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Final

Work Plan for the Expanded Remedial Investigation at Site 2 and Site 5

St. Juliens Creek Annex
Chesapeake, Virginia

Prepared for

Department of the Navy
Atlantic Division
Naval Facilities Engineering Command
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CH2MHILL

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Acronyms and Abbreviations

ABM	abrasive blast media
AOC	Area of Concern
ASTM	American Society for Testing and Materials
bgs	below ground surface
BOA	Basic Ordering Agreement
BTAG	Biological Technical Assistance Group
CERCLA	Comprehensive Environmental Response. Compensation, and Liability Act
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
CNRMA	Commander Navy Region Mid-Atlantic
COC	chain-of-custody
COPC	chemicals of potential concern
CTO	Contract Task Order
DDT	dichlorodiphenyltrichloro-ethane
DO	dissolved oxygen
DQO	Data Quality Objective
DRMO	Defense Reutilization and Marketing Office
EPIC	Environmental Photographic Interpretation Center
ERA	ecological risk assessment
ft	foot, feet
GIS	Geographic Information System
gps	global positioning system
HHRA	Human Health Risk Assessment
HRS	Hazard Ranking System
IAS	initial assessment study
ID	inside diameter
IDW	investigation-derived waste
IRP	Installation Restoration Program
LANTDIV	U.S. Navy, Naval Facilities Engineering Command, Atlantic Division
MCL	Maximum Contaminant Level
MFSP	Master Field Sampling Plan
MHSP	Master Health and Safety Plan
MIDWMP	Master Investigation-Derived Waste Management Plan
MIP	membrane interface probe
MQAPP	Master Quality Assurance Project Plan
MS/MSD	matrix spikes/matrix spike duplicate
MWP	Master Work Plan

NACIP	Naval Assessment and Control of Installation Pollutants
NFESC	Navy Facilities Engineering Service Center
NTCRA	non-time-critical removal action
NUS	NUS Corporation, Superfund Division
OE	ordnance/explosives
ORP	oxidation reduction potential
OVM	organic vapor meter
PA	Preliminary Assessment
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PID	photo-ionization detector
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
QC	quality control
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigations
RI	Remedial Investigation
RRR	Relative Risk Ranking
SIMA	Shore Intermediate Maintenance Activity
SJCA	St. Juliens Creek Annex
SOP	Standard Operating Procedure
SPAWAR	Space and Naval Warfare Systems Command
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TCE	trichloroethene
TCL	Target Compound List
TCLP	Toxicity Leaching Characteristic Procedure
TOC	total organic carbon
USEPA	United States Environmental Protection Agency
UXO	unexploded ordnance
VDEQ	Virginia Department of Environmental Quality
VOC	volatile organic compound
VSI	visual site inspection
WP	Work Plan

SECTION 1

Introduction

This Work Plan (WP) describes the investigation and activities that will be completed for the Expanded Remedial Investigation (RI) at Site 2 (Waste Disposal Area B) and Site 5 (Burning Grounds) at St. Juliens Creek Annex (SJCA), Chesapeake, Virginia. A regional location map of SJCA and its surrounding areas is provided as Figure 1-1 and the site locations are shown on Figure 1-2.

The purpose of this WP is to outline the procedures that will be used to obtain site sampling data to further define the extent of contamination at Sites 2 and 5 as recommended in the RIs conducted at each site, *Draft Remedial Investigation/Human Health Risk Assessment/ Ecological Risk Assessment Report for Site 2* (CH2M HILL, 2003d) and *Final Remedial Investigation/Human Health Risk Assessment/Ecological Risk Assessment Report for Sites 3, 4, 5, and 6* (CH2M HILL, 2003a). The Navy, in conjunction with the United States Environmental Protection Agency (USEPA) Region III and the Virginia Department of Environmental Quality (VDEQ), identified the sites for additional study based of the results and data gaps identified in the RIs. The objectives of the Expanded RIs are to:

- Install shallow monitoring wells and collect groundwater samples at Site 2 to further define the nature and extent of contamination and evaluate potential human health risks associated with shallow groundwater;
- Collect stormwater/surface water samples at Site 2 to assess the source of volatile organic compound (VOC) contamination in inlet surface water;
- Collect sediment samples in St. Juliens Creek to evaluate potential impacts from the Site 2 inlet;
- Collect surface soil samples at Site 5 to further delineate surface soil contamination and support the evaluation of potential remedial alternatives; and
- Collect an additional round of groundwater sampling to verify Maximum Contaminant Level (MCL) exceedances and the presence of explosives in Site 5 groundwater.

This WP is prepared under the U.S. Navy, Naval Facilities Engineering Command, Atlantic Division (LANTDIV), Comprehensive Long-Term Environmental Action Navy (CLEAN) III Contract N62470-02-D-3052, Contract Task Order (CTO) 0024 for submittal to LANTDIV, USEPA, VDEQ, and the SJCA Installation Restoration Program (IRP). The technical approach was jointly scoped by the Tier I SJCA Partnering Team (which consists of representatives from the Navy, USEPA, and VDEQ).

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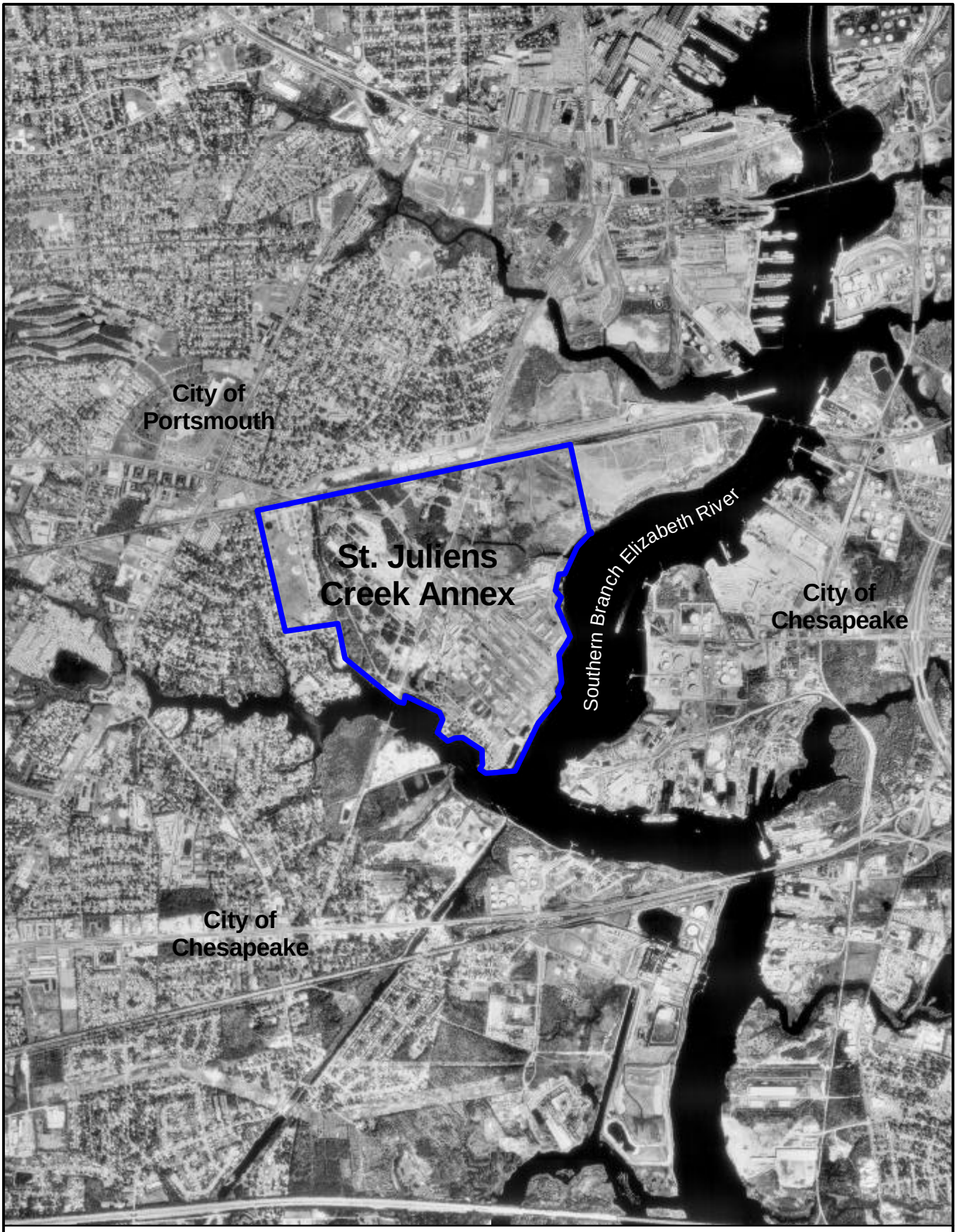

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St. Juliens Creek Annex

N

0 2000 4000 Feet

Figure 1-1
Location of St. Juliens Creek Annex
St. Juliens Creek Annex
Chesapeake, Virginia

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Site Location

Activity Boundary

N

0 800 1600 Feet

Figure 1-2
Locations of Sites 2 and 5
Within St. Juliens Creek Annex
St. Juliens Creek Annex
Chesapeake, Virginia

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SECTION 2

Site Descriptions, History, and Previous Investigations

The SJCA and site descriptions, background information, and summaries of previous basewide investigations are included in this section.

2.1 St. Juliens Creek Annex Description and History

The SJCA facility is situated at the confluence of St. Juliens Creek and the Southern Branch of the Elizabeth River in the City of Chesapeake, located in southeastern Virginia (Figure 1-1). The SJCA facility covers approximately 490 acres and includes buildings, a wharf, a central heating plant, numerous non-operational industrial facilities, and miscellaneous structures. A Dominion Virginia Power high transmission line runs parallel to Craddock Street (Figure 1-2), diagonally across the facility in a northwest-southeast trending direction, splitting the area roughly in half.

The facility is bordered to the north by the Norfolk and Western Railroad, the City of Portsmouth, and residential areas, to the west by residential areas, to the south by St. Juliens Creek, and to the east by the Southern Branch of the Elizabeth River. Most of the surrounding areas are developed, and include residences, schools, recreational areas, and shipping facilities for several large industries. Some undeveloped areas are located in various areas surrounding the facility.

St. Juliens Creek Annex began operations as a naval ammunition facility in 1849. For a majority of its history, the SJCA facility has been used for the storage and transportation of ammunition and ordnance. Processes and operations at the SJCA facility have included general ordnance operations involving wartime transfer of ammunition to various other U.S. Naval facilities throughout the United States and abroad. In addition, the Annex has been involved in specific ordnance operations and processes including those involving black powder operations, smokeless powder operations, projectile loading operations, mine loading, tracer mixing, testing operations, and decontamination operations.

The SJCA facility has also been involved in non-ordnance operations, including, paint shops, machine shops, vehicle and locomotive maintenance shops, pest control shops, battery shops, print shops, electrical shops, boiler plant operations, washrack operations, potable and salt water fire protection systems, and fire training operations. Many of these operations have been discontinued, such as locomotive maintenance and printing. Materials stored at the SJCA facility have included oil, ordnance materials, and non-ordnance chemicals.

Activity at SJCA has decreased in recent years. The current primary mission of the SJCA facility is to provide a radar testing range and various administrative and warehousing facilities for nearby Norfolk Naval Shipyard and other local Naval activities. St. Juliens Creek Annex also provides administrative offices, light industrial shops, storage facilities,

an active Defense Reutilization and Marketing Office (DRMO), Space and Naval Warfare Systems Command (SPAWAR), Shore Intermediate Maintenance Activity (SIMA), and a cryogenics school for tenant naval commands.

2.2 Site 2 History and Description

Site 2 is an unlined waste disposal area located at the corner of St. Juliens Drive and Craddock Street in the southern portion of the facility (Figure 1-2). It is estimated that Site 2 covers approximately 1.5 acres. In earlier documents, Site 2 was referred to as "Dump B" or "Landfill B." Operations at Site 2 began in 1921 and continued until sometime after 1947 (CDM, 1999). Initially, refuse was burned openly onsite and was used to fill in the adjacent swampy area. In 1942, an incinerator was installed and replaced the open burning practices.

Garbage, acids, and waste ordnance were reportedly disposed of at Site 2. The total volume of waste prior to burning is reported to have been approximately 35,185 cubic yards. It is estimated that half of this waste was disposed of prior to 1942. Site 2 also contains abrasive blast media (ABM) from ship overhaul and repair operations. The dates of ABM disposal are not known (CDM, 1999). In 1989, the site was also used for storage of heavy equipment and machinery, including storage of tools, tires, and machinery in sheds and trailers.

In the center of Site 2 is a water body surrounded by brush, trees, and grass that is directly connected to St. Juliens Creek. This inlet is tidally influenced and drains surface water from adjoining land into the creek. The Site 2 topography is generally level, sloping towards the inlet and St. Juliens Creek. Groundwater flow mimics the topography and flows towards the inlet and creek. Construction debris (concrete and brick), as well as ABM, is visible at the site. Site 2 is bounded to the north by a parking lot and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Site 17 (former Building 278/279); to the east by a grass-covered field where Building 130 once stood; to the west by a stormwater drainage ditch and Craddock Street; and to the south by St. Juliens Road and St. Juliens Creek (Figure 2-1).

Drainage ditches are located along Craddock Street. The 2 to 3 feet (ft) deep grassed drainage ditches originate north of Site 2, may contain standing water, and drain Craddock Street during high rainfall periods. The portions of the drainage ditch adjacent to the SIMA building flow through an underground stormwater pipe under the parking lot and through the northernmost culvert to the inlet. The drainage ditches south of the SIMA building enter the inlet through a culvert on the west side of the inlet. An underground storm drainage system also exists that originates approximately 1,000 ft northeast of the Site 2 area and outlets to the northernmost culvert to the inlet. The stormwater drainage is shown on Figure 2-1. Surface runoff from an adjacent parking lot to the northwest of the inlet also drains directly into the inlet.

2.3 Site 5 History and Description

Site 5 (Burning Grounds) consists of approximately 3 acres located east of Craddock Street in the northern portion of the facility (Figure 1-2) where waste ordnance materials were disposed by open burning. The exact start and closure dates of the Burning Grounds are unknown, although it is believed to have operated between the 1930s and 1970s. In 1977, the

ground surface at Site 5 was burned with straw, diced, and burned again in an effort to remediate the soil. One report stated that oil was mixed with the straw; however, a former Navy employee who had worked at the Burning Grounds stated that no oil was burned with the straw (CDM, 1999). The area where burning is thought to have occurred was determined from aerial photographs and an interview conducted in 2001 with Mr. Bryant, a Navy employee present during past burning activities. It was determined during a waste delineation activity that the remaining unburned material was pushed to the north and possibly east of the burning activities.

Wastes disposed at Site 5 include ordnance materials such as black powder (mixture of charcoal, nitrate, and sulfur), smokeless powder (nitrocellulose), Explosive D (ammonium picrate), Composition A-3 (contains RDX and wax), tetryl, trinitrotoluene (TNT), and fuzes. Other wastes consisted of carbon tetrachloride, trichloroethene (TCE), paint sludge, pesticides, and various types of refuse (CDM, 1999). The amount of ordnance disposed of varied from year to year and there is insufficient information to calculate waste volume.

The site currently consists of an open field with the southeastern portion overgrown with small shrubs, trees, and phragmites (Figure 2-2). A significant portion of the south-central area of the site is covered with a layer of gravel. Surface water at Site 5 drains either naturally or through unlined shallow man-made drainage ditches to tidally influenced Blows Creek, which eventually meets with the Southern Branch of the Elizabeth River. Site 5 groundwater flows towards Blows Creek.

In 2003, following the non-time-critical removal action (NTCRA) activities at Sites 6, a Closeout Report for Site 6 was completed. Site 6 waste/soil was completely excavated and replaced with clean backfill and the area beyond the limits of excavation was recommended to be included in future supplemental investigations at Site 5.

2.4 Previous Investigations

Previous basewide investigations conducted at SJCA related to Sites 2 and 5 are listed in Section 2.4.1. A more detailed description of these activities can be observed in the *Remedial Investigation/Human Health Risk Assessment/Ecological Risk Assessment for Site 2* (CH2M HILL, 2003d) and the *Remedial Investigation/Human Health Risk Assessment/Ecological Risk Assessment for Sites 3, 4, 5, and 6* (CH2M HILL, 2003a). Section 2.4.2 includes the RI activities, conclusions, and recommendations for Sites 2 and 5.

2.4.1 Basewide Investigations

- Initial Assessment Study (IAS) – 1981
- Preliminary Assessment (PA) – 1983
- Phase II Facility Assessment (RFA) – 1989
- Environmental Photographic Interpretation Center (EPIC) Study and Regulatory Review –1995
- Relative Risk Ranking (RRR) System Data Collection Report – 1996
- Hazard Ranking System (HRS) – 1999

2.4.2 Site-Specific Investigations

2.4.2.1 Remedial Investigation (RI) Report for Sites 3, 4, 5, and 6 - March 2003

A Final RI for Sites 3, 4, 5, and 6 was completed in March 2003 and included human health and ecological risk assessments (CH2M HILL, 2003a). Surface and subsurface soil, shallow (Columbia Aquifer) and deep (Yorktown Aquifer) groundwater, sediment, and surface water samples were collected and analyzed to characterize the nature and extent of contaminants and potential human health and ecological risks posed by contaminants at each site.

The RI concluded that potential remedial alternatives include removal and/or soil cover to address potential risk from exposure to soil. However, the RI recommended that the SJCA Partnering Team consider additional soil sampling at Site 5 in support of further characterization of the nature and extent of contamination and evaluation of remedial alternatives. Mitigation of risk through remedial actions for soil will also eliminate concern for continued transport of potential contaminants Blows Creek.

Further evaluation of the potential for adverse effects to aquatic life in Blows Creek sediment was also recommended and is scheduled for Summer 2003 under the *Final Work Plan for Baseline Ecological Risk Assessment (Step 4), Blows Creek Sites 3, 4, and 5,* submitted in August 2003.

Goundwater samples collected from the shallow monitoring wells at Site 5 indicated isolated detections of metals at concentrations above MCLs. In addition, an isolated detection of RDX was found in a sample collected from a deep monitoring well. Because these results were isolated and inconsistent between the three rounds of sampling, the Partnering Team concluded that an additional round of groundwater samples was necessary to confirm the RI results before proceeding with a more complete assessment of remedial needs for groundwater associated with Site 5.

2.4.2.2 Remedial Investigation (RI) Report for Site 2 - September 2003

A Draft RI for Site 2 was completed in September 2003 and included human health and ecological risk assessments (CH2M HILL, 2003d). Surface and subsurface soil, shallow (Columbia Aquifer) and deep (Yorktown Aquifer) groundwater, sediment, and surface water samples were collected and analyzed to characterize the nature and extent of contaminants and potential human health and ecological risks posed by contaminants at Site 2.

The RI concluded that potential remedial alternatives include removal and/or soil cover to address potential risk from exposure to soil. Mitigation of risk through remedial actions for soil will also eliminate concern for continued transport of potential contaminants to the inlet. Risks identified to human health and ecological receptors from exposure to sediment may also warrant remedial action. The SJCA Partnering Team will consider various alternatives which may include removal of impacted sediment in the inlet. The potential remedial actions may also include improving the quality of existing wetland areas adjacent to the inlet through the removal of phragmites and replacement with higher quality wetland species.

Based on the results of the Site 2 RI and data gaps identified, an Expanded RI was recommended to include shallow monitoring well installation and sampling to further define the nature and extent of shallow groundwater contamination, stormwater and surface water sampling to assess the source of VOC contamination in inlet surface water, and sediment sampling in St. Juliens Creek to evaluate potential impacts from the Site 2 inlet.

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- Site 2 Boundary (2001)
- Site 17 Boundary
- Roads
- Stormwater System

N

0 90 180 Feet

Figure 2-1
Site 2 Boundary and Vicinity
St. Juliens Creek Annex
Chesapeake, Virginia

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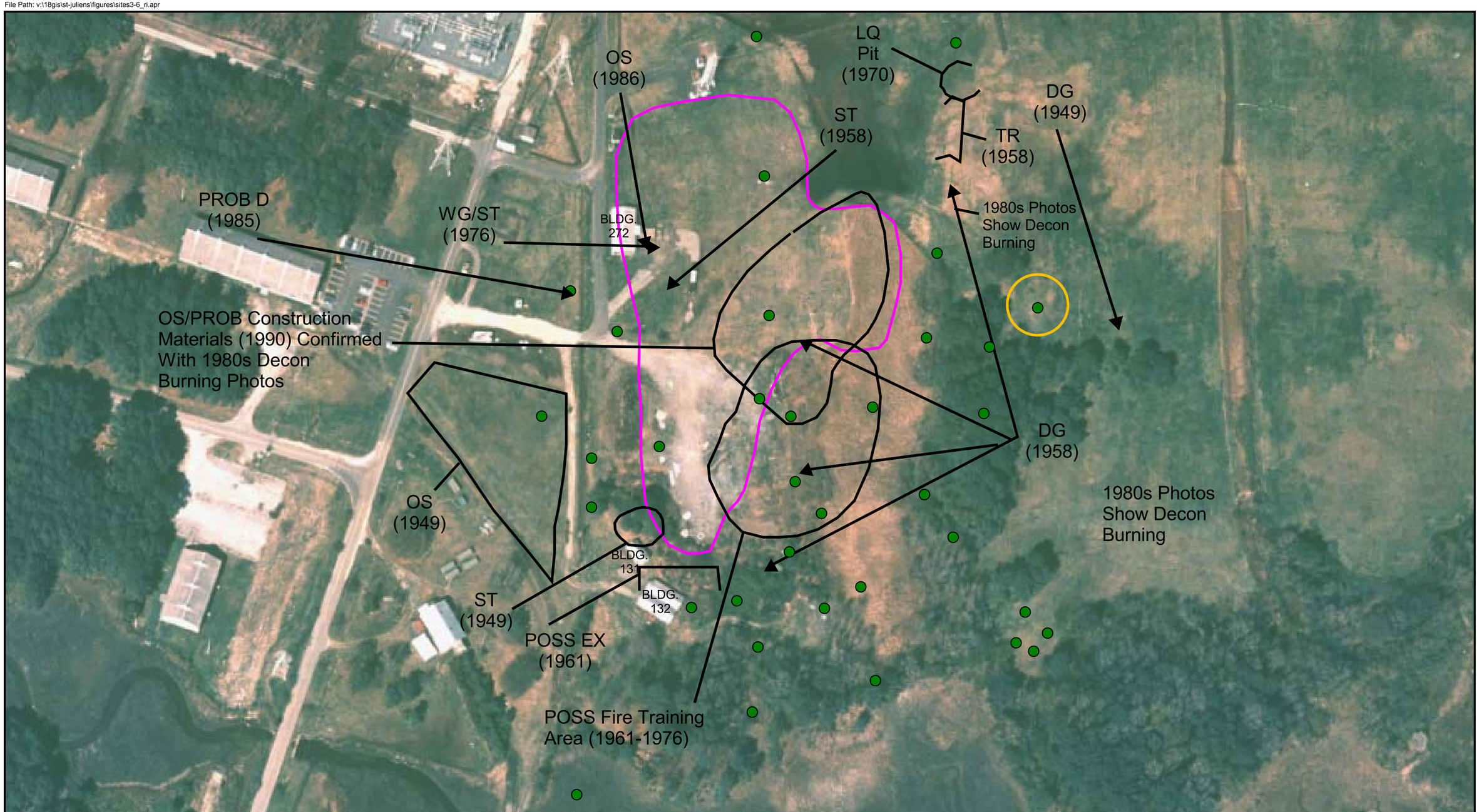

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- Existing Surface Soil Sample Locations
- Site 5 Boundary
- Former Site 6 Boundary

D - Drums
DG - Disturbed Ground
EX - Excavation
LQ - Liquid
OS - Open Storage Area
ST - Stain
TR - Trench
WG - Wet Ground

N

0 80 160 Feet

Figure 2-2
Site 5 Boundary & Vicinity and
Historical Photo Review
St. Juliens Creek Annex
Chesapeake, Virginia

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SECTION 3

Sampling Approach and Investigation Procedures

This section presents the technical approach to perform sampling activities for the Sites 2 and 5 Expanded RI at SJCA. The *Final Master Project Plan (MPP), St. Juliens Creek Annex, Chesapeake, Virginia* (CH2M HILL, 2003c) addresses the protocols and standard operating procedures (SOPs) to be used for all investigations at SJCA. The SJCA MPP consists of the Master Work Plan (MWP), Master Field Sampling Plan (MFSP), the Master Quality Assurance Project Plan (MQAPP), the Master Investigation-Derived Waste Management Plan (MIDWMP), and the Master Health and Safety Plan (MHSP). Preparation of site-specific plans is simplified through reference to the MPP documents. This WP provides site-specific details for the Sites 2 and 5 Expanded RI and references the MPP as appropriate. Checklists and a health and safety plan (HASP) to address site-specific details relevant to the MWP, MFSP, MQAPP, MIDWMP, and MHSP are provided in Appendix A. Table 3-1 provides a list of the applicable SOPs to this WP and the SOPs are included as Appendix B.

The remainder of this section provides detailed discussions of investigation protocols and procedures.

3.1 Project Management and Staffing

The CH2M HILL Activity Manager for the SJCA is Mr. William Friedmann. Ms. Kim Henderson will act as the Project Manager for the Site 2 and 5 Expanded RI. Project management activities include daily technical support and guidance, budget and schedule review and tracking, preparation and review of invoices, personnel resources, planning and allocation of resources, subcontractor coordination, preparation of monthly progress reports, and communication and coordination of events with LANTDIV, SJCA, and the project team.

The Site 2 and 5 Expanded RI field activities will be performed by qualified CH2M HILL staff members. Prior to initiating field activities, CH2M HILL will notify LANTDIV, Commander Navy Region Mid-Atlantic (CNRMA), and SJCA of the CH2M HILL and subcontracted personnel that will conduct the field investigations.

3.2 Field Investigation

The field investigation activities involve efforts related to fieldwork support, field investigation and sampling activities, sample shipping and chain-of-custody (COC), sample designation, field team performance and system audits, surveying, unexploded ordnance (UXO) support, and management of investigation-derived waste (IDW).

3.2.1 Field Work Support

As part of the initial field mobilization to SJCA, CH2M HILL will procure the following subcontractors; a utility locator, a drilling company capable of providing hollow stem auger and well construction capabilities, an ordnance/explosives (OE) management firm for UXO avoidance support, analytical laboratory, data validation services, an IDW contractor, and licensed surveyor. The firms providing these services shall be procured using the Basic Ordering Agreements (BOAs) under the CLEAN III contract. In cases where BOAs are not in place for services required under this work plan, CH2M HILL will provide subcontractor services in accordance with procedures that will be established between CH2M HILL's contract administrator and LANTDIV's contracting officer.

Mobilization for the field effort includes procurement of necessary field equipment and initial transport to the site. Equipment and supplies will be brought to the site when the CH2M HILL field team mobilizes for field activities. A photo-ionization detector (PID) will be used for monitoring sample locations for VOCs as a health and safety precaution and the applicable SOP (Volatiles Monitoring with an organic vapor meter [OVM]) is included in Appendix B. Utility clearances will be performed prior to the start of any subsurface investigation activities at SJCA. CH2M HILL will coordinate subsurface utility clearances with the Miss Utility through SJCA. Additionally, a utility clearance subcontractor will be procured to clear each sampling location in coordination with SJCA. The SOP for locating and clearing underground utilities is included in Appendix B.

Demobilization activities include general site restoration prior to the return transport of field equipment and crew. IDW consisting of soil and groundwater will be generated during the field activities and an IDW contractor will be procured for disposal.

3.2.2 Field Investigation and Sampling Activities

A description of the field activities anticipated for the Site 2 and 5 Expanded RI are included in this section. Field investigation activities will include the collection of surface soil, groundwater, sediment, and stormwater samples; the installation and sampling of groundwater monitoring wells; field quality control procedures; and sampling decontamination procedures.

The number of samples to be collected at each site from each medium of concern and the sample rationale are summarized below. All samples will be contained in laboratory-prepared pre-preserved sample bottles and packed on ice for overnight shipment to an offsite laboratory. Table 3-2 shows the required containers and holding times for samples as well as the analytical methods. The detection limits for the analytical methods are listed in the MQAPP.

3.2.2.1 Site 2

The investigation at Site 2 consists of the installation and sampling of four shallow (Columbia Aquifer) monitoring wells, gauging of all wells on the site, and collection of eight stormwater samples, two surface water samples, and sediment samples. A sample summary for Site 2 is shown on Table 3-3.

Monitoring Well Installation

Shallow monitoring wells will be installed at four locations at Site 2 (Figure 3-1) following the Installation of Shallow Monitoring Wells SOP included in Appendix B. The monitoring well locations were based on the following:

- The northernmost monitoring well was placed to the north of the inlet to further delineate groundwater flow direction and evaluate potential offsite contamination.
- The monitoring well just east of the parking lot was placed in this location to evaluate potential contamination from historical activities in the parking lot area and to further delineate groundwater flow.
- The monitoring wells to the east and west of the inlet were placed in areas where potential soil contamination was found as a result of RI activities.

At least one monitoring well is located within the extent of ABM (Figure 3-1) and a temporary casing will be used while installing the well so that ABM does not contaminate the well.

Each new monitoring well will be constructed with 2-inch inside diameter (ID) Schedule 40 polyvinyl chloride (PVC) screen and riser. Ten ft long monitoring well screens will be machine slotted to 0.010-inch. The shallow well screens will be placed at a depth just above the Yorktown Confining Unit, estimated be at no more than 20 ft bgs. The final screen interval will be determined in the field by the on-site geologist based on depth to the top of the Yorktown Confining Unit (shallow monitoring wells). A silica filter pack will be placed around the annular space of the well screen from the bottom of the boring extending to a depth of 2 ft above the top of the screen. A 2-ft bentonite layer will be placed at the top of the sand pack. After the bentonite has been hydrated, a cement-bentonite grout will be placed in the remaining annular space.

During monitoring well installation, a CH2M HILL geologist will observe and record soil descriptions that include grain size, color, moisture content, relative density, consistency, soil structure, mineralogy, and other relevant information such as possible evidence of contamination.

The monitoring wells will be completed above-grade with a locking steel protective casing set in a concrete pad. Guard posts may be installed in high-traffic areas for additional protection. A locking watertight cap will be placed on the PVC pipe and the wells will be clearly marked.

The newly installed wells will be developed before sampling in accordance with the Installation of Shallow Monitoring Wells SOP included in Appendix B. Well development will be accomplished using a combination of surging throughout the well screen and pumping, until the physical and chemical parameters of the discharge water that are measured in the field have stabilized and the turbidity of the discharge water is substantially reduced.

Groundwater Sampling

Groundwater samples will be collected from the four newly installed monitoring wells following installation and development. The groundwater samples will be analyzed for TCL

low concentration VOCs, TCL low concentration SVOCs, TCL pesticides/PCBs, explosives, TAL total metals and cyanide, and TAL dissolved metals.

Groundwater levels will be measured and recorded from the existing and newly installed monitoring wells at Site 2 prior to sample collection. In addition, groundwater parameters will be measured in the field using an in-line flow cell prior to sampling. The following parameters will be monitored in the field and recorded in the field notebook; dissolved oxygen (DO), oxidation reduction potential (ORP), pH, temperature, conductivity, turbidity, and salinity. Groundwater samples will be collected using a peristaltic pump following a low-flow sampling protocol (Appendix B).

All groundwater samples will be collected by placing the sample tubing intake in the middle of the screen interval. For the collection of water samples for VOC analysis, the pre-preserved bottles will be filled completely so as to minimize aeration, and capped to prevent the entrapment of any air bubbles in the vial. The applicable SOPs for the collection of groundwater samples are included in Appendix B.

Stormwater and Surface Water Sampling

Eight stormwater samples will be collected from storm sewers upstream of Site 2 to assess the source of potential VOCs contamination in inlet surface water (Figure 3-2). The stormwater pipes discharging to the Site 2 inlet were identified as a potential source of VOCs to the inlet surface water during the RI. Two surface water samples will also be collected at the culvert outfalls (Figure 3-2) where elevated VOCs were detected during the RI (CH2M HILL, 2003d). The stormwater and surface water samples will be analyzed for TCL low concentration VOCs. Stormwater/surface water sampling will proceed from downstream to upstream locations where applicable to reduce the amount of turbidity and potential cross-contamination of downstream samples. Sampling will be conducted at low tides during low flow, where appropriate, to minimize dilution of possible contaminants. A site visit will be conducted prior to mobilization to determine the appropriate sample procedures for the collection of the stormwater samples.

The stormwater samples will be collected using a peristaltic pump, disposal tubing, and decontaminated stainless steel tube for weight as indicated in the Sampling from Sanitary Sewers SOP included in Appendix B. The sampling intake should be lowered to below the flow surface in the manhole and the sample should be placed in a glass interim vessel that is laboratory cleaned to the same specifications as the sample containers. The following parameters will be monitored in the field and recorded in the field notebook; pH, temperature, DO, specific conductance, depth to water, and total depth of sanitary sewer.

The surface water samples will be collected by submersing the sampling container directly into the surface water body. The body of the immersed sampling container will face downstream so that any sediment disturbed during the immersion of the container does not enter the sampling vessel. If the volume of surface water encountered is insufficient to allow the direct submersion of the sampling containers, a glass interim vessel will be used to transfer the surface water sample to the sample containers. The following parameters will be monitored in the field prior to sample collection and recorded in the field notebook; pH, temperature, DO, and specific conductance.

The VOC sample bottles will be filled so as to minimize aeration of the samples. During the collection of surface water samples, care will be taken to ensure that the pre-added

preservative is not rinsed from the sampling container during sample collection. Sample vials will be filled completely and capped to prevent the entrapment of any air bubbles in the vial.

Sediment Sampling

Sediment samples will be collected from 11 locations within St. Juliens Creek, upstream of Site 2, and just outside of the Site 2 inlet in to determine if there is significant communication between the inlet and St. Juliens Creek. Two transects of four samples each (including a sediment sample collected previously) will be established as inlet outfall samples at the confluence of the Site 2 inlet and St. Juliens Creek (Figure 3-3). Five samples will be collected upstream of Site 2 in St. Juliens Creek as reference sample locations. The general areas identified for potential reference sampling are shown on Figure 3-3.

The reference sample areas were chosen as representative of anthropogenic background based on their isolation from site-related sources of contamination as compared to the inlet outfall location. The reference locations identified are primarily adjacent to residential areas as identified from aerial photographs and were selected in upstream/isolated areas believed to receive a reduced degree of point and non-point source inputs. Like the location of the inlet outfall, the reference locations are tidally influenced and the habitats are believed to be similar. Although upstream of the inlet outfall, due to the tidal nature of St. Juliens Creek, the reference locations may still be impacted by contributions from Site 2. These reference areas are expected to receive different non-site related contributions (e.g., urban and residential runoff) than sample locations immediately adjacent to the inlet outfall, with chemical concentrations levels reflective of typical urban watershed environments.

Actual reference sample locations will be based on field identification by a field biologist based on the likeness of physical properties (apparent sediment grain size and organic content) as compared to inlet outfall sediment. Representatives from the Biological Technical Assistance Group (BTAG) will be invited to participate in the selection of reference sample locations.

The sediment samples will be collected from 0 to 6 inches below sediment surface with a stainless steel hand auger or ponar dredge to minimize the potential loss of fine-grained sediments. The samples will be placed into a decontaminated stainless-steel bowl and homogenized prior to their placement in the sample containers. Coarse sandy sediment is not indicative of the low-flow finer grained material found in and around the Site 2 inlet. Therefore, in order to ensure the most representative sample of site conditions, channel sediment and/or sand will not be collected. Water quality parameters (pH, temperature, conductivity, salinity, dissolved oxygen, turbidity, and ORP) of the overlying surface water will be collected and recorded in the field notebook. The sediment samples will be logged by a CH2M HILL geologist. The applicable SOPs for sediment sampling are included in Appendix B. The sediment samples will be analyzed for TCL SVOCs, TCL pesticides/PCBs, TAL metals and cyanide, total organic carbon (TOC), and grain size.

3.2.2.2 Site 5

The investigation at Site 5 consists of the collection of 28 surface soil samples and three groundwater samples. A sample summary for Site 5 is shown in Table 3-4.

Groundwater Sampling

Groundwater samples will be collected from three existing monitoring wells at Site 5 (Figure 2-2) in order to confirm the presence or absence of constituents detected in samples collected from the three wells during previous investigations at the site. Two of the monitoring wells are screened within the Columbia (shallow) aquifer and one is located in the Yorktown (deep) aquifer. Groundwater samples collected during the RI, revealed slight exceedances of the MCLs for beryllium, cadmium, and lead at SJS05-MW03S, exceedance of the beryllium MCL at SJS05-MW02S and the detection of RDX at SJS05-MW01D. Therefore, the groundwater samples collected from SJS05-MW02S and SJS05-MW03S will be analyzed for TAL total and dissolved metals and the groundwater sample collected from SJS05-MW01D will be analyzed for explosives (Figure 3-4).

Prior to sampling, because these wells have not been utilized since 1999, monitoring wells SJS05-MW03S, SJS05-MW02S, and SJS05-MW01D will be redeveloped in order to ensure the hydraulic conductivity is consistent across the aquifer and a representative sample is obtained at each location.

Groundwater levels will be measured from all Site 5 monitoring wells and recorded prior to groundwater sampling (Figure 3-4). In addition, groundwater parameters will be measured in the field using an in-line flow cell prior to sampling. The following parameters will be monitored in the field and recorded in the field notebook; DO, ORP, pH, temperature, conductivity, turbidity, and salinity. Groundwater samples will be collected using a peristaltic pump following a low-flow sampling protocol (Appendix B). All groundwater samples will be collected by placing the sample tubing intake in the middle of the screen interval.

Surface Soil Sampling

Twenty-eight surface soil samples will be collected from 0 to 6 inches bgs at Site 5 (Figure 3-5). The number, placement, and analysis of samples were based on a review of historical photographs, an RI ecological risk driver comparison, and potential data gaps identified in the RI (Figure 2-2). Additional surface soil sampling will take place within areas where burning, disturbed ground, stains, open storage, and standing liquids were identified in historical photographs. The surface soil samples will be submitted to an off-site laboratory for the analysis of TCL PAHs, TCL pesticides, and TAL metals and cyanide. A subset of the surface soil samples, from four locations where burning was identified in historical photographs, will also be analyzed for dioxins/furans.

Soil samples will be collected with a hand auger. Some soil sample locations may be covered by gravel and to collect representative surface soil samples and minimize the influence of these surfacing materials, the overlying cover (i.e. gravel) will be removed until soil is exposed. In vegetated areas, all organic material (roots and grasses) will be removed from the samples prior to placement into sample containers. The surface soils will be collected from a depth of 0 to 6 inches bgs or the level of exposed soil. Soils will be placed in a decontaminated stainless steel bowl or on disposable plastic sheeting and homogenized prior to their placement in the sample containers. The soil samples will be logged by a CH2M HILL geologist. The applicable SOPs for soil sampling are included in Appendix B.

3.2.2.3 Sampling Equipment Decontamination

All non-disposable sampling equipment, such as the water level indicator, trowels, bowls, ponar dredge, and hand auger, will be decontaminated immediately after each use in accordance with applicable SOPs for decontamination included in Appendix B.

3.2.2.4 Field Quality Control Procedures

Quality control (QC) duplicate samples and blanks are used to provide a measure of the internal consistency of the samples and to provide an estimate of the components of variance and the bias in the analytical process. The details with regard to the number and frequency of field QC samples to be collected during Site 2 and 5 Expanded RI are included in Table 3-5. Field quality assurance/quality control (QA/QC) samples will be collected and analyzed, including: duplicate samples, equipment rinsate samples, field blanks, matrix spikes/matrix spike duplicates (MS/MSDs), temperature blanks, and trip blanks. Definitions of the different field QA/QC samples are provided below:

- **Field Duplicate Sample:** Two or more samples collected simultaneously into separate containers from the same source under identical conditions. Field duplicate samples are collected at a frequency of 10 percent of the regular environmental samples.
- **Equipment Blanks:** Equipment rinsate blanks (or rinsate blanks) are defined as samples obtained by running American Society for Testing and Materials (ASTM) Type II reagent water over/through sample collection equipment after it has been cleaned. These samples are used to determine if decontamination procedures were adequate.
- **Field Blanks:** These QA/QC samples are collected by pouring ASTM Type II reagent water into sample containers onsite to determine if ambient air conditions may have effected the samples. Field blanks are collected at a frequency of 1 per week.
- **Matrix Spikes/Matrix Spike Duplicates (MS/MSDs):** The matrix spike is used as an indicator of sample matrix effects on the recovery of target analytes, while the matrix spike duplicate is used as an indicator of sample matrix effects on the recovery of target analytes as well as method precision.
- **Temperature Blanks:** Temperature blanks are prepared prior to the sampling event, and stored with the investigative samples throughout the sampling event. They are then packaged with each shipment and sent for analysis to measure sample preservation temperature.
- **Trip Blanks:** Trip blanks are prepared prior to the sampling event, and stored with the investigative samples throughout the sampling event. They are then packaged for shipment with the other samples and sent for analysis. At no time after their preparation are the sample containers opened before they are returned to the laboratory. Field-sampling teams utilize VOC trip blanks to determine if samples may have become contaminated during storage and transportation back to the laboratory. One set of trip blanks accompany each cooler that contain samples with requested VOC analysis.

3.2.3 Sample Shipping and Chain-of-Custody (COC)

Sample shipping and COC will follow the procedures outlined in the Sample Preparation SOPs in Appendix B.

3.2.4 Sample Designation

Sampling locations and samples collected will be assigned unique designations to allow the sampling information and analytical data to be entered into the existing Geographic Information System (GIS) data management system for SJCA.

A standardized numbering system will be used to identify all samples collected during the sampling. The numbering system will provide a tracking procedure to ensure accurate data retrieval of all samples collected. The field team leader, who will be responsible for applying the use of the standardized numbering system during all sampling activities, will provide a listing of the sample identification numbers in the site-specific project instructions. The sample identification for all samples collected during this investigation will use the formats identified in Table 3-6.

3.2.5 Surveying

Installed monitoring wells will be surveyed using a licensed surveyor. Each well will be surveyed both vertically and horizontally using the Virginia State Plane Coordinate System. The vertical elevations accuracy will be +/- 0.01 ft, while the horizontal location will have an accuracy of +/- 0.1 ft. Specifically, the elevation for each monitoring well shall be established at the top of the monitoring well's inner PVC casing (this elevation point shall be designated by a permanent notch placed on top of each well's inner casing) and at ground surface. Locations of soil samples, and sediment samples will be determined by a CH2M HILL field scientist using a portable global positioning system (gps) unit.

3.2.6 UXO Support

Due to the nature of investigative work being conducted as part of this WP, OE/UXO avoidance practices will be implemented during drilling activities at Site 2 and surface soil sampling at Site 5. The UXO subcontractor for this project will be USA Environmental, Inc., a Navy approved OE/UXO contractor. USA Environmental's work plan and Health and Safety Plan are provided as Appendix C. All CH2M HILL employees and subcontractors will be responsible for following the CH2MHILL Standard of Practices HSE-35 (Drilling) and HSE-91 (Ordnance Explosives) as provided in Appendix C.

3.2.7 IDW

Field investigation activities will result in the generation of IDW. The IDW will include drill cuttings from the soil borings for monitoring well installations, well development and purge water, and solutions used to decontaminate non-disposable sampling equipment. Under VDEQ guidance (VR 672-10-1, VR-672-20-10), soil and sediment IDW will be replaced into the area of contamination from which it was generated, unless visually contaminated or elevated PID readings are encountered. Aqueous IDW will be containerized in 55-gallon drums, which will temporarily be stored onsite. IDW drums will be labeled in accordance with the procedures outlined in the MPPs. Any soil-related wastes contained will be analyzed for Toxicity Characterization Leaching Procedure (TCLP) parameters. Groundwater analytical results will be used for waste characterization and disposal of purge water. Additional samples may be required by the disposal facility. The IDW will be properly disposed of based on the results of the waste characterization.

3.3 Sample Analysis and Data Validation

CH2M HILL will track the samples from collection through analysis and obtain results from the subcontracted laboratory. Data validation for this project will be performed using the Region III Modifications to the National Functional Guidelines and will ensure that the data obtained under the USEPA protocols will be acceptable

3.3.1 Sample Analysis

All analyses will be conducted at a laboratory that fulfills all requirements of the Navy's QA/QC Program Manual and USEPA's Contract Laboratory Program (CLP). A signed certificate of analysis will be provided with each laboratory data package, along with the applicable federal, state, and local regulations. All analyses will be performed following the highest level of Navy guidance. Analyses will include the proper ratio of field QC samples recommended by Navy Facilities Engineering Service Center (NFESC) guidance for the data quality objectives (DQOs).

The laboratory will submit the data in hard copy and an electronic format that can be amended and readily incorporated into the GIS management system for SJCA.

3.3.2 Data Validation

Analytical results will be validated by a CH2M HILL subcontractor approved by the Navy. Procedures used for the validation process will be in accordance with *Region III Modifications to National Functional Guidelines for Organic Data Review Mutli-media, Multi-concentration* (USEPA, September 1994), and *Region III Modifications to Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses* (USEPA, April 1993). Data that should be qualified will be flagged appropriately. Results for QA/QC samples will be reviewed and the data will be qualified further, if necessary. Finally, the data set as a whole will be examined for consistency, anomalous results, reasonableness, and utility.

The data validator will be provided with the hard copy and electronic version of the laboratory results and will add data validation qualifiers to both versions. The electronic version will be examined for completeness and accuracy and downloaded into the CH2M HILL master database.

3.4 Data Evaluation and Reporting

3.4.1 Site 2 Data Evaluation

- A quantitative HHRA will be conducted to identify COPCs in Site 2 shallow groundwater.
- Site 2 outfall sediment data and new and existing St. Juliens Creek reference sediment data will be evaluated quantitatively to determine if significant releases have occurred from Site 2 and to determine potential ecological risks. The comparability of data sets will be determined by an evaluation of TOC and grain size. The sediment data will also help determine the potential for recontamination from St. Juliens Creek via tidal wash to inlet sediment, if inlet sediment is remediated.

- The stormwater, surface water, and groundwater data collected at Site 2 will be qualitatively evaluated to potentially determine the source of VOCs to inlet surface water.
- A qualitative evaluation of potential impacts from groundwater discharge to the Site 2 inlet will be conducted to determine the likelihood of recontamination if inlet sediment is remediated.

3.4.2 Site 5 Data Evaluation

- The previous MCL metal exceedances in shallow groundwater and RDX detection in deep groundwater at Site 5 will be verified.
- The Site 5 surface soil results will fill data gaps to better evaluate areas posing potential ecological risk to terrestrial receptors and potential remedial alternatives.

3.4.3 Reporting

The results from Site 2 and 5 investigations will be incorporated into separate Expanded RI Addendums and provided to the Navy, VDEQ, and USEPA for review. The reports will include a narrative explanation of the activities conducted at each site, data evaluation (Sections 3.4.1 and 3.4.2), and recommendations for further action. Final reports will be prepared following review and approval by the Navy, USEPA, and VDEQ.

Table 3-1 List of Applicable Standard Operating Procedures from the Master Project Plans St. Juliens Creek Annex Chesapeake, Virginia
Field Parameters
Field Measurement of pH, Specific Conductance, Turbidity, Dissolved Oxygen, ORP, and Temperature using the Horiba® U-22
Health and Safety Monitoring
Volatiles Monitoring with an OVM
Soil Sampling
Soil Sampling
Shallow Soil Sampling
Logging of Soil Borings
Hydrogeologic Investigation
General Guidance for Monitoring Well Installation
Installation of Shallow Monitoring Wells
Water Level Measurement
Groundwater Sampling
Groundwater Sampling from Monitoring Wells
Low-Flow Groundwater Sampling from Monitoring Wells
Stormwater Sampling
Sampling from Sanitary Sewers
Sediment and Surface Water Sampling
Sediment Sampling
Surface Water Sampling
Sample Preparation
VOC Sampling – Water
Preserving Non-VOC Aqueous Samples
Equipment and Field Rinse Blank Preparation
Field Filtering
Homogenization of Soil and Sediment Samples
Packaging and Shipping Procedures
Chain-of-Custody
Decontamination and Waste Management
Decontamination of Drilling Rigs and Equipment
Decontamination of Personnel and Equipment
Disposal of Waste Fluids and Solids
Utilities
Locating and Clearing Underground Utilities

Table 3-2
Analytical Methods and Required Containers, Preservatives, and Holding Times For Samples
St. Juliens Creek Annex
Chesapeake, Virginia

Analysis	Method	Sample Container	Holding Time	Volume of Sample
Soil and Sediment Samples				
TCL SVOCs/PAHs	CLP OLM04	One 8-oz glass bottle with Teflon-lined cap	14 days	Fill completely
TCL Pesticides/PCBs	CLP OLM04	Two 4-oz glass bottles with Teflon-lined cap	14 days	Fill completely
TAL Metals/Mercury/Cyanide	CLP ILM04	One 4-oz glass bottle with Teflon-lined cap	6 months; 28 days for Mercury; 14 days for Cyanide	Fill completely
TOC	USEPA SM 415 or SW-846 9060	One 4-oz glass bottle with Teflon-lined cap	28 days	Fill completely
Dioxins/Furans	SW 846 8290	Two 1- liter amber bottles with Teflon-lined cap	7 days to extraction, 40 days to analysis	Fill completely
Groundwater Samples and Aqueous QC Samples				
TCL VOCs	CLP OLM04	Three 40-ml glass vial with Teflon-lined cap	14 days	Fill completely; no air bubbles
TCL SVOCs/PAHs	CLP OLM04	Two 1-liter amber bottles with Teflon-lined cap	7 days to extraction, 40 days to analysis	Fill to shoulder
TCL LC VOCs	CLP OLC02/OLC03	Three 40-ml glass vial with Teflon-lined cap	14 days	Fill completely; no air bubbles
TCL LC SVOCs	CLP OLC02/OLC03	Two 1-liter amber bottles with Teflon-lined cap	7 days to extraction, 40 days to analysis	Fill to shoulder
TCL Pesticides/PCBs	CLP OLM04	Two 1-liter amber bottles with Teflon-lined cap	7 days to extraction, 40 days to analysis	Fill to shoulder
TAL Metals/Cyanide (total)	CLP ILM04	1-liter polyethylene bottle	6 months; 28 days for mercury; 14 days for cyanide	Fill to shoulder
TAL Metals (dissolved)	CLP ILM04	1-liter polyethylene bottle	6 months; 28 days for mercury	Fill to shoulder
Dioxins/Furans	SW 846 8290	Two 1- liter amber bottles with Teflon-lined cap	7 days to extraction, 40 days to analysis	Fill to shoulder
Explosives (RDX)	SW 846 8330	Two 1-liter amber bottles with Teflon-lined cap	7 days to extraction, 40 days to analysis	Fill to shoulder

Notes:
CLP: Contract Laboratory Program
LC: Low Concentration
PAHs: Polyaromatic Hydrocarbons
PCBs: Polychlorinated Biphenyls
SVOCs: Semivolatile Organic Comounds
SW: Solid Waste
TAL: Target Analyte List
TCL: Target Compound List
TOC: Total Organic Carbon
VOCs: Volatile Organic Compounds

Table 3-3
Site 2 Sample Summary
St. Juliens Creek Annex
Chesapeake, Virginia

Media	Number of Samples	Number of Field Duplicates	Analyses
Shallow Groundwater Monitoring Wells	4	1	TCL LC VOCs, TCL LC SVOCs, TCL Pesticides/ PCBs, explosives, TAL total and dissolved Metals and Cyanide
Surface Water	2	1	TCL LC VOCs
Stormwater	8	1	TCL LC VOCs
Sediment (0-6")	11	2	TCL SVOCs, TCL Pesticides/PCBs, TAL Metals and Cyanide, TOC, grain size

Notes:
LC: Low Concentration
PCBs: Polychlorinated Biphenyls
SVOCs: Semivolatile Organic Comounds
TAL: Target Analyte List
TCL: Target Compound List
TOC: Total Organic Carbon
VOCs: Volatile Organic Compounds

Table 3-4
Site 5 Sample Summary
St. Juliens Creek Annex
Chesapeake, Virginia

Media	Number of Samples	Number of Field Duplicates	Analyses
Surface Soil (0-6")	28	3	TCL PAHs, TCL Pesticides, TAL Metals and Cyanide, Dioxins/Furans (4 samples)
Shallow and Deep Groundwater	3	1	TAL total and dissolved Metals (2 shallow groundwater samples), RDX (1 deep groundwater sample)

Notes:
PAHs: Polyaromatic Hydrocarbons
TAL: Target Analyte List
TCL: Target Compound List

Table 3-5
General Requirements for QA/QC Sample Collection
St. Juliens Creek Annex
Chesapeake, Virginia

QA/QC Samples	QA/QC Sample Purpose	QA/QC Specified Collection Frequency
Field Duplicate	Measures accuracy of laboratory and field procedures	One per 10 samples per matrix or one duplicate per day, matrix, and site, whichever is more frequent
Trip Blank	Measures outside sources of potential VOCs contamination	One per cooler containing samples collected for VOC analysis
Equipment (Rinsate) Blank	Measures effectiveness of decontamination	One per day per matrix per site
Field Blank	Measures ambient condition	One per site per sampling event
Temperature Blank	Measures sample preservation temperature	One per cooler
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	Measures sample specific interferences due to the matrix of the sample	One per matrix for each group of up to 20 samples sent to a single laboratory (count QC samples)

Table 3-6
Summary for Sample Identification Scheme
St. Juliens Creek Annex
Chesapeake, Virginia

First Segment		Second Segment		Third Segment	Fourth Segment
Installation	Site Type and Number	Sample Type	Sample Location; MW Depth	Solid Sample Depth	Sample Date; Qualifier
AA	ANN	AA	NNA	NN	NNAA
Installation: SJ = SJCA	Site Type: S = Site Site Number/Letter: 02 = Site 2 05 = Site 5	Sample Type: SS = Surface Soil SD = Sediment MW = Monitoring Well SW = Surface Water ST = Stormwater	Sample Location: Sequential Location Number Monitoring Well Depth: S = Shallow D = Deep	Sample Depth: 00 = 0 to 0.5 ft bgs	Sample Date: NN = Last 2 digits of year A = Quarter of the Year: A = 1st Quarter B = 2nd Quarter C= 3rd Quarter D = 4th Quarter Qualifier (only if duplicate sample): P - Duplicate

Numbering format for QA/QC Samples:			
AAANN-AANNNNNN-AA			
AAANN = Installation, Site Type, and Number SJS02 = SJCA Site 2 SJS05 = SJCA Site 5	AA = QA/QC type: TB = Trip Blank EB = Equipment Blank FB = Field Blank	NNNNN = DDMMYY (example = 082903)	AA = Media/Sample Type (example = SD)

Notes: “A”= alphabetic “N”= numeric

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LEGEND

- Existing Deep Monitoring Well Locations
- Existing Shallow Monitoring Well Locations
- Proposed Shallow Monitoring Well Locations
- Site Boundary
- Site 2 Inlet Stream
- Extent of ABM
- Contours of Columbia Aquifer Potentiometric Surface (March 25,2002)
- Inferred Contours of Columbia Aquifer Potentiometric Surface (March 25,2002)
- Groundwater Flow Direction

N

0 100 200 Feet

Figure 3-1
Site 2 Existing and Proposed Monitoring Well Locations
St. Juliens Creek Annex
Chesapeake, Virginia

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LEGEND

- Stormwater Samples
- Surface Water Samples
- Stormwater System
- Site Boundary

N

0 100 200 Feet

Figure 3-2
Site 2 Proposed Stormwater and Surface Water Sampling Locations
St. Juliens Creek Annex
Chesapeake, Virginia

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LEGEND

- Site 2 Boundary
- Roads
- Existing Background Sediment Samples
- Existing Site 2 Sediment Samples
- Proposed Sediment Samples

N

0 300 600 Feet

Figure 3-3
Potential Sediment Sampling Locations
St. Juliens Creek Annex
Chesapeake, Virginia

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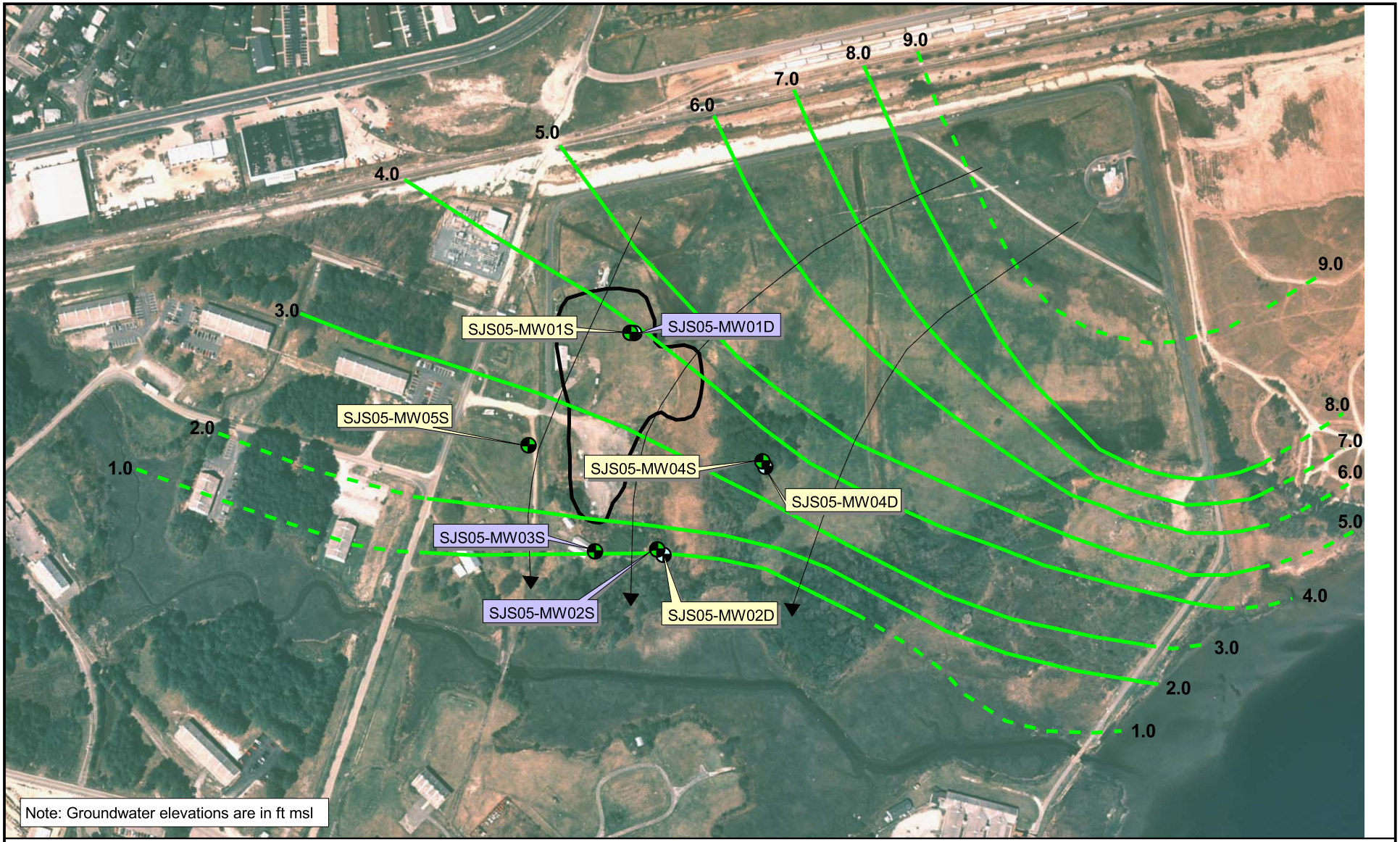

LEGEND

- Existing Deep Monitoring Well Locations
- Existing Shallow Monitoring Well Locations
- Site Boundary
- Monitoring Well To Be Sampled
- Contours of Columbia Aquifer Potentiometric Surface (August 16, 2001)
- Inferred Contours of Columbia Aquifer Potentiometric Surface (August 16, 2001)
- Groundwater Flow Direction

N

0 300 600 Feet

Figure 3-4
Site 5 Groundwater Sampling Locations
St. Juliens Creek Annex
Chesapeake, Virginia

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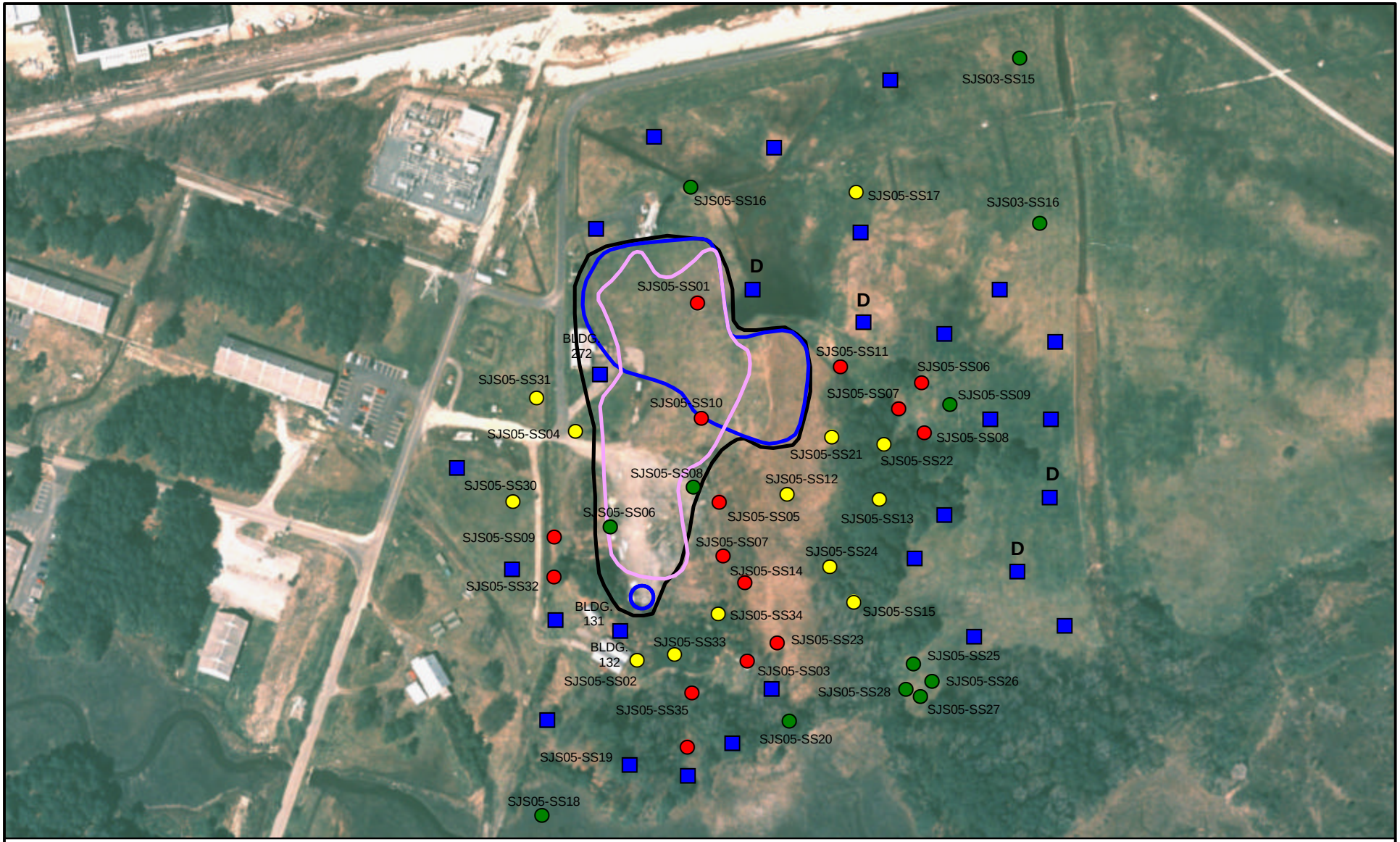

LEGEND

- Proposed Additional Surface Soil Sample Locations
- Extent of Burnt Soils
- Extent of Surface Debris
- Site Boundary
- **D** - Sample will also be analyzed for Dioxins/Furans

Previous Surface Soil Samples

- High Risk
- Medium Risk
- Low Risk

(Level of risk based on ecological risk driver compounds exceeding background UTLs)

N

0 100 200 Feet

Figure 3-5
Site 5 Previous and Proposed Surface Soil Sampling Locations
St. Juliens Creek Annex
Chesapeake, Virginia

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SECTION 4

Project Schedule

This section documents the project schedule and the due dates of deliverables. Table 4-1 shows a breakdown of primary deliverables and assumed intervals for Navy and regulatory review. Longer periods of review may result in an extended schedule. The Expanded RI for Sites 2 and 5 is expected to be conducted in Fall 2003.

TABLE 4-1
Proposed Project Milestones
Expanded Remedial Investigation, Sites 2 and 5, Contract Task Order 0024

Key Project Milestones	Date From Notice to Proceed		Duration
	Start	End	
Submittal of Final Work Plans	12/08/03	12/08/03	1
Subcontractors Procurement	10/13/03	10/27/03	14
Utility Clearance	12/01/03	12/08/03	7
Data Collection **	12/08/03	01/26/04	49
Laboratory Sample Analysis	12/22/03	02/23/04	63
Data Validation	02/23/04	03/09/04	15
Data Evaluation	03/09/04	04/09/04	30
Prepare and Submit Draft Reports	04/09/04	05/09/04	30
Regulatory Review	05/09/04	06/24/04	45
Prepare and Submit Final Reports	06/24/04	07/08/04	14

** The estimated time to complete the field work for is 49 calendar days based on two separate mobilizations to complete the field event.

SECTION 5

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Appendix A
Site-Specific Health and Safety Plan

Project-Specific Health and Safety Plan

Introduction

This Project-Specific Health and Safety Plan (HASP) presents the hazards known or anticipated to be present at the at the St. Juliens Creek Annex/Sites 2 and 5 during the Phase II field effort scheduled to take place in the fall/winter of 2003. This Project-Specific HASP will be used by CH2M HILL and its subcontractors to identify and mitigate task-specific hazards and to select appropriate health and safety protective measures not otherwise covered in the Master HASP.

The St. Juliens Creek Master HASP has been previously developed and must accompany/supplement this Project-Specific HASP. The Master HASP contains information pertinent to the general conditions at St. Juliens Creek, such as general site information, hazard evaluation and control, personnel responsibilities and requirements, a general description of personal protective equipment, customary decontamination procedures, and emergency response procedures. On-site personnel must review both the Master-HASP and the site-specific HASP and sign an agreement to comply with its provisions prior to commencing on-site work. The Master-HASP and site-specific HASP are considered operational documents that are subject to revisions in response to various site-specific conditions that may be encountered. However, these documents may be modified or updated only with the approval of the PHSO and Project Manager.

Policy

CH2M HILL's policy is that on-site hazardous waste management activities be performed in conformance with both the Master HASP and a Project-Specific HASPs. The documents are written based on the anticipated hazards and expected work conditions, and apply to field activities to be performed under the Work Plan. Applicability of this Master-HASP and the Project-Specific HASPs extends to all CH2M HILL employees, CH2M HILL's subcontractors, and visitors entering the site. CH2M HILL subcontractors must follow an established health and safety plan; in most cases, either adopting this master plan with appropriate site-specific HASP (e.g., surveyor), or adopting same and amending both with safety and/or health requirements specific to their work (e.g., driller). HASPs authored by a subcontractor must be reviewed by CH2M HILL's Project Health and Safety Officer (PHSO) before commencing on-site work. After being reviewed, this information will become part of the appropriate site-specific HASP.

This Project-Specific HASP in combination with the Master HASP will, at a minimum, meet the requirements under Occupational Safety and Health Administration (OSHA) Standard *29 Code of Federal Regulations* (CFR) 1910.120 (Hazardous Waste Operations and Emergency Response).

PRE-ENTRY REQUIREMENTS

During site mobilization, the Site Health and Safety Officer (SHSO) will perform a reconnaissance of each site as identified in the site-specific Work Plan (WP) to evaluate and determine the chemical, physical, and environmental hazards; establish or confirm emergency points of contact and procedures; and review any other issues deemed necessary to address site safety and health. The SHSO will then conduct a health and safety briefing with the site personnel to discuss data obtained from the previous site reconnaissance, provisions outlined in this Master HASP and site-specific HASP, and appropriate safety and health procedures and protocols.

CH2M HILL HEALTH AND SAFETY PLAN

This Project-Specific Health and Safety Plan (HASP) will be kept on the site during field activities and will be reviewed as necessary. The plan will be amended or revised as project activities or conditions change or when supplemental information becomes available. The plan adopts, by reference, the Standards of Practice (SOPs) in the CH2M HILL *Corporate Health and Safety Program, Program and Training Manual*, as appropriate. In addition, this plan adopts procedures in the project Work Plan. The Site Safety Coordinator (SSC) is to be familiar with these SOPs and the contents of this plan. CH2M HILL's personnel and subcontractors must read both the Master HASP and this Project-Specific HASP, and sign Attachment 1 of both documents.

Project Information and Description

PROJECT NO:	181812
CLIENT:	Department of the Navy
PROJECT/SITE NAME:	St. Juliens Creek Annex/Sites 2 and 5
SITE ADDRESS:	Victory Blvd. Chesapeake, VA
CH2M HILL ACTIVITY MANAGER:	Kim Henderson
CH2M HILL OFFICE:	Virginia Beach
DATE HSP PREPARED:	June 2003
DATE(S) OF SITE WORK:	Fall/Winter 2003
SITE ACCESS:	Main Gate (military pass required)
DESCRIPTION OF SPECIFIC TASKS TO BE PERFORMED:	Collection of groundwater, surface water, sediment, and soil samples, oversight of drilling and well installation, and logging of drill cuttings.

1 Tasks to be Performed Under this Plan

1.1 Description of Tasks

(Reference Field Project Start-up Form)

Refer to project documents (i.e., Work Plan) for detailed task information. A health and safety risk analysis (Section 1.2) has been performed for each task and is incorporated in this plan through task-specific hazard controls and requirements for monitoring and protection. Tasks other than those listed below require an approved amendment or revision to this plan before tasks begin. Refer to Section 8.2 for procedures related to "clean" tasks that do not involve hazardous waste operations and emergency response (Hazwoper).

1.1.1 Hazwoper-Regulated Tasks

- Drilling
- Groundwater sampling
- Surface water sampling
- Sediment sampling
- Hand Augering
- Surface soil sampling
- Surveying
- Investigation-derived waste (drum) sampling and disposal
- Observation of material loading for offsite disposal
- Oversight of well installation

2 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 site or the particular hazard. 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 SSC for clarification.

In addition to the controls specified in this section, Project-Activity Self-Assessment Checklists are contained in Attachment 6. These checklists are to be used to assess the adequacy of CH2M HILL and subcontractor site-specific safety requirements. The objective of the self-assessment process is to identify gaps in project safety performance, and prompt for corrective actions in addressing these gaps. Self-assessment checklists should be completed early in the project, when tasks or conditions change, or when otherwise specified by the HSM. The self-assessment checklists, including documented corrective actions, should be made part of the permanent project records, and be promptly submitted to the HSM.

Project-specific frequency for completing self-assessments: **Weekly, during drilling.**

2.1 Project-Specific Hazards

2.1.1 Arsenic

- 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.
- Arsenic is considered a "Confirmed Human Carcinogen."
- Arsenic particulates (inorganic metal dust) are odorless. Vapor and gaseous odor varies depending upon specific organic arsenic compound.
- Respiratory protection and other exposure controls selection shall be based on the most recent exposure monitoring results obtained from the competent person.

2.1.2 Cadmium

- 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.
- Cadmium is considered a "Suspected Human Carcinogen."
- Cadmium particulates (fumes and dust) are odorless.
- Respiratory protection and other exposure controls selection shall be based on the most recent exposure monitoring results obtained from the competent person.

2.1.3 Lead

The following requirements pertain to lead contaminated soils:

- Work shall progress in a sequence from less contaminated to more contaminated areas.
- Water should be added to soils prior to and during excavation, air rotary drilling, and other activities that create or have the potential to create airborne lead contaminated dust. For air rotary drilling operations, water can be added to the boring to reduce dust generation from the cyclone. Depending upon soil type, watering of soil may be required several days prior to commencing ground intrusive activities.
- Personnel working in the vicinity of lead contaminated soil shall wear disposable coveralls or equal and exercise enhanced personal hygiene (i.e., frequent hand washing prior to eating, drinking, and smoking; separation of work and street clothing/footwear; etc.).

2.1.4 Radar Hazards

- Airports and all branches of the military use radar of significant power for buildings, towers, aircraft, ships, armor vehicles and installations in general. Radar devices may emit harmful microwave radiation emissions.
- Microwave radiation is absorbed by the body and dissipated in the tissue as heat.
- The penetration ability of the radiation depends on the wavelength. Microwave wavelengths of 25-200 centimeters have the ability to reach the internal organs with potentially damaging effects. Wavelengths less than 25 centimeters are absorbed and dissipated by the skin and the human body is thought to be transparent to microwave wavelengths greater than 200 centimeters.
- The health effects of microwave radiation include deep burns and thermal damage to any organ or organ system with low blood flow, most notably the lenses of the eyes. If adequate time has elapsed between exposures, the repair mechanisms of the lens seems to limit damage.
- Studies have demonstrated that chronic microwave exposure can cause both psychological changes, disrupting task and function control, as well as chronic depression. Further studies suggest a possible relationship between mongolism (Down's Syndrome) in offspring and previous exposure of the male parent to radar, however the study was not conclusive.
- Microwave radiation can not be seen and it's effects can not be felt until serious damage has already occurred.

- Because of the inconclusive effects of microwave radiation, OSHA has set a conservative exposure limit of 10 milliwatt per square centimeter (10 mW/cm^2) averaged over any 6 minute period.
- Warning signs must be posted in areas where potentially damaging microwave radiation exists.
- The prevention method for microwave radiation exposure is to not be in the path of radar or other microwave emitting devices by either ensuring that the device is not operating or ensuring that there is sufficient shielding between you and the microwave source.

2.1.5 Drilling

(Reference CH2M HILL SOP HS-35, *Drilling*)

- Only authorized personnel are permitted to operate drill rigs.
- Stay clear of areas surrounding drill rigs during every startup.
- Stay clear of the rotating augers and other rotating components of drill rigs.
- Stay as clear as possible of all hoisting operations. Loads shall not be hoisted overhead of personnel.
- Do not wear loose-fitting clothing or other items such as rings or watches that could get caught in moving parts. Long hair should have it restrained.
- If equipment becomes electrically energized, personnel shall be instructed not to touch any part of the equipment or attempt to touch any person who may be in contact with the electrical current. The utility company or appropriate party shall be contacted to have line de-energized prior to approaching the equipment.
- Smoking around drilling operations is prohibited.

2.1.6 Working Above or Near Water

- 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 (PDFs), or life jacket, shall be worn.
- Inspect PFDs prior to use. Do not use defective PFDs.
- A life-saving skiff must be provided for emergency rescue.
- A minimum of one ring buoy with 90 feet of 3/8-inch solid-braid polypropylene (or equal) rope must be provided for emergency rescue.
- Use sampling and other equipment according to the manufacturers' instructions.

2.1.7 IDW Drum Sampling

Personnel are permitted to handle and/or sample drums containing investigation-derived waste (IDW) only; handling or sampling other drums requires a plan revision or amendment approved by the CH2M HILL HSM. The following control measures will be taken when sampling drums containing IDW:

- Minimize transportation of drums.
- Sample only labeled drums or drums known to contain IDW.
- Use caution when sampling bulging or swollen drums. Relieve pressure slowly.
- If drums contain, or potentially contain, flammable materials, use non-sparking tools to open.
- Picks, chisels, and firearms may not be used to open drums.
- Reseal bung holes or plugs whenever possible.
- Avoid mixing incompatible drum contents.
- Sample drums without leaning over the drum opening.
- Transfer the content of drums using a method that minimizes contact with material.
- PPE and air monitoring requirements specified in Sections 4 and 5 must address IDW drum sampling.
- Spill-containment procedures specified in Section 7 must be appropriate for the material to be handled.

2.5 Contaminants of Concern

(Refer to Project Files for more detailed contaminant information)

Contaminant	Location and Maximum[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Metals					
Arsenic	GW: 0.027 SB: 0.041 SS: 0.018	0.01 mg/m^3	5 Ca	Ulceration of nasal septum, respiratory irritation, dermatitis, gastrointestinal disturbances, peripheral neuropathy, hyperpigmentation	NA
Cadmium	GW: ND SB: 0.0112 SS: 0.0031	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 (hexavalent)	GW: 0.0017 SB: 0.335 SS: 0.246	0.01 mg/m^3	15 Ca	Irritated respiratory system, nasal septum perforation, liver and kidney damage, leucytosis, leupen, monocytosis, eosinophilla, eye injury, conjunctivitis, skin ulcer, sensitization dermatitis	NA
Lead	GW: 0.017 SB: 8.85 SS: 0.079	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
Mercury	GW: ND SB: 0.0063 SS: 0.00071	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
Pesticides					
DDT	GW: ND SB: 290J SS: 12.0	0.5 mg/m^3	500 Ca	Paresthesia of tongue, lips, hand, and face; tremors; dizziness; confusion; headache; fatigue; convulsion; eye and skin irritation; vomiting	UK
Endosulfan	GW: 0.00001 SB: ND SS: ND	0.1 mg/m^3	NL	Irritated skin, nausea, confusion, agitation, flushing, dry mouth, tremor, convulsion, headache	UK
VOC's					
2-Butanone (Methyl Ethyl Ketone, MEK)	GW: 0.0407 SB: ND SS: ND	200 ppm	3,000	Eye, skin, and nose irritation; headache; dizziness; vomiting; dermatitis	9.54
Chlorobenzene	GW: 0.0024 SB: ND SS: ND	10 ppm	1,000	Skin, eye, and nose irritation; drowsiness; uncoordination; CNS depression	9.07
Trichloroethylene (TCE)	GW: 0.0008 J SB: 0.012 SS: ND	50 ppm	1,000 Ca	Headache, vertigo, visual disturbance, eye and skin irritation, fatigue, giddiness, tremors, sleepiness, nausea, vomiting, dermatitis, cardiac arrhythmia, paresthesia, liver injury	9.45

2.5 Contaminants of Concern

(Refer to Project Files for more detailed contaminant information)

Contaminant	Location and Maximum[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
SVOC's					
Bis-(2-ethylhexyl)phthalate (DEHP, DOP)	GW: 0.001 J SB: 0.039 SS: 0.035	5 mg/m^3	5,000 Ca	Eye and mucous membrane irritant	UK
PCB's					
PCBs (Limits as Aroclor 1254)	GW:ND SB: 0.021J SS: 0.11J	0.5 mg/m^3	5 Ca	Eye and skin irritation, acne-form dermatitis, liver damage, reproductive effects	UK

Footnotes:

[a] Specify sample-designation and media: SB (Soil Boring), A (Air), D (Drums), GW (Groundwater), L (Lagoon), TK (Tank), S (Surface Soil), SL (Sludge), SW (Surface Water).

[b] Appropriate value of PEL, 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.

2.6 Potential Routes of Exposure

Dermal: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 4.	**Inhalation:** Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring, as specified in Sections 4 and 5, respectively.	**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).

3 Project Organization and Personnel

3.1 CH2M HILL Employee Medical Surveillance and Training

(Reference CH2M HILL SOPs HS-01, *Medical Surveillance,* and HS-02, *Health and Safety Training)*

The employees listed below are enrolled in the CH2M HILL Comprehensive Health and Safety Program and meet state and federal hazardous waste operations requirements for 40-hour initial training, 3-day on-the-job experience, and 8-hour annual refresher training. Employees designated "SSC" have completed a 12-hour site safety coordinator course, and have documented requisite field experience. An SSC with a level designation (D, C, B) equal to or greater than the level of protection being used must be present during all tasks performed in exclusion or decontamination zones. Employees designated "FA-CPR" are currently certified by the American Red Cross, or equivalent, in first aid and CPR. At least one FA-CPR designated employee must be present during all tasks performed in exclusion or decontamination zones. The employees listed below are currently active in a medical surveillance program that meets state and federal regulatory requirements for hazardous waste operations. Certain tasks (e.g., confined-space entry) and contaminants (e.g., lead) may require additional training and medical monitoring.

Pregnant employees are to be informed of and are to follow the procedures in CH2M HILL's SOP HS-04, *Reproduction Protection*, including obtaining a physician's statement of the employee's ability to perform hazardous activities before being assigned fieldwork.

Employee Name	Office	Responsibility	SSC/FA-CPR
Daniel Holloway	VBO	Field Team Leader/SC-HW	Level C SC-HW; FA-CPR
Jamie Culbreth	VBO	Field Team Leader/SC-HW	Level C SC-HW; FA-CPR
Kim Henderson	VBO	Field Team Member/SC-HW	Level C SC-HW; FA-CPR

3.2 Field Team Chain of Command and Communication Procedures

3.2.1 Client

Contact Name: Dawn Hayes
LANTNAVFACENGCOM
Phone: 757/322-4792

Facility Contact Name: Mr. Leroy Eaves
Civil Engineering
Phone: 757-485-6574

3.2.2 CH2M HILL

Activity Manager: William Friedman/VBO
Project Manager: Kim Henderson/VBO
Health and Safety Manager: Steve Beck/MKE
Field Team Leader : Daniel Holloway/VBO, Jamie Culbreth/VBO
Site Safety Coordinator: Daniel Holloway/VBO, Jamie Culbreth/VBO

The SSC is responsible for contacting the Field Team Leader and Project Manager. In general, the Project Manager will contact the client. The Health and Safety Manager should be contacted as appropriate.

3.2.3 CH2M HILL Subcontractors

(Reference CH2M HILL SOP HS-55, *Subcontractor, Contractor, and Owner*)

Ordnance Identification Subcontractor: To be determined Subcontractor Contact Name: Telephone:	**Utilities Location** Subcontractor: To be determined Subcontractor Contact Name: Telephone:
Drilling Subcontractor: To be determined Subcontractor Contact Name: Telephone:	**Surveying** Subcontractor: To be determined Subcontractor Contact Name: Telephone:

The subcontractors listed above are covered by this HSP and must be provided a copy of this plan. However, this plan does not address hazards associated with the tasks and equipment that the subcontractor has expertise in (e.g., drilling, excavation work, electrical). Subcontractors are responsible for the health and safety procedures specific to their work, and are required to submit these procedures to CH2M HILL for review before the start of field work. Subcontractors must comply with the established health and safety plan(s). The CH2M HILL SSC should verify that subcontractor employee training, medical clearance, and fit test records are current and must monitor and enforce compliance with the established plan(s). CH2M HILL's oversight does not relieve subcontractors of their responsibility for effective implementation and compliance with the established plan(s).

CH2M HILL should continuously endeavor to observe subcontractors' safety performance. 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. In addition to this level of observation, the SSC is responsible for confirming CH2M HILL subcontractor performance against both the subcontractor's safety plan and applicable self-assessment checklists. Self-assessment checklists contained in Attachment 6 are to be used by the SSC to review subcontractor performance.

Health and safety related communications with CH2M HILL subcontractors should be conducted as follows:

- Brief subcontractors on the provisions of this plan, and require them to sign the Employee Signoff Form included in Attachment 1.
- Request subcontractor(s) to brief the project team on the hazards and precautions related to their work.
- When apparent non-compliance/unsafe conditions or practices are observed, notify the subcontractor safety representative and require corrective action – the subcontractor is responsible for determining and implementing necessary controls and corrective actions.
- When repeat non-compliance/unsafe conditions are observed, notify the subcontractor safety representative and stop affected work until adequate corrective measures are implemented.
- When an apparent imminent danger exists, immediately remove all affected CH2M HILL employees and subcontractors, notify subcontractor safety representative, and stop affected work until adequate corrective measures are implemented. Notify the Project Manager and HSM as appropriate.
- Document all oral health and safety related communications in project field logbook, daily reports, or other records.

4 Personal Protective Equipment (PPE)

(Reference CH2M HILL SOP HS-07, *Personal Protective Equipment*, HS-08, *Respiratory Protection*)

PPE Specifications [a]

Task	Level	Body	Head	Respirator [b]
• General site entry • Surveying • Observation of material loading for offsite disposal	D	Work clothes; steel-toe, leather work boots; work glove.	Hardhat [c] Safety glasses Ear protection [d]	None required
• Surface water sampling • Sediment sampling • Surface soil sampling • Hand augering	Modified D	Work clothes or cotton coveralls **Boots:** Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Safety glasses Ear protection [d]	None required
• Groundwater sampling • Soil boring • Investigation-derived waste (drum) sampling and disposal	Modified D	**Coveralls:** Uncoated Tyvek® **Boots:** Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Splash shield [c] Safety glasses Ear protection [d]	None required.
• Tasks requiring upgrade	C	**Coveralls:** Polycoated Tyvek® **Boots:** Steel-toe, chemical-resistant boots OR steel-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; with GME-H cartridges or equivalent[e].
• Tasks requiring upgrade	B	**Coveralls:** Polycoated Tyvek® **Boots:** Steel-toe, chemical-resistant boots OR steel-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	Positive-pressure demand self-contained breathing apparatus (SCBA); MSA Ultralite, or equivalent.

Reasons for Upgrading or Downgrading Level of Protection

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 action levels (Section 5) exceeded.	• New information indicating that situation is less hazardous than originally thought. • Change in site conditions that decreases 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 to be determined by the SSC.

[d] Ear protection should be worn when conversations cannot be held at distances of 3 feet or less without shouting.

[e] Cartridge change-out schedule is at least every 8 hours (or one work day), except if relative humidity is > 85%, or if organic vapor measurements are > midpoint of Level C range (refer to Section 5)--then at least every 4 hours. If encountered conditions are different than those anticipated in this HSP, contact the HSM.

[f] Performing a task that requires an upgrade to a higher level of protection (e.g., Level D to Level C) is permitted only when the PPE requirements have been approved by the HSM, and an SSC qualified at that level is present.

5 Air Monitoring/Sampling

(Reference CH2M HILL SOP HS-06, *Air Monitoring)*

5.1 Air Monitoring Specifications

PID: OVM with 10.6eV lamp or equivalent	All intrusive activities	1 to - 5 ppm above b.g. → (Sustained for 1 minute)	Level D	Initially and periodically during task	Daily
		5 to 100ppm above b.g → (Sustained for 1 minute)	Level C		
		100 to 300ppm above b.g. → (Sustained for 1 minute)	Level B (Not Anticipated or authorized)		
Nose-Level Monitor[e]: Voice	All	Conversations can be held at distances of 3 feet without shouting →	No action required	Initially and periodically during task	N/A
		Conversations cannot be held at distances of 3 feet without shouting →	Hearing protection required Stop; re-evaluate		
Dust Monitor: Visual	Drilling, digging or if dusty conditions exist.	No visual dust →	Level D	Initially and periodically during tasks	N/A
		Visual Dust →	Level D – Use Dust Suppression techniques		

[a] Action levels apply to sustained breathing-zone measurements above background.

[b] The exact frequency of monitoring depends on field conditions and is to be determined by the SSC; generally, every 5 to 15 minutes if acceptable; more frequently may be appropriate. Monitoring results should be recorded. Documentation should include instrument and calibration information, time, measurement results, personnel monitored, and place/location where measurement is taken (e.g., "Breathing Zone/MW-3", "at surface/SB-2", etc.).

[c] If the measured percent of O_2 is less than 10, an accurate LEL reading will not be obtained. Percent LEL and percent O_2 action levels apply only to ambient working atmospheres, and not to confined-space entry. More-stringent percent LEL and O_2 action levels are required for confined-space entry (refer to Section 2).

[d] Refer to SOP HS-10 for instructions and documentation on radiation monitoring and screening.

[e] Noise monitoring and audiometric testing also required.

5.2 Calibration Specifications

(Refer to the respective manufacturer's instructions for proper instrument-maintenance procedures)

Instrument	Gas	Span	Reading	Method
PID: OVM, 10.6 or 11.8 eV bulb	100 ppm isobutylene	RF = 1.0	100 ppm	1.5 lpm reg T-tubing
PID: MiniRAE, 10.6 eV bulb	100 ppm isobutylene	CF = 100	100 ppm	1.5 lpm reg T-tubing
PID: TVA 1000	100 ppm isobutylene	CF = 1.0	100 ppm	1.5 lpm reg T-tubing

10 Approval

This site-specific Health and Safety Plan has been written for use by CH2M HILL only. CH2M HILL claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. The plan is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if those conditions change.

10.1 Original Plan

Written By: Dan Holloway **Date: 06/03/2003**

Approved By: SteveBeck/MKE **Date: 07/02/03**

Steven J. Beck

10.2 Revisions

Revisions Made By: **Date:**

Revisions to Plan:

Revisions Approved By: **Date:**

11 Attachments

Attachment 1: **Employee Signoff Form – Field Safety Instructions**
Attachment 2: **Project-Specific Chemical Product Hazard Communication Form**
Attachment 3: **Chemical-Specific Training Form**
Attachment 4: **Emergency Contacts**
Attachment 5: **Project H&S Forms/Permits**
Attachment 6: **Project Activity Self-Assessment Checklists**
Attachment 7: **Applicable Material Safety Data Sheets**
Attachment 8: **Metal Facts Sheet**

Employee Signoff Form

EMPLOYEE SIGNOFF FORM

Health and Safety Plan

- The CH2M HILL project employees and subcontractors listed below have been provided with a copy of this HSP, have read and understood it, and agree to abide by its provisions.

Project Name: St. Juliens Creek Annex/Sites 2 and 5 **Project Number:** 181812

EMPLOYEE NAME (Please print)	**EMPLOYEE SIGNATURE**	**COMPANY**	**DATE**

Project-Specific Chemical Product Hazard Communication Form

CH2MHILL

Project-Specific Chemical Product Hazard Communication Form

This form must be completed prior to performing activities that expose personnel to hazardous chemicals products. Upon completion of this form, the SSC shall verify that training is provided on the hazards associated with these chemicals and the control measures to be used to prevent exposure to CH2M HILL and subcontractor personnel. Labeling and MSDS systems will also be explained.

Project Name: St. Juliens Creek Annex/Sites 2 and 5 **Project Number:** 181812

MSDSs will be maintained at the following location(s): Field Vehcile

Hazardous Chemical Products Inventory

Chemical	Quantity	Location	MSDS Available	Container labels	
				Identity	Hazard
Isobutylene	1 liter, compressed	Support Zone			
Hydrochloric acid	< 500 ml	Support Zone / sample bottles			
Nitric acid	< 500 ml	Support Zone / sample bottles			
Sulfuric Acid	< 500 ml	Support Zone / sample bottles			
Sodium hydroxide	< 500 ml	Support Zone / sample bottles			
Methanol	< 1 Gallon	Support/Decon Zones			
Alconox/Liquinox	< 1liter	Support/Decon Zones			

Refer to SOP HS-05 *Hazard Communication* for more detailed information.

CHEMICAL-SPECIFIC TRAINING FORM

CH2MHILL

CHEMICAL-SPECIFIC TRAINING FORM

Location:	Project # : 181812
HCC:	Trainer:

TRAINING PARTICIPANTS:

NAME	SIGNATURE	NAME	SIGNATURE

REGULATED PRODUCTS/TASKS COVERED BY THIS TRAINING:

The HCC shall use the product MSDS to provide the following information concerning each of the products listed above.

☐ Physical and health hazards

☐ Control measures that can be used to provide protection (including appropriate work practices, emergency procedures, and personal protective equipment to be used)

☐ Methods and observations used to detect the presence or release of the regulated product in the workplace (including periodic monitoring, continuous monitoring devices, visual appearance or odor of regulated product when being released, etc.)

Training participants shall have the opportunity to ask questions concerning these products and, upon completion of this training, will understand the product hazards and appropriate control measures available for their protection.

Copies of MSDSs, chemical inventories, and CH2M HILL's written hazard communication program shall be made available for employee review in the facility/project hazard communication file.

Emergency Contacts Page

Emergency Contacts

24-hour CH2M HILL Emergency Beeper – 888/444-1226

Medical Emergency – 911 Facility Medical Response #: 757-396-3333 Local Ambulance #: 757-396-3333	**CH2M HILL Medical Consultant** Health Resources Dr. Jerry H. Berke, M.D.,M.P.H. 600 West Cummings Park, Suite 3400 Woburn, MA 01801 1-781-938-4653 or 1-800-350-4511 (After hours calls will be returned within 20 minutes)
Fire/Spill Emergency -- 911 Facility Fire Response #: 757-396-3335 Local Fire Dept #: 757-382-6297	**Corporate Director Health and Safety** Name: Mollie Netherland/SEA Phone: 206/453-5005 **24-hour emergency beeper: 888-444-1226**
Security & Police – 911 Facility Security #: 757-396-5111 Local Police #: 757-382-6161	**Regional Health, Safety & Environmental Manager** Name: John Longo/NJO Phone: 973-316-0159 ext. 4243
Utilities Emergency Water: 757-382-3550 Gas: 1-877-572-3342 Electric: 1-888-667-3000	**Health and Safety Manager (HSM)** Name: Steve Beck/MKE Phone: 414-272-2426 ext. 277
Designated Safety Coordinator (DSC) Name: Jamie Culbreth Phone: 757-460-3734 x39	**Regional Human Resources Department** Name: Cindy Bauder/WDC Phone: 703-471-6405 ext. 4243
Project Manager Name: Kim Henderson Phone: 757-460-3734 x40	**Corporate Human Resources Department** Name: Pete Hannon/DEN Phone: 303/771-0900
Federal Express Dangerous Goods Shipping Phone: 800/238-5355 **CH2M HILL Emergency Number for Shipping Dangerous Goods** Phone: 800/255-3924	**Worker's Compensation** Contact either the Regional Human Resources Dept. to have an Incident Report Form (IRF) completed. After hours contact Julie Zimmerman 303-664-3304 **Auto Claims** Rental: Carol Dietz/DEN 1-303-713-2757 CH2M Hill owned: Zurich Insurance Company 1-800-987-3373

Contact the Project Manager. Generally, the Project Manager will contact relevant government agencies.

Facility Alarms: Sound Field Vehicle Horn (3x) **Evacuation Assembly Area(s):** Field Vehicle

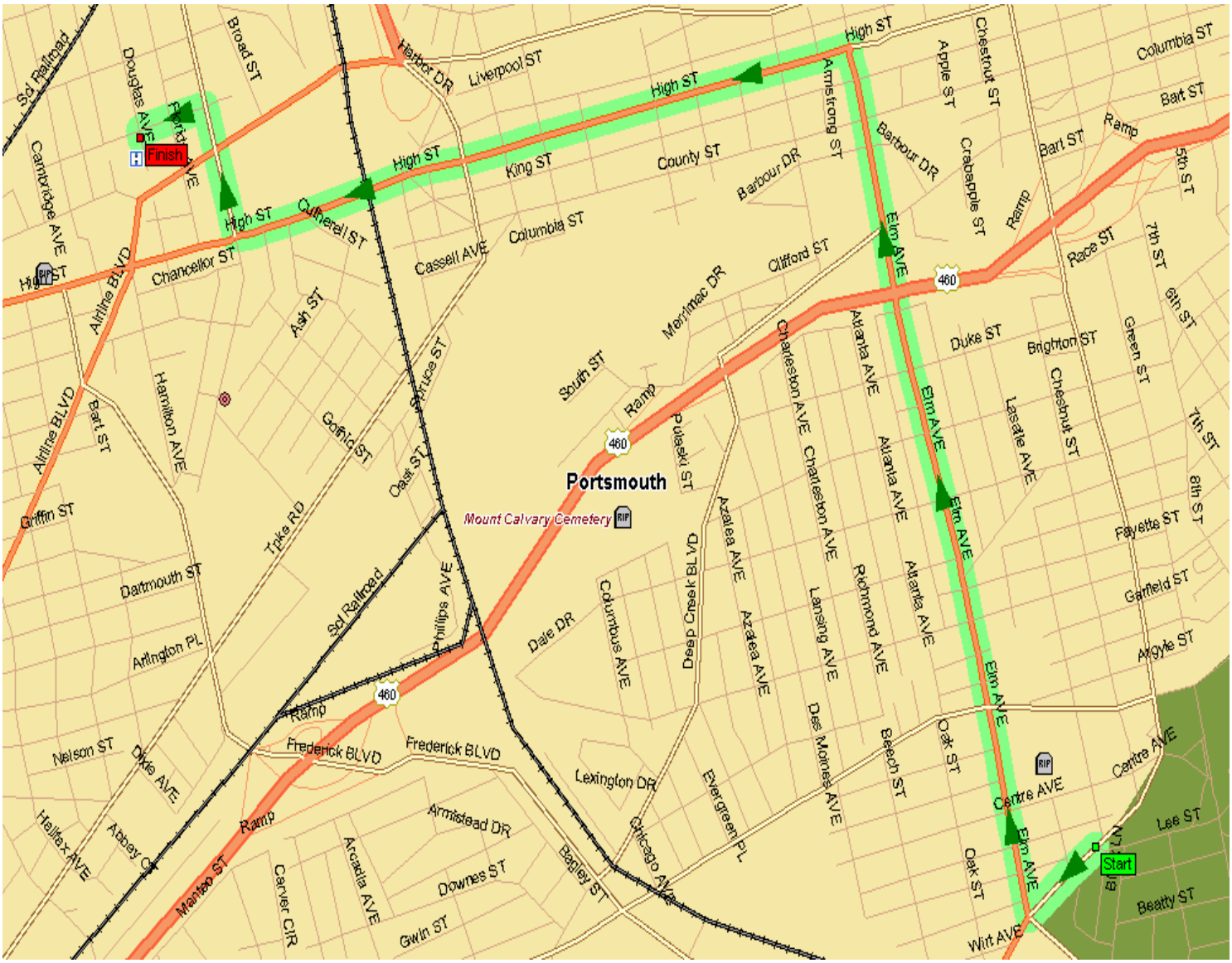
Facility/Site Evacuation Route(s): See Site Map

Hospital Name/Address:
Maryview Medical Center
3636 High Street
Portsmouth, VA 23707

Hospital Phone #: 757-398-2200

Directions to Hospital

Leave main gate of Annex and take left onto Victory Blvd.
At route 17 (George Washington Highway) take a right and go north.
Make left onto Fredrick Blvd, and continue on Fredrick until it dead ends.
Make left onto High Street, the Maryview Medical Center is on the right at the first light.



Project Forms and Permits

Project Activity Self-Assessment Checklists

CH2MHILL

H&S Self-Assessment Checklist - DRILLING

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's HSP/FSI.

This checklist is to be used at locations where: 1) CH2M HILL employees are potentially exposed to hazards associated with drilling operations (complete Sections 1 and 3), and/or 2) CH2M HILL oversight of a drilling subcontractor is required (complete entire checklist).

SSC/DSC may consult with drilling subcontractors when completing this checklist, but shall not direct the means and methods of drilling operations nor direct the details of corrective actions. Drilling subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Items considered to be imminently dangerous (possibility of serious injury or death) shall be corrected immediately or all exposed personnel shall be removed from the hazard until corrected.

Completed checklists shall be sent to the health and safety manager for review.

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposures to drilling hazards
☐ Evaluate a CH2M HILL subcontractor's compliance with drilling H&S requirements
Subcontractors Name: _____

- Check "Yes" if an assessment item is complete/correct.
- Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the drilling subcontractor. Section 3 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HS-35.

SECTION 1	Yes	No	N/A	N/O
PERSONNEL SAFE WORK PRACTICES (3.1)				
1. Only authorized personnel operating drill rig	☐	☐	☐	☐
2. Personnel cleared during rig startup	☐	☐	☐	☐
3. Personnel clear of rotating parts	☐	☐	☐	☐
4. Personnel not positioned under hoisted loads	☐	☐	☐	☐
5. Loose clothing and jewelry removed	☐	☐	☐	☐
6. Personnel instructed not to approach equipment that has become electrically energized	☐	☐	☐	☐
7. Smoking is prohibited around drilling operation	☐	☐	☐	☐
8. Personnel wearing appropriate PPE, per HSP/FSI	☐	☐	☐	☐

SECTION 2	Yes	No	N/A	N/O
GENERAL (3.2.1)				
9. Daily safety briefing/meeting conducted with crew	☐	☐	☐	☐
10. Daily inspection of drill rig and equipment conducted before use	☐	☐	☐	☐
DRILL RIG PLACEMENT (3.2.2)				
11. Location of underground utilities identified	☐	☐	☐	☐
12. Safe clearance distance maintained from overhead powerlines	☐	☐	☐	☐
13. Drilling pad established, when necessary	☐	☐	☐	☐
14. Drill rig leveled and stabilized	☐	☐	☐	☐
DRILL RIG TRAVEL (3.2.3)				
15. Rig shut down and mast lowered and secured prior to rig movement	☐	☐	☐	☐
16. Tools and equipment secured prior to rig movement	☐	☐	☐	☐
17. Only personnel seated in cab are riding on rig during movement	☐	☐	☐	☐
18. Safe clearance distance maintained while traveling under overhead powerlines	☐	☐	☐	☐
19. Backup alarm or spotter used when backing rig	☐	☐	☐	☐
DRILL RIG OPERATION (3.2.4)				
20. Kill switch clearly identified and operational	☐	☐	☐	☐
21. All machine guards are in place	☐	☐	☐	☐
22. Rig ropes not wrapped around body parts	☐	☐	☐	☐
23. Pressurized lines and hoses secured from whipping hazards	☐	☐	☐	☐
24. Drill operation stopped during inclement weather	☐	☐	☐	☐
25. Air monitoring conducted per HSP/FSI for hazardous atmospheres	☐	☐	☐	☐
26. Rig placed in neutral when operator not at controls	☐	☐	☐	☐
DRILL RIG MAINTENANCE (3.2.5)				
27. Defective components repaired immediately	☐	☐	☐	☐
28. Lockout/tagout procedures used prior to maintenance	☐	☐	☐	☐
29. Cathead in clean, sound condition	☐	☐	☐	☐
30. Drill rig ropes in clean, sound condition	☐	☐	☐	☐
31. Fall protection used for fall exposures of 6 feet or greater	☐	☐	☐	☐
32. Rig in neutral and augers stopped rotating before cleaning	☐	☐	☐	☐
33. Good housekeeping maintained on and around rig	☐	☐	☐	☐
DRILLING AT HAZARDOUS WASTE SITES (3.2.6)				
34. Waste disposed of according to HSP	☐	☐	☐	☐
35. Appropriate decontamination procedures being followed, per HSP	☐	☐	☐	☐

SECTION 3

Complete this section for all items checked “No” in Sections 1 or 2. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

Material Safety Data Sheets

Section 1 - Product and Company Identification
ISOBUTYLENE

Product Identification: ISOBUTYLENE
Date of MSDS: 09/14/1989 **Technical Review Date:** 09/13/1995
FSC: 6830 **NIIN: LIIN:** 00N042744
Submitter: N EN
Status Code: C
MFN: 01
Article: N
Kit Part: N

Manufacturer's Information

Manufacturer's Name: SCOTT SPECIALTY GASES
Manufacturer's Address1: ROUTE 611
Manufacturer's Address2: PLUMSTEADVILLE, PA 18949
Manufacturer's Country: US
General Information Telephone: 215-766-8861
Emergency Telephone: 215-766-8861
Emergency Telephone: 215-766-8861
MSDS Preparer's Name: N/P
Proprietary: N
Reviewed: N
Published: Y
CAGE: 51847
Special Project Code: N

Contractor Information

Contractor's Name: SCOTT SPECIALTY GASES
Post Office Box: 310
Contractor's Address1: 6141 EASTON RD
Contractor's Address2: PLUMSTEADVILLE, PA 18949-0310
Contractor's Telephone: 215-766-8861
Contractor's CAGE: 51847

Section 2 - Compositon /Information on Ingredients
ISOBUTYLENE

Ingredient Name: PROPENE, 2-METHYL-; (ISOBUTYLENE)
Ingredient CAS Number: 115-11-7 **Ingredient CAS Code:** M
RTECS Number: UD0890000 **RTECS Code:** M
=WT: =WT Code:
=Volume: =Volume Code:
>WT: >WT Code:
>Volume: >Volume Code:
<WT: <WT Code:
<Volume: <Volume Code:
% Low WT: % Low WT Code:
% High WT: % High WT Code:
% Low Volume: % Low Volume Code:
% High Volume: % High Volume Code:
% Text: 100
% Enviromental Weight:
Other REC Limits: N/K
OSHA PEL: N/K (FP N) **OSHA PEL Code:** M
OSHA STEL: OSHA STEL Code:
ACGIH TLV: N/K (FP N) **ACGIH TLV Code:** M
ACGIH STEL: N/P **ACGIH STEL Code:**
EPA Reporting Quantity:

DOT Reporting Quantity:
Ozone Depleting Chemical: N

Section 3 - Hazards Identification, Including Emergency Overview
ISOBUTYLENE

Health Hazards Acute & Chronic: ACUTE:ASPHYXIANT. SYMPTOMS INCLUDE RAPID RESPIRATION, MUSCULAR INCOORDINATION, FATIGUE, NAUSEA & VOMITING. LOSS OF CONSCIOUSNESS & DEATH MAY OCCUR. CONTACT W/LIQUID MAY RESULT IN SYMPTOMS OF FROSTBITE . CHRONIC:NONE.

Signs & Symptoms of Overexposure:
SEE HEALTH HAZARDS.

Medical Conditions Aggravated by Exposure:
NONE

LD50 LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.

Route of Entry Indicators:

Inhalation: YES

Skin: NO

Ingestion: NO

Carcenogenicity Indicators

NTP: NO

IARC: NO

OSHA: NO
Carcinogenicity Explanation: NOT RELEVANT

Section 4 - First Aid Measures
ISOBUTYLENE

First Aid:
INGEST:CALL MD IMMED (FP N). INHAL:IMMED REMOVE VICTIM TO FRESH AIR. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN. SKIN:IMMED FLUSH W/ COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAM CLTHG. IF FROSTBITE OCCURS, WARM AFFECTED AREA W/WATER OR TOWEL. EYE:IMMED FLUSH W/COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES.

Section 5 - Fire Fighting Measures
ISOBUTYLENE

Fire Fighting Procedures:
USE NIOSH/MSHA APPROVED SCBA & FULL PROTECTIVE EQUIPMENT (FP N). FLAMMABLE HIGH PRESSURE LIQUID OR GAS.
Unusual Fire or Explosion Hazard:
DANGEROUS. VAP MAY TRAVEL CONSIDERABLE DIST TO SOURCE OF IGNIT & FLASH BACK. MAY FORM EXPLO MIXTS W/AIR. CAN REACT VIGOROUSLY W/OXIDIZING MATLS.

Extinguishing Media:
DO NOT EXTING BURNING GAS IF FLOW CANNOT BE SHUT OFF. USE WATER SPRAY TO KEEP FIRE EXPOS CYLS COOL. MOVE CYL (SUPDAT)
Flash Point: Flash Point Text: -105F,-76C

Autoignition Temperature:

Autoignition Temperature Text: N/A

Lower Limit(s): 1.8%

Upper Limit(s): 9.6%

Section 6 - Accidental Release Measures
ISOBUTYLENE

Spill Release Procedures:
EVACUATE & VENTILATE AREA. REMOVE LEAKING CYLINDER TO EXHAUST HOOD OR SAFE OUTDOORS AREA IF THIS CAN BE DONE SAFELY.

Section 7 - Handling and Storage
ISOBUTYLENE

Handling and Storage Precautions:

Other Precautions:

Section 8 - Exposure Controls & Personal Protection
ISOBUTYLENE

Repiratory Protection:
USE NIOSH/MSHA APPROVED SCBA IN CASE OF EMERGENCY OR NON-ROUTINE USE.
Ventilation:
PROVIDE ADEQUATE & LOCAL EXHAUST VENTILATION TO MAINTAIN CONCENTRATION BELOW EXPOSURE LIMITS.
Protective Gloves:
IMPERVIOUS GLOVES (FP N).
Eye Protection: SAFETY GOGGLES.
Other Protective Equipment: SAFETY SHOES WHEN HANDLING CYLINDERS.
Work Hygenic Practices: NONE SPECIFIED BY MANUFACTURER.
Supplemental Health & Safety Information: EXTING MEDIA:AWAY FROM FIRE IF THERE IS NO RISK. OTHER PREC:HAS NOT BEEN FILLED BY THE OWNER OR W/HIS WRITTEN CONSENT IS A VIOLATION OF FEDERAL LAW (49 CFR).

Section 9 - Physical & Chemical Properties
ISOBUTYLENE

HCC: G2
NRC/State License Number:
Net Property Weight for Ammo:
Boiling Point: Boiling Point Text: 19.6F,-6.9C
Melting/Freezing Point: Melting/Freezing Text: N/K
Decomposition Point: Decomposition Text: N/K
Vapor Pressure: 2.65@21.1C **Vapor Density:** 1.947
Percent Volatile Organic Content:
Specific Gravity: 0.588 (H2O=1)
Volatile Organic Content Pounds per Gallon:
pH: N/K
Volatile Organic Content Grams per Liter:
Viscosity: N/P
Evaporation Weight and Reference: NOT APPLICABLE
Solubility in Water: SLIGHT
Appearance and Odor: COLORLESS, ETHEREAL ODOR.
Percent Volatiles by Volume: 100

Corrosion Rate: N/K

Section 10 - Stability & Reactivity Data
ISOBUTYLENE

Stability Indicator: YES
Materials to Avoid:
OXIDIZING MATERIALS.
Stability Condition to Avoid:
NONE SPECIFIED BY MANUFACTURER.
Hazardous Decomposition Products:
CARBON MONOXIDE, CARBON DIOXIDE.
Hazardous Polymerization Indicator: NO
Conditions to Avoid Polymerization:
NOT RELEVANT

Section 11 - Toxicological Information
ISOBUTYLENE

Toxicological Information:
N/P

Section 12 - Ecological Information
ISOBUTYLENE

Ecological Information:
N/P

Section 13 - Disposal Considerations
ISOBUTYLENE

Waste Disposal Methods:
DISP MUST BE I/A/W FED, STATE & LOC REGS (FP N). RETURN CYLS TO SUPPLIER FOR PROPER DISP W/ANY VALVE OUTLET PLUGS/CAPS SECURED & VALVE PROT CAP IN PLACE. DO NOT REUSE CYL. EMPTY CYL WILL CONTAIN HAZ R ESIDUE.

Section 14 - MSDS Transport Information
ISOBUTYLENE

Transport Information:
N/P

Section 15 - Regulatory Information
ISOBUTYLENE

SARA Title III Information:
N/P
Federal Regulatory Information:
N/P
State Regulatory Information:
N/P

Section 16 - Other Information
ISOBUTYLENE

Other Information:
N/P

HAZCOM Label Information

Product Identification: ISOBUTYLENE
CAGE: 51847
Assigned Individual: N
Company Name: SCOTT SPECIALTY GASES
Company PO Box: 310
Company Street Address1: 6141 EASTON RD
Company Street Address2: PLUMSTEADVILLE, PA 18949-0310 US
Health Emergency Telephone: 215-766-8861
Label Required Indicator: Y
Date Label Reviewed: 09/08/1993
Status Code: C
Manufacturer's Label Number:
Date of Label: 09/08/1993
Year Procured: N/K
Organization Code: G
Chronic Hazard Indicator: N
Eye Protection Indicator: YES
Skin Protection Indicator: YES
Respiratory Protection Indicator: YES
Signal Word: DANGER
Health Hazard: Moderate
Contact Hazard: Slight
Fire Hazard: Severe
Reactivity Hazard: None

8/9/2002

MSDS Name: **Nitric Acid**, Reagent ACS

Synonyms: Azotic Acid, Engravers Nitrate, Hydrogen Nitrate.
Company Identification: Acros Organics N.V.
One Reagent Lane
Fairlawn, NJ 07410
For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

2. Composition/Information on Ingredients

CAS#	Chemical Name	%	EINECS#
7697-37-2	Nitric acid	69-71%	231-714-2
7732-18-5	Water	Balance	231-791-2

Hazard Symbols: O C
Risk Phrases: 35 8

3. Hazards Identification

EMERGENCY OVERVIEW
Appearance: clear colorless to pale yellow.
Danger! Strong oxidizer. Contact with other material may cause a fire. Corrosive. Causes eye and skin burns. Causes digestive and respiratory tract burns. May be fatal if inhaled. Target Organs: None.
Potential Health Effects
Eye:
Causes severe eye burns. May cause irreversible eye injury.
Skin:
May cause severe skin irritation. Causes skin burns. May cause deep, penetrating ulcers of the skin.
Ingestion:
Causes gastrointestinal tract burns. May cause perforation of the digestive tract.
Inhalation:
May be fatal if inhaled. Effects may be delayed. May cause irritation of the respiratory tract with burning pain in the nose and throat, coughing, wheezing, shortness of breath and pulmonary edema.
Chronic:
Repeated inhalation may cause chronic bronchitis. Repeated exposure may cause erosion of teeth.

4. First Aid Measures

Eyes:
Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower lids. Get medical aid immediately. Do NOT allow victim to rub or keep eyes closed.

Skin:
Get medical aid immediately. Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid if irritation develops or persists. Wash clothing before reuse. Destroy contaminated shoes.

Ingestion:
If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately. Do NOT induce vomiting and seek IMMEDIATE MEDICAL ADVICE.

Inhalation:
Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid. DO NOT use mouth-to-mouth respiration.

Notes to Physician:
Treat symptomatically and supportively.

5. Fire Fighting Measures

General Information:
As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Strong oxidizer. Contact with combustible materials may cause a fire. Use water spray to keep fire-exposed containers cool. Substance is noncombustible. Containers may explode in the heat of a fire.

Extinguishing Media:
Substance is noncombustible; use agent most appropriate to extinguish surrounding fire. Do NOT get water inside containers. For large fires, use water spray, fog or alcohol-resistant foam. Do NOT use straight streams of water. For small fires, use dry chemical, carbon dioxide, sand, earth, water spray or regular foam. Cool containers with flooding quantities of water until well after fire is out.

Autoignition Temperature: Not available.
Flash Point: Not available.
NFPA Rating: Not published.
Explosion Limits, Lower: Not available.
Upper: Not available.

6. Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks:
Absorb spill with inert material, (e.g., dry sand or earth), then place into a chemical waste container. Wear a self contained breathing apparatus and appropriate Personal protection. (See Exposure Controls, Personal Protection section). Neutralize spill with sodium bicarbonate. Use water spray to disperse the gas/vapor. Remove all sources of ignition. Use a spark-proof tool.

7. Handling and Storage

Handling:
Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use with adequate ventilation. Ground and bond containers when transferring material. Keep container tightly closed. Do not get on skin or in eyes. Do not ingest or inhale.
Storage:
Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances. Corrosives area.

8. Exposure Controls/Personal Protection

Engineering Controls:
Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Nitric acid	2 ppm ; 5.2 mg/m3; 4 ppm STEL; 10 mg/m3 STEL	2 ppm TWA; 5 mg/m3 TWA 25 ppm IDLH	2 ppm TWA; 5 mg/m3 TWA

OSHA Vacated PELs:
Nitric acid: 2 ppm TWA; 5 mg/m3 TWA
Personal Protective Equipment
Eyes:
Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin:
Wear appropriate protective gloves and clothing to prevent skin exposure.

Clothing:
Wear appropriate protective clothing to prevent skin exposure.
Respirators:
Follow the OSHA respirator regulations found in 29CFR 1910.134 or European Standard EN 149. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.

9. Physical and Chemical Properties (Nitric Acid)

Appearance:	clear colorless to pale yellow liquid
Odor:	strong odor, acrid odor
Solubility:	Soluble in water
Density/Spec. Grav:	1.50
pH:	1.0
% Volatiles by volume @ 21C (70F):	Not available
Boiling Point:	72 deg C
Melting Point:	-42 deg C
Vapor Density (Air=1):	Not available
Vapor Pressure (mm Hg):	6.8 mm Hg
Evaporation Rate (Butyl Acetate=1):	Not available
Viscosity:	Not available

Molecular Formula: HNO_3
Molecular Weight: 63.0119

10. Stability and Reactivity

Chemical Stability: Decomposes when in contact with air, light, or organic matter.
Conditions to Avoid: High temperatures, incompatible materials, moisture, reducing agents.
Incompatibilities with Other Materials: Reacts with over 150 chemical combinations. Refer to NFPA Fire Protection Guide for specifics. Reacts explosively with organic materials and combustibles.
Hazardous Decomposition Products: Nitrogen oxides.
Hazardous Polymerization: Has not been reported.

11. Toxicological Information

RTECS#:
CAS# 7697-37-2: QU5775000 QU5900000
CAS# 7732-18-5: ZC0110000
LD50/LC50:
CAS# 7697-37-2: Inhalation, rat: LC50 =67 ppm(NO_2)/4H.
CAS# 7732-18-5: Oral, rat: LD50 = >90 mL/kg.
Carcinogenicity:
Nitric acid -
Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.

Epidemiology:
No information available.
Teratogenicity:
Effects on newborn: biochemical and metabolic, Oral-rat TDLo=2345 mg/kg (female 18D post). Fetotoxicity: Stunted fetus, Oral-rat TDLo=21150 mg/kg (female 1-21D post).
Reproductive Effects:
No information available.
Neurotoxicity:
No information available.
Mutagenicity:
No information available.
Other Studies:
None.

12. Ecological Information

Ecotoxicity:
Mosquito fish: TLm=72 ppm/96H (fresh water) Cockle: LC50=330-1000 ppm/48H (salt water)
Environmental Fate:
No information reported.
Physical/Chemical:
No information available.
Other:
None.

13. Disposal Considerations

Dispose of in a manner consistent with federal, state, and local regulations.
RCRA D-Series Maximum Concentration of Contaminants: None listed.
RCRA D-Series Chronic Toxicity Reference Levels: None listed.
RCRA F-Series: None listed.
RCRA P-Series: None listed.
RCRA U-Series: None listed.

16. Other Information

MSDS Creation Date: 2/01/1996 Revision #4 Date: 12/16/1997

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no way shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

MSDS Name: **Hydrochloric Acid**, Reagent ACS

Chlorohydric acid, hydrogen chloride, muriatic acid, spirits of salt.
Company Identification: Acros Organics N.V.
One Reagent Lane
Fairlawn, NJ 07410
For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

2. Composition/Information on Ingredients

CAS#	Chemical Name	%	EINECS#
7647-01-0	Hydrochloric acid, reagent ACS	37%	231-595-7
7732-18-5	Water	Balance	231-791-2

Hazard Symbols: C
Risk Phrases: 34 37

3. Hazards Identification

Emergency Overview

EMERGENCY OVERVIEW
Appearance: Clear, colorless to faintly yellow.
Danger! Corrosive. Sensitizer. Causes eye and skin burns. May cause severe respiratory and digestive tract irritation with possible
burns.
Target Organs: None.
Potential Health Effects

Eye:
May cause irreversible eye injury. Vapor or mist may cause irritation and severe burns. Contact with liquid is corrosive to the eyes and causes severe burns. May cause painful sensitization to light. May cause conjunctivitis.

Skin:

May be absorbed through the skin in harmful amounts. Contact with liquid is corrosive and causes severe burns and ulceration. May cause photosensitization in certain individuals.
Ingestion:
May cause circulatory system failure. Causes severe digestive tract burns with abdominal pain, vomiting, and possible death. May cause
corrosion and permanent tissue destruction of the esophagus and digestive tract.
Inhalation:
Causes severe irritation of upper respiratory tract with coughing, burns, breathing difficulty, and possible coma. May cause pulmonary edema and severe respiratory disturbances.
Chronic:
Prolonged or repeated skin contact may cause dermatitis. Repeated exposure may cause erosion of teeth. May cause conjunctivitis and photosensitization.

4. First Aid Measures

Eyes:
Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower lids. Get medical aid immediately. Do NOT allow victim to rub or keep eyes closed.

Skin:
Get medical aid. Rinse area with large amounts of water for at least 15 minutes. Remove contaminated clothing and shoes.

Ingestion:
Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Get medical aid immediately.

Inhalation:
Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.

Notes to Physician:
Treat symptomatically and supportively.

5. Fire Fighting Measures

General Information:
As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Not flammable, but reacts with most metals to form flammable hydrogen gas. Use water spray to keep fire-exposed containers cool.
Extinguishing Media:
Substance is nonflammable; use agent most appropriate to extinguish surrounding fire.
Autoignition Temperature: Not available.
Flash Point: Not available.
NFPA Rating: Not published.
Explosion Limits, Lower: Not available.
Upper: Not available.

6. Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks:
Large spills may be neutralized with dilute alkaline solutions of soda ash, or lime. Absorb spill using an absorbent, non-combustible
material such as earth, sand, or vermiculite.

7. Handling and Storage

Handling:
Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use with adequate ventilation. Do not get on skin
or in eyes. Do not ingest or inhale.

Storage:
Keep away from heat and flame. Do not store in direct sunlight. Store in a cool, dry, well-ventilated area away from incompatible substances.

8. Exposure Controls/Personal Protection

Engineering Controls:
Use adequate general or local exhaust ventilation to keep airborne
concentrations below the permissible exposure limits.

Exposure Limits

Chemical Name ACGIH NIOSH OSHA - Final PELs
Hydrochloric acid, reagent ACS C 5 ppm; C 7.5 mg/m3 50 ppm IDLH C 5 ppm; C 7 mg/m3
OSHA Vacated PELs:
Hydrochloric acid, reagent ACS:
No OSHA Vacated PELs are listed for this chemical.

Personal Protective Equipment

Eyes:
Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face
protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin:
Wear appropriate protective gloves to prevent skin exposure.

Clothing:
Wear appropriate protective clothing to prevent skin exposure.

Respirators:
Follow the OSHA respirator regulations found in 29CFR 1910.134 or European Standard EN 149. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.

9. Physical and Chemical Properties (Hydrochloric Acid)

Appearance:	Clear, colorless to faintly yellow liquid
Odor:	Strong, pungent
Solubility:	823g/L water at 32F
Density:	1.16-1.19
pH:	1.1 (0.1N sol)
% Volatiles by volume @ 21C (70F):	Not available
Boiling Point:	230 deg F
Melting Point:	-101 deg F
Vapor Density (Air=1):	1.257
Vapor Pressure:	160 mm Hg
Evaporation Rate (Butyl acetate =1):	2.0

Molecular Formula: HCl
Molecular Weight: 36.46

10. Stability and Reactivity

Chemical Stability:
Stable under normal temperatures and pressures.

Conditions to Avoid:
Incompatible materials, light.

Incompatibilities with Other Materials:
Acetate, acetic anhydride, alcohols + hydrogen cyanide, 2-aminoethanol, ammonium hydroxide, calcium carbide, calcium phosphide, cesium acetylene carbide, cesium carbide, chlorosulfonic acid, 1,1-difluoroethylene, ethylene diamine, ethyleneimine, fluorine, lithium silicide, magnesium boride, mercuric sulfate, oleum, perchloric acid, potassium permanganate, b-propiolactone, propylene oxide, rubidum acetylene carbide, rubidum carbide, silver perchlorate + carbon tetrachloride, sodium, sodium hydroxide, sulfuric acid, uranium phosphide, vinyl acetate. Substance polymerizes on contact with aldehydes or epoxides.
Hazardous Decomposition Products:
Hydrogen chloride, chlorine, carbon monoxide, carbon dioxide,
hydrogen gas.
Hazardous Polymerization: May occur.

11. Toxicological Information

RTECS#:
CAS# 7647-01-0: MW4025000
CAS# 7732-18-5: ZC0110000
LD50/LC50:
CAS# 7647-01-0: Inhalation, mouse: LC50 =1108 ppm/1H; Inhalation, rat: LC50 =3124 ppm/1H; Oral, rabbit: LD50 = 900 mg/kg.
CAS# 7732-18-5: Oral, rat: LD50 = >90 mL/kg.
Carcinogenicity:
Hydrochloric acid, reagent ACS -
IARC: Group 3 carcinogen
Epidemiology:
No information available.
Teratogenicity:
Embryo or Fetus: Stunted fetus, ihl-rat TCLo=450 mg/m3/1H Specific
Developmental Abnormalities: homeostasis, ihl-rat TCLo=450 mg/m3/1H.
Reproductive Effects:
No information available.
Neurotoxicity:
No information available.
Mutagenicity:
No information available.
Other Studies:
None.

12. Ecological Information

Ecotoxicity:
Trout LC100=10 mg/L/24H Shrimp LC50=100-330 ppm Starfish LC50=100-330mg/L/48H Shore crab LC50=240 mg/L/48H Chronic plant toxicity=100 ppm
Environmental Fate:
Substance will neutralize soil carbonate-based components.
Physical/Chemical:
No information available.
Other:
None.

13. Disposal Considerations

Dispose of in a manner consistent with federal, state, and local regulations.
RCRA D-Series Maximum Concentration of Contaminants: None listed.
RCRA D-Series Chronic Toxicity Reference Levels: None listed.
RCRA F-Series: None listed.
RCRA P-Series: None listed.
RCRA U-Series: None listed

16. Other Information

MSDS Creation Date: 11/09/1995 Revision #4 Date: 4/28/1998

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no way shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

MSDS Name: **Sulfuric acid**, reagent acs

Synonyms: Hydrogen Sulfate, Oil of Vitriol, Vitriol Brown Oil, Matting Acid, Battery Acid
Company Identification: Acros Organics N.V.
One Reagent Lane
Fairlawn, NJ 07410
For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

2. Composition/Information on Ingredients

CAS#	Chemical Name	%	EINECS#
7664-93-9	Sulfuric acid	95-98.0%	231-639-5
7732-18-5	Water	Balance	231-791-2

Hazard Symbols: XI C
Risk Phrases: 35 36/38

3. Hazards Identification

EMERGENCY OVERVIEW
Appearance: colorless to brown.
Danger! Harmful if inhaled. Corrosive. Hygroscopic. Causes digestive and respiratory tract burns. Causes digestive and respiratory tract irritation. Causes severe eye and skin irritation and burns. Target Organs: None known.

Potential Health Effects

Eye:
May cause irreversible eye injury. Causes eye irritation and burns.

Skin:
Causes severe skin irritation and burns.

Ingestion:
Causes gastrointestinal tract burns.

Inhalation:
Harmful if inhaled. May cause severe irritation of the respiratory tract with sore throat, coughing, shortness of breath and delayed lung edema. Causes chemical burns to the respiratory tract.

Chronic:
Prolonged or repeated skin contact may cause dermatitis. Prolonged or repeated inhalation may cause nosebleeds, nasal congestion, erosion of the teeth, perforation of the nasal septum, chest pain and bronchitis. Prolonged or repeated eye contact may cause conjunctivitis.

4. First Aid Measures

Eyes:
Get medical aid immediately. Do NOT allow victim to rub or keep eyes closed. Extensive irrigation is required (at least 30 minutes).

Skin:
Get medical aid immediately. Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. SPEEDY ACTION IS CRITICAL!

Ingestion:
Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.

Inhalation:
Get medical aid immediately. Remove from exposure to fresh air immediately. If breathing is difficult, give oxygen.

Notes to Physician:
Treat symptomatically and supportively.

5. Fire Fighting Measures

General Information:
Wear appropriate protective clothing to prevent contact with skin and eyes. Wear a self-contained breathing apparatus (SCBA) to prevent contact with thermal decomposition products. Contact with water can cause violent liberation of heat and splattering of the material.

Extinguishing Media:
Do NOT use water directly on fire. Use water spray to cool fire-exposed containers. Use carbon dioxide or dry chemical.

Autoignition Temperature: Not available.
Flash Point: 340 deg C (644.00 deg F)
NFPA Rating: Not published.
Explosion Limits, Lower: Not available.
Upper: Not available.

6. Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks:
Cover with sand, dry lime or soda ash and place in a closed container for disposal.

7. Handling and Storage

Handling:
Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use only in a well ventilated area. Do not get in eyes, on skin, or on clothing. Keep container tightly closed. Do not ingest or inhale. Do not allow contact with water. Discard contaminated shoes.
Storage:
Keep container closed when not in use. Store in a cool, dry, well-ventilated area away from incompatible substances. Corrosives area.

8. Exposure Controls/Personal Protection

Engineering Controls:
Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Sulfuric acid	1 mg/m3; 3 mg/m3 STEL	1 mg/m3 TWA; 15 mg/m3 IDLH	1 mg/m3 TWA

OSHA Vacated PELs:
Sulfuric acid:1 mg/m3 TWA
Personal Protective Equipment
Eyes:
Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin:
Wear appropriate protective gloves to prevent skin exposure.
Clothing:
Wear appropriate protective clothing to prevent skin exposure.

Respirators:
Follow the OSHA respirator regulations found in 29CFR 1910.134 or European Standard EN 149. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.

9. Physical and Chemical Properties ()

Appearance:	colorless to brown liquid
Odor:	Odorless
Solubility:	
Density:	1.8400 g/cm3
pH:	Not available
% Volatiles by volume @ 21C (70F):	
Boiling Point:	280 deg C @ 760.00mm Hg
Melting Point:	3 deg C
Vapor Density (Air=1):	1.2 kg/m3
Vapor Pressure (mm Hg):	< 0.00120 mm Hg
Evaporation Rate:	Slower than ether
Viscosity:	Not available

Molecular Formula: H2O4S
Molecular Weight: 98.08

10. Stability and Reactivity

Chemical Stability:
Stable under normal temperatures and pressures.
Conditions to Avoid:
Contact with water, metals, excess heat, combustible materials,
organic materials.
Incompatibilities with Other Materials:
Acids (mineral, oxidizing, e.g. chromic acid, hypochlorous acid, nitric acid, sulfuric acid), alcohols and glycols (e.g. butyl alcohol, ethanol, methanol, ethylene glycol), aldehydes (e.g. acetaldehyde, acrolein, chloral hydrate, formaldehyde), amines (aliphatic and aromatic, e.g. dimethyl amine, propylamine, pyridine, triethylamine), azo, diazo, and hydrazines (e.g. dimethyl hydrazine, hydrazine, methyl hydrazine), caustics (e.g. ammonia, ammonium hydrozide, calcium hydroxide, potassium hydroxide, sodium hydroxide), cyanides (e.g. potassium cyanide, sodium cyanide), dithiocarbamates (e.g. ferbam, maneb, metham, thiram), fluorides (inorganic, e.g. ammonium fluoride, calcium fluoride, cesium fluoride), isocyanates (e.g. methyl isocyanate), metals (alkali and alkaline, e.g. cesium, potassium, sodium), metals as powders (e.g. hafnium, raney nickel), metals and metal compounds (toxic, e.g. beryllium, lead acetate, nickel carbonyl, tetraethyl lead), nitrides (e.g. potassium nitride, sodium n.
Hazardous Decomposition Products:
Oxides of sulfur.
Hazardous Polymerization: Has not been reported.

11. Toxicological Information

RTECS#:
CAS# 7664-93-9: WS5600000
LD50/LC50:
CAS# 7664-93-9: Inhalation, mouse: LC50 =320 mg/m3/2H; Inhalation, rat: LC50 =510 mg/m3/2H; Oral, rat: LD50 = 2140 mg/kg.
Carcinogenicity:
Sulfuric acid -
ACGIH: A2 - Suspected Human Carcinogen
OSHA: Select carcinogen
IARC: Group 1 carcinogen
Epidemiology:
Workers exposed to industrial sulfuric acid mist showed a statistical increase in laryngeal cancer. This data suggests a possible relationship between carcinogenisis and inhalation of sulfuric acid mist.
Teratogenicity:
No data available.
Reproductive Effects:
No data available.
Neurotoxicity:
No data available.
Mutagenicity:
No data available.
Other Studies:
No data available.

12. Ecological Information

Ecotoxicity:
Sulfuric acid is harmful to aquatic life in very low concentrations. It may be dangerous if it enters water intakes. The aquatic toxicity for bluegill in fresh water was 24.5 ppm/24 hr, which was lethal.
Environmental Fate:
Not available.
Physical/Chemical:
Not available.
Other:
Not available.

13. Disposal Considerations

Dispose of in a manner consistent with federal, state, and local regulations.
RCRA D-Series Maximum Concentration of Contaminants: None listed.
RCRA D-Series Chronic Toxicity Reference Levels: None listed.
RCRA F-Series: None listed.
RCRA P-Series: None listed.
RCRA U-Series: None listed.

16. Other Information

MSDS Creation Date: 2/01/1996 Revision #3 Date: 10/01/1997

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no way shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

MSDS: Sodium Hydroxide

HAZARDOUS ACCORDING TO WORKSAFE CRITERIA
Supplied by: Chemical Co.
UN Number: 1823
Dangerous Goods Class: 8
Hazchem Code: 2X
Other Names: Caustic Soda
Soda Lye
White caustic
Properties: White deliquescent crystalline flakes or pearls

Health Hazard Information Acute Health Effects Swallowed:

Ingestion of the substance causes severe burns of the mouth and the oesophagus, nausea, vomiting and edema of the pharynx. In the worst cases perforation of the gastrointestinal tract and heart failure may occur.
Eyes: Contact of this substance with the eyes may cause severe lesions and possible loss of sight.
Skin: Skin contact with this substance causes severe burns and necrosis.
Inhaled: Inhalation of dusts may cause pulmonary congestion with subsequent compromission of respiratory functionality followed by loss of consciousness. Extremely irritative to respiratory tract (including mucous membranes, throat and lungs). Slightly toxic.

Chronic Health Effects

Prolonged and reiterated inhalations of the dusts may cause chronic disturbance of the respiratory routes. May cause dermatitis.

First Aid Swallowed:

Contact a Doctor or the Poisons Information Centre immediately. Give patient 1 - 3 cups of water. DO NOT induce vomiting. Immediately transport to a hospital or doctor.
Eyes: Flood eyes with clean water for 15 minutes - retract eyelids often. Immediately transport to a hospital or doctor **Skin:** Remove all contaminated clothing including footwear. Wash affected areas thoroughly with mild soap and water. Seek medical advice.
Inhaled: Remove from contaminated area immediately; avoid becoming a casualty. If NOT breathing apply artificial resuscitation. Experienced person may administer oxygen if breathing is difficult. Immediately transport to a hospital or doctor.

Safe Handling Information PPE:

Goggles, face screen, rubber or PVC gloves. Acid-proof overalls for operations in which there is a risk of splashes. Avoid contact with skin and eyes. Do not eat, drink or smoke in storage areas or during handling. Wash hands and face thoroughly after handling and before work breaks, eating, drinking, smoking and using toilet facilities.
Storage and Transport: Transport or store in a cool, dry place. Transport or store away from strong acids. The drums must be stored in suitable storage rooms equipped with impermeable floors, eye wash fountains and water inlets for rinsing the floor in case of spills.

Spills and Disposal:

Spills
Clean-up personnel should wear full protective clothing. Prevent product access to rivers and canals. Absorb with sand or soil, scoop up and place in suitable containers for later treatment/disposal.
Disposal
Use very dilute acid for neutralisation. Dispose of in accordance with Local, State and Federal regulations at an approved waste disposal facility. Neutralise aqueous solutions by diluting with very diluted hydrochloric acid. Drain effluent with plenty of water, keeping pH under control. Beware of heat and splashes caused by water reactions (dissolution heat) or neutralisation.

Fire/Explosion Hazard: Fire/Explosion

Generally all the reactions with acids and halogenated substances are strongly exothermic. It forms explosive products (Chloroacetylenic derivatives) by reacting with Trichloroethylene at warm temperatures. It can cause the decomposition of

maleic anhydride at explosive speed. It causes violent polymerisation of acrolein and acrilonitrile. It reacts exothermically with alcohol and chloroform mixtures. Incompatible with strong oxidising agents and strong acids, organic materials, aluminium, tin, zinc and nitro compounds. Absorbs CO_2 from air. Decomposition products: nature of decomposition products not known. Material itself is not flammable or explosive but reactions with metals can generate hydrogen gas, which is flammable in air (between 4% and 75% volume). May start fires in contact with fuels.

Extinguishing Media

Evacuate area - move upwind of fire. Summon Fire Brigade immediately, DIAL 000.

DO NOT USE WATER. Fire-fighters should wear full protective clothing including self-contained breathing apparatus.

Fire Fighting: Keep containers cool, Water spray/fog, Foam-alcohol type

MSDS: METHANOL

HAZARDOUS ACCORDING TO WORKSAFE CRITERIA

Supplied by Chemical Co. **Date:** 7/1/98 UN Number: 1230 Dangerous Goods Class: 3 3(6.1) Hazchem Code: 2WE Poisons Schedule S6
Other Names Methyl alcohol
Properties Liquid. Mixes with water.

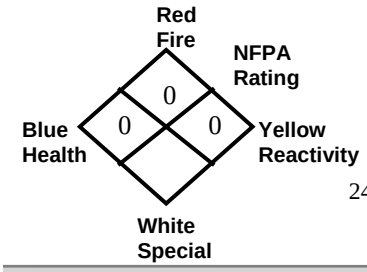
Health Hazard Information Acute Health Effects:
Irritating to eyes.
Vapours may cause dizziness or suffocation.
Ingestion may produce health damage.
Chronic Health Effects: Cumulative effects may result following exposure (limited evidence).

First Aid Swallowed: Contact a Doctor or Poisons Centre. If more than 15 mins from a Doctor, induce vomiting (if conscious). Eyes: Wash with running water (for 15 mins). Seek medical attention. Skin: Remove contaminated clothing. Wash with water and soap. Inhaled: Fresh air. Rest and keep warm. If breathing shallow, give oxygen. Seek medical attention.

Safe Handling Information PPE:
Gloves, rubber or plastic
Goggles or face-shield
Laboratory coat, plastic apron if large quantities are handled
Fume cupboard
Respirator as required when vapours/aerosols generated.
Storage and Transport:
Keep container in a well ventilated place.
Keep away from sources of ignition.
Avoid heating. No smoking.
Store in a cool, dry protected area.
Incompatible with acid halides, alkaline earth metals, oxidising agents.
Spills and Disposal:
Turn off all sources of flame.
Inform others to keep a safe distance.
Consider evacuation if it is a major spill.
Prevent from entering drains.
Contain spillage by any means.
Mop up with plenty of water.
Control vapour with water spray/fog.
Absorb with dry agent.
Fire/Explosion Hazard: Highly flammable. Vapour/air mixture explosive. Fire Fighting:
Keep containers cool.
Water spray/fog.Full protective apparatus and contain.

Warning Signs F = Flammable; T=Toxic

Alconox ®



MATERIAL SAFETY DATA SHEET

Alconox, Inc.
30 Glenn Street
White Plains, NY 10603

24 Hour Emergency Number – Chem-Tel (800) 255-3924

I. IDENTIFICATION

Product Name (as appears on label)	ALCONOX
CAS Registry Number:	Not Applicable
Effective Date:	January 1, 2001
Chemical Family:	Anionic Powdered Detergent
Manufacturer Catalog Numbers for sizes	1104, 1125, 1150, 1101, 1103 and 1112

II. HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

There are no hazardous ingredients in ALCONOX as defined by the OSHA Standard and Hazardous Substance List 29 CFR 1910 Subpart Z.

III. PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point (F):	Not Applicable
Vapor Pressure (mm Hg):	Not Applicable
Vapor Density (AIR=1):	Not Applicable
Specific Gravity (Water=1):	Not Applicable
Melting Point:	Not Applicable
Evaporation Rate (Butyl Acetate=1):	Not Applicable
Solubility in Water:	Appreciable-Soluble to 10% at ambient conditions
Appearance:	White powder interspersed with cream colored flakes.
pH:	9.5 (1%)

IV. FIRE AND EXPLOSION DATA

Flash Point (Method Used):	None
Flammable Limits:	LEL: No Data UEL: No Data
Extinguishing Media:	Water, dry chemical, CO_2, foam
Special Fire fighting Procedures:	Self-contained positive pressure breathing apparatus and protective clothing should be worn when fighting fires involving chemicals.
Unusual Fire and Explosion Hazards:	None

V. REACTIVITY DATA

Stability:	Stable
Hazardous Polymerization:	Will not occur
Incompatibility (Materials to Avoid):	None
Hazardous Decomposition or Byproducts:	May release CO_2 on burning

VI. HEALTH HAZARD DATA

Route(s) of Entry:	Inhalation? Yes Skin? No Ingestion? Yes
Health Hazards (Acute and Chronic):	Inhalation of powder may prove locally irritating to mucous membranes. Ingestion may cause discomfort and/or diarrhea. Eye contact may prove irritating.
Carcinogenicity:	NTP? No IARC Monographs? No OSHA Regulated? No
Signs and Symptoms of Exposure:	Exposure may irritate mucous membranes. May cause sneezing.
Medical Conditions Generally Aggravated by Exposure:	Not established. Unnecessary exposure to this product or any industrial chemical should be avoided. Respiratory conditions may be aggravated by powder.
Emergency and First Aid Procedures:	Eyes: Immediately flush eyes with water for at least 15 minutes. Call a physician. Skin: Flush with plenty of water. Ingestion: Drink large quantities of water or milk. Do not induce vomiting. If vomiting occurs administer fluids. See a physician for discomfort.

VII. PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken if Material is Released or Spilled:	Material foams profusely. Recover as much as possible and flush remainder to sewer. Material is biodegradable.
Waste Disposal Method:	Small quantities may be disposed of in sewer. Large quantities should be disposed of in accordance with local ordinances for detergent products.
Precautions to be Taken in Storing and Handling:	Material should be stored in a dry area to prevent caking.
Other Precautions:	No special requirements other than the good industrial hygiene and safety practices employed with any industrial chemical.

VIII. CONTROL MEASURES

Respiratory Protection (Specify Type):	Dust mask - Recommended
Ventilation:	Local Exhaust-Normal Special-Not Required Mechanical-Not Required Other-Not Required
Protective Gloves:	Impervious gloves are useful but not required.
Eye Protection:	Goggles are recommended when handling solutions.
Other Protective Clothing or Equipment:	None
Work/Hygienic Practices:	No special practices required

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Liqui-nox® Material Safety Data Sheet

Alconox, Inc.
30 Glenn Street, Suite 309
White Plains, NY 10603
24 Hour Emergency Number - Chem-Tel (800) 255-3924

I. Identification

Product Name (shown on label): LIQUI-NOX

CAS Registry Number: Not Applicable

Effective Date: January 1, 2001

Chemical Family: Anionic Liquid Detergent

Mfr. Catalog #s for Sizes: 1232, 1201, 1215, 1255

II. Hazardous Ingredients/Identity Information

There are no hazardous ingredients in LIQUI-NOX¨ as defined by the OSHA Standard and Hazardous Substance List 29 CFR 1910 Subpart Z.

National Fire Protection
Association 704 Labeling:

NJTSRN: 1200

III. Physical/Chemical Characteristics

Boiling Point (F): 214°F
Vapor Pressure (mm Hg): No Data
Vapor Density (AIR=1): No Data
Specific Gravity (Water=1): 1.075
Evaporation Rate (Butyl Acetate=1): Slower
Melting Point: No Data
Solubility in Water: Completely soluble in all proportions
Appearance: Yellow liquid, nearly odorless
pH: 8.5 (1%)

IV. Fire and Explosion Data

Flash Point (Method Used): None (Cleveland Open Cup)
Flammable Limits: LEL: No Data
UEL: No Data
Extinguishing Media: Water, dry chemical, CO2, foam
Special Fire fighting Procedures: Self-contained positive pressure breathing apparatus and protective clothing should be worn when fighting fires involving chemicals.
Unusual Fire and Explosion Hazards: None

V. Reactivity Data

Stability: Stable
Hazardous Polymerization: Will not occur.
Incompatibility (Materials to Avoid): Oxidizing agents.
Hazardous Decomposition or Byproducts: May release SO2 on burning.

VI. Health Hazard Data

Route(s) of Entry: Inhalation? No
Skin? Yes
Ingestion? Yes

Health Hazards (Acute and Chronic): Skin contact may prove locally irritating, causing drying and/or chapping. Ingestion may cause discomfort and/or diarrhea.
Carcinogenicity: NTP? No
IARC Monographs? No
OSHA Regulated? No
Signs and Symptoms of Exposure: Prolonged skin contact may cause drying and/or chapping.
Medical Conditions Generally Aggravated by Exposure: Not established. Unnecessary exposure to this product or any industrial chemical should be avoided.
Emergency and First Aid Procedures: Eyes: Immediately flush eyes with water for at least 15 minutes. Call a physician.
Skin: Flush with plenty of water.
Ingestion: Drink large quantities of water or milk. Do not induce vomiting. If vomiting occurs administer fluids. See a physician for discomfort.

VII. Precautions for Safe Handling and Use

Steps to be Taken if Material is Released or Spilled: Material foams profusely. For small spills recover as much as possible with absorbent material and flush remainder to sewer. Material is biodegradable.

Waste Disposal Method: Small quantities may be disposed of in sewer. Large quantities should be disposed of in accordance with local ordinances for detergent products.

Precautions to be Taken in Storing and Handling: No special precautions in storing. Use protective equipment when handling undiluted material.

Other Precautions: No special requirements other than the good industrial hygiene and safety practices employed with any industrial chemical.

VII. Control Measures

Respiratory Protection (Specify Type): None Required
Ventilation: Local Exhaust-Normal
Special-Not Required
Mechanical-Not Required
Other-Not Required
Protective Gloves: Impervious gloves are recommended.
Eye Protection: Goggles and/or splash shields are recommended.
Other Protective Clothing or Equipment: Not required
Work/Hygienic Practices: No special practices required.

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Metal Fact Sheets

Lead Fact Sheet

Uses and Occurrences

Lead can be found in the following: construction materials for tank linings and piping; component of lead-acid storage batteries; lead solder; plastics; steel; and pigments for paints. Lead can also be found in waste rock associated with mining activities, wood debris or stock used for electrical co-generation activities, and soil and waste associated with manufacturing activities. Elevated levels of naturally occurring lead may also be found in the soil in certain parts of this country.

Physical Characteristics

Appearance:	Bluish-white, slivery, gray metal. Very soft and easily malleable
Odor:	None
Flammable:	Noncombustible
Flash Point:	Not Applicable
Flammable Range:	Not Applicable
Specific gravity:	11.35
Stability:	very stable
Incompatibilities:	hot nitric acid, boiling concentrated hydrochloric and sulfuric acids
Melting Point:	327°C

Signs and Symptoms of Exposure

Skin and Eye: Irritation

Ingestion and Inhalation (Acute Overexposure): Lead is a potent, systemic poison that serves no known useful function once absorbed by your body. Taken in large enough doses, lead can kill you in a matter of days. A condition affecting the brain called acute encephalopathy may arise that develops quickly to seizures, coma, and death from cardio-respiratory arrest. A short term dose of lead can lead to acute encephalopathy. Short term occupational exposures of this magnitude are highly unusual, but not impossible. Similar forms of encephalopathy may, however, arise from extended, chronic exposure to lower doses of lead. There is no sharp dividing line between rapidly developing acute effects of lead, and chronic effects that take longer to acquire. Lead adversely affects numerous body systems, and causes forms of health impairment and disease that arise after periods of exposure as short as days or as long as several years.

Ingestion and Inhalation (Chronic Overexposure):Chronic overexposure to lead may result in severe damage to your blood-forming, nervous, urinary and reproductive systems. Some common symptoms of chronic overexposure include loss of appetite, metallic taste in the mouth, anxiety, constipation, nausea, pallor, excessive tiredness, weakness, insomnia, headache, nervous irritability, muscle and joint pain or soreness, fine tremors, numbness, dizziness, hyperactivity and colic. In lead colic, there may be severe abdominal pain.

Modes of Exposure

Inhalation: Dusts and fumes

Skin Absorption: None

Ingestion: Dusts and solids

Exposure Limits

Action level	0.03 mg/m^3
PEL	0.05 mg/m^3
STEL	None
PEL-C	None
TLV	0.05 mg/m^3

Exposure Level vs. Regulatory Requirements

EXPOSURE LEVEL (EL)	REGULATORY REQUIREMENTS
EL < AL	Maintain exposure as low as reasonably achievable
AL > EL, EL < PEL	Implement portions of the OSHA Lead Standard (i.e., initial medical monitoring) and Training
EL > PEL	Implement all portions of the OSHA Lead Standard including training, medical surveillance, engineering controls, establishment of work areas, etc.

PPE

Eye: Safety Glasses

Skin: Coveralls or disposable coveralls to keep lead off clothing and to prevent the spread of lead contamination.

Respiratory: Air purifying respirators and supplied air respirators, depending on the exposure.

First Aid

Inhalation: Move to fresh air, contact a physician

Skin: Wash with water

Eyes Flush with water

Ingestion: Contact a physician

2.2.1 Cadmium Fact Sheet

Uses and Occurrences

Coatings on metals; nickel-cadmium storage batteries; power transmission wire; pigments in ceramic glazes, enamels, and fungicides; corrosion-resistant coatings on marine, aircraft, and motor vehicles; manufacture of nuclear reactor rods; and welding electrodes and solder.

Physical Characteristics

Appearance:	Soft, blue-white, malleable, lustrous metal or grayish-white powder; some compounds may appear as a brown, yellow, or red powdery substance.
Odor:	None.
Flammable:	Noncombustible.
Flash Point:	Not Applicable.
Flammable Range:	Not Applicable.
Specific gravity:	8.64 (metal dust).
Stability:	Very stable.
Incompatibilities:	Nitric acid, boiling concentrated hydrochloric and sulfuric acids; contact of cadmium metal dust with strong oxidizers or with elemental sulfur, selenium, and tellurium may cause fires and explosion.
Melting Point:	321°C (metal dust).

Signs and Symptoms of Exposure

Short Term (Acute):	Dust and Fume: Irritation of nose and throat; inhalation may cause a delayed onset of cough, chest pain, sweating, chills, shortness of breath, and weakness. Death may occur. Dust: Ingestion may cause nausea, vomiting, diarrhea, and abdominal cramps.
Long Term (Chronic):	Dust and Fume: Repeated or prolonged exposure may cause loss of sense of smell, ulceration of the nose, shortness of breath (emphysema), kidney damage, and mild anemia. Exposure to cadmium has been reported to cause an increase incidence of cancer of the prostate in men.

Modes of Exposure

Inhalation:	Dusts and fumes.
Absorption:	None.
Ingestion:	Dusts and solids.

Exposure Limits

Action level	2.5 $\mu g/m^3$.
PEL	5.0 $\mu g/m^3$.
STEL	None.
PEL-C	None.
TLV	10.0 $\mu g/m^3$; 2.0 $\mu g/m^3$ (respirable fraction).

Exposure Level vs. Regulatory Requirements

EXPOSURE LEVEL (EL)	REGULATORY REQUIREMENTS
EL < AL	Maintain exposure as low as reasonable achievable
AL > EL, EL < PEL	Implement portions of the OSHA Cadmium standard and Training
EL > PEL	Implement all portions of the OSHA Cadmium Standard including training, medical surveillance, engineering controls, establishment of work areas, etc.

PPE

Eye:	Splash proof or dust resistant goggles; face shield.
Skin:	Protective coveralls, gloves, and footwear.
Respiratory:	Air purifying respirators and supplied air respirators, depending on the exposure.

First Aid

Inhalation:	Move to fresh air; seek medical attention immediately.
Skin:	Remove clothing and shoes; wash with soap or mild detergent and large amounts of water.
Eyes	Flush with water immediately, lifting the upper and lower eyelids; seek medical attention immediately.
Ingestion:	Under no circumstances should therapeutic chelation be administered; seek medical attention immediately.

Arsenic Exposure Instructions

This module was designed for employees who work in areas with percent levels of inorganic arsenic or areas where there is a potential arsenic exposure above the action level of 5µ g/m^3.

Arsenic Exposure Training Program

The OSHA arsenic standard (29 CFR 1910.1018), requires employers to provide arsenic training for those employees who may be exposed to inorganic arsenic above the action level of 5µ g/m3. This training program satisfies this OSHA requirement and is provided to assist employees in recognizing arsenic exposure hazards and understanding the procedures to be followed to minimize exposure.

Objectives

1. Inform employees of the possible adverse health effects of arsenic exposure
2. Inform employees of the regulatory requirements when working with or around arsenic
3. Identify how arsenic exposures could occur on CH2M HILL projects

How to complete this training

Employees are required to read the training materials that follow and complete a short quiz. The training materials must be read thoroughly and understood before completing the quiz; you will have only one chance at answering each question.

Quiz scores will automatically be sent electronically to the Health and Safety Training Administrator. A minimum score of 70% must be obtained to receive credit for this training. If a passing score is obtained, the H&S Training Administrator will issue you a certificate of completion. If a passing score is not obtained, you are required to contact your regional health and safety program manager to discuss the training material directly.

Arsenic Exposure Training

1. Use And Occurrences

Arsenic is a naturally occurring element found in the earth's crust. In industry, it is usually associated with the smelting of lead and copper. It was also used in various types of pesticides, but most arsenic-containing pesticides are now banned in the U.S. It continues to have limited use in the semiconductor industry, as a wood preservative, a corrosion inhibitor and a hardener in lead and copper metal. It is a frequent contaminant at hazardous waste sites. It can also be found in well water where there is naturally high amounts of arsenic in the soil.

2. Physical Characteristics

Arsenic exists as a gray solid as elemental arsenic, a white solid, as arsenic trioxide, an orange-red solid as arsenic disulfide. Arsenic compounds are generally insoluble in water.

3. Toxicity And Hazards

Arsenic is a well-known poison that causes a variety of adverse health effects from both acute and chronic exposures. Exposure can be by inhalation of arsenic-containing dust or by ingestion of arsenic-contaminated water. It causes various skin lesions including skin cancer, damage to the nervous system and the brain, and lung cancer. It can also cause birth defects to the offspring of both men and women. The highly toxic gas arsine can be formed if arsenic comes in contact with an acid. Some common symptoms of chronic overexposure include weakness, loss of appetite, nausea, vomiting, diarrhea and a sense of heaviness in the stomach.

4. Regulations

Arsenic has been specifically regulated by OSHA since 1978 (29 CFR 1910.1018). The 8-hour permissible exposure limit (PEL) is 10 micrograms per cubic meter of air (10 µg/m3). OSHA has specified an action level of 5 µg/m3. There is no short term exposure limit (STEL), but 5000 µg/m3 is considered immediately dangerous to life or health (IDLH). Initial air monitoring must be done whenever there are indications of arsenic exposure above the action level. If the action level is not exceeded, air monitoring can cease. If the action level is exceeded, arsenic training must be provided. If the action level is exceeded for more than 30 days in a year, medical surveillance must be provided which includes a medical history and physical examination (chest x-ray, skin and nasal exam, and a sputum cytology test for detection of lung cancer). If the PEL is exceeded, engineering controls must be implemented to reduce exposure. If engineering controls are not feasible or ineffective, respirators must be provided and worn. Air-purifying respirators with high-efficiency (HEPA) filters can be worn when airborne levels are as high as 100µg/m3. If levels exceed that amount, supplied air respirators must be worn. In addition, if the PEL is exceeded, OSHA requires the establishment of regulated areas, showers and change rooms, separate clean lunchrooms and warning signs. Regulated areas are demarcated from the rest of the workplace to limit access to authorized personnel who have received arsenic training. To enter a regulated area you must also wear protective clothing (coveralls, gloves and eye protection).

5. How Exposures Can Occur At CH2M HILL Projects

Most exposures to elemental arsenic or arsenic trioxide would occur at hazardous waste sites where arsenic is found in soil or groundwater. Exposure to arsenic-containing dust could occur during drilling, heavy equipment movement or other soil-disturbing activities. Dust formation can be minimized by wetting soils. Exposure to arsenic in groundwater would be hazardous only if ingested. Exposure could also occur during project work at smelters, mines or at an industrial plant where arsenic is part of the manufacturing process.

6. Additional Information

If you have information or suspect you have been exposed to arsenic above the action level, contact a health and safety manager to determine if medical monitoring is needed or other regulatory requirements apply. 1% (10,000 ppm) or greater levels of arsenic in soils at a hazardous waste site would normally require air sampling and blood testing

Site-Specific Investigation-Derived Waste Plan Checklist

This checklist supplements the Master IDW Plan with site-specific information. Once completed for a specific project, it provides necessary IDW information for each investigation. It is to be taken into the field with the Master IDW Plan.

Site: _____

1. IDW Media: _____Soil cuttings
   _____Well development or purge water
   _____Decontamination residual soil and wastewater
   _____PPE or disposable equipment
   _____Other _____

2. Expected Regulatory Status: _____Hazardous
   _____Solid Waste
   _____Unknown
   _____Other _____

3. Site Location: _____

4. Nature of Contaminants Expected:

_____Petroleum contamination _____Herbicides
_____Polyaromatic hydrocarbon _____PCBs
_____Pesticides _____Metals
_____Other _____

5. Volume of IDW Expected: _____Drums
   _____Cubic Yards
   _____Tons
   _____Gallons

6. Compositing Strategy for Sample Collection:_____

7. IDW Storage

   _____As per Master IDW Plan _____Other_____

8. Waste Disposal

   _____As per Master IDW Plan _____Other_____

Site-Specific Quality Assurance Project Plan Checklist

This checklist supplements the Master QAPP with site-specific information. Once completed for a specific project, it provides necessary quality assurance information for each investigation. It is to be taken into the field with the Master QAPP.

Site: _____

1. List sampling tasks:

2. List data quality objectives:

3. Organization:

   LANTDIV IR Section Head _____

   LANTDIV Navy Technical Representative _____

   USEPA Remedial Project Manager _____

   VDEQ Federal Facilities Project Manager _____

   CH2M HILL Activity Manager _____

   CDM Federal Project Manager _____

   Quality Control Senior Review _____

   Technical Project Manager _____

   Field Team Leader _____

4. Table of samples with analyses to be performed and associated QC samples (attached):

5. Analytical Quantitation Limits:

   _____As per Table 8-2 of Master QAPP _____Other (attached)

6. QA/QC Acceptance Criteria (e.g., precision, accuracy)

   _____As per Table 4-1 of Master QAPP _____Other (attached)

7. Data reduction, validation, and reporting:

   _____As per Section 9 of Master QAPP _____Other (attached)

8. Internal QC Procedures (field and laboratory):

   _____As per Section 10 of Master QAPP _____Other (attached)

9. Corrective Action:

   _____As per Section 14 of Master QAPP _____Other (attached)

10. Other deviations from Master QAPP _____

Site-Specific Field Sampling Plan Checklist

This checklist supplements the Master Field Sampling Plan with site-specific information. Once completed for a specific project, it provides necessary field sampling information for each investigation. It is to be taken into the field with the Master FSP.

Site:_____

1. Tasks to be performed:

_____Geophysical surveys
_____Soil gas surveys
_____Surface water and sediment sampling
_____Surface soil sampling
_____Soil boring installation
_____Subsurface soil sampling
_____Monitoring well installation and development
_____Monitoring well abandonment
_____Groundwater sampling
_____In-situ groundwater sampling
_____Aquifer testing
_____Hydrogeologic measurements
_____Biota sampling
_____Trenching
_____Land surveying
_____Investigation derived waste sampling
_____Decontamination
_____Other_____

2. Field measurements to be taken:

_____temperature
_____pH
_____dissolved oxygen
_____turbidity
_____specific conductance
_____organic vapor monitoring
_____geophysical parameters (list):
_____electromagnetic induction
_____ground-penetrating radar
_____surveying
_____magnetometry
_____global positioning system
_____soil gas parameters (list):
_____combustible gases
_____water-level measurements
_____pumping rate
_____other_____

3. Sampling program (nomenclature, etc.):

_____As per Section 3.1 of Master FSP
_____Other _____

4. Map of boring and sampling locations (attach to checklist):

5. Table of field samples to be collected:

6. Applicable SOPs (attach to checklist) or references to specific pages in Master FSP:

7. Site-specific procedures or updates to protocols established in the Master FSP:

_____

Site-Specific Health and Safety Plan

This checklist must be used in conjunction with the Master HASP. This checklist is intended for use by CDM Federal and CH2M HILL employees only. All CDM Federal and CH2M HILL employees performing tasks under this checklist must read and sign both this checklist and the Master HASP and agree to abide by their provisions (see EMPLOYEE SIGNOFF attached to the checklist).

Site:_____

Location(s)_____(reference attached map)

This document shall be maintained on site with the Master Health and Safety Plan. It will include as attachments from the Work Plan a site map and the site characterization and objectives for this site.

The procedures described in the Master Health and Safety Plan will be followed unless otherwise specified in this Site-Specific Health and Safety Plan.

1. HAZWOPER-Regulated Tasks

_____Test pit and excavation
_____Soil boring installation
_____Geoprobe boring
_____Geophysical surveys
_____Hand augering
_____Subsurface soil sampling
_____Surface soil sampling
_____Soil gas surveys
_____Sediment sampling
_____Monitoring well/drive point installation
_____Monitoring well abandonment
_____Groundwater sampling
_____Aquifer testing
_____Hydrologic measurements
_____Surface water sampling
_____Biota sampling
_____Investigation-derived waste (drum) sampling and disposal
_____Observation of loading of material for offsite disposal
_____Oversight of remediation and construction
_____Other_____

2. Hazards of Concern: (Check as many as are applicable. Refer to Section 3 of Master H&S Plan for control measures):

_____Heat stress
_____Cold stress
_____Buried utilities, drums, tanks
_____Inadequate illumination
_____Drilling
_____Heavy equipment
_____Working near water
_____Flying debris
_____Gas cylinders
_____Noise
_____Slip, trip, or fall hazards
_____Back injury
_____Confined space entry
_____Trenches, excavations
_____Protruding objects
_____Vehicle traffic
_____Ladders, scaffolds
_____Fire
_____Working on water
_____Snakes or insects
_____Poison ivy, oak, sumac
_____Ticks
_____Radiological
_____Other_____

3. Contaminants of Concern (List if known. Reduce Table 3.8 of the Master HASP to site-specific contaminants, add additional chemicals if necessary, and attach to this checklist):

_____ _____ _____

_____ _____ _____

4. Personnel (List CH2M HILL field team members and telephone numbers):

Field team leader(s) _____ _____

Site safety coordinator(s) _____ _____

Field team members _____ _____

_____ _____

5. Contractors/Subcontractors

_____Procedures as per Master HASP

_____Other_____

Name: _____ _____ _____

Contact:_____ _____ _____

Telephone:_____ _____ _____

6. Level of personal protective equipment (PPE) required:_____
Refer to Table 5.1 of Master HASP, SOPs, and Respiratory Protection, Section 2 of the Site Safety Notebook.

7. Air monitoring instruments to be used:

_____PID _____FID

_____CGI _____Dust monitor

_____O_2

8. Decontamination procedures:

_____As per Section 7 of Master HASP

_____Other _____

9. List any other deviations or variations from the Master HASP:

10. Emergency Response (Check that all names and numbers are correct on page 47 of Master HASP and attach corrected page to this checklist)

11. Map to hospital (Highlight route to hospital from site and attach to this checklist)

12. Emergency Contacts (Check that all names and numbers are correct on page 49 of Master HASP and attach corrected page to this checklist)

13. Approval. This prepared site-specific checklist must be approved Chuck Myers/CDM Federal or other authorized representative

    Name_____Title_____Date_____

14. Employee Signoff. All CDM Federal and CH2M HILL employees working at the site must sign the attached Employee Signoff for the checklist as well as for the Master HASP.

_____Site

HASP Checklist Employee Signoff

The employees listed below have been given a copy of this health and safety plan checklist, have read and understood it, and agree to abide by its provisions.

EMPLOYEE NAME	EMPLOYEE SIGNATURE AND DATE

FIELD PERFORMANCE AUDIT CHECKLIST

Project Responsibilities

Project No.: _____ Date: _____

Project Location: _____ Signature: _____

Team Members: _____

Yes __ No __ 1) Was a SAP Prepared?
Comments _____
_____
_____

Yes __ No __ 2) Was a briefing held for project participants?
Comments _____
_____
_____

Yes __ No __ 3) Were additional instructions given to project participants?
Comments _____
_____
_____

Yes __ No __ 4) Is the current approved SAP being used?
Comments _____
_____
_____

Figure 11-1
FIELD PERFORMANCE AUDIT CHECKLIST
(Continued)

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 FSP?
Comments _____
_____
_____

Yes __ No __ 3) Are samples collected in the type of containers specified in the FSP?
Comments _____
_____
_____

Yes __ No __ 4) Are samples preserved as specified in the FSP?
Comments _____
_____
_____

Yes __ No __ 5) Are the number, frequency, and type of samples collected as specified in the FSP?
Comments _____
_____
_____

Yes __ No __ 6) Are quality assurance checks performed as specified in the FSP?
Comments _____
_____
_____

Yes __ No __ 7) Are photographs taken and documented as specified in the FSP?
Comments _____
_____
_____

Figure 11-1
FIELD PERFORMANCE AUDIT CHECKLIST
(Continued)

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 _____
_____
_____

Yes __ No __ 7) Is chain-of-custody documented and maintained?
Comments _____
_____
_____

Appendix B
Applicable Standard Operating Procedures

STANDARD OPERATING PROCEDURE

Field Measurement of pH, Specific Conductance, Turbidity, Dissolved Oxygen, ORP, and Temperature Using the Horiba® U-22 with Flow-through Cell

I. Purpose and Scope

The purpose of this procedure is to provide a general guideline for using the Horiba® U-22 for field measurements of pH, specific conductance, turbidity, dissolved oxygen, oxidation-reduction potential (ORP), and temperature of groundwater samples. The operator's manual should be consulted for detailed operating procedures.

II. Equipment and Materials

- Horiba® U-22 Water Quality Checker with flow-though cell
- Distilled water in squirt bottle
- Horiba® U-22 Auto-Calibration Standard Solution

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	-1999 to +1999 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 Horiba® Standard Solution. Calibration procedure:

1. Fill the calibration beaker to about 2/3 with the pH 4 standard solution.

2. Fit 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.

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, pH will read 4.0 +/- 3%, conductivity will read 4.49 +/- 3%, and turbidity will read 0 +/- 3%

C. Sample Measurement:

As water passes through the flow-through Cell, press MEAS to obtain reading; record in the field notebook.

IV. Key Checks and Preventive Maintenance

- Calibrate meter
- Clean probe with deionized water when done
- Refer to operations manual for recommended maintenance
- 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.

STANDARD OPERATING PROCEDURE

Volatiles Monitoring by OVM

I. Purpose and Scope

The purpose of this procedure is to provide guidelines for the calibration and use of an OVM Organic Vapor Monitor. This is a broad guideline for field use of an OVM; for specific instruction, refer to the operators manual.

II. Equipment and Materials

- Operations manual
- An OVM hand readout unit and side pack assembly
- 100 ppm isobutylene as calibration gas
- T-type feeder tube with 1.5 liter/min. regulator

III. Procedures and Guidelines

ONLY PROPERLY TRAINED PERSONNEL SHOULD USE THIS INSTRUMENT. FOR SPECIFIC INSTRUCTIONS, SEE OPERATIONS MANUAL.

OVM, Organic Vapor Monitor

1. Introduction

   The OVM Organic Vapor Monitor is designed to detect organic materials in air. It uses a photo-ionization detector (PID) as its detection principle. This detector allows the monitor to respond to a wide variety of organic compounds.

2. Operational Checks

   - See basic operating instructions in operations manual.

3. Calibration

   - See basic operating instructions in operations manual.

IV. Key Checks and Preventive Maintenance

- Check battery.
- Zero and calibrate.
- Verify sensor probe is working.
- Recharge unit after use.

A complete preventive maintenance program is beyond the scope of this document. For specific instructions, refer to the operations manual. Some key issues are discussed below:

- A complete spare instrument should be available whenever field operations require volatiles monitoring.
- Spare parts should be on hand so minor repairs may be made in the field.
- Batteries should be charged daily.
- Occasionally allow the batteries to totally discharge before recharging to prevent battery memory from occurring.

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, scoopula, coring device, trier, 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 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 analysis normally are not collected from thin-walled tube samples.

IV. Attachments

ASTM D 1586.

ASTM D 1587

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.

Designation: D 1586 – 84 (Reapproved 1992)$^{\epsilon 1}$

Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils[1]

This standard is issued under the fixed designation D 1586; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense. Consult the DOD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.

ε1NOTE—Editorial changes were made throughout October 1992.

1. Scope

1.1 This test method describes the procedure, generally known as the Standard Penetration Test (SPT), for driving a split-barrel sampler to obtain a representative soil sample and a measure of the resistance of the soil to penetration of the sampler.

1.2 *This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* For a specific precautionary statement, see 5.4.1.

1.3 The values stated in inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

D 2487 Test Method for Classification of Soils for Engineering Purposes[2]

D 2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)[2]

D 4220 Practices for Preserving and Transporting Soil Samples[2]

D 4633 Test Method for Stress Wave Energy Measurement for Dynamic Penetrometer Testing Systems[2]

3. Terminology

3.1 *Descriptions of Terms Specific to This Standard*

3.1.1 *anvil*—that portion of the drive-weight assembly which the hammer strikes and through which the hammer energy passes into the drill rods.

3.1.2 *cathead*—the rotating drum or windlass in the rope-cathead lift system around which the operator wraps a rope to lift and drop the hammer by successively tightening and loosening the rope turns around the drum.

3.1.3 *drill rods*—rods used to transmit downward force and torque to the drill bit while drilling a borehole.

3.1.4 *drive-weight assembly*—a device consisting of the hammer, hammer fall guide, the anvil, and any hammer drop system.

3.1.5 *hammer*—that portion of the drive-weight assembly consisting of the 140 ± 2 lb (63.5 ± 1 kg) impact weight which is successively lifted and dropped to provide the energy that accomplishes the sampling and penetration.

3.1.6 *hammer drop system*—that portion of the drive-weight assembly by which the operator accomplishes the lifting and dropping of the hammer to produce the blow.

3.1.7 *hammer fall guide*—that part of the drive-weight assembly used to guide the fall of the hammer.

3.1.8 *N-value*—the blowcount representation of the penetration resistance of the soil. The *N*-value, reported in blows per foot, equals the sum of the number of blows required to drive the sampler over the depth interval of 6 to 18 in. (150 to 450 mm) (see 7.3).

3.1.9 ΔN—the number of blows obtained from each of the 6-in. (150-mm) intervals of sampler penetration (see 7.3).

3.1.10 *number of rope turns*—the total contact angle between the rope and the cathead at the beginning of the operator's rope slackening to drop the hammer, divided by 360° (see Fig. 1).

3.1.11 *sampling rods*—rods that connect the drive-weight assembly to the sampler. Drill rods are often used for this purpose.

3.1.12 *SPT*—abbreviation for Standard Penetration Test, a term by which engineers commonly refer to this method.

4. Significance and Use

4.1 This test method provides a soil sample for identification purposes and for laboratory tests appropriate for soil obtained from a sampler that may produce large shear strain disturbance in the sample.

4.2 This test method is used extensively in a great variety of geotechnical exploration projects. Many local correlations and widely published correlations which relate SPT blowcount, or *N*-value, and the engineering behavior of earthworks and foundations are available.

5. Apparatus

5.1 *Drilling Equipment*—Any drilling equipment that provides at the time of sampling a suitably clean open hole before insertion of the sampler and ensures that the penetration test is performed on undisturbed soil shall be acceptable. The following pieces of equipment have proven to be

[1] This method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.02 on Sampling and Related Field Testing for Soil Investigations.

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[2] *Annual Book of ASTM Standards*, Vol 04.08.

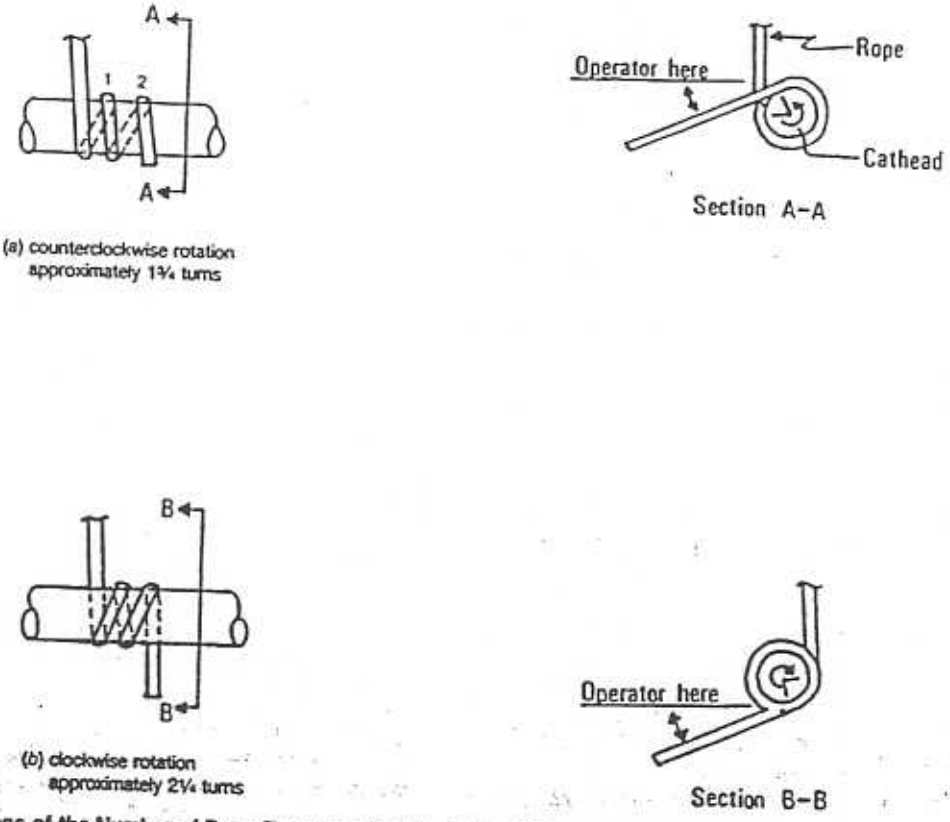


FIG. 1 Definitions of the Number of Rope Turns and the Angle for (a) Counterclockwise Rotation and (b) Clockwise Rotation of the Cathead

suitable for advancing a borehole in some subsurface conditions.

5.1.1 *Drag, Chopping, and Fishtail Bits*, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used in conjuction with open-hole rotary drilling or casing-advancement drilling methods. To avoid disturbance of the underlying soil, bottom discharge bits are not permitted; only side discharge bits are permitted.

5.1.2 *Roller-Cone Bits*, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used in conjunction with open-hole rotary drilling or casing-advancement drilling methods if the drilling fluid discharge is deflected.

5.1.3 *Hollow-Stem Continuous Flight Augers*, with or without a center bit assembly, may be used to drill the boring. The inside diameter of the hollow-stem augers shall be less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm).

5.1.4 *Solid, Continuous Flight, Bucket and Hand Augers*, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used if the soil on the side of the boring does not cave onto the sampler or sampling rods during sampling.

5.2 *Sampling Rods*—Flush-joint steel drill rods shall be used to connect the split-barrel sampler to the drive-weight assembly. The sampling rod shall have a stiffness (moment of inertia) equal to or greater than that of parallel wall "A" rod (a steel rod which has an outside diameter of 1⅝ in. (41.2 mm) and an inside diameter of 1⅛ in. (28.5 mm).

NOTE 1—Recent research and comparative testing indicates the type rod used, with stiffness ranging from "A" size rod to "N" size rod, will usually have a negligible effect on the *N*-values to depths of at least 100 ft (30 m).

5.3 *Split-Barrel Sampler*—The sampler shall be constructed with the dimensions indicated in Fig. 2. The driving shoe shall be of hardened steel and shall be replaced or repaired when it becomes dented or distorted. The use of liners to produce a constant inside diameter of 1⅜ in. (35 mm) is permitted, but shall be noted on the penetration record if used. The use of a sample retainer basket is permitted, and should also be noted on the penetration record if used.

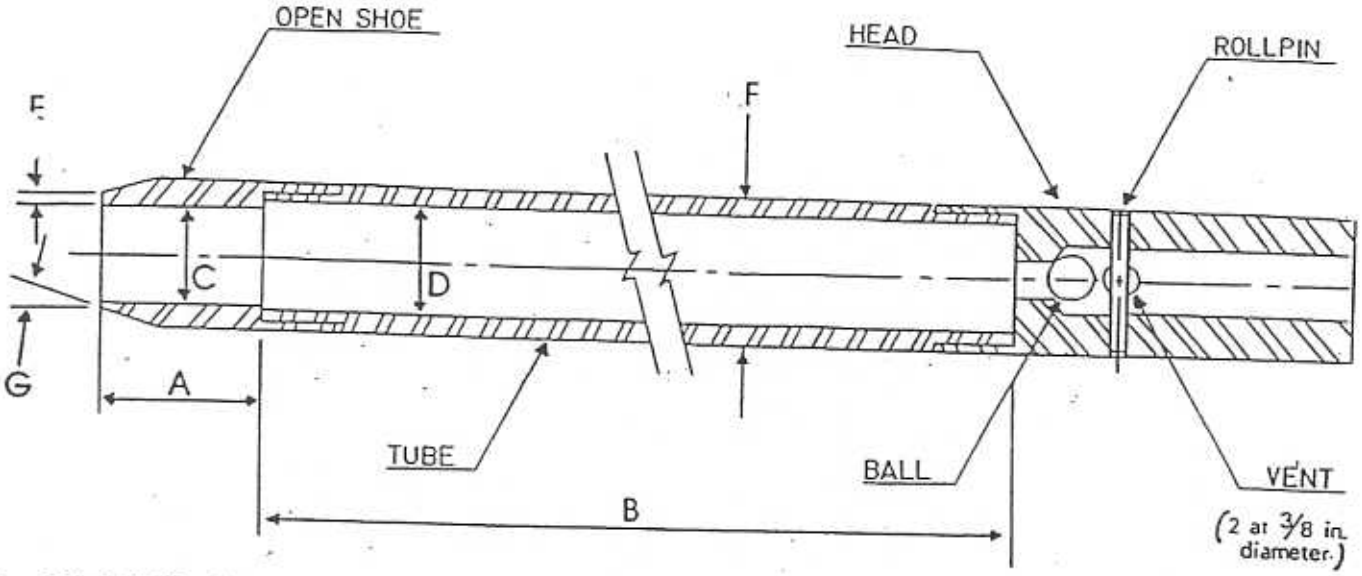
NOTE 2—Both theory and available test data suggest that *N*-values may increase between 10 to 30 % when liners are used.

5.4 *Drive-Weight Assembly:*

5.4.1 *Hammer and Anvil*—The hammer shall weigh 140 ± 2 lb (63.5 ± 1 kg) and shall be a solid rigid metallic mass. The hammer shall strike the anvil and make steel on steel contact when it is dropped. A hammer fall guide permitting a free fall shall be used. Hammers used with the cathead and rope method shall have an unimpeded overlift capacity of at least 4 in. (100 mm). For safety reasons, the use of a hammer assembly with an internal anvil is encouraged.

NOTE 3—It is suggested that the hammer fall guide be permanently marked to enable the operator or inspector to judge the hammer drop height.

5.4.2 *Hammer Drop System*—Rope-cathead, trip, semi-automatic, or automatic hammer drop systems may be used, providing the lifting apparatus will not cause penetration of



A = 1.0 to 2.0 in. (25 to 50 mm)
B = 18.0 to 30.0 in. (0.457 to 0.762 m)
C = 1.375 ± 0.005 in. (34.93 ± 0.13 mm)
D = 1.50 ± 0.05 − 0.00 in. (38.1 ± 1.3 − 0.0 mm)
E = 0.10 ± 0.02 in. (2.54 ± 0.25 mm)
F = 2.00 ± 0.05 − 0.00 in. (50.8 ± 1.3 − 0.0 mm)
G = 16.0° to 23.0°

The 1½ in. (38 mm) inside diameter split barrel may be used with a 16-gage wall thickness split liner. The penetrating end of the drive shoe may be slightly rounded. Metal or plastic retainers may be used to retain soil samples.

FIG. 2 Split-Barrel Sampler

the sampler while re-engaging and lifting the hammer.

5.5 *Accessory Equipment*—Accessories such as labels, ...le containers, data sheets, and groundwater level mea-...ing devices shall be provided in accordance with the requirements of the project and other ASTM standards.

6. Drilling Procedure

6.1 The boring shall be advanced incrementally to permit intermittent or continuous sampling. Test intervals and locations are normally stipulated by the project engineer or geologist. Typically, the intervals selected are 5 ft (1.5 mm) or less in homogeneous strata with test and sampling locations at every change of strata.

6.2 Any drilling procedure that provides a suitably clean and stable hole before insertion of the sampler and assures that the penetration test is performed on essentially undisturbed soil shall be acceptable. Each of the following procedures have proven to be acceptable for some subsurface conditions. The subsurface conditions anticipated should be considered when selecting the drilling method to be used.

6.2.1 Open-hole rotary drilling method.

6.2.2 Continuous flight hollow-stem auger method.

6.2.3 Wash boring method.

6.2.4 Continuous flight solid auger method.

6.3 Several drilling methods produce unacceptable borings. The process of jetting through an open tube sampler and then sampling when the desired depth is reached shall not be permitted. The continuous flight solid auger method shall not be used for advancing the boring below a water ... or below the upper confining bed of a confined ... cohesive stratum that is under artesian pressure. Casing may not be advanced below the sampling elevation prior to sampling. Advancing a boring with bottom discharge bits is not permissible. It is not permissible to advance the boring for subsequent insertion of the sampler solely by means of previous sampling with the SPT sampler.

6.4 The drilling fluid level within the boring or hollow-stem augers shall be maintained at or above the in situ groundwater level at all times during drilling, removal of drill rods, and sampling.

7. Sampling and Testing Procedure

7.1 After the boring has been advanced to the desired sampling elevation and excessive cuttings have been removed, prepare for the test with the following sequence of operations.

7.1.1 Attach the split-barrel sampler to the sampling rods and lower into the borehole. Do not allow the sampler to drop onto the soil to be sampled.

7.1.2 Position the hammer above and attach the anvil to the top of the sampling rods. This may be done before the sampling rods and sampler are lowered into the borehole.

7.1.3 Rest the dead weight of the sampler, rods, anvil, and drive weight on the bottom of the boring and apply a seating blow. If excessive cuttings are encountered at the bottom of the boring, remove the sampler and sampling rods from the boring and remove the cuttings.

7.1.4 Mark the drill rods in three successive 6-in. (0.15-m) increments so that the advance of the sampler under the impact of the hammer can be easily observed for each 6-in. (0.15-m) increment.

7.2 Drive the sampler with blows from the 140-lb (63.5-

kg) hammer and count the number of blows applied in each 6-in. (0.15-m) increment until one of the following occurs:

7.2.1 A total of 50 blows have been applied during any one of the three 6-in. (0.15-m) increments described in 7.1.4.

7.2.2 A total of 100 blows have been applied.

7.2.3 There is no observed advance of the sampler during the application of 10 successive blows of the hammer.

7.2.4 The sampler is advanced the complete 18 in. (0.45 m) without the limiting blow counts occurring as described in 7.2.1, 7.2.2, or 7.2.3.

7.3 Record the number of blows required to effect each 6 in. (0.15 m) of penetration or fraction thereof. The first 6 in. is considered to be a seating drive. The sum of the number of blows required for the second and third 6 in. of penetration is termed the "standard penetration resistance," or the "*N*-value." If the sampler is driven less than 18 in. (0.45 m), as permitted in 7.2.1, 7.2.2, or 7.2.3, the number of blows per each complete 6-in. (0.15-m) increment and per each partial increment shall be recorded on the boring log. For partial increments, the depth of penetration shall be reported to the nearest 1 in. (25 mm), in addition to the number of blows. If the sampler advances below the bottom of the boring under the static weight of the drill rods or the weight of the drill rods plus the static weight of the hammer, this information should be noted on the boring log.

7.4 The raising and dropping of the 140-lb (63.5-kg) hammer shall be accomplished using either of the following two methods:

7.4.1 By using a trip, automatic, or semi-automatic hammer drop system which lifts the 140-lb (63.5-kg) hammer and allows it to drop 30 ± 1.0 in. (0.76 m ± 25 mm) unimpeded.

7.4.2 By using a cathead to pull a rope attached to the hammer. When the cathead and rope method is used the system and operation shall conform to the following:

7.4.2.1 The cathead shall be essentially free of rust, oil, or grease and have a diameter in the range of 6 to 10 in. (150 to 250 mm).

7.4.2.2 The cathead should be operated at a minimum speed of rotation of 100 RPM, or the approximate speed of rotation shall be reported on the boring log.

7.4.2.3 No more than 2¼ rope turns on the cathead may be used during the performance of the penetration test, as shown in Fig. 1.

NOTE 4—The operator should generally use either 1¾ or 2¼ rope turns, depending upon whether or not the rope comes off the top (1¾ turns) or the bottom (2¼ turns) of the cathead. It is generally known and accepted that 2¾ or more rope turns considerably impedes the fall of the hammer and should not be used to perform the test. The cathead rope should be maintained in a relatively dry, clean, and unfrayed condition.

7.4.2.4 For each hammer blow, a 30-in. (0.76-m) lift and drop shall be employed by the operator. The operation of pulling and throwing the rope shall be performed rhythmically without holding the rope at the top of the stroke.

7.5 Bring the sampler to the surface and open. Record the percent recovery or the length of sample recovered. Describe the soil samples recovered as to composition, color, stratification, and condition, then place one or more representative portions of the sample into sealable moisture-proof containers (jars) without ramming or distorting any apparent stratification. Seal each container to prevent evaporation of soil moisture. Affix labels to the containers bearing : designation, boring number, sample depth, and the bl count per 6-in. (0.15-m) increment. Protect the samples against extreme temperature changes. If there is a soil change within the sampler, make a jar for each stratum and note its location in the sampler barrel.

8. Report

8.1 Drilling information shall be recorded in the field and shall include the following:

8.1.1 Name and location of job,

8.1.2 Names of crew,

8.1.3 Type and make of drilling machine,

8.1.4 Weather conditions,

8.1.5 Date and time of start and finish of boring,

8.1.6 Boring number and location (station and coordinates, if available and applicable),

8.1.7 Surface elevation, if available,

8.1.8 Method of advancing and cleaning the boring,

8.1.9 Method of keeping boring open,

8.1.10 Depth of water surface and drilling depth at the time of a noted loss of drilling fluid, and time and date when reading or notation was made,

8.1.11 Location of strata changes,

8.1.12 Size of casing, depth of cased portion of boring,

8.1.13 Equipment and method of driving sampler,

8.1.14 Type sampler and length and inside diameter of barrel (note use of liners),

8.1.15 Size, type, and section length of the sampling ro and

8.1.16 Remarks.

8.2 Data obtained for each sample shall be recorded in the field and shall include the following:

8.2.1 Sample depth and, if utilized, the sample number,

8.2.2 Description of soil,

8.2.3 Strata changes within sample,

8.2.4 Sampler penetration and recovery lengths, and

8.2.5 Number of blows per 6-in. (0.15-m) or partial increment.

9. Precision and Bias

9.1 *Precision*—A valid estimate of test precision has not been determined because it is too costly to conduct the necessary inter-laboratory (field) tests. Subcommittee D18.02 welcomes proposals to allow development of a valid precision statement.

9.2 *Bias*—Because there is no reference material for this test method, there can be no bias statement.

9.3 Variations in *N*-values of 100 % or more have been observed when using different standard penetration test apparatus and drillers for adjacent borings in the same soil formation. Current opinion, based on field experience, indicates that when using the same apparatus and driller, *N*-values in the same soil can be reproduced with a coefficient of variation of about 10 %.

9.4 The use of faulty equipment, such as an extreme massive or damaged anvil, a rusty cathead, a low sp cathead, an old, oily rope, or massive or poorly lubrica rope sheaves can significantly contribute to differences in *N*-values obtained between operator-drill rig systems.

9.5 The variability in N-values produced by different drill rigs and operators may be reduced by measuring that part of hammer energy delivered into the drill rods from the sampler and adjusting N on the basis of comparative energies. A method for energy measurement and N-value adjustment is given in Test Method D 4633.

10. Keywords

10.1 blow count; in-situ test; penetration resistance; split-barrel sampling; standard penetration test

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This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 1916 Race St., Philadelphia, PA 19103.

Standard Practice for Thin-Walled Tube Sampling of Soils[1]

This standard is issued under the fixed designation D 1587; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This practice has been approved for use by agencies of the Department of Defense and for listing in the DOD Index of Specifications and Standards.

1. Scope

1.1 This practice covers a procedure for using a thin-walled metal tube to recover relatively undisturbed soil samples suitable for laboratory tests of structural properties. Thin-walled tubes used in piston, plug, or rotary-type samplers, such as the Denison or Pitcher, must comply with the portions of this practice which describe the thin-walled tubes (5.3).

NOTE 1—This practice does not apply to liners used within the above samplers.

2. Referenced Documents

2.1 *ASTM Standards:*

D 2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)[2]

D 3550 Practice for Ring-Lined Barrel Sampling of Soils[2]

D 4220 Practices for Preserving and Transporting Soil mples[2]

3. Summary of Practice

3.1 A relatively undisturbed sample is obtained by pressing a thin-walled metal tube into the in-situ soil, removing the soil-filled tube, and sealing the ends to prevent the soil from being disturbed or losing moisture.

4. Significance and Use

4.1 This practice, or Practice D 3550, is used when it is necessary to obtain a relatively undisturbed specimen suitable for laboratory tests of structural properties or other tests that might be influenced by soil disturbance.

5. Apparatus

5.1 *Drilling Equipment*—Any drilling equipment may be used that provides a reasonably clean hole; that does not disturb the soil to be sampled; and that does not hinder the penetration of the thin-walled sampler. Open borehole diameter and the inside diameter of driven casing or hollow stem auger shall not exceed 3.5 times the outside diameter of the thin-walled tube.

5.2 *Sampler Insertion Equipment,* shall be adequate to provide a relatively rapid continuous penetration force. For hard formations it may be necessary, although not recommended, to drive the thin-walled tube sampler.

5.3 *Thin-Walled Tubes,* should be manufactured as shown in Fig. 1. They should have an outside diameter of 2 to 5 in. and be made of metal having adequate strength for use in the soil and formation intended. Tubes shall be clean and free of all surface irregularities including projecting weld seams.

5.3.1 *Length of Tubes*—See Table 1 and 6.4.

5.3.2 *Tolerances,* shall be within the limits shown in Table 2.

5.3.3 *Inside Clearance Ratio,* should be 1 % or as specified by the engineer or geologist for the soil and formation to be sampled. Generally, the inside clearance ratio used should increase with the increase in plasticity of the soil being sampled. See Fig. 1 for definition of inside clearance ratio.

5.3.4 *Corrosion Protection*—Corrosion, whether from galvanic or chemical reaction, can damage or destroy both the thin-walled tube and the sample. Severity of damage is a function of time as well as interaction between the sample and the tube. Thin-walled tubes should have some form of protective coating. Tubes which will contain samples for more than 72 h shall be coated. The type of coating to be used may vary depending upon the material to be sampled. Coatings may include a light coat of lubricating oil, lacquer, epoxy, Teflon, and others. Type of coating must be specified by the engineer or geologist if storage will exceed 72 h. Plating of the tubes or alternate base metals may be specified by the engineer or geologist.

5.4 *Sampler Head,* serves to couple the thin-walled tube to the insertion equipment and, together with the thin-walled tube, comprises the thin-walled tube sampler. The sampler head shall contain a suitable check valve and a venting area to the outside equal to or greater than the area through the check valve. Attachment of the head to the tube shall be concentric and coaxial to assure uniform application of force to the tube by the sampler insertion equipment.

6. Procedure

6.1 Clean out the borehole to sampling elevation using whatever method is preferred that will ensure the material to be sampled is not disturbed. If groundwater is encountered, maintain the liquid level in the borehole at or above ground water level during the sampling operation.

6.2 Bottom discharge bits are not permitted. Side discharge bits may be used, with caution. Jetting through an open-tube sampler to clean out the borehole to sampling elevation is not permitted. Remove loose material from the center of a casing or hollow stem auger as carefully as

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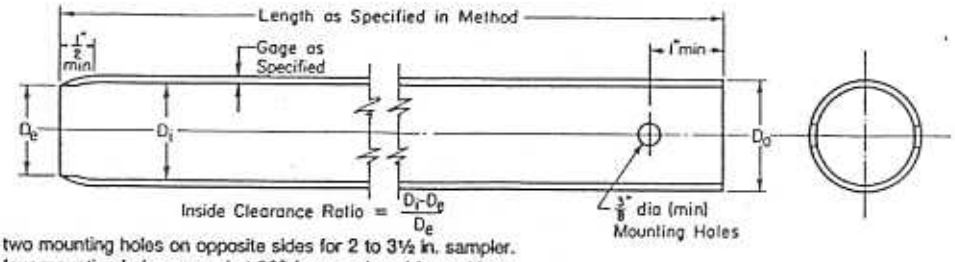
[2] *Annual Book of ASTM Standards,* Vol 04.08.



NOTE 1—Minimum of two mounting holes on opposite sides for 2 to 3½ in. sampler.
NOTE 2—Minimum of four mounting holes spaced at 90° for samplers 4 in. and larger.
NOTE 3—Tube hold with hardened screws.
NOTE 4—Two-inch outside-diameter tubes are specified with an 18-gage wall thickness to comply with area ratio criteria accepted for "undisturbed samples." Users are advised that such tubing is difficult to locate and can be extremely expensive in small quantities. Sixteen-gage tubes are generally readily available.

Metric Equivalents

in.	mm
¼	6.77
½	12.7
1	25.4
2	50.8
3½	88.9
4	101.6

FIG. 1 Thin-Walled Tube for Sampling

TABLE 1 Suitable Thin-Walled Steel Sample Tubes[A]

Outside diameter:			
in.	2	3	5
mm	50.8	76.2	127
Wall thickness:			
Bwg	18	16	11
in.	0.049	0.065	0.120
mm	1.24	1.65	3.05
Tube length:			
in.	36	36	54
m	0.91	0.91	1.45
Clearance ratio, %	1	1	1

[A] The three diameters recommended in Table 1 are indicated for purposes of standardization, and are not intended to indicate that sampling tubes of intermediate or larger diameters are not acceptable. Lengths of tubes shown are illustrative. Proper lengths to be determined as suited to field conditions.

TABLE 2 Dimensional Tolerances for Thin-Walled Tubes

Size Outside Diameter	Nominal Tube Diameters from Table 1[A] Tolerances, in.		
	2	3	5
Outside diameter	+0.007 −0.000	+0.010 −0.000	+0.015 −0.000
Inside diameter	+0.000 −0.007	+0.000 −0.010	+0.000 −0.015
Wall thickness	±0.007	±0.010	±0.015
Ovality	0.015	0.020	0.030
Straightness	0.030/ft	0.030/ft	0.030/ft

[A] Intermediate or larger diameters should be proportional. Tolerances shown are essentially standard commercial manufacturing tolerances for seamless steel mechanical tubing. Specify only two of the first three tolerances; that is, O.D. and I.D., or O.D. and Wall, or I.D. and Wall.

possible to avoid disturbance of the material to be sampled.

NOTE 2—Roller bits are available in downward-jetting and diffused-jet configurations. Downward-jetting configuration rock bits are not acceptable. Diffuse-jet configurations are generally acceptable.

6.3 Place the sample tube so that its bottom rests on the bottom of the hole. Advance the sampler without rotation by a continuous relatively rapid motion.

6.4 Determine the length of advance by the resistance and condition of the formation, but the length shall never exceed 5 to 10 diameters of the tube in sands and 10 to 15 diameters of the tube in clays.

NOTE 3—Weight of sample, laboratory handling capabilities, transportation problems, and commercial availability of tubes will generally limit maximum practical lengths to those shown in Table 1.

6.5 When the formation is too hard for push-type insertion, the tube may be driven or Practice D 3550 may be used. Other methods, as directed by the engineer or geologist, may be used. If driving methods are used, the data regard weight and fall of the hammer and penetration achie must be shown in the report. Additionally, that tube must be prominently labeled a "driven sample."

6.6 In no case shall a length of advance be greater than the sample-tube length minus an allowance for the sampler head and a minimum of 3 in. for sludge-end cuttings.

NOTE 4—The tube may be rotated to shear bottom of the sample after pressing is complete.

6.7 Withdraw the sampler from the formation as carefully as possible in order to minimize disturbance of the sample.

7. Preparation for Shipment

7.1 Upon removal of the tube, measure the length of sample in the tube. Remove the disturbed material in the upper end of the tube and measure the length again. Seal the upper end of the tube. Remove at least 1 in. of material from the lower end of the tube. Use this material for soil description in accordance with Practice D 2488. Measure the overall sample length. Seal the lower end of the tube. Alternatively, after measurement, the tube may be sealed without removal of soil from the ends of the tube if so directed by the engineer or geologist.

NOTE 5—Field extrusion and packaging of extruded samples under the specific direction of a geotechnical engineer or geologist is permitted.
NOTE 6—Tubes sealed over the ends as opposed to those sealed with expanding packers should contain end padding in end voids in order to prevent drainage or movement of the sample within the tube.

7.2 Prepare and immediately affix labels or apply m ings as necessary to identify the sample. Assure that the

ings or labels are adequate to survive transportation storage.

eport

1 The appropriate information is required as follows:

1.1 Name and location of the project,

1.2 Boring number and precise location on project,

1.3 Surface elevation or reference to a datum,

1.4 Date and time of boring—start and finish,

1.5 Depth to top of sample and number of sample,

1.6 Description of sampler: size, type of metal, type of ing,

1.7 Method of sampler insertion: push or drive,

8.1.8 Method of drilling, size of hole, casing, and drilling fluid used,

8.1.9 Depth to groundwater level: date and time measured,

8.1.10 Any possible current or tidal effect on water level,

8.1.11 Soil description in accordance with Practice D 2488,

8.1.12 Length of sampler advance, and

8.1.13 Recovery: length of sample obtained.

9. Precision and Bias

9.1 This practice does not produce numerical data; therefore, a precision and bias statement is not applicable.

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STANDARD OPERATING PROCEDURE

General Guidance for Monitoring Well Installation

I. Purpose

To provide site personnel with a review of the well installation procedures that will be performed. These procedures are to be considered general guidelines only and are in no way intended to supplement or replace the contractual specifications in the driller's subcontract.

II. Scope

Monitoring well installations are planned for shallow and/or deep unconsolidated aquifers and/or for bedrock aquifers. The SOPs *Installation of Shallow Monitoring Wells, Installation of Surface-Cased Monitoring Wells, Installation of Bedrock Monitoring Wells,* and *Installation of Monitoring Wells Using Sonic Drilling* provide more specifics.

III. Equipment and Materials

1. Drilling rig (hollow stem auger, sonic, air hammer, air rotary, or mud rotary)
2. Well-construction materials (i.e., surface casing, screens, riser, casing, caps, bottom plugs, centering guides, sand, bentonite, grout, and surface-finish materials)
3. Development equipment

IV. Procedures and Guidelines

1. Wells will be installed in accordance with standard EPA procedures. Note that USEPA Region III requires any well penetrating a confining layer to be double cased.
2. The threaded connections will be water-tight.
3. Well screens generally will be constructed of 10-slot or 20-slot Schedule 40 PVC and will be 5 to 10 feet in length depending on saturated thickness of unconsolidated sediments. The exact slot size and length will be determined by the field team supervisor. Stainless steel may be required under certain contaminant conditions.
4. Wells will be surrounded by four concrete-filled, 3-inch diameter guard posts.
5. A record of the finished well construction will be compiled.
6. All soils and liquids generated during well installations will be drummed for proper disposal.

Monitoring Well Installation

- Monitoring wells in unconsolidated materials will be installed in at least 6-inch-diameter boreholes to accommodate well completion materials in designated locations.
- All monitoring wells penetrating a confining layer will be surface-cased from the ground surface to approximately 5 feet into the confining layer. Exceptions to this may be allowed under certain circumstances (e.g., evidence of significant natural gaps in the confining layer).
- Monitoring wells in unconsolidated materials will be constructed of 2-inch-diameter, factory manufactured, flush-jointed, Schedule 40 PVC screen with threaded bottom plug and riser.
- Screens will be filter packed with a proper sized and graded, thoroughly washed, sound, durable, well-rounded basalt or siliceous sand. When using hollow-stem augers, the filter pack will be installed by slowly pouring the sand into the annular space while simultaneously raising the augers and using a weighted tape to sound for the sand surface. For rotary-drilled wells, the height of the sand pack also will be sounded with a weighted tape.
- The primary filter sand pack (typically Morie #1 or #2) will extend from 1 to 2 feet below the base to 2 feet above the top of the screen; filter pack will be allowed to settle and hydrate before final measurement is taken. For wells deeper than 30 feet, the filter pack will be placed using a tremie pipe and flowing water.
- A secondary filter sand pack (typically Morie #00) 1 foot thick will be placed above the primary sand pack.
- Annular well seals will consist of 2 feet of pelletized or granular bentonite clay placed above the filter pack. If necessary the pellets will be hydrated using potable water. For wells installed using hollow-stem augers, the bentonite will be poured into the annular space while slowly raising the augers and sounding for the top of the bentonite with a weighted tape. A high-solids bentonite slurry introduced with a side-discharging tremie pipe will be used for the bentonite seals in wells greater than 30 feet deep. For rotary-drilled wells, the height of the well seal also will be sounded with a weighted tape. High-solids slurries will have solids content of at least 20 percent.
- The top of the annular seal will be measured after the pellets have been allowed to hydrate and before the grout is applied. The pellets will be allowed to hydrate for at least 30 minutes before work in the well continues.
- The annular space above the bentonite seal will be filled to grade with a bentonite-cement slurry grout mixture.
- The grout mixture consists of 94 pounds (lbs) of cement (1 bag) per 6 gallons of water and 2 to 3 lbs of powdered bentonite per bag of cement to reduce shrinkage.
- The grout mix will be carefully applied to avoid disturbing the bentonite seal; the method of grout placement must force grout from the bottom of the space to be grouted to the surface.

- After allowing the grout to settle and set up overnight, additional grout will be added to maintain grade.
- A protective steel casing equipped with keyed alike locking caps will be grouted in place for each new well; the casing will extend at least 2 feet above grade and 3 feet below grade, and will be painted a bright color.

Well Development

- New monitoring wells will be developed after the well has been completely installed and the grout has hardened (at least 24 hours)
- The well will be developed by surging and pumping.
- Equipment placed in the well will be decontaminated before use.
- If information is available, begin developing in the least-contaminated well first.
- Development will include surging the well by abruptly stopping flow and allowing water in the well column to fall back into the well.
- Pipes and pumps must not be fitted with foot valves or other devices that might inhibit the return flow of water to the well.
- Surging should continue throughout the development process.
- The air-lift method may be used to pump materials out of the well. The air compressor will be fitted with filters to remove all oil and the air lift hose used will be made of inert materials.
- Well development will continue until the water produced is free of turbidity, sand, and silt.
- Development water will be considered hazardous and placed in sealed 55-gallon U.S. DOT approved steel drums. CH2M HILL will label and date the drums, and transport the drums to a designated site for storage.

V. Attachments

None.

VI. Key Check and Items

Ensure that all equipment is properly decontaminated as needed. Only new, sealed materials (e.g., screens, risers, and sand) will be used in constructing the well. Care shall be taken when making downhole measurements to ensure that proper heights of sand, seal, and grout are achieved.

STANDARD OPERATING PROCEDURE

Low-Flow Groundwater Sampling from Monitoring Wells

I. Purpose and Scope

This procedure presents general guidelines for the collection of groundwater samples from monitoring wells using low-flow purging and sampling procedures. Operations manuals should be consulted for specific calibration and operating procedures.

II. Equipment and Materials

- Flow-through cell with inlet/outlet ports for purged groundwater and watertight ports for each probe
- Meters to monitor pH, specific conductance, turbidity, dissolved oxygen, oxidation-reduction potential (ORP), and temperature (e.g., Horiba® U-22 or similar)
- Water-level indicator
- In-line disposable 0.45µ filters (QED® FF8100 or equivalent)
- Adjustable-rate, positive-displacement pump, submersible, or peristaltic pump
- Generator
- Disposable polyethylene tubing
- Plastic sheeting
- Well-construction information
- Calibrated bucket or other container and watch with second indicator to determine flow rate
- Sample containers
- Shipping supplies (labels, coolers, and ice)
- Field book

III. Procedures and Guidelines

A. Setup and Purging

1. For the well to be sampled, information is obtained on well location, diameter(s), depth, and screened interval(s), and the method for disposal of purged water.

2. Instruments are calibrated according to manufacturer's instructions.

3. The well number, site, date, and condition are recorded in the field logbook.

4. Plastic sheeting is placed on the ground, and the well is unlocked and opened. All decontaminated equipment to be used in sampling will be placed only on the plastic sheeting until after the sampling has been completed. To avoid cross-contamination, do not let any downhole equipment touch the ground.

5. All sampling equipment and any other equipment to be placed in the well is cleaned and decontaminated before sampling in accordance with SOP *Decontamination of Personnel and Equipment*.

6. Water level measurements are collected in accordance with SOP *Water Level Measurements*. **Do not measure the depth to the bottom of the well at this time**; this reduces the possibility that any accumulated sediment in the well will be disturbed. Obtain depth to bottom information from well installation log.

7. Attach and secure the polyethylene tubing to the low-flow pump. Lower the pump slowly into the well and set it at approximately the middle of the screen. Place the pump intake at least 2 feet above the bottom of the well to avoid mobilization of any sediment present in the bottom. Preferably, the pump should be in the middle of the screen.

8. Insert the measurement probes into the flow-through cell. The purged groundwater is directed through the cell, allowing measurements to be collected before the water contacts the atmosphere.

9. Start purging the well at 0.2 to 0.5 liters per minute. Avoid surging. Purging rates for more transmissive formations could be started at 0.5 to 1 liter per minute. The initial field parameters of pH, specific conductance, dissolved oxygen, ORP or Eh, turbidity, and temperature of water are measured and recorded in the field logbook.

10. The water level should be monitored during purging, and, ideally, the purge rate should equal the well recharge rate so that there is little or no drawdown in the well (i.e., less than 0.5 feet). The water level should stabilize for the specific purge rate. There should be at least 1 foot of water over the pump intake so there is no risk of the pump suction being broken, or entrainment of air in the sample. Record adjustments in the purge rate and changes in depth to water in the logbook. Purge rates should, if needed, be decreased to the minimum capabilities of the pump (0.1 to 0.2 liters per minute) to avoid affecting well drawdown.

11. During purging, the field parameters are measured frequently (every 3 to 5 minutes) until the parameters have stabilized. Field parameters are considered stabilized when measurements meet the following criteria:

    - pH: within 0.1 pH units
    - Specific conductance: within 3 percent
    - Dissolved oxygen: within 10 percent
    - Turbidity: within 10 percent or as low as practicable given sampling conditions
    - ORP: within 10 mV

B. Sample Collection

Once purging has been completed, the well is ready to be sampled. The elapsed time between completion of purging and collection of the groundwater sample from the well

should be minimized. Typically, the sample is collected immediately after the well has been purged, but this is also dependent on well recovery.

Samples will be placed in bottles that are appropriate to the respective analysis and that have been cleaned to laboratory standards. Each bottle typically will have been previously prepared with the appropriate preservative, if any.

The following information, at a minimum, will be recorded in the logbook:

1. Sample identification (site name, location, and project number; sample name/number and location; sample type and matrix; whether the sample is filtered or not; time and date; sampler's identity)

2. Sample source and source description

3. Field observations and measurements (appearance, volatile screening, field chemistry, sampling method), volume of water purged prior to sampling, number of well volumes purged, and field parameter measurements

4. Sample disposition (preservatives added; laboratory sent to, date and time sent; laboratory sample number, chain-of-custody number, sample bottle lot number)

The steps to be followed for sample collection are as follows:

1. The cap is removed from the sample bottle, and the bottle is tilted slightly.

2. The sample is slowly discharged from the pump so that it runs down the inside of the sample bottle with a minimum of splashing. The pumping rate should be reduced to approximately 100 ml per minute when sampling VOCs.

3. Samples may be field filtered before transfer to the sample bottle. Filtration must occur in the field immediately upon collection. Inorganics, including metals, are to be collected and preserved in the filtered form as well as the unfiltered form. The recommended method is through the use of a disposable in-line filtration module (0.45-micron filter) using the pressure provided by the pumping device for its operation.

4. Samples for analysis for volatile organic compounds should be collected first, if such samples are required.

5. Adequate space is left in the bottle to allow for expansion, except for VOC vials, which are filled to overflowing and capped.

6. The bottle is capped, then labeled clearly and carefully following the procedures in SOP *Packaging and Shipping Procedures*.

7. Samples are placed in appropriate containers and, if necessary, packed with ice in coolers as soon as practical.

C. Additional remarks

1. If the well goes dry during purging, wait until it recovers sufficiently to remove the required volumes to sample all parameters. It may be necessary to return periodically to the well but a particular sample (e.g., large amber bottles for semivolatile analysis) should be filled at one time rather than over the course of two or more visits to the well.

2. It may not be possible to prevent drawdown in the well if the water-bearing unit has sufficiently low permeability. If the water level was in the screen to start with, do not worry about it because there is no stagnant water in the riser above the screen to begin with.

   If the water level in the well is in the riser above the screen at the beginning of purging, then be sure you pump out sufficient volume from the well to remove the volume of water in the riser above the screen. For a 2-inch diameter well, each foot of riser contains 0.163 gallons; for a 4-inch riser, each foot of riser contains 0.653 gallons; for a 6-inch riser, each foot of riser contains 1.47 gallons.

   Alternatively, the water in the riser above the screen can be removed by lowering the pump into the well until the pump intake is just below the water level, starting the pump, running it at a low rate, and slowly lowering the pump as the water level in the riser declines. This approach can be terminated when the water level reaches the top of the screen, at which time the stagnant water in the riser has been removed. This may not be a practical approach for dedicated sampling equipment. As with typical low-flow sampling, the flow rate should be kept as low as practicable.

3. There may be circumstances where a positive-displacement or submersible pump cannot be used. An example is at isolated, hard-to-reach locations where the required power supply cannot be brought. In this case, a peristaltic pump may be used. Samples can be collected by the procedures described above for all but those for VOC analysis. The water to be placed in the vials for VOC analysis should not be run through the peristaltic pump but instead should be collected by the following:

   - Stop the pump when it is time to collect the VOC sample.
   - Disconnect the tubing upstream from the pump (a connector must be installed in the line to do this).
   - Pinching the tubing to keep the water in the tubing, remove the tubing from the well. Be sure that the tubing does not contact other than clean surfaces.
   - Place the end of the tubing that was in the well into each VOC vial and fill the vial by removing the finger from the other end of the tube.
   - Once the vials are filled, return the tubing to the well and collect any other samples required.

4. Nondedicated sampling equipment is removed from the well, cleaned, and decontaminated in accordance with SOP *Decontamination of Personnel and Equipment*. Disposable polyethylene tubing is disposed of with PPE and other site trash.

IV. Attachments

White paper on reasons and rationale for low-flow sampling.

V. Key Checks and Preventative Maintenance

- The drawdown in the well should be minimized as much as possible (preferably no more than 0.5 to 1 foot) so that natural groundwater-flow conditions are maintained as closely as possible.
- The highest purging rate should not exceed 1 liter per minute. This is to keep the drawdown minimized.
- Stirring up of sediment in the well should be avoided so that turbidity containing adsorbed chemicals is not suspended in the well and taken in by the pump.
- Overheating of the pump should be avoided to minimize the potential for losing VOCs through volatilization.
- Keep the working space clean with plastic sheeting and good housekeeping.
- Maintain field equipment in accordance with the manufacturer's recommendations. This will include, but is not limited to:
    - Inspect sampling pump regularly and replace as warranted
    - Inspect quick-connects regularly and replace as warranted
    - Verify battery charge, calibration, and proper working order of field measurement equipment prior to initial mobilization and daily during field efforts

Attachment to the SOP on Low-Flow Sampling Groundwater Sampling from Monitoring Wells

White Paper on Low-Flow Sampling

EPA recommends low-flow sampling as a means of collecting groundwater samples in a way that minimizes the disturbance to the natural groundwater flow system and minimizes the introduction of contamination into the samples from extraneous sources. The following are details about these issues.

When a pump removes groundwater from the well at the same rate that groundwater enters the well through the screen, the natural groundwater-flow system around the well experiences a minimum of disturbance. Some disturbance is bound to occur because you are causing groundwater to flow to the well in a radial fashion that otherwise would have flowed past it. However, the resulting low-flow sample provides the most-representative indication we can get of groundwater quality in the immediate vicinity of the well.

Normally, when a well is pumped at an excessive rate that drops the water level in the well below the water level in the aquifer, the water cascades down the inside of the well screen when it enters the well. The turbulence from this cascading causes gases such as oxygen and carbon dioxide to mix with the water in concentrations that are not representative of the native groundwater and are higher than expected. This causes geochemical changes in the nature of the water that can change the concentrations of some analytes, particularly metals, in the groundwater sample, not mention it's effect on the dissolved oxygen levels that then will be measured in the flow-through cell. Such turbulence also may cause lower-than-expected concentrations of volatile organic compounds due to volatilization.

For wells in which the water level is above the top of the screen, the water up in the riser is out of the natural circulation of the groundwater and, therefore, can become stagnant. This stagnant water is no longer representative of natural groundwater quality because its pH, dissolved-oxygen content, and other geochemical characteristics change as it contacts the air in the riser. If we minimize the drawdown in the well when we pump, then we minimize the amount of this stagnant water that is brought down into the well screen and potentially into the pump. As a result, a more-representative sample is obtained.

Typically, wells contain some sediment in the bottom of the well, either as a residue from development that has settled out of the water column or that has sifted through the sand pack and screen since the well was installed. This sediment commonly has adsorbed on it such analytes as metals, SVOCs, and dioxins that normally would not be dissolved in the groundwater. If these sediments are picked up in the groundwater when the well is disturbed by excessive pumping, they can:

- Make filtering the samples for metals analysis more difficult
- Add unreasonably to the measured concentration of SVOCs and other organic compounds

The SOP for low-flow sampling has been modified recently and should be consulted for additional information about low-flow sampling and ways of dealing with wells in which the water level cannot be maintained at a constant level.

STANDARD OPERATING PROCEDURE

Sampling from Sanitary Sewers

I. Purpose and Scope

This procedure presents guidelines for the collection of liquid samples from sanitary sewers.

II. Equipment and Materials

- pH meter; Orion Model SA250 or equivalent
- Temperature meter; YSI Model 33 or equivalent
- Peristaltic pump with disposable tubing sufficient to sample all locations
- Marine battery with recharger
- Hollow stainless steel tube, approx. ¼" inside diameter, to weight tubing for sample collection
- Water level indicator
- Pyrex flask to measure field parameters
- Decontamination supplies as described in the SOP Decontamination of Field Equipment and Waste Handling (except nitric acid, isopropanol, and hexane)
- Personal protective equipment including disposable latex gloves

III. Procedures and Guidelines

A. Setup

1. Prior to sampling, contact GSA and Army personnel to ensure security clearance is obtained and samplers will be able to access all locations.
2. For the manhole to be sampled, information is obtained on manhole location and depth to sewer.
3. Instruments are calibrated according to manufacturer's instructions.
4. The manhole number, date, and condition are recorded in the field logbook.
5. Water level measurements are collected, and the total depth of the sewer is measured. Measurements are taken from the top surface of the manhole ring.
6. Disposable tubing is attached to a decontaminated stainless steel tube to weight it down. The other end of the tubing is placed in the peristaltic pump.

7. The sampling intake is lowered to below the flow surface in the manhole. The sample intake should not come into contact with the bottom of the sewer line. Initial sample fluids are placed in a pyrex flask and the field parameters of pH and temperature are measured and recorded in the field logbook.

B. Sample Collection

Once field parameters have been recorded, the sewer location is ready to be sampled. The elapsed time between recording field parameters and collection of the sample from the manhole should be minimized. Typically, the sample is collected immediately after the field parameters have been recorded.

Samples will be placed in bottles that are appropriate to the respective analysis and that have been cleaned to laboratory standards. Each bottle typically will have been previously prepared with the appropriate preservative, if any.

The following information, at a minimum, will be recorded in the log book:

1. Sample identification (site name, location, and project number; sample name/number and location; sample type and matrix; time and date; sampler's identity)
2. Sample source and source description
3. Field observations and measurements (appearance, volatile screening, field chemistry, sampling method)
4. Sample disposition (preservatives added; laboratory sent to, date and time sent; laboratory sample number, chain-of-custody number, sample bottle lot number)
5. Additional remarks

The steps to be followed for sample collection are as follows:

1. The cap is removed from the sample bottle, and the bottle is tilted slightly.
2. The sample is slowly discharged from the pump so that it runs down the inside of the sample bottle with a minimum of splashing. The pumping rate should be reduced to approximately 100 ml per minute when sampling VOCs.
3. Adequate space is left in the bottle to allow for expansion, except for VOC vials, which are filled to overflowing and capped.
4. The bottle is capped, then labeled clearly and carefully.
5. Samples are placed in appropriate containers and, if necessary, packed with ice in coolers as soon as practical.
6. Non-disposable sampling equipment is cleaned and decontaminated in accordance with SOP Decontamination of Waste Equipment and Waste Handling

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

Maintain field equipment in accordance with the manufacturer's recommendations; this will include, but is not limited to:

- Inspect sampling pump regularly and replace as warranted
- Verify battery charge, calibration, and proper working order of field measurement equipment prior to initial mobilization and daily during field efforts

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.
2. Make a sketch of the sample area showing 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. Transfer sample into appropriate sample jars with a stainless steel spoon or utensil. The sampler's fingers should never touch the sediment since gloves may introduce organic interferences into the sample. Classify the soil type of the sample using the Unified Soil Classification System, noting particularly the percentage of silt and clay.

4. Samples for volatile organics should immediately be placed in jars. Rocks and other debris should be removed before placement in jars.

5. For channel sampling, be on the alert for submerged hazards (rocks, tree roots, drop-offs, loss silt and muck) which can make wading difficult.

6. Sample sediment for TOC and pH also, to give context to organic and inorganic data during the risk assessment.

7. Follow the site safety plan designed for the specific nature of the site's sampling activities and locations.

8. 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

Surface Water Sampling

I. Purpose and Scope

This procedure presents the techniques used in collecting surface water samples. Materials, equipment, and procedures may vary; refer to the Field Sampling Plan and operators manuals for specific details.

II. Materials and Equipment

Materials and equipment vary depending on type of sampling; the Field Sampling Plan should be consulted for project-specific details.

- Open tube sampler
- Dip sampler
- Weighted bottle sampler
- Hand pump
- Kemmerer or Van Dorn sampler
- Depth-integrating sampler
- Sample containers
- Meters for specific conductance, temperature, pH, and dissolved oxygen

III. Procedures and Guidelines

Before surface water samples are taken, all sampler assemblies and sample containers are cleaned and decontaminated as described in SOP Decontamination of Personnel and Equipment. Methods for surface water sample collection are described below.

A. Manual Sampling

Surface water samples are collected manually by submerging a clean glass, stainless steel, or Teflon container into the water body. Samples may be collected at depth with a covered bottle that can be removed with a tripline. The most common sampler types are beakers, sealable bottles and jars, pond samplers, and weighted bottle samplers. Pond samplers have a fixed or telescoping pole attached to the sample container. Weighted bottle samplers are lowered below water surface, where the attached bottle is opened, allowed to fill, and pulled out of the water. When retrieved, the bottle is tightly capped and removed from the sampler assembly. Specific types of weighted bottle samplers include dissolved oxygen, Kemmerer, or Van Dorn, and are acceptable in most instances.

A sample is taken with the following specific steps:

1. The location and desired depth for water sampling are selected.

2. The sample site is approached from downstream in a manner that avoids disturbance of bottom sediments as much as possible. The sample bottle is gently submerged

with the mouth pointed upstream and the bottle tilted slightly downstream. Bubbles and floating materials should be prevented from entering the bottle.

3. For weighted bottle samplers, the assembly is slowly lowered to the desired depth. The bottle stopper is unseated with a sharp tug and the bottle is allowed to fill until bubbles stop rising to the surface.

4. When the bottle is full, it is gently removed from the water. If sample transfer is required, it should be performed at this time.

5. Measure dissolved oxygen, specific conductance, temperature, and pH at the sampling location.

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 FSP.

III. EQUIPMENT AND MATERIALS

- Sample vials, clean latex or surgical gloves, pH meter
- Hydrochloric acid (HCl) for preservation
- pH meter or pH indicating paper
- 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. To check the amount of hydrochloric acid (HCl) that needs to be added at each location, fill a test vial (40 ml) with the water to be sampled, add one drop of hydrochloric acid (HCl), gently mix, and check the pH. Repeat this cycle (if necessary) until you reach a pH of 2, counting the number of drops of HCl required. DISCARD THE TEST VIAL and add an equal number of drops of HCl to each of the sample vials. proceed to sample.

4. Keep the caps off the sample vials for as short a time as possible.

5. Wear clean latex or surgical gloves.

6. 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.

7. Fill the sample vial with a minimum of turbulence, until the water forms a positive meniscus at the brim.

8. Replace the cap by gently stetting it on the water meniscus. Tighten firmly, but DO NOT OVERTIGHTEN.

9. 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.
- Check pH.
- Fill slowly, with as little turbulence as possible.
- Check for air bubbles.

VOC_AQ01.DOC

STANDARD OPERATING PROCEDURE

Preserving Non-VOC Aqueous Samples

I. Purpose

To provide general guidelines for preserving aqueous samples.

II. Scope

Standard aqueous sample preservation procedures for non-VOC samples are provided.

III. Equipment and Materials

- Disposable eye droppers
- Clean beakers for transfer of small portions of chemical preservative
- pH paper strips (range 0 to 14)
- Chemical preservatives, as appropriate
- Personal protection, as appropriate
- Clean out door or vented indoor area

IV. Procedures and Guidelines

1. Remove caps from sample containers to be chemically preserved in designated area. Add appropriate amount of chemical preservative to opened container. To determine the approximate amount of preservative required, preserve a sample of potable water and calculate the volume of preservative required.

2. After adding the appropriate preservatives to the sample containers, cap containers tightly. Invert sample container a few times to mix.

3. After preserving all the sample containers and mixing, open the container and check the pH of the sample by pouring out a small quantity of the sample to a clean receptacle and dipping a pH indicating strip into the sample. Add more preservative to the sample to adjust the pH, if necessary repeating steps 1 and 2. When three times the amount of preservative used to preserve a sample of potable water has been added, record the pH and notify the sample manager that the sample could not be preserved.

V. Attachments

None.

VI. Key Check Items

Be sure appropriate preservatives are used.

STANDARD OPERATING PROCEDURE

Field Rinse Blank Preparation

I. Purpose

To prepare a blank to determine adequacy of decon procedures and whether any cross-contamination is occurring during sampling.

II. Scope

The general protocols for preparing the rinse blank are outlined. The actual equipment to be rinsed will depend on the requirements of the specific sampling procedure.

III. Equipment and Materials

- Blank liquid (use ASTM Type II grade water)
- Sample bottles as appropriate
- Gloves
- Preservatives as appropriate

IV. Procedures and Guidelines

A. Decontaminate all sampling equipment that has come in contact with sample according to SOP Decontamination of Personnel and Equipment.

B. To collect the sample for volatiles analysis, pour blank water over one piece of equipment and into 40-ml vials until there is a positive meniscus and seal vials. Note the sample number and associated piece of equipment in the field notebook.

For non-volatiles, one aliquot is to be used for equipment. For example, if a pan and trowel are used, place trowel in pan and pour blank fluid in pan such that pan and trowel surfaces which contacted the sample are contacted by the blank fluid. Pour blank fluid from pan into appropriate sample bottles.

Do not let the blank fluid come in contact with any equipment that has not been decontaminated.

C. Document and ship samples in accordance with the procedures for other samples.

D. Collect next field sample.

V. Attachments

None.

VI. Key Checks and Items

- Wear gloves.
- Do not use any non-decontaminated equipment to prepare blank.
- Use ASTM-Type II grade water.

STANDARD OPERATING PROCEDURE

Field Filtering

I. Purpose

To provide a general guideline for the field filtering of water samples for dissolved metals analysis.

II. Scope

This is a general discussion of the standard method of field filtering techniques. Operating manuals should be consulted regarding specific procedures.

III. Equipment and Materials

- Geotech Filtering apparatus or equivalent
- Pump
- nitric acid (HNO_3) solution - high grade - reagent grade not acceptable
- Glass fiber prefilters
- Vacuum source
- 45 µm cellulose acetate filters
- inline filters

IV. Procedures and Guidelines

A. REAGENT PREPARATION

1. 10% HNO_3 solution: Add about 900 ml of ASTM Type II water to a 1 liter Erlenmeyer flask. Using a graduated cylinder, ASTM Type II, add 100 ml concentrated HNO_3 to the DI water while stirring.

B. PROCEDURE

1. Attach a vacuum source (pump, syringe, etc.) or a Q.E.D. online filter or equivalent to the receiver assembly.
2. Flush the entire filter system with 10% HNO_3 solution. Open assembly, discard rinsate, and reassemble unit.
3. Flush the entire filter system with 60 ml ASTM Type II water. Open assembly, discard rinsate and reassemble unit (not required when using Q.E.D. online filter).
4. Filter sample and transfer to polyethylene bottle (with preservative) for shipment.
5. Discard filter assembly and prefilter.

V. Attachments

None.

VI. Key Checks and Items

- 10% HNO_3 solution for cleaning
- All water must be ASTM Type II
- Prefilter with glass fiber filters if sample is turbid
- Record lot number of nitric acid and water
- Note monitoring wells with high concentrations of suspended solids in field notebooks
- The equipment blank collected with the sample is called a filtration blank and is collected through the filter.

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 TCL VOCs or field GC screening; samples for these analyses should NOT be homogenized.

III. Equipment and Materials

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

IV. Procedures and Guidelines

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

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

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

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

STANDARD OPERATING PROCEDURE

Packaging and Shipping Procedures

I. 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.

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.

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.

I. Separate copies of forms. Seal proper copies (traffic reports, packing lists) along with a return address label within a large zip-lock bag and tape to inside lid of cooler.

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. **Do not** cover custody seals.

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.

II. Medium- and High-Concentration Samples:

Medium- and high-concentration samples are packaged using the same techniques used to package low-concentration samples, with several additional restrictions. First, a special airbill including a Shipper's Certification for Restricted Articles is required. Second, “Flammable Liquid N.O.S.” or “Flammable Solid N.O.S.” (as appropriate) labels must be placed on at least two sides of the cooler. Third, sample containers are packaged in metal cans with lids before being placed in the cooler, as indicated below:

- Place approximately ½ inch of vermiculite in the bottom of the can.
- Position the sample jar in the zip-loc bag so that the sample tags can be read through the plastic bag.
- Place the jar in the can and fill the remaining volume with vermiculite.
- Close the can and secure the lid with metal clips.
- Write the traffic report number on the lid.
- Place “This Side Up” and “Flammable Liquid N.O.S.” or “Flammable Solid N.O.S.” (as appropriate) labels on the can.
- Place the cans in the cooler.
- For medium concentration samples, ship samples with ice or “blue ice” inside the coolers. (Double bag ice in zip-lock plastic bags.)

III. Special Instructions for Shipping Medium and High Concentration Samples by Federal Express

A. Label cooler as hazardous shipment:

- Write shipper's address on outside of cooler. If address is stenciled on, just write “shipper” above it.
- Write or affix sticker saying “This Side Up” on two adjacent sides.
- Write or affix sticker saying “ORM-E” with box around it on two adjacent sides. Below ORM-E, write NA#9188.
- Label cooler with “Hazardous Substance, N.O.S.” and “liquid” or “solid,” as applicable.

B. Complete the special shipping bill for restricted articles.

- Under <u>Proper Shipping Name</u>, write “Hazardous Substance, N.O.S.” and “liquid” or “solid,” as applicable.
- Under <u>Class</u>, write “ORM-E.
- ”Under <u>Identification No.</u>, write NA No. 9188.

C. For high concentration samples, ship samples with "blue ice" only inside coolers.

STANDARD OPERATING PROCEDURE

Chain-of-Custody

I Purpose

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

II Scope

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

III Definitions

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

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

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

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

IV Responsibilities

Project Manager - The Project Manager is responsible for ensuring that project-specific plans are in accordance with these procedures, where applicable, or that other, approved procedures

are developed. The Project Manager is responsible for development of documentation of procedures which deviate from those presented herein. The Project Manager is responsible for ensuring that chain-of-custody procedures are implemented. The Project Manager also is responsible for determining that custody procedures have been met by the analytical laboratory.

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

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

V Procedures

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

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

V.1 Sample Identification

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

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

- Field Sampler(s);
- CTO Number;
- Project Sample Number;
- Sample location or sampling station number;
- Date and time of sample collection and/or measurement;
- Field observations;
- Equipment used to collect samples and measurements; and,
- Calibration data for equipment used.

Measurements and observations shall be recorded using waterproof ink.

V.1.1 Sample Label

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

- Project - Contract Task Order (CTO) Number.
- Station Location - The unique sample number identifying this sample.
- Date - A six-digit number indicating the day, month, and year of sample collection (e.g., 12/21/85).
- Time - A four-digit number indicating the 24-hour time of collection (for example: 0954 is 9:54 a.m., and 1629 is 4:29 p.m.).
- Medium - Water, soil, sediment, sludge, waste, etc.
- Sample Type - Grab or composite.
- Preservation - Type and quantity of preservation added.
- Analysis - VOA, BNAs, PCBs, pesticides, metals, cyanide, other.
- Sampled By - Printed name of the sampler.
- Remarks - Any pertinent additional information.

Using only the work assignment number of the sample label maintains the anonymity of sites. This may be necessary, even to the extent of preventing the laboratory performing the analysis from knowing the identify of the site (e.g., if the laboratory is part of an organization that has performed previous work on the site).

V.2 Chain-of-Custody Procedures

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

V.2.1 Field Custody Procedures

- Samples are collected as described in the site Sampling and Analysis Plan. Care must be taken to record precisely the sample location and to ensure that the sample number on the label matches the Chain-of-Custody Record exactly.
- The person undertaking the actual sampling in the field is responsible for the care and custody of the samples collected until they are properly transferred or dispatched.
- When photographs are taken of the sampling as part of the documentation procedure, the name of the photographer, date, time, site location, and site description are entered sequentially in the site logbook as photos are taken. Once developed, the photographic

prints shall be serially numbered, corresponding to the logbook descriptions; photographs will be stored in the project files. It is good practice to identify sample locations in photographs by including an easily read sign with the appropriate sample/location number.

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

V.2.2 Transfer of Custody and Shipment

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

- Enter header information (CTO number, samplers, and project name).
- Enter sample specific information (sample number, media, sample analysis required and analytical method grab or composite, number and type of sample containers, and date/ time sample was collected).
- Sign, date, and enter the time under “Relinquished by” entry.
- Have the person receiving the sample sign the “Received by” entry. If shipping samples by a common carrier, print the carrier to be used in this space (i.e., Federal Express).
- If a carrier is used, enter the airbill number under “Remarks,” in the bottom right corner;
- Place the original (top, signed copy) of the Chain-of-Custody Record Form in a plastic zipper-type bag or other appropriate sample shipping package. Retain the copy with field records.
- Sign and date the custody seal, a 1- by 3-inch white paper label with black lettering and an adhesive backing. Attachment C is an example of a custody seal. The custody seal is part of the chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field. Custody seals shall be provided by the analytical laboratory.
- Place the seal across the shipping container opening so that it would be broken if the container were to be opened.
- Complete other carrier-required shipping papers.

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

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

the shipping container and the custody seals are intact, commercial carriers are not required to sign the custody form.

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

VI Quality Assurance Records

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

VII Attachments

Sample Label
Chain of Custody Form
Custody Seal

VIII References

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

Attachment A

Example Sample Label

QAL

Quality Analytical Laboratories, Inc.
2567 Fairlane Drive
Montgomery, Alabama 36116
PH. (334)271-2440

Client _____
Sample No. _____
Location _____
_____
Analysis _____
_____
Preservative HCL
Date _____ By _____

CEIMIC
CORPORATION
10 Dean Knauss Drive, Narragansett, R.I. 02882 • (401) 782-8900

SITE NAME	DATE
ANALYSIS	TIME
	PRESERVATIVE

SAMPLE TYPE

☐ Grab ☐ Composite ☐ Other _____

COLLECTED BY:

Attachment B

Example Chain-of-Custody Record

CH2M HILL
APPLIED SCIENCES LABORATORY

CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

CH2M Hill Project # ☐☐☐☐☐☐☐☐☐.☐☐.☐☐

Purchase Order #

Project Name

Company Name CH2M HILL Office

Project Manager & Phone #
Mr. [ ]
Ms. [ ]
Dr. [ ]

Report Copy to:

Requested Completion Date:

Sampling Requirements: SDWA ☐ NPDES ☐ RCRA ☐ OTHER ____

Sample Disposal: Dispose ☐ Return ☐

Sampling Date	Sampling Time	Type COMP	Type GRAB	Matrix WATER	Matrix SOIL	Matrix AIR	CLIENT SAMPLE ID (9 CHARACTERS)	# OF CONTAINERS	LAB TEST CODES	ANALYSES REQUESTED	REMARKS	LAB 1 ID	LAB 2 ID

SHADED AREA– FOR LAB USE ONLY

Lab 1 #	Lab 2 #
Quote #	Kit Request #
Project #	
No. of Samples	Page of
Login	LIMS Ver

Sampled By & Title (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name) Date/Time
Received By (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name) Date/Time
Received By (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name) Date/Time
Received By (Please sign and print name)	Date/Time	Shipped Via UPS BUS Fed-Ex Hand Other ____ Shipping #
Work Authorized By (Please sign and print name)	Remarks	

QC Level: 1 2 3 Other: ____

COC Rec	ICE
Ana Req	TEMP
Cust Seal	Ph

Instructions and Agreement Provisions on Reverse Side

DISTRIBUTION: Original - LAB, Yellow - LAB, Pink - Client

REV 3/94 FORM 340

Attachment C

Example Custody Seal

CH2M HILL

CUSTODY SEAL

Date _____ _____

Signature _____ _____

STANDARD OPERATING PROCEDURE

Decontamination of Drilling Rigs and Equipment

I. Purpose and Scope

The purpose of this guideline is to provide methods for the decontamination of drilling rigs, downhole drilling tools, and water-level measurement equipment. Personnel decontamination procedures are not addressed in this SOP; refer to the site safety plan and SOP *Decontamination of Personnel and Equipment*. Sample bottles will not be field decontaminated; instead they will be purchased with certification of laboratory sterilization.

II. Equipment and Materials

- Portable steam cleaner and related equipment
- Potable water
- Phosphate-free detergent such as Alconox® or Liquinox®
- Buckets
- Brushes
- Distilled organic-free water
- Methanol, pesticide grade
- ASTM–Type II grade water
- Aluminum foil

III. Procedures and Guidelines

A. Drilling Rigs and Monitoring Well Materials

Before the onset of drilling, after each borehole, before drilling through permanent isolation casing, and before leaving the site, heavy equipment and machinery will be decontaminated by steam cleaning at a designated area. The steam cleaning area will be designed to contain decontamination wastes and waste waters and can be an HDPE-lined, bermed pad. A pumping system will be used to convey decontaminated water from the pad to drums.

Surface casings may be steam cleaned in the field if they are exposed to contamination at the site prior to use.

B. Downhole Drilling Tools

Downhole tools will be steam cleaned before the onset of drilling, prior to drilling through permanent isolation casing, and between boreholes. This will include, but is not limited to, rods, split-spoons or similar samplers, coring equipment, augers, and casing.

Before the use of a sampling device such as a split-spoon sampler for the collection of a soil sample for physical characterization, the sampler shall be cleaned by scrubbing with a detergent solution followed by a potable water rinse.

Before the use of a sampling device such as a split-spoon sampler for the collection of a soil sample for chemical analysis, the sampler shall be decontaminated following the procedures outlined in the following subsection.

C. Field Analytical Equipment

1. Water Level Indicators

   Water level indicators that consist of a probe that comes into contact with the groundwater must be decontaminated using the following steps:

   a. Rinse with tap water
   b. Rinse with de-ionized water
   c. Solvent rinse with methanol
   d. Rinse with de-ionized water

2. Probes

   Probes, for example, pH or specific ion electrodes, geophysical probes, or thermometers that would come in direct contact with the sample, will be decontaminated using the procedures specified above unless manufacturer's instructions indicate otherwise. For probes that make no direct contact, for example, OVM equipment, the probe will be wiped with clean paper-towels or cloth wetted with methanol.

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

The effectiveness of field cleaning procedures will be monitored by rinsing decontaminated equipment with organic-free water and submitting the rinse water in standard sample containers for analysis. Anytime a sampling event occurs, at least one such quality control sample shall be collected. The total number of equipment blanks will be at least 5 percent of the number of samples collected during large-scale field sampling efforts.

At least one piece of field equipment shall be selected for this procedure each time equipment is washed. An attempt should be made to select different pieces of equipment for this procedure.

STANDARD OPERATING PROCEDURE

Decontamination of Personnel and Equipment

I. Purpose

To provide general guidelines for the decontamination of personnel, sampling equipment, and monitoring equipment used in potentially contaminated environments.

II. Scope

This is a general description of decontamination procedures.

III. Equipment and Materials

- Demonstrated analyte-free, deionized ("DI") water (specifically, ASTM Type II water)
- Distilled water
- Potable water; must be from a municipal water supplier, otherwise an analysis must be run for appropriate volatile and semivolatile organic compounds and inorganic chemicals (e.g., Target Compound List and Target Analyte List chemicals)
- 2.5% (W/W) trisodium phosphate ("TSP") and water solution
- Concentrated (V/V) pesticide grade methanol (DO NOT USE ACETONE)
- 10% (V/V) nitric acid (HNO_3) and water solution (only ultrapure grade HNO_3 is to be used)
- Large plastic pails or tubs for TSP and water, scrub brushes, squirt bottles for TSP, methanol and water, plastic bags and sheets
- DOT approved 55-gallon drum for disposal of waste
- Phthalate-free gloves
- Decontamination pad and steam cleaner/high pressure cleaner for large equipment

IV. Procedures and Guidelines

A. PERSONNEL DECONTAMINATION

To be performed after completion of tasks whenever potential for contamination exists, and upon leaving the exclusion zone.

1. Wash boots in TSP solution, then rinse with water. If disposable latex booties are worn over boots in the work area, rinse with TSP solution, remove, and discard into DOT approved 55-gallon drum.

2. Wash outer gloves in TSP solution, rinse, remove, and discard into DOT approved 55-gallon drum.

3. Remove disposable coveralls ("Tyveks") and discard into approved 55-gallon drum.

4. Remove respirator (if worn).

5. Remove inner gloves and discard.

6. At the end of the work day, shower entire body, including hair, either at the work site or at home.

7. Sanitize respirator if worn.

B. SAMPLING EQUIPMENT DECONTAMINATION—GROUNDWATER SAMPLING PUMPS

Sampling pumps are decontaminated after each use as follows.

1. Don phthalate-free gloves.

2. Spread plastic on the ground to keep hoses from touching the ground

3. Turn off pump after sampling. Remove pump from well and place pump in decontamination tube, making sure that tubing does not touch the ground

4. Turn pump back on and pump 1 gallon of TSP solution through the sampling pump.

5. Rinse with 1 gallon of 10% methanol solution pumped through the pump. (DO NOT USE ACETONE).

6. Rinse with 10% HNO_3 solution pumped through the pump, when sampling for inorganics (carbon steel split spoons will be rinsed with a 1% solution).

7. Rinse with 1 gallon of tap water.

8. Rinse with 1 gallon of deionized water.

9. Keep decontaminated pump in decontamination tube or remove and wrap in aluminum foil or clean plastic sheeting.

10. Collect all rinsate and dispose of in a DOT approved 55-gallon drum.

C. SAMPLING EQUIPMENT DECONTAMINATION—OTHER EQUIPMENT

Reusable sampling equipment is decontaminated after each use as follows.

1. Don phthalate-free gloves.

2. Prior to entering the potentially contaminated zone, wrap soil contact points in aluminum foil (shiny side out).

3. Rinse and scrub with potable water.

4. Wash all equipment surfaces that contacted the potentially contaminated soil/water with TSP solution.

5. Rinse with potable water.

6. Rinse with 10% HNO_3 solution when sampling for inorganics (carbon steel split spoons will be rinsed with a 1% solution).

7. Rinse with distilled or potable water and methanol solution (DO NOT USE ACETONE).

8. Air dry.

9. Rinse with deionized water.

10. Completely air dry and wrap exposed areas with aluminum foil (shiny side out) for transport and handling if equipment will not be used immediately.

11. Collect all rinsate and dispose of in a DOT approved 55-gallon drum.

D. HEALTH AND SAFETY MONITORING EQUIPMENT DECONTAMINATION

1. Before use, wrap soil contact points in plastic to reduce need for subsequent cleaning.

2. Wipe all surfaces that had possible contact with contaminated materials with a paper towel wet with TSP solution, then a towel wet with methanol solution, and finally three times with a towel wet with distilled water. Dispose of all used paper towels in a DOT approved 55-gallon drum.

E. SAMPLE CONTAINER DECONTAMINATION

The outsides of sample bottles or containers filled in the field may need to be decontaminated before being packed for shipment or handled by personnel without hand protection. The procedure is:

1. Wipe container with a paper towel dampened with TSP solution or immerse in the solution AFTER THE CONTAINERS HAVE BEEN SEALED. Repeat the above steps using potable water.

2. Dispose of all used paper towels in a DOT approved 55-gallon drum.

F. HEAVY EQUIPMENT AND TOOLS

Heavy equipment such as drilling rigs, drilling rods/tools, and the backhoe will be decontaminated upon arrival at the site and between locations as follows:

1. Set up a decontamination pad in area designated by the Navy

2. Steam clean heavy equipment until no visible signs of dirt are observed. This may require wire or stiff brushes to dislodge dirt from some areas.

V. Attachments

None.

VI. Key Checks and Items

- Clean with solutions of TSP, methanol, nitric acid, and distilled water.
- Do not use acetone for decontamination.
- Drum all contaminated rinsate and materials.
- Decontaminate filled sample bottles before relinquishing them to anyone.

STANDARD OPERATING PROCEDURE

Disposal of Waste Fluids and Solids

I. Purpose and Scope

This SOP describes the procedures used to dispose of hazardous fluid and solid materials generated as a result of the site operations. This SOP does not provide guidance on the details of Department of Transportation regulations pertaining to the transport of hazardous wastes; the appropriate Code of Federal Regulations (49 CFR 171 through 177) should be referenced. Also, the site investigation-derived waste management plan should be consulted for additional information and should take precedence over this SOP.

II. Equipment and Materials

A. Fluids

- DOT-approved 55-gallon steel drums or Baker® Tanks
- Tools for securing drum lids
- Funnel for transferring liquid into drum
- Labels
- Marking pen for appropriate labels
- Seals for 55-gallon steel drums

B. Solids

- DOT-approved 55-gallon steel drums or rolloffs
- Tools for securing drum lids
- Plastic sheets
- Labels
- Marking pen for appropriate labels

III. Procedures and Guidelines

A. Methodology

Clean, empty drums or rolloffs or Baker® Tanks will be brought to the site by the drilling subcontractor for soil and groundwater collection and storage. The empty drums will be located at the field staging area and moved to drilling locations as required. The drums will be filled with the drilling and well installation wastes, capped, sealed, and moved to the onsite drum storage area by the drilling subcontractor. The full drums will separate types of wastes by media. The drums will be labeled as they are filled in the field and labels indicating that the contents are potentially hazardous affixed.

The drum contents will be sampled to determine the disposal requirements of the drilling wastes. The drum sampling will be accomplished through the collection and submittal of composite samples, one sample per 10 drums containing the same media. Similar compositing will be performed in each rolloff to obtain a representative sample. The compositing of the sample will

be accomplished by collecting a specific volume of the material in each drum into a large sample container. When samples from each of the drums being sampled in a single compositing are collected, the sample will be submitted for TCLP, ignitability, corrosivity, and reactivity analysis. The analysis will be used to determine if drilling wastes are covered by land disposal restrictions.

If rolloffs are used, compositing and sampling of soil will comply with applicable state and federal regulations.

B. Labels

Drums and other containers used for storing wastes from drilling operations will be labeled when accumulation in the container begins. Labels will include the following minimum information:

- Container number
- Container contents
- Origin (source area including individuals wells, piezometers, and soil borings)
- Date that accumulation began
- Date that accumulation ended
- When laboratory results are received, drum labels will be completed or revised to indicate the hazardous waste constituents in compliance with Title 40 of the Code of Federal Regulations, Part 262, Subpart C.

C. Fluids

Drilling fluids generated during soil boring and groundwater discharged during development and purging of the monitoring wells will be collected in 55-gallon, closed-top drums. When a drum is filled, the bung will be secured tightly. Fluids may also be transferred to Baker® Tanks after being temporarily contained in drums to minimize the amount of drums used.

When development and purging is completed, the water will be tested for appropriate hazardous waste constituents. Compositing and sampling of fluids will comply with applicable state and federal regulations.

D. Solids

The soil cuttings from well and boring drilling will constitute a large portion of the solids to be disposed of.

The solid waste stream also will include plastic sheeting used for decontamination pads, Tyveks, disposable sampling materials, and any other disposable material used during the field operations that appears to be contaminated. These materials will be placed in designated drums.

E. Storage and Disposal

The wastes generated at the site at individual locations will be transported to the fenced drum storage area by the drilling services subcontractor.

Waste solid materials that contain hazardous constituents will be disposed of at an offsite location in a manner consistent with applicable solid waste, hazardous waste, and water quality regulations. Transport and disposal will be performed by a commercial firm under subcontract.

The liquid wastes meeting acceptable levels of discharge contamination may be disposed of through the sanitary sewer system at the site. Prior to disposal to the sanitary sewer system, contract arrangements will be made with the appropriate authorities. Wastes exceeding acceptable levels for disposal through the sanitary sewer system will be disposed of through contract with a commercial transport and disposal firm.

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

Check that representative samples of the containerized materials are obtained.

Standard Operating Procedure

Locating and Clearing Underground Utilities

I. Purpose

The purpose of this SOP is to provide a general guideline for 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 procure utility subcontracting services that meet the needs of individual activities and projects.

This SOP identifies the different utility locating scenarios Activity Managers may face at their activities and spells out the general approaches that should be followed under each scenario to maximize our ability to avoid hitting underground utilities and to minimize liabilities and health and safety risks to CH2M HILL and its subcontractors.
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

The scope of CH2M HILL's utility locating work at each Activity will depend greatly on:

- The utility locating services provided by the Activity. The public works center (PWC) or similar organization at some Activities will provide some degree of utility locating services ranging from comprehensive geophysical surveying to simply providing maps. Most of these services are provided in the form of dig permits which are required before you can dig or drill.
- The degree of faith you can put on the quality/thoroughness of the utility-locating and mapping services provided by the Activity. (I.e.: Does the PWC simply rely on their maps to mark utilities or do they verify mapped locations with field geophysics or other surveys?)

Generally we will find ourselves in one of three scenarios at an Activity:

Scenario 1

The Activity provides very thorough utility locating services for our work and takes on the liability of repairs for damages that may occur if there services are inaccurate. An example of this is Patuxent River NAS.

Scenario 2

The Activity does not get involved in any utility locating processes aside from providing the most recent maps. Examples of this are Indian Head and Carderock.

Scenario 3

An intermediate situation where the Activity provides utility locating services but they (and/or we) do not have a very high level of confidence in their ability to identify everything (e.g.: they may want us to assume liability, they do not field verify and mark utilities, we notice mistakes in their work, etc.). An example of this is Washington Navy Yard.

The general procedures to be followed in each of these three situations are outlined in **Part IV. Procedures and Guidelines** of this SOP. Other qualifying factors that the PM needs to consider in determining what type of effort and budget will be required for utility locating are:

- What are the types and density of underground utilities in the area of the proposed work? (Are you drilling in an open field or a city street?). Utility locations would not be necessary in completely undeveloped areas such as woods. Although we need to be convinced (from historic air photos and site records) that these areas did not have historic uses that may have involved underground utilities.
- What is the history of the area? (A recently developed area of an Activity is likely to have more accurate mapping than an area that has been active for a long time.)
- How fixed are your drilling/digging points? (If you know exactly where you are going to be drilling ahead of time you can simply clear relatively small areas. If you will be revising locations in the field as an investigation progresses you will need to clearly mark larger areas or keep a utility location service on call (or at the site) to clear each location as it is identified.)

III. Services and Equipment

This section identifies 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 look for in the work done by PWC and what we should require from our utility location subs.

Services

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 us)

Attachment A 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 B 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 used by a subcontractor or PWC is adequate.

IV. Procedures and Guidelines

This section presents general procedures for each of the three scenarios identified above in Section II. This assumes that the Activity Manager has already met with PWC, established a contact and evaluated their procedures for identifying underground utilities.

Scenario 1 - Adequate Services are Provided by Activity PWC

1. Identify PWC's procedures, information needs, and time requirements for obtaining dig permits (or equivalent).
2. Obtain utility maps from the Activity and meet with PWC to identify what types of utilities are underground vs. aboveground at the Activity and in the areas you are working at in particular. Get a feeling for the accuracy of these maps by talking with PWC (ask: how often are they updated, how are they updated). Field proof the maps in the area of the proposed investigation to see if manholes, fire hydrants, meters, valves are where they are shown on the maps.
3. Provide PWC with information needed for obtaining dig permit.
4. Identify if there are any "utility-owned" utilities at the Activity that we should rely on Miss Utility (or similar) to mark. PWC would be the first contact for this, and then Miss Utility (or similar).
5. Perform a field check prior to drilling/digging to see if field utility markings coincide with locations on utility maps. If utilities shown on maps are not shown in field markings, notify PWC or Miss Utility.

Scenario 2 – Activity PWC Provides Little or No Services

1. Obtain utility maps from the Activity and meet with PWC to identify what types of utilities are underground vs. aboveground at the Activity and in the areas you are working at in particular. Get a feeling for the accuracy of these maps by talking with PWC (ask: how often are they updated, how are they updated). Field proof the maps in the area of the proposed investigation to see if manholes, fire hydrants, meters, valves are where they are shown on the maps. Determine if there are any unmapped utilities or public utilities on the base.
2. Identify if there are any "utility-owned" utilities at the Activity that we should rely on Miss Utility (or similar) to mark. PWC would be the first contact for this, and then Miss Utility (or similar).
3. If you know the locations of the borings beforehand and plan to use a locator subcontractor to clear the immediate vicinity of each proposed boring only, follow steps 3a through 3c then go to Step 5. If you need to clear or mark a large area (all or part of a site), skip Steps 3a through 3c and go to step 4.

3a. All known subsurface boring locations should be positioned on a map to avoid known underground utility lines at the site (based on the most accurate maps available). This positioning is accomplished by using figures that show all utilities. These maps should be used as working drawings and kept in the field for use during all intrusive activities.

3b. Field locate the proposed boring locations and mark and label them on the ground (e.g. with stakes, paint, or similar markers). In a well developed area with good maps, field locating can be done by measuring from surface features that appear on the maps (building corners, manholes, etc). Distances from at least two features should be recorded on the map to insure that boring locations can be relocated if stakes or other location markers are tampered with. In areas where there are few surface features to reference and measure from, and where we have maps/GIS with good horizontal controls, proposed boring locations should be identified and field located using horizontal coordinates. In this case, a GPS unit will be required to stake boring locations in the field.

3c. When you are in the field marking boring locations check to see if there is evidence that any nearby utilities (within 50 feet of the proposed boring) are where they are shown on the maps. Look for manholes to check storm sewer and sanitary sewer lines, valve boxes and fire hydrants to check water lines, lamp posts or lighted signs to check electrical lines. For utilities such as gas, telecommunications, and many electrical service lines there may be no evidence on the surface. In this case, identify horizontal coordinates of at least two points along the utility line on the map. (this assumes we have the utilities shown accurately on maps with coordinates that can be easily read - i.e.: GIS) and mark them in the field. This can serve as a check for the utility locator's work.

4. If you need to clear or mark a large area (all or part of a site), delineate the area to be cleared/marked on a site map that includes all known utilities. If the area is not easily distinguished in the field, it may be necessary to stake out the extent of the proposed clearance work with stakes, paint, or other suitable markings. Identify all known types of utilities that may be present in the area.

5. Procure a utility locating subcontractor using the guidelines provided in Attachments A. Provide the subcontractor with copies of the utility maps as part of the procurement package and clearly identify the types of underground utilities and areas that they will be required to identify/mark.

6. Using an appropriate geophysical method selected for the types of utilities or subsurface structures expected, have the subcontractor conduct a geophysical survey within an appropriate area (See steps 3 and 4) and using an appropriate traverse around and over the proposed subsurface boring location(s) to locate any underground utility lines or structures. If clearing of individual drilling/digging locations is desired, it is suggested that the geophysical survey focus on marking all mapped utilities within a 30 foot radius of each proposed location (by tracing lines) and doing a sweep for potentially undocumented utilities within a 10 foot radius of each proposed location. If all potential drilling/digging locations are not known up front, (such as with a typical Geoprobe investigation) the PM can either have the

subcontractor sweep for and mark utilities throughout the entire area that may be addressed by the investigation up front or, keep the subcontractor on call to clear/sweep individual drilling locations as they are identified. Costs will factor in to this decision.

In areas that have only recently been developed, and complete utility as-built maps are available, it may be adequate to simply do a geophysical trace and mark the mapped utilities in the field as opposed to sweeping the entire site of each specific location.

The subcontractor should be required to use the industry standard color codes for marking utilities. See Attachment C.

7. Make note of the apparent difference between the underground utility lines and structures staked by the land survey and the corresponding underground utility lines and structures located by the geophysical survey.

8. Adjust proposed sample locations in order to avoid all subsurface utilities detected during the survey. Conduct an additional confirmatory geophysical survey at the new proposed sample location, if necessary.

9. Obtain copies of all geophysical data recorded by the geophysical surveying subcontractor, along with the subcontractor's report, if necessary. At a minimum the subcontractor should be required to mark his findings on the ground in the field with paint and provide a markup of the utility map with notes identifying what was found and where, with ties to site features.

10. The Project Manager and the Activity Manager should decide how the geophysical data will be used, in addition to its use in adjusting the proposed subsurface boring locations in the field. Geophysical data may also be recorded by professional land survey and uploaded into the Activity's GIS. You may also request the subcontractor to survey in the located utilities and create a map for future use by CH2M HILL. However, Project Managers and Activity Managers should be aware of the inherent limitations of precision and accuracy of geophysical data. In particular, the differences in the precision and accuracy of geophysical data and professional land survey data must be considered before the best use of the geophysical data is determined. **If you are being scoped to make or correct utility maps that will be provided to the navy, special precautions need to be taken to avoid the misuse of the maps and avoid exposing CH2M HILL to unreasonable liability. Requests for this type of work must be reviewed by CH2M HILL's Navy CLEAN Project Delivery Manager and Contracts Administrator.**

Scenario 3 - Activity PWC Provides Some Services, but Quality is Questionable

Under this scenario we should follow the same procedures as we would for Scenario 2, particularly if the Activity does not accept liability for mismarked utilities. Less extensive procedures on our part may be acceptable in portions of the facility where we are convinced that PWCs records (mapping) or knowledge is likely to be good.

IV. Attachments

A - Services Available for Identifying and Marking Underground Utilities
B – Equipment Used for Identifying Underground Utilities
C – Utility Marking Color Codes

Attachment A - 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 us)

Each are discussed below.

Navy Public Works Center

A Public Works Center (PWC) or Public Works Department (PWD) is usually present at each Activity. The PWC is responsible for maintaining the public works at the base including management of utilities. In many cases, the PWC has a written permit process in place to identify and mark-out the locations of Navy-owned utilities [Note: The PWC 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 PWC in order to identify non-Navy owned, public utilities].

At some Activities, there may not be a PWC, the PWC may not have a written permit process in place, or the PWC may not take responsibility for utility locating and mark-outs. In these cases, the PWC 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 PWC 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 PWC, either directly or through the LANTDIV/EFACHES 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. 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	www.onisi.com/onisi/msutil/default.htm	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.greensboro.ncocc.org/ncocc/default.htm	Public Utility Markouts in North Carolina

Private Subcontractors

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 geophysical surveying support needed for each project will vary depending on which of the three situations described in SOP we find ourselves in:

1. The Activity provides very thorough utility locating services for our work and takes on the liability of repairs for damages (Scenario 1 as described in the SOP).

   In this situation, CH2M HILL will normally not need to subcontract additional geophysical surveying support for utility-locating. However, the project manager and field personnel should work closely PWC to position proposed subsurface boring locations clear of all known active and inactive utilities.

2. The Activity does not get involved in any utility locating processes aside from providing the most recent maps. An example of this is NAB Little Creek (Scenario 2 as described in the SOP).

   In this situation, CH2M HILL will require geophysical surveying support for utility-locating and subsurface sample location clearance. 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.

3. The Activity provides utility locating services but they (and/or we) do not have a very high level of confidence in their ability to identify everything (e.g.: they want us to assume liability, they do not field-verify and mark utilities, we notice mistakes in their work, etc.) (Scenario 3 in the SOP).

   In this situation, CH2M HILL may require geophysical surveying support for utility-locating, depending on the nature of the site. At sites where no utilities are expected to exist and the utility location effort is simple, this level of support from the Activity may be acceptable. However, it will be important for the project manager to be familiar with the exact services that were provided by the Activity. At more congested sites where several utilities are known to exist, the project manager may decide to procure the services of a geophysical surveying subcontractor to supplement the Activity's efforts. In this case, the liability issues for damage to subsurface utilities should be clearly defined. For projects where geophysical surveying services are being procured for field activities other than utility-locating, it may be relatively inexpensive and efficient to have the geophysical surveying subcontractor to include the necessary utility-locating effort in the scope of work for the project to supplement the Activity's effort.

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			✓					
Utilities Search, Inc.*	Jim Davis 703-369-5758	✓				✓	✓	✓	✓
So Deep, Inc.* 8397 Euclid Avenue Manassas Park, VA 20111	703-361-6005	✓					✓	✓	✓
Accurate Locating, Inc. 1327 Ashton Rd., Suite 101 Hanover, MD 21076	Ken Shipley 410-850-0280	✓	✓						
NAEVA Geophysics, Inc. P.O. Box 7325 Charlottesville, VA 22906	Alan Mazurowski 434-978-3187	✓	✓	✓	✓	✓	✓	✓	✓
Earth Resources Technology. Inc. 8106 Stayton Rd. Jessup, MD 20794	Peter Li 240-554-0161	✓	✓	✓	✓	✓	✓	✓	
Geophex, Ltd 605 Mercury Street Raleigh, NC 27603	I. J. Won 919-839-8515	✓	✓	✓	✓	✓	✓	✓	✓

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 B – 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 used by a subcontractor or PWC is adequate.

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 newer 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 C – 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

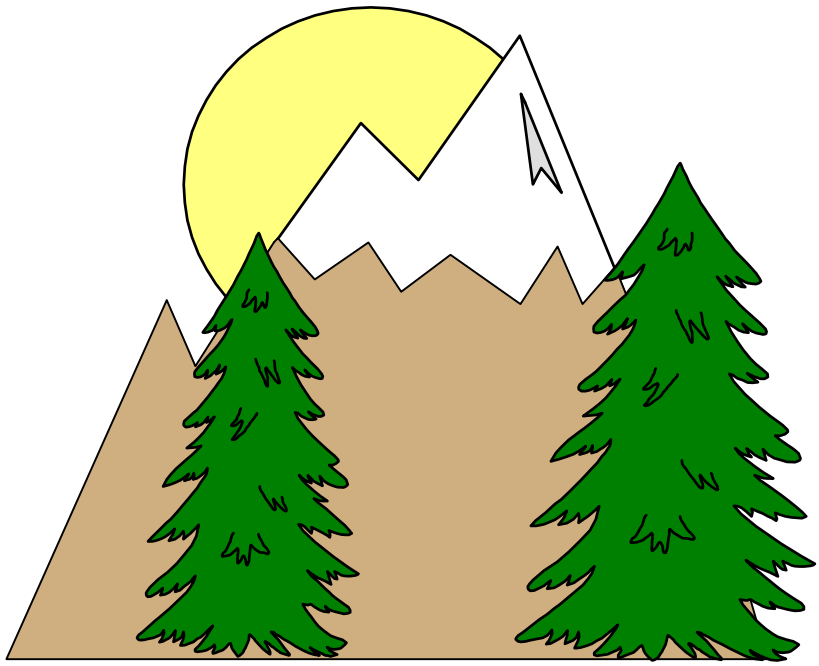
Blue – Potable water

Purple – Reclaimed water, irrigation and slurry lines

Green – Sewer and storm drain lines

Appendix C
UXO Work Plan and CH2MHILL Standard of Practices for Drilling (HSE-35) and Ordnance Explosives (HSE-91)

Environmental Restoration ... An Ethical Commitment



Work Plan & SSHP

St. Juliens Creek Annex, Chesapeake, VA

Ordnance & Explosives (OE) Avoidance Support Services

September 2003

Prepared for

CH2M HILL

Prepared By

USA Environmental, Inc.

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Appendix A: UXO Site Specific Safety and Health Plan

Appendix B: Project Forms

OE AVOIDANCE PLAN

1.0 PURPOSE

This plan outlines the procedures USA Environmental, Inc. (USA) will use to perform Ordnance and Explosives (OE) Avoidance Support Services at St. Juliens Creek Annex (SJCA), Sites 2 & 5, Chesapeake, Virginia. This plan is based on information provided by the prime contractor, CH2M HILL.

1.1 GENERAL

USA will perform operations at SJCA in a systematic manner using proven operating techniques and methods. USA operations will be executed in three distinct phases: Phase 1: Mobilization, Phase 2: - Operations, and Phase 3: Demobilization. This plan describes the activities USA will accomplish during each phase and the methodology USA will use to accomplish these activities.

1.2 SCOPE OF WORK

USA will provide will provide a two-person OE/UXO team to provide on-site OE support during installation of four (4) shallow groundwater monitoring wells (15-20' bgs) and thirty three (33) soil borings (sampling, 0-1 bgs).

1.3 PHASE 1: MOBILIZATION

USA will begin mobilization following notification in writing of approval of this work plan and receipt of notification to proceed from CH2M HILL. The goal of this phase of mobilization is to ensure that the proper attention is dedicated to coordinating with the prime contractor and moving to the operational phase as soon as practical. Actions performed during this phase include:

- Identify/procure, package, ship, and inventory project equipment;
- Coordinate with the prime contractor's project manager for communications and other support;
- Finalize operating schedules;
- Conduct site-specific training if required.

1.4 PERSONNEL

USA will deploy a UXO Technician III and a UXO Technician II. All USA UXO personnel working at this site have completed Naval Explosive Ordnance Disposal (USNAVSCLEOD) training which details procedures for evaluation and disposal of OE. All USA employees at this job site will have completed a training program, prior to beginning work on site, which complies with OSHA Regulations 29 CFR 1910.120e(9). All USA employees who work on hazardous sites receive training, which includes an equivalent of 40 hours of training off-site and actual field experience under the direct supervision of a trained, experienced Supervisor. Management and Supervisors receive an additional 8 hours training on program supervision. Each employee receives 8 hours of OSHA refresher training annually.

1.5 PROJECT EQUIPMENT

USA has thoroughly assessed the equipment requirements for this project. During mobilization, USA will:

- Package and ship corporate equipment items to SJCA;
- Perform maintenance and quality checks of the equipment to ensure that it is operationally ready;
- Coordinate with CH2M HILL for communications and other support equipment;
- Prepare and issue purchase orders for support equipment items that are not on-hand.

1.6 SITE SPECIFIC TRAINING

As part of the mobilization process, USA will perform site-specific training for all personnel assigned to this project. The purpose of this training is to ensure that all personnel fully understand the procedures and methods USA will use to perform operations at SJCA, their individual duties and responsibilities, and any and all safety and environmental practices/procedures associated with operations. All personnel will be trained as they arrive. Training topics/issues and training responsibilities are as follows:

- The UXO Technicians and support personnel will receive operational briefings and training on their duties and responsibilities. If required by the Navy USA will provide a UXO Briefing. All personnel, to include CH2M HILL crews and subcontractors, will receive ordnance recognition and UXO safety precautions. This training will be performed by the UXO Technician III;
- All personnel will receive training on the individual equipment they will operate while on-site;
- All site personnel will receive detailed training on CH2M HILL's Site Safety and Health Plan (SSHP) and Environmental Protection Plan (EPP);
- Prior to mobilization, all USA personnel will receive HAZWOPER 40 hours (or eight hour refresher) training as required.

1.7 PHASE 2: OPERATIONS

Upon completion of Phase 1 activities, USA will begin Phase 2. The following sub-paragraphs describe the general work practices that USA will follow during all operations, and the specific procedures and methods USA will use during this project.

1.8 GENERAL SITE PRACTICES

All operational activities at SJCA will be performed under the supervision and direction of qualified UXO personnel. Non-essential personnel will be prohibited from entering the UXO operations area or performing operations unless they are accompanied and/or supervised by a UXO Technician. Throughout operations, USA will strictly adhere to the following general practices.

1.8.1 WORK HOURS

Operations will be conducted during daylight hours only. USA will work to CH2M HILL's schedule.

1.8.2 SITE ACCESS

USA, in conjunction with CH2M HILL, will control access into operating areas and will limit access to only those personnel necessary to accomplish the specific operations or who have a specific purpose and authorization to be on the site. No hazardous UXO operations will be conducted when unauthorized persons are in the vicinity.

1.8.3 HANDLING OF UXO

UXO items will be handled by qualified UXO personnel only. Non-UXO site personnel will be emphatically instructed and closely supervised to ensure they do not handle any UXO. OE scrap will not be handled or touched unless a UXO Technician has first checked it.

--THIS POLICY WILL BE STRICTLY ENFORCED--

1.8.4 SAFETY TRAINING/BRIEFING

USA will routinely conduct two distinct safety meetings and briefings: daily tailgate safety briefings, and weekly safety meetings. In addition, the UXO Technician III may hold a safety stand-down at any time he notes any degradation of safety or a safety issue that warrants a review.

1.8.4.1 Daily Tailgate Briefing

The UXO Technician III will conduct tailgate safety briefings. A written record of this training and the signatures of personnel attending the training will be maintained. The training will focus on the specific hazards anticipated at each work site during that day's operations and the safety measures that will be used to eliminate or mitigate those hazards. It will also refer to other operations within the area whose proximity may have safety ramifications. As work progresses and the team's location changes within a site, or from site-to-site, any corresponding changes in ingress/egress routes and emergency evacuation routes will also be reviewed during this tailgate briefing.

1.8.4.2 Weekly Safety Meeting

The UXO Technician III will hold a weekly safety briefing for all personnel. This training will focus on safety issues observed during the past week; any newly identified safety issues, and any needed/required safety or operational refresher training. Although scheduled weekly, these training briefings will be held anytime there is a significant change in site hazards or upon modification of site safety procedures.

1.8.4.3 Visitor Safety Briefing

Site visitors must receive a safety briefing prior to entering the operating area and must be escorted at all times by the UXO Technician III or the CH2M HILL Representative. All visitors entering must sign in at the CH2M HILL field office.

1.8.5 ENVIRONMENTAL AWARENESS

The promotion of environmental awareness will be ongoing as part of safety and operational briefs.

1.8.6 SAFETY AND ENVIRONMENTAL VIOLATIONS

Safety violations or unsafe acts will be immediately reported to the UXO Technician III. Failure to comply with safety rules/regulations or failure to report violations may result in immediate termination of employment. Reckless interference with sensitive species or blatant disregard for environmental issues will likewise not be tolerated and may lead to termination of employment.

1.8.7 WORK CLOTHING AND FIELD SANITATION

Work clothing will be appropriate for the conditions encountered. In most cases this will be Level D PPE. During intrusive operations the PPE will be in accordance with CH2M HILL's Safety and Health Plan.

- Footwear will be sturdy work boots with toe protection;
- Hand protection will consist of leather or canvas work gloves. Rubber inner or outer gloves may be required where increased protection is needed;
- Safety glasses with side shields, hearing protection, and hard hats will be available and worn when engaged in activities where their use is required;
- Clothing will be full-length pants; long or short sleeve shirt (depending on the weather) and a reflective safety vest. In no case will tennis/running shoes or abbreviated attire such as tank tops or shorts be permitted.
- The team will be outfitted with field decontamination equipment, which will consist of portable eye-wash kits, containers of wash water, paper towels and soap. Prior to commencing operations each day, these facilities will be in place and ready for use in the vicinity of the team's work area as needed. Good housekeeping and decontamination measures will be practiced.

1.8.8 COMPLIANCE WITH PLANS AND PROCEDURES

USA will conduct operations at SJCA in a systematic manner using proven operating methods and techniques. All activities will be conducted under the direction, supervision and observation of the UXO Technician III. All personnel will strictly adhere to approved plans and established procedures. When operational parameters change and there is a corresponding requirement to change procedures or routines, careful evaluation of such changes will be conducted by on-site supervisory personnel in close liaison with the CH2M HILL representative. Any new course of action or desired change in procedures will be submitted with justification for approval as required. Approved changes will be implemented in a manner that will ensure uniformity in procedures and end-product quality on the part of the UXO team.

1.8.9 FIELD SANITATION AND WASH POINT

The work team will utilize existing field sanitation stations.

1.9 OE AVOIDANCE AND REMOVAL OF UXO

Throughout this operation, the UXO Technician III will closely monitor performance to ensure these procedures are being performed with due diligence and attention to detail. USA will perform UXO visual detection and avoidance operations as described below.

1.10 PREPARATION OF WORK AREAS

Prior to drilling or sampling crews going on site, the OE team will conduct a reconnaissance of the approach route to work sites. The reconnaissance will include locating a clear path for the crews, vehicles and equipment. The approach paths, at a minimum, will be twice the width of the widest vehicle. The boundaries of the approach path will be clearly marked to prevent personnel from straying into un-cleared areas. If UXO is encountered, the UXO team will mark and report the item, and divert the approach path around the UXO. Personnel will be instructed to remain within the marked boundary limits. A magnetometer will be used to search for near surface anomalies within the approach path. If an magnetic anomaly is encountered, it will be assumed to be a possible UXO, it will be marked, the approach path diverted, and reported. UXO or OE encountered will be handled in accordance with Paragraph 1.13 below.

1.11 DRILLING SITES

Prior to drilling equipment being moved to the proposed well location, the OE team will locate a subsurface anomaly free site. The cleared area will be marked and as a minimum, the cleared area will be a square, with a side dimension equal to twice the length of the largest vehicle or piece of equipment to be brought on site. Personnel will be warned to stay within the marked boundaries. If subsurface anomalies are detected they will be assumed to be UXO/OE and an anomaly free location selected.

1.12 PROCEDURES

During all intrusive operations, such as soil sampling and well installation, the proposed location will be checked with a magnetometer. If subsurface anomalies are detected they will be assumed to be UXO/OE and an anomaly free location selected. CH2M HILL may start well locations with a hand or powered auger or the drill rig. At a depth of not more than two (2) feet the auger or drill bit will be withdrawn and the hole checked with a downhole magnetometer. This procedure will be used to insure that smaller items of UXO, undetectable from the surface, can be detected. If no anomalies are detected, the procedure will be repeated at two-foot intervals to the maximum depth of the auger, but not less than six (6) feet. If a subsurface anomaly is detected the well site will moved to another location and the process repeated.

If the proposed well location is free of anomalies the drilling equipment will be brought on site and utilized. Downhole monitoring with the magnetometer will continue at two-foot intervals until installation of the monitoring well is complete.

1.13 SOIL BORING SITES

Prior to soil sampling the UXO Technician will clear the proposed location in accordance with paragraph 1.10 above. At the sample site the UXO Technician will check for subsurface anomalies and locate an anomaly free location. If, during sampling, UXO is encountered it will be handled in accordance with paragraph 1.13 below. If UXO is encountered that is not safe to move, it will be marked and a new location chosen.

1.14 LIVE AND SUSPECT OE

UXO or OE items encountered a will be inspected by the UXO Technicians. Items that are safe to move may be relocated to a bermed or sandbagged area a safe distance from ongoing operations. No items will be moved unless positively identified and determined safe to move. The item(s) will be marked and reported to CH2M HILL. OE encountered that is *not* safe to move will be marked in place and operations will be moved to another location. UXO will be marked by installing four (4) wooden stakes and encircling the stakes with flagging tape (see Table 1). Prior to installing stakes the location will be checked with a magnetometer to avoid driving the stake into a subsurface anomaly. All live and suspect live items will be inspected and identified by two UXO Technicians. If the item cannot be positively identified and determined to be inert and safe to move, it will be marked and reported.

If during identification of UXO or OE it becomes necessary to move or handle the item, non-UXO qualified personnel will withdraw to a safe distance.

1.15 OE RELATED MATERIAL

Adjacent to each operating area, the UXO Technicians will establish an OE scrap collection point. During operations OE items that are free of explosive contamination (i.e., fragments, parachutes, etc.) will be placed into these collection points and marked (see table 1). Upon completion of operations the materials in these temporary collection points will be transferred to a central collection point for disposal by CH2M HILL. As the material is being loaded, the UXO Technicians will perform a second inspection of the material to ensure it is free of explosives and other hazardous materials.

1.16 HEAVY EQUIPMENT OPERATION

Heavy equipment safety will be in accordance with the CH2M HILL SSHP.

1.17 EQUIPMENT

The equipment requirements for this activity include:

- Well drilling equipment;
- Schonstedt GA-52CX Magnetometer;
- Foerster MK-26 downhole magnetometer;
- Marking material listed in table 1;
- Miscellaneous common hand tools (e.g. hand trowel, shovel, etc.).

Table 1: Color Codes, UXO Avoidance

Color	*Used to Mark*
Red/Orange Tape	*Danger, identified suspect UXO, special precaution required*
White Pin Flag	*Boundary or temporary marker*
Green Paint	*Marking OE-related scrap*

1.18 DISPOSAL OPERATIONS

All UXO and OE-related material containing explosives or hazardous material will be disposed of by other than USA. All hazardous material encountered will be reported to CH2M HILL for disposition.

1.19 RECORDS

The UXO Technician III will prepare and maintain a daily journal that includes a detailed accounting of all UXO and OE encountered and non-hazardous OE related scrap recovered. The inventory will include information pertaining to the following:

- The number, type, and description of UXO items recovered and disposition;
- The number, type, and description of non-hazardous items recovered and stockpiled, and an estimated weight, in pounds, of the scrap remaining for CH2M HILL disposal.

1.20 PHASE 3: DEMOBILIZATION

During this phase, USA will remove its operational capability from the area. All USA owned equipment will be shipped to corporate headquarters and all leased equipment will be returned.

1.21 SUMMARY

USA has developed a comprehensive plan to locate, identify, and avoid OE and OE-related material in the operational areas located at SJCA. Our approach is systematic and the methodology proposed is technically sound and operationally safe.

APPENDIX A

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A.0 SITE SAFETY AND HEALTH PLAN

The purpose of this Site Safety and Health Plan (SSHP) is to establish general guidelines and procedures to ensure protection of USA Environmental, Inc. (USA) personnel and the public while performing operations at the St. Juliens Creek Annex, Chesapeake, VA. This SSHP addresses safety for ordnance and explosives/unexploded ordnance (OE/UXO) avoidance operations and is to be incorporated into the Work Plan. The objective of this SSHP is to provide supervisors and workers the necessary tools to maintain a safe and healthy work place and to protect the environment. USA places safety and accident prevention above operations, and places the burden of responsibility on all employees. A copy of this SSHP is available for review by all employees, and visitors upon request. All supervisors and workers will be required to review the SSHP and sign the log prior to performing any work at the site. Personnel that violate policies contained in this SSHP may be dismissed from the work site and considered for termination.

A.1 SITE DESCRIPTION

A.1.1 ST. JULIENS CREEK ANNEX, CHESAPEAKE, VA.

Refer to the CH2MHILL Work Plan (WP) for a complete description or the site.

A.1.2 SPECIFIC WORK SITES

USA Environmental, Inc. will provide UXO Avoidance Support services at locations within the project site as directed by contract requirements and CH2MHILL personnel. Soil sampling will take place at locations designated by CH2MHILL personnel. OE Support for groundwater monitoring wells and soil borings will take place at Sites 2 and 5

A.2 OBJECTIVE

The objective is for USA Environmental, Inc. to provide UXO Avoidance Support services for OE/UXO found within the project site during soil sampling operations and the installation of groundwater monitoring wells

A.3 ORGANIZATION STRUCTURE AND RESPONSIBILITIES

A.3.1 GENERAL

Ensuring the safe and healthful conduct of site operations is the responsibility of everyone assigned to the site, therefore, all USA personnel involved in site activities will be responsible for the following:

- Complying with the SSHP and all other required safety and health guidelines;
- Taking all necessary precautions to prevent injury to themselves and to their fellow employees;
- Continually being alert to any potentially harmful situation and immediately informing the UXO Technician III or UXO Safety Officer (UXOSO) of any such identified conditions;
- Performing only those tasks that they believe they can do safely and have been trained to do;

- Notifying the UXO Technician III or UXOSO of any special medical conditions (i.e., allergies, contact lenses, diabetes) which could affect their ability to safely perform site operations;
- Notifying the UXO Technician III or UXOSO of any prescription and/or over-the-counter medication which they are taking that might cause drowsiness, anxiety or other unfavorable side affects;
- Preventing spillage and splashing of materials to the greatest extent possible;
- Practicing good housekeeping by keeping the work area neat, clean and orderly;
- Immediately reporting all injuries, no matter how minor to the Technician III or UXOSO;
- Maintaining site equipment in good working order, and reporting defective equipment to the Technician III or UXOSO;
- Properly inspecting and using the PPE required by the SSHP, UXO Technician III or UXOSO.

A.3.2 ORGANIZATION

The Safety and Health (S&H) requirements listed in this plan may change as work progresses at the site, however, no changes will be made without approval of the USA Safety and Health Manager. The safety organizational structure and responsibilities for USA personnel operating at the project site are described in the following paragraphs. USA's Organizational Structure is depicted in Figure A-1 below:

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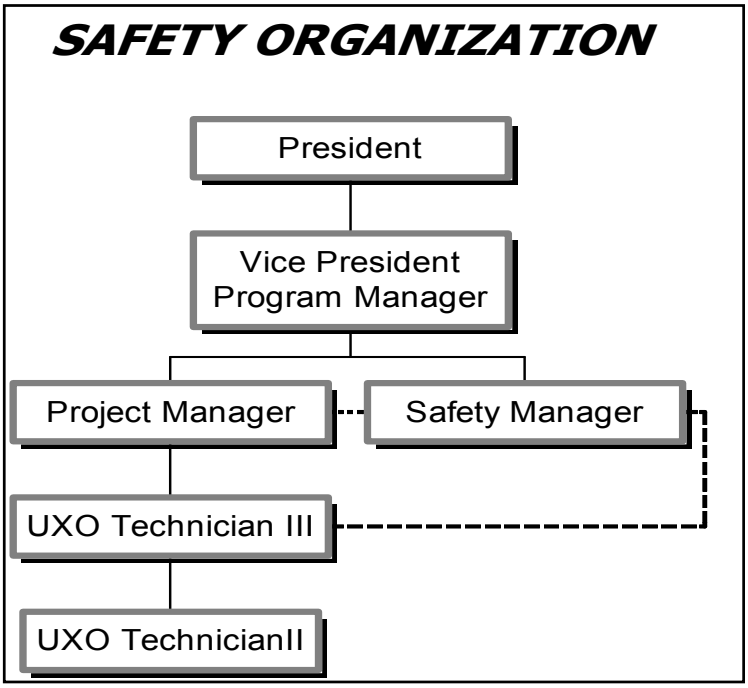

FIGURE A-1

A.3.3 PRESIDENT

Mr. Jonathan Chionchio is the President of USA Environmental, Inc. He has made safety a priority issue at USA. He has designated each and every USA employee as a Safety Officer and charged each employee with the responsibility for stopping unsafe acts before an accident occurs. USA takes safety seriously and Mr. Chionchio's personal involvement in safety is a reflection of USA's commitment to worker safety.

A.3.4 VICE PRESIDENT/PROGRAM MANAGER

Mr. John Adams is the Vice President/Program Manager for USA Environmental, Inc. He is responsible for the effective and efficient operation of all USA OE contracts.

A.3.5 SAFETY AND HEALTH MANAGER

Mr. Robert Crownover is the Safety and Health Manager for USA Environmental, Inc. He is the primary point of contact for safety and health issues at the corporate level. The SHM will have the following responsibilities:

- Reports directly to the Vice President/Program Manager of USA Environmental, Inc. for all safety and health matters;
- Assists in preparation and conducts a final review of the SSHP;
- Provides UXO safety and health consultation to site personnel;

- Coordinates with the Certified Industrial Hygienist (CIH) to ensure site compliance with the SSHP and the USA Corporate Safety and Health Plan (CSHP);
- Maintains an alternate line of communication with the President of USA Environmental, Inc.

A.3.6 PROJECT MANAGER

Mr. George Spencer is the Project Manager for USA Environmental, Inc. During the execution of this contract he will monitor performance and act as the primary point of contact for operational issues at the corporate level.

A.3.7 UXO TECHNICIAN III

The UXO Technician III is responsible for the direct supervision and safety of the personnel under their control and reports to the USA Corporate Project Manager. The Technician III is responsible for ensuring that all work accomplished and all personnel comply with the WP, SSHP, and all applicable federal, state, and local regulations. The UXO Technician III may conduct additional safety meetings and training as needed and reports all safety violations and accidents/injuries to the appropriate personnel. The Technician III will have the following responsibilities:

- Reports directly to the USA Corporate Project Manager;
- Managing the funding, manpower and equipment necessary to safely conduct site operations;
- Reviewing and becoming familiar with the site Work Plan (WP) and SSHP;
- Furnishes copies of the WP and SSHP to site personnel for their review;
- Reviewing the scope of work (SOW) and ensuring that the required safety and health elements are addressed in the SSHP and/or WP;
- Coordinating the assignment of personnel and ensuring that the personnel and equipment provided meet the requirements of the WP and SSHP;
- Ensuring implementation of project quality and safety and health procedures;
- Early detection and identification of potential problem areas, including safety and health matters, and instituting corrective measures;
- Directly interfacing with the CH2MHILL Site Manager and advising him/her of safety and health matters related to conduct of site operations.
- Acts as the alternate On-Scene-Incident-Commander (OSIC) in the event of an emergency, notifying and coordinating with off-site emergency and medical response agencies.

A.3.8 PROJECT UXO SAFETY OFFICER (UXOSO)

The UXO Technician III will perform the UXOSO responsibilities for this project. The UXO Technician III will assume all duties of the UXOSO position and oversee all safety and health aspects of this contract. The UXOSO will have the following responsibilities:

- Has ***STOP WORK*** authority for safety and health reasons;
- Complete Personnel Data Sheets on all site personnel;
- Implement and enforce the SSHP, and report safety violations to the appropriate personnel;
- Establishing work zones and controlling access to these zones;
- Confirm all contractor and subcontractor personnel's suitability for work, based upon OSHA and site specific medical and training requirements;
- Conduct daily General Safety Briefings;
- Implement and document the Site Specific Hazard Information Training Program (as specified by 29 CFR 1910.120);
- Ensure proper condition, maintenance, storage, and use of PPE;
- Consulting with the appropriate personnel prior to downgrading or altering monitoring or PPE requirements;
- Assisting in the continued development of the SSHP and other safety and health procedures;
- On-site enforcement of the Alcohol/Drug Abuse Policy;
- Investigate accidents/incidents and "near misses";
- Conduct visitor orientation;
- Enforce the "buddy" system;
- Conduct and document daily safety inspections, and weekly safety audits;
- Maintain and calibrate safety monitoring equipment, and document calibration data in the monitoring or safety log;
- Restrict site personnel from site activities if they exhibit symptoms of alcohol or drug use or illness, and continually monitor site personnel for signs of environmental exposure or physical stress;
- Maintain the site safety and monitoring logs;
- Act as the On-Scene-Incident-Commander (OSIC) in the event of an emergency, notify and coordinate off-site emergency and medical response agencies;
- Post the descriptions and maps associated with hospital and emergency evacuation routes;
- Conduct on-site safety orientation and operational review. The orientation and review will be accomplished during the first working day at the project site.

A.3.9 UXO TECHNICIAN II

The UXO Technician II is required to comply with the provisions of this SSHP, the WP and all applicable Federal, State and local laws and regulations. The Technician II will report to the UXO Technician III.

A.3.10 RESPONSIBILITIES OF ALL SITE PERSONNEL

Ensuring the safe and healthful conduct of site operations is the responsibility of everyone assigned to the site, therefore, all USA and subcontractor personnel involved in site activities will be responsible for the following:

- Complying with the SSHP and all other required safety and health guidelines;
- Taking all necessary precautions to prevent injury to themselves and to their fellow employees;
- Continual alertness to any potentially harmful situation and the need to immediately inform the Technician III of any such conditions;
- Performing only those tasks that they believe they can do safely and have been trained to do;
- Notifying the Technician III of any special medical conditions (i.e., allergies, contact lenses, diabetes) which could affect their ability to safely perform site operations;
- Notifying the Technician III of any prescription and/or over-the-counter medication which they are taking that might cause drowsiness, anxiety or other unfavorable side affects;
- Preventing spillage and splashing of materials to the greatest extent possible;
- Practicing good housekeeping by keeping the work area neat, clean and orderly;
- Immediately reporting all injuries, no matter how minor to the Technician III;
- Maintaining site equipment in good working order, and reporting defective equipment to the Technician III;
- Reporting to work clean shaven, if required to use respiratory protection;
- Properly inspecting and using the PPE required by the SSHP, Technician III.

A.4 SITE CONTROL

The Technician III coordinates access control and security on site. Due to the hazardous nature of OE/UXO only authorized personnel will be allowed in the exclusion zone (EZ). The EZ is the work site, encompassing an area large enough to prevent personnel injuries from fragmentation resulting from either unintentional or intentional detonations of UXO. During all operations the EZ will be a radius of 200 feet from the operating team for all essential personnel. The limits of the EZ will be marked with visual, suitable marking material. During UXO operations, only UXO trained or authorized essential personnel are allowed in the EZ (unless escorted by the Technician III). Authorized personnel are those that have completed the required training and meet medical requirements.

- Visitors will report to the Technician III. During all operations on individual sites, the site UXO Technician III will cease operations if non-essential personnel are observed within the operating area. During duty hours USA personnel will provide security at the individual sites. Equipment will be returned to a designated area and secured at the end of the workday.

Representatives from regulatory agencies will be permitted to enter the site at any time during business hours or any other reasonable times provided they have completed the required training and meet medical requirements. Further site controls to ensure safety are as follows:

- Eating, drinking, and smoking are prohibited except in designated areas;
- OE/UXO operations will cease if non-UXO trained personnel are present;
- The Technician III will escort all authorized visitors to the site;
- All personnel entering the site, including visitors, will be in the proper PPE;
- The Technician III will maintain the site entry control log to ensure accurate accountability for personnel;
- The Technician III will brief this SSHP to all personnel entering the site to inform them of the potential site hazards. All personnel will acknowledge this briefing by signing the SSHP briefing log;
- In case of an emergency, personnel will exit the site and move to the designated safe area. The safe area will be located upwind of the site outside of the fragmentation area. The Technician III will determine the severity of the emergency. If the emergency warrants evacuation, the Technician III will notify the CH2MHILL Site Manager.

A.5 HAZARD/RISK ANALYSIS

USA has analyzed the scope of work tasking to determine the work risk hazards associated with each task. The tasks consist of direct tasks and the implied tasks, or sub tasks, to accomplish the work. Task hazard analyzes sheets are in paragraph A.46 of this plan. USA has identified the following hazards/risks for the project site:

A.5.1 PERFORM OE/UXO AVOIDANCE SUPPORT

Exposure to hazards associated with surface and subsurface OE/UXO. These items if moved or handled improperly could detonate, either killing or seriously injuring personnel;

- Heavy Equipment operation hazards inherent in the use of EMM;
- Lifting hazards, such as back strain , associated with handling OE scrap;
- Biological hazards: exposure to irritating or toxic plant life; exposure to wildlife, rodents, insects, ticks, and snakes which present the possibility of bites and associated diseases;
- Potential trip hazard associated with ground cover, irregular terrain, and vegetation;
- Heat and cold stress.

A.6 HAZARD CONTROL, ACCIDENT PREVENTION

A.6.1 GENERAL

USA personnel will follow the below listed procedures to mitigate the hazards/risks outlined in paragraph A-5 of the SSHP:

- Any approach to a suspected OE/UXO will be conducted in accordance with procedures outlined in the U.S. Army Engineering and Support Center (CEHNC) Safety Concepts and Basic Considerations Unexploded Explosive Ordnance (UXO), 22 May 2000 (located at the end of this appendix);
- Any OE/UXO found within the confines of the work area will be positively identified by two UXO qualified technicians;
- OE/UXO items will only be moved or handled (when necessary) by qualified UXO/EOD technicians;
- All personnel will wear as a minimum Level D PPE, sleeves rolled down when in heavy vegetation, leather or canvas work gloves and sturdy work boots. This will minimize contact with potentially irritating and/or toxic plants. In addition to these measures, any person known to have allergic reactions to insect bites or exposure to toxic plants will be identified and will carry appropriate first aid materials at all times;
- While on the job, all personnel will move at a moderate pace and stay alert for possible trip hazards;
- Personnel will avoid, to the maximum extent possible, contact with any wildlife. Should a person become bitten he/she will receive immediate first aid;
- Personnel working in vegetated areas will be reminded to check themselves for ticks and insect bites after leaving the work area;
- While working on site all personnel will use the “buddy” system. Buddies will be assigned each day prior to beginning work. They will remain in sight of each other at all times to ensure safe working practices. During hazardous operations one buddy will act as a safety observer.

A.6.2 OE/UXO

These basic safety precautions are the minimum OE/UXO safety requirements required of all personnel on site. Other precautions and requirements are in the CEHNC Safety Concepts and Basic Considerations Unexploded Explosive Ordnance (UXO) at the end of this appendix and other applicable OE/UXO manuals referenced in this SSHP.

A.6.2.1 Basic Considerations

The following should be taken into consideration when planning or conducting OE/UXO operations:

- SAFETY IS PARAMOUNT;
- Do not move or disturb unidentified items.

- All OE/UXO will be identified independently by two (2) UXO technicians;
- Do not collect souvenirs;
- Do not smoke except in designated areas;
- Do not carry fire or spark producing devices into the site;
- All OE/UXO operations will use the "Buddy" system;
- Prohibit unnecessary personnel from visiting the site.

A.6.2.2 Basic Safety Precautions:

The following safety precautions are applicable to all OE/UXO:

- Suspend all operations immediately upon approach of an electrical storm;
- Observe the hazards of electromagnetic radiation (EMR) precautions when working in the vicinity of electrically initiated or susceptible OE/UXO;
- Do not handle any OE/UXO unnecessarily;
- Avoid inhalation and skin contact with smoke, fumes, dust, and vapors of detonations and OE/UXO residue;
- Do not attempt to extinguish burning explosives or any fire which might involve explosive materials;
- Incorporate appropriate property and personnel protective measures for shock and fragmentation when conducting OE/UXO operations;
- Do not subject OE/UXO to rough handling;
- Avoid unnecessary movement of armed or damaged OE/UXO;
- Avoid the forward portions of munitions employing proximity fuzing;
- Assume unknown fuzes contain cocked strikers or anti-disturbance features.

A.6.2.3 General Safety Precautions

A.6.2.1.3 Projectiles

- Determine if the projectile has been fired and if so consider it armed;
- Check for the presence of unburned tracers;
- Avoid the rear and front of rocket assisted and base ejecting projectiles.

A.6.2.2.3 Grenades

- Do not attempt to re-install safety pins on a dud fired grenade;

- Do not attempt to withdraw impinged firing pins from the fuze of a dud fired grenade.

A.6.2.3.3 Rockets

- Approach and work on rockets from the side;
- Do not dismantle or strip dud fired rockets or rocket motors;
- Do not expose electrically fired munitions to radio transmissions within 25 feet.

A.7 CHEMICAL HAZARDS

No chemical munitions have been identified as present on this site. If, during site operations, USA personnel encounter a suspected toxic chemical munition or Recovered Chemical Warfare Material (RCWM) they will immediately withdraw upwind along cleared paths, outside of the fragmentation zone of the ordnance, to a safe location and contact CH2MHILL.

A.8 BIOLOGICAL HAZARDS

Biological hazards, which may be found on site include insects, such as ticks, mosquitoes, spiders, centipedes, snakes, and hazardous plants. Depending on the season and weather the hazards will vary. For instance, during certain seasons many animals and insects are not active and many plants are dormant. Employee awareness and the safe work practices outlined in the following paragraphs should reduce the risk associated with these hazards.

A.8.1 HAZARDOUS PLANTS

During the conduct of site activities contact with hazardous plants may be encountered. The ailments associated with these plants may range from mild hay fever to contact dermatitis, to carcinogenic affects. However, the plants which present the greatest degree of risk to site personnel (i.e., potential for contact vs. affect produced) are those that produce skin and tissue injury and skin reactions.

Contact with splinters, thorns and sharp leaf edges are of special concern to site personnel. This concern stems from the fact that punctures, cuts and even minor scrapes caused by accidental contact may result in non-infectious skin lesions, and the introduction of fungi or bacteria through the skin or eye. Personnel receiving any of the injuries listed above, even minor scrapes, should report immediately to the Technician III for initial and continued observation and care of the injury.

A.8.2 REPTILES AND ANIMALS

A.8.2.1 Snakes

When site activities are conducted in warm weather on sites that are located in vegetated or rocky environments, the potential for contact with snakes becomes a possibility. Normally, if a person is approaching a snake, the noise created by the person is usually sufficient to frighten the snake off. However, during the warm months, extreme caution must be exercised when conducting site operations around areas where snakes might be found (i.e., rocks, bushes, or in holes, crevices, and abandoned pipes). If poisonous snakes are identified on-site, USA will have available for use protective clothing, such as snake leggings, for site personnel. The rules to follow if a snake bites someone are:

- Do not cut "Xs" over the bite area as this will intensify the effect of the venom;
- Do not apply suction to the wound since this has a minimal effective in removing venom;
- Do not apply a tourniquet since this will concentrate the venom and increase the amount of tissue damage in the immediate area;
- If possible, kill the snake without risk to other personnel, bag it and transport it with the victim or try to identify it so proper selection of anti-venom can be made;
- Do not allow the victim to run for help since running increases the heart rate and will increase the spread of the venom throughout the body;
- Keep the victim calm and immobile;
- Have the victim hold the affected extremity lower than the body while waiting for medical assistance;
- Transport the victim for medical attention immediately.

A.8.2.2 Other Animals

Normally wildlife avoid people and areas where activities are ongoing. Small animals may become aggressive when cornered, injured, or infected with rabies. When working remain alert for likely locations that animals inhabit. Avoid nests, dens, and holes in the ground that may be the animal's home. If bitten by an animal, seek medical attention immediately. Do not try to capture the animal, this may result in additional personnel becoming bitten.

A.8.3 TICK BITES

The Center for Disease Control (CDC) has noted that Lyme Disease and Rocky Mountain Spotted Fever (RMSF) which are caused by bites from infected ticks that live in and near vegetated areas, have been identified within the state of Virginia. Ticks are small, ranging from the size of a comma up to about one quarter inch. They are sometimes difficult to see. The tick season extends from spring through summer. When embedded in the skin, they may look like a freckle.

A.8.3.1 Treatment

If you believe you have been bitten by a tick contact the Technician III, who will authorize you to visit a physician for an examination and possible treatment.

A.8.3.2 Protective Measures

Standard field gear (work boots, socks, and work uniform) provide good protection against tick bites, particularly if the openings are taped. However, even when wearing field gear, the following precautions should be taken when working in areas that might be infested with ticks:

- When in the field, check yourself often for ticks, particularly on your lower legs and areas covered with hair;
- Spray outer clothing, particularly your pant legs and socks, ***BUT NOT YOUR SKIN***, with an insect repellant that contains permethrin;

- When walking in vegetated areas, avoid contact with bushes, tall grass, or brush as much as possible;
- If you find a tick, remove it by pulling on it gently with tweezers;
- If the tick resists, cover the tick with salad oil for about 15 minutes to asphyxiate it, then remove it with tweezers;
- Do not use matches, a lit cigarette, nail polish or any other type of chemical to "coax" the tick out;
- Be sure and remove all parts of the tick's body, and disinfect the area with alcohol or a similar antiseptic after removal.

A.8.4 BEES, HORNETS AND WASPS

Contact with stinging insects like bees, hornets and wasps may result in site personnel experiencing adverse health affects that range from being mild discomfort to life threatening. Therefore, stinging insects present a serious hazard to site personnel, and extreme caution must be exercised whenever site and weather conditions increase the risk of encountering stinging insects. Some of the factors related to stinging insects that increase the degree of risk associated with accidental contact are as follows:

- The nests for these insects are frequently found in remote wooded, grassy areas where many waste sites are located;
- The nests can be situated in trees, rocks, bushes or in the ground, and are usually difficult to see;
- Accidental contact with these insects is highly probable, especially during warm weather conditions when the insects are most active;
- If a site worker accidentally disturbs a nest, the worker may be inflicted with multiple stings, causing extreme pain and swelling which can leave the worker incapacitated and in need of medical attention;
- Some people are hypersensitive to the toxins injected by a sting, and when stung, experience a violent and immediate allergic reaction resulting in a life-threatening condition known as anaphylactic shock;
- Anaphylactic shock manifests itself very rapidly and is characterized by extreme swelling of the body, eyes, face, mouth and respiratory passages;
- The hypersensitivity needed to cause anaphylactic shock, can in some people, accumulate over time and exposure; therefore, even if someone has been stung previously, and has not experienced an allergic reaction, there is no guarantee that they will not have an allergic reaction upon receipt of another sting.

With these things in mind and with the high probability of contact with stinging insects, all site personnel will comply with the following safe work practices:

- If a worker knows that he is hypersensitive to bee, wasp or hornet stings, they must inform the Technician III of this condition prior to participation in site activities;

- All site personnel will be watchful for the presence of stinging insects and their nests, and will advise the Technician III if a stinging insect nest or presence of a swarm of bees is located or suspected in the area;
- Any nests located on-site will be flagged off and site personnel will be notified of its presence;
- If stung, site personnel will immediately report to the Technician III to obtain treatment and to allow the Technician III to observe them for signs of allergic reaction;
- Site personnel with a known hypersensitivity to stinging insects will keep required emergency medication on or near their person at all times.

A.8.5 BITING INSECTS

Many types of biting insects such as mosquitoes, flies and fleas may be encountered on-site. The use of insect repellents will be encouraged by the Technician III if deemed necessary. The biting insects of greatest concern are spiders, especially the black widow and the brown recluse. These spiders are of special concern due to the significant adverse health effects that can be caused by their bite.

A.8.5.1 Black Widow Spider

The black widow is a coal-black bulbous spider ¾ to ½ inches in length, with a bright red hour-glass on the under side of the abdomen. The black widow is usually found in dark moist locations, especially under rocks, rotting logs and may even be found in outdoor toilets where they inhabit the underside of the seat. Victims of a black widow bite may exhibit the following signs or symptoms:

- Sensation of pinprick or minor burning at the time of the bite;
- Appearance of small punctures (but sometimes none are visible);
- After 15 to 60 minutes, intense pain is felt at the site of the bite which spreads quickly, and is followed by profuse sweating, rigid abdominal muscles, muscle spasms, breathing difficulty, slurred speech, poor coordination, dilated pupils and generalized swelling of face and extremities.

A.8.5.2 Brown Recluse Spider

The brown recluse is brownish to tan in color, rather flat, 2 to 5/8 inches long with a dark brown “violin” shape on the underside. It may be found in trees, or in dark locations. Victims of a brown recluse bite may exhibit the following signs or symptoms:

- Blistering at the site of the bite, followed by a local burning at the site 30 to 60 minutes after the bite;
- Formation of a large, red, swollen, pustulating lesion with a bull’s-eye appearance;
- Systemic affects may include a generalized rash, joint pain, chills, fever, nausea and vomiting; and pain may become severe after 8 hours, with the onset of tissue necrosis.

A.8.5.3 Treatment For Spider Bites

There is no effective first aid treatment for any of these bites. Except for very young, very old or weak victims, these spider bites are not considered to be life threatening, however medical treatment must be sought to reduce the extent of damage caused by the injected toxins. If any these spiders are suspected or known to be on-site, the Technician III will brief the site personnel as to the identification and avoidance of the spiders. As with stinging insects, site personnel should report to the Technician III if they locate these spiders on site or notice any type of bite while involved in site activities.

A.9 DRUG AND ALCOHOL

USA is committed to having a drug free work place. The unlawful manufacture, distribution, dispensation, purchase, or sale of illegal drugs or alcohol at work is prohibited. Violation of this rule will result in employee termination. In accordance with the Drug-Free Workplace Act of 1988, any employee convicted of a violation of criminal drug statutes while in the employ of USA must notify the USA Human Resources Manager or the subsidiary Human Resources Representative within 5 days of the conviction.

A.10 SUBSTANCE ABUSE

A.10.1 GENERAL CONDITIONS

All employees and subcontractors shall at all times comply with all aspects of USA's Substance Abuse Prevention Program. A copy of the Program is available upon request and is included in this section on the following pages. Employees, or agents, who fail to comply with the program will be prohibited from entering the site.

A.10.2 DRUG SCREENING TEST

All USA employees or agents of subcontractors, or independent contractors hired by subcontractor to perform any of the work under the subcontract who participate in this subcontract, will be required to participate in a Drug Screening Test prior to commencing work on the project, excluding orientation, and after any project related accident that they may be involved in. Employees will be considered probationary workers until Drug Screen Test results are received by the individual's employer and such results are certified to the Technician III by an officer of the employer. The Drug Screening Test will require the production of a urine sample. The urine sample will be tested as a minimum for the following substances:

- Cocaine Metabolite;
- Amphetamines;
- Opiates;
- Phencyclidine;
- Cannabinoids.

Any USA employee, person employed or hired by any subcontractor or contractor who receives a confirmed positive test result will be permanently prohibited from entering project property.

A.10.3 SUBSTANCE ABUSE PREVENTION PROGRAM

The use of illegal drugs, on or off duty is inconsistent with law biding behavior expected of all citizens. The use of illegal drugs, or abuse of alcohol or prescription drugs, on or off duty, may impair the ability of project employees to perform tasks that are critical to proper work performance. The result is an increase in accidents and failures which pose a serious threat to the safety of all employees, visitors and the general public. Impaired employees also tend to be less productive, less reliable and prone to greater absenteeism resulting in the potential for increased cost and delays in the timely completion of our contracts.

Furthermore, employees have the right to work in a drug-free environment and to work with persons free from the effects of drugs and alcohol. Employees who abuse alcohol or drugs are a danger to themselves and to other employees. In addition, drug and alcohol abuse inflicts a terrible toll on the nation's resources and the health and well being of workers and their families.

A.10.3.1 Program Objectives

The substance abuse prevention program has the following objectives and goals:

- To assist in maintaining a safe and healthful working environment for our employees, our customers, visitors, vendors, suppliers, trade/subcontractors and members of the general public;
- To minimize absenteeism and tardiness; to improve productivity; and to ensure quality workmanship;
- To comply with contractual obligations.

A.10.3.2 Program Application

This program will apply to all regular full-time, probationary, casual or contract employees and applicants of USA. This program will be applied to USA on-site personnel. Compliance with this program will be required by USA. Entry onto the Owner's property constitutes consent to the right of the USA, or its authorized representatives, to enforce any aspect of this Substance Abuse Prevention Program.

A.10.3.3 Company Premises for Property Defined

For the purpose of this program the term "Owner's property" includes property, offices, facilities, land, buildings, structures, fixtures, installations, automobiles, vessels, trucks and all other vehicles and equipment, whether owned, leased or used. This also includes all areas under control, or any other work locations or mode of transportation to and from those locations (parameters of job site) during working time and while in the course and scope of company employment, or pay status or while the person is on company business during regular work hours.

A.10.3.4 Unauthorized Drugs, Alcoholic Beverages and Other Items

All USA employees, applicants, suppliers, vendors and visitors that use, abuse, or have presence in the body or reporting to work under the influence, bringing onto company property, unlawful manufacture, distribution, dispensation, possession, transfer, storage, concealment, transportation, promotion or sale of the following illegal and unauthorized drugs, controlled substances, alcoholic beverages, drug-related paraphernalia or weapons by employees and others is strictly prohibited from the company premises, or while on company business and/or during working time.

A.10.3.5 Illegal Drugs

Illegal drugs include:

- Marijuana - pot, dope, hash or hashish;
- Cocaine - coke, rock, crack or base;
- LSD - acid;
- PCP - angel dust, crystal;
- MDMA - ecstasy;
- Heroin - smack, black tar;
- Opium - morphine, white stuff, tar, black stuff;
- Any other unauthorized drugs and abnormal or dangerous substances which may affect an employee's/person's mood, responses, motor functions or alter or affect a person's perception, performance, judgment, reactions, or senses while working.

The foregoing list is provided by way of example only and is not to be considered as all inclusive. This policy prohibits the presence of any confirmed detectable amount of these drugs in the employee/person while on the Owner's Property regardless of when or where the substance entered their body.

A.10.3.6 Prescription Drug Abuse

Employees and others may possess prescription drugs and "over the counter" medications provided:

- The prescription drugs are prescribed by an authorized medical practitioner for current use (within the past 12 months) of the person in possession and the medicine is in its original container and in the employee's/person's name;
- Employees must not consume prescribed drugs more often than as prescribed by the employee's physician, and they must not allow any other person to consume the prescribed drug;
- Any employee who has been informed that the medication could cause adverse side effects while working or where medication indicates such warning, must inform his or her supervisor prior to using such substances on the job;
- The use of drugs/medicine prescribed by a licensed physician for the individual employee is permitted provided that it will not affect work performance. However, the Technician III reserves the right to have a licensed physician determine if use of a prescription drug or medication by an employee may produce effects which increase the risk of injury to the employee or others while working. If such a finding is made, the Technician II may limit or suspend the work activity of the employee during the period that the physician advises that the employee's ability to perform his/her job safely may be adversely affected by the consumption of such medication. Any employee who has been suspended or limited may seek substitute medication from his/her physician and if determination is made that the substitute medication will not adversely affect the employees' performance, then the suspension of limitations will be lifted.

A.10.3.7 Prohibited Material

The following material are prohibited by this program:

- Drug related paraphernalia is unauthorized material or equipment or item used or designed for use in testing, packaging, storing, injecting, ingesting, inhaling, or otherwise introducing into the human body a controlled substance;
- Unauthorized Possession of firearms, weapons, or explosive (incendiary) materials including, but not limited to: brass knuckles, illegal knives and other dangerous instruments;
- No firearms are allowed on the Owner's Property (loaded or unloaded), except when authorized for security purposes.

A.10.3.8 Program Enforcement Activity

(Work place searches, certified urine, drug and/or breathalyzer testing). USA also reserves the right to require all USA project site employees and applicants to undergo medical or physical examinations or tests at any time as a condition of employment or continued employment, including NIDA certified urine drug tests and breathalyzer tests to determine the use of any illegal or unauthorized drugs or substances prohibited in this program or to determine the employee's satisfactory fitness for duty. These tests, through the employee's direct employer, will be utilized under the following circumstances:

- Pre-employment/pre-placement testing will be required of any qualified applicant or candidate as a condition of consideration for employment with USA and trade contractors/subcontractors.
- If an employee suffers an occupational on-the-job injury: (requiring treatment from a doctor) or following a serious or potentially serious accident or incident in which safety precautions were violated, equipment or property was damaged, unusually careless acts were performed, or where the cause was due to an employee's or other person's failure to wear prescribed personal protective equipment or follow prescribed safety rules while working on the Owner's Property.

A.10.3.9 Searches

Whenever the Technician III has a reasonable basis to suspect that an employee's work performance or on-the-job behavior may have been affected by alcohol or drugs, or that the employee has sold, purchased, used or possessed alcohol, drugs, or drug paraphernalia on Owner's Property, or at all times while entering, departing, or on property, properties, or work areas, the Technician III may search the employee, the employee's locker, desk or other property under the control of the employee, as well as the employee's personal effects or automobile on the Owner's Property. *AT NO TIME WILL EMPLOYEE OR OTHERS BE TOUCHED*; only outer clothing will be required to be removed during these searches and inspections. Wherever deemed appropriate, the Technician III may use trained dogs to detect illegal drugs on personnel or on the site.

A.10.3.10 Notice of Disciplinary Action for Program Violations

The Technician III will require employees and others to participate in such Urinalysis, Breathalyzer or search activity as may be necessary to assist in providing a safe, healthful and productive working environment and to comply with Federal Laws. *NO EMPLOYEE OR PERSONS SEARCH, URINALYSIS, BREATHALYZER OR INSPECTION WILL BE CONDUCTED WITHOUT THE EMPLOYEE'S CONSENT*, and whenever practicable, the Technician III will request the employee's written consent. However, failure

to comply with the provisions of this program or failure to provide consent when requested shall be grounds for removal from the job site.

A.10.3.11 Offense Discharge

An employee shall be subject to removal from the job site for the following:

- The employee refuses to submit to a search or inspection, urinalysis or breathalyzer when requested by the Technician III. Refusal to submit to a search, inspection or test will be considered sufficient cause for removal from the job site.
- While on the site, the employee was using, manufacturing, distributing, dispensing, selling, or possessing any illegal or unlawful drug.
- The employee has failed his/her Substance Abuse Test.

A.11 SAFE WORKING PRACTICES (SWP)

All personnel on-site will be required to follow the SWPs contained in this Section and the work plan, and will immediately report to the Technician III any conditions which do not comply with this section. The provisions outlined in this section are intended to be the minimum SWPs which site personnel will follow.

A.11.1 POWER AND HAND TOOL OPERATION

A.11.1.1 Power Tools

By their very nature, power tools have great capability for inflicting serious injury upon site personnel if they are not used and maintained properly. Power tools must be manufactured by companies with a listing by an accepted testing laboratory to be authorized for use. To control the hazards associated with power tool operation, the requirements outlined in EM 385-1-1, Section 13, the manufacturers instructions and recommendations, and the safe work practices listed below shall be observed when using power tools:

- Operation will be conducted by authorized personnel familiar with the equipment, its operation, and safety precautions;
- Power tools will be inspected prior to use and on a continued periodic basis, defective equipment will be removed from service until repaired;
- Power tools designed to accommodate guards will have such guards properly in place prior to use;
- Loose fitting clothing or long hair will not be permitted around moving parts;
- Hands, feet, etc., will be kept away from all moving parts;
- Maintenance and/or adjustments to equipment will not be conducted while it is in operation; the power will be disconnected prior to maintenance activities;
- An adequate operating area will be provided, allowing sufficient clearance and access for operation;
- Personnel will use all required PPE, such as gloves, glasses, and hearing protection.

A.11.1.2 Hand Tools

Use of improper or defective tools can contribute significantly to the occurrence of accidents on site. Therefore, the requirements of EM 385-1-1, Section 13 and the safe work practices listed below shall be observed when using hand tools:

- Hand tools will be inspected for defects prior to each use and on a continued basis;
- Defective hand tools will be removed from service and repaired or properly discarded;
- Tools will be selected and used in the manner for which they were designed;
- Be sure of footing and grip before using any tool;
- Do not use tools that have split handles, mushroom heads, worn jaws, or other defects;
- Gloves will be worn to increase gripping ability and/or if cut, laceration or puncture hazards exist during the use of hand tools;
- Safety glasses or a face shield will be used if use of tools presents an eye/face hazard;
- Do not use makeshift tools or other improper tools;
- When working overhead, tools will be secured to ensure they cannot fall on someone below;
- Use non-sparking tools in the presence of explosive vapors, gases, or residue.

A.11.2 MATERIAL LIFTING

Many types of objects are handled in normal day-to-day operations. Care should be taken in lifting and handling heavy or bulky items because they are the cause of many joint and back injuries. The requirements of EM 385-1-1, Section 14 and the following fundamentals address the proper lifting of materials to avoid joint and back injuries:

- The size, shape and weight of the object to be lifted must be considered. Site personnel will not lift more than they can handle comfortably;
- A firm grip on the object is essential, therefore the hands and object shall be free of oil, grease and water, which might prevent a firm grip;
- The hands, and especially the fingers shall be kept away from any points that cause them to be pinched or crushed, especially when setting the object down;
- The item will be inspected for metal slivers, jagged edges, burrs, rough or slippery surfaces and pinch points, and gloves shall be used, if necessary, to protect the hands;
- Use powered lifting devices if possible;
- The feet will be placed far enough apart for good balance and stability;
- Personnel will ensure that solid footing is available prior to lifting the object;

- When lifting, get as close to the load as possible, bend the legs at the knees, and keep the back as straight as possible;
- To lift the object, the legs are straightened from their bending position;
- Never carry a load that you cannot see over or around;
- When placing an object down, the stance and position are identical to that for lifting: with the back kept straight and the legs bent at the knees, the object is lowered; and
- If needed, USA will provide back support devices to their personnel to aid in preventing back injuries during lifting activities.
- When two or more people are required to handle an object, coordination is essential to ensure that the load is lifted uniformly and that the weight is equally divided between the individuals carrying the load. When carrying the object, each person, if possible, shall face the direction in which the object is being carried.

A.11.3 FIRE HAZARDS

A.11.3.1 Causes of Fires and Explosions

Although fires and explosions may arise spontaneously, they are more commonly the result of carelessness during the conduct of site activities, such as moving drums, mixing/bulking of site chemicals and during refueling of heavy or hand held equipment. Personnel will review EM385-1-1, Section 9 for additional fire prevention and protective measures. Some potential causes of explosions and fires include:

- Mixing of incompatible chemicals, which cause reactions that spontaneously ignite due to the production of both flammable vapors and heat;
- Ignition of explosive or flammable chemical gases or vapors by external ignition sources;
- Ignition of materials due to oxygen enrichment;
- Agitation of shock or friction-sensitive compounds;
- Sudden release of materials under pressure.

A.11.3.2 Fire Prevention

Explosions and fires not only pose the obvious hazards of intense heat, open flames, smoke inhalation, and flying objects, but may also cause the release of toxic chemicals into the environment. Such releases can threaten both personnel on-site and members of the general public living or working nearby. Site personnel involved with potentially flammable material or operations will follow the requirements of EM 385-1-1, Section 09.B, and the guidelines listed below to prevent fires and explosions:

- Potentially explosive/flammable atmospheres involving gases or vapors will be monitored using a combustible gas indicator;
- Prior to initiation of site activities involving explosive/flammable materials, all potential ignition sources will be removed or extinguished;

- Non-sparking and explosion-proof equipment will be used whenever the potential for ignition of flammable/explosive gases/vapors/liquids exists;
- Dilution or induced ventilation may be used to decrease the airborne concentration of explosive/flammable atmospheres;
- Smoking is prohibited at OE/UXO work sites, or in the vicinity of, operations which may present a fire hazard, and the area will be conspicuously posted with signs stating "No Smoking or Open Flame Within 50 Feet";
- Flammable and/or combustible liquids must be handled only in approved, properly labeled metal safety cans equipped with flash arrestors and self-closing lids;
- Transfer of flammable liquids from one metal container to another will be done only when the containers are electrically interconnected (electrically bonded);
- Equipment fueling points will be in an approved location and a safe distance from ongoing operations;
- Equipment fueling points will have spill containment/absorbent material available;
- Equipment fueling points and storage areas will have the appropriate type and size fire extinguisher ready for use;
- The motors of all equipment being fueled will be shut off during the fueling operations;
- Metal drums used for storing flammable/combustible liquids will be equipped with self-closing safety faucets, vent bung fittings, grounding cables and drip pans, and will be stored in an area approved by the Technician III.

A.11.3.3 Fire Protection

The following safe work practices will be used to protect against fires:

- Vehicles and equipment will not be fueled while running;
- Flammable/combustible liquid storage areas will have at least one 3A:40:B:C: fire extinguisher located within 25-75 feet, marked with the appropriate fire symbol and no smoking signs;
- Temporary offices will be equipped with a fire extinguisher of not less than 2A:10B:C;
- At least one portable fire extinguisher having a rating of not less than 2A:20B:C will be located at each work site.

A.11.4 EXCAVATIONS AND CONFINED SPACES:

Excavation activities will be conducted in accordance with 29 CFR 1926, and the USA SHP. The guidelines below are intended to reflect minimum requirements to be followed on this site:

- Prior to initiation of any excavation or trenching activity, the location of underground installations will be determined if applicable;

- When the excavation/trench achieves a depth of greater than four feet, the Technician III will determine the type of soil being excavated and designate the slope which will be used;
- The excavation(s) will be inspected daily by a competent individual prior to commencement of work activities;
- Evidence of cave-ins, slides, sloughing, or surface cracks will be cause for work to cease until necessary precautions are taken to safeguard workers;
- Excavations 5 feet. or deeper, which cannot be slopped at a 1.5 to 1 ratio, will require a competent individual to design and install a protective system;
- Protective systems shall be selected from OSHA 29 CFR 1926 Subpart P and/or designed by a registered professional civil engineer;
- Spoils and other materials will be placed 2 feet. or more from the edge of the excavation;
- Materials used for sheeting, shoring, or bracing will be in good condition.
- Timbers will be sound, free of large or loose knots, and of appropriate dimensions for the excavation;
- Safe access will be provided into the excavation(s) by means of a gradually sloped personnel access/egress ramp, or ladders or stairs will be provided;
- Ladders used will extend 3 feet. above grade level and be secured from movement.
- Excavations 4 feet or more in depth will have a means of egress at a frequency such that lateral travel to the egress point does not exceed 25 feet;
- Walkways or bridges with standard guardrail will be provided where employees are required or permitted to cross over excavations;

If the depth of an excavation is greater than 4 feet, it will be inspected by the Technician III to determine if it meets the criteria for a confined space;

- If an excavation is determined to be a Confined Space the requirements set forth in the Confined Space Program found in the USE SHP will apply;
- IAW the requirements of 29 CFR 1926.651(g), if an excavation is greater than 4 feet in depth, and the potential for having a hazardous atmosphere inside the excavation exists, then the atmosphere shall be tested for oxygen deficiency and toxicity prior to entry by site personnel.

According to 29 CFR 1910.146, a confined space is defined as having all of the following criteria:

- It is large enough and so configured that an employee can bodily enter and perform assigned work;
- Is not designed for continuous human occupancy;
- Has limited or restricted means for entry or exit.

If an excavation meets all three of the criteria listed above, it must be defined as a confined space, and the provisions and safety precautions of the USA SHP will apply. To avoid classifying an excavation as a confined space, it is imperative that one of the requirements listed above be removed or avoided. The easiest requirement to remove is the one related to limited means of entry and exit. Entry/exit points must be designed and maintained which allow for easy entry and exit from the excavation. This can be accomplished through the construction of gently sloping entry and exit ramps which are located such that lateral travel to an exit is no greater than 25 feet from the work area in the excavation. If this can not be accomplished, then the excavation must be classified as a confined space and the appropriate safety precautions implemented.

A.12 BLOODBORNE PATHOGEN PROGRAM AND TRAINING

Due to the nature of OE/UXO work there is the potential for exposure to blood pathogens as a result of an accident or injury. Typically, work sites are in remote areas and first aid and/or other employees provide initial emergency first aid on site. Personnel will receive training on bloodborne pathogens prior to beginning work at the site.

A.12.1 DEFINITIONS

- Bloodborne Pathogens: Pathogenic microorganisms that are present in human blood and can cause disease in humans. These pathogens include, but are not limited to, hepatitis B virus (HBV) and human immunodeficiency virus (HIV).
- Exposure Incident: A specific eye, mouth, other mucous membrane, non-intact skin, or parenteral contact with blood or other potentially infectious materials that results from the performance of an employee's duties.
- Other Potentially Infectious Materials: Including the following human body fluids:
  - Semen, vaginal secretions, cerbro-spinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, any body fluid that is visibly contaminated with blood, and all body fluids in situations where it is difficult or impossible to differentiate between body fluids.
  - Any unfixed tissue or organ (other than intact skin) from a human living or dead.
- Parenteral: Piercing mucous membranes or the skin barrier through such events as needle sticks, human bites, cuts, and abrasions.
- Work Practice Controls: Controls that reduce the likelihood of exposure by altering the manner in which a task is performed.
- Universal Precautions: An approach to infection control. According to the concept of Universal Precautions, all human blood and certain human body fluids are treated as if known to be infectious for HIV, HBV, and other Bloodborne pathogens.

A.12.2 EXPOSURE CONTROL PLAN:

A.12.2.1 Exposure Determination

Due to the hazardous nature of OE/UXO work there is the potential for accidents and the exposure to blood pathogens. USA employees will be required to perform emergency first aid and/or CPR in the event of an accident or injury.

A.12.2.2 Work Practice Controls

PPE (CPR Pocket Mask and disposable surgical gloves) are available in all first aid kits on site. Hand washing facilities are available in the EZ and SZ. Personnel performing first aid and/or CPR will comply with the following:

- Personnel that provide any first aid will wear disposable latex gloves if there is any visible body fluids;
- The CPR Pocket mask will be used when performing CPR and disposed of after use;
- Personnel will change clothing immediately, or as soon as feasible, that becomes contaminated with body fluids as a result of performing first aid;
- Personnel will immediately wash their hands after performing first aid procedures;
- Contaminated clothing and equipment will be bagged in red BIO-Hazard bags, labeled as to date and contents, and deposed of as infectious waste.

A.12.2.3 Post-Exposure Evaluation and Follow-Up

Following an exposure incident, USA will make available, to the exposed employee, a confidential medical evaluation and follow-up containing the following elements:

- Documentation of the routes(s) of exposure, and the circumstances under which the exposure incident occurred;
- The source individual's and exposed employee's blood will be collected as soon as feasible and tested after consent is obtained;
- The results of the source individual's testing will be made available to the exposed employee, and the employee will be informed of applicable laws and regulations concerning disclosure of the identity and infectious status of the source individual.

A.12.2.4 Information and Training

Training will be provided as initial site training prior to beginning work at the site. The training will be documented on the USA *ON-SITE SAFETY MEETING RECORD* on file as part of initial training. This training will be provided and documented annually for all employees.

A.13 QUALIFICATION TRAINING

All USA UXO personnel working on site have completed Naval Explosive Ordnance Disposal (USNAVSCLEOD) training which details procedures for evaluation and disposal of OE/UXO. All employees at this job site will have completed a training program, prior to beginning work on site, which complies with OSHA Regulation 29 CFR 1910.120e (1), (4) and/or (9). All USA employees who work on hazardous sites receive training, which includes an equivalent of 40 hours of training off-site and 3 days of actual field experience under the direct supervision of a trained, experienced Supervisor. Management and Supervisors receive an additional 8 hours training on program supervision. Each employee receives 8 hours of OSHA refresher training annually. Copies of training and qualifications will be on file at the Corporate or other designated location.

A.14 SITE SPECIFIC TRAINING

The Technician III will give site-specific training to all UXO and non-UXO personnel prior to initial site entry. The training will include:

- Project scope to include: organization and responsibilities; site orientation, facilities, access, egress, evacuation routes, and other general information;
- Safety, to include: safe work practices; physical hazards, PPE; on/off-site emergencies; evacuation routes; emergency agencies/numbers; emergency equipment; medical emergencies; Drug and Alcohol; Bloodborne pathogens; and other pertinent safety information.

A.15 ADDITIONAL TRAINING/MEETINGS

A.15.1 DAILY SAFETY MEETING

Safety training will be provided each morning on-site at the daily safety meeting. The safety and health considerations for the day's activities will be reviewed. Additional training will be conducted when circumstances dictate. The daily meeting will address that day's activities; safety issues; specific hazards; and emergency procedures, to include:

- Notification procedures and phone numbers;
- Rally points, and safe areas;
- Hospital and evacuation routes;
- Emergency equipment.

A.15.2 TAILGATE SAFETY MEETING

The Technician III conducts the Tailgate Safety meeting. The safety and health considerations for the task being performed by the individual team members will be reviewed. Additional task specific training may be conducted as required. The tailgate safety meeting will address the specific task and activities being performed at the teams location and entries made on the Tailgate Safety Meeting form.

A.15.3 WEEKLY SAFETY MEETING

The week's safety and health considerations for the site will be reviewed. The Technician III will brief changes, recommendations, concerns or violations. This meeting is documented and shall include subjects covered and personnel attending.

A.16 PERSONAL PROTECTIVE EQUIPMENT (PPE)

PPE required at the site will be at a level necessary to protect personnel and IAW EM 385-1-1, Section 5. Normal work clothing will be level D. During OE/UXO operations a hard hat is not required unless a possible head injury could result from the use of equipment or overhead hazards. Steel toe footwear will not be used while operating magnetometers or geophysical instruments.

A.16.1 LEVEL D PPE

The minimum level of protection required of all personnel at the site is level D. The following is level D protection:

- Short or long sleeve cotton coveralls or work clothing;
- Sturdy work boots;
- Safety glasses with side shields or goggles when an eye hazard exists;
- Hard hat (when required);
- Leather or canvas work gloves;
- Hearing protection, when working around equipment or powered hand tools producing a noise hazard.

The level of protection is based on what is known about the site. The levels of protection may change as site conditions change. The Technician III will monitor site conditions and provide information to the CH2MHILL Site Manager as necessary. The Technician III may increase the levels of protection when necessary but will not downgrade the level without approval from the USA SHM.

A.17 MEDICAL

All personnel on site have completed a pre-placement or annual physical examination that complies with the requirements of EM 385-1-1, Section 3 and29 CFR 1910.120 and have been certified as fit to work by an Occupational Physician certified in Occupational Medicine by the American Board of Preventive Medicine, or who by necessary training and experience is board eligible. All USA UXO personnel on-site are in the USA medical surveillance program. Documentation as to the medical qualifications of personnel are on file on site and available to the Contracting Officer. All personnel are screened for drugs in accordance with the USA Drug/Alcohol Abuse Program.

A.18 EXPOSURE MONITORING/AIR SAMPLING

While OE/UXO investigation may result in emissions of inhalable particulates and other criteria pollutant, these activities are not expected to adversely affect air quality. Engineering controls, such as wetting,

may be used to eliminate the suspension of dust and other particulates that may become airborne and migrate off-site.

A.19 COLD AND HEAT STRESS

During activities conducted on OE/UXO sites, extreme temperature conditions can create serious safety and health threats to site workers. The concern at the project site will initially be heat stress as cold stress conditions are not anticipated. The Technician III will identify and monitor personnel that have had previous problems with heat stress. This section addresses the potential hazards associated with heat stress, and outlines the procedures for monitoring and controlling those hazards.

A.19.1 COLD STRESS

The affects experienced by site personnel when working in cold environments depend upon many environmental and personal factors such as ambient air temperature, wind speed, duration of exposure, type of protective clothing and equipment worn, type of work conducted, level of physical effort and health status of the worker. In cold environments, overexposure can cause significant stress on the body which can lead to very serious and permanent injury. Cold may affect just the exposed body surfaces and extremities or may affect down to the deeper body tissues and the body core. Presented below is information about the most common cold stress disorders and their signs, symptoms, affects and control techniques.

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TABLE A-1: WIND CHILL

COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED AS EQUIVALENT TEMPERATURE												
ACTUAL TEMPERATURE READING (° F)												
ESTIMATED WIND SPEED (in mph)	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (° F)											
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect)	LITTLE DANGER In<hr with dry skin. Maximum danger of false sense of security				INCREASING DANGER Danger from freezing of exposed flesh within one minute.				GREAT DANGER Flesh may freeze within 30 seconds			
	Trench foot and immersion may occur at any point on this chart											

A.19.1.1 Hypothermia/Frostbite

Hypothermia results when the body loses heat faster than it can produce it. When this occurs, the blood vessels in the skin and extremities constrict, reducing the flow of warm blood to those areas, thereby reducing the rate of heat loss. This reduction in blood flow usually affects the peripheral extremities first. Ears, fingers and toes begin to experience chilling then pain and finally numbness due to loss of both blood flow and heat. Shivering begins as the body's core temperature begins to drop and the body uses the shivering to compensate and create metabolic heat. Shivering is often the first sign of hypothermia. The pain and numbness in the extremities is an indication that the heat loss is increasing, and when shivering becomes uncontrollable, the heat loss in the body core has become extreme. Further heat loss produces speech difficulty, forgetfulness, loss of manual dexterity, collapse and finally death.

Frostbite usually occurs on exposed skin and the extremities, such as face, hands and feet. There are several degrees of injury from frostbite ranging from mild to severe: frost nip or incident frostbite is

characterized by sudden blanching or whitening of the skin; with superficial frostbite the skin has a waxy or white appearance and is firm to the touch but the tissue beneath is resilient; the most serious is deep frostbite where the tissues are cold, pale, and solid.

A.19.2 TREATMENT OF COLD STRESS DISORDERS

The intent of all cold stress treatment is to bring the deep body core temperature back to its normal temperature of about 98.6°F. Work performed in cold environments should be discontinued for any worker who exhibits the signs or symptoms associated with hypothermia or frost bite. Workers exhibiting those symptoms are brought to a warm area and allowed to rest and warm up. If a worker's clothing becomes wet, reducing its insulating effect, it should be removed and replaced by dry clothing or allowed to dry before resuming work. A warm, non-alcohol, de-caffeinated drink (not coffee) or soup may be given. Re-warming should be gradual. For frostbite the victim should be sheltered from the wind and cold and given warm drinks. If the frostbite is superficial the frozen part should be covered with extra clothing or blankets or warmed against the body. **Do not use direct heat, and do not pour hot water over or rub the affected area.** Warming should be gentle and gradual. Failure to do this could lead to bleeding in the tissues and increase the possibility of infection. If the frostbite is deep, i.e. the affected area is frozen and hard to the touch, immediate medical attention should be obtained. The safe thawing of deep frostbite is beyond the expertise and facilities found on-site.

A.19.3 PREVENTION OF COLD STRESS DISORDERS

During work in cold environments the UXOSO uses the tailgate safety briefing to inform site personnel of the measures to be utilized in the prevention and control of cold stress. The UXOSO also uses meteorological data and Table A-1 to inform site personnel of the combined temperature/wind chill affect to be expected during the day's activities. At air temperatures below 45 degrees F the temperature will be monitored. At temperatures below 30 degrees F the dry bulb temperature and wind speed will be measured every four hours to determine the wind-chill. When the temperature/wind-chill is expected to be below freezing, personnel will take more frequent breaks. Prevention methods that site personnel utilize include:

- Buddy system: Personnel monitor their buddy for signs of cold stress;
- Wearing adequate, appropriately layered clothing, including a water repellant outer layer if precipitation is forecasted;
- Layered clothing includes an innermost layer, such as cotton to trap heat and absorb perspiration, an insulating layer of wool or synthetic fiberfill (such as polypropylene), a layer of work weight clothing, and an outer protective layer designed to be wind/water proof, such as nylon or Gortex™;
- Wearing a hat and gloves and socks that are synthetic or wool insulated to help retain body heat and prevent its loss;
- Removing outer layers of clothing during breaks in heated shelters to prevent excessive sweating;
- In windy, cold conditions, covering all exposed skin;
- Eating well-balanced meals and maintaining adequate intake of non-alcoholic, decaffeinated fluids;

- Seeking shelter in a warm protected area when signs and symptoms of cold stress become evident; and
- Protecting clothing from getting wet; this includes keeping clothing from getting wet with sweat, so remove outer layers if work activities cause excessive sweating.

TABLE A-2: TLV WORK/WARM-UP

Air Temperature—Sunny Sky		No Wind		5 MPH Wind		10 MPH Wind		15 MPH Wind		20 MPH Wind	
^{0}C approx.	^{0}F approx.	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
$^-26^0$ to -28^0	-15^0 to -19^0	Normal	1	Normal	1	75 min	2	55 min	3	40 min	4
-29^0 to -31^0	-20^0 to -24^0	Normal	1	75 min.	2	55 min.	3	40 min	4	30 min	5
-32^0 to -34^0	-25^0 to -29^0	75 min.	2	55 min.	3	40 min.	4	30 min	5	Non-emergency work should cease	
-35^0 to -37^0	-30^0 to -34^0	55 min.	3	40 min.	4	30 min.	5	Non-emergency work should cease			
-38^0 to -39^0	-35^0 to -39^0	40 min.	4	30 min.	5	Non-emergency work should cease					
-40^0 to -42^0	-40^0 to -44^0	30 min.	5	Non-emergency work should cease							
-43^0 & below	-45^0 & below	Non-emergency work should cease									

Notes for Table:

1. Schedule applies to any 4-hour work period with moderate to heavy work activity, with warm-up periods of ten (10) minutes in a warm location and with an extended break (e.g., lunch) at the end of the 4-hour work period in a warm location. For Light-to-Moderate Work (limited physical movement): apply the schedule one step lower. For example, at -35^{0}C (-30^{0}F) with no noticeable wind (Step 4), a worker at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4-hour period (Step5).

2. The following is suggested as a guide for estimating wind velocity if accurate information is not available:

5 mph: light flag moves; 10 mph: light flag fully extended; 15 mph: raises newspaper sheet; 20 mph: blowing and drifting snow.

3. If only the wind chill cooling rate is available, a rough rule of thumb for applying it rather than the temperature and wind velocity factors given above would be:

- special warm-up breaks should be initiated at a wind chill cooling rate of about 1750 W/m^2;
- all non-emergency work should have ceased at or before a wind chill of 2250 W/m^2. In general, the warm-up schedules provided above slightly under-compensates for the wind at the warmer temperatures, assuming acclimatization and clothing appropriate for winter work. On the other hand, the chart slightly over-compensates for the actual temperatures in the colder ranges because windy conditions rarely prevail at extremely low temperatures.

4. TLVs apply only for workers in dry clothing.

*Adapted from the " Threshold Limit Values and Biological Exposure Indices,

American Conference of Governmental Industrial Hygienist, Cincinnati, OH.

USA assists in the prevention of cold stress by providing sheltered, warm areas where site personnel can rest and regain body heat during breaks (see Table A-2: Warm-up Schedule). When conditions warrant USA will provide hot water for personnel to prepare their cocoa, soup, etc. If approved by USACE, a heated shelter may be provided inside the EZ, upwind from the work area, where site personnel can rest and warm-up.

- Warm fluids, such as soup or decaffeinated tea and cocoa, will be provided as needed;
- A minimum of one fifteen minute break in a heated shelter every two hours;
- A heated shelter may be provided inside the EZ, upwind from the work area, where site personnel can rest and warm-up after having processed through a limited PDS consisting of glove wash and removal, respirator wash and removal, and hand washing.

A.19.4 HEAT STRESS

Heat stress is one of the most common (and potentially serious) illnesses that can affect hazardous waste site workers. The most common cause of heat stress during site activities is the affect that PPE has on the body's natural cooling mechanism. Individuals will vary in their susceptibility and degree of response to the stress induced by increased body heat. Factors which may predispose a worker to heat stress include: lack of physical fitness; lack of acclimatization to hot environments; degree of hydration; level of obesity; current health status (i.e.,. having an infection, chronic disease, diarrhea, etc.); alcohol or drug use; and the worker's age and sex. For the remainder of this Section, reference to "liquids" will indicate water or an electrolyte replacement solution - not tea, coffee or soft drinks.

A.19.4.1 Heat Stress Disorders

A.19.4.1.1 Heat Rash

Heat rash is caused by continuous exposure to heat and humid air and is aggravated by wet chafing clothes. This condition can decrease a worker's ability to tolerate hot environments.

- Symptoms: Mild red rash, especially in areas of the body that sweat heavily.
- Treatment: Decrease amount of time in protective gear and provide powder such as cornstarch or baby powder containing cornstarch to help absorb moisture and decrease chafing. Maintain good personal hygiene standards and change into dry clothes if needed.

A.19.4.2.1 Heat Cramps

Heat cramps are caused by a rate of perspiration that is not balanced by adequate fluid and electrolyte intake. The occurrence of heat related cramps are often an indication that excessive water and electrolyte loss has occurred, which can further develop into heat exhaustion or heat stroke.

- Symptoms: Acute, painful spasms of voluntary muscles such as the back, abdomen and extremities.

- Treatment: Remove victim to a cool area and loosen restrictive clothing. Stretch and massage affected muscles to increase blood flow to the area. Have patient drink one to two cups of liquids immediately, and every twenty minutes thereafter. Consult with physician if condition does not improve. If available, an electrolyte replacement solution should be taken along with water. Consumption of soft drinks will not be adequate and may aggravate the condition.

A.19.4.3.1 Heat Exhaustion

Heat exhaustion is a state of very definite weakness or exhaustion caused by excessive loss of fluids from the body. This condition leads to inadequate blood supply and cardiac insufficiency. Heat exhaustion is less dangerous than heat stroke, but nonetheless must be treated. If allowed to go untreated, heat exhaustion can quickly develop into heat stroke.

- Symptoms: Pale or flushed, clammy, moist skin, profuse perspiration, and extreme weakness. Body temperature is basically normal or slightly elevated, the pulse is weak and rapid, and breathing is shallow. The individual may have a headache, be dizzy or nauseated.

- Treatment: Remove the individual to a cool, air-conditioned place, loosen clothing, elevate feet and allow individual to rest. Consult physician, especially in severe cases. Have patient drink one to two cups of liquids immediately, and every twenty minutes thereafter. Total liquid consumption should be about one to two gallons per day. If the signs and symptoms of heat exhaustion do not subside, or become more severe, immediate medical attention will be required.

A.19.4.4.1 Heat Stroke

Heat stroke is an acute and dangerous reaction to heat stress caused by a failure of the heat regulating mechanisms of the body. Heat Stroke occurs when the body's system of temperature regulation fails and the body temperature rises to critical levels. When this occurs, the body core temperature rises very rapidly to a point where brain damage and death will result if the person is not cooled quickly.

- Symptoms: The victims skin is hot, and may or may not be red and dry, due to the fact that the individual may still be wet from having sweat while wearing protective clothing earlier; nausea; dizziness; confusion; extremely high body temperatures, rapid respiratory and pulse rate; delirium; convulsions; unconsciousness or coma.

- Treatment: Cool the victim immediately. If the body temperature is not brought down quickly, permanent brain damage or death may result. Cool the victim by either sponging or immersing the victim in very cool water to reduce the core temperature to a safe level. If conscious, give the victim cool liquids to drink. Observe the victim and obtain immediate medical help. Do not give the victim caffeine or alcoholic beverages.

A.19.5 PREVENTATIVE MEASURES

In order to avoid heat related illnesses, proper preventative measures will be implemented whenever environmental conditions dictate the need. Heat stress monitoring will begin at +75 degrees Fahrenheit. Methods for determining heat stress monitoring, such as the wet bulb globe temperature (WBGT) index from American Conference of Governmental Industrial Hygienist (ACGIH) Threshold Limit Values (TLV) booklet or portable heat stress monitoring instrumentation can be used. The preventative measures listed in this paragraph represent the minimal steps to be taken and will include the following procedures:

- The Technician III may examine each site worker prior to the start of daily operations in order to determine the individual's susceptibility to heat stress. The Technician III will closely monitor workers exhibiting factors that make them susceptible to heat stress.
- Site workers will be trained to recognize and treat heat related illnesses. This training will include the signs, symptoms and treatment of heat stress disorders.
- Workers will be encouraged to drink a minimum of sixteen ounces of liquids prior to start of work in the morning, after lunch and prior to leaving the site at the conclusion of the days activities. Acceptable liquids will include water and an electrolyte replacement solution, with the intake of each being equally divided. Liquids containing caffeine are to be avoided.
- When ambient conditions and site workload requirements dictate, as determined by the Technician III, workers will be required to drink a minimum of sixteen (16) to thirty-two (32) ounces of liquids during each rest cycle.
- A shelter or shaded area will be provided where workers may be protected from direct sunlight during rest periods.
- Monitoring of ambient or physiological heat stress indices will be conducted to allow prevention and/or early detection of heat induced stress.
- Site workers will be given time to acclimatize to working in hot environments. Acclimatization usually takes two to six days and allows the worker's body to become adjusted to working in hot environments.

A.19.6 ADDITIONAL PREVENTATIVE MEASURES

When possible and/or feasible, the following measures will also be implemented to aid in prevention or reduce the affects of heat induced stress:

- Designated rest areas should be out of the direct sun and the number and frequency of breaks increased.
- Depending on the severity of the heat exposure some form of artificial cooling may be required to ensure protection of the workers.
- Workers will be encouraged to achieve and maintain an optimum level of physical fitness. Increased physical fitness will allow workers to better tolerate and respond to hot environments and

heavy workloads. In comparison to an unfit person, a fit person will have: less physiological strain; a lower heart rate and body temperature; and a more efficient sweating mechanism.

A.20 PERSONNEL HYGIENE AND DECONTAMINATION

Site sanitation will be established and maintained in accordance with 29 CFR 1910.120(n).

A.21 POTABLE WATER SUPPLY

An adequate supply of potable (drinkable) water, coolers, and ice will be provided on site at all times in accordance with 29 CFR 1910.120. Potable water will also be used for the washing of personnel.

A.22 NON-POTABLE WATER

Containers of water, clearly marked non-potable water, will be available to teams for washing of equipment in accordance with 29 CFR 1910.120. Non-potable water will not be used for the washing of skin surfaces on personnel.

A.23 TOILET FACILITIES

To maintain sanitation, established toilet facilities will be utilized on site if available. If established facilities are not available, portable toilet facilities will be made available on-site in accordance with 29 CFR 1910.120.

A.24 WASHING FACILITIES

Hand and face washing facilities are available at the site support vehicles, and will be utilized by all personnel during breaks or upon exiting the EZ prior to eating, drinking, tobacco use, or other hand to face activities. Washing facilities in the EZ will consist of potable water containers, buckets, soap, and drying towels. These facilities will be in accordance with 29 CFR 1910.120.

A.25 SITE HOUSEKEEPING

All work areas will be maintained in a clean/neat fashion, free of loose debris and scrap. Any materials/equipment not being used will be removed and stored or disposed of accordingly. All work areas will be supplied with a trash receptacle with lid, the contents of which will be emptied daily.

A.26 ILLUMINATION

Personnel will only work during the hours of daylight, and no field activities will be scheduled during the period of thirty minutes before dusk to thirty minutes after dawn.

A.27 COMMUNICATIONS

On and off site communications will be provided using radios and/or cellular telephones. Communication of evacuation routes and assembly points will occur daily during the tailgate safety briefing. All communications will be tested daily. When emergency services are requested from any agency, the caller will remain available to provide information and directions to responding personnel.

A.28 OFF-SITE COMMUNICATIONS

Off-site communication will be available at all times. Site operations will not be conducted unless off-site communications are available.

A.29 TELEPHONE NUMBERS

The telephone numbers for all emergency services, including the telephone numbers for the USA SHM, are listed in Table A-3. These phone numbers will be posted in the vehicles and all site personnel (teams) will be aware of the location of the closest telephone or will have direct communications to someone with telephone service available.

A.30 ON-SITE COMMUNICATIONS

Communication between personnel in the SZ and personnel in the EZ will be maintained at all times. Personnel in the EZ should remain in constant communication with the Technician III. Any failure of communication requires an evaluation of whether personnel should leave the EZ. A repeated long horn blast (15 sec or longer) on the support vehicle is the emergency signal to indicate that all personnel should leave the EZ and proceed to the rally point.

A.31 LOGS, REPORTS, AND RECORD KEEPING

A.31.1 SAFETY LOG

The Technician III will maintain a safety log of all safety related site activity. The Technician III is responsible for ensuring that safety and health activities and events for the day are part of the log. The log may include the minutes of the tailgate safety meeting, or the meeting may be documented on the Tailgate Safety Briefing form. As a minimum the safety log should reference the tailgate safety briefing, and mention: accidents, near misses, internal and external audits, the reason for and duration of safety related “stop work” orders, and any other issues pertaining to site or personnel safety or health.

A.31.2 INJURY/ILLNESS/ACCIDENT REPORTS

In the event that a reportable injury/illness/accident occurs at the job site, the USA accident report will be completed and forwarded within two working days to the USA home office. All job related injuries and illnesses will be recorded on an OSHA Form 300. The Technician III will maintain this log on site. If a near miss occurs the Technician III will investigate the near miss and report the results of the investigation to the appropriate personnel or agencies.

A.31.3 TRAINING LOG

The Technician III is responsible for ensuring that all training conducted relative to job site activities is documented in the Training Log and/or on the appropriate training forms. This log will include the initial site specific training conducted prior to the start of site activities. The Technician III will maintain this log and any associated training forms on-site so they will be available for inspection.

A.31.4 EQUIPMENT MAINTENANCE LOG

Required scheduled maintenance and Calibration of equipment performed will be annotated in the Daily Journal.

A.31.5 VISITOR LOG

The Technician III will be responsible for maintaining the visitor log which will be used to record the entry and exit of all visitors, including Federal, state or local officials who visit the site. This log will reflect name, organization, date and time of visitor entry/exit. Visitors will be briefed on:

- The St. Juliens Creek SSHP;
- Restricted and safe areas;
- Site hazards and risks to include OE/UXO, biological, heat, and trip hazards;
- PPE required and use;
- Fire and OE/UXO safety requirements;
- Site evacuation and emergency procedures.

A.32 DAILY AND WEEKLY SITE INSPECTIONS

The Technician III will conduct daily Safety and Health inspections and the results will be recorded in the Safety Log. The results of the inspection will be reported to the Technician III on a weekly basis, the Technician III will conduct a compliance audit of the site and complete the Weekly Inspection form. The daily Safety and Health inspections will include:

- Scope of operations;
- Personnel assignments;
- Safety precautions on OE/UXO expected to be encountered;
- Equipment to be used;
- Emergency procedures to include requests for support;
- Communication procedures.

A.33 REGULATIONS AND REFERENCES

Following all applicable requirements and regulations listed in the following publications will ensure the safety and health of on-site personnel and the local community:

- OSHA Occupational Safety and Health Standards, 29 CFR 1910;
- OSHA Construction Standards, 29 CFR 1926;
- Applicable sections of EPA 40 CFR Parts 260 to 299;

- Applicable sections of DOT 49 CFR Parts 100 to 199;
- CEHNC Safety Concepts and Basic Considerations for Unexploded Explosive Ordnance (UXO), dated. 29 June, 2001;
- USA Safety and Health Program (SHP);
- 2003 Threshold Limit Values and Biological Exposure Indices, American Conference of Governmental Industrial Hygienists;
- DOD 6055.9-STD, DOD ammunition and Explosives Safety Standards;
- DOD 4160.21-M, Defense Reutilization and Marketing Manual;
- OPNAVINST 8020.14, Department of the Navy Explosives Safety Policy;
- NAVSEA OP-5 Volume 1, Ammunition and Explosives Ashore.

A.34 EMERGENCY RESPONSE AND CONTINGENCY PROCEDURES

This section details the procedures that USA will implement in the case of an emergency.

A.34.1 GENERAL

The frequency and severity of emergency situations can be dramatically reduced through proper implementation of the SSHP. However, if an emergency does occur, quick, decisive action will be required since delays in minutes can create or escalate life-threatening situations. In an emergency situation, site personnel involved in emergency response and rescue must be prepared to respond immediately and all required equipment must be on hand, in proper working order and ready to use. To ensure rapid, effective response to a site emergency, the procedures and contingency plans outlined in this Section and EM 385-1-1, Section 28 J, will be implemented prior to and during the conduct of any site activities involving exposure to safety and health hazards.

A.35 PRE-EMERGENCY PLANNING

A.35.1 IDENTIFICATION OF LOCAL EMERGENCY SERVICES

Prior to the conduct of site operations, USA site representatives will meet with the appropriate local authorities. The purpose of this meeting is to inform local authorities of the nature of the site activities to be performed under this SSHP, and the potential hazards that the conduct of these activities pose to site personnel, the environment, and the general public. In the unlikely event that the evacuation of the general public is required due to either normal site operations or an emergency event, USA will be responsible for contacting the appropriate personnel who will execute and coordinate the evacuation. The phone numbers for pre-notified local emergency services are listed in Table A-3 or refer to the CH2M HILL Safety and Health Plan.

TABLE A-3

EMERGENCY CONTACT	TELEPHONE NUMBER
Fire/Ambulance/Police (Emergency)	911
Chesapeake General Hospital	1-757-312-6128 (ER)
Poison Control Center	1-800-552-6337
USA Safety and Health Office	(813)-884-5722 ext.140
CH2MHILL Site Manager	See CH2MHILL S&H Plan

A.35.2 IDENTIFICATION OF POTENTIAL EMERGENCIES

During the development of this SSHP, great attention has been given to identifying potential safety and health hazards associated with the conduct of site activities. Once identified, these hazards were assessed to determine the risk that these hazards could result in an emergency situation. Contingency plans for responding to the potential emergency situations have been developed and are included in this section. The potential emergencies which may result during the conduct of site activities are as follows:

- Injury or illness;
- Fire/explosion;
- Inclement weather.

A.35.3 OTHER HAZARD INFORMATION

In the event that additional site or task hazard information becomes available during the conduct of site activities, this information will be assessed by the appropriate authorities to determine if the contingency plans in this section will need to be updated.

A.36 EMERGENCY RESPONSE RESPONSIBILITIES

A.36.1 ON-SCENE INCIDENT COMMANDER (OSIC)

In the event of an emergency, the Technician III will assume the responsibility of being the On-scene Incident Commander (OSIC). The alternate person to assume this role, in the event that the Technician III is unavailable or incapacitated, will be the CH2MHILL Site Manager or other designated person. The OSIC will have the responsibility of directing all on-site and off-site response personnel, and will, as soon as possible, advise the appropriate authorities of the emergency situation.

A.36.2 ON-SITE EMERGENCY RESPONSE SERVICES

USA personnel will provide First Aid treatment for minor injuries. The Technician III will determine if the injury requires further treatment. If necessary the Technician III will contact medical personnel to determine if additional treatment is required.

A.36.3 OFF-SITE EMERGENCY RESPONSE SERVICES

The off-site emergency response services which may be needed in the event of a emergency include fire and law enforcement personnel. Fire Protection and emergency medical services (EMS) can be obtained by dialing 911 while on site. All requests for emergency service will go through the CH2MHILL Site Manager. The CH2MHILL Site Manager will notify the required emergency services.

A.36.4 MEDICAL EVACUATION (MEDEVAC)

The emergency first responder will determine medical evacuation. The emergency first responder will determine and coordinate medical evacuation if required.

A.37 EMERGENCY TRAINING

All site personnel will receive specialized training that will be given by the Technician III and conducted prior to initiating site activities involving safety and health hazards. The content of this training will include the items listed below, and will be documented using the site Training Log.

- USA's SSHP requirements;
- Emergency chain-of-command;
- Communication methods and signals;
- Emergency equipment and PPE;
- Removing injured personnel from the site;
- Emergency contacts, phone numbers.

A.38 EMERGENCY SITE CONTROL AND SECURITY

In an emergency, it is imperative that site control and security be maintained. To control site personnel, the OSIC will utilize the Site Entry/Exit Log to ensure all personnel are present or accounted for at the assembly point(s). Depending upon site size and configuration, weather and wind conditions and the nature of the emergency, the following will, as applicable, be used to maintain site security:

- Close, but do not lock, gates as evacuation occurs;
- Erect flagging or barrier tape to prevent accidental entry;
- Use a megaphone to alert personnel to stay clear of the site;

- Use vehicles to block access routes to the site, but ensure they can be moved rapidly if emergency vehicles must use the access route.

A.39 EVACUATION ROUTE

The map showing the location and evacuation route to the emergency treatment facility is located in the CH2MHILL Safety and Health Plan. The route will be briefed to all site personnel prior to start of site activities to familiarize them with the route.

A.40 GENERAL EMERGENCY PROCEDURES

Emergency response procedures include all steps to be taken for notifying, evaluating, reacting to, documenting and following-up on a given emergency situation. To ensure all necessary elements are covered, the procedural steps outlined in this paragraph will be implemented for each emergency, regardless of its nature.

A.40.1 NOTIFICATION

Once the OSIC has been informed of the emergency, the OSIC will alert site personnel to the presence of the emergency by radios. This will be done in order to:

- Notify personnel and to get their attention;
- Stop all work activity as required;
- Lower noise levels in order to speed and simplify communication;
- Begin emergency and/or evacuation procedures.

If on-site USA personnel or off-site emergency personnel are to enter the site in response to the emergency, the OSIC will to the extent possible, notify the response personnel about the nature of the emergency, to include:

- What happened and when it happened;
- Where on-site the emergency situation occurred;
- Who is involved and, if possible, the cause of the emergency;
- The extent of damage and what hazards may be involved;
- What actions should be taken.

A.40.2 ASSESSING THE EMERGENCY

Available information related to the emergency and the on-site response capabilities should be evaluated and the information listed below obtained to the extent possible:

- What happened:
  - Type of incident;

- Casualties involved:
  - Victims (number, location and condition);
  - Treatment required; and
  - Missing personnel.
- Cause of incident;
  - Extent of damage to structures, equipment and terrain.
- What could happen from this point; consider:
  - Potential for fire or explosion;
  - Location of all personnel in relation to hazardous areas; and
  - Potential for emergency affecting the general public or the environment.
- What can be done to remediate the situation; consider:
  - Equipment and personnel needed for rescue and hazard mitigation;
  - Number of uninjured personnel available for response;
  - Resources available on-site;
  - Resources available from off-site response groups and agencies;
- Time needed for off-site response resources to reach the site;
  - Hazards involved in rescue and response.

A.40.3 RESCUE AND RESPONSE ACTIONS

Based on the information collected during the emergency assessment, the general actions listed below will be taken, with some actions being conducted concurrently. No one will attempt emergency response/rescue until the situation has been assessed and the appropriate response outlined by the OSIC.

- Enforce the Buddy System:
  - Allow no one to enter a hazardous area without a partner.
  - Personnel in the EZ should be in line-of-sight or in communication with the OSIC or his designee.
- Survey Casualties:
  - Locate all victims and assess their condition;
  - Determine resources needed for stabilization and transport;
  - Assess Existing and Potential Hazards and Determine;
  - Whether and how to respond;
  - The need for evacuation of site personnel and off-site population;
  - The resources needed for evacuation and response.

- Request Aid:
  - Contact the required off-site/on-site personnel or facilities, such as ambulance, fire department, police, etc.
- Allocate Resources:
  - Allocate on-site personnel and equipment to rescue and initiate incident response operations;
- Control the site;
  - Assist in bringing the hazardous situation under complete or temporary control and use measures to prevent the spread of the emergency, i.e. control fire, secure site, etc.
- Extricate:
  - Remove or assist victims from the area.
- Stabilize:
  - Administer any medical procedures that are necessary before the victims can be moved.
  - Stabilize or permanently fix the hazardous condition.
  - Attend to what caused the emergency and anything damaged or endangered by the emergency (e.g., drums, tanks).
- Transport:
  - Using either on-site or off-site assets.
  - Casualty Logging;
  - Record who, time, destination and condition upon transport.
- Evacuate:
  - Move site personnel to the rally point, a safe distance upwind of the incident.
  - Monitor the incident for significant changes; the hazards may diminish, permitting personnel to re-enter the site, or hazards may increase and require public evacuation.
- Casualty Tracking:
  - Record disposition, condition and location.

A.40.4 POST EMERGENCY FOLLOW-UP

Before normal site activities can resume, the site and personnel must be prepared and equipped to handle another emergency. It is also imperative that all Federal, state and local regulatory agencies be notified of the emergency. Therefore, the following activities must be conducted prior to re-start of site activities:

- Notify all appropriate governmental agencies as required (i.e. OSHA must be notified if there have been any fatalities or three or more personnel hospitalized);
- Restock and clean all equipment and supplies utilized or damaged in the emergency;*

- Conduct an accident investigation to determine the cause of the emergency and what preventative measures could be taken to ensure the emergency does not occur again; *
- Complete the USA accident and/or insurance forms;
- Review and revise, as needed, the site operational procedures, and if necessary update the SSHP to reflect the new procedures.

*To be accomplished prior to re-starting site activities

A.40.5 DOCUMENTATION

Documentation related to the emergency will be recorded in an accurate, authentic and complete fashion. Documentation shall be recorded as soon as possible after the emergency to ensure it is recorded while the events are vivid in the minds of the personnel involved. The information recorded will include:

- A chronological record of events;
- A listing of the personnel involved, including personnel on-site, site personnel who responded, personnel in charge, and off-site groups or agencies that responded;
- A listing of the actions taken to minimize the effects of or mitigate the emergency;
- An assessment of the potential exposures received by site personnel and the surrounding public;
- A recording of the injuries or illnesses, which occurred as a result of the emergency.

A.41 ON-SITE EMERGENCY EQUIPMENT

The emergency equipment listed below in Table A-4 will be on-site, stored in the location indicated, and available for use during the operation specified. The Support Vehicle EZ will be on the work site with each team. The team support vehicle will be designated as an emergency vehicle. All emergency equipment will be maintained in proper working order and inspected by the Technician III at least weekly to ensure completeness and proper working order. The results of the inspection will be documented on the Safety Inspection Control Log. In the event that any of the disposable items are utilized, the Technician III will ensure they are replaced immediately. Site operations will not be conducted if the required emergency equipment is not available on-site.

A.42 CONTINGENCY PLANS

The following paragraphs contain emergency specific contingency plans. These plans outline the procedures for mitigating each of the potential emergency situations that were identified in the pre-emergency planning. These contingency plans specify the minimum emergency procedures and may be subject to alteration by the Technician III, based on actual or changing site conditions. The appropriate authorities will approve any changes to these contingency plans.

A.43 INJURY OR ILLNESS

In the event of an emergency involving personal injury or illness, immediate response will be key in preventing further injury/illness and providing comfort to the affected party. When EZ personnel are injured or overcome by illness, the following procedure will be followed:

- Upon notification of the occurrence and nature of the injury/illness the OSIC will, if deemed necessary, summon emergency personnel;
- EZ personnel will transport the injured/ill victim to the rally point using the stretcher;
- The OSIC will assess the severity of the injury/illness, direct the EZ personnel to provide immediate life support if required;
- If immediate life support is not required, or once the victim is stabilized, and if required, transport victim to the appropriate medical facility for further attention.

TABLE A-4

Emergency Equipment	Number per Location	Location Stored	Operation Where Emergency Equipment is Required
First Aid/Burn Kit, (16 unit minimum)	1 ea.	Team Support Vehicle, EZ.	Each team has complete sets of first aid equipment.
Eye Wash	1 ea.	All First Aid Kits	
CPR Pocket Mask	1 ea	All First Aid Kits	
Disposable latex Gloves	5 ea.	All First Aid Kits	
Fire Extinguisher 2A:10 BC rated	1 ea.	All Vehicles.	All operations.

To ensure that adequate first aid supplies are available, the size (16 unit minimum) and number of first aid kits will be sufficient to accommodate the maximum number of people (including government personnel and visitors) on-site at any given time. The kits will be located at each EZ work site and the location of the kit will be made known to all EZ personnel. Additional kits may also be maintained in each vehicle and in the SZ. Kit locations will be provided with adequate water and other supplies necessary to cleanse and decontaminate burns, wounds or lesions.

A.44 FIRES AND EXPLOSIONS

A.44.1 FIRE EXTINGUISHERS

The occurrence of a fire on-site can present a serious threat to all site personnel, the environment and the general public. To ensure immediate, aggressive response is possible, dry-chemical-type fire extinguishers will be available at each individual work site. Dry chemical fire extinguishers (3A:40B:C)will also be provided at any other site location where flammable materials may present a fire risk, such as the petroleum, oil and lubricant (POL) storage area. Additionally, a fire extinguisher rated at least 2A:10B:C will be located with each piece of heavy equipment and in each site vehicle. Fire extinguishers will be inspected, and the results recorded, weekly by the Technician III.

A.44.2 SMALL FIRES

A small fire is defined as a fire that can be extinguished with a 2A:10B:C type fire extinguisher. In the event of a small fire, site personnel will take the following actions:

- All unnecessary personnel will be evacuated from the immediate area, to an upwind location;
- Extinguish the fire using portable fire extinguishers or by smothering from an upwind location;
- Request emergency response assistance (fire, ambulance, police) as needed;
- Do not attempt to extinguish a fire, even a small one, involving explosives;
- Notify the Technician III.

A.44.3 LARGE FIRES

In the event of a large fire or small fire which cannot be extinguished, the following actions will be taken:

- All unnecessary personnel will be evacuated from the site, to an upwind location;
- The Emergency Response Services (fire, police, ambulance, hospital, etc.) will be notified as required;
- If it can be conducted safely, the OSIC will direct personnel to move vital equipment/supplies from the fire path;
- The OSIC will order the appropriate level of protective clothing to be worn by personnel fighting the fire;
- To the extent possible, and with available resources, fight the fire from an upwind location;
- At no time, will attempts be made to extinguish a fire involving explosives;
- Notify the Technician III.

A.44.4 EXPLOSION

In the event of an explosion, all-nonessential personnel will evacuate and help secure the site, the OSIC will request the required support equipment and personnel, and ensure proper authorities are notified. It is essential that the site be evacuated and no one is allowed to re-enter, except to possibly save a life, until at least 30 minutes, or longer if necessary, after the explosion. The OSIC will determine what actions, if any, are appropriate.

A.45 INCLEMENT WEATHER

In the event of inclement weather: high winds, electrical storms, extremely hot weather (>100°F) it may be necessary to cease operations and evacuate the site. The Technician III will be responsible for contacting the weather service on a daily basis. If necessary, the weather service will be contacted on a more frequent basis.

A.46 HAZARD ANALYSIS

The following Hazard Analysis worksheets were used to identify hazards associated with operations at the St. Juliens Creek project site and the safety methods that would be used to mitigate, eliminate, or control exposure to hazards.

TABLE A-5: HAZARD ANALYSIS

PROJECT NAME: St. Juliens Creek, Chesapeake, VA **CUSTOMER:** CH2MHILL **ACTIVITY**: OE/UXO Avoidance and Construction Support Services		
PRINCIPLE STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Locate, identify and mark UXO and anomalies.	Potential OE; unplanned detonation. Wildlife, insects. Toxic Plants. Slips, trips, falls. Heat/Cold Stress. Sunburn/Windburn. Unauthorized personnel.	UXO safety precautions IAW the WP and SSHP. UXO qualified personnel will accompany all non-UXO qualified personnel. Establish an EZ for site control. Check for subsurface anomalies prior to driving stakes or excavating samples Do Not handle UXOs. Mark UXO IAW the WP. Do not subject UXO to heat, shock or friction. Avoid toxic plants. Do not handle wildlife. Wear Level D PPE. Use insect repellent/barrier cream as necessary. Be alert, watch for slip/trip/fall hazards. Dress for the weather. Use Buddy system monitoring. Use Sunscreen as necessary. No Smoking except in designated areas.
EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
Vehicle. First Aid kit. Fire extinguisher. Communications equipment. Hand tools. Flagging material.	Daily PMCS vehicle. Daily check of First Aid Kit contents. Check extinguisher. Calibration checks. Communications check.	Current state driver license. OSHA Qualifications. UXO personnel are EOD trained. Safe work practices and hazard protection IAW the SSHP. Daily tailgate safety briefings to include evacuation and notification procedures. UXO identification and safety precautions training for non-UXO trained personnel.

A.47 ATTACHMENT 1: CEHNC SAFETY CONCEPTS

The following pages contain the EP 385-95a, U.S. Army Engineering and Support Center, Huntsville, Basic Safety Concepts and Considerations for Ordnance and Explosives Operations, dated 29 June 2001.

APPENDIX B: FORMS

This appendix contains general preprinted forms that USA may use to record the operations associated with this work plan. This appendix contains the following forms:

UXO Operations:

- Daily Report of OE Operations
- Safety Meeting Attendance Log
- Safety Inspections Log
- Quality Control Log
- Site Visitors Log
- Tailgate Safety Briefing

DAILY OE OPERATIONS SUMMARY

DATE: ____/____/____ **PAGE ___ OF ___ PAGES**

SITE / LOCATION: _____

1. WORK SUMMARY

a. Work Accomplished:

	Number Completed	Total
(1) Survey	_____	_____
(2) Preparation	_____	_____
(3) Mag & Flag	_____	_____
(4) Geophysical	_____	_____
(5) Intrusive	_____	_____
(6) Quality Control	_____	_____
(7) Quality Assurance	_____	_____

b. Discrepancies: _____
_____
_____
_____

c. Inspection Results:

	Pass	Fail
(1) Quality Control	_____	_____
(2) Quality Assurance	_____	_____
(3) Safety	_____	_____

2. INSTRUCTIONS RECEIVED FROM CUSTOMER REPRESENTATIVE: _____
_____
_____
_____
_____

Daily Operations Summary Con't. **PAGE ___ OF ___ PAGES**

3. **UXO SUMMARY**

   a. **UXO Located:**

Type:	Quantity:	Total:	Remarks:

Daily Operations Summary Con't. **PAGE ___ of ___ PAGES**

b. Demolition Supplies Expended:

Type:	Quantity:	Total:	Remarks:

c. Scrap Generation / Deposition:

Type:	Quantity:	Total:	Weight:	Total:

Daily Operations Summary Con't. **PAGE ___ of ___ PAGES**

4. **Utilization**

   a. **Daily Man-hours:**

Labor Category:	Task:	M/H Used Today:	M/H Remaining:	% M/H Remaining:	Remarks:
Project Manager					
SUXO					
UXO Supervisor					
UXO Specialist					
UXO Assistant					
Laborer					
Site Safety					
Admin Personnel					
Visitor					
Sub-Contractor Personnel (List by Category)					

Daily Operations Summary Con't. **PAGE ___ of ___ PAGES**

b. Daily Equipment:

Description:	Task:	Hours Used:	Hours Remaining:	% Hours Remaining:	Remarks:
Schonstedt					
Geophysical					
Truck (Heavy)					
Truck (Light)					
Radio, Base					
Radio, Handheld					
Backhoe					
Front-end Loader					
Rental Car					
GPS					
Weed eater					
Chainsaw					
Chipper					

5. Operational Remarks:

_____
_____
_____
_____
_____
_____

6. Signature / Date:

_____ **Date: ____/____/____**
SUXO / Project Manager

USA Environmental, Inc.

SAFETY MEETING/TRAINING RECORD

DATE: _____/_____/_____ **TIME: _____ AM PM**

LOCATION/SITE: _____

1. Reason for Meeting/Training: (Check all that apply)	
	Daily Safety Meeting/Training
	Initial Site Safety Meeting/Training
	New Task Briefing
	Periodic Safety Meeting/Training
	New Site Procedures
	New Site Information
	Periodic Review of Site Information
	Other (Explain):

2. Personnel Attending Meeting/Training:		
Name	**Signature**	**Company**

USA Environmental Inc.

Safety Meeting/Training Record Con't:

3. Topics Covered (Check all that apply)			
	Site Safety Personnel		Decontamination Procedures
	Site/Work Area Description		Emergency Response Plan
	Site Characterization		Hazard Communication
	Biological Hazard(s)		On-Site Emergency
	Chemical Hazard(s)		On-Site Injuries/Illnesses
	Physical Hazard(s)		Evacuation Procedures
	Heat Stress		Rally Point(s)
	Cold Stress		Emergency Communication
	Site Control		Directions to Medical Facility
	Work and Support Zones		Drug and Alcohol Policies
	PPE		Medical Monitoring Program
	Air monitoring		Specific Task Training
	Safe Work Practices		Confined Spaces
	Engineering Controls and Equipment		Heavy Equipment
	Spill Containment Procedures		Other: (Specify)
4. Remarks:			

5. Verification:

I certify that the personnel listed above on this record received the Information and/or Training described as indicated. Personnel not attending this meeting/training will receive said information/training prior to commencing their assigned duties.

_____

Site Safety Officer **Date: ____/____/____**

Page 2 of 2 Pages

SAFETY INSPECTION REPORT

USA Environmental, Inc.

Site / Location: _____ Date: ____/____/____

Type of Inspection: ____ Daily ____ Weekly ____ Re-Inspection ____ Other

Type of Operation Inspected:

_____
_____

Equipment Inspected: (Specify if Safety or Operational in Nature)

_____
_____
_____
_____
_____

Comments:

_____
_____
_____
_____

Deficiencies Found or Noted:

_____
_____
_____

Corrective Action:

_____
_____
_____

Re-Inspection Required: ____ Yes ____ No If Yes, Date of Re-Inspection: ____/____/___

Signature:_____

_____
Site Safety Officer
SUXO / Project Manager

* Copy to Supervisor if Deficiencies or Corrective Action were found, noted or deemed necessary.

USA Environmental, Inc.

DAILY QUALITY CONTROL REPORT

Date: ____/____/____ Contract #: _____ **Task Order #:** _____

Site/Location : _____

Weather: _____ Temperature: _____ Rainfall: _____

1. Preparatory Inspection: _____
_____
_____
Results: _____

2. QC Audits Performed

a. Operations: _____
_____
_____
Results: _____

b. Safety: _____
_____
_____
Results: _____

c. Administrative: _____
_____
_____
Results: _____

d. Equipment: _____
_____
_____
_____
Results: _____
_____

Daily Quality Control Report Con't:

3. QC Performed (Grids)

Number of Grids QC'd: _____ Results: _____ # Pass _____ # Fail

Comments: _____
_____
_____
_____

4. Follow Up Inspections and Results

Section(s): _____
_____
_____
Results: _____

5. Instructions Received: _____
_____
_____
_____
_____

Remarks: _____
_____
_____
_____

QC Signature: _____ **Date:** ____/____/____

Printed Name: _____

Page 2 of 2

SITE VISITOR'S LOG

CONTRACT NO._____
DELIVERY ORDER NO._____
LOCATION_____

DATE	NAME	COMPANY	SAFETY BRIEF: Y/N	US CITIZEN Y/N	TIME		REMARK
					IN	OUT	

USA Environmental, Inc.

Tailgate Safety Briefing

Date: _____/_____/_____
Location:_____
Time: _____ **AM PM** **Team #:** _____

1. Reason for Briefing:

	Daily Safety Briefing		New Site Procedure
	Initial Safety Briefing		New Site Information
	New Task Briefing		Review of Site Information
	Periodic Safety Meeting		Other: (Specify)

2. Personnel Attending:

Name	Signature	Position

Briefing Given By:

Name	Signature	Position

3. Topics: (Check All That Apply)

	Site Safety Personnel		Decontamination Procedures
	Site/Work Area Description		Emergency Response/Equipment
	Physical Hazards		On-Site Injuries/Illnesses
	Chemical/Biological Hazards		Reporting Procedures
	Heat/Cold Stress		Directions to Medical Facility
	Work/Support Zones		Drug and Alcohol Policies
	PPE		Medical Monitoring
	Safe Work Practices		Evacuation/Egress Procedures
	Air Monitoring		Communications
	Task Training		Confined Spaces
	OE Precautions		Other:

4. Remarks:

Scope Of Work

USA will provide UXO Avoidance Support services, during investigative activities for well installation and during Soil Sampling. USA will perform these services in accordance with the Technical Specifications and CH2M Hill instructions:

- **UXO Avoidance Support during installation of groundwater monitoring wells**
- **UXO Avoidance for collection of thirty three (33) soil samples**

In support of the SOW, USA will provide the following:

Personnel

- UXO Technician III (1)
- UXO Technician II (1)

Equipment

- Magnetometers
- Personnel Protective Equipment
- Personnel Decontamination Equipment

UXO/Anomaly Avoidance

Techniques employed by EOD or UXO personnel, at sites with known or suspected OE contamination, to avoid any potential surface UXO and any subsurface anomalies.

This usually occurs at mixed hazard sites when HTRW investigations must occur prior to an OE removal action.

Intrusive anomaly investigation is not authorized during ordnance avoidance activities.

U.S. ARMY ENGINEERING PAMPHLET EP 75-1-2, Dtd. 11/20/00

UXO Avoidance Hazard Analysis

Actions	Potential Hazards	Recommended Controls
Identifying and Marking Anomalies	-Potential UXO	-Only UXO personnel will identify OE/UXO items.
	-Unplanned Detonation	-Personnel in the immediate vicinity of OE/UXO ops will be kept to a minimum, but no less than two UXO technicians. Mark OE/UXO. Do not expose OE/UXO to heat, shock or friction.
	-Unauthorized Personnel in Exclusion Zone	Establish Exclusion Zones (EZ). Post Warning signs. Stop all operations when non-essential personnel are in EZ.
	-Slips/Trips/Falls	Be aware of footing and terrain, avoid obstacles

UXO Avoidance Hazard Analysis (Cont.)

Actions	Potential Hazards	Recommended Controls
Identifying and Marking Anomalies	-Cold Stress, Sunburn/Windburn, Trench Foot	-Dress for weather and Task. Keep feet dry.
	-Hypothermia	-Maintain Buddy System

General Procedures For UXO Avoidance

SAFETY IS PARAMOUNT

- **UXO personnel will clear all routes and sampling sites prior to the CH2M Hill personnel entering.**
- **All operations will use the "Buddy System".**
- **No unnecessary personnel allowed to visit site during operations.**
- **Do not move or disturb objects which have not been positively unidentified as safe to handle.**
- **All UXO will be identified independently by two UXO Techs.**
- **Any OE/UXO found will be clearly marked and reported to the UXO Tech III and CH2M Hill Site Manager.**
- **Do not collect souvenirs.**
- **Do not run, move at a moderate pace, watch for trip hazards.**
- **No smoking or flame/spark producing devices on site**

UXO Avoidance for Soil Sampling Activities

- CH2M Hill sampling team leader and the UXO Tech III will determine site and initial route.
- UXO Team will, using magnetometer will check route for surface UXO and subsurface anomalies
- Surface UXO will be staked and flagged.
- Access route will be routed around subsurface anomalies. If area will be visited repeatedly, the route will be staked every 25'.
- CH2M Hill sampling crew will be escorted to sampling site by UXO Tech.
- Sampling site will be checked for surface UXO and subsurface anomalies, if any are located the sampling site will be moved to a clear area.
- CH2M Hill sampling crew will take sample while observed by UXO personnel.
- CH2M Hill sampling crew will be escorted to the next sampling site.

UXO Avoidance and Construction Support for Test Trenches/Pits

- **The UXO Personnel should focus on observation of the trenching activities.**
- **Operations will cease if UXO items are encountered, until identification and disposition have been determined.**
- **Appropriate notification will be made to the CH2M Hill Site Manager.**

MK 23 Practice Bomb

The bomb, practice, MK 23 is made of cast iron. The Mk 23 is 8.30 inches in length and 2.20 inches in diameter. This practice bomb also contains a cartridge having an explosive primer, expelling charge of black powder, and a spotting charge.

BDU 33/Mk 76

The bomb, practice, BDU-33 is made of cast iron with a sheet steel fin assembly attached. The BDU-33 is painted blue in color, is 22.50 inches in length and 4.00 inches in diameter.It has an cartridge containing an explosive primer, expelling charge of black powder, and a spotting charge that is impact or impact inertia fired.

3.25” Rocket Body,Base

This is an example of the 3.25 inch Target Rocket body base as found in a field environment.

3.25 “ Rocket

This is a 3.25 inch Antiaircraft Target Rocket, M2. The rocket is constructed of a thin wall metal cylinder that is 59.1 inches in length and 3.25 inches in diameter. The fins (3) are made of plywood. This rocket contains a propelling charge of 3.2 pounds of 7/8 inch diameter stick powder. The nose cavity contains an igniting mixture and a electric squib.

4 lb. Incendiary Bomb

This is an example of 4 Pound Incendiary Bomb. These bombs are dropped in clusters and usually where one is found there are more. Items such as these do not look like OE/UXO items in general. This demonstrates the need for continued vigilance in order to ensure the safety of all personnel on site.

REPORT ALL SUSPECT ITEMS TO THE UXO PERSONNEL. DO NOT TOUCH.

Tailgate Safety Briefing

ALL PERSONNEL ON SITE MUST ATTEND

- **Covers operational and safety related information on days activities.**
- **Reinforces all hazards and safety precautions associated with the on-going operation.**
- **Presents specific or unique hazards and safety precautions for that days activities.**
- **Introduces new procedures and tasks to all site personnel.**
- **Addresses changes in site operations or conditions.**
- **Updates emergency information and notification procedures.**
- **Provides a semi-formal means of communication to all site personnel.**

Tailgate Safety Briefing (Cont.)

Topics Covered

-Site Safety Personnel
-Site/Work Area Description
-Physical Hazards
-Heat/Cold Stress
-Work Zones
-PPE
-Safe Work Practices
-Task Training
-OE/UXO Precautions
- Decontamination Procedures
- Emergency Response/Equipment
- On-Site Injuries/Illness
- Reporting Procedures
- Directions to Medical Facilities
- Evacuating/Egress Procedures
- Communications
- Confined Spaces
- Other Topics As Required

CH2MHILL

Drilling
Standard of Practice HSE-35

1.0 Applicability and Scope

1.1 Applicability

This Standard of Practice (SOP) applies to: 1) CH2M HILL employees who are potentially exposed to hazards associated with drilling operations because of their proximity to the drilling work location, and/or 2) CH2M HILL Safety Coordinators (SCs) who may be responsible for providing oversight of a drilling subcontractor's operation. This SOP is applicable to all forms of drilling activities, including cable tool, rotary, geo-probe, rotosonic, and hollow-stem auger drilling. Drilling is defined as any man-made boring of holes in hard materials or an earth surface, usually by rotating abrasion or repeated blows.

1.2 Scope

This SOP provides information regarding the spectrum of hazards and issues to be addressed during each phase of a project associated with drilling operations. Drilling hazards addressed in this SOP include contacting overhead powerlines, masts acting as lightning rods, overturning because of top-heavy configuration and poor footing, drilling into underground utilities or structures, catching persons in rotating parts of the drill equipment and drilling operations in areas with known or potential Ordnance Explosives (OE)/Unexploded Ordnance (UXO) hazards (HSE-91). CH2M HILL employees who work in proximity to drilling activities must take precautions to avoid these hazards and be aware of associated safe work practices.

As described in the "Subcontractor, Contractor, and Owner" SOP HSE-55, responsibilities for health and safety (HS&E) are expressly defined through the subcontract terms and conditions, and CH2M HILL's HS&E practices in the field are determined based on these defined responsibilities. Consistent with HSE-55, drilling subcontractors must determine how to drill safely and in compliance with applicable HS&E regulations and industry standards, and how to correct deficiencies. CH2M HILL employees shall not direct the means and methods of safe drilling operations or details of corrective actions.

1.3 Regulatory Review

There are no Occupational Safety and Health Administration (OSHA) regulations specific to drilling activities; however, OSHA has authority to issue citations for unsafe and/or unhealthful conditions based on failure to comply with established industry standards.

2.0 Project Planning

2.1 Training Requirements

CH2M HILL employees who work on projects that involve only drill rigs or earthmoving equipment used for the purpose of moving earth or lifting underground objects (Level 2 construction projects) are required to complete either the CH2M HILL Drilling/Excavating

Construction Safety training course or the CH2M HILL 10-Hour Construction Safety Awareness training course. The 10-Hour course was developed for Level 1 construction projects, but covers the necessary information for Level 2 construction projects.

CH2M HILL employees who work on projects involving construction, renovation/ modification, or demolition of a structure, building, and/or facility; or projects involving heavy equipment, other than drill rigs or earthmoving equipment (Level 1 construction projects) are required to complete the CH2M HILL 10-Hour Construction Safety Awareness training course.

Additional information regarding construction training requirements may be found in the "Frequently Asked Questions: Construction Safety Training" document.

Waste management training is required where waste streams (e.g., drill cuttings, purge water, decontamination water, PPE) will be generated.

Drilling subcontractors are responsible for complying with all applicable HS&E training requirements and for providing the training necessary to complete their tasks safely.

Drilling activities that are performed at hazardous waste projects also require hazardous waste training. Subcontractors are responsible for ensuring their employees have received hazardous waste training.

CH2M HILL employees and subcontractors who work on projects that involve OE must complete the additional training requirements and provide qualified UXO technicians as described in HSE-91.

2.2 Medical Surveillance Requirements

There are no medical surveillance requirements specific to drilling activities; however, locations that involve toxicological (HS-65-70) or OE/UXO (HSE-91) hazards or respiratory protection (HS-08) may require medical surveillance. Subcontractors are responsible for ensuring their employees receive medical surveillance as required.

2.3 Competent Person Requirements

Drilling subcontractors shall provide a competent person to inspect the drill rig and associated equipment and to oversee all drilling activities. The competent person shall be capable of identifying drilling hazards and have the authority to take corrective actions to eliminate the hazards.

CH2M HILL employees and subcontractors who work on projects that involve OE are responsible for providing a competent person to oversee OE operations as described in HSE-91.

2.4 Safety Equipment

Drilling subcontractors are responsible for providing all personal protective equipment (PPE) necessary for its employees. CH2M HILL shall provide PPE only for its own employees. Other safety equipment shall be provided as delineated in the subcontract and referenced documents.

- Detection equipment shall be provided if the exact location of underground utilities cannot be determined.
- Air monitoring instruments shall be provided if the potential for a hazardous atmosphere exists within the drilling location.
- High-visibility warning vests should be provided when personnel are exposed to public vehicular traffic.
- Minimum PPE includes safety-toed shoes/boots, hard hats, safety glasses, and hearing protection. Body protection (such as gloves, coveralls, or Tyvek) and respirators may be needed when chemical hazards exist.
- Fall protection shall be provided when personnel are exposed to a fall of 6 feet or greater. This includes individuals climbing the drill rig mast.
- Lockout/tagout devices may be required for on-the-job maintenance of equipment.
- Adequate supplies of first aid materials should be available at the work site.

2.5 Subcontractor Selection

Drilling subcontractors are selected as described in the "Subcontractor, Contractor, and Owner" SOP HSE-55. The "Subcontractor Safety Procedure Criteria - Drilling" found in Attachment 1 provides the minimum criteria for drilling safety procedures. These criteria shall be used by the Health and Safety Manager (HSM) to review subcontractor drilling procedures submitted when CH2M HILL oversight is required by SOP HSE-55.

OE/UXO subcontractors are selected as described in the "Subcontractor, Contractor, and Owner" SOP HSE-55 and Ordnance Explosives (OE) Standard of Practice HSE- 91. These criteria shall be used by the UXO Safety Officer (UXOSO) to review subcontractor OE/UXO procedures.

2.6 Planning Activities

The exact location of underground utilities and structures must be identified. Many states have a one-call phone number for locating underground utilities (refer to the project's written safety plan). The party responsible for this action shall be delineated in the subcontract.

Drilling subcontractors shall determine the safest drilling location based on topography and location of utility lines, both underground and overhead. It may be necessary for the subcontractor to contact the utility company to deenergize and ground the powerlines when safe clearance distances cannot be maintained from overhead lines.

Subcontractor training and current medical examinations (when required) shall be verified prior to the start of field operations.

Determine if the aquifer is designated as a sole source aquifer, if the project is located near water wells or "well fields" supplying public water systems, or if the project will require

withdrawals of large amounts of water. The Environmental Compliance Coordinator (ECC) can determine if these conditions require a permit (see Section 3.3).

Drilling activities that are performed on sites with known or potential Ordnance Explosives (OE) hazards must implement OE/UXO avoidance during access, setup and drilling operations as described in Section 3.2.8 and HSE-91. Subcontractors are responsible for ensuring qualified UXO technicians provide OE/UXO avoidance support (HSE-91).

3.0 Project Execution

3.1 Safe Work Practices

The requirements of this section shall be followed by CH2M HILL employees who are potentially exposed to hazards associated with drilling activities, regardless of the company performing the drilling operation. These requirements also pertain to drilling subcontractor personnel when CH2M HILL is providing oversight.

- Only authorized personnel are permitted to operate drill rigs. Drilling subcontractors shall ensure that each drill rig operator is qualified to safely operate the specific equipment through appropriate training and/or experience.
- Personnel shall be cleared from areas surrounding drill rigs during every startup.
- Personnel shall stay clear of the rotating augers and other rotating components of drill rigs.
- Personnel shall stay as clear as possible of all hoisting operations. Loads shall not be hoisted overhead of personnel.
- Personnel shall not wear loose-fitting clothing or other items such as rings or watches that could get caught in moving parts. Individuals with long hair should have it restrained.
- If equipment becomes electrically energized, personnel shall be instructed not to touch any part of the equipment or attempt to touch any person who may be in contact with the electrical current. The utility company or appropriate party shall be contacted to have line deenergized prior to approaching the equipment.
- Smoking around drilling operations is prohibited.
- Personnel shall wear the appropriate PPE. Minimum protection includes safety-toed shoes/boots, hard hats, safety glasses, and hearing protection. Gloves, coveralls, Tyvek, and respirators may also be required based on the chemical hazards (refer to the project's written safety plan).

3.2 Regulations/Industry Standards

The following subsections provide the minimum regulatory and industry standard requirements pertaining to drilling operations. Drilling subcontractors are responsible and accountable for implementing these requirements as well as requirements established in their own safety procedures.

As described in the "Subcontractor, Contractor, and Owner" SOP HSE-55, CH2M HILL's project SC may be required to provide oversight of a drilling subcontractor. The following subsections are provided to inform the SC of established regulations and industry standards so that an appropriate level of oversight may be provided. Subcontractors retain control over their practices, and CH2M HILL's oversight does not relieve them of their own responsibility for effective implementation and enforcement of HS&E requirements.

3.2.1 General

- A daily safety briefing/meeting should be conducted with all drilling personnel to discuss the work planned for the day and the HS&E requirements to be followed.
- The drill rig and associated equipment should be inspected each day, before use, to ensure safe operational condition. This inspection should include, at a minimum, the "kill" switch, cathead, ropes, hoses, pressurized lines, operator controls, and drilling tools.

3.2.2 Drill Rig Placement

- The location of underground utilities such as electric, fuel, water, cable, telephone, and sewer either in service or abandoned shall be identified before drilling is permitted. Utility companies and/or installation owners shall be contacted for exact location. When the exact location cannot be identified, detection equipment or other acceptable means of locating the utility lines shall be used before drilling.
- Safe clearance distances shall be maintained between overhead powerlines and any part of the drill rig unless the powerlines have been deenergized and grounded or where insulating barriers have been installed to prevent physical contact. To avoid physical contact and potential arcing from the powerline to the drill rig, rigs shall remain at least 10 feet from overhead powerlines for voltages of 50 kV or less and 10 feet plus ½ inch for every 1 kV over 50 kV. When it is difficult for the drill rig operator to maintain the safe clearance distance, a person shall be designated to observe the clearance and warn the operator.
- Drilling pad preparation is recommended, particularly on steep slopes or areas that are covered with dry dead grass and weeds. Clean fill or gravel can be brought in to cover areas with surface contamination and to construct a relatively level work surface. Care should be taken in constructing pads if extensive cutting into existing slopes or surfaces is required to level the area. Areas in which extensive fill is required should be avoided. Compaction is recommended if significant amounts of fill are needed.
- The drill rig should be leveled and stabilized with jacks and adequate cribbing before raising the mast and during drilling operations. Cribbing materials should be made from materials that are capable of supporting the weight of the rig. Care should be taken in muddy, soggy soils, or partially frozen areas. In addition to cribbing, guy wires should be used to improve stability if the rig is located on wet, partially frozen ground, or in areas with loose, caving soil, or in an area subject to frequent gusty winds.

3.2.3 Drill Rig Travel

- The drill rig should be shut down and the mast lowered and secured prior to moving.
- All tools and equipment should be securely stowed before the drill rig is moved.

- Only personnel in the drill rig cab are permitted to ride the rig.
- The following safe clearance distances shall be maintained while traveling under overhead powerlines with the mast lowered: 4 feet for voltages less than 50 kV, 10 feet for voltages between 50 kV and 345 kV, and 16 feet for voltages between 346 kV and 750 kV.
- A backup alarm or spotter shall be used when backing the drill rig.

3.2.4 Drill Rig Operation

- The drill rig should be provided with a "kill" switch, which, when activated, will shut down the rig. The switch should be clearly identified and tested daily to confirm operational status. All drilling crew members should be made aware of the location and purpose of this switch.
- All machine guards shall be in place while the rig is in operation.
- The rope, wire rope, or cable on the drill rig should never be wrapped around any part of the body.
- Pressurized lines and hose connections should be secured together to prevent whipping. These connections should be inspected daily.
- The drill rig should not be operated during severe inclement weather such as during lightning storms, high winds, or severe rain. The mast should be lowered during these conditions.
- When the potential exists for hazardous atmospheres to develop within the drilling location, air monitoring shall be conducted to ensure it is safe to continue drilling operations (refer to the project's written safety plan).
- The drill gear boxes (transmission for rotary drive, feed control, etc.) should be placed in neutral while an operator is not at the controls. The operator should shut down the rig engine prior to leaving the immediate vicinity of the drill rig.

3.2.5 Drill Rig Maintenance

- Components found to be in defective condition during inspections or during rig operation should be repaired immediately.
- Rig maintenance shall only be performed after appropriate lockout/tagout procedures have been implemented.
- The cathead should be kept clean and free of rust, oil, and grease. The cathead should be cleaned with a wire brush if it becomes rusty. Should the rope "grab" the cathead or otherwise become tangled in the drum, the operator should release the rope and sound an appropriate alarm for all personnel to rapidly back away and stay clear. The operator should also back away and stay clear.
- Clean, dry, and sound rope should be used. A wet or oily rope may "grab" the cathead and cause drill tools or other items to be rapidly hoisted to the top of the mast, where the rope will often break, releasing the tools. If the rope does not break, personnel should be

instructed to stay clear of the drill rig until the operator cautiously returns to turn off the drill rig engine and appropriate action is taken to release the tools. The operator should keep careful watch on the suspended tools and should back away after turning off the engine. The rope should always be protected from contact with all chemicals. Chemicals can cause deterioration of the rope.

- Drilling operations may require repair or disentanglement of wire rope on the mast while it is raised. Fall protection shall be used when personnel are exposed to a fall of 6 feet or greater.
- Augers should be cleaned only when the drill rig is in neutral and the augers have stopped rotating. Hands or feet should not be used to move cuttings away from the auger.
- All work areas, platforms, walkways, scaffolding, and other accessways should be maintained free of materials, debris, obstructions, and substances such as ice, grease, or oil.

3.2.6 Drilling Waste Management

Drill cuttings and purge water where no soil or groundwater contamination shall be managed in accordance with HSE-81 (Non-hazardous Waste Management) and HSE-89 (Wastewater/Storm Water).

3.2.7 Drilling at Hazardous Waste Sites

The Environmental Compliance Coordinator (ECC) shall be consulted on proper evaluation, disposal, and decontamination procedures involving potential hazardous waste.

- All wastes generated shall be evaluated for appropriate disposal (see HSE-78, Waste Analysis and Characterization), HSE-79 (On-site Waste Management) and HSE-80 (Off-site Waste Management).
- If drilling involves hazardous wastes, HSE-13 (Decontamination) shall be followed. No potentially contaminated equipment shall be permitted to leave the work site.

3.2.8 Drilling at Potential OE Sites

If the project site is suspected of OE contamination, the UXO team will conduct a reconnaissance and OE avoidance to provide clear access routes to each site prior to drilling crews entering the area. The following procedures will be implemented:

- Drilling operations on OE sites will not be conducted until a complete plan for the site is prepared and approved by CH2M HILL EE&SBG UXOSO. OE/UXO avoidance must be conducted during drilling operations on known or suspect OE sites (HSE-91).
- The UXO team will identify, and clearly mark the boundaries of a clear approach path for the drilling crews, vehicles, and equipment to enter the site. This path will be, at a minimum, twice the width of the widest vehicle. No personnel will be allowed outside any marked boundary.
- If OE is encountered on the ground surface, the UXO team will clearly mark the area where it is found, report it to the proper authorities, and divert the approach path around it.
- The UXO team will conduct an access survey using the appropriate geophysical instrument over the approach path for avoidance of OE that may be in the subsurface. If a magnetic anomaly is encountered, it will be assumed to be OE and the approach path will be diverted

around the anomaly. UXO personnel only will operate the appropriate geophysical instrument and identify OE.

- An incremental geophysical survey of the drill hole location(s) will be initially accomplished by the UXO team using a hand auger to install a pilot hole. If OE is encountered or an anomaly cannot be positively identified as inert material, HTRW sampling personnel will select a new drill hole location.
- Once a drilling site has been surface cleared and a pilot hole established as described above, the drilling contractor will be notified that the site is available for subsurface drilling.

3.3 Forms/Permits

There are no CH2M HILL forms or permits required for drilling activities.

The following permits and notifications may be required, depending on state or local requirements. The ECC should be contacted to determine applicability.

- Well driller's license/certification or Professional Geologist requirements. Subcontractors are required to submit copies of licenses/certifications prior to subcontract award.
- Drill rig permit.
- Well installation or abandonment notification. Submittal of well log or inventory may be required after installation or abandonment.
- A groundwater withdrawal permit may be required for large water withdrawals in some states. Check with the ECC for specific requirements.
- A "dig permit" may be required at certain client facilities.

3.4 Self-Assessment Checklists

The "HS&E Self-Assessment Checklist - Drilling" found in Attachment 2 is provided as a method of verifying compliance with established safe work practices, regulations, and industry standards pertaining to drilling operations. CH2M HILL's project SC shall use this checklist when: 1) CH2M HILL employees are potentially exposed to hazards associated with drilling operations, and/or 2) CH2M HILL oversight of a drilling subcontractor is required by the "Subcontractor, Contractor, and Owner" SOP HSE-55. The HSM shall specify the frequency in which this checklist shall be completed and provide this information in the project's written safety plan. Completed checklists shall be sent to the HSM for review. The HSM shall assist the SC in resolving any deficiencies identified during the self-assessment. This SOP may be used to clarify checklist questions.

4.0 Attachments

Attachment 1: Subcontractor Safety Procedure Criteria - Drilling

Attachment 2: HS&E Self-Assessment Checklist - Drilling

Attachment 1

Subcontractor Safety Procedure Criteria - Drilling

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Subcontractor Safety Procedure Criteria - Drilling

The following criteria are not intended to be all inclusive, but are provided as a tool to facilitate development and review of subcontractor safety procedures. Subcontractors are expected to address the following items, at a minimum, in their safety procedures.

Minimum Acceptable Criteria for Subcontractor Drilling Safety Procedures:

1 Provide name and qualifications of the drilling "competent person" responsible for drilling (years and type of experience, training background, etc.):

2 Describe drill rig and equipment inspection criteria or procedures (frequency of inspections, visual vs. written inspections, items that are inspected):

3 Describe methods of identifying underground utilities (contacting utility companies, detection equipment):

4 Describe methods of avoiding contact with overhead powerlines (deenergizing and grounding, insulating, safe clearance distances):

5 Describe methods to identify hazardous atmospheres and controls used to eliminate (detection equipment and controls):

6 Describe leveling and stabilizing methods of drill rig (drilling pad, jacks, cribbing, guy wires):

7 Verify that rig equipment is in good operational condition (including, "kill" switch, cathead, ropes, pressurized hoses and lines, operator controls, machine guards, and drilling tools):

8 Describe procedures for operating in inclement weather, including lightning, high winds, severe rain storms:

9 Describe other safe work practices for equipment operation (drill rig, equipment, tools, rig transportation, rig travel):

10 Describe on-the-job maintenance procedures, including lockout/tagout:

11 Describe safe work practices for other activities to be performed during this project (use of ladders, fall protection, use of electrical power tools, use of personal protective equipment, etc.):

12 Describe methods for disposal of non-hazardous drill cuttings and purge water (including accumulation, transport and disposal):

13 If hazardous waste project, provide documentation of hazardous waste worker training and medical surveillance records for all project personnel (40-hour or 24-hour training, 8-hour refresher training) and describe methods of hazardous waste management (including accumulation, transport and disposal):

14 Submit a copy of drilling license/certification and drill rig permit.

15 Describe methods and responsibilities for submittal of notifications and logs:

16 Complete the Waste Subcontractor Qualification Form for each proposed transport and disposal facility.

17 Describe procedures for OE avoidance, identification and marking the boundaries of a clear approach path and work site for the sampling crews, vehicles, and equipment to enter the site. (HSE-91

18 If this is an OE project, provide documentation of UXO qualifications, hazardous waste worker training and medical surveillance records for all project personnel (40-hour or 24-hour training, 8-hour refresher training) for review by the CH2M HILL EE&SBG UXOSO (HSE-91).

19 Describe the procedures for drilling, monitoring and process for encountered OE. (HSE-91)

Drilling
Standard of Practice HSE-35
Attachment 2

HS&E Self-Assessment Checklist - Drilling

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HS&E Self-Assessment Checklist - DRILLING

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's HSP/FSI.

This checklist is to be used at locations where: 1) CH2M HILL employees are potentially exposed to hazards associated with drilling operations (complete Sections 1 and 3), and/or 2) CH2M HILL oversight of a drilling subcontractor is required (complete entire checklist).

SC may consult with drilling subcontractors when completing this checklist, but shall not direct the means and methods of drilling operations nor direct the details of corrective actions. Drilling subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Items considered to be imminently dangerous (possibility of serious injury or death) shall be corrected immediately or all exposed personnel shall be removed from the hazard until corrected.

Completed checklists shall be sent to the health and safety manager for review.

Project Name: __Site 3 Delineation/Confirmation Sampling Event_____ Project No.: 138804.CI.FS_____

Location: St. Julians Creek Annex, Chesapeake VA_____ PM: __William Friedmann____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposures to drilling hazards
X Evaluate a CH2M HILL subcontractor's compliance with drilling HS&E requirements
Subcontractors Name: _____

- Check "Yes" if an assessment item is complete/correct.
- Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the drilling subcontractor. Section 3 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HS-35.

SECTION 1	Yes	No	N/A	N/O
PERSONNEL SAFE WORK PRACTICES (3.1)				
1. Only authorized personnel operating drill rig	☐	☐	☐	☐
2. Personnel cleared during rig startup	☐	☐	☐	☐
3. Personnel clear of rotating parts	☐	☐	☐	☐
4. Personnel not positioned under hoisted loads	☐	☐	☐	☐
5. Loose clothing and jewelry removed	☐	☐	☐	☐
6. Personnel instructed not to approach equipment that has become electrically energized	☐	☐	☐	☐
7. Smoking is prohibited around drilling operation	☐	☐	☐	☐
8. Personnel wearing appropriate PPE, per HSP/FSI	☐	☐	☐	☐
9. OE/UXO avoidance provided, ,routes and boundaries cleared and marked	☐	☐	☐	☐
10. OE sites, Initial pilot hole established by UXO technician with hand auger.	☐	☐	☐	☐

SECTION 2	Yes	No	N/A	N/O
GENERAL (3.2.1)				
11. Aquifer evaluated for contamination, sole source and wellhead protection	☐	☐	☐	☐
. Daily safety briefing/meeting conducted with crew	☐	☐	☐	☐
. Daily inspection of drill rig and equipment conducted before use	☐	☐	☐	☐
14. Approved OE/UXO plan utilized on site	☐	☐	☐	☐
DRILL RIG PLACEMENT (3.2.2)				
12. Location of underground utilities identified	☐	☐	☐	☐
13. Safe clearance distance maintained from overhead powerlines	☐	☐	☐	☐
14. Drilling pad established, when necessary	☐	☐	☐	☐
15. Drill rig leveled and stabilized	☐	☐	☐	☐
DRILL RIG TRAVEL (3.2.3)				
16. Rig shut down and mast lowered and secured prior to rig movement	☐	☐	☐	☐
17. Tools and equipment secured prior to rig movement	☐	☐	☐	☐
18. Only personnel seated in cab are riding on rig during movement	☐	☐	☐	☐
19. Safe clearance distance maintained while traveling under overhead powerlines	☐	☐	☐	☐
20. Backup alarm or spotter used when backing rig	☐	☐	☐	☐
DRILL RIG OPERATION (3.2.4)				
21. Kill switch clearly identified and operational	☐	☐	☐	☐
22. All machine guards are in place	☐	☐	☐	☐
23. Rig ropes not wrapped around body parts	☐	☐	☐	☐
24. Pressurized lines and hoses secured from whipping hazards	☐	☐	☐	☐
25. Drill operation stopped during inclement weather	☐	☐	☐	☐
26. Air monitoring conducted per HSP/FSI for hazardous atmospheres	☐	☐	☐	☐
27. Rig placed in neutral when operator not at controls	☐	☐	☐	☐
DRILL RIG MAINTENANCE (3.2.5)				
28. Defective components repaired immediately	☐	☐	☐	☐
29. Lockout/tagout procedures used prior to maintenance	☐	☐	☐	☐
30. Cathead in clean, sound condition	☐	☐	☐	☐
31. Drill rig ropes in clean, sound condition	☐	☐	☐	☐
32. Fall protection used for fall exposures of 6 feet or greater	☐	☐	☐	☐
33. Rig in neutral and augers stopped rotating before cleaning	☐	☐	☐	☐
34. Good housekeeping maintained on and around rig	☐	☐	☐	☐
DRILLING WASTE MANAGEMENT (3.2.6)				
35. Drill cuttings and purge water managed and disposed properly	☐	☐	☐	☐
DRILLING AT HAZARDOUS WASTE SITES (3.2.7)				
36. Waste disposed of according to HSP and RCRA regulations	☐	☐	☐	☐
37. Appropriate decontamination procedures being followed, per HSP	☐	☐	☐	☐
FORMS/PERMITS (3.3)				
38. Driller license/certification and drill rig permit obtained	☐	☐	☐	☐
39. Well development/abandonment notifications and logs submitted and in project files	☐	☐	☐	☐
40. Water withdrawal permit obtained, where required	☐	☐	☐	☐
41. Dig permit obtained, where required	☐	☐	☐	☐

SECTION 3

Complete this section for all items checked "No" in Sections 1 or 2. Deficient items must be corrected in a timely manner.

Item #	**Corrective Action Planned/Taken**	**Date Corrected**

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Ordnance Explosives (OE) Standard of Practice HSE- 91

1.0 Applicability and Scope

1.1 Applicability

This Standard of Practice (SOP) applies to: 1) CH2M HILL employees who enter areas known or suspected of having Ordnance Explosives (OE) and 2) CH2M HILL Safety Coordinators (SCs) and CH2M HILL EE&SBG Unexploded Ordnance Safety Officers (UXOSO) who may be responsible for providing oversight of a subcontractors OE operations. OE operations may be conducted on active, inactive, closed, transferring, or transferred ranges; former battlefields; disposal sites; or munitions manufacturing and storage sites.

1.2 Scope

This SOP provides information regarding the spectrum of hazards and issues to be addressed during each phase of a project associated with OE operations. OE hazards addressed in this SOP include exposure to Unexploded Ordnance (UXO), Chemical Warfare Material (CWM), explosives contaminated soil and groundwater, and the hazards associated with operations to locate, identify, remove, and dispose of OE. CH2M HILL employees who enter OE areas must take precautions to avoid these hazards and be aware of associated safe work practices.

As described in the "Subcontractor, Contractor, and Owner" SOP HSE-55, responsibilities for health, safety and environment (HS&E) are expressly defined through the subcontract terms and conditions, and CH2M HILL's HS&E practices in the field are determined based on these defined responsibilities. Consistent with HSE-55, the subcontractor must determine how to operate safely and in compliance with applicable HS&E regulations and industry standards, and how to correct deficiencies. CH2M HILL employees shall not direct the means and methods of OE operations nor direct the details of corrective actions.

1.3 Regulatory Review

OE projects are often complex and have a myriad of regulatory requirements to ensure safety. Support for determining the governing laws and regulations for any specific OE project must be reviewed by the EE&SBG UXOSO to ensure compliance and safety.

Department of Defense (DOD) Ammunition and Explosives Safety Standards, DOD 6055.9-STD, establishes uniform safety standards applicable to ammunition and explosives, to associated personnel and property, and to unrelated personnel and property exposed to the potential damaging effects of an accident involving ammunition and explosives during their development, manufacturing, testing, transportation, handling, storage, maintenance, demilitarization, and disposal.

The U.S. Environmental Protection Agency (EPA) regulates the disposal of military munitions and waste containing military munitions through the Military Munitions Rule (RCRA; 40 CFR part 266, subpart M). The rule 1) identifies when conventional and chemical military munitions become a solid waste and 2) provides criteria for storage and transportation of such waste, including a conditional exemption if the munitions are managed under DOD rules.

2.0 Project Planning

2.1 Training Requirements

CH2M HILL employees and subcontractors who work on projects that involve OE must complete the following training:

- 40-hour hazardous waste comprehensive course with training in hazard recognition and basic health and safety issues, as required by the occupational safety and health regulations contained in 29 CFR 1910.120(e)
- Annual 8-hour hazardous waste refresher course
- Hazardous waste supervisory training as specified in 29 CFR 1910.120(e) [only required for management and supervisors]
- All UXO personnel will be graduates of one of the following: U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD; U.S. Naval Explosive Ordnance Disposal (EOD) School, Indian Head, MD; U.S. Naval EOD School, Eglin Air Force Base, FL; EOD Assistants Course, Redstone Arsenal AL; EOD Assistant Course at Eglin Air Force Base, FL; or a U.S. DOD-certified equivalent course

The EE&SBG UXOSO can provide assistance in reviewing subcontractor personnel qualifications.

2.2 Medical Surveillance Requirements

All CH2M HILL employees who work on OE sites must be on a medical surveillance program consisting of a baseline health assessment that includes a medical and occupational history review, blood and urine tests for contaminants of interest, electrocardiogram, slit-lamp corneal examination, pulmonary function tests, chest x-ray, respiratory fit test, and a general physical examination that includes hearing and vision.

Employees who terminate employment and who have worked at OE project sites may be required to undergo an exit examination equivalent to the baseline health assessment.

Subcontractors are responsible for ensuring that their employees receive medical surveillance as required.

2.3 Drug Abuse Surveillance Requirements

CH2M HILL employees who perform OE operations and oversight are subject to the provisions contained in HSE-76.

2.4 Competent Person Requirements

OE/UXO subcontractors are responsible for providing a competent person to oversee OE operations. A competent person may be a Senior UXO Supervisor, UXO Safety Officer, UXO Quality Control Specialist, or a UXO Technician III. The competent person must meet the following minimum qualification requirements:

- Be a graduate of either of one of the following: U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD; U.S. Naval Explosive Ordnance Disposal (EOD) School, Indian Head, MD; U.S. Naval EOD School, Eglin Air Force Base, FL; EOD Assistants Course, Redstone Arsenal Alabama; EOD Assistant Course at Eglin Air Force Base, FL; or a U.S. DOD-certified equivalent course
- Have at least 10 years of combined active duty military EOD and contractor UXO experience
- Have experience in OE clearance operations and supervising personnel

CH2M HILL competent person requirements are the same as for a subcontractor.

2.5 Safety Equipment

OE subcontractors are responsible for providing all personal protective equipment (PPE) necessary for their employees. CH2M HILL will provide PPE only for its own employees. Other safety equipment will be provided as delineated in the subcontract and referenced documents. The EE&SBG UXOSO must review subcontractor work plans and health and safety plans to ensure that appropriate safety equipment has been included to meet the scope of work requirements.

2.6 Subcontractor Selection

OE subcontractors are selected as described in the "Subcontractor, Contractor, and Owner" SOP HSE-55. The "Subcontractor Safety Procedure Criteria – OE Operations" found in Attachment 1 provides the minimum criteria for OE operations. Additional criteria may be developed dependent upon the specific OE scope of work requirements for the subcontractor. These criteria shall be used by the CH2M HILL EE&SBG UXOSO to review subcontractor OE procedures submitted when oversight is required by HSE-55.

2.7 Planning Activities

Assistance for planning OE operations is available from the CH2M HILL EE&SBG UXOSO for planning and executing OE support for Hazardous Toxic Radiological Waste (HTRW) support activities, construction support activities, OE response actions, CWM activities, explosive contaminated soils, and ordnance demilitarization. The following types of support may be needed for OE operations:

- On a HTRW site with known or suspected OE, UXO support refers to the anomaly avoidance techniques implemented to avoid any potential surface UXO and any subsurface anomalies.
- On a construction site with known or suspected OE, UXO support is provided by qualified UXO personnel during construction activities. The level of UXO support

required is dependent on the probability of encountering UXO, as determined on a project-by-project basis.

- OE response actions in which location, identification, excavation, removal, and disposal of UXO is accomplished require qualified UXO personnel, including a Senior UXO Supervisor, UXO Safety Officer, and UXO Quality Control Specialist to provide oversight for UXO Teams performing operations.
- On an OE site that has OE contamination of soils and/or groundwater, UXO support may include both anomaly avoidance techniques and OE construction support for excavation and/or treatment of OE contaminated soil and groundwater.
- On ordnance demilitarization and CWM projects, OE support may be needed for identification, handling, disassembly, processing, transportation, and treatment or disposal of munition components.
- On projects where OE waste (OEW) is transported or disposed off-range, the UXO and Environmental Compliance Coordinator (ECC) may assist in identifying the applicable regulations and permits required.
- On projects where Ordnance Related Scrap (ORS) or inert ordnance is recovered and processed for disposal as scrap, UXO and ECC support may determine if incineration and certification is required, along with any permitting requirements for portable incinerator operation.

The CH2M HILL EE&SBG UXOSO or EE&SBG UXO Quality Control Specialist shall verify subcontractor training and current medical examinations prior to the start of field operations.

3.0 Definitions

3.1 Active Range. A military range that is currently in use and being regularly used for range activities.

3.2 Anomaly. Any item that is seen as a subsurface irregularity after geophysical investigation. This irregularity should deviate from the expected subsurface ferrous and nonferrous material at a site.

3.3 Anomaly Avoidance. Techniques employed by EOD or UXO personnel at sites with known or suspected OE to avoid any potential surface UXO or subsurface anomalies. This usually occurs at mixed hazard sites when HTRW investigations must occur prior to execution of an OE removal action. Intrusive anomaly investigations are not authorized during ordnance avoidance operations.

3.4 Chemical Warfare Materials (CWM). An item configured as a munition containing a chemical substance that is intended to kill, seriously injure, or incapacitate a person through its physiological effects. Also includes V- and G-series nerve agents, H-series blister agent, and lewisite in other-than-munition configurations. Due to their hazards, prevalence, and military-unique application, chemical agent identification sets (CAIS) are also considered CWM. CWM does not include: riot control agents, chemical herbicides, smoke and flame producing items, or soil, water, debris, or other media contaminated with a chemical agent.

3.5 OE Construction Support. Support provided by qualified UXO personnel during construction activities at potential OE sites to ensure the safety of construction personnel from the harmful effects of UXO. When a determination is made that the probability of encountering UXO is low (current or previous land use leads to a determination that OE may be present), a two person UXO team will stand by in case the construction contractor encounters a suspected UXO. When a determination is made that the probability of encountering a UXO is moderate to high (current or previous land use leads to a determination that OE was employed or disposed of in the parcel of concern, e.g., open burn and open detonation areas), UXO teams are required to conduct subsurface UXO clearance for the known construction footprint either in conjunction with the construction contractor or prior to construction.

3.6 EOD Personnel. EOD personnel are those active duty military individuals performing EOD operations.

3.7 Explosive Ordnance Disposal (EOD). EOD includes the detection, identification, field evaluation, rendering safe, and final disposal of OE.

3.8 Explosive Safety Submission (ESS). The document that serves as the specifications for conducting work activities at the project. The ESS details the scope of the project, the planned work activities, and potential hazards and the methods for their control.

3.9 Explosive Soil. Refers to mixtures of explosives in soil, sand, clay, or other solid media at concentrations such that the mixture itself is explosive.

(a) The concentration of a particular explosive in soil necessary to present an explosion hazard depends on whether an explosive is classified as "primary" or "secondary."

(b) Primary explosives are those extremely sensitive explosives (or mixtures thereof) that are used in primers, detonators, and blasting caps. They are easily detonated by heat, sparks, impact, or friction. Examples of primary explosives include lead azide, lead styphnate, and mercury fulminate.

(c) Secondary explosives are bursting and boostering explosives (i.e., they are used as the main bursting charge or as the booster that sets off the main bursting charge). Secondary explosives are much less sensitive than primary explosives.

(d) Soil containing 10 percent or more by weight of any secondary explosive mixture of secondary explosives is considered "explosive soil."

(e) Soil containing propellants (as opposed to primary or secondary high explosives) may also present explosion hazards.

3.10 Inactive Range. A military range that is not currently being used, but that is still under military control and considered by the military to be a potential range area, and that has not been put to a new use that is incompatible with range activities.

3.11 Intentional Detonation. An intentional detonation is a planned, controlled detonation.

3.12 Intrusive Activity. An activity that involves or results in the penetration of the ground surface at an area known or suspected to contain OE. Intrusive activities can be of an investigative or removal action nature.

3.13 Maximum Credible Event. The worst single event that could occur at any time, with maximum release of a chemical agent from a munition, container, or process as a result of unintended, unplanned, or accidental occurrence.

3.14 Most Probable Event (MPE). The most likely event, as a result of an accidental, unplanned, or unintended detonation of an item of ordnance, that could occur during OE activities. The event must be realistic with reasonable probability of occurrence.

3.15 Most Probable Munition (MPM). The OE item that has the greatest hazard distance based on calculations of the explosion effects of the OE items anticipated to be found at a site. Typically, the MPM is the OE item with the greatest fragmentation or overpressure distance based on the type of OE items that were historically used at the site.

3.16 Military Munitions. All ammunition products and components produced or used by or for the U.S. DOD or the U.S. Armed Services for national defense and security, including military munitions under the control of the DOD, the U.S. Coast Guard, the U.S. Department of Energy (DOE), and the National Guard personnel. The term military munitions includes: confined gases, liquid, and solid propellants, explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries used by DOD components, including bulk explosives and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components thereof.

3.17 Military Range. Designated land and water areas set aside, managed, and used to conduct research on, develop, test, and evaluate military munitions and explosives, other ordnance or weapons systems, or to train military personnel in their use and handling. Ranges include firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, and buffer zones with restricted access and exclusionary areas.

3.18 Non-Stockpile Chemical Warfare Materials. CWM (defined above) that is not included in the chemical stockpile. Nonstockpile CWM is divided into five categories:

(1) Buried CWM.

(2) Recovered chemical weapons (items recovered during range clearing operations, from chemical burial sites, and from research and development testing).

(3) Former chemical weapon production facilities.

(4) Binary chemical weapons.

(5) Miscellaneous CWM (unfilled munitions and devices and equipment specially designed for use directly in connection with employment of chemical weapons).

3.19 Ordnance and Explosives (OE) consists of:

(1) Ammunition, ammunition components, chemical or biological warfare materials that have been abandoned, expelled from demolition pits or burning pads, lost, discarded, buried or fired. Such ammunition, ammunition components, and explosives are no longer under accountable record control of any DOD organization or activity.

(2) Explosive Soil. See definition under "explosive soils."

(3) OE market includes: Unexploded Ordnance (UXO), Chemical Weapons Materials (CWM), OE Contaminated Soils and Groundwater, Range Maintenance, Ordnance Demilitarization (Demil), and Demining (DM).

3.20 Quantity-Distance (QD). The quantity of explosives material and distance separations that provide defined types of protection. These relationships are based on levels of risk considered acceptable for the stipulated exposures and are tabulated in the appropriate Q-D tables provided in DOD 6055.9-STD. Separation distances are not absolute safe distances but are relative protective safe distances. Greater distances than those shown in the Q-D tables shall be used whenever possible.

3.21 Removal Action. The cleanup of OE from the environment to include the disposal of removed material. The term includes, in addition, without being limited to, security fencing or other measures to prevent, minimize, or mitigate damage to the public health or welfare or the environment.

3.22 Response Action. Action taken instead of or in addition to a removal action to prevent or minimize the release of OE so that it does not cause substantial danger to present or future public health or welfare or the environment.

3.23 Senior UXO Supervisor (SUXOS). Supervises all contractor onsite UXO activities. This individual must be a graduate of the U.S. Army Bomb Disposal School, Aberdeen proving Ground, MD, or the U.S. Naval EOD School, Indian Head, MD. This individual must have at least 15 years of combined active duty military EOD and contractor UXO experience, to include at least 10 years in supervisory positions.

3.24 Unintentional Detonation. A detonation not planned in advance.

3.25 Unexploded Ordnance (UXO). Military munitions that have been primed, fuzed, armed, or otherwise prepared for action, and have been fired dropped, launched, projected or placed in such a manner as to constitute a hazard to operations, installation, personnel, or material and remain unexploded either by malfunction, design, or any other cause.

3.26 UXO Personnel. Contractor personnel who have completed specialized military training in EOD methods and have satisfactorily performed the EOD function while serving in the military. Various grades and contract positions are established based on skills and experience.

3.27 UXO Safety Officer (UXOSO). Contractor personnel with the responsibility of enforcing the contractor's SSHP. This individual must, therefore, be in the field whenever possible to observe operations. This individual must have the same minimum qualifications as the UXO Technician III. In addition, this individual must have the specific training,

knowledge, and experience necessary to implement the SSHP and verify compliance with applicable safety and health requirements.

3.28 UXO Technician III. Supervises a UXO team. This individual must be a graduate of the U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD, the U.S. Naval EOD School, Indian Head, MD, or U.S. Naval EOD School, Elgin Air Force Base, FL, or a DOD-equivalent certified course. This individual must have a minimum of 10 years of military EOD or contractor UXO experience.

3.29 UXO Technician II. This individual must be a graduate of the U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD, the U.S. Naval EOD School, Indian Head, MD, or U.S. Naval EOD School, Elgin Air Force Base, FL, or a DOD-equivalent certified course. This individual must have a minimum of 5 years of military EOD or contractor UXO experience.

4.0 Project Execution

4.1 Safe Work Practices

The requirements of this section are to be followed by CH2M HILL employees who enter OE exclusion zones, regardless of the company performing OE operations. These requirements also pertain to OE subcontractor personnel when CH2M HILL is providing oversight.

4.2 Regulations/Industry Standards

As described in the "Subcontractor, Contractor, and Owner" SOP HSE-55, CH2M HILL's project EE&SBG UXOSO may be required to provide oversight of an OE subcontractor. OE subcontractors retain control over their practices, and CH2M HILL's oversight does not relieve them of their own responsibility for effective implementation and enforcement of HS&E requirements. The following subsections provide the minimum regulatory and industry standard requirements pertaining to OE operations.

4.2.1 General Safety Concerns and Procedures

(a) OE operations will not be conducted until a complete plan for the site is prepared and approved by the CH2M HILL EE&SBG UXOSO. These plans will be based upon limiting exposure to the minimum number of personnel, for the minimum amount of time, to the least amount of OE consistent with safe and efficient operations.

(b) Only UXO qualified personnel will perform OE procedures. Non-UXO personnel may be used to perform OE-related procedures when supervised by a UXO Technician III. All personnel engaged in field operations will be thoroughly trained and capable of recognizing the specific hazards of the procedures being performed. To ensure that these procedures are performed to standards, all field personnel will be under the direct supervision of a UXO Technician III.

(c) Personnel who will be handling OE items will not wear outer or inner garments having static electricity-generating characteristics. Materials made of 100 percent polyester, nylon, silk, and wool are highly static producing.

(d) UXO Technicians are required to wear hard hats except when investigating suspect UXO. Hard hats may create an unsafe condition by falling off of the head of a UXO technician at a critical moment. In the event of the accidental detonation of a UXO (the worst case accident scenario), the hard hat will not protect the UXO technician from fragments and may worsen the injury by reflecting fragments into the head of the technician. This is consistent with safety guidance from the U.S. Army Corps of Engineers OE Center of Excellence. Also, protective shoes worn by personnel performing UXO operations should be constructed of nonferrous materials (e.g., fiberglass) to prevent interference with sensitive geophysical instruments.

(e) Prior to any action being performed on an ordnance item, all fuzing will be positively identified. This identification will consist of fuze type by function, condition (armed or unarmed), and the physical state/condition of the fuze, i.e., burned, broken, parts exposed/sheared, etc.

4.2.2 OE Safety Precautions

(a) Every effort will be made to identify a suspect OE item. Under no circumstances will any OE be moved in an attempt to make a positive identification. The OE item will be visually examined for markings and other external features such as shape, size, and external fittings. If an unknown OE item is encountered, the CH2M HILL EE&SBG UXOSO will be notified immediately. The following are additional considerations for the safe handling of OE items:

(1) Projectiles containing base detonating (BD) fuzes are to be considered armed if the round is fired.

(2) Arming wires and pop-out pins on unarmed fuzes should be secured prior to any movement.

(3) Do not depress plungers, turn vanes, rotate spindles, levers, setting rings, or other external fittings on OE items. Such actions may arm or activate the OE.

(4) Do not attempt to remove any fuzes from the OE. Do not dismantle or strip components from any OE items unless the item is included in the scope of work (SOW).

(5) UXO personnel are not authorized to inert any OE items found onsite unless it is a part of the SOW.

(6) OE/UXO items will not be taken from the site as souvenirs/training aids.

(7) Civil War ordnance will be treated as any other OE.

(b) Prior to entering U.S. Army-controlled areas/ranges contaminated with Improved Conventional Munitions (ICM), an approved Department of the Army (DA) wavier must be obtained.

(c) Any time suspect chemical warfare material (CWM) is encountered during conventional OE site activities, all work will immediately cease. Project personnel will withdraw along cleared paths upwind from the discovery. A team consisting of two personnel will secure the area to prevent unauthorized access. Personnel should

position themselves as far upwind as possible while still maintaining security of the area. The local point of contact designated in the Work Plan will be immediately notified.

(d) Avoid inhalation and skin contact with smoke, fumes, and vapors of explosives and other related materials.

(e) Consider OE items that have been exposed to fire and detonation as extremely hazardous. Chemical and physical changes may have occurred to the contents, which might render them more sensitive than their original state.

(f) Do not rely on the color coding of OE for positive identification. Munitions having incomplete or improper color codes have been encountered.

(g) Avoid approaching the forward area of an OE item until it can be determined whether or not the item contains a shaped charge. The explosive jet, which is formed during detonation, can be lethal at great distances. Assume that all shaped charge munitions contain piezoelectric (PZ) fuzing system until identified. PZ is extremely sensitive. It can function at the slightest physical change and can remain hazardous for an indefinite period of time.

(h) Approach an unfired rocket motor from the side at a 45-degree angle. Accidental ignition can cause a missile hazard and hot exhaust.

(i) Do not expose unfired rocket motors to any electromagnetic radiation (EMR) sources.

(j) Consider an emplaced landmine armed until proven otherwise. It may be intentionally booby-trapped to deceive.

(k) Assume that practice OE contains a live charge until it can be determined otherwise. Expended pyrotechnic and practice devices can contain red or white phosphorous residue. Due to incomplete combustion, the phosphorous may reignite if the crust is broken and exposed to air.

(l) Do not approach a smoking white phosphorous (WP) munition. Burning WP may detonate the explosive burster charge at anytime.

(m) Foreign ordnance was returned to the United States for exploitation and subsequent disposal. Every effort must be made to research the applicable documentation and publications prior to commencement of a project.

4.2.3 OE Storage

(a) During OE projects, explosive storage falls into two categories, on-DOD installations and off-DOD installations.

(b) For On-DOD installations the provisions of DOD 6055.9-STD will be followed.

(c) In the event the installation does not have an existing storage facility, the provisions of DOD 6055.9-STD will apply.

(d) For Off-DOD installations, establish a temporary explosive storage area that will meet all local, state, and 27 CFR, Bureau of Alcohol Tobacco, and Firearms (BATF) requirements and as much of DOD 6055.9-STD as is practical to implement. The establishment of a temporary explosive storage area must meet the following requirements:

(1) The area will, if possible, meet the inhabited building and public traffic route distances specified in DOD 6055.9-STD. If the distances are less than required by the DOD guidance, a proposed barricading plan to protect the public from accidental detonation must be developed and reviewed by the CH2M HILL Corporate UXOSO.

(2) Magazines must meet the requirements of the BATF regulations, and each magazine must have a Net Explosive Weight (NEW) established for the explosives to be stored.

(3) Each magazine must be grounded as specified in NFPA 780 and must meet the intermagazine distances as defined in the DOD guidance.

(4) A physical security survey will be conducted to determine if fencing or guards are required. This survey will be coordinated through the CH2M HILL EE&SBG UXOSO and local law enforcement agencies.

(5) A fire plan for either on- or off-installation explosive storage areas will be prepared and coordinated through the CH2M HILL EE&SBG UXOSO and the local fire department. All magazines will have placards.

(e) OE Waste (OEW) may be stored: 1) in RCRA regulated units (i.e., tanks, containers, containment buildings, etc.) as described in HSE-80; 2) in military magazines conforming to DDESB standards (as described above); or 3) under the MMR conditional exemption (40 CFR 266.205). The MMR conditional exemption applies to military non-chemical munitions, and the following procedures must be met:

(1) Follow DDESB requirements for storage.

(2) Notify EPA of the location of the unit within 90 days of when storage unit first is used for waste munitions storage.

(3) Notify EPA within 24 hours of any loss or theft of munitions from the storage area.

(4) Inventory wastes annually, conduct inspections quarterly and keep records for at least three years.

(5) Limit access to the area to appropriately trained and authorized personnel.

4.2.4 OE Transportation

In the event that OE items must be transported offsite, the provisions of 49 CFR, DA Pam 385-64 state and local laws must be followed. These additional considerations are provided for the safe transport of OE items:

(a) Do not transport WP munitions unless they are immersed in water, mud, or wet sand.

(b) If loose pyrotechnic, tracer, flare, or similar mixtures are to be transported, they will be placed in #10 mineral oil or equivalent to minimize the fire and explosion hazards.

(c) Incendiary loaded munitions should be placed on a bed of sand and covered with sand to help control the burn if a fire should start.

(d) If a base-ejection projectile must be transported to a disposal area, the base will be oriented in the vehicle so that it is parallel to the rear axle. This will afford maximum protection for the personnel operating the vehicle.

(e) OE with exposed hazardous fillers such as high explosives (HE), will be placed in appropriate containers with packing materials to prevent migration of the hazardous fillers. Padding should be added to protect the exposed filler from heat, shock, and friction.

4.2.5 OE Exclusion Zone Operations

On OE project sites, it is the responsibility of the UXOSO to establish the exclusion zone for each UXO team. This exclusion zone should not be confused with the safe separation distance that is maintained between teams.

(a) The purpose of the exclusion zone is for the protection of nonessential project personnel and the public from blast overpressure and fragmentation hazards. There are two criteria for calculating exclusion zones:

(1) Intentional Detonations. When destroying ordnance, both the hazards from fragmentation and overpressure must be considered. The minimum separation distances in DOD 6055.9-STD will also be used unless otherwise stated.

(2) Unintentional Detonations. If the identification of OE on an OE site is unknown, the minimum separation specified in DOD 6055.9-STD, Chapter 5, Paragraph C5.5.4, will be used to establish the exclusion zones.

(b) When multiple teams are working onsite, a safe separation distance will be established. The minimum distance maintained between teams will never be less than 200 feet or the K50 overpressure distance. The one that is greater will be used.

(c) While OE operations are being conducted, only personnel essential for the operation will be allowed in the exclusion zone. When nonessential personnel enter the exclusion zone, all OE operations will cease. In addition to this work stoppage, the following actions will be accomplished:

(1) The individuals must receive a safety briefing and sign the visitors' log prior to entering the zone.

(2) The individuals will be escorted by a UXO qualified individual.

(3) All OE operations will cease within the radius of the exclusion zone for the areas to be visited.

(d) All personnel working within the exclusion zone must comply with the following:

(1) There will be no smoking within the exclusion zone, except in areas designated by the UXOSO.

(2) There will be no open fires for heating or cooking within the exclusion zone, except where authorized by the UXOSO.

(3) During magnetometer operations, workers will have no metal parts in or on their shoes that would cause the magnetometer to present false indications.

4.2.6 OE Excavation Operations

(a) Hand excavation is the most reliable method for uncovering OE, provided the item is near the surface. Hand excavation exposes personnel to the hazard of detonation for longer periods of time than any other method. Taking this into consideration, only UXO qualified personnel will be used to accomplish this task.

(b) Earth-Moving Machinery (EMM) may be used to excavate overburden from suspected OE. EMM will not be used to excavate within 12 inches of a suspected OE. Once the EMM is within 12 inches of the OE, the excavation will be completed by hand excavation methods. Personnel who are not UXO qualified may operate EMM only when supervised by a UXO Technician III.

(1) If more than one EMM is to be used onsite, the same minimum separation distances required for multiple work teams applies.

(2) EMM operations will be conducted within the guidelines of HSE-32 "Excavations."

(c) Excavation operations, whether by hand or EMM, will employ a step-down or offset access method. Under no circumstances will any excavation be made directly over the suspected OE.

4.2.7 OE Disposal Operations

To avoid MMR regulation, all demolition operations will be conducted on-range in accordance with TM/EODB 60A 1-1-31. Any deviation from this policy must be approved by the UXOSO and ECC. The following are on-range disposal procedures.

(a) As a general rule, all demolition operations will be accomplished by use of shock tubing or electrical means to assure maximum safety. There are exceptions to this requirement in situations where static electricity of EMR hazards are present.

(b) The only acceptable disposal method is the one stated in the appropriate TM/EODB 60-series manual for specific ordnance types. Any commercial explosives being used will be equivalent to the military explosive required for the disposal operation.

(c) If a situation dictates, protective measures to reduce shock, blast overpressure, and fragmentation will be taken. The CH2M HILL EE&SBG UXOSO will assist in any design work and must review and approve all proposed protective works. As a minimum requirement, all demolition shots will be tamped with clean earth or sand. In accordance with DOD 6055.9-STD the following separation distances will be observed unless otherwise directed:

(1) Minimum separation distance for nonfragmenting explosive materials will be no less than 1,250 feet.

(2) Minimum separation distance for fragmenting explosive ordnance will be no less than 2,500 feet. For bombs and projectiles with a diameter of 5 inches or greater, use a minimum distance of 4,000 feet.

(3) Ordnance items with lifting lugs, strong backs, base plates, etc., will be oriented away from personnel, as fragments from these items tends to travel farther than normal.

(d) Once demolition operations are completed, a thorough search of the demolition area will be conducted with a magnetometer to ensure a complete disposal was accomplished.

(e) Inert ordnance will not be disposed of for scrap until the internal fillers/voids have been exposed and unconfined. Heat generated during the reclamation process can cause the inert fillers, moisture, or air to expand and burst the sealed casings. In this situation, Oil Well Perforators can be used for venting these ordnance items that require demilitarization.

(f) Inert ordnance to be disposed of as scrap may require certification by the UXOSO and a government representative. This may require further treatment by operation of a portable incinerator, depending on local requirements and acceptance criteria. The UXOSO and ECC will determine if certification and incineration is necessary, along with any permitting requirements during project planning.

4.2.8 OEW Disposal

When the used or fired munition is managed off-range (i.e., transported off-range and stored, reclaimed, treated or disposed) or disposed of on-range (i.e., buried without treatment), it is subject to regulation as a solid waste under RCRA. This means it may also be subject to regulation as a hazardous waste. Also, munitions that land off-range, and that are not promptly retrieved, are solid wastes. Table 4-1 describes how solid wastes may be characterized as hazardous in these situations. All characterization must be based on field observations by the EE&SBG UXOSO, who is trained in the proper identification of waste ordnance items and meet the requirements for an "emergency response expert" under RCRA. In the event the OEW is regulated as hazardous waste, refer to the Hazardous Waste SOP, HSE-80 for RCRA hazardous waste management requirements.

Table 4-1 Waste Characterization

Item	Characterization	Waste Code
Uncontaminated Metal Debris	If visual inspection determines if item does not contain waste residue, waste is non-hazardous scrap metal, excluded from RCRA regulation under 40 CFR 261.6(a)(3). Waste may be subject to further incineration and certification requirements.	None
Contaminated Metal Debris	If visual inspection determines item contains hazardous waste residue, manage as potential hazardous waste.	Potential D003 and/or D008
Ordnance Items Less than 0.5 Caliber	Small-arms ammunition is not considered reactive hazardous waste in accordance with EPA policy (November 30, 1984 Memorandum, John Skinner, OSWER Director).	None
Ordnance Items Greater than 0.5 Caliber	Untreated UXO presumed to be reactive hazardous waste using generator knowledge under 40 CFR 261.23.	D003
Ordnance Items Greater than 0.5 Caliber w/ Lead Projectiles	Ordnance containing lead projectiles will be presumed to be toxic hazardous waste under 40 CFR 261.24.	D008

4.3 Forms/Permits

(a) **Type-33 User of High Explosives License/Permit** issued by the BATF? is required for the purchase, storage, and use of high explosives (HE) in support of OE operations, construction projects, and demolition and disposal (D&D) projects. Written authorization designating the individuals who can purchase, store, or use explosives must be included in the site-specific work plans.

(b) **State and Local Explosive Permits** may be required for the purchase, storage, and use of HE in support of OE operations, construction projects, and D&D projects.

4.4 Self-Assessment Checklists

The "HS&E Self-Assessment Checklist—OE Operations" found in Attachment 2 is provided as a method of verifying compliance with established safe work practices, regulations, and industry standards pertaining to OE operations. CH2M HILL's project UXOSO/EE&SBG UXOSO shall use this checklist when: 1) CH2M HILL employees are potentially exposed to hazards associated with OE operations, and/or 2) CH2M HILL oversight of an OE subcontractor is required. The EE&SBG UXOSO shall specify the frequency in which this checklist shall be completed and provide this information in the project's written safety plan. Completed checklists shall be sent to the EE&SBG UXOSO for review. The EE&SBG UXOSO shall assist the Site UXOSO in resolving any deficiencies identified during the self-assessment.

5.0 Attachments

Attachment 1: Subcontractor Safety Procedure Criteria for OE Operations

Attachment 2: H&S Self-Assessment Checklist for OE Operations

Ordnance Explosives (OE)

Standard of Practice HSE-91

Attachment 1: Subcontractor Safety Procedure Criteria for OE Operations

Pending. Contact the CH2M HILL EE&SBG UXO Safety Officer for assistance.

Ordnance Explosives (OE)
Standard of Practice HSE-91
Attachment 2: HS&E Self-Assessment Checklist - OE Operations

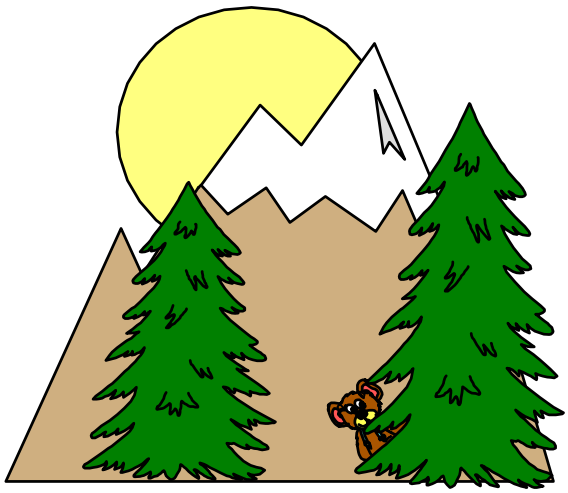
Pending. Contact the CH2M HILL EE&SBG UXO Safety Officer for assistance.

Principal Steps	Potential Safety/Health Hazards	Recommended Controls
Surveying and establishing boundaries and grids.	Accidental detonation of explosives	Personnel involved will attend a site-specific OE/Unexploded Ordnance (UXO) recognition class prior to the commencement of site activities.
		Observe the Basic Safety Concepts and Considerations for UXO Operations.
		UXO personnel will escort non-UXO personnel at all times.
		Mark and avoid UXO. Only UXO personnel will handle OE.
		Check location with magnetometer prior to driving stakes.
Clearing and grubbing	Accidental detonation of explosives.	Observe the Basic Safety Concepts and Considerations for UXO Operations.
		Personnel involved will attend a site-specific OE/UXO recognition class prior to the commencement of any site activities.
		Be alert and mark all OE located.
		Only clear and grub to within four inches of the ground surface.
		UXO trained personnel will escort non-UXO personnel at all times.
		Surface sweeps will be conducted with magnetometers or other suitable geophysical instrumentation to identify potential OE.
OE Related Scrap Demilitarization	Accidental detonation of explosives	Observe the Basic Safety Concepts and Considerations for UXO Operations.
		Only UXO technicians will perform explosive demilitarization of OE related scrap.
	Shredder Operations	Stay clear of moving mechanical parts.
		Insure only inspected scrap is fed into shredder.
Inspection/Certification of OE Related Scrap	Accidental detonation of explosives	Observe the Basic Safety Concepts and Considerations for UXO Operations.
		Only UXO technicians will inspect OE related scrap.
		Personnel in the immediate vicinity of OE related scrap inspections will be kept to the minimum necessary for safe operations but no less than two UXO technicians.
		Observe requirements of DOD 4160.21-M-1.

SITE SPECIFIC SAFETY AND HEALTH PLAN (SSHP) ACKNOWLEDGEMENT

I have read, understand, and agree to abide by the provisions of this Site Specific Safety and Health Plan prepared by USA Environmental, Inc. Failure to comply with these provisions may lead to disciplinary action and/or my dismissal from the work site.

Printed Name	Signature	Employee Number	Date



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29 June 2001

US Army Corps
of Engineers®

SAFETY

BASIC SAFETY CONCEPTS AND CONSIDERATIONS FOR ORDNANCE AND EXPLOSIVES OPERATIONS

ENGINEER PAMPHLET

"Approved for public release; distribution is unlimited."

AVAILABILITY

Electronic copies of this and other U.S. Army Corps of Engineers publications are available on the Internet at http://www.usace.army.mil/inet/usace-docs/. This site is the only repository for all official USACE engineer regulations, circulars, manuals, and other documents originating from HQUSACE. Publications are provided in portable document format (PDF).

DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, DC 20314-1000

CESO

Pamphlet
No. 385-1-95a

29 June 2001

Safety
BASIC SAFETY CONCEPTS AND
CONSIDERATIONS FOR ORDNANCE
AND EXPLOSIVES OPERATIONS

1. Purpose. This pamphlet establishes U.S. Army Corps of Engineers (USACE) operating procedures for dealing with ordnance and explosives (OE) items at Formerly Used Defense Sites (FUDS), Base Realignment and Closure, and Installation Restoration projects. There are no absolutely safe procedures for dealing with OE items, merely procedures considered to be least dangerous; therefore, it is essential that a planned and systematic approach to dealing with such items be established.

2. Applicability. This pamphlet applies to all Headquarters, U.S. Army Corps of Engineers elements and all USACE Commands having responsibility for performing OE response activities.

3. Distribution Statement. Approved for public release; distribution is unlimited.

4. References.

a. 27 CFR 55, Commerce in Explosives.

b. 29 CFR 1926, Subpart P, Excavations.

c. DOD 6055.9-STD, DOD Ammunition and Explosives Safety Standards.

d. AR 385-64, U.S. Army Explosives Safety Program.

e. DA Pam 385-64, Ammunition and Explosives Safety Standards.

f. TM 60A-1-1-31, Explosive Ordnance Disposal Procedures: General Information on EOD Disposal Procedures.

g. TB 700-2, Department of Defense Ammunition and Explosives Hazard Classification Procedures.

h. ER 5-1-11, Program and Project Management.

i. ER 1110-1-12, Quality Management.

j. EP 1110-1-17, Establishing a Temporary Open Burn and Open Detonation Site for Conventional Ordnance and Explosives Projects.

k. EP 1110-1-18, Ordnance and Explosives Response.

l. EM 385-1-1, Safety and Health Requirements Manual.

m. HNC-ED-CS-S-98-1, Methods for Predicting Primary Fragmentation Characteristics of Cased Explosives, January 1998. This document is available on the Internet at http://www.hnd.usace.army.mil/.

n. HNC-ED-CS-S-98-2, Method for Calculating Ranges to No More Than One Hazardous Fragment per 600 Square Feet, January 1998. This document is available on the Internet at http://www.hnd.usace.army.mil/.

o. Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives (OE) Sites, U.S. Army Engineering and Support Center, Huntsville, August 1998. This document is available on the Internet at http://www.hnd.usace.army.mil/.

p. AFM 91-201, Explosives Safety Standards.

q. NAVSEA OP5, Ammunition and Explosives Ashore Safety Regulations for Handling, Storing, Production, Renovation, and Shipping.

r. NFPA 780, Standard for the Installation of Lightning Protection Systems.

5. Explanation of Abbreviations and Terms. Abbreviations/acronyms and special terms used in this document are explained in the glossary.

6. Policy. The policy of USACE is to produce products and services that fully meet customers' expectations of quality, timeliness, and cost effectiveness, within the bounds of legal responsibility. An acceptable level of quality does not imply perfection; however, there should be no compromise of functional, health, or safety requirements. Adherence to the principles outlined in ER 5-1-11 and ER 1110-1-12 will contribute to achieving this goal. OE response procedures must be formulated to ensure harmony with the USACE Strategic Vision and should be executed in concert with activities presented in other USACE guidance.

7. Responsibilities. USACE and contractor personnel involved with OE response projects are responsible for safely executing response actions in accordance with (IAW) the approved Site Safety and Health Plan, approved Work Plan, and all applicable laws, regulations, and policies.

8. General Safety Concerns and Procedures.

a. As a general rule, all fuzed unexploded ordnance (UXO) will be detonated in the original position found. This is the safest method to effect final disposition of munitions.

b. OE operations will not be conducted until all applicable plans for the site in question are prepared and approved. These plans will be based upon the concept of limiting exposure to the minimum number of personnel, for the minimum amount of time, to the minimum amount of OE consistent with safe and efficient operations.

c. Only UXO-qualified personnel will perform OE procedures. As an exception, a UXO Technician I may assist in the performance of OE procedures when under the supervision of a UXO Technician III or a UXO-qualified individual of higher rank than UXO Technician III. Non-UXO-qualified personnel who have been determined to be essential for the operations being performed may be utilized to perform OE-related procedures when supervised by a UXO Technician III or a UXO-qualified individual of higher rank than UXO Technician III. All personnel engaged in field operations will be thoroughly trained and capable of recognizing the specific hazards of the procedures being performed. To ensure that these procedures are performed to standards, all field personnel will be under the direct supervision of a UXO Technician III or a UXO-qualified individual of higher rank than UXO Technician III.

d. Personnel who will be handling OE items will not wear outer or inner garments having static-electricity-generating characteristics. Materials made of 100-percent polyester, nylon, silk, and wool are highly static producing. Refer to DA Pam 385-64 for more information regarding nonstatic-producing clothing.

e. Prior to any action being performed on an ordnance item, all fuzing will be definitively identified. This identification will consist of fuze type by function and condition (armed or unarmed) and the physical state/condition of the fuze, i.e., burned, broken, parts exposed/ sheared, etc.

f. OE operations will be conducted only during daylight hours.

9. OE Safety Precautions.

a. Every effort will be made to identify a suspect OE item. Under no circumstances will any fuzed UXO be moved in an attempt to make a definitive identification. The OE item will be visually examined for markings and other external features such as shape, size, and external

fittings. If an unknown OE item is encountered, the onsite USACE representative will be notified immediately. If there is no onsite USACE representative, the USACE district or the U.S. Army Engineering and Support Center, Huntsville (USAESCH) OE Safety Group will be notified as soon as possible. If research of documentation is required, it will be initiated by USAESCH. Following is additional guidance for the safe handling of OE items:

(1) Projectiles containing base-detonating fuzes are to be considered armed if the round is fired.

(2) Arming wires and popout pins on unarmed fuzes should be secured prior to moving OE items.

(3) Do not depress plungers, turn vanes, or rotate spindles, levers, setting rings, or other external fittings on OE items. Such actions may arm or activate the items.

(4) Do not attempt to remove any fuze(s) from OE items. Do not dismantle or strip components from any OE items.

(5) UXO personnel are not authorized to render inert any OE items found onsite.

(6) OE items will not be taken from the site as souvenirs/training aids.

(7) Civil War ordnance will be treated in the same manner as any other OE items.

b. Prior to entering areas/ranges contaminated with Improved Conventional Munitions (ICMs) or submunitions, a Department of the Army (DA) waiver must be obtained by the affected installation or for FUDS properties, the executing Corps district. If an ICM or submunition is found at a site not previously known to contain ICMs or submunitions, work will cease. The discovered item will be identified, then properly disposed of (including guarding the item if disposition is to be delayed). Work will resume only when an ICM waiver has been obtained. For guidance on the preparation of waiver requests, contact the OE Mandatory Center of Expertise.

c. Any time suspect chemical warfare materiel is encountered during conventional OE site activities, all work will immediately cease. Project personnel will withdraw along cleared paths upwind from the discovery. A team consisting of a minimum of two personnel will secure the area to prevent unauthorized access. Personnel should position themselves as far upwind as possible while still maintaining security of the area.

(1) On FUDS properties, the UXO team will notify the local point of contact (POC) designated in the Work Plan. The local POC will facilitate explosive ordnance disposal (EOD) response, and two personnel will secure the site until the EOD unit's arrival. If the local POC

designated in the Work Plan is not the local law enforcement agency, the local POC will inform the local law enforcement agency of the discovery if necessary. The EOD unit will notify the Technical Escort Unit (TEU) and secure the area until TEU's arrival. After notifying the local law enforcement agency (when necessary), the local POC will notify the USAESCH OE Safety Group of the actions taken.

(2) On active installations, the UXO team will normally notify the Range Control Officer, the Facility Engineer, post headquarters, or the POC designated in the Work Plan.

d. Avoid inhalation of and skin contact with smoke, fumes, and vapors of explosives and related hazardous materials.

e. Consider OE items which may have been exposed to fire and detonation as extremely hazardous. Chemical and physical changes may have occurred to an item's contents, which may have rendered the item more sensitive than in its original state.

f. Do not rely on the color coding of OE items for definitive identification. Munitions having incomplete or improper color codes have been encountered.

g. Avoid approaching the forward area of an OE item until it can be determined whether or not the item contains a shaped charge. The explosive jet, which is formed during detonation, can be lethal at great distances. Assume that all shaped-charge munitions contain a piezoelectric (PZ) fuzing system until investigation proves otherwise. PZ fuzing is extremely sensitive. It can function at the slightest physical change and can remain hazardous for an indefinite period of time.

h. Approach an unfired rocket motor from the rear at a 45-degree angle. Accidental ignition can cause a missile hazard and hot exhaust.

i. Do not expose unfired rocket motors to any electromagnetic radiation (EMR) sources. See DA Pam 385-64 for safe separation distances from various sources of EMR.

j. Consider an emplaced landmine to be armed until proven otherwise. It may be intentionally boobytrapped to deceive.

(1) Many training mines contain spotting charges capable of inflicting serious injury.

(2) Exercise extreme care with wooden mines that have been buried for long periods of time. Certain soil conditions can cause the wood to deteriorate, and any inadvertent movement or pressure can initiate the fuze.

k. Assume that a practice OE item contains a live charge until investigation proves otherwise. Expended pyrotechnic and practice devices can contain red or white phosphorus (WP) residue. Due to incomplete combustion, this residue may re-ignite spontaneously if the crust is broken and exposed to air.

l. Do not approach a smoking WP munition. Burning WP may detonate the explosive burster charge at any time.

m. Foreign ordnance was shipped to the United States for exploitation and subsequent disposal. Every effort will be made to research all applicable documentation prior to commencement of a project involving foreign ordnance.

10. OE Storage. During OE projects, explosives storage falls into two categories, on Department of Defense (DOD) installations and off DOD installations.

a. On DOD installations, DOD 6055.9-STD and Service requirements (Army – AR 385-64; Navy – NAVSEA OP5; Air Force – AFM 91-201) will be met. For the remainder of this pamphlet, reference to DOD standards (i.e., DOD 6055.9-STD) also implies that Service explosives safety publications will be adhered to. Generally, the installation will have an existing explosives storage facility that meets DOD standards. If not, the contractor will establish a temporary storage facility. The compatibility of explosives defined in chapter 3, DOD 6055.9-STD, will be followed. Recovered OE items awaiting final disposition will not be stored with serviceable explosives. Commercial explosives will be assigned a DOD hazard classification (i.e., 1.1, 1.2, etc.) and storage compatibility grouping by the U.S. Army Technical Center for Explosives Safety prior to being stored on a military installation.

b. Off DOD installations, the contractor will be responsible for establishing a temporary explosives storage facility. This temporary storage facility will meet local, state, 27 CFR 55, AR 385-64, and DOD 6055.9-STD requirements to the greatest extent practicable.

(1) In cases where the facility cannot meet the intermagazine, inhabited building, and public traffic route quantity-distance requirements specified in DA Pam 385-64 and DOD 6055.9-STD, a barricading plan or other engineering controls to protect the public from accidental detonation must be submitted to and approved by the USAESCH Directorate of Engineering.

(2) Magazines must meet the requirements of 27 CFR 55, and each magazine must have a Net Explosive Weight and hazard classification established for the explosives to be stored.

(3) Each magazine must be provided lightning protection IAW DA Pam 385-64. The provisions of NFPA 780, which are consistent with Army guidance, may be used to supplement Army guidance where necessary.

(4) A physical security survey will be conducted to determine if fencing or guards are required. This survey will be coordinated through local law enforcement agencies. Generally, a fence around the magazine is not needed, IAW 27 CFR 55. However, the contractor is responsible for providing the degree of protection needed to prevent the theft of OE items.

c. A fire plan for either an on- or off-installation explosives storage facility will be prepared and coordinated with the local fire department. Placarding of magazines will be IAW local rules and regulations.

11. OE Transportation, Offsite. In the event that OE items must be transported offsite, the provisions of chapter 15, EP 1110-1-18, will be followed. In addition, USACE contractors are prohibited from transporting UXO offsite for destruction until the provisions of paragraph 1-9, TB 700-2, have been met.

12. OE Transportation, Onsite. The following safety procedures will be followed for the transportation of OE items onsite:

a. Do not transport WP munitions unless they are immersed in water, mud, or wet sand.

b. If loose pyrotechnic, tracer, flare, or similar mixtures are to be transported, they will be placed in No. 10 mineral oil or equivalent to minimize the fire and explosion hazards.

c. Incendiary-loaded munitions should be placed on a bed of sand and covered with sand to help control the burn if a fire should start.

d. If an unfired rocket motor must be transported, it will be positioned in the vehicle parallel to the rear axle. This will afford maximum protection for the personnel operating the vehicle.

e. If a base-ejection projectile must be transported to a disposal facility, the base will be oriented in the vehicle such that it is parallel to the rear axle. This will afford maximum protection for the personnel operating the vehicle.

f. OE items with exposed hazardous fillers, such as High Explosive, will be placed in appropriate containers with packing material to prevent migration of the hazardous fillers. Padding should be added to protect the exposed filler from heat, shock, and friction.

13. Exclusion Zone Operations. On OE project sites, it is the responsibility of the contractor's Unexploded Ordnance Safety Officer (UXOSO) to establish the exclusion zone for each UXO work area.

a. The purpose of the exclusion zone is to protect nonessential personnel from blast overpressure and fragmentation hazards. Calculating exclusion zones with respect to intentional and unintentional detonations is discussed below.

(1) Intentional Detonations. The minimum separation distances specified in DOD 6055.9-STD, chapter 5, paragraph C5.5.4, will be used unless lesser distances have been calculated using HNC-ED-CS-S-98-1.

(2) Unintentional Detonations. If the identity of OE items on a site is unknown, the minimum separation distance specified in DOD 6055.9-STD, chapter 5, paragraph C5.5.4, will be used to establish the exclusion zones. When the identity of OE items is known, the USAESCH Directorate of Engineering will use HNC-ED-CS-S-98-1 and HNC-ED-CS-S-98-2 to determine the criteria for establishing the exclusion zones.

b. When multiple teams are working onsite, a team separation distance (TSD) will be established. The minimum TSD will be the greater of 200 feet or the K50 (0.9 pounds per square inch) overpressure distance.

c. While OE procedures are being conducted, only personnel essential for the operation will be allowed in the exclusion zone. When nonessential personnel enter the exclusion zone, all OE operations will cease. In addition to this work stoppage, the following actions will be taken:

(1) The individual(s) must receive a safety briefing and sign the visitors log prior to entering the zone.

(2) The individual(s) will be escorted by a UXO-qualified individual.

d. All personnel working within the exclusion zone will comply with the following:

(1) There will be no smoking within the exclusion zone, except in areas designated by the UXOSO.

(2) There will be no open fires for heating or cooking (gas stoves, grills, etc.) within the exclusion zone, except where authorized by the UXOSO.

(3) During geophysical detection operations, personnel will not wear any metal that would interfere with instrument operations.

14. OE Excavation Operations.

a. Hand excavation is the most reliable method for uncovering an OE item. However, hand excavation exposes personnel to the hazard of detonation . Therefore, only UXO-qualified personnel will be used to perform this task.

b. Earth-moving machinery (EMM) may be used to excavate overburden from suspected OE items. EMM will not be used to excavate within 12 inches of a suspected OE item. Once the EMM is within 12 inches of the suspected OE item, the excavation will be completed by hand excavation methods. Personnel who are not UXO qualified may operate EMM only when supervised by a UXO Technician III or a UXO-qualified individual of higher rank than UXO Technician III.

(1) If more than one earth-moving machine is to be used onsite, the same minimum separation distances required for multiple work teams apply.

(2) EMM operations will be conducted within the guidelines of EM 385-1-1 and 29 CFR 1926, subpart P.

c. Excavation operations, whether by hand or EMM, will employ a stepdown or offset access method. Under no circumstances will any excavation be made directly over suspected OE items.

15. OE Disposal Operations. All disposal operations will be conducted IAW TM 60A-1-1-31, EP 1110-1-17, and the unnumbered USAESCH publication entitled Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives (OE) Sites.

a. As a general rule, all disposal operations will be accomplished by electrical means to ensure maximum safety. There are exceptions to this requirement in situations where static electricity or EMR hazards are present. Unintentional detonations can occur because of these induced currents (or lightning). The following precautions from DA Pam 385-64 are to be followed:

(1) Premature detonation of electric blasting caps by induced current from radio frequency signals is possible. Refer to DA Pam 385-64 for minimum safe distance with respect to transmitter power and indication of distance beyond which it is safe to conduct electric blasting even under the most adverse conditions.

(2) Lightning is a hazard with respect to both electric and nonelectric blasting caps. A direct hit or a nearby miss is almost certain to initiate either type of cap or other sensitive explosive elements such as caps in delay detonators. Lightning strikes, even at distant locations, may cause extremely high local earth currents that may initiate electrical firing circuits. Effects

of remote lightning strikes are multiplied by their proximity to conducting elements such as those found in buildings, fences, railroads, bridges, streams, and underground cables or conduits. The only safe procedure is to suspend all blasting activities when an electrical storm approaches to within 10 miles of the site.

(3) Electric power lines also pose a hazard with respect to electric initiating systems. It is recommended that any disposal operation closer than 155 meters to electric power lines be done with a nonelectric system.

b. The only acceptable disposal method is the one stated in the appropriate TM 60 Series manual for specific ordnance types. Any commercial explosives being used will be equivalent to the military explosive required for the disposal operation.

c. If justified by the situation, protective measures to reduce shock, blast over-pressure, and fragmentation will be taken. The USAESCH Directorate of Engineering will assist in any design work and will review for approval all proposed protective measures.

d. Minimum separations distances for personnel during OE disposal will be IAW DOD 6055.9-STD, chapter 5.

e. During open detonation operations, lifting lugs, strong backs, base plates, etc., will be oriented away from personnel locations.

f. Once disposal operations are completed, a thorough search of the immediate area will be conducted with a magnetometer to ensure that a complete disposal was accomplished.

g. Inert ordnance will not be disposed of as scrap until the internal tillers/voids have been exposed and unconfined.

FOR THE COMMANDER:

ROBERT L. DAVIS
Colonel, Corps of Engineers
Chief of Staff

GLOSSARY

Section I
Abbreviations

AFM ..... Air Force Manual

AR ..... Army Regulation

CFR ..... Code of Federal Regulations

DA ..... Department of the Army

DA Pam ..... Department of the Army Pamphlet

DOD ..... Department of Defense

EMM ..... Earth-Moving Machinery

EMR ..... Electromagnetic Radiation

EOD ..... Explosive Ordnance Disposal

FUDS ..... Formerly Used Defense Sites

IAW ..... In Accordance With

ICM ..... Improved Conventional Munition

NAVSEA OP ..... Naval Sea Systems Command Ordnance Pamphlet

NFPA ..... National Fire Protection Association

OE ..... Ordnance and Explosives

POC ..... Point of Contact

PZ ..... Piezoelectric

STD ..... Standard

TB ..... Technical Bulletin

TEU ..... Technical Escort Unit

TSD ..... Team Separation Distance

USACE ..... U.S. Army Corps of Engineers

USAESCH ..... U.S. Army Engineering and Support Center, Huntsville

UXO ..... Unexploded Ordnance

UXOSO ..... Unexploded Ordnance Safety Officer

WP ..... White Phosphorus

Section II
Terms

OE Procedures
Procedures which include, but are not limited to, the following actions performed by a UXO-qualified individual:

a. Gaining access to (manual excavation) and identifying subsurface anomalies and assessing the condition of buried OE.

b. Identifying and assessing the condition of surface OE.

c. Recovering and making final disposal of all OE.

OE-Related Procedures
Procedures which include, but are not limited to, the following actions which may be performed by a non-UXO-qualified individual:

a. Locating and marking subsurface anomalies.

b. Locating and marking suspected surface OE.

c. Transporting and storing recovered OE.

d. Utilizing EMM to excavate overburden from suspected OE.

Ordnance and Explosives (OE)
Consists of (1) military munitions that have been abandoned, expelled from demolition pits or burning pads, lost, discarded, or buried, (2) UXO, (3) soil presenting explosion hazards, and (4) buildings with explosives residues that present explosion hazards.

Unexploded Ordnance (UXO)
Military munitions that have been primed, fuzed, armed, or otherwise prepared for action and have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material and remain unexploded either by malfunction, design, or any other cause.

UXO-Qualified Personnel
Personnel meeting the requirements for the positions of UXO Technician II, UXO Technician III, UXO Safety Officer, UXO Quality Control Specialist, and Senior UXO Supervisor. For qualification requirements, refer to EP 1110-1-18.