6/1/06-005-20

Final

Work Plan for the Expanded Remedial Investigation Addendum at Site 5

St. Juliens Creek Annex
Chesapeake, Virginia

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Under the

CLEAN III Program
Contract N62470-02-D-3052
Contract Task Order 0024

June 2006

Prepared by

CH2MHILL

Contents

Acronyms and Abbreviations

ASTM	American Society for Testing and Materials
bgs	below ground surface
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
COC	Chain of Custody
CRQL	contract required quantitation limit
CTO	Contract Task Order
CY	cubic yards
DO	dissolved oxygen
DQO	Data Quality Objectives
DRMO	Defense Reutilization and Marketing Office
EE/CA	Engineering Evaluation/Cost Analysis
EPIC	Environmental Photographic Interpretation Center
ERI	Expanded Remedial Investigation
GIS	Geographic Information System
HHRA	Human Health Risk Assessment
HRS	Hazard Ranking System
IAS	Initial Assessment Study
ICP-MS	Inductively Coupled Plasma-Mass Spectrometry
IDW	Investigation-Derived Waste
IR	Installation Restoration
MARMC	Mid-Atlantic Regional Maintenance Center
MCL	maximum contaminant level
MFSP	Master Field Sampling Plan
µg/L	micrograms per liter
MHSP	Master Health and Safety Plan
MIDWMP	Master Investigation-Derived Waste Management Plan
MPP	Master Project Plan
MQAPP	Master Quality Assurance Project Plan
MS/MSD	matrix spike/matrix spike duplicate
MSAP	Master Sampling and Analysis Plan
MWP	Master Work Plan
NAPEC	Naval Ammunition Production Engineering Center
NAVFAC	Naval Facilities Engineering Command
NEESA	Naval Energy and Environmental Support Activity
NFESC	Navy Facilities Engineering Service Center
NTCRA	Non-Time-Critical Removal Action

ORP	oxidation reduction potential
PAH	polycyclic aromatic hydrocarbon
QA	quality assurance
QC	quality control
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RDX	research development explosive
RFA	RCRA Facility Assessment
RI	Remedial Investigation
ROD	Record of Decision
RRR	Relative Risk Ranking
SJCA	St. Juliens Creek Annex
SOP	standard operating procedure
SPAWAR	Space and Naval Warfare Systems Command
SWMU	Solid Waste Management Unit
TAL	target analyte list
TNT	tetryl, trinitrotoluene
USEPA	United States Environmental Protection Agency
UTL	upper tolerance limit
VDEQ	Virginia Department of Environmental Quality
WP	work plan

SECTION 1

Introduction

This work plan (WP) outlines the procedures that will be used to obtain two sets of additional shallow groundwater data at Site 5, St. Juliens Creek Annex (SJCA), Chesapeake, Virginia (Figure 1-1). Based on the variability in existing shallow groundwater data, the Draft Final Expanded Remedial Investigation (ERI) report (CH2M HILL, August 2005) recommended collection of additional inorganics data from the existing monitoring wells to re-evaluate the potential human health risks.

This WP has been prepared under the U.S. Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, Comprehensive Long-Term Environmental Action Navy (CLEAN) III Contract N62470-02-D-3052, Contract Task Order (CTO) 0024, for submittal to the NAVFAC Mid-Atlantic, U.S. Environmental Protection Agency (USEPA), and Virginia Department of Environmental Quality (VDEQ).

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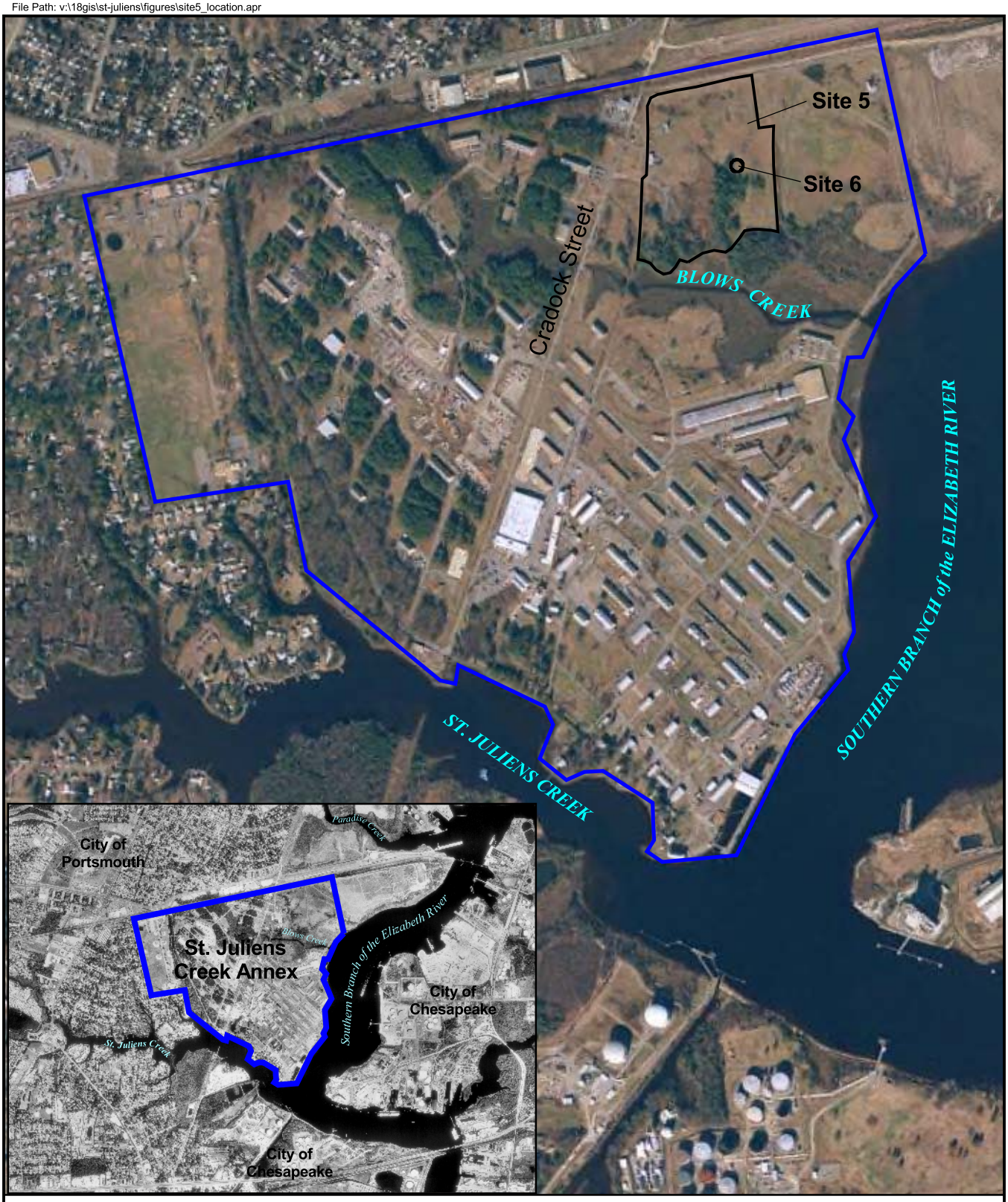

LEGEND

- Site Location
- Activity Boundary

N

0 500 1000 Feet

Figure 1-1
Location of SJCA and Site 5
Site 5 ERI Addendum Work Plan
St. Juliens Creek Annex
Chesapeake, Virginia

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SECTION 2

Site History and Previous Investigations

2.1 SJCA 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, southeastern Virginia (Figure 1-1). The facility covers approximately 490 acres and includes administrative buildings, wharf areas to the Elizabeth River, a central heating plant, numerous non-operational industrial facilities, and miscellaneous structures. Most surrounding areas are developed and include residences, schools, recreational areas, and shipping facilities for several large industries.

SJCA 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. Past operations at the SJCA facility have included ordnance operations involving wartime transfer of ammunition to various other naval facilities throughout the United States and abroad. Decontamination was performed in, around, and under ordnance-handling facilities at SJCA in 1977, after ordnance operations had ceased. The SJCA facility has also been involved in non-ordnance operations, including degreasing operations, paint shops, machine shops, vehicle and locomotive maintenance shops, pest control shops, battery shops, print shops, electrical shops, boiler plant operations, wash rack operations, potable water and salt water fire-protection systems, fire-fighter training operations, and storage of oil and chemicals.

Activity at SJCA has decreased in recent years and many of the aging structures are being demolished. The current primary mission of SJCA is to provide a radar-testing range and various administrative and warehousing facilities for nearby Norfolk Naval Shipyard and other local naval activities. SJCA also provides administrative offices, light industrial shops, storage facilities; including Defense Reutilization and Marketing Office (DRMO) storage, Space and Naval Warfare Systems Command (SPAWAR), Mid-Atlantic Regional Maintenance Center (MARMC), and a cryogenics school.

2.2 Site 5 Description and History

Site 5 is the former Burning Grounds consisting of approximately 21 acres located in the northeastern portion of SJCA (Figure 1-1). In earlier documents, Site 5 was also referred to as Solid Waste Management Unit (SWMU) 8 and was reported to consist of approximately 3 acres. Review of historical aerial photographs indicate that prior to use as a disposal area, the site and much of the adjacent area had been used for placement of dredge spoil material that reportedly originated from Blows Creek and the Southern Branch of the Elizabeth River.

Operations began at the Burning Grounds in the 1930s when waste ordnance materials, including black powder (mixture of charcoal, nitrate, and sulfur), smokeless powder (nitrocellulose), Explosive D (ammonium picrate), and Composition A-3 (contains research development explosive [RDX] and wax), were disposed of by open burning on three main

pads. Tetryl, trinitrotoluene (TNT), fuzes, solvents, paint sludge, pesticides, and various types of refuse were also disposed of. Reports stated that the Burning Grounds spontaneously caught fire several times in the 1970s. The amount of ordnance disposed varied from year to year and there is insufficient information to calculate the waste volume. Interviews conducted with former employees in December 2001 indicated that asbestos piping was disposed at the site, along with material from buildings, including tables and metal. In 1974, 427 tons of ordnance items were reportedly disposed.

In mid-1977, the Burning Grounds was used for facility-wide ordnance and equipment decontamination. The decontamination process included filling equipment from buildings with oil and straw and igniting them. Afterwards, the ground surface was reportedly covered with oil and straw and burned. The top 6 inches of soil was then diced, and the ground surface was covered with oil and straw and burned again. After the decontamination was completed, the Naval Ammunition Production Engineering Center (NAPEC) collected samples for chemical analyses and certified decontamination; however, the level of decontamination was not specified.

The site currently consists of an open field with a wetland in the central portion and a forested area in the southern portion. A significant portion of the site's southwestern area is covered with a layer of gravel. The Site 5 topography, ranging in elevation from 5 to 8 feet above mean sea level, is generally level and slopes gently toward Blows Creek. Groundwater flow follows the topography and flows toward Blows Creek. One to three ft deep vegetated drainage ditches are reducing runoff onto the site from adjacent areas. Site 6, located within the east-central portion of Site 5, is a former Installation Restoration site that was closed under a no action Record of Decision (ROD) in September of 2003 after a removal action (Figure 1-1).

2.3 Previous Investigations

Previous facility-wide investigations conducted at SJCA related to Site 5 are listed in Section 2.3.1. A more detailed description of these facility-wide activities can be obtained in Section 2.4.2 of the Final Remedial Investigation (RI) report (CH2M HILL, March 2003). A detailed description of the site-specific investigations conducted at Site 5 is provided in Section 2.3.2.

2.3.1 Facility-Wide Investigations

- Initial Assessment Study (IAS) – Naval Energy and Environmental Support Activity (NEESA), August 1981
- Phase II Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) – A.T. Kearney, March 1989
- Relative Risk Ranking (RRR) System Data Collection Report - CH2M HILL, April 1996
- Environmental Photographic Interpretation Center (EPIC) Study and Regulatory Review - USEPA, February 1995
- Hazard Ranking System (HRS) Documentation Record – Tetra Tech, January 2000
- Background Investigation – CH2M HILL, October 2001 and August 2004

2.3.2 Site-Specific Investigations

Remedial Investigation for Sites 3, 4, 5, and 6 - CH2M HILL, March 2003

The RI field investigation activities for Site 5 included geophysical investigations; monitoring well installation; water-level monitoring; waste delineation; and the collection and analysis of surface and subsurface soil, groundwater, drainage sediment, and surface water samples. Based on the waste delineation activities, it was determined that the site was larger than historical records indicated and the Site 5 boundaries were adjusted to the current 21-acre size.

The human health and ecological risk assessments conducted as part of the RI concluded that there is potential risk to human and ecological receptors from exposure to chemicals in soil and upland drainage ditch sediment (primarily inorganics, pesticides, and polycyclic aromatic hydrocarbons [PAHs]). Because surface water is transient at the site and the upland ditches provide minimal ecological habitat, there is no significant risk to human health and the environment identified from direct exposure to surface water. Groundwater samples collected from the shallow monitoring wells indicated isolated detections of inorganics at concentrations above maximum contaminant levels (MCLs). In addition, an isolated detection of RDX was found in a sample collected from a deep monitoring well. The RI did not identify any human health risk in shallow groundwater; however, only the construction worker scenario was evaluated. The RI recommended additional soil and groundwater sampling to further define the nature and extent of contamination in support of evaluating remedial alternatives for Site 5.

Expanded Remedial Investigation - CH2M HILL, 2003 - Present

The ERI field investigation activities were completed in December 2003 and included the collection and analysis of surface soil samples to fill spatial data gaps, better evaluate areas posing potential ecological risk, and evaluate potential remedial alternatives. In addition, the human health risk assessment (HHRA) from the RI was revised to evaluate potential future residential scenarios. Groundwater samples were collected from the existing monitoring wells to confirm or deny MCL exceedances of inorganics in shallow groundwater and the presence/absence of RDX in deep groundwater identified during the RI. Based on the new and historical data, the revised HHRA indicated that groundwater presents potential human health risk to future residents. The Draft ERI (CH2M HILL, November 2004) and Draft Final ERI (CH2M HILL, August 2005) reports recommended that additional shallow groundwater samples be collected based on the variability in analytical results and the human health risks re-evaluated; and an Engineering Evaluation/Cost Analysis (EE/CA) and subsequent FS be submitted to evaluate remedial action alternatives for waste, surface soil, and drainage sediment posing potential risk at Site 5. The ERI report will be finalized in FY 2006.

Engineering Evaluation/Cost Analysis and Action Memorandum - CH2M HILL, March 2006

Based on the findings of the RI, an EE/CA was conducted to identify and analyze removal action alternatives to mitigate potential risk in the Waste/Burnt Soil Area of Site 5. The remaining areas of concern at the site (shallow groundwater, surrounding surface soil, and drainage sediment) will be addressed in the future through a Feasibility Study and potentially a Remedial Action. In the EE/CA, five alternatives were identified, evaluated, and ranked. Based on a comparative analysis of the alternatives, the recommended Non-Time-Critical Removal Action (NTCRA) involved excavation, disposal characterization, and disposal of waste, burnt, and contaminated soil followed by restoration of the site. The

volume of the material and soil to be removed was estimated to be 18,210 cubic yards (CY) and confirmatory samples were to be collected from the remaining soils at the bottom of the excavated areas to verify that clean-up goals were met.

The EE/CA is currently in draft format and is under regulatory review. After the EE/CA is finalized, an Action Memorandum will be prepared to implement the NTCRA selected in the EE/CA.

SECTION 3

Technical Approach

This section presents the technical approach to perform two additional rounds of groundwater sampling at Site 5. The Final Master Project Plan (MPP) (CH2M HILL, July 2003) 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 Sampling and Analysis Plan (MSAP), Master Field Sampling Plan (MFSP), the Master Quality Assurance Project Plan (MQAPP), Master Investigation-Derived Waste Management Plan (MIDWMP), and 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 groundwater sampling and references the MPP as appropriate. Checklists and a health and safety plan (HASP) to address site-specific details relevant to the MPP are provided as Appendix A. Table 3-1 provides a list of the SOPs applicable to this WP, and the SOPs are included as Appendix B.

3.1 Field Work Support

Field work support will consist of overall project planning and coordination. As part of the initial field mobilization to SJCA, the following subcontractors will be procured: analytical laboratory, data validation services, and Investigation-Derived Waste (IDW). The firms providing these services shall be procured using the Basic Ordering Agreements (BOAs) under the CLEAN III contract. Mobilization for the field efforts will also include procurement of necessary field equipment and initial transport to the site. Equipment and supplies will be brought to the site each time the field team mobilizes for field activities.

Demobilization activities include general site restoration prior to the return transport of field equipment and crew. Purged groundwater will be generated during the field activities and disposed through an IDW subcontractor.

3.2 Field Investigation

3.2.1 Groundwater Sampling Activities

Groundwater samples will be collected from the five shallow (Columbia Aquifer) monitoring wells during two separate sampling events. The monitoring well locations are shown in Figure 3-1. The groundwater samples will be analyzed for target analyte list (TAL) total inorganics and cyanide and TAL dissolved inorganics.

Groundwater levels will be measured and recorded from the shallow monitoring wells 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 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. The applicable SOPs for the collection of groundwater samples are included in Appendix B. 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, holding times, and analytical methods for groundwater samples.

Contract required quantitation limits (CRQLs) for the compounds that will be analyzed can be found in the MPP. CRQLs that differ from the MPP for the inorganics that will be analyzed by Inductively Coupled Plasma - Mass Spectrometry (ICP-MS) using method ILM05.2 are listed below (USEPA, 2004):

- Antimony—2 µg/L
- Arsenic—1 µg/L
- Lead—1 µg/L
- Selenium—5 µg/L
- Thallium —1 µg/L

3.2.1.1 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. Field quality assurance (QA)/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), and temperature blanks. Definitions of the different field QA/QC samples are provided below:

- **Field Duplicate Samples:** Two or more samples collected simultaneously and placed into separate containers from the same source under identical conditions. Field duplicate samples are collected at a frequency of 10 percent (one per ten samples per matrix) of the site environmental samples. These samples are used to verify consistency of the field sampling procedures.
- **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 or before it has been used. These samples are used to determine if decontamination procedures were adequate and/or if sampling equipment could have contaminated the sample during collection. Equipment rinsate blanks are collected each day field equipment is decontaminated for reuse or one per batch of samples in which the equipment is not reused.
- **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 one per week unless ambient air conditions change (rain, wind, etc).
- **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. MS/MSDs are collected at a frequency of 1 for every 20 samples collected.

- **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.

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

Sample shipping and COC will follow the procedures outlined in the Sample Preparation SOPs in Appendix B. The COC will include the sample ID, analysis required for each sample, QA/QC samples, dates, times, and any other pertinent information the lab may require.

3.2.3 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. The numbering system will provide a tracking procedure to ensure accurate data retrieval of all samples collected. The sample identification for all samples collected during the groundwater monitoring will use the format identified in Table 3-3.

3.2.4 IDW

Field investigation activities will result in the generation of IDW. The IDW will include purged groundwater from the monitoring wells and solutions used to decontaminate non-disposable sampling equipment. Aqueous IDW will be containerized in a 55-gallon drum, which will temporarily be stored at a location designated by NAVFAC prior to disposal. The IDW drum will be labeled in accordance with the procedures outlined in the MPPs. Groundwater analytical results will be used for waste characterization and appropriate disposal of purge water. Additional samples may be required by the disposal facility. The applicable SOP for IDW storage and disposal is located in Appendix B.

3.3 Sample Analysis and Data Validation

The groundwater samples will be tracked from collection through analysis to receipt of the results from the subcontracted laboratory.

3.3.1 Sample Analysis

All analyses will be conducted at a laboratory that fulfills all requirements of the Navy's Installation Restoration (IR) QA Program Manual as administered by Naval Facilities Engineering Service Center (NFESC) and USEPA's Contract Laboratory Program (CLP). A laboratory selection letter, including the laboratory qualifications and Navy approval letter, will be provided to the Navy once the analytical laboratory has been selected. 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 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 third party subcontractor approved by the Navy. Procedures used for the validation process will be in accordance with *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

Following receipt of the validated data from the analytical laboratory, the HHRA will be revised to incorporate the new data. The shallow groundwater will be evaluated for exposure by future lifetime (child/adult) residents. The baseline HHRA methodology described in the RI report (CH2M HILL, March 2003) will be followed, updated to reflect the latest USEPA screening values and guidance. Historical results determined to be false positive detections based on professional judgment, will not be included in the revised HHRA. The shallow groundwater background data for SJCA (CH2M HILL, August 2004) will then be used to determine if the constituents posing potential unacceptable risk may be present at concentrations similar to background concentrations. The maximum detected site concentrations will be compared to the 95% upper tolerance limits (UTLs) for shallow groundwater.

The analytical results and revised HHRA for shallow groundwater will be presented in an addendum to the Final ERI report for Site 5. The investigation results will be summarized in conjunction with data previously collected at the site. Based on the revised HHRA, the SJCA Project Management Team (representatives from the Navy, USEPA, and VDEQ) will discuss and determine the path forward for shallow groundwater at Site 5.

Table 3-1
List of Applicable Standard Operating Procedures
Site 5 ERI Addendum Work Plan
St. Juliens Creek Annex
Chesapeake, Virginia

Decontamination and Waste Management
Disposal of Waste Fluids and Solids
Field Parameters
Field Measurement of pH, Salinity, Specific Conductance, Turbidity, Dissolved Oxygen, ORP, and Temperature using the Horiba® U-22
Groundwater Sampling
Low-Flow Groundwater Sampling from Monitoring Wells
Groundwater Sampling from Monitoring Wells
Water Level Measurements
Sample Preparation and Handling
Equipment and Field Rinse Blank Preparation
Field Filtering
Packaging and Shipping Procedures
Chain-of-Custody

Table 3-2
Analytical Methods and Required Containers, Preservatives, and Holding Times for Samples
Site 5 ERI Addendum Work Plan
St. Juliens Creek Annex
Chesapeake, Virginia

Analysis	Method	Sample Container	Holding Time	Volume of Sample
TAL Metals/Cyanide (total)	CLP ILM05	1-liter polyethylene bottle	6 months; 28 days for mercury; 14 days for cyanide	Fill to shoulder
TAL Metals (dissolved)	CLP ILM05	1-liter polyethylene bottle	6 months; 28 days for mercury	Fill to shoulder

Notes:
CLP: Contract Laboratory Program
TAL: Target Analyte List

Table 3-3
Summary for Sample Identification Scheme
Site 5 ERI Addendum Work Plan
St. Juliens Creek Annex
Chesapeake, Virginia

First Segment		Second Segment	Third Segment
Installation	Site Type and Number	Sample Type	Sample Date; Qualifier
AA	ANN	AANNA	NNAA
Installation: SJ = St. Juliens Creek Annex	Site Type: S = Site Site Number/Letter: 05 = Site 5	Sample Type: MW = Monitoring Well Monitoring Well Number: 04 = Monitoring Well 4 Monitoring Well Description: S = Shallow Groundwater Monitoring Well	Sample Date: NN = Last 2 digits of year Quarter of the Year: A = 1st Quarter B = 2nd Quarter C= 3rd Quarter D = 4th Quarter Qualifier (only if duplicate sample): P - Duplicate

Example: SJS05-MW04S-06C

Numbering format for QA/QC Samples: AAANN-AANNNNNN		
AAANN = Installation, Site Type, and Number SJS05 = SJCA Site 5	AA = QA/QC type: EB = Equipment Blank FB = Field Blank TB = Trip Blank	NNNNN = DDMMYY (example = 062006)

Example: SJS05-FB062006

Notes: “A”= alphabetic “N”= numeric

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LEGEND

- Shallow Monitoring Well Locations
- Site Boundary

N

0 200 400 Feet

Figure 3-1
Site 5 Monitoring Well Locations
Site 5 ERI Addendum Work Plan
St. Juliens Creek Annex
Chesapeake, Virginia

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SECTION 4

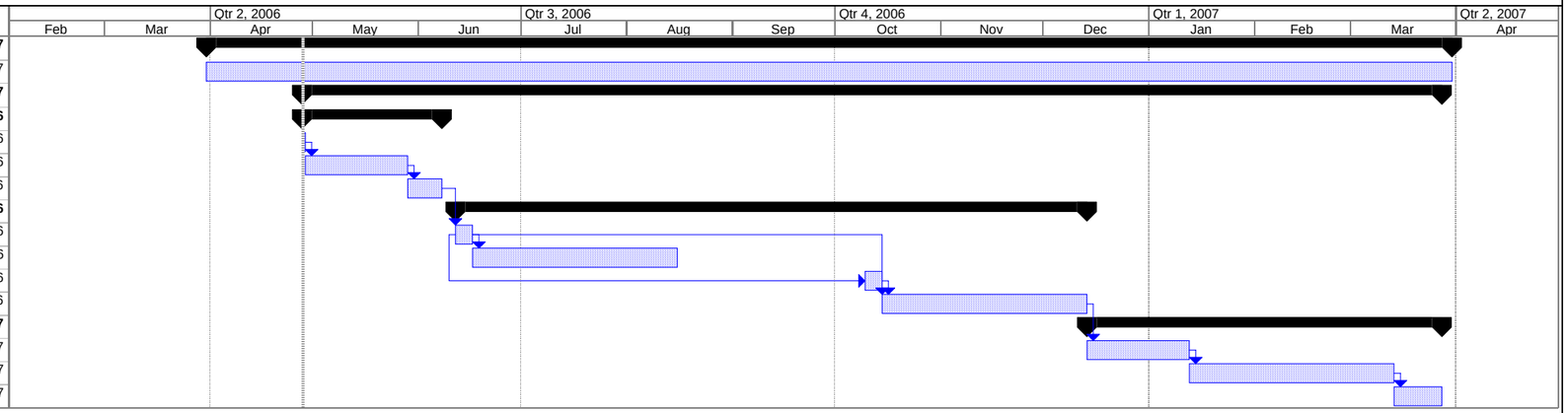
Project Staff and Schedule

The CH2M HILL Activity Manager for SJCA is Ms. Kimberly Henderson. Ms. Henderson will also be serving as the Project Manager for this project. Activity and project management responsibilities include daily technical support and guidance, budget and schedule review and tracking, preparation and review of invoices, planning and allocation of personnel and resources, subcontractor coordination, preparation of monthly progress reports, and communication and coordination of events with the Navy and the project team.

Prior to initiating field activities, CH2M HILL will notify the Navy of the CH2M HILL staff and subcontracted personnel that will conduct the field investigation. Figure 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 first round of groundwater sampling is expected to be conducted in June 2006 and the second sampling event in October2006.

Figure 4-1
Project Schedule
Site 5 ERI Addendum Work Plan
St. Juliens Creek Annex
Chesapeake, Virginia

ID	Task Name	Duration	Start	Finish
1	**Project Planning**	**365 days**	**Fri 3/31/06**	**Fri 3/30/07**
2	Project Management	365 days	Fri 3/31/06	Fri 3/30/07
3	**Site 5 - Burning Grounds**	**334 days**	**Fri 4/28/06**	**Tue 3/27/07**
4	**Work Plan**	**41 days**	**Fri 4/28/06**	**Wed 6/7/06**
5	Draft Work Plan	1 day	Fri 4/28/06	Fri 4/28/06
6	Regulatory Review and Response to Comments	30 days	Sat 4/29/06	Sun 5/28/06
7	Final Work Plan	10 days	Mon 5/29/06	Wed 6/7/06
8	**Field Investigation**	**185 days**	**Mon 6/12/06**	**Wed 12/13/06**
9	Groundwater Sampling - Round 1	5 days	Mon 6/12/06	Fri 6/16/06
10	Sample Management and Data Evaluation - Round 1	60 days	Sat 6/17/06	Tue 8/15/06
11	Groundwater Sampling - Round 2	5 days	Tue 10/10/06	Sat 10/14/06
12	Sample Management and Data Evaluation - Round 2	60 days	Sun 10/15/06	Wed 12/13/06
13	**Expanded Remedial Investigation Report Addendum**	**104 days**	**Thu 12/14/06**	**Tue 3/27/07**
14	Draft Expanded RI Addendum Report	30 days	Thu 12/14/06	Fri 1/12/07
15	Regulatory/Navy Review of Draft Expanded RI Addendum Report	60 days	Sat 1/13/07	Tue 3/13/07
16	RTC and Final Expanded RI Addendum Report	14 days	Wed 3/14/07	Tue 3/27/07



Date: Fri 4/28/06

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

SECTION 5

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Appendix A
Project-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/Site 5 during the groundwater sampling events scheduled to take place in June 2006 and the fall of 2006. 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/Site 5
SITE ADDRESS:	Victory Blvd. Chesapeake, VA
CH2M HILL ACTIVITY MANAGER:	Kim Henderson/VBO
CH2M HILL OFFICE:	5700 Cleveland St. Suite 101 Virginia Beach, VA 23462
DATE HASP PREPARED:	June 2003
DATE HASP UPDATED:	April 2006
SITE ACCESS:	Refer to Master HASP
FACIITY DESCRIPTION:	Refer to Master HASP
CLIMATE	Refer to Master HASP
TOPOGRAPHY:	Refer to Master HASP
DESCRIPTION OF SPECIFIC TASKS TO BE PERFORMED:	Collection of groundwater samples; oversight of IDW sampling and management.

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

- Groundwater Sampling
- Investigation-derived waste (drum) sampling and disposal

1.1.2 Non-Hazwoper-Regulated Tasks

- None

1.1.3 Project HS&E Change Management Form

*This evaluation form should be reviewed on a **continuous** basis to determine if the current site-specific health and safety plan adequately addresses ongoing project work, and should be completed whenever new tasks are contemplated or changed conditions are encountered..*

Project Task: **Sampling** Activity Manager: **Kim Henderson/VBO**
Project Number: **181812**

	Evaluation Checklist	Yes	No
1.	Have CH2MHILL staff changed?		
2.	Has a new subcontractor been added to the project?		
3.	Is any chemical or product to be used that is not listed in Attachment 2 of the plan?		
4.	Are all tasks addressed in Section 1.1 of the site-specific HASP?		
5.	Have new contaminants or higher than anticipated levels of original contaminants been encountered?		
6.	Have other safety, equipment, activity or environmental hazards been encountered that are not addressed in Section 2.1 of the plan?		

If the answer is "YES" to Questions 1-3, an HSP revision is NOT needed. Please take the following actions:

Confirm that staff's medical and training status is current – check training records at:
http://www.int.ch2m.com/hands (or contact your regional SPA), and confirm subcontractor qualifications.
Confirm with the project KA that subcontractor safety performance has been reviewed and is acceptable
Confirm with H&S that subcontractor safety procedures have been reviewed and are acceptable.

If the answer is "YES" to Questions 4-6, an HSP revision MAY BE NEEDED. To determine if revision is needed please contact HS&E directly or complete the field project start-up form at:
http://www.int.ch2m.com/hsdocgen/fppricing.asp.

1.2 Task Hazard Analysis

(Refer to Section 2 for hazard controls)

POTENTIALHAZARDS	TASKS	
	Groundwater monitoring, aquifer testing	IDW drum sampling and disposal
Flying debris/objects		X
Electrical	X	
Slip, trip, fall	X	X
Back injury	X	X
Visible lightning	X	X
Fires		X
IDW Drum Sampling		X

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: Initally

2.1 Project-Specific Hazards

2.1.1 Groundwater Sampling & Aquifer Testing

- Tie down loose items if utilizing a van.
- Utilize a spotter if backing vehicles or equipment towards monitoring wells.
- Inspect the area around the well for obstructions and Poison Ivy and Poison Oak.
- If well locations are located in dense tall grassy areas consider utilizing a Bug-Out suit or Tyvek to mitigate the potential for tick bites.
- If lifting heavy equipment from vehicle, move items to the rear and get assistance when lifting.
- Be alert for bees, wasps and other insects when opening well housing.
- Ensure only personnel with current 40-hour HAZWOPER and 8 hour refresher training perform task.
- Log calibration of Direct Reading Instrument in either a field log book or on attached form.
- Notify others in area that task is going to be performed, delineate an exclusion zone as applicable.
- Don personal protective equipment (PPE) as specified in Section 4 of this Site Specific Health and Safety Plan.
- Position yourself upwind prior to sampling, and do not lean directly over the well when sampling.
- Review Material Safety Data Sheets for chemical preservatives, decontamination agents and calibration gas.
- Do not handle sample jars without nitrile gloves.

2.1.2 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.
- 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 Ordnance and Explosives (OE)

Due to the site history, the potential for exposure to Ordnance and Explosives (OE) exist, the chance for encountering ordnance items during sampling activities is very small. An OE hazards awareness safety brief should be included as part of the site-specific briefing and discussed at daily tailgate briefings.

- Prior to any action being performed on an ordnance item, all fuzing shall be positively identified. This identification will consist of fuze type by function, condition (armed or unarmed), and physical state/condition of the fuze (burned, broken, parts exposed or sheared, etc.).
- A projectile containing a base-detonating (BD) fuze is to be considered armed if the round has been fired.
- Arming wires and pop-out pins on unarmed fuzes should be secured prior to any movement.
- Do not depress plungers, turn vanes, rotate spindles, or move levers, setting rings, or other external fittings on OE items. Such actions may arm or activate the OE.
- Do not attempt to remove any fuzes from the OE. Do not dismantle or strip components from any OE item unless the item is included in the SOW.
- UXO personnel are not authorized to inert any OE item found on site unless it is a part of the SOW.
- OE/UXO items shall not be taken from the site as souvenirs or training aids.
- Civil War ordnance shall be treated like any other OE.
- Before entering U.S. Army-controlled areas or ranges contaminated with improved conventional munitions (ICM), an approved Department of the Army (DA) waiver must be obtained.
- Whenever suspect Chemical Weapons Material (CWM) is encountered during conventional OE site activities, all work shall immediately cease. Project personnel shall withdraw along cleared paths upwind from the discovery. A team consisting of two personnel shall secure the area to prevent unauthorized access. Personnel should position themselves as far upwind as possible while still maintaining security of the area. The local point of contact designated in the work plan shall be immediately notified.
- Avoid inhalation and skin contact with smoke, fumes, and vapors of explosives and other related materials.
- 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 in their original state.
- Do not rely on the color coding of OE for positive identification. Munitions having incomplete or improper color codes have been encountered.

2.2 General Hazards

- **Refer to the MASTER HASP for General Hazards**

2.3 Biological Hazards

- **Refer to the MASTER HASP for Biological Hazards**

2.4 Radiological Hazards

- **Refer to the MASTER HASP for Radiological Hazards**

2.5 Contaminants of Concern

(Refer to Project Files for more detailed contaminant information)

Contaminant	Location and Maximum[a] Concentration (µg/L)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Metals[e]					
Aluminum	GW: 87,400 MW-02S	10 mg/m^3	ND	Eye, skin and respiratory system irritant.	NA
Arsenic	GW: 27.3 MW-03S	0.01 mg/m^3	5 mg/m^3 Ca	Ulceration of nasal septum, respiratory irritation, dermatitis, gastrointestinal disturbances, peripheral neuropathy, hyperpigmentation	NA
Cadmium (dissolved)	GW: 11.5 MW-03S	0.005 mg/m^3	9 mg/m^3 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
Iron	GW: 83,700 MW-03S	10 mg/ m^3	2500 mg/m^3	Benign pneumoconiosis with x-ray shadows indistinguishable from fibrotic pneumoconiosis (siderosis)	NA
Manganese	GW: 4,320 MW-03S	5 mg/m^3	500 mg/m^3	Parkinson's; asthenia, insomnia; mental confusion; metal fume fever; dry throat, cough, tight chest, dyspnea, rales, flu-like fever; low-back pain; vomiting; malaise; fatigue; kidney damage	NA
Thallium	GW: 2.1 MW-03S	0.1 mg/m^3	15 mg/m^3	Nausea, diarrhea, abdominal pain, vomiting; ptosis, strabismus; peripheral neuropathy, tremor; retrosternal tightness, chest pain, pulmonary edema, seizures, chorea, psychosis; liver and kidney damage; alopecia; paresthesia of legs	UK
Vanadium	GW: 82.8 MW-03S	C 0.05 mg/m^3	35 mg/m^3	Eye, skin and throat irritant; green tongue, metallic taste; eczema; cough; fine rales, wheezing, bronchitis, dyspnea	NA

Footnotes:

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

[b] Appropriate value of 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.

[e] Metal concentrations are of total metals unless noted

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-113, *Medical Surveillance,* and HS-110, *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
Adrienne Jones	VBO	Field Team Leader/SC-HW	Level C SC-HW; FA-CPR
Mark Ost	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:	Agnes Sullivan NAVFAC Mid-Atlantic
Phone:	757/444-4120
Facility Contact Name:	Kimberly Mazur
Phone:	757/396-7475

3.2.2 CH2M HILL

Activity Manager:	Kim Henderson /VBO
Project Manager:	Kim Henderson/VBO
Health and Safety Manager:	Steve Beck/MKE
Field Team Leader :	Adrienne Jones/VBO
Site Safety Coordinator:	Adrienne Jones /VBO, Mark Ost/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-215, *Subcontractor, Contractor, and Owner*)

Investigation-Derived Waste Management
Subcontractor: **To be determined** 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-117, *Personal Protective Equipment*, HS-121, *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 • Aquifer Testing • 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-207, *Exposure Assessment for Airborne Chemical Hazards)*

5.1 Air Monitoring Specifications

PID: OVM with 10.6eV lamp or equivalent	All intrusive activities	Up to 1 ppm →	Level D	Initially and periodically during task	Daily
		1 to 25 ppm above b.g. → (Sustained for 1 minute)	Level D; collect vinyl chloride tube; vinyl chloride action level not exceeded		
		25 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)		
Colormetric Tube: Drager vinyl chloride specific (0.5 to 30 ppm range) with pre-tube, or equivalent	All intrusive activities	<0.5 ppm→ 0.5 ppm→	Level D Level B	Initially and periodically when PID >1 ppm	Not applicable
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

6 Decontamination

(Reference CH2M HILL SOP HSE-506, *Decontamination*)

- **Refer to the MASTER HASP for Decontamination Protocols**

6.1 General Decontamination Specifications

- **Refer to the MASTER HASP for Decontamination Specifications**

6.2 Diagram of Personnel-Decontamination Line

- **Refer to the MASTER HASP for Personnel-Decontamination Line**

7 Spill-Containment Procedures

- **Refer to the MASTER HASP for Spill-Containment Procedures**

8 Site-Control Plan

- **Refer to the Master HASP for details regarding the Site-Control Plan**

8.1 Site-Control Procedures

- **Refer to the Master HASP for details regarding Site –Control Procedures**

8.2 Hazwoper Compliance Plan

- **Refer to the Master HASP for details regarding the Hazwoper Compliance Plan**

9 Emergency Response Plan

- **Refer to the Master HASP for details regarding the Emergency Response Plan**

9.1 Pre-Emergency Planning

- **Refer to the Master HASP for details regarding the Emergency Response Planning**

9.2 Emergency Equipment and Supplies

- **Refer to the Master HASP for details regarding Emergency Equipment and Suppies.**

9.3 Incident Response

- **Refer to the Master HASP for details regarding Incident response**

9.4 Emergency Medical Treatment

- **Refer to the Master HASP for details regarding Emergency Medical Treatment.**

9.5 Evacuation

- **Refer to the Master HASP for details regarding Evacuation Protocols.**

9.6 Evacuation Signals

- **Refer to the Master HASP for details regarding Evacuation Signals.**

9.7 Incident Notification and Reporting

- **Refer to the Master HASP for details regarding Incident Notification and Reporting.**

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**

10.2 Revisions

Revisions Made By: **SteveBeck/MKE** **Date: 04/18/2006**

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/Site 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/Site 5 **Project Number:** 181812

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

Hazardous Chemical Products Inventory

Chemical	Quantity	Location	MSDS Available	Container labels	
				Identity	Hazard
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			

Refer to SOP HS-210 *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: Jerry Lyle/BOI
Phone: 208-383-6244
Cell: 208-850-2532
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: Steve Beck/MKE
Phone: 414-272-2426 ext. 277

Utilities Emergency
Water: 757-382-3550
Gas: 1-877-572-3342
Electric: 1-888-667-3000

Regional Environmental Compliance Coordinator
Name: Linda Hickok/SYC
Phone: 315-422-8495 ext. 229

Designated Safety Coordinator (DSC)
Name:Adrienne Jones
Phone: 757-671-8311 x442

Regional Human Resources Department
Name: Cindy Bauder/WDC
Phone: 703-471-6405 ext. 4243

Project Manager
Name: Kim Henderson
Phone: 757-671-8311 x440

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

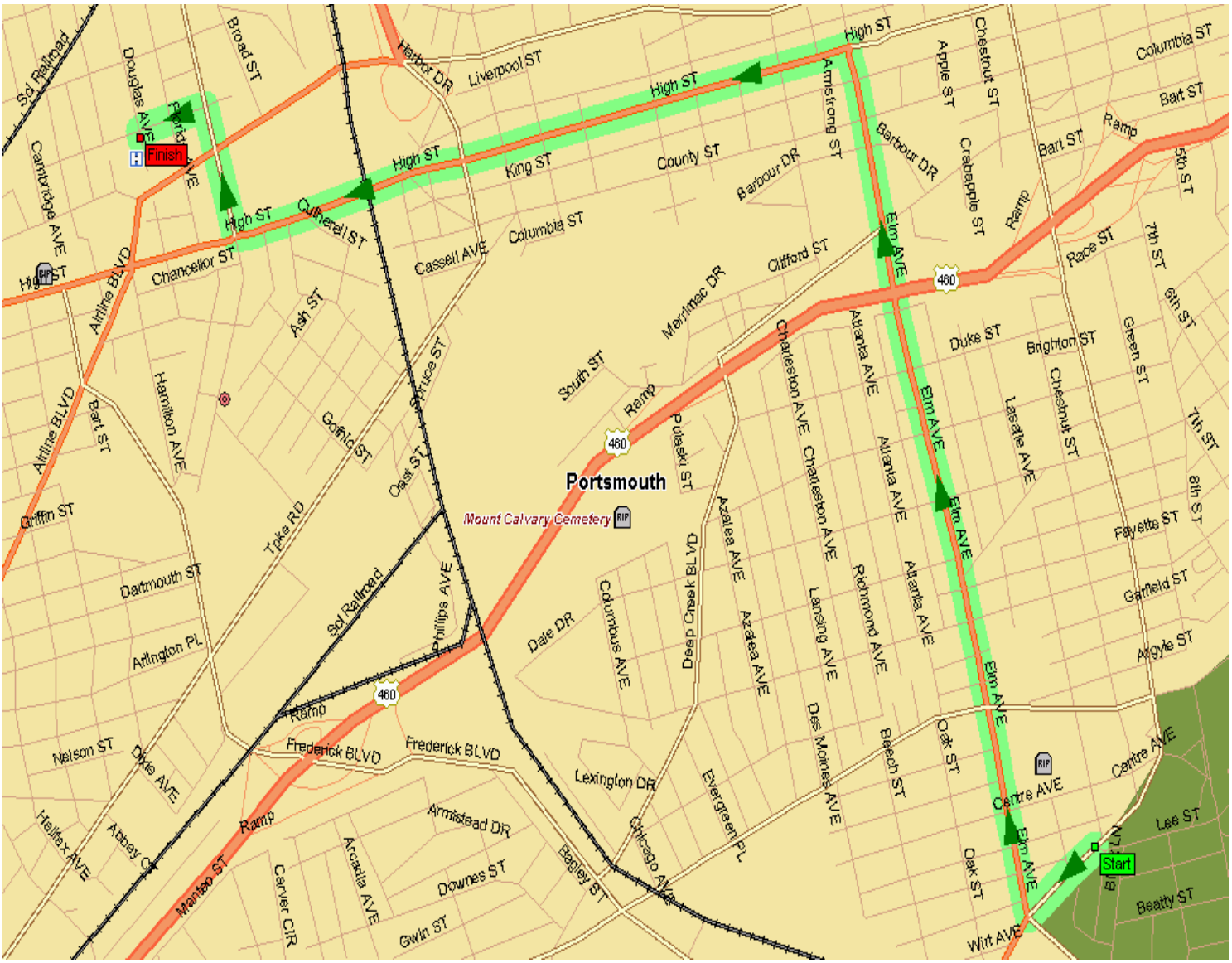
Facility/Site Evacuation Route(s): See Site Map

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

Arsenic
Standard of Practice HSE-501

Arsenic Fact Sheet

Uses and Occurrences

The manufacture and transportation of arsenic compounds; use in the manufacture of herbicide, pesticide, fungicides, and defoliants; use in the manufacture and handling of calcium arsenate; use in the manufacture of electrical semiconductors, diodes, and solar batteries; as an additive for food and drinking water for animals; use as a preharvest desiccant, sugarcane ripener, soil sterilant, or for timber thinning; use as a bronzing or decolorizing addition in glass manufacturing; use in the production of opal glass and enamels; use as an addition to alloys to increase hardening and heat resistance; during smelting of ores; during the cleanup of soil contaminated with arsenic; military applications; and general handling, storage, and use of arsenic.

Physical Characteristics

Appearance:	Gray metal or white powder
Odor:	Garlic-like when heated
Flammable:	None
Flash Point:	None
Flammable Range:	None
Specific gravity:	5.73 for arsenic metal, 2.16 for arsenic trioxide
Stability:	Stable
Incompatibilities:	Heat, hydrogen gas, and oxidizing agents
Melting Point:	Sublimes at 613^{o}C; -8.5^{o}C for arsenic trioxide
Boiling Point:	Sublimes at 613^{o}C; 130^{o}C for arsenic trioxide

Signs and Symptoms of Exposure

Short term (Acute):	Nausea, vomiting, diarrhea, weakness, loss of appetite, cough, chest pain, giddiness, headache, and breathing difficulty.
Long term (Chronic):	Numbness and weakness in the legs and feet, skin and eye irritation, hyperpigmentation, thickening of palms and soles (hyperkeratosis), contact dermatitis, skin sensitization, warts, ulceration and perforation of the nasal septum

Modes of Exposure

Inhalation:	Dusts and Vapors
Absorption:	Liquid
Ingestion:	Dusts and Liquid

Exposure Limits

Action level	5 μg/m^3
PEL	10 μg/m^3
STEL	None
TLV	10 μg/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 Arsenic standard and Training
EL > PEL	Implement all portions of the OSHA Arsenic Standard including training, medical surveillance, engineering controls, establishment of work areas, etc.

PPE

Eye:	Safety Glasses; contact lenses should **not** be worn
Skin:	Chemical protective gloves and body protection
Respiratory:	Air purifying respirators and supplied air respirators, depending on the exposure

First Aid

Inhalation:	Move to fresh air; seek medical attention promptly
Skin:	Quick drenching with water; wash skin with soap and water; seek medical attention promptly
Eyes	Flush with water for 15 minutes, lifting the lower and upper lids occasionally; seek medical attention promptly
Ingestion:	Seek medical attention promptly

Cadmium
Standard of Practice HSE-504

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^{o}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 μg/m$^{3.}$
PEL	5.0 μg/m^{3} .
STEL	None.
PEL-C	None.
TLV	10.0 μg/m^{3} ; 2.0 μg/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.

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
_____ Polyaromatic hydrocarbon
_____ Pesticides
_____ Other _____
_____ Herbicides
_____ PCBs
_____ Metals

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 _____
   CNRMA IR Manager _____
   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:

_____

Project Activity Self-Assessment Checklists

Material Safety Data Sheets

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

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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.

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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: HNO3
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.

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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(NO2)/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

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.

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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.

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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.

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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.

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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

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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.

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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.

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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.

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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

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16. Other Information

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

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

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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

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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.

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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.

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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.

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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.

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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.

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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.

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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

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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.

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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.

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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.

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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.

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16. Other Information

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

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, aluminum, 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

Metal Fact Sheets

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.

MEC / UXO Avoidance Plan

MEC / UXO AVOIDANCE PLAN

1.0 INTRODUCTION

This UXO Avoidance plan has been developed as an attachment to the Health and Safety Plan for CH2M HILL personnel.

1.1 Plan Objective

This plan is designed to inform CH2MHILL employees of the specific hazards and procedures when performing operations in or around areas where Munitions & Explosives of Concern (MEC) /Unexploded Ordnance (UXO) materials may be encountered. All CH2M HILL employees who are not UXO qualified must become familiar with the sections of this plan, and all requirements of the subcontractors specific Safety & Health Plan while on site. Any discrepancies in the directives of this plan, and that of the subcontractor should be brought to the immediate attention of the CH2M HILL RHSM or MEC Health & Safety Staff for resolution.

1.2 General Safety Requirements

MEC/UXO may be present and may be encountered during site activities. All CH2MHILL non-UXO qualified personnel will follow the safe work practices listed below:

- Non-UXO qualified personnel will receive site-specific UXO recognition briefing prior to participation in site activities.
- No soil penetrating activities will be allowed without the area first being cleared by UXO qualified personnel.
- Non-UXO qualified personnel will not touch or disturb any object which could potentially be UXO/MEC-related, and will immediately notify the nearest UXO qualified person of the presence of the object.
- All CH2MHILL employees will be at least 200 feet from any excavation activities. After the intrusive excavation has been completed, and the removed soil screened for MEC / UXO, CH2M HILL employees may return to the site to perform their sampling procedures.
- Immediately notify the UXO qualified escort of any suspicious items or possible MEC / UXO in the area of operation.
- If the UXO qualified escort finds an item of MEC / UXO and must uncover it for identification or marking, all CH2MHILL employees will depart the area in the same direction they entered to a distance of 200 feet, and remain there until notified by the UXO qualified escort that it is safe to return.

Information on the exact types and density of MEC is vague. Projectile cartridge casings, propellant, and primers are the most likely items to be encountered. Should anything more hazardous be encountered, plans and procedures will be updated to accommodate safety requirements for more hazardous UXO/MEC.

1.3 UXO Recognition and Safety

As part of the site-specific training, project Non-UXO personnel will receive Unexploded Ordnance Recognition and Safety training. Training will include a review of the MEC Removal Action Explosive Safety Submission Addendum, UXO terms and definitions, ordnance identification, and reporting and specific safety procedures.

2.0 HAZARD/RISK ANALYSIS

Unexploded ordnance is a safety hazard that may constitute an imminent and substantial danger to the personnel performing environmental investigation and removal action activities and the public in general. UXO contamination must be considered a possibility on all formerly used defense sites (FUDS) and active military installations. The surface danger zone of a range (active or inactive), the target area, impact area, ricochet area and the secondary danger zones may be contaminated with UXO (both surface and/or subsurface contamination). The varying types of ammunition, angle of fire, and soil types preclude the accurate estimation of the depth of any subsurface UXO.

2.1 Site Tasks and Operations

CH2MHILL will perform or have subcontractors perform the following tasks where MEC / UXO may be encountered:

- Near Surface (less than 2 feet) soil sampling
- Soil sampling from excavated areas
- Drilling of environmental sampling wells
- Surface water sampling
- Sampling from environmental sampling wells

2.1.1 Near Surface Soil Sampling

The collection of near surface soil sampling will be conducted utilizing the following general requirements:

- The access routes have been surface cleared and marked to allow safe entrance and exit of employees
- All CH2M HILL employees are escorted by a UXO qualified individual
- The area to be sampled has been determined free of anomalies by the use of subsurface detection equipment by a UXO qualified individual, and a recheck is accomplished prior to digging the sample
- No sample will be taken deeper than 2 feet without the area being re-checked for anomalies with the subsurface detection equipment
- If significant resistance is encountered while taking a sample, remove the sample tool and inform a UXO qualified individual

2.1.2 Soil Sampling Excavated Areas

- Stay 200 feet from the work site while excavations are being accomplished, and until the soil has been emptied from the bucket and screened for MEC / UXO
- Do not enter an excavation unless it has been properly shored or sloped
- Do not enter an excavation until a UXO qualified individual has entered the area and performed a surface and subsurface search for MEC / UXO items
- No sample will be taken deeper than 2 feet without the area being re-checked for anomalies with the subsurface detection equipment

2.1.3 Drilling of Environmental Sampling Wells

- The route into the site for the drill rig will be surface and sub surface cleared by UXO qualified personnel. The lanes will be clearly marked for all personnel to see
- There will be adequate surface and subsurface clearance to allow the drill rig movement around the area to be sampled
- During the intrusive operation, all non-essential personnel will be evacuated to a distance of 200 feet
- The bore hole will be checked by MEC detection instrument at 2-foot intervals until the final depth is reached.
- Hard hats will be worn in the working area of the drill rig by all personnel, including the UXO qualified personnel

2.1.4 Surface Water Sampling

- The access routes to the sampling area will be surface cleared by UXO qualified personnel prior to CH2MHILL employees entering the area
- If the water area to be sampled does not allow for an easy observation of what is below the surface, care should be taken when inserting instruments or equipment into the water for sampling. MEC / UXO items may be located below the surface

2.1.5 Sampling from Environmental Wells

- Ensure to stay on the cleared pathways when approaching the well site. Weather and other conditions may uncover MEC / UXO items that were previously unseen
- CH2MHILL employees should be escorted by UXO qualified personnel when entering a potentially contaminated MEC /UXO area that has not already been cleared

Appendix B
Applicable Standard Operating Procedures

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.

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

Check that representative samples of the containerized materials are obtained.

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 °C	+/- 1.0 °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

Groundwater Sampling from Monitoring Wells

I. Purpose and Scope

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

II. Equipment and Materials

- Probe box with inlet/outlet ports for purged groundwater and watertight ports for each probe
- pH meter: Orion Model SA250 or equivalent
- Temperature/conductivity meter: YSI Model 33 or equivalent
- Dissolved oxygen meter: YSI Model 57 or equivalent
- In-line disposable 0.45µ filters: QED FF8100 or equivalent
- Bailer, teflon or stainless steel
- Peristaltic pump, bladder pump, or submersible sampling pump with tubing, support cables, and power supply (may not be required if well yield is low)

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. A pump will be used for well purging if the well yield is adequate; otherwise, a bailer may be used.
3. Instruments are calibrated according to manufacturer's instructions.
4. The well number, site, date, and condition are recorded in the field logbook.
5. 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.

6. Water level measurements are collected in accordance with SOP Water Level Measurements, and the total depth of the well is measured.

7. The volume in gallons of water in the well casing or sections of telescoping well casing is calculated as follows:

$0.052 (\pi r^2 h) = 0.163 (r^2 h) = \text{gallons}$

where: $\pi = 3.14$

r = Radius of the well pipe in inches
h = height of water in well in feet

The volume of water in typical well casings may be calculated as follows:

2-inch diameter well:
0.163 gal/ft x ___ (linear feet of water) = gallons

4-inch diameter well:
0.653 gal/ft x ___ (linear feet of water) = gallons

6-inch diameter well:
1.469 gal/ft x ___ (linear feet of water) = gallons

The initial field parameters of pH, specific conductance, and temperature of water are measured and recorded in the field logbook. The measurement probes are inserted into the probe box. The purged groundwater is directed throughout the box, allowing measurements to be collected before the water contacts the atmosphere.

8. Sampling equipment is cleaned and decontaminated prior to sampling in accordance with SOP Decontamination of Personnel and Equipment.

9. If a bailer is being used, it is removed from either its protective covering or the well casing and attached to a cord compatible with constituents and long enough to reach the bottom of the well. If a sampling pump is being used, the air line, discharge line, and support cable or rope are attached to the pump. The support line should bear the weight of the pump. If the well is purged using dedicated tubing, it is lowered into the well to the top of the screened zone.

10. The sampling device is lowered to the well interval from which the sample is to be collected. The pump intake will be placed above the top of the screen, where possible. If a bailer is being used, it is allowed to fill with a minimum of surface disturbance to prevent sample water aeration. When the bailer is raised, the bailer cord must not touch the ground.

During purging, the field parameters are measured at least once for each well volume. In productive wells, the well purging end point is determined using the field measurements. In nonproductive wells, the

well is repeatedly bailed dry to obtain a minimum of three well volumes, then allowed to recover before sampling.

12. Three to five well volumes are purged (more may be purged if parameters do not stabilize). Purging is stopped when field parameters have stabilized over two consecutive well volumes. Field parameters are considered stabilized when pH measurements agree within 0.5 units, temperature measurements agree within 1°C, and specific conductance and dissolved oxygen measurements agree within 10 percent.

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 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), 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)
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 poured from the bailer or 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. 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. When a bailer is used, filtration may be driven by a peristaltic pump.

3. VOC samples from wells purged using dedicated tubing and a sampling pump will be collected using a bailer

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

5. The bottle is capped, then labeled clearly and carefully.

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

7. If the sampler is dedicated, it is returned to the well and the well is capped and locked. Nondedicated samplers are cleaned and decontaminated in accordance with SOP Decontamination of Personnel and Equipment.

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
- Bring supplies for replacing the bladder if using a positive-displacement bladder pump
- Inspect tubing regularly and replace as warranted
- Inspect air/sample line 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

STANDARD OPERATING PROCEDURE

Water-Level Measurements

I. Purpose and Scope

The purpose of this procedure is to provide a guideline for the measurement of the depth to groundwater in monitoring wells, where a second phase of floating liquid (e.g., gasoline) is not encountered. This SOP includes guidelines for discrete measurements of static water levels.

II. Equipment and Materials

A. Discrete Measurements of Static Water Level

- Electronic water level meter, Solinst or equivalent, with a minimum 100-foot tape; the tape should have graduations in increments of 0.01 feet or less

III. Procedures and Guidelines

A. Measurement of Static Water Level

Verify that the unit is turned on and functioning properly. Slowly lower the probe on its cable into the well until the probe just contacts the water surface; the unit will respond with a tone or light signal. Sight across the top of the locking well casing adjacent to the measuring point, recording the position of the cable when the probe is at the water surface. The measuring point will be a standardized surveyed location on the top of each well casing, adjacent to the lock hasp, indicated by a notch, paint mark, or similar method. Measure the distance from this point to the closest interval marker on the tape, and record the water level reading in the log book.

Measure and record the three following additional readings: (1) the depth of the well; (2) the depth from the top of the casing to the top of the well riser; and (3) the distance to the surface of the concrete pad or to ground. Measurements are to be taken with respect to the measuring point on the top of the well casing. The depth of the well may be measured using the water-level probe with the instrument turned off.

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

A. Discrete Measurements of Static Water Level

Prior to each use, verify that the battery is charged by pressing the test button on the water-level meter. Verify that the unit is operating correctly by testing the probe in distilled or deionized water. Leave the unit turned off when not in use.

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

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

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

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

SHADED AREA– FOR LAB USE ONLY	
Lab 1 #	Lab 2 #
Quote #	Kit Request #
Project #	
No. of Samples	Page of
Login	LIMS Ver

REMARKS	LAB 1 ID	LAB 2 ID

Sampled By & Title (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name)	Date/Time	QC Level: 1 2 3 Other: ____	
Received By (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name)	Date/Time	COC Rec	ICE
Received By (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name)	Date/Time	Ana Req	TEMP
Received By (Please sign and print name)	Date/Time	Shipped Via UPS BUS Fed-Ex Hand Other ____	Shipping #	Cust Seal	Ph
Work Authorized By (Please sign and print name)	Remarks				

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 _____ _____