GW, SS, SB, SD, SMI / EXPLO</td><td>LC-MS</td><td></td><td></td><td></td></tr>
<tr><td>LOGIN01</td><td>Sample Receiving and Login, 10/15/10, Rev. 14</td><td>N/A</td><td>GW, SS, SB, SD, SMI / EXPLO</td><td>NA</td><td rowspan="4">Microbac</td><td rowspan="4">N</td><td rowspan="4">N</td></tr>
<tr><td>SOP33</td><td>Laboratory Waste Management, 8/15/11, Rev. 13</td><td>N/A</td><td>GW, SS, SB, SD, SMI / EXPLO</td><td>NA</td></tr>
<tr><td>KNITRO-C-S</td><td>Nitrocellulose in Soil, 10/15/2010, Rev. 1</td><td>Definitive</td><td>SS, SB, SD, SMI / EXPLO</td><td rowspan="2">Smartchem Discrete Wet Chemistry Analyzer</td></tr>
<tr><td>KNITRO-C-W</td><td>Nitrocellulose in Water dated 10/15/2010, Rev.1</td><td>Definitive</td><td>GW/ EXPLO</td></tr>
</table>

[1]If yes, then specify the modification that has been made. Note that any analytical SOP modification made relative to project specific needs must be reviewed and approved by the Navy QA Officer.

HPLC = high performance liquid chromatography
ICP-MS = inductively coupled plasma-mass spectrometer
GC-MS = gas chromatograph-mass spectrometer
LC-MS = liquid chromatograph- mass spectrometer
QSM = U.S. Department of Defense (DoD) Quality Systems Manual

SAP Worksheet #24–Analytical Instrument Calibration Table

Instrument[3]	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA[2]	SOP Reference[1]
ICP-MS	Tune	Daily prior to calibration	Mass calibration within 0.1 atomic mass unit (amu) of true value, Resolution < 0.9 amu at 10% peak height	Perform necessary equipment maintenance	Analyst, Supervisor	100.0110
	Initial calibration (ICAL)	Daily prior to sample analysis.	4 point calibration plus blank – correlation coefficient ≥ 0.995.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards		
	Second source calibration verification (ICV)	Before beginning a sample run.	Recovery within $\pm$ 10% of true value.	Do not use results for failing elements, unless ICV >110% and sample result < project quantitation limit (PQL)/reporting limit.		
	Continuing calibration verification (CCV)	At the beginning and end of each run sequence and every 10 samples	90-110% of True Values	Check problem, recalibrate and reanalyze any samples not bracketed by passing CCVs.		
	Low-level Calibration Check Standard	At beginning and end of run	80-120% of True Values	Correct problem then reanalyze		
CVAA (mercury)	ICAL	Instrument receipt, major instrument change, at the start of each day	6 point calibration; Correlation coefficient ≥ 0.995.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards	Analyst, Supervisor	00071
	ICV	Once after each ICAL, prior to beginning a sample run.	The %R must be within 90-110% of true value for mercury.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.		
	CCV	At beginning and end of each run sequence and every 10 samples	80-120% of True Value	Check problem, recalibrate and reanalyze any samples not bracketed by passing CCVs.		
Spectrophotometer (CN)	ICAL	Daily prior to sample analysis.	7 point calibration; Correlation coefficient ≥ 0.995	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards	Analyst, Supervisor	00034
	ICV	Once after each ICAL, prior to beginning a sample run.	The %R must be within 85-115% of true value for cyanide.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.		
	Distilled standards	Once per multipoint calibration	Within 85-115% of true value	Correct problem then repeat distilled standards		
	CCV	At beginning and end of each run sequence and every 10 samples	Within 85-115% of true value	If the CCV fails high, report samples that are <PQL. Recalibrate and/or reanalyze samples back to last acceptable CCV recovery.		

SAP Worksheet #24–Analytical Instrument Calibration Table (continued)

Instrument[3]	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA[2]	SOP Reference[1]
GC-MS (VOCs)	ICAL	Instrument receipt, instrument change (new column, source cleaning, etc.), when CCV is out of criteria.	Six-point initial - The average response factors (RFs) for system performance check compounds (SPCCs) must be ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachlorobenzene and ≥ 0.10 for chloromethane, 1,1-dichloroethane and bromoform. The percent relative standard deviation (%RSD) for RFs for calibration check compounds must be ≤ 30%, and one option below must be met: Option 1) %RSD < 15% for all other compounds. If not met: Option 2) Linear least squares regression: correlation coefficient (r) ≥ 0.995. Option 3) Non-linear regression: coefficient of determination (r2) ≥ 0.99 (6 points for second order).	Repeat calibration if criterion is not met	Analyst, Supervisor	00039
	ICV	Once after each ICAL.	The %R must be within 80-120% for all target compounds.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.		
	CCV	At the beginning of each 12 hour shift immediately after BFB tune.	SPCCs RF ≥0.10 & 0.30; %D (difference or drift) for all target compounds and surrogates ≤ 20%	Repeat initial calibration and reanalyze all samples analyzed since the last successful calibration verification		
	Retention time window position establishment for each analyte and surrogate	Once per ICAL	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA		
	Evaluation of relative retention time (RRT)	With each sample	RRT of each target analyte within +/- 0.06 RRT units	Correct problem them rerun ICAL		
	BFB Tune	Every 12 hours	Criteria listed in current revision of SOP 00039.	Retune and/or clean source		
GC-MS (SVOCs)	ICAL	Instrument receipt, instrument change (new column, source cleaning, etc.), when CCV is out of criteria.	Six-point initial - The average RF for SPCCs must be > 0.050; The %RSD for RFs for calibration check compounds must be <30%, and one option below must be met: Option 1) %RSD < 15% for all other compounds. If not met: Option 2) Linear least squares regression: r ≥ 0.995 Option 3) Non-linear regression: r2 ≥ 0.99 (6 points for second order).	Repeat calibration if criterion is not met	Analyst, Supervisor	00033, 00150
	ICV	Once after each ICAL.	The %R must be within 80-120% for all target compounds.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.		
	CCV	At the beginning of each 12 hour shift immediately after DFTPP tune.	SPCCs RF ≥0.050; %D for all target compounds and surrogates < 20%	Repeat initial calibration and reanalyze all samples analyzed since the last successful calibration verification		
	Retention time window position establishment for each analyte and surrogate	Once per ICAL	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA		
	Evaluation of relative retention time (RRT)	With each sample	RRT of each target analyte within +/- 0.06 RRT units	Correct problem them rerun ICAL		
	Breakdown Check	At the beginning of each 12-hour period, prior to analysis of samples	Degradation ≤ 20% for DDT. Benzidine and pentachlorophenol should be present at their normal responses, and should not exceed a tailing factor of 2.	Correct problem then repeat breakdown check.		
	DFTPP Tune	Every 12 hours	Criteria listed in current revision of SOPs 00033 and 00159	Retune and/or clean source		

SAP Worksheet #24–Analytical Instrument Calibration Table (continued)

Instrument[3]	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA[2]	SOP Reference[1]
HPLC (EXPLO inc. PETN and nitroglycerin)	ICAL - minimum five-points for all analytes	ICAL prior to sample analysis. Once calibration curve or line is generated, the lowest calibration standard must be reanalyzed.	RSD ≤ 20%	Correct problem then repeat ICAL.	Analyst, Supervisor	00055
	ICV	Immediately following ICAL.	All project analytes and surrogates within ± 15% of true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.		
	Retention time window position establishment for each analyte and surrogate	Once per ICAL	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA		
	CCV	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All target analytes and surrogates within ± 15% of the expected value from the ICAL.	Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since last acceptable CCV.		
HPLC (Nitroguanadine)	ICAL - minimum five-points for all analytes	ICAL prior to sample analysis.	correlation coefficient ≥ 0.995	Correct problem then repeat ICAL.	Analyst, Supervisor	HPLC05
	ICV	Immediately following ICAL.	All project analytes and surrogates within ± 30% of true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.		
	CCV	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All target analytes and surrogates within ± 20% of the expected value from the ICAL.	Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since last acceptable CCV.		
Smartchem Analyzer (Nitrocellulose)	ICAL - minimum six-points	ICAL prior to sample analysis.	Correlation coefficient ≥ 0.995	Correct problem then repeat ICAL.	Analyst, Supervisor	KNITRO-C-S, KNITRO-C-W
	ICV	Immediately following ICAL.	All project analytes and surrogates within 90-110% recovery.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.		
	CCV	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All project analytes and surrogates within 90-110% recovery.	Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since last acceptable CCV.		
TOC Analyzer (TOC)	ICAL	Quarterly or after instrument maintenance	Correlation coefficient ≥ 0.995	Correct problem then repeat ICAL.	Analyst, Supervisor	100.0410
	ICV	Immediately following ICAL.	All project analytes and surrogates within 85-115% recovery.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.		
	CCV	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All project analytes and surrogates within 85-115% recovery.	Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since last acceptable CCV.		

SAP Worksheet #24—Analytical Instrument Calibration Table (continued)

Instrument[3]	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA[2]	SOP Reference[1]
LC-MS (perchlorate)	ICAL	Minimum of five calibration standards to establish linearity at method set-up and after major maintenance.	r ≥ 0.995 or RSD ≤ 20%. The concentration corresponding to the absolute value of the calibration curve's Y-intercept must be ≤ LOD.	Correct problem then repeat ICAL.	Analyst, Supervisor	SOP 239
	ICV	Once after each ICAL, analysis of a second source standard at the midpoint of the calibration.	Within ±15% of true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.		
	CCV	Analysis of mid-level standard after every 10 field samples. All samples must be bracketed by the analysis of a standard demonstrating that the system was capable of accurately detecting and quantifying perchlorate.	Within ±15% of true value.	Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since last acceptable CCV.		
	Tuning	Prior to ICAL and after any mass calibration or maintenance is performed.	Tuning standards must contain the analytes of interest and meet acceptance criteria outlined in the laboratory SOP.	Retune instrument. If the tuning will not meet acceptance criteria, an instrument mass calibration must be performed and the tuning redone.		
	Limit of Detection Verification (LODV) (per batch)	Prior to sample analysis and at the end of the analysis sequence. It can be analyzed after every 10 samples in order to reduce the reanalysis rate.	Within ± 30% of true value.	Correct problem and rerun LODV and all samples analyzed since last successful LODV. If a sample with perchlorate concentration at or between the LOD and RL is bracketed by a failing LODV, it must be reanalyzed. A sample with concentration above the RL can be reported.		
	Mass Calibration	Instrument must have a valid mass calibration prior to any sample analysis. The mass calibration is updated on an as-needed basis (e.g., QC failures, ion masses show large deviations from known masses, major instrument maintenance is performed, or the instrument is moved).	Mass calibration range must bracket the ion masses of interest without greatly exceeding the range. The most recent mass calibration must be used for an analytical run, and the same mass calibration must be used for all data files in an analytical run. Mass calibration must be verified by acquiring a full scan continuum mass spectrum of a perchlorate stock standard. Perchlorate ions should be within ± 0.3 m/z of mass 99, 101, and 107 or their respective daughter ion masses (83, 85, and 89), depending on which ions are quantitated.	If the mass calibration fails, recalibrate. If it still fails, consult manufacturer instructions on corrective maintenance.		

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).

[2]Name or title of responsible person may be used.

[3]DoD QSM v. 4.2 is the basis for specifications on this table. Specifications are based on the SW-846 method that will be performed. Laboratory SOPs and analytical methods are the basis for nitrocellulose, nitroguanidine, and TOC analysis.

SAP Worksheet #25–Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person[2]	SOP Reference[1]
ICP-MS	Clean torch assembly and spray chamber when discolored or when degradation in data quality is observed. Clean nebulizer, check argon, replace peristaltic pump tubing as needed. Other maintenance specified in lab Equipment Maintenance SOP.	QC standards	Torch, nebulizer, spray chamber, pump tubing	Prior to ICAL and as necessary	Acceptable calibration or CCV	Correct the problem and repeat calibration or CCV	Analyst, Department Manager	100.0110
CVAA (mercury)	Replace peristaltic pump tubing, replace mercury lamp, replace drying tube, clean optical cell and/or clean liquid/gas separator as needed. Other maintenance specified in lab Equipment Maintenance SOP.	QC standards	Tubing, sample probe, optical cell	Prior to ICAL and as necessary	Acceptable calibration or CCV	Correct the problem and repeat calibration or CCV	Analyst, Department Manager	00071
Spectophotometer (CN)	Check and clean segments weekly, clean reagent tubes monthly. Change lamp, change diluent and wash tubes, change mixing paddles and syringes, change dispensing needle, all as needed.	QC standards	Reagent tubes, lamp, wash tubes, paddles, syringes, dispensing needles.	Prior to ICAL and/or as necessary.	Acceptable calibration or CV	Correct the problem and repeat calibration or CV	Analyst, Department Manager	00034
GC-MS (VOCs)	Check pressure and gas supply daily. Bake out trap and column, manual tune if BFB not in criteria, change septa as needed, cut column as needed, change trap as needed. Other maintenance specified in lab Equipment Maintenance SOP.	QC standards	Ion source, injector liner, column, column flow, purge lines, purge flow, trap	Prior to ICAL and/or as necessary.	Acceptable Tune	Correct the problem and repeat tune check	Analyst, Department Manager	00039
GC-MS (SVOCs)	Check pressure and gas supply daily. Manual tune if DFTPP not in criteria, change septa as needed, change liner as needed, cut column as needed. Other maintenance specified in lab Equipment Maintenance SOP	QC standards	Ion source, injector liner, column, column flow	Prior to ICAL and/or as necessary	Acceptable Tune	Correct the problem and repeat tune check	Analyst, Department Manager	00033, 00150

SAP Worksheet #25–Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table (continued)

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person[2]	SOP Reference[1]
HPLC (EXPLO)	Change analytical column as needed; change mobile phase when insufficient for run or contamination; change inlet filters as needed for contamination.	QC standards	Check pump pressure; check for leaks; check for adequate mobile phase.	Prior to ICAL or as necessary.	Calibration criteria are met.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst/ Supervisor	00055, HPLC05
Smartchem analyzer (Nitrocellulose)	Change or clean cadmium coil as needed, empty waste container as needed	QC standards	Inspect drying pad and pump tubes; check lamps	Prior to ICAL or as necessary.	Calibration criteria are met.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst/ Supervisor	KNITRO-C-S, KNITRO-C-W
TOC analyzer (TOC)	Clean as needed	QC standards	Check gas supply	Prior to ICAL or as necessary.	Calibration criteria are met.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst/ Supervisor	100.0410
LC-MS (Perchlorate)	Change analytical column as needed; change mobile phase when insufficient for run or contamination; change inlet filters as needed for contamination.	QC standards	Check pump pressure; check for leaks; check for adequate mobile phase.	Instrument receipt; instrument change (new column, etc.); when CCV does not meet criteria.	Calibration criteria are met.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst/ Supervisor	SOP 239

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).

[2]Name or title of responsible person may be used.

SAP Worksheet #26—Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): FTL (TBD)/CH2M HILL
Sample Packaging (Personnel/Organization): Sample Processor or Field Team Member (TBD)/CH2M HILL
Coordination of Shipment (Personnel/Organization): Sample Processor or Field Team Member (TBD)/CH2M HILL
Type of Shipment/Carrier: Overnight/FedEx
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Sample Receipt Personnel/Spectrum Analytical-Tampa; Note that all fractions will be shipped directly to Spectrum Analytical-Tampa and they will ship applicable fractions to Spectrum Analytical-Rhode Island, Empirical and Microbac.
Sample Custody and Storage (Personnel/Organization): Sample Receipt Personnel/Spectrum Analytical-Tampa
Sample Preparation (Personnel/Organization): Extractions Personnel/Spectrum Analytical-Tampa; Spectrum Analytical-Rhode Island; Empirical Laboratories, LLC; and Microbac Laboratories, Inc. Note that all SMI samples are shipped to Spectrum Analytical - Tampa for SMI processing. Aliquots for extraction are then shipped Spectrum Analytical-Rhode Island, Empirical Laboratories, LLC, and Microbac Laboratories, Inc. The METAL analytical group will not undergo the grinding procedure.
Sample Determinative Analysis (Personnel/Organization): Analyst/ Spectrum Analytical-Tampa; Spectrum Analytical-Rhode Island; Empirical; and Microbac
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): 90 days
Sample Extract/Digestate Storage (No. of days from extraction/digestion): Extracts may be disposed of 90 days after extraction.
Biological Sample Storage (No. of days from sample collection): N/A
SAMPLE DISPOSAL
Personnel/Organization: Environmental Health and Safety Office/ Spectrum Analytical-Tampa; Spectrum Analytical-Rhode Island; Empirical; and Microbac
Number of Days from Analysis: Samples may be disposed of 90 days after report mail date

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SAP Worksheet #27—Sample Custody Requirements Table

Sample Labeling

Sample labels will include, at a minimum, client name, site, sample ID, date/time collected, analysis group or method, preservative, and sampler's initials. Labels will be taped to the jar to ensure that they do not separate.

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory):

Samples will be collected by field team members under the supervision of the FTL. As samples are collected, they will be placed into containers and labeled, as outlined above. Sample containers will be cushioned with packaging material and placed into coolers containing enough ice to keep the samples below 4°C until they are received by the laboratory. The chain of custody (COC) will also be placed into the cooler. Coolers will be shipped to the laboratory via FedEx, with the airbill number indicated on the COC (to relinquish custody). Upon delivery, the laboratory will log in each cooler and report the status of the samples.

Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal):

See the laboratories' sample handling SOPs (Attachment B): 00010, 20.0003, 30.0024, QS10, QS14, LOGIN01, and SOP33 for details on sample handling.

Sample Identification Procedures:

Upon opening the cooler, the receiving clerk signs the COC and then takes the temperature using the temperature blank (if absent, then a sample container or infrared thermometer is used). The sample containers in the cooler are unpacked and checked against the client's COC, and any discrepancies or breakage is noted on the COC. Next, if any water samples require preservative, the clerk will check the pH values to see if they are in the acceptable pH range. The clerk will deliver the COC (and any other paperwork; for example, temperature or pH QA notice) to the PM for Laboratory Information Management Systems entry and client contact (if needed).

The field log book will identify the sample ID with the location, depth, date/time collected, and the parameters requested. The laboratory will assign each field sample a laboratory sample ID based on information in the COC. The laboratory will send sample log-in forms to the PDM to check sample IDs and parameters are correct.

COC Procedures:

COCs will include, at a minimum, laboratory contact information, client contact information, sample information, and relinquished by/received by information. Sample information will include sample ID, date/time collected, number and type of containers, preservative information, analysis method, and comments. The COC will also have the sampler's name and signature. The COC will link location of the sample from the field log book to the laboratory receipt of the sample. The laboratory will use the sample information to populate the Laboratory Information Management Systems database for each sample.

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SAP Worksheet #28-1—Laboratory QC Samples Table

Matrix: GW and AQ (blanks)
Analytical Group: METAL, FMETAL
Analytical Method / SOP Reference: SW-846 6020A, 7470A, 9012B / 100.0110, 00071, 00034

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
METALs and FMETALs by SW-846 6020A						
Method Blank	One per preparatory batch.	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ (see Box D-1 of DoD QSM v 4.2) .	Correct problem, then see criteria in Box D-1 of DoD QSM v. 4.2 . If required, reprep and reanalyze method blank and all samples processed with the contaminated blank. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analytes(s) in all samples in the associated preparatory batch.	Analyst	Accuracy/Bias, Contamination	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ (see Box D-1 of DoD QSM v 4.2) .
Calibration Blank	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence.	No analytes detected > LOD.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed. Apply B-flag to all results for specific analyte(s) in all samples associated with the blank.	Analyst	Accuracy/Bias, Contamination	No analytes detected > LOD.
Interference Check Solutions (ICS)	At the beginning of an analytical run.	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD (unless they are a verified trace impurity from one of the spike analytes) ICS-AB: Within ±20% of true value.	Terminate analysis; locate and correct problem; reanalyze ICS; reanalyze all samples. If corrective action fails, apply Q-flag to all results for specific analyte(s) in al samples associated with the ICS.	Analyst	Accuracy/Bias	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD (unless they are a verified trace impurity from one of the spike analytes) ICS-AB: Within ±20% of true value.
Laboratory control sample (LCS) containing all analytes required to be reported	One per preparatory batch.	Refer to Worksheet #15-1. Limits are as per DoD QSM v. 4.2 . In-house statistical laboratory limits are provided when DoD QSM v. 4.2 does not specify.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Refer to Appendix G of DoD QSM v. 4.2 . If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Analyst	Accuracy/Bias	Refer to Worksheet #15-1. Limits are as per DoD QSM v. 4.2 . In-house statistical laboratory limits are provided when DoD QSM v. 4.2 does not specify.
MS	One per preparatory batch per matrix.	Same as LCS.	Examine the project-specific DQOs. If the matrix spike falls outside of DoD criteria, additional quality control tests are required to evaluate matrix effects. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	Analyst	Accuracy/Bias	Same as LCS.
MSD or sample duplicate	One per preparatory batch per matrix.	Same as MS and refer to Worksheet #15-1.	Same as MS	Analyst	Accuracy/Bias, Precision	Same as MS and refer to Worksheet #15-1.
Serial Dilution	One per preparatory batch.	Five-fold dilution must agree within ±10% of the original measurement. Only applicable for samples with concentrations > 50X LOQ.	Perform post-digestion spike (PDS) addition.	Analyst	Accuracy	Five-fold dilution must agree within ±10% of the original measurement. Only applicable for samples with concentrations > 50X LOQ.
PDS	When dilution test fails or analyte concentration in all samples < 50X LOD.	75-125%R	Run all associated samples in the preparatory batch by method of standard additions. Or, for the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	Analyst	Accuracy	75-125%R

SAP Worksheet #28-1—Laboratory QC Samples Table (continued)

Matrix: GW and AQ (blanks)

Analytical Group: METAL, FMETAL

Analytical Method / SOP Reference: SW-846 6020A, 7470A, 9012B / 100.0110, 00071, 00034

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Mercury by SW-846 7470A						
Method Blank	One per preparatory batch.	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. See Box D-1 of DoD QSM v 4.2 .	Correct problem, then see criteria in Box D-1 of DoD QSM v. 4.2 . If required, reprep and reanalyze method blank and all samples processed with the contaminated blank. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analytes(s) in all samples in the associated preparatory batch.	Analyst	Accuracy/Bias, Contamination	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. See Box D-1 of DoD QSM v 4.2 .
Calibration Blank	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence.	No analytes detected > LOD.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed. Apply B-flag in all samples associated with the blank.	Analyst	Accuracy/Bias, Contamination	No analytes detected > LOD.
LCS	One per preparatory batch.	Refer to Worksheet #15-1. Limits are as per DoD QSM v. 4.2 . In-house statistical laboratory limits are provided when DoD QSM v. 4.2 does not specify.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Refer to Appendix G of DoD QSM v. 4.2 . If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Analyst	Accuracy/Bias	Refer to Worksheet #15-1. Limits are as per DoD QSM v. 4.2 . In-house statistical laboratory limits are provided when DoD QSM v. 4.2 does not specify.
MS	One per preparatory batch per matrix.	Same as LCS.	Examine the project-specific DQOs. If the matrix spike falls outside of DoD criteria, additional quality control tests are required to evaluate matrix effects. Apply J-flag if acceptance criteria are not met.	Analyst	Accuracy/Bias	Same as LCS.
MSD	One per preparatory batch per matrix.	Same as MS and refer to Worksheet #15-1.	Same as MS	Analyst	Accuracy/Bias, Precision	Same as MS and refer to Worksheet #15-1.
Cyanide by SW-846 9012B						
LCS	One LCS and duplicate per analytical batch	Refer to Worksheet #15-1. Limits are as per DoD QSM v. 4.2 .	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available	Group Analyst	Accuracy	Refer to Worksheet #15-1. Limits are as per DoD QSM v. 4.2 .
MS/MSD	One MS/SD Set per analytical batch per matrix	Refer to Worksheet #15-1. Limits are as per DoD QSM v. 4.2 .	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	Group Analyst	Accuracy, Precision	Refer to Worksheet #15-1. Limits are as per DoD QSM v. 4.2 .
Method blank	One per analytical batch	No analytes detected > LOQ	Correct problem; if required, reprep then reanalyze method blank and all samples processed with the contaminated blank.	Group Analyst	Contamination	No analytes detected > LOQ

[1]DoD QSM v. 4.2 is the basis for specifications on this table.

SAP Worksheet #28-2—Laboratory QC Samples Table

Matrix: GW and AQ (blanks)
Analytical Group: VOC
Analytical Method / SOP Reference: SW-846 8260B / 00039

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Method Blank	One per preparatory batch.	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ (see Box D-1 of DoD QSM v 4.2) .	Correct problem, then see criteria in Box D-1 of DoD QSM v. 4.2 . If required, reprep and reanalyze method blank and all samples processed with the contaminated blank. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analytes(s) in all samples in the associated preparatory batch.	Analyst	Accuracy/Bias, Contamination	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ (see Box D-1 of DoD QSM v 4.2) .
LCS	One per preparatory batch.	Refer to Worksheet #15-2. Limits are as per DoD QSM v. 4.2 . In-house statistical laboratory limits are provided when DoD QSM v. 4.2 does not specify.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Refer to Appendix G of DoD QSM v. 4.2 . If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Analyst	Accuracy/Bias	Refer to Worksheet #15-2. Limits are as per DoD QSM v. 4.2 . In-house statistical laboratory limits are provided when DoD QSM v. 4.2 does not specify.
MS	One per preparatory batch per matrix.	Same as LCS.	Examine the project-specific DQOs. Contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	Analyst	Accuracy/Bias	Same as LCS.
MSD	One per preparatory batch per matrix.	Same as MS and refer to Worksheet #15-2.	Same as MS	Analyst	Accuracy/Bias, Precision	Same as MS and refer to Worksheet #15-2.
Internal Standards Verification	Every field sample, standard, and QC sample.	Retention time ±30 seconds from retention time of the midpoint standard in the ICAL; electron ionization current plot (EICP) area within -50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions. Reanalysis of samples analyzed while system was malfunctioning is mandatory. If corrective action fails in field samples, apply Q-flag to analytes associated with the non-compliant internal standard (IS).	Analyst	Accuracy	Retention time ±30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard.
Surrogates	4 Per Sample	1,2-Dichloroethane-d4: 70-120%R 4-Bromofluorobenzene: 75-120%R Dibromofluoromethane: 85-115%R Toluene-d8: 85-120%R	For field and QC sample, correct problem then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary. Apply Q-flag to all associated analytes if acceptance criteria are not met.	Analyst	Accuracy/Bias	1,2-Dichloroethane-d4: 70-120%R 4-Bromofluorobenzene: 75-120%R Dibromofluoromethane: 85-115%R Toluene-d8: 85-120%R

[1]DoD QSM v. 4.2 is the basis for specifications on this table.

SAP Worksheet #28-3—Laboratory QC Samples Table

Matrix: GW and AQ (blanks)
Analytical Group: SVOC
Analytical Method / SOP Reference: SW-846 8270D, 8270D_SIM / 00033, 00150

QC Sample[1]	Frequency	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Method Blank	One per preparatory batch.	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ (see Box D-1 of DoD QSM v 4.2) .	Correct problem, then see criteria in Box D-1 of DoD QSM v. 4.2 . If required, reprep and reanalyze method blank and all samples processed with the contaminated blank. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analytes(s) in all samples in the associated preparatory batch.	Analyst	Accuracy/Bias, Contamination	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ (see Box D-1 of DoD QSM v 4.2) .
LCS	One per preparatory batch.	Refer to Worksheet #15-3. Limits are as per DoD QSM v. 4.2 for analytes analyzed by 8270D scan and in-house statistical laboratory limits for analytes analyzed by 8270D SIM.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Refer to Appendix G of DoD QSM v. 4.2 . If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Analyst	Accuracy/Bias	Refer to Worksheet #15-3. Limits are as per DoD QSM v. 4.2 for analytes analyzed by 8270D scan and in-house statistical laboratory limits for analyzed by 8270D SIM.
MS	One per preparatory batch per matrix.	Same as LCS.	Examine the project-specific DQOs. Contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	Analyst	Accuracy/Bias	Same as LCS.
MSD	One per preparatory batch per matrix.	Same as MS and refer to Worksheet #15-3.	Same as MS	Analyst	Accuracy/Bias, Precision	Same as MS and refer to Worksheet #15-3.
Internal Standards Verification	Every field sample, standard, and QC sample.	Retention time ±30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions. Reanalysis of samples analyzed while system was malfunctioning is mandatory. If corrective action fails in field samples, apply Q-flag to analytes associated with the non-compliant IS.	Analyst	Accuracy	Retention time ±30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard.
Surrogates	6 per sample for SW-846 8270D	2-Fluorobiphenyl: 50-110%R Terphenyl-d14: 50-135%R 2,4,6-Tribromophenol: 40-125%R 2-Fluorophenol: 20-110%R Nitrobenzene-d5: 40-110%R	For field and QC sample, correct problem then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary. Apply Q-flag to all associated analytes if acceptance criteria are not met.	Analyst	Accuracy/Bias	2-Fluorobiphenyl: 50-110%R Terphenyl-d14: 50-135%R 2,4,6-Tribromophenol: 40-125%R 2-Fluorophenol: 20-110%R Nitrobenzene-d5: 40-110%R
	4 per sample for SW-846 8270D SIM	2-Methylnaphthalene-d10: 43-92%R Fluorene-d10: 29-101%R Pyrene-d10: 53-166%R 2,4-Dibromophenol: 10-130%R				2-Methylnaphthalene-d10: 43-92%R Fluorene-d10: 29-101%R Pyrene-d10: 53-166%R 2,4-Dibromophenol: 10-130%R

[1]DoD QSM v. 4.2 is the basis for specifications on this table. Criteria for 8270D SIM may vary (LCS, MS/MSD, and surrogate recovery limits).

SAP Worksheet #28-4—Laboratory QC Samples Table

Matrix: GW and AQ (blanks)
Analytical Group: EXPLO
Analytical Method / SOP Reference: SW-846 8330B, 6850, USATHAMA/353.2/353.3 / 00055, KNITRO-C-W, HPLC05

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Explosives including PETN and Nitroglycerin by SW-846 8330B						
Method Blank	One is performed for each batch of up to 20 samples.	Target analytes must be < ½ LOQ or < 1/10 the concentration found in the sample or < 1/10th the regulatory limit. Blank results must not otherwise affect sample results.	Correct the problem, then see DoD QSM v4.2 Box D-1. If required, reprep and reanalyze the method blank and all samples processed with the contaminated blank.	Analyst/ Laboratory Area Supervisor	Contamination/ Bias	Target analytes must be < ½ LOQ or < 1/10 the concentration found in the sample or < 1/10th the regulatory limit. Blank results must not otherwise affect sample results.
LCS		Contains all target analytes. Percent recoveries must meet the control limits listed in Worksheet #15-4	Re-prepare and analyze all associated samples if holding time remains. Discuss qualification with client.		Accuracy/ Bias	Contains all target analytes. Percent recoveries must meet the control limits listed in Worksheet #15-4
MS/MSD		Contains all target analytes. For matrix evaluation only. Percent recoveries must meet the LCS limits. Relative Percent Difference (RPD) <30%	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.		Precision / Accuracy / Bias	Contains all target analytes. For matrix evaluation only. Percent recoveries must meet the LCS limits. RPD <30%
Confirmation of positive results	All positive results must be confirmed on second column	Calibration and QC criteria same as for initial or primary column analysis; Results between two columns RPD ≤ 40%	Narrate and qualify the results		Accuracy	Calibration and QC criteria same as for initial or primary column analysis; Results between two columns RPD ≤ 40%
Surrogates	All field and QC samples.	1-chloro-3-nitrobenzene 40-145%	Re-prepare and reanalyze all failed samples in the associated preparatory batch for confirmation of matrix interference.		Accuracy / Bias	1-chloro-3-nitrobenzene 40-145%
Nitroguanadine by SW-846 8330B						
Method Blank	One is performed for each batch of up to 20 samples.	Target analytes must be < ½ LOQ or < 1/10 the concentration found in the sample or < 1/10th the regulatory limit. Blank results must not otherwise affect sample results.	Correct the problem, then see DoD QSM v4.2 Box D-1. If required, reprep and reanalyze the method blank and all samples processed with the contaminated blank.	Analyst/ Laboratory Area Supervisor	Contamination/ Bias	Target analytes must be < ½ LOQ or < 1/10 the concentration found in the sample or < 1/10th the regulatory limit. Blank results must not otherwise affect sample results.
LCS		Contains all target analytes. Percent recoveries must meet the control limits listed in Worksheet #15-4	Re-prepare and analyze all associated samples if holding time remains. Discuss qualification with client.		Accuracy/ Bias	Contains all target analytes. Percent recoveries must meet the control limits listed in Worksheet #15-4
MS/MSD		Contains all target analytes. For matrix evaluation only. Percent recoveries must meet the LCS limits.	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.		Precision / Accuracy / Bias	Contains all target analytes. For matrix evaluation only. Percent recoveries must meet the LCS limits.

SAP Worksheet #28-4—Laboratory QC Samples Table (continued)

Matrix: GW and AQ (blanks)

Analytical Group: EXPLO

Analytical Method / SOP Reference: SW-846 8330B, 6850, USATHAMA/353.2/353.3 / 00055, KNITRO-C-W, HPLC05

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Nitrocellulose by USATHAMA/353.2/353.3						
Method Blank	One is performed for each batch of up to 20 samples.	Target analytes must be < ½ LOQ or < 1/10 the concentration found in the sample or < 1/10th the regulatory limit. Blank results must not otherwise affect sample results.	Correct the problem, then see DoD QSM v4.2 Box D-1. If required, reprep and reanalyze the method blank and all samples processed with the contaminated blank.	Analyst/ Laboratory Area Supervisor	Contamination/ Bias	Target analytes must be < ½ LOQ or < 1/10 the concentration found in the sample or < 1/10th the regulatory limit. Blank results must not otherwise affect sample results.
LCS		Contains all target analytes. Percent recoveries must meet the control limits listed in Worksheet #15-4	Re-prepare and analyze all associated samples if holding time remains. Discuss qualification with client.		Accuracy/ Bias	Contains all target analytes. Percent recoveries must meet the control limits listed in Worksheet #15-4
MS, Sample Duplicate		Contains all target analytes. For matrix evaluation only. Percent recoveries must meet the LCS limits.	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.		Precision / Accuracy / Bias	Contains all target analytes. For matrix evaluation only. Percent recoveries must meet the LCS limits.
Perchlorate by SW-846 6850						
Isotope ratio	Each sample, QC sample, and standard	Monitor for either the parent ion at masses 99/101 or the daughter ion at masses 83/85. Must fall within 2.3 - 3.8	Re-extract using cleanup procedures or alternate techniques to confirm the presence of perchlorate such as post spikes or dilutions to reduce interference.	Analyst, Laboratory Supervisor	Precision / Accuracy / Bias	Monitor for either the parent ion at masses 99/101 or the daughter ion at masses 83/85. Must fall within 2.3 - 3.8
IS	One per sample	RRTs for internal standard must be 0.98-1.02 and the responses within ± 50% of the average response of the ICAL.	Reanalyze samples at increasing dilutions until the ± 50% criteria can be met		Precision / Accuracy / Bias	Relative retention times for internal standard must be 0.98-1.02 and the responses within ± 50% of the average response of the initial calibration (ICAL).
ICS	One is performed for each batch of up to 20 samples. Must undergo the same preparation and pretreatment steps as the samples in the batch, It verifies the method performance at the matrix conductivity threshold. At least one ICS must be analyzed daily.	Within 30% of true value	Correct problem and then reanalyze all samples in that batch. If poor recovery from the cleanup filters is suspected, a different lot of filters must be used to re-extract all samples in the batch. If column degradation is suspected, a new column must be calibrated before the samples can be reanalyzed.		Precision / Accuracy / Bias	Within 30% of true value

SAP Worksheet #28-4—Laboratory QC Samples Table (continued)

Matrix: GW and AQ (blanks)
Analytical Group: EXPLO
Analytical Method / SOP Reference: SW-846 8330B, 6850, USATHAMA/353.2/353.3 / 00055, KNITRO-C-W, HPLC05

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Lab reagent blank	Prior to calibration, after samples with over range concentration of perchlorate, and at the end of the analytical sequence.	No perchlorate > 1/2 LOQ	Reanalyze reagent blank (until no carryover is observed) and all samples processed since the contaminated blank.		Bias / Contamination	No perchlorate > 1/2 LOQ
Method blank	One is performed for each batch of up to 20 samples	Target analytes must be < ½ LOQ or < 1/10 the concentration found in the sample or < 1/10th the regulatory limit. Blank results must not otherwise affect sample results.	Re-clean, retest, re-extract, reanalyze, and/or qualify data		Bias / Contamination	Target analytes must be < ½ LOQ or < 1/10 the concentration found in the sample or < 1/10th the regulatory limit. Blank results must not otherwise affect sample results.
LCS		See Worksheet #15-4	Evaluate and re-prepare/ reanalyze the LCS and associated samples.		Precision / Accuracy / Bias	See Worksheet #15-4
MS/MSD		See Worksheet #15-4	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.		Precision / Accuracy / Bias	See Worksheet #15-4

[1]DoD QSM v. 4.2 is the basis for specifications for Explosives by 8330B and perchlorate. In-house laboratory limits were applied for nitrocellulose and nitroguanidine.

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SAP Worksheet #28-5—Laboratory QC Samples Table

Matrix: GW
Analytical Group: WCHEM (Hardness)
Analytical Method / SOP Reference: SM 2340B / N/A

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Hardness by SM 2340B						
N/A	N/A: Laboratory QC samples are not planned for WCHEM (Hardness) other than those required by Worksheet #28-1 for GW/ METAL via 6020A.					

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SAP Worksheet #28-6—Laboratory QC Samples Table

Matrix: SD, SS, SB, SMI
Analytical Group: METAL
Analytical Method / SOP Reference: SW-846 6020A, 7470B, 9012B / 100.0110, 00071, 00034

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
			METALs by SW-846 6020A			
Method Blank	One per preparatory batch.	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ (see Box D-1 of DoD QSM v 4.2) .	Correct problem, then see criteria in Box D-1 of DoD QSM v. 4.2 . If required, reprep and reanalyze method blank and all samples processed with the contaminated blank. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analytes(s) in all samples in the associated preparatory batch.	Analyst	Accuracy/Bias, Contamination	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ (see Box D-1 of DoD QSM v 4.2) .
Calibration Blank	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence.	No analytes detected > LOD.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed. Apply B-flag to all results for specific analyte(s) in all samples associated with the blank.	Analyst	Accuracy/Bias, Contamination	No analytes detected > LOD.
ICS	At the beginning of an analytical run.	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD (unless they are a verified trace impurity from one of the spike analytes) ICS-AB: Within ±20% of true value.	Terminate analysis; locate and correct problem; reanalyze ICS; reanalyze all samples. If corrective action fails, apply Q-flag to all results for specific analyte(s) in al samples associated with the ICS.	Analyst	Accuracy/Bias	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD (unless they are a verified trace impurity from one of the spike analytes) ICS-AB: Within ±20% of true value.
LCS containing all analytes required to be reported	One per preparatory batch.	Refer to Worksheet #15-1. Limits are as per DoD QSM v. 4.2 . In-house statistical laboratory limits are provided when DoD QSM v. 4.2 does not specify.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Refer to Appendix G of DoD QSM v. 4.2 . If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Analyst	Accuracy/Bias	Refer to Worksheet #15-1. Limits are as per DoD QSM v. 4.2 . In-house statistical laboratory limits are provided when DoD QSM v. 4.2 does not specify.
MS	One per preparatory batch per matrix.	Same as LCS.	Examine the project-specific DQOs. If the MS falls outside of DoD criteria, additional quality control tests are required to evaluate matrix effects. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	Analyst	Accuracy/Bias	Same as LCS.
MSD or sample duplicate	One per preparatory batch per matrix.	Same as MS and refer to Worksheet #15-1.	Same as MS	Analyst	Accuracy/Bias, Precision	Same as MS and refer to Worksheet #15-1.
Serial Dilution	One per preparatory batch.	Five-fold dilution must agree within ±10% of the original measurement. Only applicable for samples with concentrations > 50X LOQ.	Perform PDS addition.	Analyst	Accuracy	Five-fold dilution must agree within ±10% of the original measurement. Only applicable for samples with concentrations > 50X LOQ.
PDS	When dilution test fails or analyte concentration in all samples < 50X LOD.	75-125%R	Run all associated samples in the preparatory batch by method of standard additions. Or, for the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	Analyst	Accuracy	75-125%R

SAP Worksheet #28-6—Laboratory QC Samples Table (continued)

Matrix: SD, SS, SB, SMI
Analytical Group: METAL
Analytical Method / SOP Reference: SW-846 6020A, 7470B, 9012B / 100.0110, 00071, 00034

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Mercury by SW-846 7471B						
Method Blank	One per preparatory batch.	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. See Box D-1 of DoD QSM v 4.2 .	Correct problem, then see criteria in Box D-1 of DoD QSM v. 4.2 . If required, reprep and reanalyze method blank and all samples processed with the contaminated blank. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analytes(s) in all samples in the associated preparatory batch.	Analyst	Accuracy/Bias, Contamination	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. See Box D-1 of DoD QSM v 4.2 .
Calibration Blank	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence.	No analytes detected > LOD.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed. Apply B-flag in all samples associated with the blank.	Analyst	Accuracy/Bias, Contamination	No analytes detected > LOD.
LCS	One per preparatory batch.	Refer to Worksheet #15-1. Limits are as per DoD QSM v. 4.2 . In-house statistical laboratory limits are provided when DoD QSM v. 4.2 does not specify.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Refer to Appendix G of DoD QSM v. 4.2 . If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Analyst	Accuracy/Bias	Refer to Worksheet #15-1. Limits are as per DoD QSM v. 4.2 . In-house statistical laboratory limits are provided when DoD QSM v. 4.2 does not specify.
MS	One per preparatory batch per matrix.	Same as LCS.	Examine the project-specific DQOs. If the MS falls outside of DoD criteria, additional quality control tests are required to evaluate matrix effects. Apply J-flag if acceptance criteria are not met.	Analyst	Accuracy/Bias	Same as LCS.
MSD	One per preparatory batch per matrix.	Same as MS and refer to Worksheet #15-1.	Same as MS	Analyst	Accuracy/Bias, Precision	Same as MS and refer to Worksheet #15-1.
Cyanide by SW-846 9012B						
LCS	One LCS and duplicate per analytical batch	Refer to Worksheet #15-1. Limits are as per DoD QSM v. 4.2 .	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available	Group Analyst	Accuracy	Refer to Worksheet #15-1. Limits are as per DoD QSM v. 4.2 .
MS/MSD	One MS/SD Set per analytical batch per matrix	Refer to Worksheet #15-1. Limits are as per DoD QSM v. 4.2 .	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	Group Analyst	Accuracy, Precision	Refer to Worksheet #15-1. Limits are as per DoD QSM v. 4.2 .
Method blank	One per analytical batch	No analytes detected > LOQ	Correct problem; if required, reprep then reanalyze method blank and all samples processed with the contaminated blank.	Group Analyst	Contamination	No analytes detected > LOQ

SAP Worksheet #28-6—Laboratory QC Samples Table (continued)

Matrix: SD, SS, SB, SMI
Analytical Group: METAL
Analytical Method / SOP Reference: SW-846 6020A, 7470B, 9012B / 100.0110, 00071, 00034

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Preparation for SMI (does not apply to SS, SB, or SD samples)						
Soil drying procedure	See Worksheet #28-9					
Soil sieving procedure	See Worksheet #28-9					
Soil subsampling process	Each sample, duplicate, and batch LCS.	Metals samples will be subsampled prior to grinding. Entire sample is mixed, spread out on a large flat surface (e.g., baking tray), and 30 or more randomly located increments are removed from the entire depth to sum a ~10 g subsample.	N/A	Analyst	Accuracy	N/A
Soil sample laboratory triplicate	At the subsampling step, one sample per batch. Cannot be performed on any type of blank sample.	Three subsamples are taken from a sample expected to contain the highest levels of explosives (i.e. the same sample as for the explosives triplicate) within the quantitation range of the method. The RSD for results above the RL should not exceed 20%.	Advisory for metals. CA need not be taken if this criterion is not met. Apply a J flag.	Analyst	Accuracy	Three subsamples are taken from a sample expected to contain the highest levels of explosives (i.e. the same sample as for the explosives triplicate) within the quantitation range of the method. The RSD for results above the RL should not exceed 20%.

[1]DoD QSM v. 4.2 is the basis for specifications on this table.

SAP Worksheet #28-7—Laboratory QC Samples Table

Matrix: SD, SS, SB
Analytical Group: VOC
Analytical Method / SOP Reference: SW-846 8260B / 00039

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Method Blank	One per preparatory batch.	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ (see Box D-1 of DoD QSM v 4.2) .	Correct problem, then see criteria in Box D-1 of DoD QSM v. 4.2 . If required, reprep and reanalyze method blank and all samples processed with the contaminated blank. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analytes(s) in all samples in the associated preparatory batch.	Analyst	Accuracy/Bias, Contamination	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ (see Box D-1 of DoD QSM v 4.2) .
LCS	One per preparatory batch.	Refer to Worksheet #15-6. Limits are as per DoD QSM v. 4.2 . In-house statistical laboratory limits are provided when DoD QSM v. 4.2 does not specify.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Refer to Appendix G of DoD QSM v. 4.2 . If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Analyst	Accuracy/Bias	Refer to Worksheet #15-6. Limits are as per DoD QSM v. 4.2 . In-house statistical laboratory limits are provided when DoD QSM v. 4.2 does not specify.
MS	One per preparatory batch per matrix.	Same as LCS.	Examine the project-specific DQOs. Contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	Analyst	Accuracy/Bias	Same as LCS.
MSD	One per preparatory batch per matrix.	Same as MS and refer to Worksheet #15-6.	Same as MS	Analyst	Accuracy/Bias, Precision	Same as MS and refer to Worksheet #15-6.
Internal Standards Verification	Every field sample, standard, and QC sample.	Retention time ±30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions. Reanalysis of samples analyzed while system was malfunctioning is mandatory. If corrective action fails in field samples, apply Q-flag to analytes associated with the non-compliant IS.	Analyst	Accuracy	Retention time ±30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard.
Surrogates	2 Per Sample	4-Bromofluorobenzene: 85-120%R Toluene-d8: 85-115%R	For field and QC sample, correct problem then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary. Apply Q-flag to all associated analytes if acceptance criteria are not met.	Analyst	Accuracy/Bias	4-Bromofluorobenzene: 85-120%R Toluene-d8: 85-115%R

[1]DoD QSM v. 4.2 is the basis for specifications on this table.

SAP Worksheet #28-8—Laboratory QC Samples Table

Matrix: SS, SB, SD
Analytical Group: SVOC
Analytical Method / SOP Reference: SW-846 8270D, 8270D_SIM / 00033, 00150

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Method Blank	One per preparatory batch.	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ (see Box D-1 of DoD QSM v 4.2) .	Correct problem, then see criteria in Box D-1 of DoD QSM v. 4.2 . If required, reprep and reanalyze method blank and all samples processed with the contaminated blank. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analytes(s) in all samples in the associated preparatory batch.	Analyst	Accuracy/Bias, Contamination	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ (see Box D-1 of DoD QSM v 4.2) .
LCS	One per preparatory batch.	Refer to Worksheet #15-3. Limits are as per DoD QSM v. 4.2 for analytes analyzed by 8270D scan and in-house statistical laboratory limits for analytes analyzed by 8270D SIM.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Refer to Appendix G of DoD QSM v. 4.2 . If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Analyst	Accuracy/Bias	Refer to Worksheet #15-3. Limits are as per DoD QSM v. 4.2 for analytes analyzed by 8270D scan and in-house statistical laboratory limits for analytes analyzed by 8270D SIM.
MS	One per preparatory batch per matrix.	Same as LCS.	Examine the project-specific DQOs. Contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	Analyst	Accuracy/Bias	Same as LCS.
MSD	One per preparatory batch per matrix.	Same as MS and refer to Worksheet #15-3.	Same as MS	Analyst	Accuracy/Bias, Precision	Same as MS and refer to Worksheet #15-3.
Internal Standards Verification	Every field sample, standard, and QC sample.	Retention time ±30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions. Reanalysis of samples analyzed while system was malfunctioning is mandatory. If corrective action fails in field samples, apply Q-flag to analytes associated with the non-compliant IS.	Analyst	Accuracy	Retention time ±30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard.
Surrogates	5 per sample for SW-846 8270D	2-Fluorobiphenyl: 45-105%R Terphenyl-d14: 30-125%R 2,4,6-Tribromophenol: 35-125%R 2-Fluorophenol: 35-105%R Nitrobenzene-d5: 35-100%R Phenol-d5/d6: 40-100%	For field and QC sample, correct problem then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary. Apply Q-flag to all associated analytes if acceptance criteria are not met.	Analyst	Accuracy/Bias	2-Fluorobiphenyl: 45-105%R Terphenyl-d14: 30-125%R 2,4,6-Tribromophenol: 35-125%R 2-Fluorophenol: 35-105%R Nitrobenzene-d5: 35-100%R Phenol-d5/d6: 40-100%
	1 per sample for SW-846 8270D SIM	p-Terphenyl: 53-170%R				p-Terphenyl: 53-170%R

[1]DoD QSM v. 4.2 is the basis for specifications on this table. Criteria for 8270D SIM may vary (ie LCS, MS/MSD, and surrogate recovery limits).

SAP Worksheet #28-9—Laboratory QC Samples Table

Matrix: SS, SB, SD, SMI
Analytical Group: EXPLO
Analytical Method / SOP Reference: SW-846 8330B, 6850, USATHAMA/353.2/353.3 / 00055, KNITRO-C-S, HPLC05

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Explosives including PETN and Nitroglycerin by SW-846 8330B						
Method Blank	One is performed for each batch of up to 20 samples.	Target analytes must be < ½ LOQ or < 1/10 the concentration found in the sample or < 1/10th the regulatory limit. Blank results must not otherwise affect sample results.	Correct the problem, then see DoD QSM v4.2 Box D-1. If required, reprep and reanalyze the method blank and all samples processed with the contaminated blank.	Analyst/ Laboratory Area Supervisor	Contamination/ Bias	Target analytes must be < ½ LOQ or < 1/10 the concentration found in the sample or < 1/10th the regulatory limit. Blank results must not otherwise affect sample results.
LCS		Contains all target analytes. Percent recoveries must meet the control limits listed in Worksheet #15-8	Re-prepare and analyze all associated samples if holding time remains. Discuss qualification with client.		Accuracy/ Bias	Contains all target analytes. Percent recoveries must meet the control limits listed in Worksheet #15-8
MS/MSD		Contains all target analytes. For matrix evaluation only. Percent recoveries must meet the LCS limits. RPD <30%	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.		Precision / Accuracy / Bias	Contains all target analytes. For matrix evaluation only. Percent recoveries must meet the LCS limits. RPD <30%
Confirmation of positive results	All positive results must be confirmed on second column	Calibration and QC criteria same as for initial or primary column analysis; Results between two columns RPD ≤ 40%	Narrate and qualify the results		Accuracy	Calibration and QC criteria same as for initial or primary column analysis; Results between two columns RPD ≤ 40%
Surrogates	All field and QC samples.	1-chloro-3-nitrobenzene 40-145%	Re-prepare and reanalyze all failed samples in the associated preparatory batch for confirmation of matrix interference.		Accuracy / Bias	1-chloro-3-nitrobenzene 40-145%
Nitroguanadine by SW-846 8330B						
Method Blank	One is performed for each batch of up to 20 samples.	Target analytes must be < ½ LOQ or < 1/10 the concentration found in the sample or < 1/10th the regulatory limit. Blank results must not otherwise affect sample results.	Correct the problem, then see DoD QSM v4.2 Box D-1. If required, reprep and reanalyze the method blank and all samples processed with the contaminated blank.	Analyst/ Laboratory Area Supervisor	Contamination/ Bias	Target analytes must be < ½ LOQ or < 1/10 the concentration found in the sample or < 1/10th the regulatory limit. Blank results must not otherwise affect sample results.
LCS		Contains all target analytes. Percent recoveries must meet the control limits listed in Worksheet #15-8	Re-prepare and analyze all associated samples if holding time remains. Discuss qualification with client.		Accuracy/ Bias	Contains all target analytes. Percent recoveries must meet the control limits listed in Worksheet #15-8
MS/MSD		Contains all target analytes. For matrix evaluation only. Percent recoveries must meet the LCS limits.	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.		Precision / Accuracy / Bias	Contains all target analytes. For matrix evaluation only. Percent recoveries must meet the LCS limits.

SAP Worksheet #28-9—Laboratory QC Samples Table (continued)

Matrix: SS, SB, SD, SMI
Analytical Group: EXPLO
Analytical Method / SOP Reference: SW-846 8330B, 6850, USATHAMA/353.2/353.3 / 00055, KNITRO-C-S, HPLC05

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Nitrocellulose by USATHAMA/353.2/353.3						
Method Blank	One is performed for each batch of up to 20 samples.	Target analytes must be < ½ LOQ or < 1/10 the concentration found in the sample or < 1/10th the regulatory limit. Blank results must not otherwise affect sample results.	Correct the problem, then see DoD QSM v4.2 Box D-1. If required, reprep and reanalyze the method blank and all samples processed with the contaminated blank.	Analyst/ Laboratory Area Supervisor	Contamination/ Bias	Target analytes must be < ½ LOQ or < 1/10 the concentration found in the sample or < 1/10th the regulatory limit. Blank results must not otherwise affect sample results.
LCS		Contains all target analytes. Percent recoveries must meet the control limits listed in Worksheet #15-8	Re-prepare and analyze all associated samples if holding time remains. Discuss qualification with client.		Accuracy/ Bias	Contains all target analytes. Percent recoveries must meet the control limits listed in Worksheet #15-8
MS, Sample Duplicate		Contains all target analytes. For matrix evaluation only. Percent recoveries must meet the LCS limits.	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.		Precision / Accuracy / Bias	Contains all target analytes. For matrix evaluation only. Percent recoveries must meet the LCS limits.
Perchlorate by SW-846 6850						
Isotope ratio	Each sample, QC sample, and standard	Monitor for either the parent ion at masses 99/101 or the daughter ion at masses 83/85. Must fall within 2.3 - 3.8	Re-extract using cleanup procedures or alternate techniques to confirm the presence of perchlorate such as post spikes or dilutions to reduce interference.	Analyst, Laboratory Supervisor	Precision / Accuracy / Bias	Monitor for either the parent ion at masses 99/101 or the daughter ion at masses 83/85. Must fall within 2.3 - 3.8
IS	One per sample	Relative retention times for internal standard must be 0.98-1.02 and the responses within ± 50% of the average response of the ICAL.	Reanalyze samples at increasing dilutions until the ± 50% criteria can be met		Precision / Accuracy / Bias	Relative retention times for internal standard must be 0.98-1.02 and the responses within ± 50% of the average response of the ICAL.
ICS	One is performed for each batch of up to 20 samples. Must undergo the same preparation and pretreatment steps as the samples in the batch, It verifies the method performance at the matrix conductivity threshold. At least one ICS must be analyzed daily.	Within 30% of true value	Correct problem and then reanalyze all samples in that batch. If poor recovery from the cleanup filters is suspected, a different lot of filters must be used to re-extract all samples in the batch. If column degradation is suspected, a new column must be calibrated before the samples can be reanalyzed.		Precision / Accuracy / Bias	Within 30% of true value
Lab reagent blank	Prior to calibration, after samples with over range concentration of perchlorate, and at the end of the analytical sequence.	No perchlorate > 1/2 LOQ	Reanalyze reagent blank (until no carryover is observed) and all samples processed since the contaminated blank.		Bias / Contamination	No perchlorate > 1/2 LOQ

SAP Worksheet #28-9—Laboratory QC Samples Table (continued)

Matrix: SS, SB, SD, SMI
Analytical Group: EXPLO
Analytical Method / SOP Reference: SW-846 8330B, 6850, USATHAMA/353.2/353.3 / 00055, KNITRO-C-S, HPLC05

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Method blank	One is performed for each batch of up to 20 samples	Target analytes must be < ½ LOQ or < 1/10 the concentration found in the sample or < 1/10th the regulatory limit. Blank results must not otherwise affect sample results.	Re-clean, retest, re-extract, reanalyze, and/or qualify data		Bias / Contamination	Target analytes must be < ½ LOQ or < 1/10 the concentration found in the sample or < 1/10th the regulatory limit. Blank results must not otherwise affect sample results.
LCS		Contains all target analytes. Percent recoveries must meet the control limits listed in Worksheet #15-8	Evaluate and re-prepare/ reanalyze the LCS and associated samples.		Precision / Accuracy / Bias	Contains all target analytes. Percent recoveries must meet the control limits listed in Worksheet #15-8
MS/MSD		Contains all target analytes. Percent recoveries must meet the control limits listed in Worksheet #15-8	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.		Precision / Accuracy / Bias	Contains all target analytes. Percent recoveries must meet the control limits listed in Worksheet #15-8
Preparation for SMI (does not apply to SS, SB, or SD samples)						
Soil drying procedure	Each sample and batch LCS	Laboratory must have a procedure to determine when the sample is dry to constant weight. Record date, time, and ambient temperature on a daily basis while drying samples.	N/A	Analyst	Accuracy	N/A
Soil sieving procedure		Weigh entire sample. Sieve entire sample with a 10 mesh sieve. Breakup pieces of soil (especially clay) using gloved hands. Do not intentionally include vegetation in the portion of the sample that passes through the sieve unless it is a project specific requirement. Collect and weigh any portion unable to pass through the sieve.	N/A	Analyst	Accuracy	N/A
Soil grinding procedure (for EXPLO only)	Initial demonstration	The laboratory must initially demonstrate that the grinding procedure is capable of reducing the particle size to < 75 um by passing representative portions of ground samples through a 200-mesh sieve (ASTM E11).	N/A	Analyst	Accuracy	N/A

SAP Worksheet #28-9—Laboratory QC Samples Table (continued)

Matrix: SS, SB, SD, SMI
Analytical Group: EXPLO
Analytical Method / SOP Reference: SW-846 8330B, 6850, USATHAMA/353.2/353.3 / 00055, KNITRO-C-S, HPLC05

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Soil grinding blank (for EXPLO only)	Between each sample	A grinding blank using clean solid matrix (such as clean Ottawa sand) must be prepared (ground and subsampled) and analyzed in the same manner as a field sample. Grinding blanks can be analyzed individually or composited. No target analytes detected greater than 1/2 LOQ	All blank results must be reported and the affected samples must be flagged accordingly if blank criteria are not met. If the composite grinding blank exceeds the acceptance criteria, apply a B flag to all samples associated with the grinding composite. If any individual grinding blank is found to exceed the acceptance criteria, apply a B flag to the sample following that blank.	Analyst	Accuracy/ Bias, Contamination	A grinding blank using clean solid matrix (such as clean Ottawa sand) must be prepared (ground and subsampled) and analyzed in the same manner as a field sample. Grinding blanks can be analyzed individually or composited. No target analytes detected greater than 1/2 LOQ
Soil sample laboratory triplicate	At the subsampling step, one sample per batch. Cannot be performed on any type of blank sample.	Three 10 gram subsamples are taken from a sample expected to contain the highest levels of explosives within the quantitation range of the method. The RSD for results about the RL must not exceed 20%.	Corrective action must be taken if this criterion is not met, the grinding process should be investigated to ensure the samples are being reduced to a sufficiently small particle size. Apply a J flag if the CA does not solve the problem and no sample is available.	Analyst	Accuracy	Three 10 gram subsamples are taken from a sample expected to contain the highest levels of explosives within the quantitation range of the method. The RSD for results about the RL must not exceed 20%.
Soil subsampling process	Each sample, duplicate, and batch LCS.	Metals samples will be subsampled prior to grinding. Entire ground sample is mixed, spread out on a large flat surface (e.g., baking tray), and 30 or more randomly located increments are removed from the entire depth to sum a ~10 g subsample.	N/A	Analyst	Accuracy	N/A

[1]DoD QSM v. 4.2 is the basis for specifications for Explosives by 8330B and perchlorate. In-house laboratory limits were applied for nitrocellulose and nitroguanidine.

SAP Worksheet #28-10—Laboratory QC Samples Table

Matrix: SS, SB, SD

Analytical Group: WCHEM (pH and TOC)

Analytical Method / SOP Reference: SW-846 9045C, Lloyd Kahn / 00083, 100.0410

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
pH (SW-846 9045C)						
LCS	One per batch of 20or fewer samples	90-110% recovery	Correct problem, recalibrate	Analyst, Laboratory Supervisor	Accuracy, Bias	90-110% recovery
Laboratory replicate	One laboratory replicate per every 10 field samples	RPD ≤20%	(1) Investigate problem and reanalyze sample in duplicate. (2) If RPD is still unacceptable, report original result with notation or narration.	Analyst, Laboratory Supervisor	Precision	RPD <20%
TOC (Lloyd Kahn)						
Method Blank	One per prep batch	No analyte detected > 1/2 LOQ	Investigate source of contamination. Evaluate the samples and associated QC: i.e. If the blank results are above the PQL, report sample results which are <PQL or > 10X the blank concentration. Otherwise, reprep a blank and the remaining samples.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias, Contamination	No analyte detected > 1/2 LOQ
Laboratory replicate	One laboratory replicate per 20 samples	RPD < 20%	If lab QC in criteria and matrix interference suspected, flag data. Else, reanalyze.	Analyst, Laboratory Department Manager and Data Validator	Precision	RPD < 20%
MS	One MS per 10 samples	75-125% recovery	If LCS in criteria and matrix interference suspected, flag data. Else, reanalyze.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	75-125% recovery
LCS	One LCS per prep batch	80-120% recovery	Investigate source of problem. If the LCS recovery is high but the sample results are <QL, narrate. Otherwise, reprep a blank and the remaining samples.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	80-120% recovery

[1]In-house laboratory limits were the basis for measurement performance criteria.

SAP Worksheet #29—Project Documents and Records Table

Document	Where Maintained
Field Notebooks	Electronic .pdf copies in the project file. Hardcopy (bound notebook) in the project file. Archived at project closeout.
Chain-of-Custody Records	Electronic .pdf copies in the project file. Hardcopy in the data validation report. 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.
PID/Flame ionization detector readings	Recorded in Field Notebook. Stored in Data Warehouse
Water quality parameters collected during groundwater sampling	Recorded in Field Notebook. Stored in Data Warehouse
organic vapor monitor/organic vapor analyzer readings	Recorded in Field Notebook. Stored in Data Warehouse
Various field measurements	Recorded in Field Notebook.
All field equipment calibration information	Recorded in Field Notebook.
Pertinent telephone conversations	Recorded in Field Notebook.
Field equipment maintenance records	Inspected by Field Team Leader. 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	Kept on file at the laboratory. Not maintained.
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/Cleanup 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.

In general, documents are stored at a CH2M HILL project office until they are archived.

<u>CH2M HILL Project Office:</u>

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SAP Worksheet #30– Analytical Services Table

Matrix	Analytical Group	Sample Locations/ ID Number	Analytical Method	Data Package Turnaround Time	Laboratory / Organization[1] (name and address, contact person, and telephone number)	Backup Laboratory / Organization (name and address, contact person, and telephone number)
GW	VOC	10	VOCs by SW-846 8260B	28 Calendar Days	Spectrum Analytical, Inc. 8405 Benjamin Road, Suite A Tampa, FL 33634 Mr. John Heyman (813) 888-9507	TBD
	SVOC		SVOCs by SW-846 8270D and 8270D_SIM			
	METAL		Mercury by SW-846 7470A Cyanide by SW-846 9012B			
			METALs by SW-846 6020A		Spectrum Analytical, Inc. 175 Metro Center Boulevard Warwick, RI 02886-1755 Mr. Ed Lawler (401) 732-3400	
	FMETAL		FMETALs by SW-846 6020A			
			Filtered Mercury by SW-846 7470A		Spectrum Analytical-Tampa	
	EXPLO		EXPLOs (incl. Nitroglycerin and PETN) by SW-846 8330B			
			Nitrocellulose by EPA USATHAMA/353.2/353.3		Microbac Laboratories, Inc. 158 Starlite Drive Marietta, OH 45750 Ms. Kathy Albertson (740) 373-4071	
			Nitroguanidine by SW846 8330B		Spectrum Analytical-Tampa	
			Perchlorate by SW-846 6850		Empirical Laboratories, LLC 621 Mainstream Drive, Suite 270 Nashville, TN 37228 Ms. Sonya Gordon (615) 345-1115	
	WCHEM		Hardness by SM2340B		Spectrum Analytical-Rhode Island	
SS, SB, SD	VOC	50 (23 SS, 23 SB, and 4 SD)	VOCs by SW-846 8260B	28 Calendar Days	Spectrum Analytical-Tampa	TBD
	SVOC		SVOCs by SW-846 8270D and 8270D_SIM			
	METAL		Mercury by SW-846 7471A Cyanide by SW-846 9012B			
			METALs by SW-846 6020A		Spectrum Analytical-Rhode Island	
	EXPLO		EXPLOs (incl. Nitroglycerin and PETN) by SW-846 8330B		Spectrum Analytical-Tampa	
			Nitrocellulose by EPA USATHAMA/353.2/353.3		Microbac Laboratories, Inc.	
			Nitroguanidine by SW846 8330B		Spectrum Analytical-Tampa	
			Perchlorate by SW-846 6850		Empirical Laboratories, LLC	
	WCHEM		pH by SW-846 9045C		Spectrum Analytical-Tampa	
			TOC by Lloyd Kahn		Spectrum Analytical-Rhode Island	

SAP Worksheet #30– Analytical Services Table (continued)

<table>
<tr><th>Matrix</th><th>Analytical Group</th><th>Sample Locations/ ID Number</th><th>Analytical Method</th><th>Data Package Turnaround Time</th><th>Laboratory / Organization[1] (name and address, contact person, and telephone number)</th><th>Backup Laboratory / Organization (name and address, contact person, and telephone number)</th></tr>
<tr><td rowspan="6">SMI</td><td rowspan="2">METAL</td><td rowspan="6">1</td><td>METALs by SW-846 6020A</td><td rowspan="6">28 Calendar Days</td><td>Spectrum Analytical-Rhode Island</td><td rowspan="6">TBD</td></tr>
<tr><td>Mercury by SW-846 7471A
Cyanide by SW-846 9012B</td><td rowspan="3">Spectrum Analytical-Tampa</td></tr>
<tr><td rowspan="4">EXPLO</td><td>EXPLOs (incl. Nitroglycerin and PETN) by SW-846 8330B</td></tr>
<tr><td>Nitroguanidine by SW846 8330B</td></tr>
<tr><td>Nitrocellulose by EPA USATHAMA/353.2/353.3</td><td>Microbac Laboratories, Inc.</td></tr>
<tr><td>Perchlorate by SW-846 6850</td><td>Empirical Laboratories, LLC</td></tr>
</table>

[1]If the laboratory is not known at time of SAP submission, put "TBD" in the column as a placeholder.

SAP Worksheet #31—Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing CAs	Person(s) Responsible for Monitoring Effectiveness of CAs
Offsite Laboratory Technical Systems Audit	Laboratory must have current DoD Environmental Laboratory Accreditation (ELAP) program letter, which will identify the expiration date. The laboratory must be re-evaluated prior to expiration.	External	DOD ELAP Accrediting Body (TBD)	DOD ELAP Accrediting Body (TBD)	Respective Laboratory QA Officer	Respective Laboratory QA Officer	Respective Laboratory QA Officer
Project Chemist Review of DoD ELAP Accreditation Letter and Laboratory SOPs	Once at project startup (laboratory procurement process) to review laboratory SOPs to ensure project goals can be met and that the laboratory will remain accredited throughout the expected timeframe.	Internal	CH2M HILL	Juan Acaron/ CH2M HILL	Juan Acaron/ CH2M HILL	Juan Acaron/ CH2M HILL	Anita Dodson/ CH2M HILL

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SAP Worksheet #32—Assessment Findings and CA Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of CA Response Documentation	Individual(s) Receiving CA Response	Timeframe for Response
Field Performance Audit	Checklist and Written Audit Report	Victoria Waranoski, PM/CH2M HILL	Within 1 week of audit	Memorandum	TBD, FTL/CH2M HILL Brett Doerr, QAM/CH2M HILL	Within 1 week of receipt of CA form
Offsite Laboratory Technical Systems Audit	Written Audit Report	Respective Laboratory QA Officer	Within 2 months of audit	Memorandum	DOD ELAP Accrediting Body (TBD)	Within 2 months of receipt of initial notification.
Project Chemist Review of DoD ELAP Accreditation Letter	Email from project chemist to laboratory QA Officer	TBD	Immediately	Email	Juan Acaron/CH2M HILL Anita Dodson/CH2M HILL	Immediately

Worksheet #32-1—Laboratory Corrective Action Form

Person initiating corrective action ________________________________ **Date** ______________

Description of problem and when identified: ____

____

____

____

Cause of problem, if known or suspected: ____

____

____

____

<u>Sequence of Corrective Action (CA):</u> (including date implemented, action planned and personnel/data affected)

____

____

____

____

____

____

____

CA implemented by: ____________________________________ **Date:** ______________

CA initially approved by: ________________________________ **Date:** ______________

Follow-up date: ____

Final CA approved by: ____________________________ **Date:** _______________

Information copies to:

____

____

____

____

Worksheet #32-2—Field Performance Audit Checklist

Project Responsibilities

Project No.: ____________ Date: ____________________________________

Project Location: __________ Signature: _________________________________

Team Members:

Yes _ No _ 1) Is the approved work plan being followed?
Comments ____

____

Yes _ No _ 2) Was a briefing held for project participants?
Comments ____

____

Yes _ No _ 3) Were additional instructions given to project participants?
Comments ____

____

Sample Collection

Yes _ No _ 1) Is there a written list of sampling locations and descriptions?
Comments ____

____

Yes _ No _ 2) Are samples collected as stated in the Master SOPs?
Comments ____

____

Yes _ No _ 3) Are samples collected in the type of containers specified in the work plan?
Comments ____

____

Yes _ No _ 4) Are samples preserved as specified in the work plan?
Comments ____

____

Worksheet #32-2—Field Performance Audit Checklist (continued)

Yes _ No _ 5) Are the number, frequency, and type of samples collected as specified in the work plan?
Comments ____

____

Yes _ No _ 6) Are quality assurance checks performed as specified in the work plan?
Comments ____

____

Yes _ No _ 7) Are photographs taken and documented?
Comments ____

____

Document Control

Yes _ No _ 1) Have any accountable documents been lost?
Comments ____

____

Yes _ No _ 2) Have any accountable documents been voided?
Comments ____

____

Yes _ No _ 3) Have any accountable documents been disposed of?
Comments ____

Yes _ No _ 4) Are the samples identified with sample tags?
Comments ____

____

Yes _ No _ 5) Are blank and duplicate samples properly identified?
Comments ____

____

Yes _ No _ 6) Are samples listed on a chain-of-custody record?
Comments ____

____

Worksheet #32-2—Field Performance Audit Checklist (continued)

Yes _ No _ 7) Is chain-of-custody documented and maintained?

Comments ____

____

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SAP Worksheet #33—QA Management Reports Table

Type of Report	Frequency	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation	Report Recipient(s)
Field Progress Report(s)	Daily	Week of daily reporting will be submitted to Navy POC the following Monday.	Site Superintendent	Report(s) will be included as an Attachment to the RI report. RI report distribution will include the Navy, EPA, and MDE.
Data Usability Assessment report	Once after all data are generated and validated	Submitted with final reports	Juan Acaron, Project Chemist/ CH2M HILL	Report(s) will be included as an Attachment to the RI report. RI report distribution will include the Navy, EPA, and MDE.
RI Report	Once results are received from data validator	2012	NSF-IH STTP Team, CH2M HILL	Will be provided to the IHIRT and posted in CH2M HILL project file.

Data Validation:

- Performed by CH2M HILL
- Provide a data validation narrative

The following will be addressed in the QA/QC section of RI report:

- Summary of project QA/QC programs and training
- Conformance of project activities to SAP requirements and procedures
- Status of project and schedule delays
- Deviations from approved SAP and approved amendments to SAP
- Description and findings of audits
- Results of data review activities in terms of amount of usable data generated (results of the Chemist's QC check on data prior to loading into database)
- Required CAs and effectiveness of CA implementation
- Data usability assessments in terms of accuracy, precision, representativeness, completeness, comparability and sensitivity
- Limitations on use of measurement data generated

The report will also address data quality concerns:

- Narrative and timelines of project activities summary of PQO development
- Reconciliation of project data with PQOs
- Summary of major problems encountered and their resolution
- Data summary, including tables, charts, graphs, with appropriate sample identification or station location numbers, concentration units, percent solids (not applicable), and data quality flags
- Conclusions and recommendations

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SAP Worksheets #34-36–Data Verification and Validation (Steps I and IIa/IIb) Process Table

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
Step 1			
Field Notebooks	Field notebooks will be reviewed internally and placed into the project file for archival at project closeout.	Internal	FTL (TBD)/CH2M HILL
COC and Shipping Forms	COC forms and shipping documentation will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the COC will be initialed by the reviewer, a copy of the COC retained in the site file, and the original and remaining copies taped inside the cooler for shipment.	Internal / External	FTL(TBD)/CH2M HILL PDM: Hillary Ott/CH2M HILL
Sample Condition upon Receipt	Any discrepancies, missing, or broken containers will be communicated to the PDM in the form of laboratory logins.	External	PDM: Hillary Ott/CH2M HILL
Documentation of Laboratory Method Deviations	Laboratory method deviations will be discussed and approved by the Project Chemist. Documentation will be incorporated into the case narrative which becomes part of the final hardcopy data package.	Internal / External	Project Chemist: Juan Acaron/CH2M HILL
Electronic Data Deliverables	Electronic data deliverables will be compared against hardcopy laboratory results (10% check).	External	PDM: Hillary Ott/CH2M HILL
Case Narrative	Case narratives will be reviewed by the data validator during the data validation process. This is verification that they were generated and are applicable to the data packages.	External	Data Validator: Ward Dickens/CH2M HILL
Laboratory Data	All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal.	Internal	Laboratory QA Officer (Spectrum Analytical-Tampa; Spectrum Analytical-Rhode Island; Empirical Laboratories, LLC; Microbac Laboratories, Inc.)
Laboratory Data	The data will be verified for completeness by a PDM specialist.	External	PDM: Hillary Ott/CH2M HILL
Audit Reports	Upon report completion, a copy of all audit reports will be placed in the site file. If CAs are required, a copy of the documented CA taken will be attached to the appropriate audit report in the QA site file. Periodically, and at the completion of site work, site file audit reports and CA forms will be reviewed internally to ensure that all appropriate CAs have been taken and that CA reports are attached. If CAs have not been taken, the site manager will be notified to ensure action is taken.	Internal	PM: Victoria Waranoski/CH2M HILL Project Chemist: Juan Acaron/CH2M HILL
CA Reports	CA reports will be reviewed by the Project Chemist or PM and placed into the project file for archival at project closeout.	External	PM: Victoria Waranoski/CH2M HILL Project Chemist: Juan Acaron/CH2M HILL

SAP Worksheets #34-36–Data Verification and Validation (Steps I and IIa/IIb) Process Table

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
Step 2a			
Laboratory Methods	Ensure the laboratory analyzed samples using the correct methods.	External	Project Chemist: Juan Acaron/CH2M HILL
TCL and TAL	Ensure the laboratory reported all analytes from each analysis group as per Worksheet #15.	External	Project Chemist: Juan Acaron/CH2M HILL
Reporting Limits	Ensure the laboratory met the project-designated QLs as per Worksheet #15. If QLs were not met, the reason will be identified and documented.	External	Project Chemist: Juan Acaron/CH2M HILL
Laboratory SOPs	Ensure that approved analytical laboratory SOPs were followed.	External	Data Validator: Ward Dickens/CH2M HILL
Step 2b			
Sample Chronology	Holding times from collection to extraction or analysis and from extraction to analysis will be considered by the data validator during the data validation process.	External	Data Validator: Ward Dickens/CH2M HILL
Raw Data	10 percent review of raw data to confirm laboratory calculations.	External	Data Validator: Ward Dickens/CH2M HILL
Onsite Screening	All non-analytical field data will be reviewed against QAPP requirements for completeness and accuracy based on the field calibration records.	Internal	FTL (TBD)
Documentation of Method QC Results	Establish that all required QC samples were run and met limits.	External	Data Validator: Ward Dickens/CH2M HILL
Documentation of field QC Sample Results	Establish that all required QAPP QC samples were run and met limits.	Internal	Project Chemist: Juan Acaron/CH2M HILL Data Validator: Ward Dickens/CH2M HILL
Step 2b: Analytical Data Validation			
METAL or FMETAL	Analytical methods and laboratory SOPs, as presented in this UFP-SAP, will be used to evaluate compliance against QA/QC criteria. QA/QC criteria for field QC samples are presented in Worksheet #12, TALs, LOQs, LODs, DLs, and limits for precision and accuracy are presented in Worksheet #15, QA/QC criteria for calibrations are presented in Worksheet #24, and QA/QC criteria for laboratory QC samples are presented in Worksheet #28. Data may be qualified if QA/QC exceedances have occurred. Data qualifiers will be those presented in *Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses* (EPA Region III, April 1993). Guidance from *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, Rev. Final, October, 2004) may also be applicable.	External	Data Validator: Ward Dickens/CH2M HILL

SAP Worksheets #34-36–Data Verification and Validation (Steps I and IIa/IIb) Process Table

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
VOC, SVOC, or EXPLO	Analytical methods and laboratory SOPs, as presented in this UFP-SAP, will be used to evaluate compliance against QA/QC criteria. QA/QC criteria for field QC samples are presented in Worksheet #12, TCLs, LOQs, LODs, DLs, and limits for precision and accuracy are presented in Worksheet #15, QA/QC criteria for calibrations are presented in Worksheet #24, and QA/QC criteria for laboratory QC samples are presented in Worksheet #28. Data may be qualified if QA/QC exceedances have occurred. Data qualifiers will be those presented in *Region III Modifications to National Functional Guidelines for Organic Data Review* (EPA, September, 1994). Guidance from *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (EPA, October, 1999) may also be applicable.	External	
WCHEM or GRAINSIZE	WCHEM and GRAINSIZE are subject to the verification and validation procedures specified in Worksheets #34 and #35. The case narratives will be read, any issues will be investigated, and the impact (if any) on data quality or data usability will be discussed with the project team.	External	Project Chemist: Juan Acaron/CH2M HILL

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SAP Worksheet #37—Usability Assessment

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

- The data will be evaluated to see if the project-required QLs listed in Worksheet #15 were achieved for non-detected constituents.
- For statistical comparisons, non-detect values will be represented by a concentration equal to one-half the QL. Where duplicates are collected, the greater of the two concentrations will be used.
- The data will not be evaluated for outliers. It is anticipated that the data will have significant variations because of localized sources.
- Analytical data will be checked to ensure that they are accurately transferred to the electronic project database and geographic information system.
- Laboratory and field precision, as computed from duplicate samples will be assessed. These computations will be based on calculation of RPD. RPD = (Difference of two results) / (average of two results) * 100%. Field and laboratory QC limits for precision are defined in Worksheets #12 and #28, respectively.
- Deviations from the procedures outlined in this UFP-SAP will be reviewed to assess whether the deviations were significant enough to compromise the attainment of project objectives.

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

- The validated data will be reconciled with the method performance criteria to assess whether sufficient data of acceptable quality are available for decision making. A series of evaluations and statistical analyses will be performed to estimate the data characteristics. The statistical evaluations will include, for each target constituent or group: maximum concentration, minimum concentration, number of samples with non-detected results, number of samples with positive results, and the proportion of samples with detected and non-detected results
- If an exceedance occurs for lab or field precision (as defined in Worksheets #12 and #28 and as calculated using the formula, above), the cause will be investigated, described, and interpreted for its impact on decision making.
- If significant biases are detected (represented by low or high matrix spike, LCS, or surrogate recoveries), this will be noted and evaluated for impacts on decision making. The tendency will be to emphasize low biases more than high biases unless biased results are near action levels. Low biases will be emphasized more because they are likely to represent an inability to detect compounds that are present at the site and, on a percentage basis, generally represent a greater proportion of the reported values.

Identify the personnel responsible for performing the usability assessment:

- The CH2M HILL PM, Project Chemist, and other CH2M HILL team members will compile project data and make recommendations pertaining to the usability of the data. The data will be provided to the project team for discussion and review, and the project team as a whole will weigh in on the usability of the data.

SAP Worksheet #37—Usability Assessment (continued)

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 will be presented in tabular format in the report. Data qualification such as estimation (J, UJ) or rejection (R) will be presented. Specific qualifiers are defined below. Written documentation will be provided to support any non-compliance, or rejected data results. The project report will identify and describe the data usability limitations and suggest corrective actions.
  - U: Not detected.
  - [CLEAR]: Confirmed identification.
  - R: Unreliable result.
  - N: Tentative identification. Consider present. Special methods may be needed to confirm its presence or absence in future sampling efforts.
  - J: Consider present. Special methods may be needed to confirm its presence or absence in future sampling efforts.
  - K: Consider present. Reported value may be biased high. Actual value is expected to be lower.
  - L: Consider present. Reported value may be biased low. Actual value is expected to be higher.
  - UJ: Not detected. QL may be inaccurate or imprecise.
  - UL: Not detected. QL is probably higher.
  - NJ: Qualitative identification questionable due to poor resolution. Presumptively present at approximate quantity.
  - I: Interferences present that may cause the result to be biased high.
- If verification and validation are not acceptable, the data will be qualified by the validator. The data may be qualified for minor QC deviations that do not affect the data usability (estimated flags such as J, UJ), or the data may be rejected for major QC deviations affecting data usability. The use and implications of estimated data will be discussed in the project report. Rejected data will not be used. The impact of data qualified as rejected due to analytical deficiencies will be discussed with the project team and will be evaluated to determine the need for any CAs. Depending on the analytical deficiency and the intended use of the data, the project team may or may not agree that the data are of sufficient quality to support project decisions. A description of the precision and bias evaluations described above will be included in the field investigation report. This report will include a summary with supporting documentation. Significant deviations or deficiencies will be conveyed to the Navy RPM for consideration.

VBO \\NORTHEND\PROJ\USNAVFACENGCOM\NASPATUXENTRIVER\MAPFILES\380785_UXO20_UFPSAP\FIGURE 1 - FACILITY MAP.MXD BHATHAWA 9/16/2011 3:49:18 PM

Legend

UXO 20 Site Boundary

Installation Boundary

N W E S

0 2,250 4,500 Feet

Imagery Source: Google Earth Pro

Figure 1
Facility Map
UFP-SAP UXO 20 - Safety Thermal Treatment Point Remedial Investigation
NSF-IH, Indian Head, Maryland

CH2MHILL

VBO \\NORTHEND\PROJ\USNAVFACENGCOM\359525INDIANHEAD\MAPFILES\380785_UXO20_UFPSAP\FIGURE 2 - SITE MAP.MXD BHATHAWA 9/16/2011 4:55:22 PM

Legend

UXO 20 Site Boundary (1.64 acres) Identified in the PA

Current UXO 20 Site Boundary (0.97 acres)

N W E S

0 100 200 Feet

Figure 2
Site Map
UFP-SAP UXO 20 - Safety Thermal Treatment Point Remedial Investigation
NSF-IH, Indian Head, Maryland

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LEGEND

- Current UXO 20 Site Boundary (0.97 acres)
- Groundwater Flow Direction
- Open Tank
- Former Burn Chamber
- Steel Deflection Shield
- Concrete Block

NOTES

Figure not to scale.

COPCs: Constituents of Potential Concern

Terrestrial Plants: Exposed to contaminants in soil through root uptake.

Soil Invertebrates: Exposed to contaminants in soil through dermal contact and ingestion.

Current Authorized Navy Personnel (Adult Military and Civilian Site Workers) and Adult Contractors/Adult Visitors: Exposed to COPCs in surface soil, sediment and surface water through incidental ingestion and dermal contact and inhalation of particulate and volatile emissions from soil.

Future Authorized Navy Personnel (Adult Military and Civilian Site Workers) and Adult Contractors/Adult Visitors: Exposed to COPCs in surface, subsurface soil, sediment and surface water through incidental ingestion and dermal contact, in groundwater used as potable water supply through ingestion, dermal contact and inhalation of volatiles while showering, and inhalation of particulate emissions from soil.

Soil Invertebrates: Exposure to contaminants in soil through dermal contact and ingestion

Birds , Mammals, and Reptiles: Exposed to contaminants through bioaccumulation and through incidental ingestion of surface soil.

Semi-Aquatic Birds, Mammals, and Reptiles: Exposed to contaminants through bioaccumulation and through incidental ingestion of surface sediment.

Future Construction Workers and Adult Contractors Who Perform Maintenance Work Along the Shoreline: Exposed to COPCs in surface and subsurface soil through incidental ingestion and dermal contact, inhalation of particulate emissions from soil, and in groundwater during excavation and construction activities through dermal contact and inhalation of volatiles.

Current Adult, Adolescent, and Child Recreational River Users/Trespassers: Exposed to COPCs in surface soil, sediment and surface water through incidental ingestion and dermal contact, and inhalation of particulate and volatile emissions from surface soil.

Future Adult, Adolescent, and Child Recreational River Users/Trespassers: Exposed to COPCs in surface soil, subsurface soil, sediment and surface water through incidental ingestion and dermal contact, and inhalation of particulate and volatile emissons from soil.

Future Adult, Adolescent, and Child Residents: Exposed to COPCs in groundwater used as potable water supply through ingestion, dermal contact and inhalation of volatiles while showering.

Aquatic Receptors: Indirectly exposed to contaminants in groundwater through ingestion of and direct contact with surface water after discharge of groundwater to surface water

Aquatic Plants: Exposed to contaminants in sediment through root uptake.

Benthic Invertebrates, Amphibians, and Reptiles: Exposed to contaminants in sediment and sediment pore water through dermal contact and ingestion.

FIGURE 3
Conceptual Site Model
UFP-SAP UXO-20 – Safety Thermal Treatment Point
Remedial Investigation
NSF-IH, Indian Head, Maryland

CH2MHILL

ES013012182832WDC IH_UXO20_CSM_v7.ai 2-15-12 mlb

VBO \\NORTHEND\PROJ\USNAVFACENGCOM\359525INDIANHEAD\MAPFILES\380785_UXO20_UFPSAP\FIGURE 4 - PROPOSED DISCRETE SAMPLE LOCATIONS.MXD JCROCKET 2/2/2012 4:10:57 PM

Notes:
1. Sample locations may be relocated based on anomaly avoidance and/or field observations.
2. The Phase I RI investigation will take place within the current UXO 20 site boundary as discussed in the text.

Legend
- Sediment Sample
- Discrete Surface/Subsurface Sample
- Discrete Surface/Subsurface Soil and In Situ Groundwater Sample
- Current UXO 20 Site Boundary (0.97 acres)
- Former Burn Chamber
- Open Tank
- Steel Deflection Shield

N W E S

0 50 100 Feet

Figure 4
Proposed Discrete Sample Locations
UFP-SAP UXO 20 - Safety Thermal Treatment Point
Remedial Investigation
NSF-IH, Indian Head, Maryland

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VBO \\NORTHEND\PROJ\USNAVFACENGCOM\359525INDIANHEAD\MAPFILES\380785_UXO20_UFPSAP\FIGURE 5 - PROPOSED SMI SAMPLE LOCATION.MXD BHATHAWA 2/15/2012 11:34:17 AM

Note:
1. Plug locations may be relocated based on anomaly avoidance and/or field observations.
2. The Phase I RI investigation will take place within the current UXO 20 site boundary as discussed in the text.
3. Approximately 30-100 plugs will be collected to a depth of 2 inches below ground surface and composite into 1 MIS soil sample.

Legend

- MIS Plug
- Current UXO 20 Site Boundary (0.97 acres)
- Former Burn Chamber
- Open Tank
- Steel Deflection Shield

N W E S

0 50 100 Feet

Figure 5
Proposed MIS Sample Location
UFP-SAP UXO 20 - Safety Thermal Treatment Point Remedial Investigation
NSF-IH, Indian Head, Maryland

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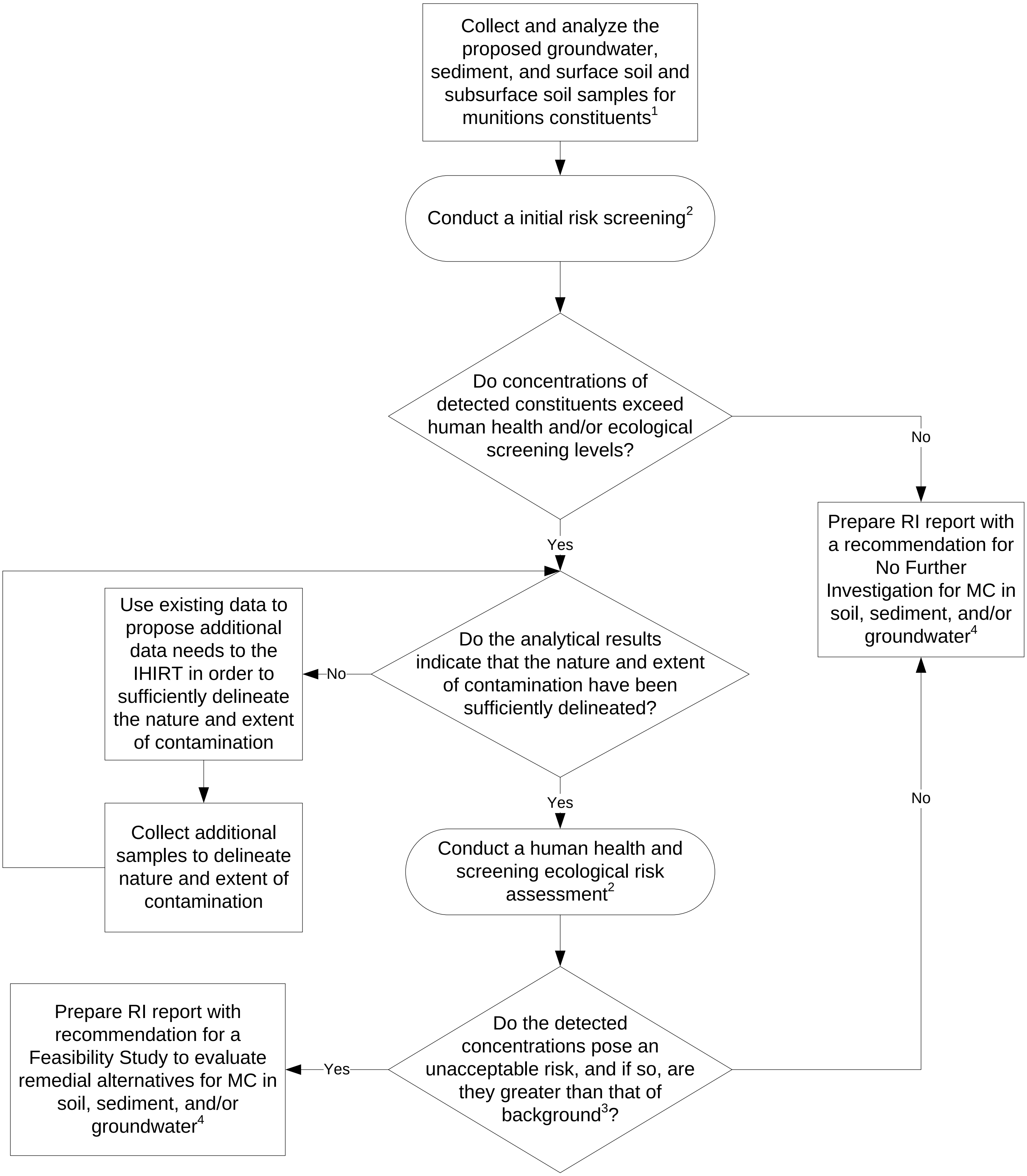

Notes:

[1] Munitions constituents at UXO 20 comprise of TAL metals, TCL VOCs, TCL SVOCs, and explosives (including pentaerythritol tetranitrate, nitroguanidine, nitrocellulose, nitroglycerin, and perchlorate)

[2] The human health and screening ecological risk assessment will not be conducted using the SMI soil sample, which is being collected from the 0 to 2 inch surface soil interval; however, the SMI soil sample results will be used in the human health and/or ecological screening step above to evaluate the presence or absence of site-related contamination in the spits.

[3] The comparison of data to background levels is a secondary evaluation criteria to support risk management decisions. Background values are not used to eliminate COCs during the risk assessment. Background data set generated for soil, groundwater, freshwater sediments, and biota can be found in the *Background Soil Investigation report for Indian Head and Stump Neck Annex; Naval Surface Warfare Center; Indian Head, Maryland* (TtNUS, 2002)

[4] The results of the MEC investigation, documented under a separate work plan, will be taken into account in the RI report and any subsequent action(s) or remedial alternatives generated in a Feasibility Study.

Figure 6
Sampling Decision Tree
UFP-SAP UXO 20 – Safety Thermal Treatment Point Remedial Investigation
NSF-IH, Indian Head, Maryland

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Attachment A
Field Standard Operating Procedures

Locating and Clearing Underground Utilities

I. Purpose

The purpose of this SOP is to provide general guidelines and specific procedures that must be followed on Navy CLEAN projects for locating underground utilities and clearing dig locations in order to maximize our ability to avoid hitting underground utilities and to minimize liabilities to CH2M HILL and its subcontractors and health and safety risks to our project staff.

This SOP shall be used by Activity Managers and Project Managers to, in-turn, develop Activity-specific and project-specific utility location procedures. The activity and project-specific procedures will become part of work plans and project instructions and will be used to prepare scopes of work (SOWs) for the procurement of utility location subcontractors to meet the needs of individual projects.

This SOP also identifies the types of utility locating services that are available from subcontractors and the various tools that are used to locate utilities, and discusses when each type of service and tool may or may not be applicable.

II. Scope

Depending on the Navy/Marine Activity we typically find ourselves in one of two scenarios:

Scenario 1

The Activity provides utility locating (or dig clearance) services through the public works department or similar organization, or has a contract with an outside utility clearance service. Some of these services are provided in the form of dig permits which are required before you can dig or drill. In other cases no official permit is required and the process is somewhat vague.

Scenario 2

The Activity does not get involved in any utility locating processes aside from possibly providing the most recent utility maps, and relies on CH2M HILL to clear the dig locations.

Table 1 provides an up to date summary of which scenarios apply to the various primary Activities served under the Navy CLEAN program.

Scenario 1 is preferred because under this scenario the Navy tends to assume the responsibility if the location is improperly cleared, a utility is struck, and property damage results. However, our experience has been that the clearance services provided by the Navy do not meet the standards that we consider to be adequate, in that they often simply rely on available base maps to mark utilities and do not verify locations using field geophysics. And if they do use locating tools, they do not provide adequate documentation or marking to confirm that a location has been cleared. So while the Navy's process may protect us from liability for property damage, it does not adequately protect our staff and subcontractors from health risks nor does it compensate us for down time, should a utility be hit.

Therefore, regardless of what services the Navy provides, in most cases we still need to supplement this effort with clearance services from our own third party utility location subcontractor following the procedures and guideline outlined in Section IV of this SOP. The cost implications of providing this service will range from $500 to several $1,000 depending on the size of the project.

The scope of services that we ask our subcontractors to provide can involve utility marking/mapping or the clearing of individual dig locations. In the former we ask our subs to mark all utilities within a "site" and often ask them to prepare a map based on their work. In the later, we ask them to clear (identify if there are any utilities within) a certain radius of a proposed dig/drill location.

The appropriate requested scope of services for a project will depend on the project. Clearing individual boreholes is often less expensive and allows the sub to concentrate their efforts on a limited area. However if the scope of the investigation is fluid (all borehole locations are not predetermined) it may be best to mark and map an entire site or keep the subcontractor on call.

Clearance of individual dig locations should be done to a minimum 20 foot radius around the location.

An example SOW for a utility subcontractor procurement is provided in Attachment A.

III. Services and Equipment

This section provides a general description of the services available to help us locate subsurface utilities and describes the types of equipment that these services may (or may not) use to perform their work. It identifies the capabilities of each type of equipment to help the PM specify what they should require from our utility location subs.

Services

The services that are available to us for identifying and marking underground utilities are:

- The local public/private utility-run service such as Miss Utility
- Utility location subcontractors (hired by us)

Attachment B provides a detailed description of each type of organization. It also provides contact numbers and web sites for the various Miss-Utility-type organizations in the areas where we do work for the Navy and contacts and services provided by several subcontractors that we have used or spoken to in the past.

Equipment

Attachment C provides a summary of the various types of equipment used for subsurface utility location. It describes the capabilities and limitations of each in order to help the PM determine if the equipment being used by a subcontractor is adequate.

It is important to make the potential subcontractors aware of the possible types of utilities (and utility materials) that are at the site, and to have them explain in their bid what types of equipment they will use to locate utilities /clear dig locations, and what the limitations of these equipment are.

A list of in-house experts that can be used to help you evaluate bids or answer questions you may have is provided in Appendix C.

IV. Procedures and Guidelines

This section presents specific procedures to be followed for the utility location work to be conducted by CH2M HILL and our subcontractors. In addition, a PM will have to follow the procedures required by the Activity to obtain their approvals, clearances and dig permits where necessary. These "dig permit" requirements vary by Activity and must be added to the project-specific SOP, or project instructions. It is preferable that the Activity perform their clearance processes before we follow up with our clearance work.

Activity Notification and Dig Permit Procedures

Identify Activity-specific permit and/or procedural requirements for excavation and drilling activities. Contact the Base Civil Engineer and obtain the appropriate form to begin the clearance process.

Activity Specific: To be provided by Activity or Project Manager

CH2M HILL Utility Clearance Procedures

Do not begin subsurface construction activities (e.g., trenching, excavation, drilling, etc.) until a check for underground utilities and similar obstructions has been conducted by CH2M HILL as a follow-up to the services provided by the Navy. 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 (subcontracted to CH2M HILL) to identify additional and undiscovered buried utilities.

Examples of the type of geophysical technologies include (these are further described in Attachment C):

- **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, soil conditions, etc.
- **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 mm iron disk to a depth of about one meter or a 25 mm steel paper clip to a depth of about 20 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.

The following procedures shall be used to identify and mark underground utilities during subsurface construction activities on the project:

- Contact utility companies or the state/regional utility protection service (such as Miss Utility) at least two (2) working days prior to intrusive 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: this is a law. These services will only mark the location of public-utility-owned lines and not Navy-owned utilities. In many cases there will not be any public-utility-owned lines on the Activity. There may also be Base-access issues to overcome.
- Procure and schedule the independent survey.
- The survey contractor shall determine the most appropriate geophysical technique or combinations of techniques to identify the buried utilities on the project site, based on the survey contractor's experience and expertise, types of utilities anticipated to be present and specific site conditions. ***The types of utilities must be provided to the bidding subcontractors in the SOW and procedures to be used must be specified by the bidder in their bid. It is extremely helpful to provide the sub with utility maps, with the caveat that all utilities are not necessarily depicted.***
- The survey subcontractor shall employ the same geophysical techniques used to identify the buried utilities, to survey the proposed path of subsurface investigation/construction work to confirm no buried utilities are present.
- Obtain utility clearances for subsurface work on both public and private property.
- Clearances provided by both the "Miss Utility" service and the CH2M HILL-subcontracted service are to be in writing, signed by the party conducting the clearance. The Miss Utility service will have standard notification forms/letters which typically simply state that they have been to the site and have done their work. The CH2M HILL subcontractor shall be required to fill out the form provided in Attachment D (this can be modified for a particular project) indicating that each dig/drill location has been addressed. ***This documentation requirement (with a copy of the form) needs to be provided in the subcontractor SOW.***

- Marking shall be done using the color coding presented in Attachment E. The type of material used for marking must be approved by the Activity prior to marking. Some base commanders have particular issues with persistent spray paint on their sidewalks and streets. ***Any particular marking requirements need to be provided in the subcontractor SOW.***
- 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 Project Manager must notify the utility company or utility protection service to inform them that the markings have been destroyed.
- Perform a field check prior to drilling/digging (preferably while the utility location sub is still at the site) to see if field utility markings coincide with locations on utility maps. Look for fire hydrants, valves, manholes, light poles, lighted signs, etc to see if they coincide with utilities identified by the subcontractor.
- Underground utility locations must be physically verified (or dig locations must be physically cleared) by hand digging using wood or fiberglass-handled tools, air knifing, or by some other acceptable means approved by CH2M HILL, when the dig location (e.g. mechanical drilling, excavating) is expected to be within 5 feet of a marked underground system. Hand clearance shall be done to a depth of four feet unless a utility cross-section is available that indicates the utility is at a greater depth. In that event, the hand clearance shall proceed until the documented depth of the utility is reached.
- Conduct a site briefing for employees at the start of the intrusive work 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.
- Monitor for signs of utilities during advancement of intrusive work (e.g., sudden change in advancement of auger or split spoon during drilling or change in color, texture or density during excavation that could indicate the ground has been previously disturbed).

IV. Attachments

A- Example SOW for Utility Location Subcontractor Procurement
B - Services Available for Identifying and Marking Underground Utilities
C – Equipment Used for Identifying Underground Utilities
D – Utility Clearance Documentation Form
E – Utility Marking Color Codes

Attachment A – Example SOW for Subcontracting Underground Utilities Locating Services

CTO-XXX

Scope of Work

Subsurface Utility Locating

Site XX

Navy Activity

City, State

A licensed and insured utility locator will be subcontracted to identify and mark out subsurface utilities for an environmental investigation/remediation project at Site XX of <<insert name of base, city, and state>>. The subcontractor will need to be available beginning at <<insert time>> on <<insert date>>. It is estimated that the work can be completed within XX days.

Proposed Scope of Work

The subcontractor will identify and mark all subsurface utilities (CHOOSE 1) that lie within a radius of 20 feet of each of XX sampling locations at Site XX shown on the attached Figure 1; (OR) that lie within the bounds of Site XX as delineated on the attached Figure 1. (If multiple sites are to be cleared, provide maps of each site with sample locations or clearance boundaries clearly delineated and a scale provided.)

Utilities will be identified using all reasonably available as-built drawings, electronic locating devices, and any other means necessary to maintain the safety of drilling and sampling personnel and the protection of the base infrastructure. The location of utilities identified from as-built drawings or other maps must be verified in the field prior to marking.

Base utility drawings for the Site(s) (CHOOSE 1) can be found at <<insert specific department and address or phone number on the base>> and should be reviewed by the subcontractor and referenced as part of the utility locating. (OR), will be provided to the subcontractor by CH2M HILL upon the award of the subcontract. (OR), are not available. Utility drawings shall not be considered definitive and must be field verified.

Field verification will include detection using nonintrusive subsurface detection equipment (magnetometers, GPR, etc) as well as opening manhole covers to verify pipe directions. As part of the bid, the Subcontractor shall provide a list of the various subsurface investigation tools they propose to have available and use at the site and what the limitations are of each tool.

A CH2M HILL representative shall be present to coordinate utility clearance activities and identify points and features to be cleared.

Field Marking and Documentation

All utilities located within (CHOOSE 1) a 20-ft radius of the XX proposed soil boring locations (OR) within the boundary of the site(s) as identified on the attached figure(s) will be marked using paint (some Bases such as the WNY may have restrictions on the use of permanent paint) and/or pin flags color coded to indicate electricity, gas, water, steam, telephone, TV cable, fiber optic, sewer, etc. The color coding shall match the industry standard as described on the attached form. In addition, the Buried Utility Location Tracking Form (attached) will be completed by the Subcontractor based upon what is identified in the field during the utility locating and submitted back to CH2M HILL (field staff or project manager) within 24 hours of completing the utility locating activities.

(OPTIONAL) ***The subcontractor shall also provide a map (or hand sketch) of the identified utilities to the Engineer within XX days of field demobilization. The map shall include coordinates or ties from fixed surface features to each identified subsurface utility.***

Bid Sheet/Payment Units

The subcontractor will bid on a time and materials basis for time spent on site and researching utility maps. Mobilization (including daily travel to the site) should be bid as a lump sum, as well as the preparation of the AHA and any required mapping. The per diem line item should be used if the field crew will require overnight accommodations at the project site.

Health and Safety Requirements

The utility locating subcontractor is to provide and assume responsibility for an adequate corporate Health and Safety Plan for onsite personnel. Standard personal safety equipment including: hard hat, safety glasses, steel-toed boots, gloves are recommended for all project activities. Specific health and safety requirements will be established by the Subcontractor for each project. The health and safety requirements will be subject to the review of CH2M HILL.

The subcontractor shall also prepare and provide to the Engineer, at least 48 hours prior to mobilization, an acceptable Activity Hazard Analysis (AHA) using the attached AHA form or similar.

It is also required that all subcontractor personnel who will be on site attend the daily 15-minute health and safety tailgate meeting at the start of each day in the field.

Subcontractor personnel showing indications of being under the influence of alcohol or illegal drugs will be sent off the job site and their employers will be notified. Subcontractor personnel under the influence of prescription or over-the-counter medication that may impair their ability to operate equipment will not be permitted to do so. It is expected that the subcontractor will assign them other work and provide a capable replacement (if necessary) to operate the equipment to continue work.

Security

The work will be performed on US Navy property. CH2M HILL will identify the Subcontractor personnel who will perform the work to the appropriate Navy facility point-of-contact, and will identify the Navy point-of-contact to the Subcontractor crew. The Subcontractor bears final responsibility for coordinating access of his personnel onto Navy property to perform required work. This responsibility includes arranging logistics and providing to CH2M HILL, in advance or at time of entry as specified, any required identification information for the Subcontractor personnel. Specifically, the following information should be submitted with the bid package for all personnel that will perform the work in question (this information is required to obtain a base pass):

- Name
- Birth Place
- Birth Date
- Social Security Number
- Drivers License State and Number
- Citizenship

Please be advised that no weapons, alcohol, or drugs will be permitted on the Navy facility at any time. If any such items are found, they will be confiscated, and the Subcontractor will be dismissed.

Quality Assurance

The Subcontractor will be licensed and insured to operate in the State of <<state>> and will comply with all applicable federal, state, county and local laws and regulations. The subcontractor will maintain, calibrate, and operate all electronic locating instruments in accordance with the manufacturer's recommendations. Additionally, the Subcontractor shall make all reasonable efforts to review as-built engineering drawings maintained by Base personnel, and shall notify the CH2M HILL Project Manager in writing (email is acceptable) whenever such documentation was not available or could not be reviewed.

Subcontractor Standby Time

At certain periods during the utility locating activities, the Subcontractor's personnel may be asked to stop work and standby when work may normally occur. During such times, the Subcontractor will cease activities until directed by the CH2M HILL representative to resume operations. Subcontractor standby time also will include potential delays caused by the CH2M HILL representative not arriving at the site by the agreed-upon meeting time for start of the work day. Standby will be paid to the

Subcontractor at the hourly rate specified in the Subcontractor's Bid Form attached to these specifications.

Cumulative Subcontractor standby will be accrued in increments no shorter than 15 minutes (i.e., an individual standby episode of less than 15 minutes is not chargeable).

During periods for which standby time is paid, the surveying equipment will not be demobilized and the team will remain at the site. At the conclusion of each day, the daily logs for the Subcontractor and CH2M HILL representative will indicate the amount of standby time incurred by the Subcontractor, if any. Payment will be made only for standby time recorded on CH2M HILL's daily logs.

Down Time

Should equipment furnished by the Subcontractor malfunction, preventing the effective and efficient prosecution of the work, or inclement weather conditions prevent safe and effective work from occurring, down time will be indicated in the Subcontractor's and CH2M Hill representative's daily logs. No payment will be made for down time.

Schedule

It is anticipated that the subsurface utility locating activities will occur on <<insert date>>. It is estimated that the above scope will be completed within XXX days.

Attachment B - Services Available for Identifying and Marking Underground Utilities

The services that are available to us for identifying and marking underground utilities are:

- The Activity's PWC (or similar organization)
- The local public/private utility -run service such as Miss Utility
- Utility location subcontractors (hired by CH2M HILL)

Each are discussed below.

Navy Public Works Department

A Public Works Department (PWD) is usually present at each Activity. The PWD is responsible for maintaining the public works at the base including management of utilities. In many cases, the PWD has a written permit process in place to identify and mark-out the locations of Navy-owned utilities [Note: The PWD is usually NOT responsible for the locations/mark-outs of non-Navy owned, public utilities (e.g., Washington Gas, Virginia Power, municipal water and sewer, etc.). Therefore, it is likely that we will have to contact other organizations besides the PWD in order to identify non-Navy owned, public utilities].

At some Activities, there may not be a PWD, the PWD may not have a written permit process in place, or the PWD may not take responsibility for utility locating and mark-outs. In these cases, the PWD should still be contacted since it is likely that they will have the best understanding of the utility locations at the Activity (i.e., engineering drawings, institutional knowledge, etc.). Subsequently, the PWD should be brought into a cooperative arrangement (if possible) with the other services employed in utility locating and mark-out in order to have the most comprehensive assessment performed.

At all Activities we should have a contact (name and phone number), and preferably an established relationship, with PWD, either directly or through the NAVFAC Atlantic, Midlant, or Washington NTR or Activity Environmental Office that we can work with and contact in the event of problems.

Miss Utility or "One Call" Services for Public Utility Mark-outs

Miss Utility or "One Call" service centers are information exchange centers for excavators, contractors and property owners planning any kind of excavation or digging. The "One Call" center notifies participating public utilities of the upcoming excavation work so they can locate and mark their underground utilities in advance to prevent possible damage to underground utility lines, injury, property damage and service outages. In some instances, such with southeastern Virginia bases, the Navy has entered into agreement with Ms. Utilities and is part of the response process for Miss

Utilities. Generally, a minimum of 48 hours is required for the public utility mark-outs to be performed. The "One Call" services are free to the public. Note that the "One Call" centers only coordinate with participating public utilities. There may be some public utilities that do NOT participate in the "One Call" center which may need to be contacted separately. For example, in Washington, DC, the Miss Utility "One Call" center does not locate and mark public sewer and water lines. Therefore, the municipal water and sewer authority must be contacted separately to have the sewer and water lines marked out. The AM should contact the appropriate one-call center to determine their scope of services.

A national listing of the "One Call" service centers for each state is presented on the web at http://www.underspace.com/refs/ocdir.htm. For the Mid-Atlantic region, the following "One Call" service centers are available.

Name	Phone	Website	Comments
Miss Utility of DELMARVA	800-257-7777	www.missutility.net	Public utility mark-outs in Delaware, Maryland, Washington, DC, and Northern Virginia
Miss Utility of Southern Virginia (One Call)	800-552-7001	not available	Public utility mark-outs in Southern Virginia
Miss Utility of Virginia	800-257-7777 800-552-7007	www.missutilityofvirginia.com	General information on public utility mark-outs in Virginia, with links to Miss Utility of DELMARVA and Miss Utility of Southern Virginia (One Call)
Miss Utility of West Virginia, Inc	800-245-4848	none	Call to determine what utilities they work with in West Virginia
North Carolina One Call Center	800-632-4949	www.ncocc.org/ncocc/default.htm	Public Utility Markouts in North Carolina

Private Subcontractors

1. Utility-locating support is required at some level for most all CH2M HILL field projects in "clearing" proposed subsurface boring locations on the project site. Utility location and sample clearance can include a comprehensive effort of GIS map interpretation, professional land surveying, field locating, and geophysical surveying. Since we can usually provide our own GIS-related services for projects and our professional land surveying services are normally procured separately, utility-locating subcontractors will normally only be required for some level of geophysical surveying support in the field. This level of geophysical surveying support can range widely from a simple electromagnetic (EM) survey over a known utility line, to a blind geophysical effort, including a ground-penetrating radar (GPR) survey and/or a comprehensive EM survey to delineate and characterize all unknown subsurface anomalies.

   The level of service required from the subcontractor will vary depending on the nature of the site. At sites where utility locations are well defined on the maps and recent construction is limited, CH2M HILL may be confident with a limited effort from a traditional utility-locating subcontractor providing a simple EM survey. At sites where utility locations are not well defined, where recent constructions may have altered utility locations, or the nature of the site makes utility location difficult, CH2M HILL will require the services of a comprehensive geophysical surveying subcontractor, with a wide range of GPR and EM services available for use on an "as-needed" basis. Typical costs for geophysical surveying subcontractors will range from approximately $200 per day for a simple EM effort (usually one crew member and one instrument) to approximately $1,500 per day for a comprehensive geophysical surveying effort (usually a two-person crew and multiple instruments). Comprehensive geophysical surveying efforts may also include field data interpretation (and subsequent report preparation) and non-destructive excavation to field-verify utility depths and locations.

The following table provides a list of recommended geophysical surveying support subcontractors that can be used for utility-locating services:

Company Name and Address	Contact Name and Phone Number	Equipment[1]					Other Services[2]		
		1	2	3	4	5	A	B	C
US Radar, Inc.* PO Box 319 Matawan, NJ 07747	Ron LaBarca 732-566-2035			4					
Utilities Search, Inc.*	Jim Davis 703-369-5758	4				4	4	4	4
So Deep, Inc.* 8397 Euclid Avenue Manassas Park, VA 20111	703-361-6005	4					4	4	4
Accurate Locating, Inc. 1327 Ashton Rd., Suite 101 Hanover, MD 21076	Ken Shipley 410-850-0280	4	4						
NAEVA Geophysics, Inc. P.O. Box 7325 Charlottesville, VA 22906	Alan Mazurowski 434-978-3187	4	4	4	4	4	4	4	4
Earth Resources Technology. Inc. 8106 Stayton Rd. Jessup, MD 20794	Peter Li 240-554-0161	4	4	4	4	4	4	4	
Geophex, Ltd 605 Mercury Street Raleigh, NC 27603	I. J. Won 919-839-8515	4	4	4	4	4	4	4	4

Notes:

*Companies denoted with an asterisk have demonstrated reluctance to assume responsibility for damage to underground utilities or an inability to accommodate the insurance requirements that CH2M HILL requests for this type of work at many Navy sites.

[1]Equipment types are:

1. Simple electromagnetic instruments, usually hand-held
2. Other, more innovative, electromagnetic instruments, including larger instruments for more area coverage
3. Ground-penetrating radar systems of all kinds
4. Audio-frequency detectors of all kinds
5. Radio-frequency detectors of all kinds

[2]Other services include:

A. Data interpretation and/or report preparation to provide a permanent record of the geophysical survey results and a professional interpretation of the findings, including expected accuracy and precision.
B. Non-destructive excavation to field-verify the depths, locations, and types of subsurface utilities.
C. Concrete/asphalt coring and pavement/surface restoration.

Attachment C – Equipment Used for Identifying Underground Utilities

This attachment provides a summary of the various types of equipment used for subsurface utility location. It describes the capabilities and limitations of each in order to help the AM and PM determine if the equipment being proposed by a subcontractor or Navy is adequate. A list of in-house experts that can be used to answer questions you may have is provided below.

CH2M HILL In-house Utility Location Experts

Tamir Klaff/WDC

Home Office Phone – 703-669-9611

Electromagnetic Induction (EMI) Methods

EMI instruments, in general, induce an electromagnetic field into the ground (the primary field) and then record the response (the secondary field), if any. Lateral changes in subsurface conductivity, such as caused by the presence of buried metal or by significant soil variations, cause changes in the secondary field recorded by the instrument and thus enable detection and mapping of the subsurface features. It should be noted that EMI only works for electrically conductive materials--plastic or PVC pipes are generally not detected with EMI. Water and gas lines are commonly plastic, although most new lines include a copper “locator” strip on the top of the PVC to allow for detection with EMI.

EMI technology encompasses a wide range of instruments, each with inherent strengths and weaknesses for particular applications. One major division of EMI is between “time-domain” and “frequency-domain” instruments that differ in the aspect of the secondary field they detect. Another difference in EMI instruments is the operating frequency they use to transmit the primary field. Audio- and radio-frequencies are often used for utility detection, although other frequencies are also used. Consideration of the type of utility expected, surface features that could interfere with detection, and the “congestion” of utilities in an area, should be made when choosing a particular EMI instrument for a particular site.

One common EMI tool used for utility location is a handheld unit that can be used to quickly scan an area for utilities and allows for marking locations in “real time”. This method is most commonly used by “dig-safe” contractors marking out known utilities prior to excavation. It should be noted that this method works best when a signal (the primary field) can be placed directly onto the line (i.e., by clamping or otherwise connecting to the end of the line visible at the surface, or for larger utilities such as sewers, by running a transmitter through the utility). These types of tools also have a limited capability to scan an area for unknown utilities. Usually this requires having enough area to separate a hand held transmitter at least a hundred feet from the receiver. Whether hunting for unknown, or confirming known, utilities, this method will only detect continuous lengths of metallic conductors.

In addition to the handheld EMI units, larger, more powerful EMI tools are available that provide more comprehensive detection and mapping of subsurface features. Generally, data with these methods are collected on a regular grid in the investigation area, and are then analyzed to locate linear anomalies that can be interpreted as utilities. These methods will usually detect *all* subsurface metal (above a minimum size), including pieces of abandoned utilities. In addition, in some situations, backfill can be detected against native soils giving information on trenching and possible utility location. Drawbacks to these methods are that the secondary signals from utilities are often swamped (i.e., undetectable) close to buildings and other cultural features, and that the subsurface at heavily built-up sites may be too complicated to confidently interpret completely.

Hand-held metal detectors (treasure-finders) are usually based on EMI technology. They can be used to locate shallow buried metal associated with utilities (e.g., junctions, manholes, metallic locators). Advantages of these tools is the ease of use and real-time marking of anomalies. Drawbacks include limited depths of investigations and no data storage capacity.

Ground Penetrating Radar (GPR)

GPR systems transmit radio and microwave frequency (e.g., 80 megaHertz to 1,000 megaHertz) waves into the ground and then record reflections of those waves coming back to the surface. Reflections of the radar waves typically occur at lithologic changes, subsurface discontinuities, and subsurface structures. Plastic and PVC pipes can sometimes be detected in GPR data, especially if they are shallow, large, and full of a contrasting material such as air in a wet soil, or water in a dry soil. GPR data are usually collected in regular patterns over an area and then analyzed for linear anomalies that can be interpreted as utilities. GPR is usually very accurate in x-y location of utilities, and can be calibrated at a site to give very accurate depth information as well. A significant drawback to GPR is that depth of investigation is highly dependant on background soil conductivity, and it will not work on all sites. It is not uncommon to get only 1-2 feet of penetration with the signal in damp, clayey environments. Another drawback to GPR is that sites containing significant fill material (e.g., concrete rubble, scrap metal, garbage) will result in complicated anomalies that are difficult or impossible to interpret.

Magnetic Field Methods

Magnetic field methods rely on detecting changes to the earth's magnetic field caused by ferrous metal objects. This method is usually more sensitive to magnetic metal (i.e., deeper detection) than EMI methods. A drawback to this method is it is more susceptible to being swamped by surface features such as fences and cars. In addition, procedures must usually be implemented that account for natural variations in the earth's background field as it changes throughout the day. One common use of the method is to measure and analyze the gradient of the magnetic field, which eliminates most of the drawbacks to the method. It should be noted this method only detects ferrous metal, primarily iron and steel for utility location applications. Some utility detector combine magnetic and EMI methods into a single hand-held unit.

Optical Methods

Down the hole cameras may be useful in visually reviewing a pipe for empty conduits and/or vaults.

Attachment D – Utility Clearance Documentation Form

Buried Utility Location Tracking Form

(Submit to CH2M HILL PM within 24 hrs of location activities)

Project Location:

CH2M HILL Project No.:

CH2M HILL Project Manager: Name/Phone:

Fax:

Email:

CH2M HILL Field Team Leader: Name/Phone:

CH2M HILL Purchase Order:

Utility Location Subcontractor:

Subcontractor POC:

Dates of location activities:

	Check each box using an "X" if a buried utility is present within 5 feet of a marked Station ID. If color of the flag or paint differs from listed color, note change in color on the form.																		
Station ID	**Gas (Yellow)**	**Electric (Red)**	**Fiber optic (Orange)**	**Cable (Orange)**	**Water (Blue)**	**San. Sewer (Green)**	**Storm Sewer (Green)**	**Steam (Yellow)**	**Petroleum (Yellow)**	**Compressed air (Yellow)**	**Other ____**	**Other ____**	**Other ____**	**Other ____**	**Date completed**	**Technician initials**	Notes (methods/tools used)		

The findings of the buried utility location activities summarized herein were conducted in strict accordance with the CH2M HILL scope of work.

________________________ __________

Subcontractor's Signature   Date

Attachment E – Utility Marking Color Codes

The following is the standard color code used by industry to mark various types of utilities and other features at a construction site.

White – Proposed excavations and borings

Pink – Temporary survey markings

Red – Electrical power lines, cables, conduits and lighting cables

Yellow – Gas, oil, steam, petroleum or gaseous materials

Orange – Communication, alarm or signal lines, cables, or conduits

Blue – Potable water

Purple – Reclaimed water, irrigation and slurry lines

Green – Sewer and storm drain lines

PMS 219

PMS 1795*

PMS 108

PMS 144*

13.5 parts process
2.5 parts reflex

PMS 253

PMS 3415

UNIFORM COLOR CODE

WHITE - Proposed Excavation

PINK - Temporary Survey Markings

RED - Electric Power Lines, Cables, Conduit and Lighting Cables

YELLOW - Gas, Oil, Steam, Petroleum or Gaseous Materials

ORANGE - Communication, Alarm or Signal Lines, Cables or Conduit

BLUE - Potable Water

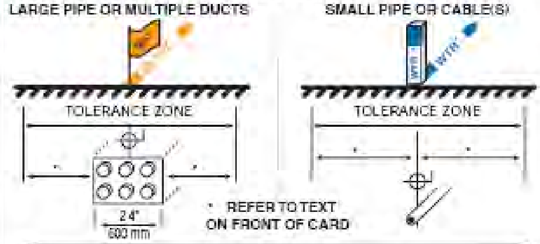
PURPLE - Reclaimed Water, Irrigation and Slurry Lines

GREEN - Sewers and Drain Lines

TYPICAL MARKING

LARGE PIPE OR MULTIPLE DUCTS

SMALL PIPE OR CABLE(S)



* REFER TO TEXT ON FRONT OF CARD

Customize with your center's phone and address information

GUIDELINES FOR UNIFORM TEMPORARY MARKING OF UNDERGROUND FACILITIES

This marking guide provides for universal use and understanding of the temporary marking of subsurface facilities to prevent accidents and damage or service interruption by contractors, excavators, utility companies, municipalities or any others working on or near underground facilities.

ONE-CALL SYSTEMS
The One-Call damage prevention system shall be contacted prior to excavation.

PROPOSED EXCAVATION
Use white marks to show the location, route or boundary of proposed excavation. Surface marks on roadways do not exceed 1.5" by 18" (40 mm by 450 mm). The facility color and facility owner identity may be added to white flags or stakes.

USE OF TEMPORARY MARKING
Use color-coded surface marks (i.e., paint or chalk) to indicate the location or route of active and out-of-service buried lines. To increase visibility, color coded vertical markers (i.e., stakes or flags) should supplement surface marks. Marks and markers indicate the name, initials or logo of the company that owns or operates the line, and width of the facility if it is greater than 2" (50 mm). Marks placed by other than line owner/operator or its agent indicate the identity of the designating firm. Multiple lines in joint trench are marked in tandem. If the surface over the buried line is to be removed, supplementary offset markings are used. Offset markings are on a uniform alignment and clearly indicate the actual facility is a specific distance away.

TOLERANCE ZONE
Any excavation within the tolerance zone is performed with non-powered hand tools or non-invasive method until the marked facility is exposed. The width of the tolerance zone may be specified in law or code. If not, a tolerance zone including the width of the facility plus 18" (450 mm) measured horizontally from each side of the facility is recommended.

ADOPT UNIFORM COLOR CODE
The American Public Works Association encourages public agencies, utilities, contractors, other associations, manufacturers and all others involved in excavation to adopt the APWA Uniform Color Code, using ANSI standard Z535.1 Safety Colors for temporary marking and facility identification.

Rev. 4/99

MRP – SOP – 0001

MUNITIONS RESPONSE PROGRAM (MRP)

STANDARD OPERATING PROCEDURE (SOP)

SURFACE MUNITIONS AND EXPLOSIVES OF CONCERN (MEC)

& SUBSURFACE ANOMALY AVOIDANCE

1.0 OBJECTIVE:

Provide safe procedures to avoid Munitions and Explosives or Concern (MEC) during visitor/personnel escort, land survey, vegetation reduction, sediment sampling, soil boring, drilling, direct push technology-core sampling, or other environmental or construction activities conducted in an environment where the presence of MEC is suspected.

2.0 PURPOSE:

This SOP provides guidance for avoiding surface MEC (e.g., Unexploded Ordnance (UXO), Discarded Military Munitions (DMM)), Material Potentially Presenting an Explosive Hazard (MPPEH), and subsurface anomalies.

3.0 APPLICABILITY:

This SOP applies MEC avoidance procedures per Department of Army Engineering Pamphlet (EP) 75-1-2 Munitions and Explosives of Concern Support During Hazardous Toxic and Radioactive Waste (HTRW) and Construction Activities.

4.0 TECHNCIAL GUIDANCE:

This SOP lists processes and procedures that comply with the following sources:

- DOD 6055.09-M, Ammunition and Explosives Safety Standards, February 2008
- USN Environmental Restoration Program (MRP Chapter 12) August 2006
- NAVSEA OP 5Volume 1, Ammunition and Explosives Safety Ashore, July 2009;
- NOSSA Instruction 8023.11(series), Standard Operating Procedure Development
- USAF Manual 91-201, Explosive Safety Standards, November 2008
- DA Pamphlet 385-64, Ammunition and Explosives Safety Standards, October, 8, 2008
- DA Field Manual (FM) 21-16, Unexploded Ordnance (UXO) Procedures, August, 1994
- DA Engineering Manual (EM) 1110-1-4009, Military Munitions Response Actions, June, 2007
- DA Engineering Pamphlet (EP) 1110-1-18, Military Munitions Response Process, April 2006
- DA Engineering Manual (EM) 385-1-97, Explosives, Health and Safety, September 2008
- **Note: Electronic copies for the sources listed above are available via CH2M HILL SUXOS Laptop Computer**

5.0 SOP VALIDATION RECORD:

SOP Title: MEC Anomaly Avoidance ....Work Instruction Identification/ SOP: # MRP-SOP-0001

Author: K. Lombardo Date: December 1, 2009.................Revision Date: 02/16/2012

Review: G. DeMetropolis, Date: February 16, 2012 ....Approval; J. Bowles

Validation Date: December 14, 2009 ....Process Observer: Kevin Lombardo, December 14, 2009

6.0 HAZARDOUS MATERIALS:

Hazardous Chemicals: None; Product Name: N/A; Material Safety Data Sheets: N/A; Health Hazards: N/A

7.0 EMERGENCY RESPONSE INFORMATION

Work Site Name (location) address/building # Street):

____

Nearest intersection (cross streets) or entrance gate:

____

Safe Area Rally Point (gate/building or intersection) Note: Rally Point should be upwind of work location:

____

UXO Qualified Technician Incident Commander: (name) ______________________________

Personnel Injury or Medical Distress:

1. Summon Emergency Medical Services (EMS)
2. Administer Fist Aid and/or CPR
3. Notify Project Manager
4. PM implements CH2M HILL SOP 111, Incident Notification, Reporting, and Investigations.

Fire:

1. Evacuate personnel from the Munitions Response Site and Area to safe rally point
2. Notify Fire Department of "Work site Name," fire location, and personnel safe rally point
3. Obtain head count, ensuring all personnel are present and or accounted for.
4. Notify Project Manager
5. PM implements CH2M HILL SOP 111, Incident Notification, Reporting, and Investigations.

(Fire/Rescue radio call sign): ______________________ Phone # ______________________

Medical Services radio call sign: ___________________ Phone # ______________________

Range Control radio call sign: _____________________ Phone # ______________________

Project Manager POC: ____________________________ Phone # ______________________

Identify local disaster warning system (radio, PA, phone, other):________________________
Flag(s): ____
Warning Bells/Horns/Sirens/Lights/Strobes: ____
Public Address System: ____
Weather Radio Channel: ____
Other: ____

8.0 PERSONNEL ROLES AND RESPONSIBILITY

Note: Roles and responsibilities are dependent upon work plan direction; one or all roles and responsibilities may be applicable.

1. Project/Construction Manager (P/CM): Provides the necessary resources and personnel to safely and efficiently accomplish the scope of work. Ensures CH2M HILL unexploded ordnance (UXO) personnel shall be qualified in accordance with:
   - OPNAVINST 8020.14/MCO P8020.11 (series).
   - And are certified to perform the job assigned and that the certification is current. Contractors who perform those duties described in NAVSEA OP5, paragraph 2-3 involving ammunition and explosives shall comply with NAVMED P117 Article 15-107.
   - Prior to site operations, CH2M HILL will verify training, medical qualification statements by physicians, and conformance to substance abuse testing and reporting programs.
   - Shall confirm active explosive certification program conformance for personnel compliance to requirements for UXO personnel identified IAW DDESB Technical Paper (TP) 18, and monitors these personnel for conformance to the Bureau of Alcohol, Tobacco, Firearms, and Explosives, Safe Explosives Act 2003 Certification requirements for "Employee Possessor," and or "Responsible Person."
2. Senior UXO Supervisors or Unexploded Ordnance Technician III or II: Supervises the operational resources necessary to implement, and accomplish this procedure and requirements set forth within the Work, Health, Safety, Quality and Accident Prevention Plans. May stop work at anytime to prevent accidents, remedy unsafe conditions, stop an unsafe act, or question the safety of a process or procedure or

observe non conformance to this SOP and/or plans. Provides a Site Specific Tailgate Safety Briefing to include MEC, construction, industrial, environmental, and natural safety hazard awareness. Provides the plan of day. As applicable provides a Hazardous Materials briefing for items used, consumed, or required for this SOP. Brief personnel on communications, security, emergency/medical response, evacuation, rally points, IAW with project instructors, and plans. Also, informs personnel to prevent disclosure of classified work, site observations, or information.

3. Non-UXO Qualified Personnel are obligated to follow guidance within this SOP, Work, Health and Safety and Accident Prevention Plans.

9.0 PRE-OPERATIONAL CHECK LIST	
1. ( ) CH2M HILL Inc. Safety Risk Evaluation (SRE) and Explosives Safety Submission Determination (ESSD) (Navy Projects)	2. ( ) Project Task/Work/ Instructions
3. ( ) Work Plan/Accident Prevention Plan/ Health and Safety Plan	4. ( ) Personal Protective Equipment (PPE) IAW Safety Plan
5. ( ) Emergency P.O.C List	6. ( ) Directions and map to hospital
7. ( ) Communications (2 methods)	8. ( ) First aid/Fire Extinguisher/- (GPS/compasses optional)

10.0 ANOMALY DETECTION EQUIPMENT (as required by project instruction)
( ) Ferrous Metal Detector (Schonstedt GA 52CX or Ferex 4.021 MK 26 Mod 0 or equivalent), with extra batteries, carry case, & instruction manual (as required by project instructions)
( ) All Metals Detector (White Spectrum XLT or equivalent) with extra battery, carry case, & instruction manual (as required by project instructions)
( ) Down-hole Instrument Direct Push Technology – Schonstedt MG 230 Gradiometer maximum 2.12-inch "Outside Diameter" (OD) Probe Head - Extra batteries and instruction manual (as required by project instructions)

11.0 EXPLOSIVE ORDNANCE RECONNAISSANCE EQUIPMENT
WARNING   **Direct physical contact with or movement of MEC or MPPEH is not authorized.**   ( ) Tape Measure, ruler, pen/paper, item for scale perspective (e.g. dollar bill),
( ) Camera (digital), with spare batteries (as required by project instructions)
( ) Small dry erase white board and dry erase marker for photograph item number, date, time, location, and description.

12.0 GENERAL INFORMATION	
CATEGORY **Surface MEC/Anomaly Avoidance**	**DIRECTIONS** **(S)** = Safety, **(O)** = Operations, **(Q) =** Quality Control
Note: (o) PM shall obtain MISS Utilities Check and or local Dig (intrusive) permits prior to intrusive actions (such as use of direct push technology, drilling, and use of hand augers) **(WARNING)** **Fire: (s)** Do not attempt to fight a fire, evacuate area, move upwind or crosswind to safe rally point, notify fire department. **Wildlife: (s)** Aggressive/defensive – Avoid wildlife –withdraw from area **Hunters: (s)** Withdraw from area, retreat to vehicle, contact project authority **CWM: (s)** Evacuate upwind to safe rally point, mark area on map, contact PM **Severe Weather (lighting, winds, and storms): (s)** Evacuate to vehicle, follow PM guidance	
13.0 SAFETY	
Munitions Response Group Safety Manager	George DeMetropolis/SDO Telephone (Office): (619) 687 – 0120, Ext. 37239 Telephone (Cellular): (619) 564 – 9627
Safety Plan, Accident Prevention Plan and Activity Hazard Analysis	(s) All field personnel require reading, compliance, and acknowledging they understand and comprehend the safety information contained within these plans, SOP and AHA; attesting through signature and date
Visitors access to work location	(s) All visitors (contract/transient/witness) require a safety briefing, wearing of PPE IAW site specific safety plan, and conformance to UXO Technician instructions.
Safety Meeting:	(s) Each morning – Project Personnel shall participate in a tailgate safety briefing, discussing the operational activities (plan of the day), MEC/HTRW hazards/risks, safety controls, and emergency procedures; daily weather forecast, work activity OSHA PPE

	level, insect/poisonous plant avoidance, and heat/cold stress prevention. Personnel shall sign and date, the safety briefing acknowledgment form; confirming individual participation, understanding, and comprehension prior to operations. Personnel who do not participate in the safety briefing or, understand, or comprehend the safety briefing may not access work areas.
Safety Pre-field operations check list	(s) ( ) First Aid Kit (serviceable and supplies within shelf life) (s) ( ) Fire Extinguisher 10BC (or greater) (charged/indicator green) (s) ( ) Water (minimum 1 liter per person) (s) ( ) Cell phone/identified alternate land line location/or two/way Radio (s) ( ) Identification of wind direction, and rally points (s) ( ) PPE IAW Activity Hazard Analysis (s) ( ) Vehicles unlocked; keys in announced location (s) ( ) Insect repellant/sun screen (available)
Equipment Check-out: 1) Schonstedt – GA52CX magnetometer or equivalent 2) White's (E series) Spectrum model XLT Metal Detector or equivalent 3) Schonstedt gradiometer MG 230 for Down-hole or underwater search or equivalent 4) Forster Ferex 4.021 models K,L, & W or MK 26 MOD 0 magnetometer for down-hole or underwater search or equivalent	(o) Assemble/inspect, IAW manufacture instructions (o) Test geophysical instruments against a known source (ferrous or non-ferrous) for instrument response. (o) Source (ferrous) Schedule 40, 2-inch x 5-inch steel pipe or equivalent (q) Pass/Fail - instrument shall detect source on surface at 12-inches above item/fail non-detect - replace instrument (o) Source on surface (non-ferrous) ¾-inch x 6-inch Brass Pipe nipple (aka) couple fitting or equivalent (q) Pass/Fail - instrument shall detect source on surface at 6-inches above item/fail non-detect - replace instrument

<table>
<tr><td></td><td>(q) Name of individual recording geophysical instrument source test results by instrument manufacturer with: type, model, serial number, by the date of daily equipment check. Record results for pass/fail source test with remarks. Reject and replace geophysical instrument that does not pass quality control source test.</td></tr>
<tr><td colspan="2">14.0 SITE ACCESS</td></tr>
<tr><td>WARNING:
UXO Technician(s) shall not make physical contact with MEC, or commercial explosives. UXO Technicians assigned to implement this SOP shall not intentionally move MEC or explosives, incendiaries, smokes, propellants, or commercial explosives.
NOTE:
If MEC, to include Unexploded Ordnance (UXO), Discarded Military Munitions, (DMM) or Material Potentially Presenting an Explosive Hazard (MPPEH) are encountered, the UXO Technician shall respond IAW 3R training, avoid such items, and notify Project Manger IAW site-specific project instructions.</td><td>(o) Implement 3R (R, R, R) process, and procedures.
(o) Recognize MEC, UXO, DMM, and or MPPEH; offset mark anomaly location with flag, ribbon, paint, stakes, other location identifier
(o) Retreat from MEC location and avoid MEC location
(o) Report & record MEC location in logbook and contact Project Manager IAW project instructions to request additional guidance.
Note:
MR Safety may instruct UXO Qualified Technician to perform a zero contact Explosive Ordnance Reconnaissance of the item requesting information for type by function, condition, filler, and nomenclature (if visually possible), supported by photographs of the item.</td></tr>
<tr><td colspan="2">15.0 EXPLOSIVE ORDNANCE RECONNAISSANCE (EOR)</td></tr>
<tr><td colspan="2">EXPLOSIVE ORDNANCE RECONNAISSANCE
Reconnaissance involving the investigation, detection, location, marking, initial identification, and reporting of suspected MPPEH in order to determine future action</td></tr>
<tr><td>EOR Method
UXO Qualified Technician is required prior to performing an Explosive Ordnance Reconnaissance to review Department of the Army, Field Manual (FM) 21-16, Unexploded Ordnance (UXO) Procedures, August 1994 – A copy can be obtained from:</td><td>(o) Use general Explosive Ordnance Disposal (EOD) safety precautions until munition type, fuzing , condition, and filler are identified
(o) Upon identification, of type by function, fuzing, and condition use general EOD safety precautions for the category of munition (e.g.</td></tr>
</table>

WWW.UXOINFO.COM or from CH2M HILL MR Operations, Kevin Lombardo/WDC	Rocket; avoid approach to the front and rear of item, etc). (s) Approach Unexploded Ordnance (UXO) 45^0 to the rear (s) Do not cast shadows over UXO fuze (s) Remain cognizant to avoid dispensed wires, filaments, or other items that could initiate movement (s) Remain cognizant of Electromagnetic Hazardous Radiation, to Ordnance (HERO) precautions.
Information Recovery	(o) Photograph item from each vantage point. Identify each photograph with item name, view (side, front, rear, etc.), and distance from camera to item, (f-stop & shutter speed and film speed if applicable). It is required that a photograph log be kept for each item. Use a ruler in photo to demonstrate perspective of the item. (o) Close-up photograph fuze, markings, nose, tail, and or markings

16.0 PERSONNEL ESCORT	
Personnel Escort A minimum of one UXO qualified Technician(II) shall escort non-UXO qualified site personnel conducting access to a Munitions Response Area or Site The UXO qualified person shall visually search the surface of walking paths, roads, and parking areas to locate, mark, and avoid MEC during walking, driving, or setting-up equipment.	(o) Establish a wind streamer of tape/ribbon (flag) within/near the project site to observe wind direction. (o) A UXO Technician shall visually search the surface area, for MEC/HTRW to avoid such items. The UXO Technician may augment the visual search with the application of a geophysical instrument to detect surface/subsurface ferrous and or non-ferrous anomaly sources for the purpose of anomaly avoidance (o/s) When escorting non-qualified UXO personnel, a UXO Technician shall lead, and non-UXO qualified personnel shall follow along a path identified by the UXO Technician. (o) The UXO Technician shall identify surface hazards (MPPEH) and avoid such hazards. The location of a hazard requires, the UXO Technician to communicate the location to non-UXO qualified persons for avoidance around the item. (s) Communication can be by hand signals (pointing), or marking with flags, tape, ribbon, paint, stakes, or other means identified during a safety briefing.

	(s) Essential Personnel Limits - MR Escorts are a minimum of one UXO qualified Technician II or above, to no more than six (6) non-qualified persons. (s) Non UXO qualified personnel shall not approach and avoid a marked MPPEH or HTRW hazard.

17.0 MEC AVOIDANCE SUPPORT **LAND SURVEY, SEDIMENT SAMPLING, GROUNDWATER COLLECTION, ENDANGERED SPECIES SAMPLING/MONITORING**	
Applicable to Visitors, Land Survey, Sediment Sampling, Groundwater Collection, Endangered Species Sampling/Monitoring	
WARNING: Subsurface intrusive acts could initiate MEC, through physical contact, movement, or shock.	(o) A UXO Technician shall search each intrusive point from the surface with a magnetometer and or all metals detector in accordance with the instruments manufactures instructions, to locate ferrous and/or non-ferrous subsurface anomalies. Location of such subsurface anomalies requires the placement of an offset marker (pin flag a minimum of 12-inches) to the north of the greatest signal strength for the anomaly. (s) For land survey and sampling activities where detection of an anomaly occurs, an alternative location free of ferrous and non-ferrous anomalies is required to proceed with intrusive activities. (q) The UXO Technician shall note within the daily logbook the rejection of the primary location and selection of the alternative location, with a written description of direction and feet/inches for the offset location from the primary point.
NOTE: Personnel performing subsurface intrusive activities for the purpose of land survey and environmental sampling require a UXO Technician to search the subsurface with either or both (dependent on MEC site-specific history) a magnetometer and/or all metals detector to confirm the subsurface is free of ferrous and or non-ferrous anomalies. A UXO Technician shall mark the boundaries /limits for ingress/egress access from a safe area (i.e.: road) to the work activity location or provide escort to and from the work activity location.	
18.0 VEGETATION REDUCTION MEC AVOIDANCE (MANUAL/MECHANICAL)	
WARNING: DO not apply vegetation cutting	(o) A UXO Technician shall escort vegetation reduction personnel, perform a visual and/or magnetometer and/or all metals detection instrument search of surface

closer than six-inches to ground surface. Vegetation reduction actions that occur less than six-inches above ground surface, may result in movement, or shock to MEC, resulting in an unintentional detonation or functioning as designed of the item.	access routes, walking paths, and vegetation reduction locations for MEC/HTRW and or obstruction hazards. (o) The UXO Technician shall operate a magnetometer and or all metals detection instrument to locate surface anomalies with potential to be a hazard to vegetation reduction crews. (o) The UXO Technician shall perform a visual surveillance of the surface to locate surface hazards (MEC, HTRW) or obstructions to equipment, mark the location and instruct vegetation reduction crews to avoid the location. (s) The UXO Technician shall remain away from the immediate operating radius of powered equipment and remain alert for flying debris (s) The UXO Technician shall wear high visibility outerwear, use hearing, and eye protection, and avoid swing radius of powered equipment.
Warning : Personnel performing vegetation reduction activities shall not operate equipment closer than 6-inches to the ground thus, all brush cutting equipment (chain saws, weed whackers, string trimmers, brush cutters, bush hogs, hydro-ax, or debarking equipment) shall operate six-inches or greater above ground.	
19.0 MEC AVOIDANCE (DOWN HOLE)	
WARNING: When applying MEC avoidance procedures for drilling or the use of direct push technology, the steel mass of drill rigs and direct push technology DPT power plants will influence gradiometers, and magnetometer reporting instruments. Thus, drill rigs and DPT equipment shall be withdrawn a minimum of ten feet from intrusive points while performing down-hole avoidance search.	(o) Prior to drilling, the UXO Technician will conduct a visual reconnaissance of access paths and drilling area. The reconnaissance will include locating the designated sampling or drilling location(s) ensuring that the locations do not have surface MEC, or MPPEH, and magnetometers or all metal detection search do not indicate the presence of subsurface anomalies. If detection of subsurface anomalies occurs, at the sampling point, the sampling point is abandoned. Once the designated sampling point has been determined free of anomalies, an access route for the sampling crew's vehicles is searched. The access path requires twice the width of the widest vehicle and marking along the sides with flags, ribbon, engineer tape, stakes, or equivalent to define limits. (s) If an observation of MEC or MPPEH should occur, the UXO Technician shall mark the item, avoid it, and notify the PM for either military EOD or UXO Contractor

	support. (o) A UXO Technician will clear each work site for drilling/DPT and clearly mark the safe to walk, and drill or DPT, boundaries. Each drill/DPT safe area will be large enough to accommodate the drilling equipment and provide a work area for the crews. As a minimum, the safe area will be a rectangle, with a side dimension equal to twice the length of the largest vehicle or piece of equipment for use on site.
NOTE: (p) Drilling and application of DPT may require an ingress route and pad turning radius, twice the width, and length of the mechanical equipment.	
NOTE: MEC may exist within the subsurface up to 30 feet below ground surface, dependent on site-specific history. Refer to project instruction to determine maximum depth for down-hole MEC avoidance support.	
The UXO Technician is required to escort personnel and remain with personnel when sampling/drilling at an MRP or MEC/MPPEH suspect site.	(o) Soil bore holing may be by hand auger, power-auger, drilling, DPT. A UXO Technician will examine, prior to sampling/drilling, the borehole location with a down-hole gradiometer or magnetometer, a minimum of every one (1) foot, to the deepest sampling depth or a maximum of 30 feet below ground surface to ensure avoidance of anomalies, or to depth identified within the project instruction.
WARNING: Drilling equipment may produce injury from snapping cables, pinch points, chain failures or falling booms, derricks, and drill piping. Avoid the immediate operational radius of drillers when supporting efforts.	(o) Drilling down–hole monitoring requires at a minimum of one (1) foot increments of search, during the actual well drilling operation. This will require the withdrawal of the drill rod or augers from the hole and moving the drill rig a minimum of 10 feet or enough feet away from the drill-hole location to prevent the metal in the rig from influencing the magnetometer/gradiometer. (o) The UXO Technician shall perform down-hole monitoring for anomalies at each location identified within the project instruction.
20.0 QUALITY CONTROL	

The QC Manager will be responsible for ensuring this SOP is effectively implemented. Surveillances and/or inspections will be conducted to ensure SOP compliance.	(q) UXOQC personnel shall document nonconforming materials, items or activities in a NCR based on surveillances and/or inspections
21.0 ACTIVITY COMPLETION	
Completion of documentation:	( ) Project site logs to Project Manager ( ) Tail gate safety meeting log to Project Manager ( ) Equipment check-out report to Project Manager ( ) Quality control reports to Project Manager

21.0 EQUIPMENT

ITEM	QUANTITY
Cellular telephone	1
Dow-hole (only) Magnetometer/Gradiometer capable of down-hole operations to 30 feet	1 or (as required by Project instruction)
Magnetometer capable of monitoring to a depth of two-feet below ground surface for ferrous items	1 or (as required by Project instruction)
All metals detector capable of monitoring to a depth of 6-inches below ground surface for non-ferrous items	Optional
Multi colors of marking flags, ribbon, and tape	As determined by SUXOS
Batteries	Two day supply for instruments
First –aid Kit (25 person)	1 within the work area
Water	Minimum 1 liter per person in work area
Camera/Tape Measure/Ruler/Calipers/Paper Pencil	As determined by SUXOS
Hand tools, (hammer, general purpose tools, etc.)	Assorted as determined by SUXOS

MINIMUM PERSONAL PROTECTIVE EQUIPMENT: IAW with Safety Plan and AHA or a minimum of OSHA LEVEL "D"

Coveralls (or long pants, sleeved shirt)

Boots (level “D”) Cover (cap, floppy, skull) Gloves (leather) Safety Eye protection (as required by AHA) Hard hats (when working in an area with a potential for head injury or heavy equipment e.g. drill rig) Because this is a possible HTRW operation, the MR Supervisor will direct the required explosive safety site PPE conditions.
SPECIAL TRAINING AND REFRESHER REQUIREMENTS: UXO Technicians will be qualified at a minimum Level II designation and be graduates of the U.S. Naval School of Explosive Ordnance Disposal or other DOD DEDSB TP 18 approved course or school/course of instruction, Hazard Waste Operations IAW 29CFR 1910.120 (e) & (f) and medical clearance physical authorization to perform work.
WAIVERS, EXEMPTIONS, SPECIFIC AUTHORIZATIONS, OR APPROVED DEVIATIONS THAT APPLY TO THIS OPERATION: None
ACTIVITY HAZARD ANLAYSIS

Safe Work Method Statement/ Job Hazard Analysis

Company Name: **CH2M HILL**	Project Name/#: SOP MRP 0001- MEC Anomaly Avoidance
Work Activity/Task: MEC Anomaly Avoidance	Principal Contractor: **CH2M HILL**
Date: December 09, 2009	Note: Sign off to be provided at Tool Box talk
Prepared by: George DeMetropolis	Supervisor: TBD by project location
Signature: 	Safety Coordinator (SC): TBD by project location
All metals detection equipment, metal detection instruments, magnetometry equipment, gradiometers, and military ordnance detection equipment, plant & equipment required: - machinery: maintenance checks provided and recorded by subcontractor or operator: suitably qualified and competent, with health, safety, and environment (HS&E) training	Training Requirements 29 CFR 1910.120 (e) & (f); DDESB TP 18 minimum qualifications for Unexploded Ordnance Technicians; OPNAVINST 8020.14/MCO P8020.11 (series) and are certified to perform the job assigned and certification is current. NAVSEA OP5, paragraph 2-3 involving ammunition and explosives shall comply with NAVMED P117 Article 15-107. Prior to site operations, CH2M HILL will verify training, medical qualification statements by physicians, and conformance to substance abuse testing and reporting programs. CH2M HILL has an active explosive certification program and monitors these personnel for conformance to the Bureau of Alcohol, Tobacco, Firearms, and Explosives, Safe Explosives Act 2003 Certification requirements for "Employee Possessor," and or "Responsible Person." 3R training for non-UXO qualified Personnel. (in addition to those in project's written safety plan: - OHS Construction Induction - Waste Management for waste streams and materials

Job Step	Potential Hazard	Controls
Forms/Permits	Unknown client-specific hazards. MEC Surface/Subsurface	UXO qualified personnel, SOP MR 0001, 3Rs Training for Non-UXO qualified personnel, Metal (ferrous/nonferrous) detection equipment, DA EP 75-1-2. Well driller license, drill rig permit •Well installation or abandonment notification •Dig/drill permit obtained, where required by client facility •Water withdrawal permit obtained, where required
Site Setup	Striking underground utilities, impact with MEC	•Location of underground utilities and installations identified •Daily briefing Avoid Surface and Subsurface MEC through the use of MR SOP 0001 – MEC Anomaly Avoidance
	Striking overhead utilities	•Locate and take appropriate precautions with required distances from power lines •Lower mast and secure during travel

	Physical environmental hazards	•Use of appropriate personal protective equipment (PPE) where required. Safety boots, hard hats, safety glasses and hearing protection are mandatory. Respirators when chemical hazards exist. No loose-fitting clothing, rings, watches, etc.; long hair to be restrained close to the head.
	Dermal or inhalation exposure to contaminants	•Investigate history of area; determine nature and degree of contaminants that could be present •Conduct air monitoring for potential hazardous atmospheres as described in the project's written safety plan. •Use respirators and other PPE as prescribed in the project's written safety plan

Job Step	Potential Hazard	Controls
Site Setup (Continued)	Fire /Explosion	• No smoking around the drill rig – MR SOP-0001 MEC Anomaly Avoidance
	Struck by vehicles	•Follow traffic control plan •Wear high-visibility warning vests
	Drill rig travel	•Ensure stable ground and adequate footing for machinery. Adequate ground preparation to support loads and accommodate waste materials. •Drill rig travel will be conducted with mast secured in its lowered position •Tools and equipment secured prior to rig movement •Only personnel seated in cab are to ride on the rig vehicle •Ensure clearance of overhead power lines •Use alarm or spotter when reversing rig
	Illegal offsite impacts	• Excavation area checked for wetlands, endangered species, cultural/historic resources
	Spread of contamination from contaminated drill cuttings	•Manage cuttings in accordance with all project plans

Drilling Activities	Rotating machinery parts of drill rig MEC- surface/Subsurface – physical contact	•Daily inspection of drill rig & equipment •Ensure appropriate guards are installed or suitable barriers to forewarn personnel of dangers •Personnel clear during set up, clear of rotating parts •Loose clothing, long hair, and jewelry to be safely secured •Hands or feet should not be used to move cuttings away from auger •Rig in neutral and augers stopped rotating before cleaning •Kill switch installed, clearly identified and operational •Rig placed in neutral when operator not at controls •Pressurized lines and hoses secured from whipping hazards Advance Drill/bore hole/DPT in one foot increments applying MR SOP 0001-MEC Anomaly Avoidance Procedures
	Hoisting operations	•Ensure all personnel are clear of operation to a suitable safe distance
	Overturning of drill rig	•Establish drill pad if necessary •Drill rig level and stabilized
	Securing ropes and cables	•Ensure security to stable fixture. Do not wrap around any part of the body. •Drill rig ropes in clean, sound condition

22.0 PROCESS SUPERVISOR'S STATEMENT

I have read and understand this SOP. To the best of my knowledge, the processes described within this SOP can be done in a safe, healthful, and environmentally sound manner. I have made sure that all persons assigned to this process are qualified, have read and understand the requirements of this SOP, and have signed the workers statement for this process. I will ensure the SOP is the most recent revision. If a major change to the SOP is necessary, I will ensure that the processes are stopped until the SOP is revised and approved. If unexpected safety, health, or environmental hazards arise, I will stop activities, until hazards have been controlled, reduced, or eliminated to an acceptable risk level.

SOP MRP 0001 PROCEDURE SUPERVISOR ACKNOWLEDGEMENT

UXO Supervisor's Name (print):	Supervisor's Signature	Organization	Date

23.0 PERSONNEL STATEMENT

I have read this SOP and I have received adequate demonstration of the procedure, training to perform the process and procedure according to requirements, procedure, and guidance identified below. I agree to follow this SOP, unless I identify a hazard, work condition, or compliance issue not addressed within this SOP or encounter a situation, condition, or issue that, I cannot perform according to the SOP. If such a stoppage occurs, I will immediately notify the SUXOS, UXO Technician III, or II. Should the situation, condition, or compliance remain unresolved for greater than 24-hours, I shall contact the Munitions Response Safety Manager (619) 564-9627.

SOP MRP – 0001 - PERSONNEL STATEMENT ACKNOWLEDGEMENT

Personnel Name (print):	Personnel Signature	Organization	Date

STANDARD OPERATING PROCEDURE

Direct-Push Groundwater Sample Collection

I. Purpose

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

II. Scope

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

III. Equipment and Materials

- Truck-mounted hydraulic percussion hammer.
- Direct-push (e.g., Geoprobe®) sampling rods and slotted lead rod
- Polyethylene sampling tubing and stainless steel foot valve
- Pre-cleaned sample containers
- Clean latex or surgical gloves.

IV. Procedures and Guidelines

1. Decontaminate slotted lead rod and other downhole equipment in accordance with SOP *Decontamination of Personnel and Equipment*.
2. Drive slotted steel lead rod to the desired sampling depth using the truck-mounted hydraulic percussion hammer.
3. Insert the stainless steel foot valve into the end of the polyethylene sampling tubing and insert tubing through the rods.
4. Fill all sample containers, beginning with the containers for VOC analysis.
5. Remove polyethylene sampling tubing from the rods. Remove the foot valve and discard polyethylene tubing.
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

- Verify that the hydraulic percussion hammer is clean and in proper working order.
- Ensure that the direct-push operator thoroughly completes the decontamination process between sampling locations.
- Ensure that the slotted lead rod has been inserted to the desired sampling depth.
- Verify that the borehole made during sampling activities has been properly backfilled.

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 accordingly.

If warranted, procedures for dangerous-goods shipping may be implemented. Dangerous goods and hazardous materials pose an unreasonable risk to health, safety, or property during transportation without special handling. As a result only employees who are trained under CH2M HILL Dangerous Goods Shipping course may ship or transport dangerous goods. Employees should utilize the HAZMAT ShipRight tool on the Virtual Office and/or contact a designated CH2M HILL HazMat advisor with questions.

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 potential additional restrictions. If applicable, 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. If warranted, procedures for dangerous-goods shipping may be implemented. Dangerous goods and hazardous materials pose an unreasonable risk to health, safety, or property during transportation without special handling. As a result only employees who are trained under CH2M HILL Dangerous Goods Shipping course may ship or transport dangerous goods. Employees should utilize the HAZMAT ShipRight tool on the Virtual Office and/or contact a designated CH2M HILL HazMat advisor with questions.

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

VOC Sampling--Water

I. Purpose

To provide general guidelines for sampling aqueous volatile organic compounds.

II. Scope

Standard techniques for collecting representative samples are summarized. Site-specific details are discussed in the Field Sampling Plan.

III. Equipment and Materials

- Sample vials pre-preserved at laboratory with Hydrochloric acid (HCl)
- Surgical or latex gloves

IV. Procedures and Guidelines

1. Sample VOCs before sampling other analyte groups.

2. When sampling for VOCs, especially residential wells, evaluate the area around the sampling point for possible sources of air contamination by VOCs. Products that may give off VOCs and possibly contaminate a sample include perfumes and cosmetics, skin applied pharmaceuticals, automotive products (gasoline, starting fluid, windshield deicers, carburetor cleaners, etc.) and household paint products (paint strippers, thinners, turpentine, etc.).

3. Keep the caps off the sample vials for as short a time as possible.

4. Wear clean latex or surgical gloves.

5. Fill the sample vial immediately, allowing the water stream to strike the inner wall of the vial to minimize formation of air bubbles. DO NOT RINSE THE SAMPLE VIALS BEFORE FILLING.

6. Fill the sample vial with a minimum of turbulence, until the water forms a positive meniscus at the brim.

7. Replace the cap by gently setting it on the water meniscus. Tighten firmly, but DO NOT OVERTIGHTEN.

8. Invert the vial and tap it lightly. If you see air bubbles in the sample, do not add more sample. Use another vial to collect another sample. Repeat if necessary until you obtain a proper sample.

V. Attachments

None.

VI. Key Checks and Items

- Check for possible sources of contamination.
- Fill slowly, with as little turbulence as possible.
- Check for air bubbles.

STANDARD OPERATING PROCEDURE

Field Measurement of pH, Specific Conductance, Turbidity, Dissolved Oxygen, ORP, and Temperature Using a Horiba or YSI Water Quality Parameter Meter with Flow-through Cell

I. Purpose and Scope

The purpose of this procedure is to provide a general guideline for using a water quality parameter meter (e.g., Horiba® or YSI) for field measurements of pH, specific conductance, turbidity, dissolved oxygen, oxidation-reduction potential (ORP), and temperature of aqueous samples. The YSI instrument does not measure turbidity. A separate turbidity meter (i.e., Hanna Turbidity Meter) will need to be used in conjunction with the YSI meter. The operator's manual should be consulted for detailed operating procedures.

II. Equipment and Materials

- Water Quality Parameter Meter such as a Horiba® Water Quality Monitoring System or YSI with flow-though cell
- Auto-Calibration Standard Solution (provided by rental company)
- Distilled water in squirt bottle

III. Procedures and Guidelines

A. Parameters and Specifications:

Parameter	Range of measurement	Accuracy
pH	0 to 14 pH units	+/- 0.1 pH units
Specific conductance	0 to 9.99 S/m	+/- 3 % full scale
Turbidity	0 to 800 NTU	+/- 5 % full scale
Dissolved oxygen	0 to 19.99 mg/l	+/- 0.2 mg/l
Temperature	0 to 55 ^{o}C	+/- 1.0 ^{o}C
ORP	-999 to +999 mV	+/- 15 mV
Salinity	0 to 4 %	+/- 0.3 %

B. Calibration:

Prior to each day's use, clean the probe and flow-through cell using deionized water and calibrate using the Standard Solution.

Horiba Calibration procedure:

1. Fill a calibration beaker with standard solution to the recommended fill line.
2. Insert the probe into the beaker. All the parameter sensors will now be immersed in the standard solution except the D.O. sensor; the D.O. calibration is done using atmospheric air.
3. Turn power on and allow some time for the machine to warm-up prior to starting the calibration. When the initial readings appear to stabilize the instrument is ready to calibrate.
4. Press CAL key to put the unit in the calibration mode.
5. Press the ENT key to start automatic calibration. Wait a moment, and the upper cursor will gradually move across the four auto-calibration parameters one by one: pH, COND, TURB, and DO. When the calibration is complete, the readout will briefly show END. The instrument is now calibrated.
6. If the unit is calibrated properly the instrument readings, while immersed in the standard solution, will match the standard solution values provided on the solution container. The typical standard solution values are: pH = 4.0 +/- 3%, conductivity 4.49 mS/cm +/- 3%, and turbidity = 0 NTU +/- 3%.
7. Record the calibration data (e.g. time, instrument ID, solution lot number and expiration date, final calibrated readings, and solution temperature in the field logbook.

YSI Calibration procedure:

1. Press the **On/off** key to display the run screen
2. Press the **Escape** key to display the main menu screen
3. Use the arrow keys to highlight the **Calibrate**
4. Press the **Enter** key. The Calibrate screen is displayed
5. Choose the parameter to calibrate

   A. Conductivity Calibration:

   This procedure calibrates specific conductance (recommended), conductivity and salinity. Calibrating any one option automatically calibrates the other two.

   1) Use the arrow keys to highlight the **Conductivity** selection
   2) Press **Enter.** The Conductivity Calibration Selection Screen is displayed.
   3) Use the arrow keys to highlight the Specific Conductance selection.
   4) Press **Enter.** The Conductivity Calibration Entry Screen is displayed.
   5) Place the correct amount of conductivity standard (see Instrument Manual) into a clean, dry or pre-rinsed transport/calibration cup.
   6) Carefully immerse the sensor end of the probe module into the solution.

7) Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell.

    NOTE: The sensor must be completely immersed past its vent hole. Using the recommended volumes from the Instrument Manual Calibration Volumes should ensure that the vent hole is covered.

8) Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

    NOTE: Do not over tighten as this could cause damage to the threaded portions.

9) Use the keypad to enter the calibration value of the standard you are using.

    NOTE: Be sure to enter the value in **mS/cm at 25°C**.

10) Press **Enter**. The Conductivity Calibration Screen is displayed.
11) Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
12) Observe the reading under Specific Conductance. When the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.
13) Press **Enter**. This returns you to the Conductivity Calibrate Selection Screen
14) Press **Escape** to return to the calibrate menu.
15) Rinse the probe module and sensors in tap or purified water and dry.

B. Dissolved Oxygen Calibration:

This procedure calibrates dissolved oxygen. Calibrating any one option (% or mg/L) automatically calibrates the other.

1) Go to the calibrate screen as described in Section

    NOTE: The instrument must be on for at least 20 minutes to polarize the DO sensor before calibrating.

2) Use the arrow keys to highlight the **Dissolved Oxygen** selection.
3) Press **Enter**. The dissolved oxygen calibration screen is displayed.
4) DO calibration in mg/L is carried out in a water sample which has a known concentration of dissolved oxygen (usually determined by a Winkler titration).
5) Use the arrow keys to highlight the **DO mg/L** selection.
6) Press **Enter**. The DO mg/L Entry Screen is displayed.
7) Place the probe module in water with a known DO concentration.

    NOTE: Be sure to completely immerse all the sensors.

8) Use the keypad to enter the known DO concentration of the water.
9) Press **Enter**. The Dissolved Oxygen mg/L Calibration Screen is displayed.
10) Stir the water with a stir bar, or by rapidly moving the probe module, to provide fresh sample to the DO sensor.
11) Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
12) Observe the DO mg/L reading, when the reading is stable (shows no significant change for approximately 30 seconds), press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.
13) Press **Enter**. This returns you to the DO calibration screen.

14) Press **Escape** to return to the calibrate menu.
15) Rinse the probe module and sensors in tap or purified water and dry.

C. pH Calibration:

1) Go to the calibrate screen.
2) Use the arrow keys to highlight the **pH** selection.
3) Press **Enter**. The pH calibration screen is displayed.
   - Select the **1-point** option only if you are adjusting a previous calibration. If a 2-point or 3-point calibration has been performed previously, you can adjust the calibration by carrying out a one point calibration. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to select only one pH buffer.
   - Select the **2-point** option to calibrate the pH sensor using only two calibration standards. Use this option if the media being monitored is known to be either basic or acidic. For example, if the pH of a pond is known to vary between 5.5 and 7, a two-point calibration with pH 7 and pH 4 buffers is sufficient. A three point calibration with an additional pH 10 buffer will not increase the accuracy of this measurement since the pH is not within this higher range.
   - Select the **3-point** option to calibrate the pH sensor using three calibration solutions. In this procedure, the pH sensor is calibrated with a pH 7 buffer and two additional buffers. The 3-point calibration method assures maximum accuracy when the pH of the media to be monitored cannot be anticipated. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to select a third pH buffer.
4) Use the arrow keys to highlight the **2-point** selection.
5) Press **Enter**. The pH Entry Screen is displayed.
6) Place the correct amount of pH buffer into a clean, dry or pre-rinsed transport/calibration cup.

   NOTE: For maximum accuracy, the pH buffers you choose should be within the same pH range as the water you are preparing to sample.
   NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the pH sensor with a small amount of buffer that can be discarded. Be certain that you avoid cross-contamination of buffers with other solutions.
7) Carefully immerse the sensor end of the probe module into the solution.
8) Gently rotate and/or move the probe module up and down to remove any bubbles from the pH sensor.

   NOTE: The sensor must be completely immersed. Using the recommended volumes from Table 6.1 Calibration Volumes, should ensure that the sensor is covered.
9) Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

   NOTE: Do not over tighten as this could cause damage to the threaded portions.
10) Use the keypad to enter the calibration value of the buffer you are using **at the current temperature**.

NOTE: pH vs. temperature values are printed on the labels of all YSI pH buffers.

11) Press **Enter**. The pH calibration screen is displayed.
12) Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
13) Observe the reading under pH, when the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.
14) Press **Enter**. This returns you to the Specified pH Calibration Screen.
15) Rinse the probe module, transport/calibration cup and sensors in tap or purified water and dry.
16) Repeat steps 6 through 13 above using a second pH buffer.
17) Press **Enter**. This returns you to the pH Calibration Screen.
18) Press **Escape** to return to the calibrate menu.
19) Rinse the probe module and sensors in tap or purified water and dry.

D. ORP Calibration:

1) Go to the calibrate screen.
2) Use the arrow keys to highlight the **ORP** selection.
3) Press **Enter**. The ORP calibration screen is displayed.
4) Place the correct amount of a known ORP solution into a clean, dry or pre-rinsed transport/calibration cup.

   NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the ORP sensor with a small amount of solution that can be discarded. Be certain that you avoid cross-contamination with other solutions.
5) Carefully immerse the sensor end of the probe module into the solution.
6) Gently rotate and/or move the probe module up and down to remove any bubbles from the ORP sensor.

   NOTE: The sensor must be completely immersed.
7) Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.
8) Use the keypad to enter the correct value of the calibration solution you are using at the current temperature.
9) Press **Enter**. The ORP calibration screen is displayed.
10) Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
11) Observe the reading under ORP, when the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.
12) Press **Enter**. This returns you to the Calibrate Screen.
13) Rinse the probe module and sensors in tap or purified water and dry.

    Record the calibration data (e.g. time, instrument ID, solution lot number and expiration date, final calibrated readings, and solution temperature in the field logbook.

C. Sample Measurement:

Horiba measurement procedure:

As water passes through the flow-through the flow cell, press MEAS to obtain reading; record data in a field notebook.

YSI measurement procedure:

As water passes through the flow-through the flow cell, the readings are displayed for each parameter. Record the water quality parameter data in a field notebook. In addition, the data is recorded in the YSI and can be downloaded to a computer following completion of the sampling event.

IV. Key Checks and Preventive Maintenance

- Calibrate meter
- Clean probe with deionized water when done
- Refer to operations manual for recommended maintenance and troubleshooting
- Check batteries, and have a replacement set on hand
- Due to the importance of obtaining these parameters, the field team should have a spare unit readily available in case of an equipment malfunction.

V. References

YSI 556 Multi Probe System Operator Manual

STANDARD OPERATING PROCEDURE

Sediment Sampling

I. Purpose

These general outlines describe the collection and handling of sediment samples during field operations.

II. Scope

The sediment sampling procedures generally describe the equipment and techniques needed to collect representative sediment samples. Operators manual , if available, should be consulted for specific details

III. Equipment and Materials

- Sample collection device (hand corer, scoop, dredge, grab sampler, or other suitable device)
- Stainless steel spoon or spatula for media transfer
- Measuring tape
- Log book
- Personal protection equipment (rubber or latex gloves, boots, hip waders, etc.)
- Materials for classifying soils, particularly the percentage of fines
- Sample jars, including jars for Total Organic Carbon and pH, as appropriate

IV. Procedures and Guidelines

1. Field personnel will start downstream and work upstream to prevent contamination of unsampled areas. In surface water bodies that are tidally influenced, sampling will be performed at low tide and under low flow conditions to minimize the dilution of possible contaminants. Sediment sampling activities will not occur immediately after periods of heavy rainfall.
2. Make a sketch of the sample area that shows important nearby river features and permanent structures that can be used to locate the sample points on a map. Whenever possible, include measured distances from such identifying features. Also include depth and width of waterway, rate of flow, type and consistency of sediment, and point and depth of sample removal (along shore, mid-channel, etc).

3. Note in the field book any possible outside sources of contamination. For example, the outlet to a drainage culvert in the water body near your sampling location.

4. Transfer sample into appropriate sample jars with a stainless steel utensil. Be especially careful to avoid the loss of the very fine clay/silt particles when collecting the sample. The fine particles have a higher adsorption capacity than larger particles. Minimize the amount of water that is collected within the sample matrix. Decant the water off of the sample slowly and carefully to maximize retention of the very fine particles. The sampler's fingers should never touch the sediment since gloves may introduce organic interference into the sample. Classify the soil type of the sample using the Unified Soil Classification System, noting particularly the percentage of silt and clay.

5. Samples for volatile organics should immediately be placed in jars. Rocks and other debris should be removed before placement in jars.

6. For channel sampling, be on the alert for submerged hazards (rocks, tree roots, drop-offs, loss silt and muck) which can make wading difficult.

7. Sample sediment for TOC and pH also, to give context to organic and inorganic data during the risk assessment.

8. Follow the site safety plan designed for the specific nature of the site's sampling activities and locations.

9. Decontaminate all sampling implements and protective clothing according to prescribed procedures.

V. Attachments

None.

VI. Key Checks and Items

- Start downstream, work upstream.
- Log exact locations using permanent features.
- Beware of hidden hazards.

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
- Pre-cleaned sample containers and stainless-steel sampling implements
- Personal Protective Equipment as specified by the Health and Safety Plan

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 sampling tube from the lead rod.

4. Cut open the acetate liner using a specific knife designed to slice the acetate liners (see below).

5. Fill all sample containers, beginning with the containers for VOC analysis, using a decontaminated or dedicated sampling implement. For the VOC samples, place the sample into a pre-preserved VOA vial or direct sample container such as an **En Core®** sampler and seal the cap tightly. Ideally, the operation should be completed in one minute. Label the vials and place on ice for shipment to the laboratory.

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

7. 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.

STANDARD OPERATING PROCEDURE

Soil Boring Drilling and Abandonment

I. Purpose and Scope

The purpose of this guideline is to describe methods to obtain samples of subsurface soil using either hollow-stem auger, rotary or sonic drilling methods, or tripod-mounted rig and then backfill boreholes to the surface. The guideline covers both split-spoon sampling and thin-walled tube sampling and includes soil borings through surface casings installed to prevent potential contamination in shallow water-bearing units from migrating downward into deeper units.

II. Equipment and Materials

- Truck-mounted drilling rig, skid rig, or tripod rig
- Hollow-stem augers and associated equipment or either rotary-drilling or sonic-drilling equipment
- Black iron steel or Schedule 80 PVC casing, at least 6-inch inside diameter (if surface casing is required), or sonic rig with telescoping casing
- Split-spoon or thin-walled tube samplers
- Downhole compacting tool (e.g., a pipe with a flat plate attached to the bottom)
- Cement
- Bentonite

III. Procedures and Guidelines

A. Drilling

Continuous-fight hollow-stem augers (HSA) with an inside diameter of at least 3.25 inches typically are used. The use of water or other fluid to assist in hollow-stem drilling will be avoided. Rotary drilling will be with a similar minimum diameter.

The bit of the auger or drill is placed on the ground at the location to be drilled and then turned with the drilling or soil-coring rig. The drilling is advanced to a depth just above the top of the interval to be sampled. For sonic drilling, a continuous core is collected and the sample interval is selected from the length of core run.

While advancing the auger or drill to the full borehole depth, the soils removed from the boring will be screened using a portable volatile organics detector.

A tripod drilling rig is generally a tripod equipped to collect soil samples using a hammer-driven sampler. The soil sample collection will be the same as that outlined for hollow-stem and rotary drilling. Borehole collapse due to soft sediments may occur when collecting samples using a tripod drilling rig.

Temporary surface casing may be installed where soil borings will penetrate a confining layer. The surface casing will be installed to prevent potential contamination in shallow water-bearing units from migrating downward into deeper units. Typically, surface casing has a 6-inch inside diameter (ID).

If the split-spoon sampling is to be advanced with a 3.25-inch ID and 7.25-inch outside diameter (O.D.) HSA, it will be necessary to pull the 3.25-inch augers and ream the hole with a minimum 10.25-inch ID HAS for the installation of the temporary surface casing. Alternatively, if the split-spoon sampling is advanced with mud-rotary drilling, it would require a 10.25-inch rotary bit to make room for the 6-inch I.D. surface casing.

The surface casing will be seated at least 5 feet into an underlying clay or silt layer and will be sealed in place using a bentonite slurry or bentonite pellets. This seal will prevent movement of groundwater downward from the shallow water-bearing unit but will allow the casing to be removed easily when the split-spoon sampling is completed. The split-spoon sampling will then be advanced with a 6-inch mud-rotary bit.

B. Sampling

Using the drilling rig, a hole is advanced to the desired depth. For split-spoon sampling, the samples are then collected following the ASTM D 1586 standard (attached). The sampler is lowered into the hole and driven to a depth equal to the total length of the sampler; typically this is 24 inches. The sampler is driven in 6-inch increments using a 140-pound weight (``hammer'') dropped from a height of 30 inches. The number of hammer blows for each 6-inch interval is counted and recorded on the boring log and/or field notebook. To obtain enough volume of sample for subsequent laboratory analysis, use of a 3-inch ID sampler may be required. Blow counts obtained with a 3-inch ID spoon would not conform to ASTM D 1586 and would therefore not be used for geotechnical evaluations. Samples will be collected from the soil borings at 2-foot to 5-foot intervals. For sonic drilling, a continuous core is collected and the sample interval is selected from the length of core run.

Once retrieved from the hole, the sampler is carefully split open. Care should be taken not to allow material in the sampler to fall out of the open end of the sampler. Samples may be collected for chemical analysis. These samples are collected in either decontaminated stainless-steel split-spoon samplers or new plastic sleeves for sonic drilling. Sampling the soil for chemical analysis is described in SOP *Soil Boring Sampling – Split Spoon.*

Undisturbed fine-grained samples may be collected for analysis for geotechnical parameters such as vertical hydraulic conductivity. These samples will be collected using thin-walled sampling tubes (sometimes called Shelby tubes). Tubes will be 24- to 36 inches long and 3- to 4-inches in diameter, depending upon the quantity of sample required. Undisturbed samples will be obtained by smoothly pressing the sampling tube through the interval to be sampled using the weight of the drilling rig. Jerking the sample should be avoided. Once the sample is brought to the surface, the ends will be sealed with bees wax and then sealed with end caps and heavy tape. The sample designation, data and time of sampling, and the up direction will be noted on the sampling tube. The tube shall be kept upright as much as possible and will be protected from freezing, which could disrupt the undisturbed nature of the sample. Samples for geochemical analysis normally are not collected from thin-walled tube samples. More details are provided in the ASTM D 1587 standard (attached).

C. Abandonment

The borehole will be grouted from total depth to the surface with bentonite-cement grout. The cement-bentonite grout will be installed continuously in one operation from the bottom of the space to be grouted to the ground surface. When installing grout in soil borings, the grout will be installed through a tremie pipe that is placed inside the augers or to the bottom of the borehole. The grouting will be completed before the augers or any temporary casing or drilling mud is removed.

D. Decontamination and Waste Disposal

Before sampling begins, equipment will be decontaminated according to the procedures identified in SOPs *Decontamination of Personnel and Equipment* and *Decontamination of Drilling Rig and Equipment*. The location to be sampled is cleared of debris and trash, and the location is noted in the logbook.

The soil cuttings are to be drummed and managed as described in SOP *Disposal of Waste Fluids and Soils* and the investigation-derived waste management plan.

IV. Attachments

ASTM D 1586 *Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils*

ASTM D 1587 *Standard Practice for Thin-Walled Tube Sampling of Soils*

V. Key Checks and Preventative Maintenance

- Check that the drilling rig or soil-coring rig is in working order.
- Check that the borehole is grouted to the ground surface at the completion of drilling and sampling.

STANDARD OPERATING PROCEDURE

Logging of Soil Borings

I. Purpose and Scope

This SOP provides guidance to obtain accurate and consistent descriptions of soil characteristics during soil-sampling operations. The characterization is based on visual examination and manual tests, not on laboratory determinations.

II. Equipment and Materials

- Indelible pens
- Tape measure or ruler
- Field logbook
- Spatula
- HCl, 10 percent solution
- Squirt bottle with water
- Rock- or soil-color chart (e.g., Munsell)
- Grain-size chart
- Hand lens
- Unified Soil Classification System (USCS) index charts and tables to help with soil classification (attached)

III. Procedures and Guidelines

This section covers several aspects of soil characterization: instructions for completing the CH2M HILL soil boring log Form D1586 (attached), field classification of soil, and standard penetration test procedures.

A. Instructions for Completing Soil Boring Logs

Soil boring logs will be completed in the field log books or on separate soil boring log sheets. Information collected will be consistent with that required for Form D1586 (attached), a standard CH2M HILL form (attached), or an equivalent form that supplies the same information.

The information collected in the field to perform the soil characterization is described below.

Field personnel should review completed logs for accuracy, clarity, and thoroughness of detail. Samples also should be checked to see that information is correctly recorded on both jar lids and labels and on the log sheets.

B. Heading Information

Boring/Well Number. Enter the boring/ well number. A numbering system should be chosen that does not conflict with information recorded for previous exploratory work done at the site. Number the sheets consecutively for each boring.

Location. If station, coordinates, mileposts, or similar project layout information is available, indicate the position of the boring to that system using modifiers such as "approximate" or "estimated" as appropriate.

Elevation. Elevation will be determined at the conclusion of field activities through a survey.

Drilling Contractor. Enter the name of the drilling company and the city and state where the company is based.

Drilling Method and Equipment. Identify the bit size and type, drilling fluid (if used), and method of drilling (e.g., rotary, hollow-stem auger). Information on the drilling equipment (e.g., CME 55, Mobile B61) also is noted.

Water Level and Date. Enter the depth below ground surface to the apparent water level in the borehole. The information should be recorded as a comment. If free water is not encountered during drilling or cannot be detected because of the drilling method, this information should be noted. Record date and time of day (for tides, river stage) of each water level measurement.

Date of Start and Finish. Enter the dates the boring was begun and completed. Time of day should be added if several borings are performed on the same day.

Logger. Enter the first and last name.

C. Technical Data

Depth Below Surface. Use a depth scale that is appropriate for the sample spacing and for the complexity of subsurface conditions.

Sample Interval. Note the depth at the top and bottom of the sample interval.

Sample Type and Number. Enter the sample type and number. SS-1 = split spoon, first sample. Number samples consecutively regardless of type. Enter a sample number even if no material was recovered in the sampler.

Sample Recovery. Enter the length to the nearest 0.1-foot of soil sample recovered from the sampler. Often, there will be some wash or caved material above the sample; do not include the wash material in the measurement. Record soil recovery in feet.

Standard Penetration Test Results. In this column, enter the number of blows required for each 6 inches of sampler penetration and the "N" value, which is the sum of the blows in the middle two 6-inch penetration intervals. A typical standard penetration test involving successive blow counts of 2, 3, 4, and 5 is recorded as 2-3-4-5 and (7). The standard penetration test is terminated if the sampler encounters refusal. Refusal is a penetration of less than 6 inches with a blow count of 50. A partial penetration of 50 blows for 4 inches is recorded as 50/4 inches. Penetration by the weight of the slide hammer only is recorded as "WOH."

Samples should be collected using a 140-pound hammer and 2-inch diameter split spoons. Samples may be collected using direct push sampling equipment. However, blow counts will not be available. A pocket penetrometer may be used instead to determine relative soil density of fine grained materials (silts and clays).

Sample also may be collected using a 300-pound hammer or 3-inch-diameter split-spoon samples at the site. However, use of either of these sample collection devices invalidates standard penetration test results and should be noted in the comments section of the log. The 300-pound hammer should only be used for collection of 3-inch-diameter split-spoon samples. Blow counts should be recorded for collection of samples using either a 3-inch split-spoon, or a 300-pound hammer. An "N" value need not be calculated.

Soil Description. The soil classification should follow the format described in the "Field Classification of Soil" subsection below.

Comments. Include all pertinent observations (changes in drilling fluid color, rod drops, drilling chatter, rod bounce as in driving on a cobble, damaged Shelby tubes, and equipment malfunctions). In addition, note if casing was used, the sizes and depths installed, and if drilling fluid was added or changed. You should instruct the driller to alert you to any significant changes in drilling (changes in material, occurrence of boulders, and loss of drilling fluid). Such information should be attributed to the driller and recorded in this column.

Specific information might include the following:

- The date and the time drilling began and ended each day
- The depth and size of casing and the method of installation
- The date, time, and depth of water level measurements
- Depth of rod chatter
- Depth and percentage of drilling fluid loss
- Depth of hole caving or heaving
- Depth of change in material
- Health and safety monitoring data
- Drilling interval through a boulder

D. Field Classification of Soil

This section presents the format for the field classification of soil. In general, the approach and format for classifying soils should conform to ASTM D 2488, Visual-Manual Procedure for Description and Identification of Soils (attached).

The Unified Soil Classification System is based on numerical values of certain soil properties that are measured by laboratory tests. It is possible, however, to estimate these values in the field with reasonable accuracy using visual-manual procedures (ASTM D 2488). In addition, some elements of a complete soil description, such as the presence of cobbles or boulders, changes in strata, and the relative proportions of soil types in a bedded deposit, can be obtained only in the field.

Soil descriptions should be precise and comprehensive without being verbose. The correct overall impression of the soil should not be distorted by excessive emphasis on insignificant details. In general, similarities rather than differences between consecutive samples should be stressed.

Soil descriptions must be recorded for every soil sample collected. The format and order for soil descriptions should be as follows:

1. Soil name (synonymous with ASTM D 2488 Group Name) with appropriate modifiers. Soil name should be in all capitals in the log, for example "POORLY-GRADED SAND."

2. Group symbol, in parentheses, for example, "(SP)."

3. Color, using Munsell color designation

4. Moisture content

5. Relative density or consistency

6. Soil structure, mineralogy, or other descriptors

This order follows, in general, the format described in ASTM D 2488.

E. Soil Name

The basic name of a soil should be the ASTM D 2488 Group Name on the basis of visual estimates of gradation and plasticity. The soil name should be capitalized.

Examples of acceptable soil names are illustrated by the following descriptions:

- A soil sample is visually estimated to contain 15 percent gravel, 55 percent sand, and 30 percent fines (passing No. 200 sieve). The fines are estimated as either low or highly plastic silt. This visual classification is SILTY SAND WITH GRAVEL, with a Group Symbol of (SM).

- Another soil sample has the following visual estimate: 10 percent gravel, 30 percent sand, and 60 percent fines (passing the No. 200 sieve). The fines are estimated as low plastic silt. This visual classification is SANDY SILT. The gravel portion is not included in the soil name because the gravel portion was estimated as less than 15 percent. The Group Symbol is (ML).

The gradation of coarse-grained soil (more than 50 percent retained on No. 200 sieve) is included in the specific soil name in accordance with ASTM D 2488. There is no need to further document the gradation. However, the maximum size and angularity or roundness of gravel and sand-sized particles should be recorded. For fine-grained soil (50 percent or more passing the No. 200 sieve), the name is modified by the appropriate plasticity/elasticity term in accordance with ASTM D 2488.

Interlayered soil should each be described starting with the predominant type. An introductory name, such as "Interlayered Sand and Silt," should be used. In addition, the relative proportion of each soil type should be indicated (see Table 1 for example).

Where helpful, the evaluation of plasticity/elasticity can be justified by describing results from any of the visual-manual procedures for identifying fine-grained soils, such as reaction to shaking, toughness of a soil thread, or dry strength as described in ASTM D 2488.

F. Group Symbol

The appropriate group symbol from ASTM D 2488 must be given after each soil name. The group symbol should be placed in parentheses to indicate that the classification has been estimated.

In accordance with ASTM D 2488, dual symbols (e.g., GP-GM or SW-SC) can be used to indicate that a soil is estimated to have about 10 percent fines. Borderline symbols (e.g., GM/SM or SW/SP) can be used to indicate that a soil sample has been identified as having properties that do not distinctly place the soil into a specific group. Generally, the group name assigned to a soil with a borderline symbol should be the group name for the first symbol. The use of a borderline symbol should not be used indiscriminately. Every effort should be made to first place the soil into a single group.

G. Color

The color of a soil must be given. The color description should be based on the Munsell system. The color name and the hue, value, and chroma should be given.

H. Moisture Content

The degree of moisture present in a soil sample should be defined as dry, moist, or wet. Moisture content can be estimated from the criteria listed on Table 2.

I. Relative Density or Consistency

Relative density of a coarse-grained (cohesionless) soil is based on N-values (ASTM D 1586 [attached]). If the presence of large gravel, disturbance of the sample, or non-standard sample collection makes determination of the in situ relative density or consistency difficult, then this item should be left out of the description and explained in the Comments column of the soil boring log.

Consistency of fine-grained (cohesive) soil is properly based on results of pocket penetrometer or torvane results. In the absence of this information, consistency can be estimated from N-values. Relationships for determining relative density or consistency of soil samples are given in Tables 3 and 4.

J. Soil Structure, Mineralogy, and Other Descriptors

Discontinuities and inclusions are important and should be described. Such features include joints or fissures, slickensides, bedding or laminations, veins, root holes, and wood debris.

Significant mineralogical information such as cementation, abundant mica, or unusual mineralogy should be described.

Other descriptors may include particle size range or percentages, particle angularity or shape, maximum particle size, hardness of large particles, plasticity of fines, dry strength, dilatancy, toughness, reaction to HCl, and staining, as well as other information such as organic debris, odor, or presence of free product.

K. Equipment and Calibration

Before starting the testing, the equipment should be inspected for compliance with the requirements of ASTM D 1586. The split-barrel sampler should measure 2-inch or 3-inch O.D., and should have a split tube at least 18 inches long. The minimum size sampler rod allowed is "A" rod (1-5/8-inch O.D.). A stiffer rod, such as an "N" rod (2-5/8-inch O.D.), is required for depths greater than 50 feet. The drive weight assembly should consist of a 140-pound or 300-pound hammer weight, a drive head, and a hammer guide that permits a free fall of 30 inches.

IV. Attachments

Soil Boring Log (Sample Soil Boring Log.xls)

CH2M HILL Form D1586 and a completed example (Soil_Log_Examp.pdf)

ASTM D 2488 *Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)* (ASTM D2488.pdf)

ASTM 1586 *Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils* (ASTM D1586.pdf)

Tables 1 through 4 (Tables 1-4.pdf)

V. Key Checks and Preventive Maintenance

- Check entries to the soil-boring log and field logbook in the field; because the samples will be disposed of at the end of fieldwork, confirmation and corrections cannot be made later.
- Check that sample numbers and intervals are properly specified.
- Check that drilling and sampling equipment is decontaminated using the procedures defined in SOP *Decontamination of Drilling Rigs and Equipment*.

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.

CH2MHILL

PROJECT NUMBER	BORING NUMBER

SOIL BORING LOG

PROJECT : LOCATION :

ELEVATION : DRILLING CONTRACTOR :

DRILLING METHOD AND EQUIPMENT USED :

ATD WATER LEVEL : START : END : LOGGER :

DEPTH BELOW SURFACE (FT) / INTERVAL (FT) / RECOVERY (IN) / SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N')	COPR Strata	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS. PID Readings: Breathing Zone: Above Hole:

CH2M HILL

PROJECT NUMBER	BORING NUMBER SHEET OF
	SOIL BORING LOG

PROJECT ______ LOCATION ______

ELEVATION ______ DRILLING CONTRACTOR ______

DRILLING METHOD AND EQUIPMENT ______

WATER LEVELS ______ START ______ FINISH ______ LOGGER ______

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION

Figure 1
SOIL BORING LOG, FORM D1586

REV 11/89 FORM D1586

CH2M HILL

PROJECT NUMBER	BORING NUMBER	SHEET 1 OF 3
DEN 22371.G5	BL-3	

SOIL BORING LOG

PROJECT Howard Ave Landslide LOCATION Howard & 24th Ave, Centennial, CO

ELEVATION 5136 Feet DRILLING CONTRACTOR Kendall Explorations, Ashcan, Colorado

DRILLING METHOD AND EQUIPMENT 4"-inch H.S. Augers, Mobil B-61 rotary drill rig

WATER LEVELS 3.2 Feet, 8/5/89 START August 4, 1989 FINISH August 8, 1989 LOGGER J.A. Michner

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0	2.5				Surface material consist of 4 inches AC underlain by 6 inches of 3/4 inch minus base rock	Start Drilling @ 3:00
	4.0	1-S	1.5	2-3-4 (7)	POORLY-GRADED SAND WITH SILT, (SP-SM), fine, light brown, wet, loose	Driller notes water at 4 feet
5	5.0 / 6.5	2-S	0.9	WOH/12"-1	ORGANIC SILT, (OL), very dark, gray to black, wet, very soft; strong H_2S odor, many fine roots up to about 1/4 inch	Driller notes very soft drilling 4ft. dark grey, wet silty cuttings.
	8.0 / 10.0	3-ST	1.3	—	ORGANIC SILT, similar to 2-S, except includes fewer roots (by volume)	
10	11.5	4-S	1.3	2-2-2 (4)	SILT, (ML), very dark gray to black, wet, soft	water level @ 3.2 feet on 8/5/89 @ 0730
						Driller notes rough drilling action and chatter @ 13ft
15	15.0 / 15.5	5-S	0.5	60/6"	SILTY GRAVEL, (GM), rounded gravel up to about 1 inch maximum observed size, wet, very dense	
20	20.0 / 21.0	6-S	1.0	12-50/6"	LEAN CLAY WITH SAND, (CL), medium to light green, moist, very stiff	Driller notes smoother, firm drilling @ 19 ft. some angular rock chips @ bot. tip of 6-S, poss boulders or rock. Driller notes very hard, slow grinding, smooth drilling action from 21 to 23 ft, possibly bedrock
	23.0 / 23.1	7-S	0	50/1"	NO RECOVERY	
					END SOIL BORING @ 23.1 FEET SEE ROCK CORE LOG FOR CONTINUATION OF BL-3	

Figure 2
EXAMPLE OF COMPLETED LOG FORM

REV 11 89 FORM D1586

STANDARD OPERATING PROCEDURE

Soil Sampling

I. Purpose and Scope

The purpose of this procedure is to provide guidelines for obtaining samples of surface and subsurface soils using hand and drilling-rig mounted equipment.

II. Equipment and Materials

- Stainless-steel trowel, shovel, scoop, coring device, hand auger, or other appropriate hand tool
- Stainless-steel, split-spoon samplers
- Thin-walled sampling tubes
- Drilling rig or soil-coring rig
- Stainless-steel pan or bowl
- Sample bottles

III. Procedures and Guidelines

Before sampling begins, equipment will be decontaminated using the procedures described in SOP *Decontamination of Drilling Rigs and Equipment*. The sampling point is located and recorded in the field logbook. Debris should be cleared from the sampling location.

A. Surface and Shallow Subsurface Sampling

A shovel, post-hole digger, or other tool can be used to remove soil to a point just above the interval to be sampled. A decontaminated sampling tool will be used to collect the sample when the desired sampling depth has been reached. Soil for semivolatile organic and inorganic analyses is placed in the bowl and mixed; soil for volatile organic analysis is not mixed or composited but is placed directly into the appropriate sample bottles. A stainless-steel or dedicated wooden tongue depressor is used to transfer the sample from the bowl to the container.

The soils removed from the borehole should be visually described in the field log book, including approximated depths.

When sampling is completed, photo-ionization device (PID) readings should be taken directly above the hole, and the hole is then backfilled.

More details are provided in the SOP *Shallow Soil Sampling*.

B. Split-Spoon Sampling

Using a drilling rig, a hole is advanced to the desired depth. For split-spoon sampling, the samples are then collected following the ASTM D 1586 standard (attached). The sampler is lowered into the hole and driven to a depth equal to the total length of the sampler; typically this is 24 inches. The sampler is driven in 6-inch increments using a 140-pound weight ("hammer") dropped from a height of 30 inches. The number of hammer blows for each 6-inch interval is counted and recorded. To obtain enough volume of sample for subsequent laboratory analysis, use of a 3-inch ID sampler may be required. Blow counts obtained with a 3-inch ID spoon would not conform to ASTM D 1586 and would therefore not be used for geotechnical evaluations.

Once retrieved from the hole, the sampler is carefully split open. Care should be taken not to allow material in the sampler to fall out of the open end of the sampler. To collect the sample, the surface of the sample should be removed with a clean tool and disposed of. Samples collected for volatiles analysis should be placed directly into the sample containers from the desired depth in the split spoon. Material for samples for all other parameters should be removed to a decontaminated stainless steel tray. The sample for semivolatile organic and inorganic analyses should be homogenized in the field by breaking the sample into small pieces and removing gravel. The homogenized sample should be placed in the sample containers. If sample volume requirements are not met by a single sample collection, additional sample volume may be obtained by collecting a sample from below the sample and compositing the sample for non-volatile parameters only.

Split-spoon samples also will be collected using a tripod rig. When using a tripod rig the soil samples are collected using an assembly similar to that used by the drilling rig.

C. Thin-Walled Tube Sampling

Undisturbed fine grained samples may be collected for analysis for geotechnical parameters such as vertical hydraulic conductivity. These samples will be collected using thin-walled sampling tubes (sometimes called Shelby tubes) according to ASTM D 1587 (attached). Tubes will be 24- to 36 inches long and 3- to 4-inches in diameter, depending upon the quantity of sample required. Undisturbed samples will be obtained by smoothly pressing the sampling tube through the interval to be sampled using the weight of the drilling rig. Jerking the sample should be avoided. Once the sample is brought to the surface, the ends will be sealed with bees wax and then sealed with end caps and heavy tape. The sample designation, data and time of sampling, and the up direction will be noted on the sampling tube. The tube shall be kept upright as much as possible and will be protected from freezing, which could disrupt the undisturbed nature of the sample. Samples for geochemical analysis normally are not collected from thin-walled tube samples.

IV. Attachments

ASTM D 1586 *Standard Penetration Test Method for Penetration Test and Split-Barrel Sampling of Soils* (ASTM D1586.pdf)

ASTM D 1587 *Standard Practice for Thin-Walled Tube Sampling of Soils* (ASTM D1587.pdf)

V. Key Checks and Preventative Maintenance

- Check that decontamination of equipment is thorough.
- Check that sample collection is swift to avoid loss of volatile organics during sampling.

STANDARD OPERATING PROCEDURE

Global Positioning System

I. Purpose

The procedure describes the calibration, operation, and functions associated with a Trimble® Pro XRS GPS Unit with a TSC-1 Asset Surveyor for datalogging. GPS signal information is differentially corrected to sub-meter accuracy on a continual basis using a second satellite signal broadcast from OmniSTAR satellite subscription service. The procedure applies to all field data collection activities.

II. Scope

This procedure provides information regarding the field operation and general maintenance of a Trimble® Pro XRS GPS Unit with a TSC-1 Asset Surveyor for datalogging. The information contained herein presents the operation procedures for this equipment. Review of the equipment's instruction manual is a necessity for more detailed descriptions pertaining to the operation and maintenance of the equipment.

III. Definitions

GPS: Global Positioning System - A system of 24 satellites developed and operated by the US DOD. Continuous 3D coordinate information is broadcast free of charge on a worldwide basis enabling precise positional location. Three standard categories of positional accuracy are generally used:

1. Uncorrected Signal - accuracy +/-10 meters - a single satellite transmission is used
2. Differentially Corrected Signal - accuracy +/- <1 meter - additional positional transmissions are recorded simultaneously and used to triangulate coordinate position.
3. Carrier Phase Signal- accuracy +/- <1 centimeter - requires a second receiver and additional software. Both receivers need to be equipped to receive Carrier Phase signals.

IV. Procedures and Guidelines

The procedure for calibration, operation, and maintenance of the GPS unit is outlined below. Daily calibration and battery recharging is typical operating procedure; frequencies other than daily shall be noted in the logbook and reason for increased frequency recorded. If using a different instrument, the operation manual supplied by the manufacturer should be consulted for instructions.

The procedures described below include additional features pre-programmed into the GPS datalogger to aid the data collection process.

A. Calibration

1. Check to ensure that the datalogger and antenna cables are properly connected to the receiver and that the batteries are securely connected.
2. Turn the datalogger unit on by pressing the green **On** key in the bottom left corner. The datalogger will perform a self-calibration. Wait to ensure that the antenna is receiving a sufficient number of satellite signals (usually a minimum of 3).
3. Once the datalogger receives a satellite signal then it is ready for operation.

B. Operations for surveying coordinates of a location

1. The datalogger and GPS receiver are ready for use after the initial self-calibration.
2. Field data may be immediately recorded in the datalogger.
3. The first screen view is the 'Main Menu'. Use the round keypad to select 'Data Collection' and press the **Enter** key.
4. Use the round keypad to select either 'Create new file' or 'Open existing file' and press the **Enter** key. It is not necessary to create a new file at each new location; however, it may be useful to create a new file at the beginning of each day.
5. If a new file is created then the GPS unit will automatically assign it a file name. The file name may be changed if desired. Press the enter key after the file name is assigned. If opening an existing file then use the round keypad to scroll through existing file names.
6. The next screen is 'Antenna options'. Press the **Enter** key to move to the next screen.
7. Select the type of activity to be performed. At the beginning of each day 'Sample Site Detail' should be completed. This allows the operator to enter each field team member, weather, objectives, health and safety meetings, etc. Once the 'Sample Site Detail' is completed then data entry activities may begin including well purging, water level elevations, and sample collection
8. The datalogger prompts the operator when a data field is required and by using the round key pad, numeric, alphanumeric, enter, and escape keys, the operator can perform electronic data capture on the GPS datalogger.
9. Once all information pertaining to an individual site has been recorded, press enter to complete data entry. If GPS signal is obstructed (tree canopy, building height, etc) user may choose to remain in same location until satellite transmission clears the obstruction. This usually takes only a few moments. Data may still be captured and recorded electronically even if GPS signal is insufficient for positioning.
10. To shut down, press the **Escape** key to return to the 'Main Menu'. The unit can be turned off by pressing the green key in the left hand corner. The datalogger should only be turned off when the 'Main Menu' screen is displayed.
11. All data from the datalogger should be downloaded into Trimble Pathfinder Office software on a PC a minimum of once daily. It is recommended that data is downloaded twice daily. Data may be viewed and mapped using Pathfinder Office or exported to

other software. Export file formats support standard ASCII text, generic database .dbf and most GIS and CAD software.

C. Operations for locating a point using coordinates/reacquiring a previously surveyed location

1. The datalogger and GPS receiver are ready for use after the initial self-calibration.
2. Use the Trimble Pathfinder software to load the data file containing the coordinates for each desired location ("programmed location").
3. The first screen view is the 'Main Menu'. Use the keypad to select 'Navigation' and press the **Enter** key.
4. Use the round keypad to select 'Open existing file' to open the file loaded in Step 2 above.
5. Select the location to be reacquired from the screen and press the enter key.
6. A circle with an arrow will appear. As you begin walking, the arrow will point in the direction of the programmed location. Walk in the direction indicated by the arrow.
7. Once you are within 10-feet of the location being reacquired, the GPS unit will display a circle (representing the programmed location) and an "X" (representing the GPS unit). Continue to walk in the direction of the circle until the "X" is centered in the circle. Once the "X" is centered, you are standing at the programmed location.
8. To shut down, press the **Escape** key to return to the 'Main Menu'. The unit can be turned off by pressing the green key in the left hand corner. The datalogger should only be turned off when the 'Main Menu' screen is displayed.

D. Preventive Maintenance

The antenna and datalogger are weatherproof. It is recommended that the receiver remain in the provided backpack carrier. Care should be taken not to crease, pinch or bend the antenna cable. Data should be downloaded from the datalogger a minimum of once daily, twice daily is preferred. At the end of each day the receiver batteries should be recharged. For technical assistance call the rental company through which you acquired the Trimble® unit. Guidance is also provided in the manual and at http://www.trimble.com.

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 collection 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

Multi RAE Photoionization Detector (PID)

I. Purpose

The purpose of this SOP is to provide general reference information for using the Multi RAE PID in the field. Calibration and operation, along with field maintenance, will be included in this SOP.

II. Scope

This procedure provides information on the field operation and general maintenance of the Multi RAE PID. Review of the information contained herein will ensure that this type of field monitoring equipment will be properly utilized. Review of the owner's instruction manuals is a necessity for more detailed descriptions.

III. Definitions

Carbon Monoxide Sensor (CO) - Expresses the Carbon Monoxide concentration in ppm.

Volatile Organic Compound (VOC) – Expresses the VOC concentration in ppm

Lower Explosive Limit (LEL) - Combustible gas is expressed as a percent of the lower explosive limit.

Hydrogen Sulfide Sensor (H_2S) - Expresses the Hydrogen Sulfide concentration in ppm.

Oxygen Sensor (OXY) - Expresses the Oxygen concentration as a percentage.

ppm - parts per million: parts of vapor or gas per million parts of air by volume.

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 selecting qualified individuals for the monitoring activities.

Health and Safety Coordinator - The Health and Safety Coordinator is responsible for developing a site-specific Health and Safety Plan (HASP) which specifies air monitoring requirements.

Field Team Leader - It is the responsibility of the Field Team Leader to implement these procedures in the field, and to ensure that the field team performing air monitoring activities have been briefed and trained to execute these procedures before the start of site operations.

Safety Coordinator-Hazard Worker (SC-HW)- The SC-HW is responsible for ensuring that the specified air monitoring equipment is on site, calibrated, and used correctly by the field personnel. The SC-HW will coordinate these activities with the Field Team Leader if the SC-HW is not the Field Team Leader as well.

Field team - It is the responsibility of the field team to follow these procedures or to follow documented project-specific procedures as directed by the Field Team Leader/ Safety Coordinator-Hazard Worker. The field personnel are responsible for documenting all air monitoring results in the field logbook during each field investigation.

V. Procedures

The Multi RAE utilizes the principle of detecting sensors. The PID operates on the principle that most organic compounds and some inorganic compounds are ionized when they are bombarded by high-energy ultraviolet light. These compounds absorb the energy of the light, which excites the molecules and results in a loss of electron and the formation of a positively charged ion. The number of ions formed and the ion current produced is directly proportional to mass and concentration. The amount of energy required to displace an electron is called ionization potential (IP). The air sample is drawn into a UV lamp using a pump or a fan. The energy of the lamp determines whether a particular chemical will be ionized. Each chemical compound has a unique ionizing potential. When the UV light energy is greater than the ionization potential of the chemical, ionization will occur. When the sample is ionized, the electrical signal is displayed on an analog or digital output. Although the output does not distinguish between chemicals, it does detect an increase in the ion current. If only one chemical is present in the air, it is possible to use PIDs quantitatively. Chemical structure and lamp intensity affects the sensitivity of the instrument to a given contaminant. All PID readings are relative to the calibration gas, usually isobutylene. It is important to calibrate the PID in the same temperature and elevation that the equipment will be used, and to determine the background concentrations in the field before taking measurements. For environments where background readings are high, factory zero calibration gas should be used.

The following subsections will discuss Multi RAE calibration, operation, and maintenance. These sections, however, do not take the place of the instruction manual.

A. Calibration

For Multi RAE configured with O_2, LEL, H_2S, CO, sensors and a 10.6eV PID Lamp.

Start up Instrument

- Press **Mode** button

- Observe displays:

On!……..

Multi RAE Version X.XX

Model Number SN XXXX

Date Time Temp

Checking Sensor Ids….

VOC Installed

CO Installed

H_2S Installed

OXY Installed

LEL Installed

H_2S VOC CO LEL OXY

Alarm Limits=

XX XX.X XX XX High XX.X

XX XX.X XX XX Low XX.X

XX XX.X XX STEL

XX XX.X XX TWA

Battery = X.XV Shut off at 4.2V

User Mode=

Alarm Mode=

Datalog Time Left

Datalog Mode

Datalog Period

Unit ready in…..
10 Seconds

- The pump will start, the seconds will count down to zero, and the instrument will be ready for use

Calibration Check and Adjustment

Allow instrument to warm up for 15 minutes.

- Depress the **[N/-]** key first, then while depressing the **[N/-]**, depress the **[Mode]** key also and depress both keys for 5 seconds.
- Display will read:

Calibrate
Monitor?

- Press the **[Y/+]** key
- Display will read:

Fresh Air
Calibration?

- If "Zero Air" is necessary, attach the calibration adapter over the inlet port of the Multi RAE Monitor and connect the other end of the tube to the gas regulator (HAZCO loaner regulator LREG.5, RAE Systems P/N 008-3011 or suitable .5 LPM regulator) on the Zero Air bottle (HAZCO P/N SGZA, RAE P/N 600-0024). If no Zero Air is available, perform the Fresh Air Calibration in an area free of any detectable vapor.
- Press the **[Y/+]** key
- Display will read:

Zero….
In progress…

CO Zeroed!
Reading = X

VOC Zeroed!
Reading = X

LEL Zeroed! Reading = X

OXY Zeroed! Reading = X

Zero Cal done!
H_2S Zeroed! Reading = X

In each of the above screens, "X" is equal to the reading of the sensor before it was zeroed.

- Display will then read:

Multiple Sensor Calibration?

- Press the **[Y/+]** key
- The display shows all of the pre-selected sensors and the "OK?" question:

CO H_2S LEL OK? OXY

- Apply calibration gas – use either HAZCO Services Part Number R-SGRAE4 or Rae Systems Part Number 008-3002 – using a .5 LPM regulator and direct tubing.
- Press the **[Y/+]** key. Display will read:

Apply Mixed gas

Calibration In progress …

- The display will count down showing the number of remaining seconds:

CO cal'ed Reading=50

H_2S cal'ed Reading=25

LEL cal'ed Reading=50

OXY cal'ed Reading=20.9

Calibration done Turn off gas!

- Display will read:

Single Sensor Calibration?

- Press the **[Y/+]**.
- Display will read:

CO VOC H_2S LEL pick? OXY

- Attach 100 ppm Isobutylene (HAZCO P/N r-SGISO or Rae P/N 600-0002) using a 1.0 LPM regulator (HAZCO P/N LR10HS or Rae P/N 008-3021). Open regulator.
- Press the **[Mode]** key once, the V of VOC will be highlighted.
- Press the **[Y/+]**. The display will read:

Apply VOC Gas

Calibration In progress…

- The display will count down showing the number of remaining seconds:, then display:

VOC cal'd Reading=100

Calibration done Turn off gas!

Single Sensor Calibration?

- Press **[Mode]** key twice to return to main screen.
- **CALIBRATION IS COMPLETE!**

B. Operation

Due to the Multi RAE having many functions in terms of operation, it is recommended that you follow the operational procedures as outlined in the instruction manual from pages 9 to 14.

C. Site Maintenance

After each use, the meter should be recharged and the outside of the instruments should be wiped clean with a soft cloth.

D. Scheduled Maintenance

<u>Function</u>	<u>Frequency</u>
Check alarm and settings	Monthly/before each use

Clean screens and gaskets around sensors	Monthly
Replace sensors	Biannually or when calibration is unsuccessful

VI. Quality Assurance Records

Quality assurance records will be maintained for each air monitoring event. The following information shall be recorded in the field logbook.

- Identification - Site name, date, location, CTO number, activity monitored, (surface water sampling, soil sampling, etc), serial number, time, resulting concentration, comments and identity of air monitoring personnel.
- Field observations - Appearance of sampled media (if definable).
- Additional remarks (e.g, Multi RAE had wide range fluctuations during air monitoring activities.)

VII. References

Multi RAE Plus Multiple Gas Monitor User Manual, RAE Systems, Revision B1, November 2003.

Attachment B
DoD ELAP Accreditation Letters

LABORATORY ACCREDITATION BUREAU

Certificate of Accreditation

ISO/IEC 17025:2005 **_Certificate Number L2226_**

Empirical Laboratories, LLC

621 Mainstream Drive, Suite 270
Nashville, TN 37228

has met the requirements set forth in L-A-B's policies and procedures, all requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).*

The accredited lab has demonstrated technical competence to a defined "Scope of Accreditation" and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation Granted through: November 30, 2012

R. Douglas Leonard, Jr., Managing Director
Laboratory Accreditation Bureau
Presented the 30th of November 2009

*See the laboratory's Scope of Accreditation for details of the DoD ELAP requirements
Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).

LABORATORY ACCREDITATION BUREAU

Certificate # L2226

Scope of Accreditation
For
Empirical Laboratories, LLC

621 Mainstream Drive, Suite 270
Nashville, TN 37228
Marcia K. McGinnity
877-345-1113

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.1) based on the National Environmental Laboratory Accreditation Conference Chapter 5 Quality Systems Standard (NELAC Voted Revision June 5, 2003), accreditation is granted to Empirical Laboratories, LLC to perform the following tests:

Accreditation granted through: **November 30, 2012**

Testing - Environmental

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B	1,1,1-Trichloroethane (1,1,1-TCA)
GC/MS	EPA 8260B	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B	1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113; Freon 113)
GC/MS	EPA 8260B	1,1,2-Trichloroethane
GC/MS	EPA 8260B	1,1-Dichloroethane (1,1-DCA)
GC/MS	EPA 8260B	1,1-Dichloroethene (1,1-DCE)
GC/MS	EPA 8260B	1,1-Dichloropropene
GC/MS	EPA 8260B	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B	1,2,3-Trichloropropane
GC/MS	EPA 8260B	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B	1,2-Dibromoethane (EDB)
GC/MS	EPA 8260B	1,2-Dichlorobenzene
GC/MS	EPA 8260B	1,2-Dichloroethane (EDC)
GC/MS	EPA 8260B	1,2-Dichloropropane
GC/MS	EPA 8260B	1,3,5-Trimethylbenzene

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8260B	1,3-Dichlorobenzene
GC/MS	EPA 8260B	1,3-Dichloropropane
GC/MS	EPA 8260B	1,4-Dichlorobenzene
GC/MS	EPA 8260B	1,4-Dioxane
GC/MS	EPA 8260B	1-Chlorohexane
GC/MS	EPA 8260B	2,2-Dichloropropane
GC/MS	EPA 8260B	2-Butanone (Methyl ethyl ketone; MEK)
GC/MS	EPA 8260B	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B	2-Chlorotoluene
GC/MS	EPA 8260B	2-Hexanone (Methyl butyl ketone; MBK)
GC/MS	EPA 8260B	4-Chlorotoluene
GC/MS	EPA 8260B	4-Methyl-2-pentanone (Methyl isobutyl ketone; MIBK)
GC/MS	EPA 8260B	Acetone
GC/MS	EPA 8260B	Acetonirile
GC/MS	EPA 8260B	Acrolein
GC/MS	EPA 8260B	Acrylonitrile
GC/MS	EPA 8260B	Allyl chloride
GC/MS	EPA 8260B	Benzene
GC/MS	EPA 8260B	Bromobenzene
GC/MS	EPA 8260B	Bromochloromethane
GC/MS	EPA 8260B	Bromodichloromethane
GC/MS	EPA 8260B	Bromoform
GC/MS	EPA 8260B	Bromomethane
GC/MS	EPA 8260B	Carbon Disulfide
GC/MS	EPA 8260B	Carbon Tetrachloride
GC/MS	EPA 8260B	Chlorobenzene
GC/MS	EPA 8260B	Chloroethane
GC/MS	EPA 8260B	Chloroform
GC/MS	EPA 8260B	Chloromethane
GC/MS	EPA 8260B	Chloroprene
GC/MS	EPA 8260B	cis-1,2-Dichloroethene (cis-1,2-DCE)
GC/MS	EPA 8260B	cis-1,3-Dichloropropene
GC/MS	EPA 8260B	cis-1,4-Dichloro-2-butene

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Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	Cyclohexane
GC/MS	EPA 8260B	Dibromochloromethane
GC/MS	EPA 8260B	Dibromomethane
GC/MS	EPA 8260B	Dichlorodifluoromethane (CFC-12)
GC/MS	EPA 8260B	Di-isopropyl ether
GC/MS	EPA 8260B	ETBE
GC/MS	EPA 8260B	Ethyl methacrylate
GC/MS	EPA 8260B	Ethylbenzene
GC/MS	EPA 8260B	Hexachlorobutadiene
GC/MS	EPA 8260B	Hexane
GC/MS	EPA 8260B	Iodomethane
GC/MS	EPA 8260B	Isobutyl alcohol
GC/MS	EPA 8260B	Isopropylbenzene (Cumene)
GC/MS	EPA 8260B	Methacrylonitrile
GC/MS	EPA 8260B	Methyl Acetate
GC/MS	EPA 8260B	Methyl methacrylate
GC/MS	EPA 8260B	Methyl Tertiary Butyl Ether (MTBE)
GC/MS	EPA 8260B	Methylcyclohexane
GC/MS	EPA 8260B	Methylene Chloride, or Dichloromethane
GC/MS	EPA 8260B	Naphthalene
GC/MS	EPA 8260B	n-Butylbenzene
GC/MS	EPA 8260B	n-Propylbenzene
GC/MS	EPA 8260B	p-Isopropyltoluene
GC/MS	EPA 8260B	Propionitrile
GC/MS	EPA 8260B	sec-Butylbenzene
GC/MS	EPA 8260B	Styrene
GC/MS	EPA 8260B	t-Butyl alcohol
GC/MS	EPA 8260B	tert-Amyl methyl ether
GC/MS	EPA 8260B	tert-Butylbenzene
GC/MS	EPA 8260B	Tetrachloroethene (PCE; PERC)
GC/MS	EPA 8260B	Tetrahydrofuran
GC/MS	EPA 8260B	Toluene
GC/MS	EPA 8260B	trans-1,2-Dichloroethene (trans-1,2-DCE)

LABORATORY ACCREDITATION BUREAU

Certificate # L2226

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	trans-1,3-Dichloropropene
GC/MS	EPA 8260B	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B	Trichloroethene (TCE)
GC/MS	EPA 8260B	Trichlorofluoromethane (CFC-11)
GC/MS	EPA 8260B	Vinyl acetate
GC/MS	EPA 8260B	Vinyl Chloride (VC)
GC/MS	EPA 8260B	Xylenes (Total)
GC/MS	EPA 8270C/D	1,1'-Biphenyl
GC/MS	EPA 8270C/D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270C/D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270C/D	1,2-Dichlorobenzene
GC/MS	EPA 8270C/D	1,2-Diphenylhydrazine
GC/MS	EPA 8270C/D	1,3-Dichlorobenzene
GC/MS	EPA 8270C/D	1,4-Dichlorobenzene
GC/MS	EPA 8270C/D	1,4-Dioxane
GC/MS	EPA 8270C/D	1-Methylnaphthalene
GC/MS	EPA 8270C/D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270C/D	2,4,5-Trichlorophenol
GC/MS	EPA 8270C/D	2,4,6-Trichlorophenol (TCP)
GC/MS	EPA 8270C/D	2,4-Dichlorophenol (DCP)
GC/MS	EPA 8270C/D	2,4-Dimethylphenol
GC/MS	EPA 8270C/D	2,4-Dinitrophenol
GC/MS	EPA 8270C/D	2,4-Dinitrotoluene (DNT)
GC/MS	EPA 8270C/D	2,6-Dichlorophenol
GC/MS	EPA 8270C/D	2,6-Dinitrotoluene
GC/MS	EPA 8270C/D	2-Chloronaphthalene
GC/MS	EPA 8270C/D	2-Chlorophenol
GC/MS	EPA 8270C/D	2-Methylnaphthalene
GC/MS	EPA 8270C/D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270C/D	2-Nitroaniline
GC/MS	EPA 8270C/D	2-Nitrophenol (ONP)
GC/MS	EPA 8270C/D	3,3'-Dichlorobenzidine (DCB)
GC/MS	EPA 8270C/D	3-Methylphenol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C/D	3-Nitroaniline
GC/MS	EPA 8270C/D	4,6-Dinitro-2-methylphenol (DNOC)
GC/MS	EPA 8270C/D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270C/D	4-Chloro-3-methylphenol
GC/MS	EPA 8270C/D	4-Chloroaniline
GC/MS	EPA 8270C/D	4-Chlorophenyl phenyl ether
GC/MS	EPA 8270C/D	4-Methylphenol (p-Cresol)
GC/MS	EPA 8270C/D	4-Nitroaniline (PNA)
GC/MS	EPA 8270C/D	4-Nitrophenol (PNP)
GC/MS	EPA 8270C/D	7,12-Dimethylbenz(a)anthracene
GC/MS	EPA 8270C/D	Acenaphthene
GC/MS	EPA 8270C/D	Acenaphthylene
GC/MS	EPA 8270C/D	Acetaphenone
GC/MS	EPA 8270C/D	Aniline
GC/MS	EPA 8270C/D	Anthracene
GC/MS	EPA 8270C/D	Atrazine
GC/MS	EPA 8270C/D	Benzaldehyde
GC/MS	EPA 8270C/D	Benzidine
GC/MS	EPA 8270C/D	Benzo(a)anthracene
GC/MS	EPA 8270C/D	Benzo(a)pyrene
GC/MS	EPA 8270C/D	Benzo(b)fluoranthene
GC/MS	EPA 8270C/D	Benzo(g,h,i)perylene
GC/MS	EPA 8270C/D	Benzo(k)fluoranthene
GC/MS	EPA 8270C/D	Benzoic Acid
GC/MS	EPA 8270C/D	Benzyl alcohol
GC/MS	EPA 8270C/D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270C/D	bis(2-Chloroethyl)ether (BCEE)
GC/MS	EPA 8270C/D	Bis(2-chloroisopropyl)ether, or 2,2'-oxybis (1-Chloropropane)
GC/MS	EPA 8270C/D	bis(2-Ethylhexyl)phthalate (BEHP)
GC/MS	EPA 8270C/D	Butyl benzyl phthalate (BBP)
GC/MS	EPA 8270C/D	Caprolactam
GC/MS	EPA 8270C/D	Carbazole

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8270C/D	Chrysene
GC/MS	EPA 8270C/D	Dibenz(a,h)anthracene
GC/MS	EPA 8270C/D	Dibenzofuran (DBF)
GC/MS	EPA 8270C/D	Diethyl phthalate (DEP)
GC/MS	EPA 8270C/D	Dimethyl phthalate (DMP)
GC/MS	EPA 8270C/D	Di-n-butyl phthalate (DBP)
GC/MS	EPA 8270C/D	Di-n-octyl phthalate (DNOP)
GC/MS	EPA 8270C/D	Fluoranthene
GC/MS	EPA 8270C/D	Fluorene
GC/MS	EPA 8270C/D	Hexachlorobenzene (HCB)
GC/MS	EPA 8270C/D	Hexachlorobutadiene (HCBD)
GC/MS	EPA 8270C/D	Hexachlorocyclopentadiene (HCCPD)
GC/MS	EPA 8270C/D	Hexachloroethane (HCE)
GC/MS	EPA 8270C/D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270C/D	Isophorone
GC/MS	EPA 8270C/D	Naphthalene
GC/MS	EPA 8270C/D	Nitrobenzene
GC/MS	EPA 8270C/D	N-Nitrosodimethylamine
GC/MS	EPA 8270C/D	N-Nitroso-di-n-propylamine (NDPA)
GC/MS	EPA 8270C/D	N-nitrosodiphenylamine (NDPHA)
GC/MS	EPA 8270C/D	Pentachlorophenol
GC/MS	EPA 8270C/D	Phenanthrene
GC/MS	EPA 8270C/D	Phenol
GC/MS	EPA 8270C/D	Pyrene
GC/MS	EPA 8270C/D	Pyridine
GC/ECD	EPA 8081A/B	4,4'-DDD
GC/ECD	EPA 8081A/B	4,4'-DDE
GC/ECD	EPA 8081A/B	4,4'-DDT
GC/ECD	EPA 8081A/B	Aldrin
GC/ECD	EPA 8081A/B	alpha-BHC (alpha-HCH)
GC/ECD	EPA 8081A/B	alpha-Chlordane
GC/ECD	EPA 8081A/B	beta-BHC (beta-HCH)
GC/ECD	EPA 8081A/B	delta-BHC (delta-HCH)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8081A/B	Dieldrin
GC/ECD	EPA 8081A/B	Endosulfan I
GC/ECD	EPA 8081A/B	Endosulfan II
GC/ECD	EPA 8081A/B	Endosulfan sulfate
GC/ECD	EPA 8081A/B	Endrin
GC/ECD	EPA 8081A/B	Endrin aldehyde
GC/ECD	EPA 8081A/B	Endrin ketone
GC/ECD	EPA 8081A/B	gamma-BHC (Lindane; gamma-HCH)
GC/ECD	EPA 8081A/B	gamma-Chlordane
GC/ECD	EPA 8081A/B	Heptachlor
GC/ECD	EPA 8081A/B	Heptachlor epoxide
GC/ECD	EPA 8081A/B	Methoxychlor
GC/ECD	EPA 8081A/B	Chlordane
GC/ECD	EPA 8081A/B	Toxaphene
GC/ECD	EPA 8082 /A	Aroclor-1016
GC/ECD	EPA 8082 /A	Aroclor-1221
GC/ECD	EPA 8082 /A	Aroclor-1232
GC/ECD	EPA 8082 /A	Aroclor-1242
GC/ECD	EPA 8082 /A	Aroclor-1248
GC/ECD	EPA 8082 /A	Aroclor-1254
GC/ECD	EPA 8082 /A	Aroclor-1260
GC/ECD	EPA 8082 /A	Aroclor-1262
GC/ECD	EPA 8082 /A	Aroclor-1268
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4,5-TP (Silvex)
GC/ECD	EPA 8151A	2,4-D
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichlorprop
GC/ECD	EPA 8151A	Dinoseb
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP (Mecoprop)

Non-Potable Water

Technology	Method	Analyte
HPLC/UV	EPA 8330A/B	1,3,5-Trinitrobenzene
HPLC/UV	EPA 8330A/B	1,3-Dinitrobenzene
HPLC/UV	EPA 8330A/B	2,4,6-Trinitrophenylmethylnitramine (Tetryl)
HPLC/UV	EPA 8330A/B	2,4,6-Trinitrotoluene (TNT)
HPLC/UV	EPA 8330A/B	2,4-Dinitrotoluene (DNT)
HPLC/UV	EPA 8330A/B	2,6-Dinitrotoluene
HPLC/UV	EPA 8330A/B	2-Amino-4,6-dinitrotoluene
HPLC/UV	EPA 8330A/B	2-Nitrotoluene (ONT)
HPLC/UV	EPA 8330A/B	3,5-Dinitroaniline
HPLC/UV	EPA 8330A/B	3-Nitrotoluene
HPLC/UV	EPA 8330A/B	4-Amino-2,6-dinitrotoluene
HPLC/UV	EPA 8330A/B	4-Nitrotoluene (PNT)
HPLC/UV	EPA 8330A/B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC/UV	EPA 8330A/B	Nitrobenzene
HPLC/UV	EPA 8330A/B	Nitroglycerin
HPLC/UV	EPA 8330A/B	Nitroguanidine
HPLC/UV	EPA 8330A/B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	EPA 8330A/B	3,5-Dinitroaniline
HPLC/UV	EPA 8330A/B	PETN
GC/FID	FLPRO	Petroleum Range Organics
GC/FID	EPA 8015B	TPH DRO
GC/FID	EPA 8015B	TPH GRO
GC/FID	RSK-175	Methane
GC/FID	RSK-175	Ethane
GC/FID	RSK-175	Ethene
GC/ECD	EPA 8011	1,2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1,2-Dibromo-3-chloropropane (DBCP)
HPLC/MS	EPA 6850	Perchlorate
ICP	EPA 6010B/C	Aluminum
ICP	EPA 6010B/C	Antimony
ICP	EPA 6010B/C	Arsenic
ICP	EPA 6010B/C	Barium
ICP	EPA 6010B/C	Beryllium

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Non-Potable Water		
Technology	**Method**	**Analyte**
ICP	EPA 6010B/C	Boron
ICP	EPA 6010B/C	Cadmium
ICP	EPA 6010B/C	Calcium
ICP	EPA 6010B/C	Chromium, total
ICP	EPA 6010B/C	Cobalt
ICP	EPA 6010B/C	Copper
ICP	EPA 6010B/C	Iron
ICP	EPA 6010B/C	Lead
ICP	EPA 6010B/C	Magnesium
ICP	EPA 6010B/C	Manganese
CVAA	EPA 7470A	Mercury
ICP	EPA 6010B/C	Molybdenum
ICP	EPA 6010B/C	Nickel
ICP	EPA 6010B/C	Potassium
ICP	EPA 6010B/C	Selenium
ICP	EPA 6010B/C	Silver
ICP	EPA 6010B/C	Sodium
ICP	EPA 6010B/C	Strontium
ICP	EPA 6010B/C	Thallium
ICP	EPA 6010B/C	Tin
ICP	EPA 6010B/C	Titanium
ICP	EPA 6010B/C	Vanadium
ICP	EPA 6010B/C	Zinc
IC	EPA 300.0	Chloride
IC	EPA 300.0	Fluoride
IC	EPA 300.0	Nitrate
IC	EPA 300.0	Nitrite
IC	EPA 300.0	Sulfate
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Nitrate
IC	EPA 9056A	Nitrite
IC	EPA 9056A	Sulfate

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Non-Potable Water		
Technology	**Method**	**Analyte**
Titration	SM 2320B 20th/21st edition	Alkalinity
Colorimetric	SM 4500 B, G, 20th/21st edition	Ammonia
Colorimetric	EPA 410.4	COD
UV/Vis	EPA 7196A	Hexavalent Chromium
Colorimetric	EPA 353.2	Nitrocellulose
Colorimetric	EPA 353.2	Nitrate/Nitrite
Gravimetric	EPA 1664A	O&G
Titration	Chap.7, Sect. 7.3.4 Mod.	Reactive Sulfide
Titration	SM 4500 S-2CF, 20th/21st edition	Sulfide
UV/Vis	SM 4500 P B5, E, 20th/21st edition	Total Phosphorus (as P)
UV/Vis	SM 4500 PE, 20th/21st edition	Ortho-Phosphate (as P)
TOC	9060A/SM5310C, 20th/21st edition	Total Organic Carbon
Gravimetric	SM 2540C, 20th/21st edition	TDS
Gravimetric	SM 2540D, 20th/21st edition	TSS
Colorimetric	EPA 9012A/B	Cyanide
Physical	EPA 1010A	Ignitability
Physical	EPA 9095B	Paint Filter
Probe	EPA 9040B/C	pH
Preparation	**Method**	**Type**
Preparation	EPA 1311	TCLP
Preparation	EPA 3005A	Metals digestion
Preparation	EPA 3010A	Metals digestion
Preparation	EPA 3510C	Organics Liquid Extraction
Preparation	EPA 5030A/B	Purge and Trap Water

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	1,1,1-Trichloroethane (1,1,1-TCA)

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Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B	1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113; Freon 113)
GC/MS	EPA 8260B	1,1,2-Trichloroethane
GC/MS	EPA 8260B	1,1-Dichloroethane (1,1-DCA)
GC/MS	EPA 8260B	1,1-Dichloroethene (1,1-DCE)
GC/MS	EPA 8260B	1,1-Dichloropropene
GC/MS	EPA 8260B	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B	1,2,3-Trichloropropane
GC/MS	EPA 8260B	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B	1,2-Dibromoethane (EDB)
GC/MS	EPA 8260B	1,2-Dichlorobenzene
GC/MS	EPA 8260B	1,2-Dichloroethane (EDC)
GC/MS	EPA 8260B	1,2-Dichloropropane
GC/MS	EPA 8260B	1,3,5-Trimethylbenzene
GC/MS	EPA 8260B	1,3-Dichlorobenzene
GC/MS	EPA 8260B	1,3-Dichloropropane
GC/MS	EPA 8260B	1,4-Dichlorobenzene
GC/MS	EPA 8260B	1,4-Dioxane
GC/MS	EPA 8260B	2,2-Dichloropropane
GC/MS	EPA 8260B	2-Butanone (Methyl ethyl ketone; MEK)
GC/MS	EPA 8260B	2-Chlorotoluene
GC/MS	EPA 8260B	2-Hexanone (Methyl butyl ketone; MBK)
GC/MS	EPA 8260B	4-Chlorotoluene
GC/MS	EPA 8260B	4-Methyl-2-pentanone (Methyl isobutyl ketone; MIBK)
GC/MS	EPA 8260B	Acetone
GC/MS	EPA 8260B	Acetonitrile
GC/MS	EPA 8260B	Acrolein
GC/MS	EPA 8260B	Acrylonitrile
GC/MS	EPA 8260B	Allyl chloride

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Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	Benzene
GC/MS	EPA 8260B	Bromobenzene
GC/MS	EPA 8260B	Bromochloromethane
GC/MS	EPA 8260B	Bromodichloromethane
GC/MS	EPA 8260B	Bromoform
GC/MS	EPA 8260B	Bromomethane
GC/MS	EPA 8260B	Carbon Disulfide
GC/MS	EPA 8260B	Carbon Tetrachloride
GC/MS	EPA 8260B	Chlorobenzene
GC/MS	EPA 8260B	Chloroethane
GC/MS	EPA 8260B	Chloroform
GC/MS	EPA 8260B	Chloromethane
GC/MS	EPA 8260B	Chloroprene
GC/MS	EPA 8260B	cis-1,2-Dichloroethene (cis-1,2-DCE)
GC/MS	EPA 8260B	cis-1,3-Dichloropropene
GC/MS	EPA 8260B	cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260B	Cyclohexane
GC/MS	EPA 8260B	Dibromochloromethane
GC/MS	EPA 8260B	Dibromomethane
GC/MS	EPA 8260B	Dichlorodifluoromethane (CFC-12)
GC/MS	EPA 8260B	Ethyl methacrylate
GC/MS	EPA 8260B	Ethylbenzene
GC/MS	EPA 8260B	Hexachlorobutadiene
GC/MS	EPA 8260B	Hexane
GC/MS	EPA 8260B	Iodomethane
GC/MS	EPA 8260B	Isobutyl alcohol
GC/MS	EPA 8260B	Isopropylbenzene (Cumene)
GC/MS	EPA 8260B	Methacrylonitrile
GC/MS	EPA 8260B	Methyl Acetate
GC/MS	EPA 8260B	Methyl methacrylate
GC/MS	EPA 8260B	Methyl Tertiary Butyl Ether (MTBE)
GC/MS	EPA 8260B	Methylcyclohexane

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	Methylene Chloride, or Dichloromethane
GC/MS	EPA 8260B	Naphthalene
GC/MS	EPA 8260B	n-Butylbenzene
GC/MS	EPA 8260B	n-Propylbenzene
GC/MS	EPA 8260B	p-Isopropyltoluene
GC/MS	EPA 8260B	Propionitrile
GC/MS	EPA 8260B	sec-Butylbenzene
GC/MS	EPA 8260B	Styrene
GC/MS	EPA 8260B	tert-Butylbenzene
GC/MS	EPA 8260B	Tetrachloroethene (PCE; PERC)
GC/MS	EPA 8260B	Toluene
GC/MS	EPA 8260B	trans-1,2-Dichloroethene (trans-1,2-DCE)
GC/MS	EPA 8260B	trans-1,3-Dichloropropene
GC/MS	EPA 8260B	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B	Trichloroethene (TCE)
GC/MS	EPA 8260B	Trichlorofluoromethane (CFC-11)
GC/MS	EPA 8260B	Vinyl acetate
GC/MS	EPA 8260B	Vinyl Chloride (VC)
GC/MS	EPA 8260B	Xylenes (Total)
GC/MS	EPA 8270C/D	Bis(2-chloroisopropyl)ether, or 2,2'-oxybis (1-Chloropropane)
GC/MS	EPA 8270C/D	1,1'-Biphenyl
GC/MS	EPA 8270C/D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270C/D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270C/D	1,2-Dichlorobenzene
GC/MS	EPA 8270C/D	1,2-Diphenylhydrazine
GC/MS	EPA 8270C/D	1,3-Dichlorobenzene
GC/MS	EPA 8270C/D	1,4-Dichlorobenzene
GC/MS	EPA 8270C/D	1,4-Dioxane
GC/MS	EPA 8270C/D	1-Methylnaphthalene
GC/MS	EPA 8270C/D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270C/D	2,4,5-Trichlorophenol
GC/MS	EPA 8270C/D	2,4,6-Trichlorophenol (TCP)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C/D	2,4-Dichlorophenol (DCP)
GC/MS	EPA 8270C/D	2,4-Dimethylphenol
GC/MS	EPA 8270C/D	2,4-Dinitrophenol
GC/MS	EPA 8270C/D	2,4-Dinitrotoluene (DNT)
GC/MS	EPA 8270C/D	2,6-Dichlorophenol
GC/MS	EPA 8270C/D	2,6-Dinitrotoluene
GC/MS	EPA 8270C/D	2-Chloronaphthalene
GC/MS	EPA 8270C/D	2-Chlorophenol
GC/MS	EPA 8270C/D	2-Methylnaphthalene
GC/MS	EPA 8270C/D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270C/D	2-Nitroaniline
GC/MS	EPA 8270C/D	2-Nitrophenol (ONP)
GC/MS	EPA 8270C/D	3,3'-Dichlorobenzidine (DCB)
GC/MS	EPA 8270C/D	3-Methylphenol
GC/MS	EPA 8270C/D	3-Nitroaniline
GC/MS	EPA 8270C/D	4,6-Dinitro-2-methylphenol (DNOC)
GC/MS	EPA 8270C/D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270C/D	4-Chloro-3-methylphenol
GC/MS	EPA 8270C/D	4-Chloroaniline
GC/MS	EPA 8270C/D	4-Chlorophenyl phenyl ether
GC/MS	EPA 8270C/D	4-Methylphenol (p-Cresol)
GC/MS	EPA 8270C/D	4-Nitroaniline (PNA)
GC/MS	EPA 8270C/D	4-Nitrophenol (PNP)
GC/MS	EPA 8270C/D	Acenaphthene
GC/MS	EPA 8270C/D	Acenaphthylene
GC/MS	EPA 8270C/D	Acetaphenone
GC/MS	EPA 8270C/D	Aniline
GC/MS	EPA 8270C/D	Anthracene
GC/MS	EPA 8270C/D	Atrazine
GC/MS	EPA 8270C/D	Benzaldehyde
GC/MS	EPA 8270C/D	Benzidine
GC/MS	EPA 8270C/D	Benzo(a)anthracene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C/D	Benzo(a)anthracene
GC/MS	EPA 8270C/D	Benzo(a)pyrene
GC/MS	EPA 8270C/D	Benzo(b)fluoranthene
GC/MS	EPA 8270C/D	Benzo(g,h,i)perylene
GC/MS	EPA 8270C/D	Benzo(k)fluoranthene
GC/MS	EPA 8270C/D	Benzoic Acid
GC/MS	EPA 8270C/D	Benzyl alcohol
GC/MS	EPA 8270C/D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270C/D	bis(2-Chloroethyl)ether (BCEE)
GC/MS	EPA 8270C/D	bis(2-Ethylhexyl)phthalate (BEHP)
GC/MS	EPA 8270C/D	Butyl benzyl phthalate (BBP)
GC/MS	EPA 8270C/D	Caprolactam
GC/MS	EPA 8270C/D	Carbazole
GC/MS	EPA 8270C/D	Chrysene
GC/MS	EPA 8270C/D	Dibenz(a,h)anthracene
GC/MS	EPA 8270C/D	Dibenzofuran (DBF)
GC/MS	EPA 8270C/D	Diethyl phthalate (DEP)
GC/MS	EPA 8270C/D	Dimethyl phthalate (DMP)
GC/MS	EPA 8270C/D	Di-n-butyl phthalate (DBP)
GC/MS	EPA 8270C/D	Di-n-octyl phthalate (DNOP)
GC/MS	EPA 8270C/D	Fluoranthene
GC/MS	EPA 8270C/D	Fluorene
GC/MS	EPA 8270C/D	Hexachlorobenzene (HCB)
GC/MS	EPA 8270C/D	Hexachlorobutadiene (HCBD)
GC/MS	EPA 8270C/D	Hexachlorocyclopentadiene (HCCPD)
GC/MS	EPA 8270C/D	Hexachloroethane (HCE)
GC/MS	EPA 8270C/D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270C/D	Isophorone
GC/MS	EPA 8270C/D	Naphthalene
GC/MS	EPA 8270C/D	Nitrobenzene
GC/MS	EPA 8270C/D	N-Nitrosodimethylamine
GC/MS	EPA 8270C/D	N-Nitroso-di-n-propylamine (NDPA)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C/D	N-nitrosodiphenylamine (NDPHA)
GC/MS	EPA 8270C/D	Pentachlorophenol
GC/MS	EPA 8270C/D	Phenanthrene
GC/MS	EPA 8270C/D	Phenol
GC/MS	EPA 8270C/D	Pyrene
GC/MS	EPA 8270C/D	Pyridine
GC/ECD	EPA 8081A/B	4,4'-DDD
GC/ECD	EPA 8081A/B	4,4'-DDE
GC/ECD	EPA 8081A/B	4,4'-DDT
GC/ECD	EPA 8081A/B	Aldrin
GC/ECD	EPA 8081A/B	alpha-BHC (alpha-HCH)
GC/ECD	EPA 8081A/B	alpha-Chlordane
GC/ECD	EPA 8081A/B	beta-BHC (beta-HCH)
GC/ECD	EPA 8081A/B	delta-BHC (delta-HCH)
GC/ECD	EPA 8081A/B	Chlordane
GC/ECD	EPA 8081A/B	Dieldrin
GC/ECD	EPA 8081A/B	Endosulfan I
GC/ECD	EPA 8081A/B	Endosulfan II
GC/ECD	EPA 8081A/B	Endosulfan sulfate
GC/ECD	EPA 8081A/B	Endrin
GC/ECD	EPA 8081A/B	Endrin aldehyde
GC/ECD	EPA 8081A/B	Endrin ketone
GC/ECD	EPA 8081A/B	gamma-BHC (Lindane; gamma-HCH)
GC/ECD	EPA 8081A/B	gamma-Chlordane
GC/ECD	EPA 8081A/B	Heptachlor
GC/ECD	EPA 8081A/B	Heptachlor epoxide
GC/ECD	EPA 8081A/B	Methoxychlor
GC/ECD	EPA 8081A/B	Toxaphene
GC/ECD	EPA 8082 /A	Aroclor-1016
GC/ECD	EPA 8082 /A	Aroclor-1221
GC/ECD	EPA 8082 /A	Aroclor-1232
GC/ECD	EPA 8082 /A	Aroclor-1242

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8082 /A	Aroclor-1248
GC/ECD	EPA 8082 /A	Aroclor-1254
GC/ECD	EPA 8082 /A	Aroclor-1260
GC/ECD	EPA 8082 /A	Aroclor-1262
GC/ECD	EPA 8082 /A	Aroclor-1268
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4,5-TP (Silvex)
GC/ECD	EPA 8151A	2,4-D
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichlorprop
GC/ECD	EPA 8151A	Dinoseb
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP (Mecoprop)
HPLC/UV	EPA 8330A	1,3,5-Trinitrobenzene
HPLC/UV	EPA 8330A	1,3-Dinitrobenzene
HPLC/UV	EPA 8330A	2,4,6-Trinitrophenylmethylnitramine (Tetryl)
HPLC/UV	EPA 8330A	2,4,6-Trinitrotoluene (TNT)
HPLC/UV	EPA 8330A	2,4-Dinitrotoluene (DNT)
HPLC/UV	EPA 8330A	2,6-Dinitrotoluene
HPLC/UV	EPA 8330A	2-Amino-4,6-dinitrotoluene
HPLC/UV	EPA 8330A	2-Nitrotoluene (ONT)
HPLC/UV	EPA 8330A	3-Nitrotoluene
HPLC/UV	EPA 8330A	3,5-Dinitroaniline
HPLC/UV	EPA 8330A	4-Amino-2,6-dinitrotoluene
HPLC/UV	EPA 8330A	4-Nitrotoluene (PNT)
HPLC/UV	EPA 8330A	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC/UV	EPA 8330A	Nitroglycerin
HPLC/UV	EPA 8330A	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	EPA 8330A	Nitrobenzene
HPLC/UV	EPA 8330A	Nitroguanidine

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
HPLC/UV	EPA 8330A	PETN
HPLC/UV	EPA 8330B	1,3,5-Trinitrobenzene
HPLC/UV	EPA 8330B	1,3-Dinitrobenzene
HPLC/UV	EPA 8330B	2,4,6-Trinitrophenylmethylnitramine (Tetryl)
HPLC/UV	EPA 8330B	2,4,6-Trinitrotoluene (TNT)
HPLC/UV	EPA 8330B	2,4-Dinitrotoluene (DNT)
HPLC/UV	EPA 8330B	2,6-Dinitrotoluene
HPLC/UV	EPA 8330B	2-Amino-4,6-dinitrotoluene
HPLC/UV	EPA 8330B	2-Nitrotoluene (ONT)
HPLC/UV	EPA 8330B	3-Nitrotoluene
HPLC/UV	EPA 8330B	3,5-Dinitroaniline
HPLC/UV	EPA 8330B	4-Amino-2,6-dinitrotoluene
HPLC/UV	EPA 8330B	4-Nitrotoluene (PNT)
HPLC/UV	EPA 8330B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC/UV	EPA 8330B	Nitroglycerin
HPLC/UV	EPA 8330B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	EPA 8330B	Nitrobenzene
HPLC/UV	EPA 8330B	Nitroguanidine
HPLC/UV	EPA 8330B	PETN
GC/FID	FLPRO	Petroleum Range Organics
GC/FID	EPA 8015B	TPH DRO
GC/FID	EPA 8015B	TPH GRO
HPLC/MS	EPA 6850	Perchlorate
ICP	EPA 6010B/C	Aluminum
ICP	EPA 6010B/C	Antimony
ICP	EPA 6010B/C	Arsenic
ICP	EPA 6010B/C	Barium
ICP	EPA 6010B/C	Beryllium
ICP	EPA 6010B/C	Boron
ICP	EPA 6010B/C	Cadmium
ICP	EPA 6010B/C	Calcium
ICP	EPA 6010B/C	Chromium, total

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP	EPA 6010B/C	Cobalt
ICP	EPA 6010B/C	Copper
ICP	EPA 6010B/C	Iron
ICP	EPA 6010B/C	Lead
ICP	EPA 6010B/C	Magnesium
ICP	EPA 6010B/C	Manganese
CVAA	EPA 7471A/B	Mercury
ICP	EPA 6010B/C	Molybdenum
ICP	EPA 6010B/C	Nickel
ICP	EPA 6010B/C	Potassium
ICP	EPA 6010B/C	Selenium
ICP	EPA 6010B/C	Silver
ICP	EPA 6010B/C	Sodium
ICP	EPA 6010B/C	Strontium
ICP	EPA 6010B/C	Tin
ICP	EPA 6010B/C	Titanium
ICP	EPA 6010B/C	Thallium
ICP	EPA 6010B/C	Vanadium
ICP	EPA 6010B/C	Zinc
UV/Vis	EPA 7196A	Hexavalent Chromium
TOC	Lloyd Kahn	Total Organic Carbon
Colorimetric	EPA 353.2	Nitrocellulose
Colorimetric	EPA 9012A/B	Cyanide
Titration	Chap.7, Sect. 7.3.4 Mod.	Reactive Sulfide
Titration	EPA 9034	Sulfide
Probe	EPA 9045C/D	pH
Preparation	**Method**	**Type**
Preparation	EPA 1311	TCLP
Preparation	EPA 1312	SPLP
Preparation	NJ Modified 3060A	Hexavalent Chromium
Preparation	EPA 3050B	Metals Digestion
Preparation	EPA 3546	Organics Microwave Extraction

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Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Preparation	EPA 3550B/C	Organics Sonication
Preparation	SM 2540B 20th/21st edition	Percent Solids (Percent Moisture)
Preparation	EPA 5035 /A	Purge and Trap Solid

Notes:

1) This laboratory offers commercial testing service.

Approved By: ______________________ Date: April 8, 2011

R. Douglas Leonard
Chief Technical Officer

Issued: 11/30/09 Revised: 2/9/10 Revised: 3/31/10 Revised: 10/8/10 Revised: 1/25/11 Revised: 4/8/11

SCOPE OF ACCREDITATION TO ISO/IEC 17025-2005

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ENVIRONMENTAL

Valid To: December 31, 2011 Certificate Number: 2936.01

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with ISO IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the current DoD Quality Systems Manual for Environmental Laboratories) accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below:

Testing Technologies

Atomic Absorption/ICP-AES Spectrometry, ICP/MS, Gas Chromatography, Gas Chromatography/Mass Spectrometry, Gravimetry, High Performance Liquid Chromatography, LC/MS/MS, Ion Chromatography, Misc.- Electronic Probes (pH, O_2), Oxygen Demand, Hazardous Waste Characteristics Tests, Spectrophotometry (Visible), Spectrophotometry (Automated), IR Spectrometry, Titrimetry, Total Organic Carbon

Parameter/Analyte	**Nonpotable Water (1)**	**Solid and Chemical Materials (2)**
Metals		
Aluminum	EPA 200.7 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Antimony	EPA 200.7 EPA 200.8 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C EPA 3015/6020 EPA 3015A/6020 EPA 3015/6020A EPA 3015A/6020A	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C EPA 3051/6020 EPA 3051A/6020 EPA 3051/6020A EPA 3051A/6020A
Arsenic	EPA 200.7 EPA 200.8 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C EPA 3015/6020 EPA 3015A/6020 EPA 3015/6020A EPA 3015A/6020A	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C EPA 3051/6020 EPA 3051A/6020 EPA 3051/6020A EPA 3051A/6020A
Barium	EPA 200.7 EPA 200.8 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C EPA 3015/6020 EPA 3015A/6020 EPA 3015/6020A EPA 3015A/6020A	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C EPA 3051/6020 EPA 3051A/6020 EPA 3051/6020A EPA 3051A/6020A
Beryllium	EPA 200.7 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Boron	EPA 200.7 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C
Cadmium	EPA 200.7 EPA 200.8 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C EPA 3015/6020 EPA 3015A/6020 EPA 3015/6020A EPA 3015A/6020A	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C EPA 3051/6020 EPA 3051A/6020 EPA 3051/6020A EPA 3051A/6020A
Calcium	EPA 200.7 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C
Chromium	EPA 200.7 EPA 200.8 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C EPA 3015/6020 EPA 3015A/6020 EPA 3015/6020A EPA 3015A/6020A	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C EPA 3051/6020 EPA 3051A/6020 EPA 3051/6020A EPA 3051A/6020A
Cobalt	EPA 200.7 EPA 200.8 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C EPA 3015/6020 EPA 3015A/6020 EPA 3015/6020A	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C EPA 3051/6020 EPA 3051A/6020 EPA 3051/6020A EPA 3051A/6020A

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
	EPA 3015A/6020A	
Copper	EPA 200.7 EPA 200.8 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C EPA 3015/6020 EPA 3015A/6020 EPA 3015/6020A EPA 3015A/6020A	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C EPA 3051/6020 EPA 3051A/6020 EPA 3051/6020A EPA 3051A/6020A
Iron	EPA 200.7 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C
Lead	EPA 200.7 EPA 200.8 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C EPA 3015/6020 EPA 3015A/6020 EPA 3015/6020A EPA 3015A/6020A	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C EPA 3051/6020 EPA 3051A/6020 EPA 3051/6020A EPA 3051A/6020A
Lithium	EPA 200.7 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C
Magnesium	EPA 200.7 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Manganese	EPA 200.7 EPA 200.8 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C EPA 3015/6020 EPA 3015A/6020 EPA 3015/6020A EPA 3015A/6020A	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C EPA 3051/6020 EPA 3051A/6020 EPA 3051/6020A EPA 3051A/6020A
Mercury	EPA 245.1 EPA 7470A	EPA 7471A EPA 7471B
Molybdenum	EPA 200.7 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C
Nickel	EPA 200.7 EPA 200.8 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA3015A/6010C EPA 3015/6020 EPA 3015A/6020 EPA 3015/6020A EPA 3015A/6020A	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C EPA 3051/6020 EPA 3051A/6020 EPA 3051/6020A EPA 3051A/6020A
Phosphorus	EPA 200.7 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C
Potassium	EPA 200.7 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Selenium	EPA 200.7 EPA 200.8 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C EPA 3015/6020 EPA 3015A/6020 EPA 3015/6020A EPA 3015A/6020A	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C EPA 3051/6020 EPA 3051A/6020 EPA 3051/6020A EPA 3051A/6020A
Silicon	EPA 200.7 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C	-----------------------------------
Silver	EPA 200.7 EPA 200.8 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C EPA 3015/6020 EPA 3015A/6020 EPA 3015/6020A EPA 3015A/6020A	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C EPA 3051/6020 EPA 3051A/6020 EPA 3051/6020A EPA 3051A/6020A
Sodium	EPA 200.7 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C
Strontium	EPA 200.7 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Thallium	EPA 200.7 EPA 200.8 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C EPA 3015/6020 EPA 3015A/6020 EPA 3015/6020A EPA 3015A/6020A	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C EPA 3051/6020 EPA 3051A/6020 EPA 3051/6020A EPA 3051A/6020A
Tin	EPA 200.7 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C
Titanium	EPA 200.7 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C
Uranium	EPA 200.8 EPA 3015/6020 EPA 3015A/6020 EPA 3015/6020A EPA 3015A/6020A	EPA 3051/6020 EPA 3051A/6020 EPA 3051/6020A EPA 3051A/6020A
Vanadium	EPA 200.7 EPA 200.8 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C EPA 3015/6020 EPA 3015A/6020 EPA 3015/6020A EPA 3015A/6020A	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C EPA 3051/6020 EPA 3051A/6020 EPA 3051/6020A EPA 3051A/6020A

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Zinc	EPA 200.7 EPA 200.8 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C EPA 3015/6020 EPA 3015A/6020 EPA 3015/6020A EPA 3015A/6020A	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C EPA 3051/6020 EPA 3051A/6020 EPA 3051/6020A EPA 3051A/6020A
Zirconium	EPA 200.7 EPA 3005A/6010B EPA 3015/6010B EPA 3015A/6010B EPA 3005A/6010C EPA 3015/6010C EPA 3015A/6010C	EPA 3051/6010B EPA 3051A/6010B EPA 3051/6010C EPA 3051A/6010C
Nutrients		
Ammonia (as N)	EPA 350.1 SM 4500-NH3 B	EPA 350.1 SM 4500-NH3 B
Kjeldahl nitrogen	EPA 351.2	------------------------------------
Nitrate (as N)	EPA 300.0 EPA 9056 EPA 9056A EPA 353.2	EPA 9056 EPA 9056A
Nitrate-nitrite (as N)	EPA 300.0 EPA 9056 EPA 9056A EPA 353.2	EPA 9056 EPA 9056A
Nitrite (as N)	EPA 300.0 EPA 9056 EPA 9056A EPA 354.1	EPA 9056 EPA 9056A
Orthophosphate (as P)	EPA 365.2 SM 4500-P E	EPA 365.2
Total phosphorus	EPA 365.4	------------------------------------
Demands		
Biochemical oxygen demand	SM 5210 B	------------------------------------
Chemical oxygen demand	EPA 410.4 HACH 8000	------------------------------------
Total organic carbon	EPA 415.1 EPA 9060A SM5310 C	LLOYDKAHN

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Wet Chemistry		
Alkalinity	EPA 310.1 EPA 310.2 SM 2320 B	------------------------------------
Bromide	EPA 300.0 EPA 9056 EPA 9056A	EPA 9056 EPA 9056A
Chloride	EPA 300.0 EPA 9056 EPA 9056A EPA 325.2 SM 4500-CL E	EPA 9056 EPA 9056A EPA 325.2 SM 4500-CL E
Cyanide	SM 4500 CN-C,E EPA 9010C/9014	EPA 9010C/9014
Amenable Cyanide	SM 4500 CN-G EPA 9010C/9014	EPA 9010C/9014
Fluoride	EPA 300.0 EPA 9056 EPA 9056A SM 4500 F,C	EPA 300.0 EPA 9056 EPA 9056A SM 4500 F,C
pH	SM 4500-H^+ B EPA 9040C	EPA 9040C EPA 9045D
Oil and Grease	EPA 1664A	EPA 1664A
Phenols	EPA 420.1	EPA 420.1
Total residue	EPA 160.3 SM 2540 B	------------------------------------
Filterable residue	EPA 160.1 SM 2540 C	------------------------------------
Nonfilterable residue	EPA 160.2 SM 2540 D	------------------------------------
Sulfate	EPA 300.0 EPA 9056 EPA 9056A EPA 375.4 SM 426C	EPA 9056 EPA 9056A EPA 375.4 SM 426 C
Sulfide	EPA 376.1 SM 4500-S F	EPA 9030B/9034
Flashpoint	EPA 1010A	EPA 1010A
Ferrous Iron	SM 3500-Fe B	------------------------------------
Hexavalent chromium	SM 3500-Cr D 19th Ed SM 3500-Cr B 20th and 21st Ed EPA 7196A	SM 3500-Cr D 19th Ed SM 3500-Cr B 20th and 21st Ed EPA 7196A
Purgeable Organics (Volatiles)		
Acetone	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Acetonitrile	EPA 624 EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Acrolein	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Acrylonitrile	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Allyl chloride	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
T-amylmethylether	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Benzene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Bromobenzene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Bromochloromethane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Bromodichloromethane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Bromoform	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Bromomethane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1,3-Butadiene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
2-Butanone	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
n-Butyl alcohol	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
tert-Butyl alcohol	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
n-Butylbenzene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Sec-Butylbenzene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Tert-Butylbenzene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Carbon disulfide	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Carbon tetrachloride	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Chlorobenzene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Chloroethane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
2-Chloroethyl vinyl ether	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Chloroform	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Chloroprene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1-Chlorohexane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Chloromethane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
2-Chlorotoluene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
4-Chlorotoluene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Cyclohexane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Cyclohexanone	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Dibromochloromethane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Dibromofluoromethane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1,2-Dibromo-3-chloropropane (DBCP)	EPA 624 EPA 5030B/8260B EPA 5030C/8260B EPA 8011	EPA 5035/8260B EPA 5035A/8260B
Dibromomethane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1,2Dibromomethane (EDB)	EPA 624 EPA 5030B/8260B EPA 5030C/8260B EPA 8011	EPA 5035/8260B EPA 5035A/8260B
1,2-Dichlorobenzene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1,3-Dichlorobenzene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1,4-Dichlorobenzene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Trans-1,4-Dichloro-2-butene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Dichlorodifluoromethane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1,1-Dichloroethane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1,2-Dichloroethane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1,1-Dichloroethene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
cis-1,2-Dichloroethene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
trans-1,2-Dichloroethene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1,2-Dichloropropane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
1,3-Dichloropropane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
2,2-Dichloropropane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1,1-Dichloropropene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
cis-1,3-Dichloropropene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
trans-1,3-Dichloropropene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Diethyl ether	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Di-isopropyl ether	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Dimethyldisulfide	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Dimethyl sulfide	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1,4-Dioxane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Ethyl acetate	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Ethyl –t-butyl ether	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Ethyl methacrylate	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Ethyl benzene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Gas Range Organics (GRO)	EPA 5030B/8015B NWTPH GX EPA 5030C/8015B WADOE VPH EPA 5030B/8015C EPA 5030C/8015C EPA 5030B/8015D EPA 5030C/8015D	EPA 5035/8015B NWTPH GX EPA 5035/8015C WADOE VPH EPA 5035/8015D EPA 5035A/8015B EPA 5035A/8015C EPA 5035A/8015D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
2-Hexanone	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Hexachlorobutadiene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Isoprene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Isopropylbenzene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1,4-Isopropyltoluene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Iodomethane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Isobutyl alcohol	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Isopropyl alcohol	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Methacrylonitrile	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Methyl acetate	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Methylcyclohexane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Methyl methacrylate	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Alpha-Methylstyrene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Methyl tert-butyl ether	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Methylene chloride	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
4-Methyl-2-pentanone	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Naphthalene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
2-Nitropropane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
n-Propylbenzene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Propionitrile	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Styrene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1,1,1,2-Tetrachloroethane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1,1,2,2-Tetrachloroethane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Tetrachloroethene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Tetrahydrofuran	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Toluene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1,1,1-Trichloroethane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1,1,2-Trichloroethane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Trichloroethene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Trichlorofluoromethane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1,2,3-Trichlorobenzene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1,2,3-Trichloropropane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
1,2,4-Trichlorobenzene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1,2,4-Trimethylbenzene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1,3,5-Trimethylbenzene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Vinyl acetate	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Vinyl chloride	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Xylenes, total	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1,2-Xylene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1,3-Xylene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1,4-Xylene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Headspace Organics		
Carbon dioxide	EPA 5021/RSK175	-----------------------------------
Methane	EPA 5021/RSK175	-----------------------------------
Ethane	EPA 5021/RSK175	-----------------------------------
Ethene	EPA 5021/RSK175	-----------------------------------
Acetylene	EPA 5021/RSK175	-----------------------------------
Extractable Organics (Semivolatiles)		
Acenaphthene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Acenaphthylene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Acetophenone	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
2-Acetylaminofluorene	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
4-Aminobiphenyl	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Anilene	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Anthracene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Aramite	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Benzidine	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Benzoic acid	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Benzo (a) anthracene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Benzo (b) fluoranthene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Benzo (k) fluoranthene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Benzo (ghi) fluoranthene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Benzo (a) pyrene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Benzyl alcohol	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Benzaldehyde	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Biphenyl	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Bis(2-chloroethoxy) methane	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Bis (2-chloroethyl) ether	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Bis(2-chloroisopropyl) ether	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	**Nonpotable Water (1)**	**Solid and Chemical Materials (2)**
Bis (2-ethylhexyl) phthalate	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
4-Bromophenylphenylether	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Butyl benzyl phthalate	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Caprolactam	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Carbazole	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
4-Chloroaniline	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Chlorobenzilate	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
4-Chloro-3-methylphenol	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
1-Chloronaphthalene	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
2-Chloronaphthalene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	**Nonpotable Water (1)**	**Solid and Chemical Materials (2)**
2-Chlorophenol	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
4-Chlorophenylphenyl ether	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Chrysene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Cresols	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Diallate	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Dibenzo (a,h) anthracene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Dibenzofuran	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
1,2-Dichlorobenzene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
1,3-Dichlorobenzene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
1,4-Dichlorobenzene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
3,3'-Dichlorobenzidine	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
2,4-Dichlorophenol	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
2,6-Dichlorophenol	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Diethyl phthalate	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Dimethoate	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
4-Dimethylaminoazobenzene	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
7,12-Dimethylbenz(a)anthracene	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
3,3’-Dimethylbenzidine	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Alpha-,alpha-Dimethylphenethylamine	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
2,4-Dimethylphenol	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	**Nonpotable Water (1)**	**Solid and Chemical Materials (2)**
Dimethyl phthalate	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Di-n-butyl phthalate	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Di-n-octyl phthalate	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
2,4-Dinitrophenol	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
2,4-Dinitrotoluene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
2,6-Dinitrotoluene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
1,4-Dioxane	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Diphenylamine	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
1,2-Diphenylhydrazine	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Disulfoton	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
DRO/ORO	EPA 3510C/8015B EPA 3510C/8015C EPA 3510C/8015D NWTPH DX WADOE EPH	EPA 3545/8015B NWTPH DX EPA 3545A/8015B WADOE EPH EPA 3550B/8015B EPA 3550C/8015B EPA 3545/8015C EPA 3545A/8015C EPA 3550B/8015C EPA 3550C/8015C EPA 3545/8015D EPA 3545A/8015D EPA 3550B/8015D EPA 3550C/8015D
Ethyl methanesulfonate	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Ethyl parathion	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Famphur	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Fluoroanthene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Fluorene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Hexachlorobenzene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Hexachlorobutadiene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Hexachlorocyclopentadiene	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Hexachloroethane	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Hexachlorophene	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Hexachloropropene	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Indeno (1,2,3-cd) pyrene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Isodrin	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Isophorone	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Isosafrole	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Kepone	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Methapyrilene	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
3-Methylcholanthrene	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
2-Methyl-4,6-Dinitrophenol	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Methyl methanesulfonate	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
1-Methylnaphthalene	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
2-Methylnaphthalene	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Methyl parathion	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Naphthalene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
1,4-Naphthoquinone	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
1-Naphthylamine	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
2-Naphthylamine	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
2-Nitroaniline	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
3-Nitroaniline	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
4-Nitroaniline	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Nitrobenzene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
5-Nitro-o-toluidine	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
2-Nitrophenol	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
4-Nitrophenol	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Nitroquinoline-1-oxide	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
n-Nitrosodiethylamine	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
n-Nitrosodimethylamine	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
n-Nitroso-di-n-butylamine	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	**Nonpotable Water (1)**	**Solid and Chemical Materials (2)**
n-Nitrosodi-n-propylamine	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
n-Nitrosodiphenylamine	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
n-Nitrosomorpholine	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
n-Nitrosopiperidine	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
n-Nitrosopyrrolidine	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Pentachlorobenzene	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Pentachloroethane	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Pentachloronitobenzene	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Pentachlorophenol	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Phenacetin	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Phenanthrene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Phenol	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
1,4-Phenylenediamine	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Phorate	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
2-Picoline	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Pronamide	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Pyrene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Pyridine	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Safrole	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Sulfotepp	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
1,2,4,5-Tetrachlorobenzene	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
2,3,4,6-Tetrachlorophenol	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
o,o,o-Triethyl phosphorothioate	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Thionazin	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
1,2,4-Trichlorobenzene	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
2,4,5-Trichlorophenol	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
2,4,6-Trichlorophenol	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
O-Toluidine	EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D EPA 3580A/8270D
Pesticides/Herbicides/PCBs		
Aldrin	EPA 608 EPA 3510C/8081A EPA 3510C/8081B	EPA 3550B/8081A EPA 3550C/8081A EPA 3580A/8081A EPA 3550B/8081B EPA 3550C/8081B EPA 3580A/8081B
alpha-BHC	EPA 608 EPA 3510C/8081A EPA 3510C/8081B	EPA 3550B/8081A EPA 3550C/8081A EPA 3580A/8081A EPA 3550B/8081B EPA 3550C/8081B EPA 3580A/8081B
Beta-BHC	EPA 608 EPA 3510C/8081A EPA 3510C/8081B	EPA 3550B/8081A EPA 3550C/8081A EPA 3580A/8081A EPA 3550B/8081B EPA 3550C/8081B EPA 3580A/8081B

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
delta-BHC	EPA 608 EPA 3510C/8081A EPA 3510C/8081B	EPA 3550B/8081A EPA 3550C/8081A EPA 3580A/8081A EPA 3550B/8081B EPA 3550C/8081B EPA 3580A/8081B
Gamma-BHC	EPA 608 EPA 3510C/8081A EPA 3510C/8081B	EPA 3550B/8081A EPA 3550C/8081A EPA 3580A/8081A EPA 3550B/8081B EPA 3550C/8081B EPA 3580A/8081B
Chlordane (technical)	EPA 608 EPA 3510C/8081A EPA 3510C/8081B	EPA 3550B/8081A EPA 3550C/8081A EPA 3580A/8081A EPA 3550B/8081B EPA 3550C/8081B EPA 3580A/8081B
alpha-chlordane	EPA 608 EPA 3510C/8081A EPA 3510C/8081B	EPA 3550B/8081A EPA 3550C/8081A EPA 3580A/8081A EPA 3550B/8081B EPA 3550C/8081B EPA 3580A/8081B
gamma-chlordane	EPA 608 EPA 3510C/8081A EPA 3510C/8081B	EPA 3550B/8081A EPA 3550C/8081A EPA 3580A/8081A EPA 3550B/8081B EPA 3550C/8081B EPA 3580A/8081B
4,4'-DDD	EPA 608 EPA 3510C/8081A EPA 3510C/8081B	EPA 3550B/8081A EPA 3550C/8081A EPA 3580A/8081A EPA 3550B/8081B EPA 3550C/8081B EPA 3580A/8081B
4,4'-DDE	EPA 608 EPA 3510C/8081A EPA 3510C/8081B	EPA 3550B/8081A EPA 3550C/8081A EPA 3580A/8081A EPA 3550B/8081B EPA 3550C/8081B EPA 3580A/8081B
4,4',-DDT	EPA 608 EPA 3510C/8081A EPA 3510C/8081B	EPA 3550B/8081A EPA 3550C/8081A EPA 3580A/8081A EPA 3550B/8081B EPA 3550C/8081B EPA 3580A/8081B

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Dieldrin	EPA 608 EPA 3510C/8081A EPA 3510C/8081B	EPA 3550B/8081A EPA 3550C/8081A EPA 3580A/8081A EPA 3550B/8081B EPA 3550C/8081B EPA 3580A/8081B
Endosulfan I	EPA 608 EPA 3510C/8081A EPA 3510C/8081B	EPA 3550B/8081A EPA 3550C/8081A EPA 3580A/8081A EPA 3550B/8081B EPA 3550C/8081B EPA 3580A/8081B
Endosulfan II	EPA 608 EPA 3510C/8081A EPA 3510C/8081B	EPA 3550B/8081A EPA 3550C/8081A EPA 3580A/8081A EPA 3550B/8081B EPA 3550C/8081B EPA 3580A/8081B
Endonsulfan sulfate	EPA 608 EPA 3510C/8081A EPA 3510C/8081B	EPA 3550B/8081A EPA 3550C/8081A EPA 3580A/8081A EPA 3550B/8081B EPA 3550C/8081B EPA 3580A/8081B
Endrin	EPA 608 EPA 3510C/8081A EPA 3510C/8081B	EPA 3550B/8081A EPA 3550C/8081A EPA 3580A/8081A EPA 3550B/8081B EPA 3550C/8081B EPA 3580A/8081B
Endrin aldehyde	EPA 608 EPA 3510C/8081A EPA 3510C/8081B	EPA 3550B/8081A EPA 3550C/8081A EPA 3580A/8081A EPA 3550B/8081B EPA 3550C/8081B EPA 3580A/8081B
Endrin ketone	EPA 3510C/8081A EPA 3510C/8081B	EPA 3550B/8081A EPA 3550C/8081A EPA 3580A/8081A EPA 3550B/8081B EPA 3550C/8081B EPA 3580A/8081B
Heptachlor	EPA 608 EPA 3510C/8081A EPA 3510C/8081B	EPA 3550B/8081A EPA 3550C/8081A EPA 3580A/8081A EPA 3550B/8081B EPA 3550C/8081B EPA 3580A/8081B

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Heptachlor epoxide	EPA 608 EPA 3510C/8081A EPA 3510C/8081B	EPA 3550B/8081A EPA 3550C/8081A EPA 3580A/8081A EPA 3550B/8081B EPA 3550C/8081B EPA 3580A/8081B
Methoxychlor	EPA 3510C/8081A EPA 3510C/8081B	EPA 3550B/8081A EPA 3550C/8081A EPA 3580A/8081A EPA 3550B/8081B EPA 3550C/8081B EPA 3580A/8081B
Toxaphene	EPA 608 EPA 3510C/8081A EPA 3510C/8081B	EPA 3550B/8081A EPA 3550C/8081A EPA 3580A/8081A EPA 3550B/8081B EPA 3550C/8081B EPA 3580A/8081B
PCB-1016 (Aroclor)	EPA 608 EPA 3510C/8082 EPA 3510C/8082A	EPA 3550B/8082 EPA 3550C/8082 EPA 3580A/8082 EPA 3550B/8082A EPA 3550C/8082A EPA 3580A/8082A
PCB-1221	EPA 608 EPA 3510C/8082 EPA 3510C/8082A	EPA 3550B/8082 EPA 3550C/8082 EPA 3580A/8082 EPA 3550B/8082A EPA 3550C/8082A EPA 3580A/8082A
PCB-1232	EPA 608 EPA 3510C/8082 EPA 3510C/8082A	EPA 3550B/8082 EPA 3550C/8082 EPA 3580A/8082 EPA 3550B/8082A EPA 3550C/8082A EPA 3580A/8082A
PCB-1242	EPA 608 EPA 3510C/8082 EPA 3510C/8082A	EPA 3550B/8082 EPA 3550C/8082 EPA 3580A/8082 EPA 3550B/8082A EPA 3550C/8082A EPA 3580A/8082A
PCB-1248	EPA 608 EPA 3510C/8082 EPA 3510C/8082A	EPA 3550B/8082 EPA 3550C/8082 EPA 3580A/8082 EPA 3550B/8082A EPA 3550C/8082A EPA 3580A/8082A

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
PCB-1254	EPA 608 EPA 3510C/8082 EPA 3510C/8082A	EPA 3550B/8082 EPA 3550C/8082 EPA 3580A/8082 EPA 3550B/8082A EPA 3550C/8082A EPA 3580A/8082A
PCB-1260	EPA 608 EPA 3510C/8082 EPA 3510C/8082A	EPA 3550B/8082 EPA 3550C/8082 EPA 3580A/8082 EPA 3550B/8082A EPA 3550C/8082A EPA 3580A/8082A
2,4-D	EPA 8151A	EPA 8151A
Dalapon	EPA 8151A	EPA 8151A
2,4-DB	EPA 8151A	EPA 8151A
Dicamba	EPA 8151A	EPA 8151A
Dichloroprop	EPA 8151A	EPA 8151A
Dinoseb	EPA 8151A	EPA 8151A
MCPA	EPA 8151A	EPA 8151A
MCPP	EPA 8151A	EPA 8151A
Pentachlorophenol	EPA 8151A	EPA 8151A
2,4,5-T	EPA 8151A	EPA 8151A
2,4,5-TP	EPA 8151A	EPA 8151A
HPLC		
1,3,5-Trinitrobenzene	EPA 3535A/8330A EPA 3535A/8330B	EPA 8330A EPA 8330B
1,3-Dinitrobenzene	EPA 3535A/8330A EPA 3535A/8330B	EPA 8330A EPA 8330B
2,4,6-Trinitrotoluene	EPA 3535A/8330A EPA 3535A/8330B	EPA 8330A EPA 8330B
2,4-Dinitrotoluene	EPA 3535A/8330A EPA 3535A/8330B	EPA 8330A EPA 8330B
2,6-Dinitrotoluene	EPA 3535A/8330A EPA 3535A/8330B	EPA 8330A EPA 8330B
2-Amino-4,6-dinitrotoluene	EPA 3535A/8330A EPA 3535A/8330B	EPA 8330A EPA 8330B
2-Nitrotoluene	EPA 3535A/8330A EPA 3535A/8330B	EPA 8330A EPA 8330B
3-Nitrotoluene	EPA 3535A/8330A EPA 3535A/8330B	EPA 8330A EPA 8330B
4-Amino-2,6-dinitrotoluene	EPA 3535A/8330A EPA 3535A/8330B	EPA 8330A EPA 8330B
4-Nitrotoluene	EPA 3535A/8330A EPA 3535A/8330B	EPA 8330A EPA 8330B
Nitrobenzene	EPA 3535A/8330A EPA 3535A/8330B	EPA 8330A EPA 8330B
Nitroglycerin	EPA 3535A/8330A EPA 3535A/8330B	EPA 8330A EPA 8330B

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
HMX	EPA 3535A/8330A EPA 3535A/8330B	EPA 8330A EPA 8330B
PETN	EPA 3535A/8330A EPA 3535A/8330B	EPA 8330A EPA 8330B
RDX	EPA 3535A/8330A EPA 3535A/8330B	EPA 8330A EPA 8330B
Tetryl	EPA 3535A/8330A EPA 3535A/8330B	EPA 8330A EPA 8330B
Nitroglycerin	EPA 3535A/8330A EPA 3535A/8330B	EPA 8330A EPA 8330B
Nitroguanidine	EPA 3535A/8330A EPA 3535A/8330B	EPA 8330A EPA 8330B
Nitrocellulose	EPA USATHAMA/353.2/353.3	EPA USATHAMA/353.2/353.3
Hazardous Waste Characteristics		
Corrosivity	EPA 9040C	EPA 9040C EPA 9045D
Ignitibility	EPA 1010A	EPA 1010A
Reactivity	EPA SW 846 Ch 7	EPA SW 846 Ch 7
Synthetic Precipitation Leaching Procedure (SPLP)	EPA 1312	EPA 1312
Toxicity Characteristic Leaching Procedure (TCLP)	EPA 1311	EPA 1311
LC/MS/MS		
Perchlorate	EPA 6850 EPA 331	EPA 6850

(1) Method List includes Clean Water Act and RCRA water parameters
(2) Method List includes RCRA parameters only

The American Association for Laboratory Accreditation

World Class Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

MICROBAC LABORATORIES, INC.
OHIO VALLEY DIVISION

Marietta, OH

for technical competence in the field of

Environmental Testing

In recognition of the successful completion of the A2LA evaluation process that includes an assessment of the laboratory's compliance with ISO/IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the current DoD Quality Systems Manual for Environmental Laboratories; accreditation is granted to this laboratory to perform recognized EPA methods as defined on the associated A2LA Environmental Scope of Accreditation. This accreditation demonstrates technical competence for this defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION
CORPORATE SEAL 1978
DISTRICT OF COLUMBIA
A2LA

Presented this 28th day of September 2009.

President & CEO
For the Accreditation Council
Certificate Number 2936.01
Valid to December 31, 2011

For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.

LABORATORY ACCREDITATION BUREAU

Certificate of Accreditation

ISO/IEC 17025:2005 Certificate Number L2247

Mitkem Laboratories,

A Division of Spectrum Analytical, Inc.

175 Metro Center Blvd
Warwick, RI 02886

has met the requirements set forth in L-A-B's policies and procedures, all requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).*

The accredited lab has demonstrated technical competence to a defined "Scope of Accreditation" and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation Granted through: April 1, 2013

R. Douglas Leonard, Jr., Managing Director
Laboratory Accreditation Bureau
Presented the 26th of July 2010

*See the laboratory's Scope of Accreditation for details of the DoD ELAP requirements
Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).

Certificate # L2247

Scope of Accreditation
For
Mitkem Laboratories,
A Division of Spectrum Analytical, Inc.

175 Metro Center Blvd.
Warwick, RI 02886
Sharyn Lawler
401-732-3400

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.1) based on the National Environmental Laboratory Accreditation Conference Chapter 5 Quality Systems Standard (NELAC Voted Revision June 5, 2003), accreditation is granted to MITKEM to perform the following tests:

Accreditation granted through: April 1, 2013

Testing - Environmental

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260C	1,1,1-Trichloroethane
GC/MS	EPA 8260C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260C	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 8260C	1,1,2-Trichloroethane
GC/MS	EPA 8260C	1,1-Dichloroethane
GC/MS	EPA 8260C	1,1-Dichloroethene
GC/MS	EPA 8260C	1,1-Dichloropropene
GC/MS	EPA 8260C	1,2,3-Trichlorobenzene
GC/MS	EPA 8260C	1,2,3-Trichloropropane
GC/MS	EPA 8260C	1,2,4-Trichlorobenzene
GC/MS	EPA 8260C	1,2,4-Trimethylbenzene
GC/MS	EPA 8260C	1,2-Dibromo-3-chloropropane
GC/MS	EPA 8260C	1,2-Dibromoethane
GC/MS	EPA 8260C	1,2-Dichlorobenzene
GC/MS	EPA 8260C	1,2-Dichloroethane
GC/MS	EPA 8260C	1,2-Dichloropropane
GC/MS	EPA 8260C	1,3,5-Trimethylbenzene
GC/MS	EPA 8260C	1,3-Dichlorobenzene
GC/MS	EPA 8260C	1,3-Dichloropropane
GC/MS	EPA 8260C	1,4-Dichlorobenzene

LABORATORY ACCREDITATION BUREAU

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8260C	1-Chlorohexane
GC/MS	EPA 8260C	2,2-Dichloropropane
GC/MS	EPA 8260C	2-Butanone
GC/MS	EPA 8260C	2-Chlorotoluene
GC/MS	EPA 8260C	2-Hexanone
GC/MS	EPA 8260C	4-Chlorotoluene
GC/MS	EPA 8260C	4-Isopropyltoluene
GC/MS	EPA 8260C	4-Methyl-2-pentanone
GC/MS	EPA 8260C	Acetone
GC/MS	EPA 8260C	Acetonitrile
GC/MS	EPA 8260C	Acrolein
GC/MS	EPA 8260C	Acrylonitrile
GC/MS	EPA 8260C	Allyl Chloride
GC/MS	EPA 8260C	Benzene
GC/MS	EPA 8260C	Bromobenzene
GC/MS	EPA 8260C	Bromochloromethane
GC/MS	EPA 8260C	Bromodichloromethane
GC/MS	EPA 8260C	Bromoform
GC/MS	EPA 8260C	Bromomethane
GC/MS	EPA 8260C	Carbon disulfide
GC/MS	EPA 8260C	Carbon tetrachloride
GC/MS	EPA 8260C	Chlorobenzene
GC/MS	EPA 8260C	Chloroethane
GC/MS	EPA 8260C	Chloroform
GC/MS	EPA 8260C	Chloromethane
GC/MS	EPA 8260C	cis-1,2-Dichloroethene
GC/MS	EPA 8260C	cis-1,3-Dichloropropene
GC/MS	EPA 8260C	Cyclohexane
GC/MS	EPA 8260C	Dibromochloromethane
GC/MS	EPA 8260C	Dibromomethane
GC/MS	EPA 8260C	Dichlorodifluoromethane
GC/MS	EPA 8260C	Diethyl Ether
GC/MS	EPA 8260C	Diisopropyl ether
GC/MS	EPA 8260C	Ethanol
GC/MS	EPA 8260C	Ethylbenzene
GC/MS	EPA 8260C	Ethyl methacrylate
GC/MS	EPA 8260C	Ethyl tert-butyl ether
GC/MS	EPA 8260C	Hexachlorobutadiene
GC/MS	EPA 8260C	Hexachloroethane
GC/MS	EPA 8260C	Iodomethane
GC/MS	EPA 8260C	Isobutyl alcohol
GC/MS	EPA 8260C	Isopropylbenzene
GC/MS	EPA 8260C	m,p-Xylene
GC/MS	EPA 8260C	Methacrylonitrile
GC/MS	EPA 8260C	Methyl acetate

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8260C	Methylcyclohexane
GC/MS	EPA 8260C	Methyl methacrylate
GC/MS	EPA 8260C	Methyl tert-butyl ether
GC/MS	EPA 8260C	Methylene chloride
GC/MS	EPA 8260C	n-Butylbenzene
GC/MS	EPA 8260C	n-Propylbenzene
GC/MS	EPA 8260C	Naphthalene
GC/MS	EPA 8260C	o-Xylene
GC/MS	EPA 8260C	Propionitrile
GC/MS	EPA 8260C	sec-Butylbenzene
GC/MS	EPA 8260C	Styrene
GC/MS	EPA 8260C	tert-Amyl Methyl ether
GC/MS	EPA 8260C	tert-Butyl alcohol
GC/MS	EPA 8260C	tert-Butylbenzene
GC/MS	EPA 8260C	Tetrachloroethene
GC/MS	EPA 8260C	Tetrahydrofuran
GC/MS	EPA 8260C	Toluene
GC/MS	EPA 8260C	trans-1,2-Dichloroethene
GC/MS	EPA 8260C	trans-1,3-Dichloropropene
GC/MS	EPA 8260C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260C	Trichloroethene
GC/MS	EPA 8260C	Trichlorofluoromethane
GC/MS	EPA 8260C	Vinyl acetate
GC/MS	EPA 8260C	Vinyl chloride
GC/MS	EPA 8260C	Xylene (Total)
GC/MS	EPA 8270D	1,1´-Biphenyl
GC/MS	EPA 8270D	Benzaldehyde
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270D	1,2-Dichlorobenzene
GC/MS	EPA 8270D	1,3-Dichlorobenzene
GC/MS	EPA 8270D	1,4-Dichlorobenzene
GC/MS	EPA 8270D	1,4-Dioxane
GC/MS	EPA 8270D	1-Methylnaphthalene
GC/MS	EPA 8270D	2,2´-oxybis(1-Chloropropane)
GC/MS	EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 8270D	2,4-Dinitrotoluene
GC/MS	EPA 8270D	2,6-Dinitrotoluene
GC/MS	EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	2-Methylnaphthalene

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8270D	2-Methylphenol
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	3,3´-Dichlorobenzidine
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4,6-Dinitro-2-methylphenol
GC/MS	EPA 8270D	4-Bromophenyl-phenylether
GC/MS	EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	4-Chlorophenyl-phenylether
GC/MS	EPA 8270D	4-Methylphenol
GC/MS	EPA 8270D	4-Nitroaniline
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	Acenaphthene
GC/MS	EPA 8270D	Acenaphthylene
GC/MS	EPA 8270D	Aniline
GC/MS	EPA 8270D	Anthracene
GC/MS	EPA 8270D	Atrazine
GC/MS	EPA 8270D	Azobenzene
GC/MS	EPA 8270D	Benzidine
GC/MS	EPA 8270D	Benzyl Alcohol
GC/MS	EPA 8270D	Benzo(a)anthracene
GC/MS	EPA 8270D	Benzo(a)pyrene
GC/MS	EPA 8270D	Benzo(b)fluoranthene
GC/MS	EPA 8270D	Benzo(g,h,i)perylene
GC/MS	EPA 8270D	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Bis(2-chloroethoxy)methane
GC/MS	EPA 8270D	Bis(2-chloroethyl)ether
GC/MS	EPA 8270D	Bis(2-ethylhexyl)phthalate
GC/MS	EPA 8270D	Butylbenzylphthalate
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	Chrysene
GC/MS	EPA 8270D	Di-n-butylphthalate
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Diethylphthalate
GC/MS	EPA 8270D	Dimethylphthalate
GC/MS	EPA 8270D	Di-n-octylphthalate
GC/MS	EPA 8270D	Dibenzo(a,h)anthracene
GC/MS	EPA 8270D	Fluoranthene
GC/MS	EPA 8270D	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Indeno(1,2,3-cd)pyrene

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8270D	Isophorone
GC/MS	EPA 8270D	N-Nitroso-di-n-propylamine
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	Pentachlorophenol
GC/MS	EPA 8270D	N-Nitrosodimethylamine
GC/MS	EPA 8270D	N-Nitrosodiphenylamine
GC/MS	EPA 8270D	Naphthalene
GC/MS	EPA 8270D	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	Pyrene
GC/MS	EPA 8270D	Pyridine
GC/ECD	EPA 8081B	4,4′-DDD
GC/ECD	EPA 8081B	4,4′-DDE
GC/ECD	EPA 8081B	4,4′-DDT
GC/ECD	EPA 8081B	Aldrin
GC/ECD	EPA 8081B	alpha-BHC
GC/ECD	EPA 8081B	alpha-Chlordane
GC/ECD	EPA 8081B	beta-BHC
GC/ECD	EPA 8081B	delta-BHC
GC/ECD	EPA 8081B	Dieldrin
GC/ECD	EPA 8081B	Endosulfan I
GC/ECD	EPA 8081B	Endosulfan II
GC/ECD	EPA 8081B	Endosulfan sulfate
GC/ECD	EPA 8081B	Endrin
GC/ECD	EPA 8081B	Endrin aldehyde
GC/ECD	EPA 8081B	Endrin ketone
GC/ECD	EPA 8081B	gamma-BHC (Lindane)
GC/ECD	EPA 8081B	gamma-Chlordane
GC/ECD	EPA 8081B	Heptachlor
GC/ECD	EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 8081B	Methoxychlor
GC/ECD	EPA 8081B	Toxaphene
GC/ECD	EPA 8081B	Chlordane (technical)
GC/ECD	EPA 8082A	Aroclor-1016
GC/ECD	EPA 8082A	Aroclor-1221
GC/ECD	EPA 8082A	Aroclor-1232
GC/ECD	EPA 8082A	Aroclor-1242
GC/ECD	EPA 8082A	Aroclor-1248
GC/ECD	EPA 8082A	Aroclor-1254
GC/ECD	EPA 8082A	Aroclor-1260
GC/ECD	EPA 8082A	Aroclor-1262
GC/ECD	EPA 8082A	Aroclor-1268
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4,5-TP (Silvex)
GC/ECD	EPA 8151A	2,4-D

Non-Potable Water

Technology	Method	Analyte
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichlorprop
GC/ECD	EPA 8151A	Dinoseb
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP
GC/FID	EPA 8015D	Diesel Range Organics
GC/FID	EPA 8015D	Gasoline Range Organics
ICP/AES	EPA 6010C	Aluminum
ICP/AES	EPA 6010C	Antimony
ICP/AES	EPA 6010C	Arsenic
ICP/AES	EPA 6010C	Barium
ICP/AES	EPA 6010C	Beryllium
ICP/AES	EPA 6010C	Boron
ICP/AES	EPA 6010C	Cadmium
ICP/AES	EPA 6010C	Calcium
ICP/AES	EPA 6010C	Chromium
ICP/AES	EPA 6010C	Cobalt
ICP/AES	EPA 6010C	Copper
ICP/AES	EPA 6010C	Iron
ICP/AES	EPA 6010C	Lead
ICP/AES	EPA 6010C	Magnesium
ICP/AES	EPA 6010C	Manganese
ICP/AES	EPA 6010C	Molybdenum
ICP/AES	EPA 6010C	Nickel
ICP/AES	EPA 6010C	Potassium
ICP/AES	EPA 6010C	Selenium
ICP/AES	EPA 6010C	Silver
ICP/AES	EPA 6010C	Sodium
ICP/AES	EPA 6010C	Thallium
ICP/AES	EPA 6010C	Tin
ICP/AES	EPA 6010C	Vanadium
ICP/AES	EPA 6010C	Zinc
ICP/AES	SM 2340 B	Hardness, Ca/Mg (As CaCO3) BY CALCULATION
ICP/MS	EPA 6020A	Aluminum
ICP/MS	EPA 6020A	Antimony
ICP/MS	EPA 6020A	Arsenic
ICP/MS	EPA 6020A	Barium
ICP/MS	EPA 6020A	Beryllium
ICP/MS	EPA 6020A	Cadmium
ICP/MS	EPA 6020A	Calcium
ICP/MS	EPA 6020A	Chromium
ICP/MS	EPA 6020A	Cobalt
ICP/MS	EPA 6020A	Copper

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Non-Potable Water

Technology	Method	Analyte
ICP/MS	EPA 6020A	Iron
ICP/MS	EPA 6020A	Lead
ICP/MS	EPA 6020A	Magnesium
ICP/MS	EPA 6020A	Manganese
ICP/MS	EPA 6020A	Nickel
ICP/MS	EPA 6020A	Potassium
ICP/MS	EPA 6020A	Selenium
ICP/MS	EPA 6020A	Silver
ICP/MS	EPA 6020A	Sodium
ICP/MS	EPA 6020A	Thallium
ICP/MS	EPA 6020A	Vanadium
ICP/MS	EPA 6020A	Zinc
CVAA	EPA 7470A	Mercury
FIA	EPA 9012B	Total Cyanide
IC	EPA 9056A	Bromide
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Nitrogen, Nitrate (As N)
IC	EPA 9056A	Nitrogen, Nitrite (As N)
FIA	EPA 353.2	Nitrogen, Nitrate-Nitrite
IC	EPA 9056A	ortho-Phosphate (As P)
UV/VIS	SM 4500 P B(5)+E 18th ED	Total Phosphorus
IC	EPA 9056A	Sulfate
IC	EPA 300.0 mod.	Acetic Acid
IC	EPA 300.0 mod.	Butyric Acid
IC	EPA 300.0 mod.	Lactic Acid
IC	EPA 300.0 mod.	Propionic Acid
IC	EPA 300.0 mod.	Pyruvic Acid
UV/VIS	SM 4500 S2- D 20th ED	Sulfide
combustion/IR	EPA 9060A	Organic Carbon, Total
UV/VIS	SM 3500 Cr D 18th ED	Chromium, Hexavalent
Pensky-Marten	EPA 1010	Ignitability
pH meter	SM 4500 H+B 18th ED	pH
UV/VIS	SM 4500 NH3 B,C 18th ED	Ammonia-N
UV/VIS	SM 4500 N Org C 20th ED	TKN-N
Titration	SM 2320 B 20th ED	Alkalinity, Total (As CaCO3)
Gravimetric	SM 2540 C 20th ED	Total Dissolved Solids
Gravimetric	SM 2540 D 20th ED	Total Suspended Solids
Gravimetric	EPA 1664A	Oil & Grease, Total Recoverable
Conductivity Meter	EPA 120.1	Specific Conductance
UV/VIS	SM 5220 D 20th ED	Chemical Oxygen Demand
UV/VIS	SM 3500 Fe B 20th ED	Ferrous Iron
GC/FID	RSK-175	Ethane
GC/FID	RSK-175	Ethene
GC/FID	RSK-175	Methane

Non-Potable Water

Preparation	Method	Type
Organic Preparation	EPA 3510C	Separatory Funnel
Organic Preparation	EPA 3520C	Continuous Liquid Liquid
Inorganic Preparation	EPA 3005A	Hotblock
Inorganic Preparation	EPA 3010A	Hotblock
Volatile Organic Preparation	EPA 5030B	Purge and Trap

Solid and Chemical Waste

Technology	Method	Analyte
CVAA	EPA 7471B	Mercury
FIA	EPA 9012B	Total Cyanide
Titration	WALKLEY BLACK	Organic Carbon, Total
Combustion/IR	EPA 9060A	Organic Carbon, Total
Combustion/IR	Lloyd Kahn	Organic Carbon, Total
UV/VIS	EPA 7196A	Chromium, Hexavalent
Oven	ASTM D2216	Percent moisture
pH meter	EPA 9045C	pH
ICP/AES	EPA 6010C	Aluminum
ICP/AES	EPA 6010C	Antimony
ICP/AES	EPA 6010C	Arsenic
ICP/AES	EPA 6010C	Barium
ICP/AES	EPA 6010C	Beryllium
ICP/AES	EPA 6010C	Boron
ICP/AES	EPA 6010C	Cadmium
ICP/AES	EPA 6010C	Calcium
ICP/AES	EPA 6010C	Chromium
ICP/AES	EPA 6010C	Cobalt
ICP/AES	EPA 6010C	Copper
ICP/AES	EPA 6010C	Iron
ICP/AES	EPA 6010C	Lead
ICP/AES	EPA 6010C	Magnesium
ICP/AES	EPA 6010C	Manganese
ICP/AES	EPA 6010C	Molybdenum
ICP/AES	EPA 6010C	Nickel
ICP/AES	EPA 6010C	Potassium
ICP/AES	EPA 6010C	Selenium
ICP/AES	EPA 6010C	Silver
ICP/AES	EPA 6010C	Sodium
ICP/AES	EPA 6010C	Thallium
ICP/AES	EPA 6010C	Tin
ICP/AES	EPA 6010C	Vanadium
ICP/AES	EPA 6010C	Zinc
ICP/MS	EPA 6020A	Aluminum
ICP/MS	EPA 6020A	Antimony

Solid and Chemical Waste

Technology	Method	Analyte
ICP/MS	EPA 6020A	Arsenic
ICP/MS	EPA 6020A	Barium
ICP/MS	EPA 6020A	Beryllium
ICP/MS	EPA 6020A	Cadmium
ICP/MS	EPA 6020A	Calcium
ICP/MS	EPA 6020A	Chromium
ICP/MS	EPA 6020A	Cobalt
ICP/MS	EPA 6020A	Copper
ICP/MS	EPA 6020A	Iron
ICP/MS	EPA 6020A	Lead
ICP/MS	EPA 6020A	Magnesium
ICP/MS	EPA 6020A	Manganese
ICP/MS	EPA 6020A	Nickel
ICP/MS	EPA 6020A	Potassium
ICP/MS	EPA 6020A	Selenium
ICP/MS	EPA 6020A	Silver
ICP/MS	EPA 6020A	Sodium
ICP/MS	EPA 6020A	Thallium
ICP/MS	EPA 6020A	Vanadium
ICP/MS	EPA 6020A	Zinc
GC/FID	EPA 8015D	Diesel Range Organics
GC/FID	EPA 8015D	Gasoline Range Organics
GC/ECD	EPA 8082A	Aroclor-1016
GC/ECD	EPA 8082A	Aroclor-1221
GC/ECD	EPA 8082A	Aroclor-1232
GC/ECD	EPA 8082A	Aroclor-1242
GC/ECD	EPA 8082A	Aroclor-1248
GC/ECD	EPA 8082A	Aroclor-1254
GC/ECD	EPA 8082A	Aroclor-1260
GC/ECD	EPA 8082A	Aroclor-1262
GC/ECD	EPA 8082A	Aroclor-1268
GC/ECD	EPA 8081B	4,4′-DDD
GC/ECD	EPA 8081B	4,4′-DDE
GC/ECD	EPA 8081B	4,4′-DDT
GC/ECD	EPA 8081B	Aldrin
GC/ECD	EPA 8081B	alpha-BHC
GC/ECD	EPA 8081B	alpha-Chlordane
GC/ECD	EPA 8081B	beta-BHC
GC/ECD	EPA 8081B	delta-BHC
GC/ECD	EPA 8081B	Dieldrin
GC/ECD	EPA 8081B	Endosulfan I
GC/ECD	EPA 8081B	Endosulfan II
GC/ECD	EPA 8081B	Endosulfan sulfate
GC/ECD	EPA 8081B	Endrin
GC/ECD	EPA 8081B	Endrin aldehyde

Solid and Chemical Waste

Technology	Method	Analyte
GC/ECD	EPA 8081B	Endrin ketone
GC/ECD	EPA 8081B	gamma-BHC (Lindane)
GC/ECD	EPA 8081B	gamma-Chlordane
GC/ECD	EPA 8081B	Heptachlor
GC/ECD	EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 8081B	Methoxychlor
GC/ECD	EPA 8081B	Toxaphene
GC/ECD	EPA 8081B	Chlordane (technical)
GC/MS	EPA 8260C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260C	1,1,1-Trichloroethane
GC/MS	EPA 8260C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260C	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 8260C	1,1,2-Trichloroethane
GC/MS	EPA 8260C	1,1-Dichloroethane
GC/MS	EPA 8260C	1,1-Dichloroethene
GC/MS	EPA 8260C	1,1-Dichloropropene
GC/MS	EPA 8260C	1,2,3-Trichlorobenzene
GC/MS	EPA 8260C	1,2,3-Trichloropropane
GC/MS	EPA 8260C	1,2,4-Trichlorobenzene
GC/MS	EPA 8260C	1,2,4-Trimethylbenzene
GC/MS	EPA 8260C	1,2-Dibromo-3-chloropropane
GC/MS	EPA 8260C	1,2-Dibromoethane
GC/MS	EPA 8260C	1,2-Dichlorobenzene
GC/MS	EPA 8260C	1,2-Dichloroethane
GC/MS	EPA 8260C	1,2-Dichloropropane
GC/MS	EPA 8260C	1,3,5-Trimethylbenzene
GC/MS	EPA 8260C	1,3-Dichlorobenzene
GC/MS	EPA 8260C	1,3-Dichloropropane
GC/MS	EPA 8260C	1,4-Dichlorobenzene
GC/MS	EPA 8260C	1,4-Dioxane
GC/MS	EPA 8260C	1-Chlorohexane
GC/MS	EPA 8260C	2,2-Dichloropropane
GC/MS	EPA 8260C	2-Butanone
GC/MS	EPA 8260C	2-Chlorotoluene
GC/MS	EPA 8260C	2-Hexanone
GC/MS	EPA 8260C	4-Chlorotoluene
GC/MS	EPA 8260C	4-Isopropyltoluene
GC/MS	EPA 8260C	4-Methyl-2-pentanone
GC/MS	EPA 8260C	Acetone
GC/MS	EPA 8260C	Acetonitrile
GC/MS	EPA 8260C	Acrolein
GC/MS	EPA 8260C	Acrylonitrile
GC/MS	EPA 8260C	Allyl Chloride
GC/MS	EPA 8260C	Benzene
GC/MS	EPA 8260C	Bromobenzene

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Solid and Chemical Waste

Technology	Method	Analyte
GC/MS	EPA 8260C	Bromochloromethane
GC/MS	EPA 8260C	Bromodichloromethane
GC/MS	EPA 8260C	Bromoform
GC/MS	EPA 8260C	Bromomethane
GC/MS	EPA 8260C	Carbon disulfide
GC/MS	EPA 8260C	Carbon tetrachloride
GC/MS	EPA 8260C	Chlorobenzene
GC/MS	EPA 8260C	Chloroethane
GC/MS	EPA 8260C	Chloroform
GC/MS	EPA 8260C	Chloromethane
GC/MS	EPA 8260C	cis-1,2-Dichloroethene
GC/MS	EPA 8260C	cis-1,3-Dichloropropene
GC/MS	EPA 8260C	Cyclohexane
GC/MS	EPA 8260C	Dibromochloromethane
GC/MS	EPA 8260C	Dibromomethane
GC/MS	EPA 8260C	Dichlorodifluoromethane
GC/MS	EPA 8260C	Diethyl Ether
GC/MS	EPA 8260C	Diisopropyl ether
GC/MS	EPA 8260C	Ethanol
GC/MS	EPA 8260C	Ethylbenzene
GC/MS	EPA 8260C	Ethyl methacrylate
GC/MS	EPA 8260C	Ethyl tert-butyl ether
GC/MS	EPA 8260C	Hexachlorobutadiene
GC/MS	EPA 8260C	Hexachloroethane
GC/MS	EPA 8260C	Iodomethane
GC/MS	EPA 8260C	Isobutyl alcohol
GC/MS	EPA 8260C	Isopropylbenzene
GC/MS	EPA 8260C	m,p-Xylene
GC/MS	EPA 8260C	Methacrylonitrile
GC/MS	EPA 8260C	Methyl acetate
GC/MS	EPA 8260C	Methylcyclohexane
GC/MS	EPA 8260C	Methyl methacrylate
GC/MS	EPA 8260C	Methyl tert-butyl ether
GC/MS	EPA 8260C	Methylene chloride
GC/MS	EPA 8260C	n-Butylbenzene
GC/MS	EPA 8260C	n-Propylbenzene
GC/MS	EPA 8260C	Naphthalene
GC/MS	EPA 8260C	o-Xylene
GC/MS	EPA 8260C	Propionitrile
GC/MS	EPA 8260C	sec-Butylbenzene
GC/MS	EPA 8260C	Styrene
GC/MS	EPA 8260C	tert-Amyl Methyl ether
GC/MS	EPA 8260C	tert-Butyl alcohol
GC/MS	EPA 8260C	tert-Butylbenzene
GC/MS	EPA 8260C	Tetrachloroethene

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Solid and Chemical Waste

Technology	Method	Analyte
GC/MS	EPA 8260C	Tetrahydrofuran
GC/MS	EPA 8260C	Toluene
GC/MS	EPA 8260C	trans-1,2-Dichloroethene
GC/MS	EPA 8260C	trans-1,3-Dichloropropene
GC/MS	EPA 8260C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260C	Trichloroethene
GC/MS	EPA 8260C	Trichlorofluoromethane
GC/MS	EPA 8260C	Vinyl acetate
GC/MS	EPA 8260C	Vinyl chloride
GC/MS	EPA 8260C	Xylene (Total)
GC/MS	EPA 8270D	1,1´-Biphenyl
GC/MS	EPA 8270D	Benzaldehyde
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270D	1,2-Dichlorobenzene
GC/MS	EPA 8270D	1,3-Dichlorobenzene
GC/MS	EPA 8270D	1,4-Dichlorobenzene
GC/MS	EPA 8270D	1-Methylnaphthalene
GC/MS	EPA 8270D	2,2´-oxybis(1-Chloropropane)
GC/MS	EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 8270D	2,4-Dinitrotoluene
GC/MS	EPA 8270D	2,6-Dinitrotoluene
GC/MS	EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	2-Methylnaphthalene
GC/MS	EPA 8270D	2-Methylphenol
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	3,3´-Dichlorobenzidine
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4,6-Dinitro-2-methylphenol
GC/MS	EPA 8270D	4-Bromophenyl-phenylether
GC/MS	EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	4-Chlorophenyl-phenylether
GC/MS	EPA 8270D	4-Methylphenol
GC/MS	EPA 8270D	4-Nitroaniline
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	Acenaphthene
GC/MS	EPA 8270D	Acenaphthylene
GC/MS	EPA 8270D	Aniline

Solid and Chemical Waste

Technology	Method	Analyte
GC/MS	EPA 8270D	Anthracene
GC/MS	EPA 8270D	Atrazine
GC/MS	EPA 8270D	Azobenzene
GC/MS	EPA 8270D	Benzyl Alcohol
GC/MS	EPA 8270D	Benzo(a)anthracene
GC/MS	EPA 8270D	Benzo(a)pyrene
GC/MS	EPA 8270D	Benzo(b)fluoranthene
GC/MS	EPA 8270D	Benzo(g,h,i)perylene
GC/MS	EPA 8270D	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Bis(2-chloroethoxy)methane
GC/MS	EPA 8270D	Bis(2-chloroethyl)ether
GC/MS	EPA 8270D	Bis(2-ethylhexyl)phthalate
GC/MS	EPA 8270D	Butylbenzylphthalate
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	Chrysene
GC/MS	EPA 8270D	Di-n-butylphthalate
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Diethylphthalate
GC/MS	EPA 8270D	Dimethylphthalate
GC/MS	EPA 8270D	Di-n-octylphthalate
GC/MS	EPA 8270D	Dibenzo(a,h)anthracene
GC/MS	EPA 8270D	Fluoranthene
GC/MS	EPA 8270D	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isophorone
GC/MS	EPA 8270D	N-Nitroso-di-n-propylamine
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	Pentachlorophenol
GC/MS	EPA 8270D	N-Nitrosodimethylamine
GC/MS	EPA 8270D	N-Nitrosodiphenylamine
GC/MS	EPA 8270D	Naphthalene
GC/MS	EPA 8270D	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	Pyrene
UV/VIS	EPA 9031	Extractable Sulfides
Preparation	**Method**	**Type**
Organic Preparation	EPA 3550B	Sonication
Inorganics Preparation	EPA 3050B	Hotblock

LABORATORY ACCREDITATION BUREAU

Certificate # L2247

Solid and Chemical Waste

Preparation	Method	Type
Volatile Organics Prepration	EPA 5035	Closed System Purge and Trap
Inorganics Preparation	EPA 3060A	Alkaline Digestion
Preparation	EPA 1311	Toxicity Characteristic Leaching Procedure
Preparation	ASTM D3987	Shake ext of solid waste with water

Notes:

1) This laboratory offers commercial testing service.

Approved By: R.D.

R. Douglas Leonard
Chief Technical Officer

Date: March 8, 2011

Issued: 04/01/10 Revised 04/06/10 Revised: 7/26/10 Revised: 3/8/11

LABORATORY ACCREDITATION BUREAU

Certificate of Accreditation

ISO/IEC 17025:2005 Certificate Number L2259

Spectrum Analytical, Inc.

featuring Hanibal Technology, Florida Division

8405 Benjamin Road, Suite A
Tampa, FL 33634

has met the requirements set forth in L-A-B's policies and procedures, all requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).*

The accredited lab has demonstrated technical competence to a defined "Scope of Accreditation" and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation Granted through: July 13, 2013

R. Douglas Leonard, Jr., Managing Director
Laboratory Accreditation Bureau
Presented the 10th of June 2011

*See the laboratory's Scope of Accreditation for details of the DoD ELAP requirements
Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).

LABORATORY ACCREDITATION BUREAU

Certificate # L2259

Scope of Accreditation
For
Spectrum Analytical, Inc.
featuring Hanibal Technology, Florida Division

8405 Benjamin Road, Suite A
Tampa, FL 33634
Mark-Allen W. Barnard
813-888-9507

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.2) based on the National Environmental Laboratory Accreditation Conference Chapter 5 Quality Systems Standard (NELAC Voted Revision June 5, 2003), accreditation is granted to Spectrum Analytical, Inc. featuring Hanibal Technology, Florida Division to perform the following tests:

Accreditation granted through: **July 13, 2013**

Testing – Environmental

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8011	1,2-Dibromo-3-chloropropane (DBCP)
GC/ECD	EPA 8011	1,2-Dibromoethane (EDB)
GC/ECD	EPA 8081A/8081B	4,4’-DDD
GC/ECD	EPA 8081A/8081B	4,4’-DDE
GC/ECD	EPA 8081A/8081B	4,4’-DDT
GC/ECD	EPA 8081A/8081B	Aldrin
GC/ECD	EPA 8081A/8081B	alpha-BHC
GC/ECD	EPA 8081A/8081B	alpha-Chlordane
GC/ECD	EPA 8081A/8081B	beta-BHC
GC/ECD	EPA 8081A/8081B	Chlordane
GC/ECD	EPA 8081A/8081B	delta-BHC
GC/ECD	EPA 8081A/8081B	Dieldrin
GC/ECD	EPA 8081A/8081B	Endosulfan I
GC/ECD	EPA 8081A/8081B	Endosulfan II
GC/ECD	EPA 8081A/8081B	Endosulfan sulfate

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8081A/8081B	Endrin
GC/ECD	EPA 8081A/8081B	Endrin aldehyde
GC/ECD	EPA 8081A/8081B	Endrin ketone
GC/ECD	EPA 8081A/8081B	gamma-BHC (Lindane)
GC/ECD	EPA 8081A/8081B	gamma-Chlordane
GC/ECD	EPA 8081A/8081B	Heptachlor
GC/ECD	EPA 8081A/8081B	Heptachlor epoxide
GC/ECD	EPA 8081A/8081B	Methoxychlor
GC/ECD	EPA 8081A/8081B	Mirex
GC/ECD	EPA 8081A/8081B	Toxaphene
GC/ECD	EPA 8082/8082A	Aroclor-1016
GC/ECD	EPA 8082/8082A	Aroclor-1221
GC/ECD	EPA 8082/8082A	Aroclor-1232
GC/ECD	EPA 8082/8082A	Aroclor-1242
GC/ECD	EPA 8082/8082A	Aroclor-1248
GC/ECD	EPA 8082/8082A	Aroclor-1254
GC/ECD	EPA 8082/8082A	Aroclor-1260
GC/ECD	EPA 8151/8151A	2,4,5-T
GC/ECD	EPA 8151/8151A	2,4,5-TP (Silvex)
GC/ECD	EPA 8151/8151A	2,4-D
GC/ECD	EPA 8151/8151A	2,4-DB
GC/ECD	EPA 8151/8151A	Dalapon
GC/ECD	EPA 8151/8151A	Dicamba
GC/ECD	EPA 8151/8151A	Dichloroprop
GC/ECD	EPA 8151/8151A	Dinoseb
GC/ECD	EPA 8151/8151A	MCPA
GC/ECD	EPA 8151/8151A	MCPP
GC/ECD	EPA 8151/8151A	Pentachlorophenol
GC/ECD	EPA 8151/8151A	Picloram
GC/FID	FL PRO	Total Petroleum Hydrocarbons
GC/FID	EPA RSK-175	Ethane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/FID	EPA RSK-175	Ethene
GC/FID	EPA RSK-175	Methane
GC/FID	EPA 8015C	TPH C10-C28
GC/FID	EPA 8015C	TPH >C6-C10
GC/FID	TX1005	TPH C10-C28
GC/FID	TX1005	TPH C6-C12
GC/FID	TPH-Direct	C6-C8 Aliphatic
GC/FID	TPH-Direct	C8-C10 Aliphatic
GC/FID	TPH-Direct	C10-C12 Aliphatic
GC/FID	TPH-Direct	C12-C16 Aliphatic
GC/FID	TPH-Direct	C16-C21 Aliphatic
GC/FID	TPH-Direct	C21-C35 Aliphatic
GC/FID	TPH-Direct	C7-C8 Aromatic
GC/FID	TPH-Direct	C8-C10 Aromatic
GC/FID	TPH-Direct	C10-C12 Aromatic
GC/FID	TPH-Direct	C12-C16 Aromatic
GC/FID	TPH-Direct	C16-C21 Aromatic
GC/FID	TPH-Direct	C21-C35 Aromatic
GC/MS	EPA 8260B/8260C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B/8260C	1,1,1-Trichloroethane
GC/MS	EPA 8260B/8260C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B/8260C	1,1,2-Trichloroethane
GC/MS	EPA 8260B/8260C	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 8260B/8260C	1,1-Dichloroethane
GC/MS	EPA 8260B/8260C	1,1-Dichloroethylene
GC/MS	EPA 8260B/8260C	1,1-Dichloropropene
GC/MS	EPA 8260B/8260C	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B/8260C	1,2,3-Trichloropropane
GC/MS	EPA 8260B/8260C	1,2,3-Trimethylbenzene
GC/MS	EPA 8260B/8260C	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B/8260C	1,2,4-Trimethylbenzene

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Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/8260C	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B/8260C	1,2-Dibromoethane (EDB)
GC/MS	EPA 8260B/8260C	1,2-Dichlorobenzene
GC/MS	EPA 8260B/8260C	1,2-Dichloroethane
GC/MS	EPA 8260B/8260C	1,2-Dichloroethene (total)
GC/MS	EPA 8260B/8260C	1,2-Dichloropropane
GC/MS	EPA 8260B/8260C	1,3,5-Trimethylbenzene
GC/MS	EPA 8260B/8260C	1,3-Dichlorobenzene
GC/MS	EPA 8260B/8260C	1,3-Dichloropropane
GC/MS	EPA 8260B/8260C	1,4-Dioxane
GC/MS	EPA 8260B/8260C	1,4-Dichloro-2-butene
GC/MS	EPA 8260B/8260C	1,4-Dichlorobenzene
GC/MS	EPA 8260B/8260C	1-Chlorohexane
GC/MS	EPA 8260B/8260C	2,2-Dichloropropane
GC/MS	EPA 8260B/8260C	2-Butanone
GC/MS	EPA 8260B/8260C	2-Chloro-1,1,1-trifluoroethane
GC/MS	EPA 8260B/8260C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B/8260C	2-Chlorotoluene
GC/MS	EPA 8260B/8260C	2-Hexanone
GC/MS	EPA 8260B/8260C	2-Nitropropane
GC/MS	EPA 8260B/8260C	3,3-Dimethyl-1-butanol
GC/MS	EPA 8260B/8260C	4-Chlorotoluene
GC/MS	EPA 8260B/8260C	4-Isopropyltoluene
GC/MS	EPA 8260B/8260C	4-Methyl-2-pentanone
GC/MS	EPA 8260B/8260C	Acetone
GC/MS	EPA 8260B/8260C	Acetonitrile
GC/MS	EPA 8260B/8260C	Acrolein
GC/MS	EPA 8260B/8260C	Acrylonitrile
GC/MS	EPA 8260B/8260C	Allyl chloride
GC/MS	EPA 8260B/8260C	Benzene
GC/MS	EPA 8260B/8260C	Benzyl chloride

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Certificate # L2259

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/8260C	Bromobenzene
GC/MS	EPA 8260B/8260C	Bromochloromethane
GC/MS	EPA 8260B/8260C	Bromodichloromethane
GC/MS	EPA 8260B/8260C	Bromoethane
GC/MS	EPA 8260B/8260C	Bromoform
GC/MS	EPA 8260B/8260C	Carbon disulfide
GC/MS	EPA 8260B/8260C	Carbon tetrachloride
GC/MS	EPA 8260B/8260C	Chlorobenzene
GC/MS	EPA 8260B/8260C	Chlorodibromomethane
GC/MS	EPA 8260B/8260C	Chloroethane
GC/MS	EPA 8260B/8260C	Chloroform
GC/MS	EPA 8260B/8260C	Chloroprene
GC/MS	EPA 8260B/8260C	Chlorotrifluoroethylene
GC/MS	EPA 8260B/8260C	cis-1,2-Dichloroethylene
GC/MS	EPA 8260B/8260C	cis-1,3-Dichloropropene
GC/MS	EPA 8260B/8260C	Cyclohexane
GC/MS	EPA 8260B/8260C	Cyclohexanone
GC/MS	EPA 8260B/8260C	Dibromomethane
GC/MS	EPA 8260B/8260C	Dichlorodifluoromethane
GC/MS	EPA 8260B/8260C	Diethyl ether
GC/MS	EPA 8260B/8260C	Di-isopropylether (DIPE)
GC/MS	EPA 8260B/8260C	Ethanol
GC/MS	EPA 8260B/8260C	Ethyl acetate
GC/MS	EPA 8260B/8260C	Ethyl methacrylate
GC/MS	EPA 8260B/8260C	Ethyl-t-butylether (ETBE)
GC/MS	EPA 8260B/8260C	Ethylbenzene
GC/MS	EPA 8260B/8260C	Hexachlorobutadiene
GC/MS	EPA 8260B/8260C	Iodomethane
GC/MS	EPA 8260B/8260C	Isobutyl alcohol
GC/MS	EPA 8260B/8260C	Isopropylbenzene (Cumene)
GC/MS	EPA 8260B/8260C	m+p-Xylene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/8260C	Methacrylonitrile
GC/MS	EPA 8260B/8260C	Methyl acetate
GC/MS	EPA 8260B/8260C	Methyl bromide
GC/MS	EPA 8260B/8260C	Methyl chloride
GC/MS	EPA 8260B/8260C	Methylcyclohexane
GC/MS	EPA 8260B/8260C	Methyl methacrylate
GC/MS	EPA 8260B/8260C	Methylene chloride
GC/MS	EPA 8260B/8260C	Methyl tert-butyl ether
GC/MS	EPA 8260B/8260C	Naphthalene
GC/MS	EPA 8260B/8260C	n-Butylbenzene
GC/MS	EPA 8260B/8260C	n-hexane (C6)
GC/MS	EPA 8260B/8260C	n-Propylbenzene
GC/MS	EPA 8260B/8260C	o-Xylene
GC/MS	EPA 8260B/8260C	Propionitrile
GC/MS	EPA 8260B/8260C	sec-Butylbenzene
GC/MS	EPA 8260B/8260C	Styrene
GC/MS	EPA 8260B/8260C	t-Amyl alcohol
GC/MS	EPA 8260B/8260C	t-Butyl alcohol
GC/MS	EPA 8260B/8260C	t-Butyl formate
GC/MS	EPA 8260B/8260C	tert-Amyl-methyl-ether (TAME)
GC/MS	EPA 8260B/8260C	tert-Butylbenzene
GC/MS	EPA 8260B/8260C	Tetrachloroethylene
GC/MS	EPA 8260B/8260C	Tetrahydrofuran
GC/MS	EPA 8260B/8260C	Toluene
GC/MS	EPA 8260B/8260C	trans-1,3-Dichloropropylene
GC/MS	EPA 8260B/8260C	Trichloroethene
GC/MS	EPA 8260B/8260C	Trichlorofluoromethane
GC/MS	EPA 8260B/8260C	Vinyl acetate
GC/MS	EPA 8260B/8260C	Vinyl chloride
GC/MS	EPA 8260B/8260C	Xylene (total)
GC/MS	EPA 8270B/8270C/8270D	o,o,o-Triethyl phosphorothioate

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Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270B/8270C/8270D	1,2 Diphenylhydrazine
GC/MS	EPA 8270B/8270C/8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270B/8270C/8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270B/8270C/8270D	1,2-Dichlorobenzene
GC/MS	EPA 8270B/8270C/8270D	1,3,5-Trinitrobenzene
GC/MS	EPA 8270B/8270C/8270D	1,3-Dichlorobenzene
GC/MS	EPA 8270B/8270C/8270D	1,3-Dinitrobenzene
GC/MS	EPA 8270B/8270C/8270D	1,4-Dichlorobenzene
GC/MS	EPA 8270B/8270C/8270D	1,4-Naphthoquinone
GC/MS	EPA 8270B/8270C/8270D	1-Methylnaphthalene
GC/MS	EPA 8270B/8270C/8270D	1-Naphthylamine
GC/MS	EPA 8270B/8270C/8270D	2,2′-Oxybis(1-chloropropane)
GC/MS	EPA 8270B/8270C/8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270B/8270C/8270D	2,4,5-Trichlorophenol
GC/MS	EPA 8270B/8270C/8270D	2,4,6-Trichlorophenol
GC/MS	EPA 8270B/8270C/8270D	2,4-Dichlorophenol
GC/MS	EPA 8270B/8270C/8270D	2,4-Dimethylphenol
GC/MS	EPA 8270B/8270C/8270D	2,4-Dinitrophenol
GC/MS	EPA 8270B/8270C/8270D	2,4-Dinitrotoluene
GC/MS	EPA 8270B/8270C/8270D	2,6-Dichlorophenol
GC/MS	EPA 8270B/8270C/8270D	2,6-Dinitrotoluene
GC/MS	EPA 8270B/8270C/8270D	2-Acetylaminofluorene
GC/MS	EPA 8270B/8270C/8270D	2-Chloronaphthalene
GC/MS	EPA 8270B/8270C/8270D	2-Chlorophenol
GC/MS	EPA 8270B/8270C/8270D	2-Methyl-4,6-dinitrophenol
GC/MS	EPA 8270B/8270C/8270D	2-Methylnaphthalene
GC/MS	EPA 8270B/8270C/8270D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270B/8270C/8270D	2-Naphthylamine
GC/MS	EPA 8270B/8270C/8270D	2-Nitroaniline
GC/MS	EPA 8270B/8270C/8270D	2-Nitrophenol
GC/MS	EPA 8270B/8270C/8270D	2-Picoline

LABORATORY ACCREDITATION BUREAU

Certificate # L2259

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270B/8270C/8270D	3,3'-Dichlorobenzidine
GC/MS	EPA 8270B/8270C/8270D	3,3'-Dimethylbenzidine
GC/MS	EPA 8270B/8270C/8270D	3-Methylcholanthrene
GC/MS	EPA 8270B/8270C/8270D	3-Nitroaniline
GC/MS	EPA 8270B/8270C/8270D	4-Aminobiphenyl
GC/MS	EPA 8270B/8270C/8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270B/8270C/8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270B/8270C/8270D	4-Chloroaniline
GC/MS	EPA 8270B/8270C/8270D	4-Chlorophenyl phenylether
GC/MS	EPA 8270B/8270C/8270D	4-Dimethyl aminoazobenzene
GC/MS	EPA 8270B/8270C/8270D	4-Methylphenol
GC/MS	EPA 8270B/8270C/8270D	4-Nitroaniline
GC/MS	EPA 8270B/8270C/8270D	4-Nitrophenol
GC/MS	EPA 8270B/8270C/8270D	4-Nitroquinoline-1-oxide
GC/MS	EPA 8270B/8270C/8270D	5-Nitro-o-toluidine
GC/MS	EPA 8270B/8270C/8270D	7,12-Dimethylbenz(a)anthracene
GC/MS	EPA 8270B/8270C/8270D	a-a-Dimethylphenethylamine
GC/MS	EPA 8270B/8270C/8270D	Acenaphthene
GC/MS	EPA 8270B/8270C/8270D	Acenaphthylene
GC/MS	EPA 8270B/8270C/8270D	Acetophenone
GC/MS	EPA 8270B/8270C/8270D	Aniline
GC/MS	EPA 8270B/8270C/8270D	Anthracene
GC/MS	EPA 8270B/8270C/8270D	Aramite
GC/MS	EPA 8270B/8270C/8270D	Atrazine
GC/MS	EPA 8270B/8270C/8270D	Benzaldehyde
GC/MS	EPA 8270B/8270C/8270D	Benzidine
GC/MS	EPA 8270B/8270C/8270D	Benzo(a)anthracene
GC/MS	EPA 8270B/8270C/8270D	Benzo(a)pyrene
GC/MS	EPA 8270B/8270C/8270D	Benzo(b)fluoranthene
GC/MS	EPA 8270B/8270C/8270D	Benzo(g,h,i)perylene
GC/MS	EPA 8270B/8270C/8270D	Benzo(k)fluoranthene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270B/8270C/8270D	Benzoic acid
GC/MS	EPA 8270B/8270C/8270D	Benzyl alcohol
GC/MS	EPA 8270B/8270C/8270D	Biphenyl
GC/MS	EPA 8270B/8270C/8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270B/8270C/8270D	bis(2-Chloroethyl)ether
GC/MS	EPA 8270B/8270C/8270D	bis(2-ethylhexyl)phthalate
GC/MS	EPA 8270B/8270C/8270D	Butyl benzyl phthalate
GC/MS	EPA 8270B/8270C/8270D	Caprolactam
GC/MS	EPA 8270B/8270C/8270D	Carbazole
GC/MS	EPA 8270B/8270C/8270D	Chlorobenzilate
GC/MS	EPA 8270B/8270C/8270D	Chrysene
GC/MS	EPA 8270B/8270C/8270D	Cresols (total)
GC/MS	EPA 8270B/8270C/8270D	Diallate (Avadex)
GC/MS	EPA 8270B/8270C/8270D	Dibenz(a,h)anthracene
GC/MS	EPA 8270B/8270C/8270D	Dibenz(a,j)acridine
GC/MS	EPA 8270B/8270C/8270D	Dibenzofuran
GC/MS	EPA 8270B/8270C/8270D	Diethylphthalate
GC/MS	EPA 8270B/8270C/8270D	Dimethyl-phthalate
GC/MS	EPA 8270B/8270C/8270D	Di-n-butylphthalate
GC/MS	EPA 8270B/8270C/8270D	Di-n-octylphthalate
GC/MS	EPA 8270B/8270C/8270D	Dinoseb
GC/MS	EPA 8270B/8270C/8270D	Ethyl methanesulfonate
GC/MS	EPA 8270B/8270C/8270D	Fluoranthene
GC/MS	EPA 8270B/8270C/8270D	Fluorene
GC/MS	EPA 8270B/8270C/8270D	Hexachlorobenzene
GC/MS	EPA 8270B/8270C/8270D	Hexachlorobutadiene
GC/MS	EPA 8270B/8270C/8270D	Hexachlorocyclopentadiene
GC/MS	EPA 8270B/8270C/8270D	Hexachloroethane
GC/MS	EPA 8270B/8270C/8270D	Hexachloropropene
GC/MS	EPA 8270B/8270C/8270D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270B/8270C/8270D	Isodrin

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270B/8270C/8270D	Isophorone
GC/MS	EPA 8270B/8270C/8270D	Isosafrole
GC/MS	EPA 8270B/8270C/8270D	Kepone
GC/MS	EPA 8270B/8270C/8270D	Methapyriline
GC/MS	EPA 8270B/8270C/8270D	Methyl methanesulfonate
GC/MS	EPA 8270B/8270C/8270D	Naphthalene
GC/MS	EPA 8270B/8270C/8270D	Nitrobenzene
GC/MS	EPA 8270B/8270C/8270D	n-Nitrosodibutylamine
GC/MS	EPA 8270B/8270C/8270D	n-Nitrosodiethylamine
GC/MS	EPA 8270B/8270C/8270D	n-Nitrosodimethylamine
GC/MS	EPA 8270B/8270C/8270D	n-Nitroso-di-n-propylamine
GC/MS	EPA 8270B/8270C/8270D	n-Nitrosodiphenylamine
GC/MS	EPA 8270B/8270C/8270D	n-Nitrosomethylethylamine
GC/MS	EPA 8270B/8270C/8270D	n-Nitrosomorpholine
GC/MS	EPA 8270B/8270C/8270D	n-Nitrosopiperidine
GC/MS	EPA 8270B/8270C/8270D	n-Nitrosopyrrolidine
GC/MS	EPA 8270B/8270C/8270D	o-Toluidine
GC/MS	EPA 8270B/8270C/8270D	Pentachlorobenzene
GC/MS	EPA 8270B/8270C/8270D	Pentachloroethane
GC/MS	EPA 8270B/8270C/8270D	Pentachloronitrobenzene(PCNB)
GC/MS	EPA 8270B/8270C/8270D	Pentachlorophenol
GC/MS	EPA 8270B/8270C/8270D	Phenacetin
GC/MS	EPA 8270B/8270C/8270D	Phenanthrene
GC/MS	EPA 8270B/8270C/8270D	Phenol
GC/MS	EPA 8270B/8270C/8270D	p-Phenylenediamine
GC/MS	EPA 8270B/8270C/8270D	Pronamide
GC/MS	EPA 8270B/8270C/8270D	Pyrene
GC/MS	EPA 8270B/8270C/8270D	Pyridine
GC/MS	EPA 8270B/8270C/8270D	Safrole
HPLC/UV	EPA 8310	1-Methylnaphthalene
HPLC/UV	EPA 8310	2-Methylnaphthalene

Non-Potable Water		
Technology	**Method**	**Analyte**
HPLC/UV	EPA 8310	Acenaphthene
HPLC/UV	EPA 8310	Acenaphthylene
HPLC/UV	EPA 8310	Anthracene
HPLC/UV	EPA 8310	Benzo(a)anthracene
HPLC/UV	EPA 8310	Benzo(a)pyrene
HPLC/UV	EPA 8310	Benzo(b)fluoranthene
HPLC/UV	EPA 8310	Benzo(g,h,i)perylene
HPLC/UV	EPA 8310	Benzo(k)fluoranthene
HPLC/UV	EPA 8310	Chrysene
HPLC/UV	EPA 8310	Dibenz(a,h)anthracene
HPLC/UV	EPA 8310	Fluoranthene
HPLC/UV	EPA 8310	Fluorene
HPLC/UV	EPA 8310	Indeno(1,2,3-cd)pyrene
HPLC/UV	EPA 8310	Naphthalene
HPLC/UV	EPA 8310	Phenanthrene
HPLC/UV	EPA 8310	Pyrene
HPLC/UV	EPA 8315Mod	Formaldehyde
HPLC/UV	EPA 8315Mod	Hydrazine
HPLC/UV	EPA 8330A	1-nitroso-3,5-dinitro-1,3,5- triazacyclohexane (MNX)
HPLC/UV	EPA 8330A	1,3,5-Trinitrobenzene
HPLC/UV	EPA 8330A	1,3-Dinitrobenzene
HPLC/UV	EPA 8330A	2,4,6-Trinitrotoluene
HPLC/UV	EPA 8330A	2,4-Dinitrotoluene
HPLC/UV	EPA 8330A	2,6-Dinitrotoluene
HPLC/UV	EPA 8330A	2-Amino-4,6-dinitrotoluene
HPLC/UV	EPA 8330A	2-Nitrotoluene
HPLC/UV	EPA 8330A	3-Nitrotoluene
HPLC/UV	EPA 8330A	3,5-Dinitroaniline
HPLC/UV	EPA 8330A	4-Amino-2,6-dinitrotoluene
HPLC/UV	EPA 8330A	4-Nitrotoluene
HPLC/UV	EPA 8330A	Methyl-2,4,6-trinitrophenylnitramine (tetryl)

Non-Potable Water		
Technology	**Method**	**Analyte**
HPLC/UV	EPA 8330A	Nitrobenzene
HPLC/UV	EPA 8330A	Nitroglycerin
HPLC/UV	EPA 8330A	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	EPA 8330A	Pentaerythritoltetranitrate (PETN)
HPLC/UV	EPA 8330A	RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)
IC-COND	EPA 300.1/9056A	Bromide
IC-COND	EPA 300.1/9056A	Chloride
IC-COND	EPA 300.1/9056A	Fluoride
IC-COND	EPA 300.1/9056A	Nitrate
IC-COND	EPA 300.1/9056A	Nitrite
IC-COND	EPA 300.1/9056A	Orthophosphate
IC-COND	EPA 300.1/9056A	Sulfate
IC-COND	EPA 314.0	Perchlorate
ICP-AES	EPA 6010B/6010C	Aluminum
ICP-AES	EPA 6010B/6010C	Antimony
ICP-AES	EPA 6010B/6010C	Arsenic
ICP-AES	EPA 6010B/6010C	Barium
ICP-AES	EPA 6010B/6010C	Beryllium
ICP-AES	EPA 6010B/6010C	Cadmium
ICP-AES	EPA 6010B/6010C	Calcium
ICP-AES	EPA 6010B/6010C	Chromium
ICP-AES	EPA 6010B/6010C	Cobalt
ICP-AES	EPA 6010B/6010C	Copper
ICP-AES	EPA 6010B/6010C	Iron
ICP-AES	EPA 6010B/6010C	Lead
ICP-AES	EPA 6010B/6010C	Magnesium
ICP-AES	EPA 6010B/6010C	Manganese
ICP-AES	EPA 6010B/6010C	Molybdenum
ICP-AES	EPA 6010B/6010C	Nickel
ICP-AES	EPA 6010B/6010C	Potassium
ICP-AES	EPA 6010B/6010C	Selenium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-AES	EPA 6010B/6010C	Silver
ICP-AES	EPA 6010B/6010C	Sodium
ICP-AES	EPA 6010B/6010C	Strontium
ICP-AES	EPA 6010B/6010C	Thallium
ICP-AES	EPA 6010B/6010C	Tin
ICP-AES	EPA 6010B/6010C	Titanium
ICP-AES	EPA 6010B/6010C	Vanadium
ICP-AES	EPA 6010B/6010C	Zinc
GFAA	EPA 7010	Antimony
GFAA	EPA 7010	Arsenic
GFAA	EPA 7010	Lead
GFAA	EPA 7010	Selenium
GFAA	EPA 7010	Thallium
GFAA	EPA 7041	Antimony
GFAA	EPA 7060A	Arsenic
GFAA	EPA 7421	Lead
GFAA	EPA 7740	Selenium
GFAA	EPA 7841	Thallium
CVAA	EPA 7470/7470A	Mercury
Gravimetric	EPA 160.1/SM 2540C	Residue-filterable (TDS)
Gravimetric	EPA 160.2/SM 2540D	Total Suspended Solids
Gravimetric	EPA 1664A (HEM)	Oil & Grease
Probe	EPA 150.1/9040/ SM 4500-H+ B	pH
Titration	EPA 310.1/SM 2320B	Alkalinity (Bicarbonate)
Titration	EPA 310.1/SM 2320B	Alkalinity (Carbonate)
Titration	EPA 310.1/SM 2320B	Alkalinity (Hydroxide)
Titration	EPA 310.1/SM 2320B	Alkalinity (Total)
Titration	EPA 376.1/SM 4500-S_2^{-}F	Sulfide
TOC-IR	EPA 9060/9060A/SM 5310B	Total Organic Carbon
TURB	EPA 375.4/ASTM D516-90	Sulfate
Calculation	SM 2340B	Hardness

Non-Potable Water		
Technology	**Method**	**Analyte**
Colorimetric	EPA 325.2/SM 4500-Cl^- E	Chloride
Colorimetric	EPA 350.1/SM 4500-NH_3 G	Ammonia
Colorimetric	EPA 351.2/SM 4500-Norg D	Total Kjeldahl Nitrogen
Colorimetric	EPA 353.2/SM 4500-NO_3^- F	Nitrate
Colorimetric	EPA 353.2/SM 4500-NO_3^- F	Nitrate + Nitrite
Colorimetric	EPA 354.1/SM 4500-NO_3^- F	Nitrite
Colorimetric	EPA 365.1/SM 4500-P F	Orthophosphate
Colorimetric	EPA 365.4/SM 4500-P F	Total Phosphorus
Colorimetric	SM 3500-Cr D	Chromium VI
Colorimetric	SM 3500-Fe D	Ferrous Iron
Colorimetric	EPA 7196A	Chromium VI
Colorimetric/Distillation	EPA 9012B	Total and Amenable Cyanide
Preparation	**Method**	**Type**
Inorganic Preparation	EPA 3005A	Hotblock
Inorganic Preparation	EPA 3010A	Hotblock
Inorganic Preparation	EPA 3020A	Hotblock
Leaching Preparation	EPA 1311	TCLP Leaching, Volatiles ZHE and SVOA/Metals
Preparation	EPA 1312	Synthetic Precipitation Leaching Procedure
Organic Preparation	EPA 3500C	Organic Extraction and Sample Preparation
Organic Preparation	EPA 3510C	Separatory Funnel
Volatile Organic Preparation	EPA 5030/5030A	Purge and Trap
Volatile Organic Preparation	EPA 5021	Equilibrium Headspace Analysis
Organic Preparation	EPA 3620C	Florisil Cleanup
Organic Preparation	EPA 3630C	Silica Gel Cleanup
Organic Preparation	EPA 3660B	Sulfur Cleanup (Copper)
Organic Preparation	EPA 3665A	Sulfuric Acid Cleanup

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8081A/8081B	4,4'-DDD
GC/ECD	EPA 8081A/8081B	4,4'-DDE
GC/ECD	EPA 8081A/8081B	4,4'-DDT
GC/ECD	EPA 8081A/8081B	Aldrin
GC/ECD	EPA 8081A/8081B	alpha-BHC
GC/ECD	EPA 8081A/8081B	alpha-Chlordane
GC/ECD	EPA 8081A/8081B	beta-BHC
GC/ECD	EPA 8081A/8081B	Chlordane
GC/ECD	EPA 8081A/8081B	delta-BHC
GC/ECD	EPA 8081A/8081B	Dieldrin
GC/ECD	EPA 8081A/8081B	Endosulfan I
GC/ECD	EPA 8081A/8081B	Endosulfan II
GC/ECD	EPA 8081A/8081B	Endosulfan sulfate
GC/ECD	EPA 8081A/8081B	Endrin
GC/ECD	EPA 8081A/8081B	Endrin aldehyde
GC/ECD	EPA 8081A/8081B	Endrin ketone
GC/ECD	EPA 8081A/8081B	gamma-BHC (Lindane)
GC/ECD	EPA 8081A/8081B	gamma-Chlordane
GC/ECD	EPA 8081A/8081B	Heptachlor
GC/ECD	EPA 8081A/8081B	Heptachlor epoxide
GC/ECD	EPA 8081A/8081B	Methoxychlor
GC/ECD	EPA 8081A/8081B	Mirex
GC/ECD	EPA 8081A/8081B	Toxaphene
GC/ECD	EPA 8082/8082A	Aroclor-1016
GC/ECD	EPA 8082/8082A	Aroclor-1221
GC/ECD	EPA 8082/8082A	Aroclor-1232
GC/ECD	EPA 8082/8082A	Aroclor-1242
GC/ECD	EPA 8082/8082A	Aroclor-1248
GC/ECD	EPA 8082/8082A	Aroclor-1254
GC/ECD	EPA 8082/8082A	Aroclor-1260
GC/ECD	EPA 8151/8151A	2,4,5-T

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8151/8151A	2,4,5-TP (Silvex)
GC/ECD	EPA 8151/8151A	2,4'-D
GC/ECD	EPA 8151/8151A	2,4-DB
GC/ECD	EPA 8151/8151A	Dalapon
GC/ECD	EPA 8151/8151A	Dicamba
GC/ECD	EPA 8151/8151A	Dichloroprop
GC/ECD	EPA 8151/8151A	Dinoseb
GC/ECD	EPA 8151/8151A	MCPA
GC/ECD	EPA 8151/8151A	MCPP
GC/ECD	EPA 8151/8151A	Pentachlorophenol
GC/ECD	EPA 8151/8151A	Picloram
GC/FID	FL PRO	Total Petroleum Hydrocarbons
GC/FID	EPA 8015C	TPH C10-C28
GC/FID	EPA 8015C	TPH >C6-C10
GC/FID	TX1005	TPH C12-28
GC/FID	TX1005	TPH C6-C12
GC/FID	TPH-Direct	C6-C8 Aliphatic
GC/FID	TPH-Direct	C8-C10 Aliphatic
GC/FID	TPH-Direct	C10-C12 Aliphatic
GC/FID	TPH-Direct	C12-C16 Aliphatic
GC/FID	TPH-Direct	C16-C21 Aliphatic
GC/FID	TPH-Direct	C21-C35 Aliphatic
GC/FID	TPH-Direct	C7-C8 Aromatic
GC/FID	TPH-Direct	C8-C10 Aromatic
GC/FID	TPH-Direct	C10-C12 Aromatic
GC/FID	TPH-Direct	C12-C16 Aromatic
GC/FID	TPH-Direct	C16-C21 Aromatic
GC/FID	TPH-Direct	C21-C35 Aromatic
GC/MS	EPA 8260B/8260C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B/8260C	1,1,1-Trichloroethane
GC/MS	EPA 8260B/8260C	1,1,2,2-Tetrachloroethane

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/8260C	1,1,2-Trichloroethane
GC/MS	EPA 8260B/8260C	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 8260B/8260C	1,1-Dichloroethane
GC/MS	EPA 8260B/8260C	1,1-Dichloroethylene
GC/MS	EPA 8260B/8260C	1,1-Dichloropropene
GC/MS	EPA 8260B/8260C	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B/8260C	1,2,3-Trichloropropane
GC/MS	EPA 8260B/8260C	1,2,3-Trimethylbenzene
GC/MS	EPA 8260B/8260C	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B/8260C	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B/8260C	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B/8260C	1,2-Dibromoethane (EDB)
GC/MS	EPA 8260B/8260C	1,2-Dichlorobenzene
GC/MS	EPA 8260B/8260C	1,2-Dichloroethane
GC/MS	EPA 8260B/8260C	1,2-Dichloroethene (total)
GC/MS	EPA 8260B/8260C	1,2-Dichloropropane
GC/MS	EPA 8260B/8260C	1,3,5-Trimethylbenzene
GC/MS	EPA 8260B/8260C	1,3-Dichlorobenzene
GC/MS	EPA 8260B/8260C	1,3-Dichloropropane
GC/MS	EPA 8260B/8260C	1,4-Dioxane
GC/MS	EPA 8260B/8260C	1,4-Dichloro-2-butene
GC/MS	EPA 8260B/8260C	1,4-Dichlorobenzene
GC/MS	EPA 8260B/8260C	1-Chlorohexane
GC/MS	EPA 8260B/8260C	2,2-Dichloropropane
GC/MS	EPA 8260B/8260C	2-Butanone
GC/MS	EPA 8260B/8260C	2-Chloro-1,1,1-trifluoroethane
GC/MS	EPA 8260B/8260C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B/8260C	2-Chlorotoluene
GC/MS	EPA 8260B/8260C	2-Hexanone
GC/MS	EPA 8260B/8260C	2-Nitropropane
GC/MS	EPA 8260B/8260C	3,3-Dimethyl-1-butanol

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/8260C	4-Chlorotoluene
GC/MS	EPA 8260B/8260C	4-Isopropyltoluene
GC/MS	EPA 8260B/8260C	4-Methyl-2-pentanone
GC/MS	EPA 8260B/8260C	Acetone
GC/MS	EPA 8260B/8260C	Acetonitrile
GC/MS	EPA 8260B/8260C	Acrolein
GC/MS	EPA 8260B/8260C	Acrylonitrile
GC/MS	EPA 8260B/8260C	Allyl chloride
GC/MS	EPA 8260B/8260C	Benzene
GC/MS	EPA 8260B/8260C	Benzyl chloride
GC/MS	EPA 8260B/8260C	Bromobenzene
GC/MS	EPA 8260B/8260C	Bromochloromethane
GC/MS	EPA 8260B/8260C	Bromodichloromethane
GC/MS	EPA 8260B/8260C	Bromoethane
GC/MS	EPA 8260B/8260C	Bromoform
GC/MS	EPA 8260B/8260C	Carbon disulfide
GC/MS	EPA 8260B/8260C	Carbon tetrachloride
GC/MS	EPA 8260B/8260C	Chlorobenzene
GC/MS	EPA 8260B/8260C	Chlorodibromomethane
GC/MS	EPA 8260B/8260C	Chloroethane
GC/MS	EPA 8260B/8260C	Chloroform
GC/MS	EPA 8260B/8260C	Chloroprene
GC/MS	EPA 8260B/8260C	Chlorotrifluoroethylene
GC/MS	EPA 8260B/8260C	cis-1,2-Dichloroethylene
GC/MS	EPA 8260B/8260C	cis-1,3-Dichloropropene
GC/MS	EPA 8260B/8260C	Cyclohexane
GC/MS	EPA 8260B/8260C	Cyclohexanone
GC/MS	EPA 8260B/8260C	Dibromomethane
GC/MS	EPA 8260B/8260C	Dichlorodifluoromethane
GC/MS	EPA 8260B/8260C	Diethyl Ether
GC/MS	EPA 8260B/8260C	Di-isopropylether (DIPE)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/8260C	Ethanol
GC/MS	EPA 8260B/8260C	Ethyl acetate
GC/MS	EPA 8260B/8260C	Ethyl methacrylate
GC/MS	EPA 8260B/8260C	Ethyl tert-butyl ether
GC/MS	EPA 8260B/8260C	Ethylbenzene
GC/MS	EPA 8260B/8260C	Hexachlorobutadiene
GC/MS	EPA 8260B/8260C	Iodomethane
GC/MS	EPA 8260B/8260C	Isobutyl alcohol
GC/MS	EPA 8260B/8260C	Isopropylbenzene (Cumene)
GC/MS	EPA 8260B/8260C	m+p-Xylene
GC/MS	EPA 8260B/8260C	Methacrylonitrile
GC/MS	EPA 8260B/8260C	Methyl acetate
GC/MS	EPA 8260B/8260C	Methyl bromide
GC/MS	EPA 8260B/8260C	Methyl chloride
GC/MS	EPA 8260B/8260C	Methylcyclohexane
GC/MS	EPA 8260B/8260C	Methyl methacrylate
GC/MS	EPA 8260B/8260C	Methylene chloride
GC/MS	EPA 8260B/8260C	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 8260B/8260C	Naphthalene
GC/MS	EPA 8260B/8260C	n-Butylbenzene
GC/MS	EPA 8260B/8260C	n-hexane (C6)
GC/MS	EPA 8260B/8260C	n-Propylbenzene
GC/MS	EPA 8260B/8260C	o-Xylene
GC/MS	EPA 8260B/8260C	Propionitrile
GC/MS	EPA 8260B/8260C	sec-Butylbenzene
GC/MS	EPA 8260B/8260C	Styrene
GC/MS	EPA 8260B/8260C	t-Amyl alcohol
GC/MS	EPA 8260B/8260C	t-Butyl alcohol
GC/MS	EPA 8260B/8260C	t-Butyl formate
GC/MS	EPA 8260B/8260C	tert-Amyl methyl ether (TAME)
GC/MS	EPA 8260B/8260C	tert-Butylbenzene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/8260C	Tetrachloroethylene
GC/MS	EPA 8260B/8260C	Tetrahydrofuran
GC/MS	EPA 8260B/8260C	Toluene
GC/MS	EPA 8260B/8260C	trans-1,3-Dichloropropylene
GC/MS	EPA 8260B/8260C	Trichloroethene
GC/MS	EPA 8260B/8260C	Trichlorofluoromethane
GC/MS	EPA 8260B/8260C	Vinyl acetate
GC/MS	EPA 8260B/8260C	Vinyl chloride
GC/MS	EPA 8260B/8260C	Xylene (total)
GC/MS	EPA 8270B/8270C	o,o,o-Triethyl phosphorothioate
GC/MS	EPA 8270B/8270C	1,2 Diphenylhydrazine
GC/MS	EPA 8270B/8270C	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270B/8270C	1,2,4-Trichlorobenzene
GC/MS	EPA 8270B/8270C	1,2-Dichlorobenzene
GC/MS	EPA 8270B/8270C	1,3,5-Trinitrobenzene
GC/MS	EPA 8270B/8270C	1,3-Dichlorobenzene
GC/MS	EPA 8270B/8270C	1,3-Dinitrobenzene
GC/MS	EPA 8270B/8270C	1,4-Dichlorobenzene
GC/MS	EPA 8270B/8270C	1,4-Naphthoquinone
GC/MS	EPA 8270B/8270C	1-Methylnaphthalene
GC/MS	EPA 8270B/8270C	1-Naphthylamine
GC/MS	EPA 8270B/8270C	2,2′-Oxybis(1-chloropropane)
GC/MS	EPA 8270B/8270C	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270B/8270C	2,4,5-Trichlorophenol
GC/MS	EPA 8270B/8270C	2,4,6-Trichlorophenol
GC/MS	EPA 8270B/8270C	2,4-Dichlorophenol
GC/MS	EPA 8270B/8270C	2,4-Dimethylphenol
GC/MS	EPA 8270B/8270C	2,4-Dinitrophenol
GC/MS	EPA 8270B/8270C	2,4-Dinitrotoluene
GC/MS	EPA 8270B/8270C	2,6-Dichlorophenol
GC/MS	EPA 8270B/8270C	2,6-Dinitrotoluene

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Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270B/8270C	2-Acetylaminofluorene
GC/MS	EPA 8270B/8270C	2-Chloronaphthalene
GC/MS	EPA 8270B/8270C	2-Chlorophenol
GC/MS	EPA 8270B/8270C	2-Methyl-4,6-dinitrophenol
GC/MS	EPA 8270B/8270C	2-Methylnaphthalene
GC/MS	EPA 8270B/8270C	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270B/8270C	2-Naphthylamine
GC/MS	EPA 8270B/8270C	2-Nitroaniline
GC/MS	EPA 8270B/8270C	2-Nitrophenol
GC/MS	EPA 8270B/8270C	2-Picoline
GC/MS	EPA 8270B/8270C	3,3'-Dichlorobenzidine
GC/MS	EPA 8270B/8270C	3,3'-Dimethylbenzidine
GC/MS	EPA 8270B/8270C	3-Methylcholanthrene
GC/MS	EPA 8270B/8270C	3-Nitroaniline
GC/MS	EPA 8270B/8270C	4-Aminobiphenyl
GC/MS	EPA 8270B/8270C	4-Bromophenyl-phenylether
GC/MS	EPA 8270B/8270C	4-Chloro-3-methylphenol
GC/MS	EPA 8270B/8270C	4-Chloroaniline
GC/MS	EPA 8270B/8270C	4-Chlorophenyl-phenylether
GC/MS	EPA 8270B/8270C	4-Methylphenol
GC/MS	EPA 8270B/8270C	4-Nitroaniline
GC/MS	EPA 8270B/8270C	4-Nitrophenol
GC/MS	EPA 8270B/8270C	4-Nitroquinoline-1-oxide
GC/MS	EPA 8270B/8270C	5-Nitro-o-toluidine
GC/MS	EPA 8270B/8270C	7,12-Dimethylbenz(a)anthracene
GC/MS	EPA 8270B/8270C	a-a-Dimethylphenethylamine
GC/MS	EPA 8270B/8270C	Acenaphthene
GC/MS	EPA 8270B/8270C	Acenaphthylene
GC/MS	EPA 8270B/8270C	Acetophenone
GC/MS	EPA 8270B/8270C	Aniline
GC/MS	EPA 8270B/8270C	Anthracene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270B/8270C	Aramite
GC/MS	EPA 8270B/8270C	Atrazine
GC/MS	EPA 8270B/8270C	Benzaldehyde
GC/MS	EPA 8270B/8270C	Benzidine
GC/MS	EPA 8270B/8270C	Benzo(a)anthracene
GC/MS	EPA 8270B/8270C	Benzo(a)pyrene
GC/MS	EPA 8270B/8270C	Benzo(b)fluoranthene
GC/MS	EPA 8270B/8270C	Benzo(g,h,i)perylene
GC/MS	EPA 8270B/8270C	Benzo(k)fluoranthene
GC/MS	EPA 8270B/8270C	Benzoic acid
GC/MS	EPA 8270B/8270C	Benzyl alcohol
GC/MS	EPA 8270B/8270C	Biphenyl
GC/MS	EPA 8270B/8270C	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270B/8270C	bis(2-Chloroethyl)ether
GC/MS	EPA 8270B/8270C	bis(2-ethylhexyl)phthalate
GC/MS	EPA 8270B/8270C	Butylbenzylphthalate
GC/MS	EPA 8270B/8270C	Caprolactam
GC/MS	EPA 8270B/8270C	Carbazole
GC/MS	EPA 8270B/8270C	Chlorobenzilate
GC/MS	EPA 8270B/8270C	Chrysene
GC/MS	EPA 8270B/8270C	Cresols (total)
GC/MS	EPA 8270B/8270C	Diallate (Avadex)
GC/MS	EPA 8270B/8270C	Dibenz(a,h)anthracene
GC/MS	EPA 8270B/8270C	Dibenz(a,j)acridine
GC/MS	EPA 8270B/8270C	Dibenzofuran
GC/MS	EPA 8270B/8270C	Diethylphthalate
GC/MS	EPA 8270B/8270C	Dimethyl-phthalate
GC/MS	EPA 8270B/8270C	Di-n-butylphthalate
GC/MS	EPA 8270B/8270C	Di-n-octylphthalate
GC/MS	EPA 8270B/8270C	Dinoseb
GC/MS	EPA 8270B/8270C	Ethyl methanesulfonate

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270B/8270C	Fluoranthene
GC/MS	EPA 8270B/8270C	Fluorene
GC/MS	EPA 8270B/8270C	Hexachlorobenzene
GC/MS	EPA 8270B/8270C	Hexachlorobutadiene
GC/MS	EPA 8270B/8270C	Hexachlorocyclopentadiene
GC/MS	EPA 8270B/8270C	Hexachloroethane
GC/MS	EPA 8270B/8270C	Hexachloropropene
GC/MS	EPA 8270B/8270C	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270B/8270C	Isodrin
GC/MS	EPA 8270B/8270C	Isophorone
GC/MS	EPA 8270B/8270C	Isosafrole
GC/MS	EPA 8270B/8270C	Kepone
GC/MS	EPA 8270B/8270C	Methapyriline
GC/MS	EPA 8270B/8270C	Methylmethanesulfonate
GC/MS	EPA 8270B/8270C	Naphthalene
GC/MS	EPA 8270B/8270C	Nitrobenzene
GC/MS	EPA 8270B/8270C	N-Nitrosodibutylamine
GC/MS	EPA 8270B/8270C	N-Nitrosodiethylamine
GC/MS	EPA 8270B/8270C	N-Nitrosodimethylamine
GC/MS	EPA 8270B/8270C	N-Nitroso-di-n-propylamine
GC/MS	EPA 8270B/8270C	N-Nitrosodiphenylamine
GC/MS	EPA 8270B/8270C	N-Nitrosomethylethylamine
GC/MS	EPA 8270B/8270C	N-Nitrosomorpholine
GC/MS	EPA 8270B/8270C	N-Nitrosopiperidine
GC/MS	EPA 8270B/8270C	N-Nitrosopyrrolidine
GC/MS	EPA 8270B/8270C	o-Toluidine
GC/MS	EPA 8270B/8270C	p-Dimethylaminoazobenzene
GC/MS	EPA 8270B/8270C	Pentachlorobenzene
GC/MS	EPA 8270B/8270C	Pentachloroethane
GC/MS	EPA 8270B/8270C	Pentachloronitrobenzene (PCNB)
GC/MS	EPA 8270B/8270C	Pentachlorophenol

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270B/8270C	Phenacetin
GC/MS	EPA 8270B/8270C	Phenanthrene
GC/MS	EPA 8270B/8270C	Phenol
GC/MS	EPA 8270B/8270C	p-Phenylenediamine
GC/MS	EPA 8270B/8270C	Pronamide
GC/MS	EPA 8270B/8270C	Pyrene
GC/MS	EPA 8270B/8270C	Pyridine
GC/MS	EPA 8270B/8270C	Safrole
HPLC/UV	EPA 8310	1-Methylnaphthalene
HPLC/UV	EPA 8310	2-Methylnaphthalene
HPLC/UV	EPA 8310	Acenaphthene
HPLC/UV	EPA 8310	Acenaphthylene
HPLC/UV	EPA 8310	Anthracene
HPLC/UV	EPA 8310	Benzo(a)anthracene
HPLC/UV	EPA 8310	Benzo(a)pyrene
HPLC/UV	EPA 8310	Benzo(b)fluoranthene
HPLC/UV	EPA 8310	Benzo(g,h,i)perylene
HPLC/UV	EPA 8310	Benzo(k)fluoranthene
HPLC/UV	EPA 8310	Chrysene
HPLC/UV	EPA 8310	Dibenz(a,h)anthracene
HPLC/UV	EPA 8310	Fluoranthene
HPLC/UV	EPA 8310	Fluorene
HPLC/UV	EPA 8310	Indeno(1,2,3-cd)pyrene
HPLC/UV	EPA 8310	Naphthalene
HPLC/UV	EPA 8310	Phenanthrene
HPLC/UV	EPA 8310	Pyrene
HPLC/UV	EPA 8315Mod	Formaldehyde
HPLC/UV	EPA 8330A / 8330B	1-nitroso-3,5-dinitro-1,3,5- triazacyclohexane (MNX)
HPLC/UV	EPA 8330A / 8330B	1,3,5-Trinitrobenzene
HPLC/UV	EPA 8330A / 8330B	1,3-Dinitrobenzene
HPLC/UV	EPA 8330A / 8330B	2,4,6-Trinitrotoluene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
HPLC/UV	EPA 8330A / 8330B	2,4-Dinitrotoluene
HPLC/UV	EPA 8330A / 8330B	2,6-Dinitrotoluene
HPLC/UV	EPA 8330A / 8330B	2-Amino-4,6-dinitrotoluene
HPLC/UV	EPA 8330A / 8330B	2-Nitrotoluene
HPLC/UV	EPA 8330A / 8330B	3-Nitrotoluene
HPLC/UV	EPA 8330A / 8330B	3,5-Dinitroaniline
HPLC/UV	EPA 8330A / 8330B	4-Amino-2,6-dinitrotoluene
HPLC/UV	EPA 8330A / 8330B	4-Nitrotoluene
HPLC/UV	EPA 8330A / 8330B	Methyl-2,4,6-trinitrophenylnitramine (tetryl)
HPLC/UV	EPA 8330A / 8330B	Nitrobenzene
HPLC/UV	EPA 8330A / 8330B	Nitroglycerin
HPLC/UV	EPA 8330A / 8330B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	EPA 8330A / 8330B	Pentaerythritoltetranitrate (PETN)
HPLC/UV	EPA 8330A / 8330B	RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)
IC-COND	EPA 314.0Mod	Perchlorate
IC-COND	EPA 9056Mod	Bromide
IC-COND	EPA 9056Mod	Chloride
IC-COND	EPA 9056Mod	Fluoride
IC-COND	EPA 9056Mod	Nitrate
IC-COND	EPA 9056Mod	Nitrite
IC-COND	EPA 9056Mod	Phosphate
IC-COND	EPA 9056Mod	Sulfate
ICP-AES	EPA 6010B/6010C	Aluminum
ICP-AES	EPA 6010B/6010C	Antimony
ICP-AES	EPA 6010B/6010C	Arsenic
ICP-AES	EPA 6010B/6010C	Barium
ICP-AES	EPA 6010B/6010C	Beryllium
ICP-AES	EPA 6010B/6010C	Cadmium
ICP-AES	EPA 6010B/6010C	Calcium
ICP-AES	EPA 6010B/6010C	Chromium
ICP-AES	EPA 6010B/6010C	Cobalt

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP-AES	EPA 6010B/6010C	Copper
ICP-AES	EPA 6010B/6010C	Iron
ICP-AES	EPA 6010B/6010C	Lead
ICP-AES	EPA 6010B/6010C	Magnesium
ICP-AES	EPA 6010B/6010C	Manganese
ICP-AES	EPA 6010B/6010C	Molybdenum
ICP-AES	EPA 6010B/6010C	Nickel
ICP-AES	EPA 6010B/6010C	Potassium
ICP-AES	EPA 6010B/6010C	Selenium
ICP-AES	EPA 6010B/6010C	Silver
ICP-AES	EPA 6010B/6010C	Sodium
ICP-AES	EPA 6010B/6010C	Strontium
ICP-AES	EPA 6010B/6010C	Thallium
ICP-AES	EPA 6010B/6010C	Tin
ICP-AES	EPA 6010B/6010C	Titanium
ICP-AES	EPA 6010B/6010C	Vanadium
ICP-AES	EPA 6010B/6010C	Zinc
GFAA	EPA 7010	Antimony
GFAA	EPA 7010	Arsenic
GFAA	EPA 7010	Lead
GFAA	EPA 7010	Selenium
GFAA	EPA 7010	Thallium
GFAA	EPA 7041	Antimony
GFAA	EPA 7060A	Arsenic
GFAA	EPA 7421	Lead
GFAA	EPA 7740	Selenium
GFAA	EPA 7841	Thallium
CVAA	EPA 7471A/7471B	Mercury
Colorimetric	EPA 7196A	Chromium VI
Colorimetric/Distillation	EPA 9012B	Total and Amenable Cyanide
TOC-IR	EPA 9060/9060A/ SM 5310B	Total Organic Carbon

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Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Probe	EPA 9045C	pH
Preparation	**Method**	**Type**
Preparation	EPA 1311	Toxicity Characteristic Leaching Procedure
Preparation	EPA 1312	Synthetic Precipitation Leaching Procedure
Organic Preparation	EPA 3500C	Organic Extraction and Sample Preparation
Organic Preparation	EPA 3550B/3550C	Sonication
Organic Preparation	EPA 3545A	Pressurized Fluid Extraction
Inorganic Preparation	EPA 3050B	Hotblock
Inorganic Preparation	EPA 3060 A	Alkaline Digestion for Hexavalent Chromium
Volatile Organics Preparation	EPA 5035/5035A	Closed System Purge and Trap
Organic Preparation	EPA 3580/3580A	Waste dilution
Organic Preparation	EPA 3585	Waste dilution for Volatile Organics
Organic Preparation	EPA 3620C	Florisil Cleanup
Organic Preparation	EPA 3630C	Silica Gel Cleanup
Organic Preparation	EPA 3660B	Sulfur Cleanup (Copper)
Organic Preparation	EPA 3665A	Sulfuric Acid Cleanup

Notes:

1) This laboratory offers commercial testing service.

Approved by: ______________________ Date: June 29, 2011

R. Douglas Leonard
Chief Technical Officer

Issued: 7/13/10 Revised: 7/16/10 Revised: 1/20/11 Revised: 3/14/11 Revised: 6/10/11
Revised: 6/29/11