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FINAL SAMPLING AND ANALYSIS PLAN ANOMALY ACQUISITION AND INVESTIGATION AREA UXO 1 ST JULIENS CREEK ANNEX VA

6/1/2012

CH2MHILL

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Final

Sampling and Analysis Plan Anomaly Acquisition and Investigation Area UXO 1

St. Juliens Creek Annex
Chesapeake, Virginia

Prepared for

Department of the Navy

Naval Facilities Engineering Command Mid-Atlantic

Contract No.
N62470-08-D-1000
CTO-WE10

June 2012

Prepared by

CH2MHILL

SAP Worksheet #1—Title and Approval Page

Final

Sampling and Analysis Plan
Anomaly Acquisition and Investigation
Area UXO 1

St. Juliens Creek Annex
Chesapeake, Virginia

Contract Task Order WE10

June 2012

Prepared for:

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Prepared under:

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

Prepared by:

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VDEQ – Remedial Project Manager

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Executive Summary

This Munitions Response Program (MRP) Uniform Federal Policy (UFP) – Sampling and Analysis Plan (SAP) has been prepared to support the anomaly acquisition activities for Area UXO 1 at St. Juliens Creek Annex (SJCA) in Chesapeake, Virginia. The investigation is being performed to support the determination of whether there was a release of munitions and explosives of concern (MEC) at the site due to the use of the on-site wharfs that were used for loading ships with munitions; Phase 1 was a geophysical investigation to locate underwater anomalies, Phase 2 is an anomaly investigation that will use the Phase 1 data to target areas for investigation. The SI is not intended as a full-scale study of the nature and extent of contamination or explosives hazards, rather it is conducted to determine whether there is an on-site presence, or potential presence, of MEC, specifically discarded military munitions (DMM) or munitions constituents (MC), and the nature of the associated threats. Its purpose is to augment the data collected in the PA and SI and to generate sampling and other field data to determine if further response action or remedial investigation is appropriate.

Area UXO 1 is the current and former wharf areas at SJCA along the shoreline of the Southern Branch of the Elizabeth River. It comprises approximately 2,230 linear feet of current and former wharf (Wharf 1, Wharf 2, and Wharf 3). The original Wharf 1 and Wharf 2 was constructed in the southeast portion of the SJCA by 1903 and were connected during World War II to support the increased production of munitions for the war. Munitions loading activities continued until the early 1970s. The southern wharf was damaged when two ships struck it in 1975; however, portions of it are still functional. Wharf 3, constructed in 1917 for loading Mark VI mines, was located in the northeast portion of SJCA adjacent to Buildings M-5 and 190. This wharf is no longer present, with the exception of remaining pilings.

This UFP-SAP provides for a targeted anomaly investigation of items of interest identified during the Phase 1 investigation. This will include using an electromagnet to recover metallic debris in areas with concentrations of anomalies identified during the Phase 1 investigation to determine if anomalies are DMM or DMM-related, collecting sediment samples from extracted material, and analyzing sediment samples for select constituents. If sufficient sediment cannot be recovered from the extracted metallic debris, a ponar dredge or similar equipment will be used to obtain sediment samples from the riverbed. Data from this investigation will be used to confirm the presence or absence of DMM, identify environmental contamination resulting from DMM presence, and evaluate the need for additional investigations (such as removal activities or further sampling).

This MRP UFP-SAP is intended to be the primary work-planning document for the activities being performed at the site. It serves as a guideline for the field activities and data quality assessment. This SAP was developed in accordance with the following documents:

- *EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5, QAMS (USEPA, 2002)*
- *Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP) (USEPA, 2005)*
- *USEPA QA/G-5, QAMS (*USEPA, 2002*)*
- *Guidance on Systematic Planning Using the Data Quality Objectives Process (*USEPA, 2006*)*

This document consists of 37 worksheets, which are based upon the UFP-SAP format designed specifically for chemical sampling. Eleven tables are embedded within the worksheets. Figures are included at the end of worksheets, where applicable.

The Navy, Naval Facilities Engineering Command (NAVFAC), Mid-Atlantic, is conducting this SI in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) investigation process. This site has been identified under the Navy Munitions Response Program (MRP). The United States Environmental Protection Agency, Region III is the lead regulatory agency and works in consultation with the Virginia Department of Environmental Quality (VDEQ). This SAP will help ensure that the field and analytical data collected or compiled are scientifically sound, of known and documented quality, and suitable for intended uses.

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Appendices

A Standard Operating Procedures
B DoD ELAP Accreditation Letter

Abbreviations and Acronyms

AM	Activity Manager
AQM	Activity Quality Manager
BTAG	Biological Technical Assistance Group
CA	corrective action
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CLEAN	Comprehensive Long-term Environmental Action—Navy
CSM	conceptual site model
DGM	digital geophysical mapping
DMM	discarded military munitions
DoD	Department of Defense
DQI	data quality indicator
DV	Data Validator
ELAP	Environmental Laboratory Accreditation Program
EOD	explosive ordnance disposal
ERP	Environmental Restoration Program
ESS	explosive safety submission
FS	Feasibility Study
FTL	Field Team Leader
FTP	file transfer protocol
FY	Fiscal Year
GIS	geographic information system
H&S	health and safety
HPLC	High Performance Liquid Chromatograph
HSP	Health and Safety Plan
IAS	Initial Assessment Study
ICAL	initial calibration
ICS	Interference Check Sample
IDW	investigation-derived waste
iNFADS	internet Navy Facility Assets Data Store
LC/MS	liquid chromatograph/mass spectrometer
MC	munitions constituents
MEC	munitions and explosives of concern
mg/kg	milligrams per kilogram
MPC	measurement performance criteria
MRP	Munitions Response Program
N/A	not applicable
NAVFAC	Naval Facilities Engineering Command
NFA	no further action
NIRIS	Navy Installation Restoration Information System
NOSSA	Naval Ordnance Safety and Security Activity

PA	Preliminary Assessment
PAL	project action limit
PDM	Project Data Manager
PM	Project Manager
POC	point of contact
PQL	Project Quantitation Limit
QA	quality assurance
QAO	Quality Assurance Officer
QC	quality control
QSM	Quality Systems Manual
RI	Remedial Investigation
RPM	Remedial Project Manager
RRR	Relative Risk Ranking
SAP	Sampling and Analysis Plan
SI	Site Inspection
SJCA	St. Juliens Creek Annex
SOP	standard operating procedure
SSA	Site Screening Assessment
SSC	site safety coordinator
SVOC	semivolatile organic compound
TBD	to be determined
UFP	Uniform Federal Policy
USEPA	United States Environmental Protection Agency
VDEQ	Virginia Department of Environmental Quality
VOC	volatile organic compound
WWII	World War II

SAP Worksheet #2—SAP Identifying Information

Site Name/Number: St. Juliens Creek Annex (SJCA) Area UXO 1
Operable Unit: Not Applicable (N/A)
Contractor Name: CH2M HILL
Contract Number: N62470-08-D-1000, Contract Task Order WE10
Contract Title: Comprehensive Long-term Environmental Action—Navy (CLEAN) 1000

1. This Sampling and Analysis Plan (SAP) was prepared in accordance with the requirements of:

- *Uniform Federal Policy – Quality Assurance Project Plans* (USEPA, 20005)
- *Guidance for Quality Assurance Project Plans (QAPPs*)
- USEPA QA/G-5, QAMS (USEPA, 2002)
- *Guidance on Systematic Planning Using the Data Quality Objectives Process* (USEPA, 2006)

2. Identify regulatory program:

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

3. This SAP is specific to:

Phase 2 of the SJCA Area UXO 1 Site Inspection

4. List dates of scoping sessions that were held:

Scoping Session	Date
SJCA Tier I Partnering Meeting – Initial scoping session	27 January 2010
SJCA Tier I Partnering Meeting –Scoping session	18 March 2010
SJCA Tier I Partnering Team Phone Call	3 May 2010
SJCA Tier I Partnering Meeting –Scoping session	20 May 2010
SJCA Tier I Partnering Meeting – Scoping Session	3 February 2011
SJCA Tier I Partnering Meeting – Scoping Session	11 May 2011
SJCA Tier I Partnering Meeting – Scoping Session	6 July 2011

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

Title	Date
Final Quality Assurance Project Plan Site Inspection, Phase 1 Underwater Geophysical Survey Area UXO 1, St. Juliens Creek Annex Chesapeake, Virginia	January 2010

SAP Worksheet #2—SAP Identifying Information (continued)

6. List organizational partners (stakeholders) and connection with lead organization:
   - Lead Organization—Naval Facilities Engineering Command (NAVFAC), Mid-Atlantic
   - Lead Regulatory Agency—United States Environmental Protection Agency (USEPA) Region 3
   - State Regulatory Agency—Virginia Department of Environmental Quality (VDEQ)
   - Land Owner—Department of Defense (DoD)

7. If any required SAP elements or required information are not applicable to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion below:

   - All SAP Elements required for this project are described herein on the 37 Uniform Federal Policy Sampling and Analysis Plan (UFP-SAP) Worksheets. Therefore, the crosswalk table is not necessary for this project.

SAP Worksheet #3—Distribution List

Name of SAP Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address	Document Control Number
Walter Bell, P.E.	Remedial Project Manager (RPM)	NAVFAC Mid-Atlantic	757-341-0484	walt.j.bell@navy.mil	An administrative record number will be assigned when the final document is being prepared.
Mike Green	Munitions Response Program (MRP) Quality Assurance Officer (QAO)	NAVFAC Atlantic	757-322-8108 757-202-0865	mike.green@navy.mil	
Robert Stroud	RPM	USEPA Region 3	410-305-2748	Stroud.Robert@epa.gov	
Karen Doran	RPM	VDEQ	804-698-4594	karen.doran@deq.virginia.gov	
Janna Staszak, P.E.	Activity Manager (AM)	CH2M HILL	757-671-6256	janna.staszak@ch2m.com	
Mike Skeean, P.E.	Project Manager (PM)	CH2M HILL	704-543-3285	mike.skeean@ch2m.com	
Sonya Gordon	PM	Empirical Laboratories	615-345-1115	sgordon@empirlabs.com	
Ward Dickens	Data Validator (DV)	CH2M HILL	352-384-7049	ward.dickens@ch2m.com	
Nate Price	Field Team Leader (FTL)	CH2M HILL	757-671-6280	nathaniel.price@ch2m.com	
TBD	Field Team Members	CH2M HILL	TBD	TBD	

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SAP Worksheet #4—Project Personnel Sign-Off Sheet

Name	Organization/Title/Role	Telephone Number	Signature/email receipt	SAP Section Reviewed	Date SAP Read
Janna Staszak, P.E.	CH2M HILL /AM	757-671-6256			
Mike Skeean, P.E.	CH2M HILL /PM	704-543-3285			
Sonya Gordon	Empirical/ PM	615-345-1115			
Ward Dickens	CH2M HILL/ DV	352-384-7049			
Nate Price	FTL	757-671-6280			
TBD	Field Team Member	TBD			

Once the UFP-SAP is finalized, CH2M HILL will send copies to all parties on the distribution list in Worksheet #3 and request signatures. Returned copies will be kept in internal CH2M HILL project folders.

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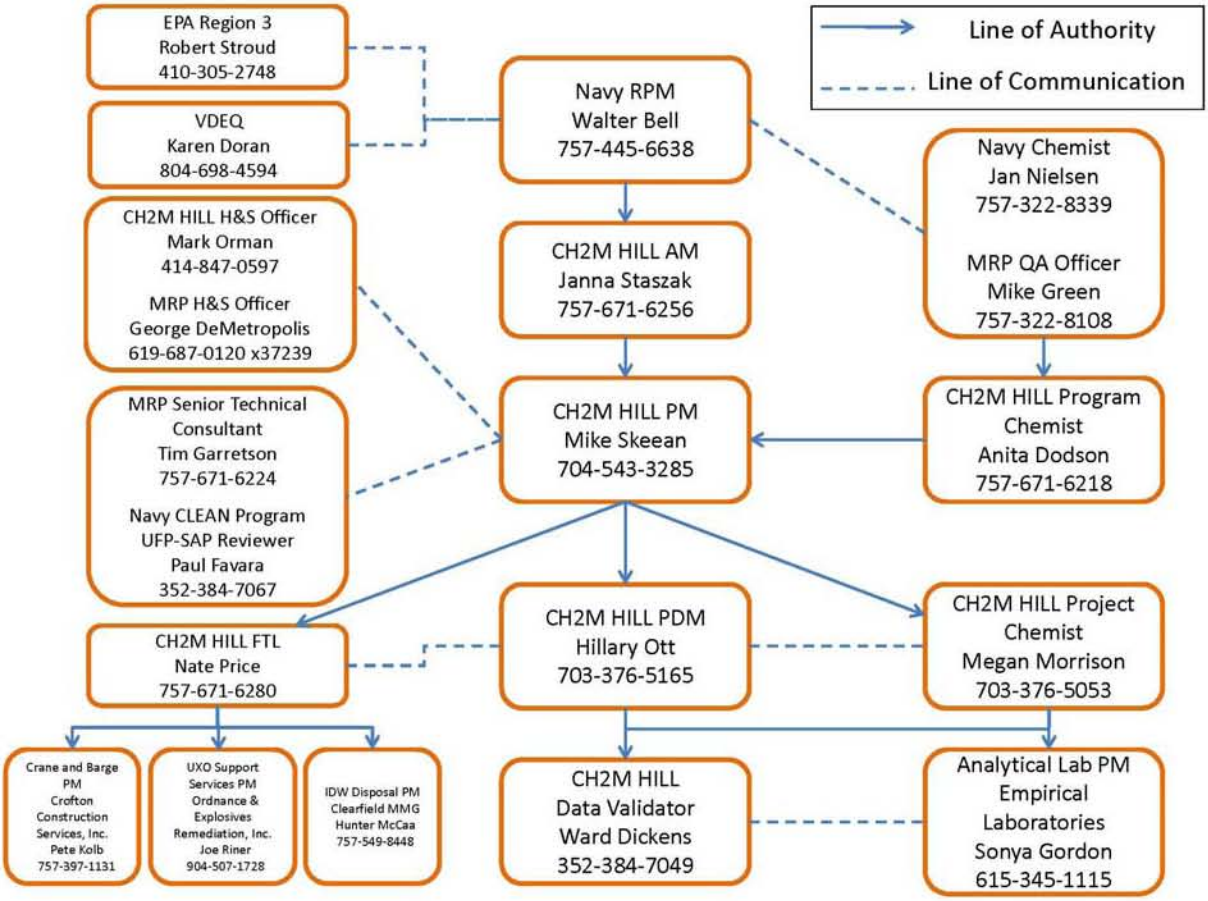
SAP Worksheet #5—Project Organizational Chart



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SAP Worksheet #6—Communication Pathways

Communication Drivers	Responsible Affiliation	Name	Phone Number	Procedure
Communication with Navy (lead agency)	RPM	Walter Bell	757-341-0484	Primary point of contact (POC) for Navy; can delegate communication to other internal or external points of contact. Any issue that may impact project work should be reported to Walter immediately.
Communication with USEPA (regulatory agency)	RPM	Robert Stroud	410-305-2748	Primary POC for USEPA; can delegate communication to other internal or external points of contact. Upon notification of field changes, USEPA will have 24 hrs to approve or comment on the field changes.
Communication with VDEQ (regulatory agency)	RPM	Karen Doran	804-698-4594	Primary POC for VDEQ; can delegate communication to other internal or external points of contact. Upon notification of field changes, VDEQ will have 24 hrs to approve or comment on the field changes.
Navy Quality Assurance (QA)/Quality Control (QC) input	Navy Chemist	Jan Nielsen	757-322-8339	Provides review comments to Navy contractor on Pre-draft SAP via email through Navy RPM. Provides overall Navy guidance via direct communication with Navy contractor chemist, as warranted.
Oversight of Environmental Restoration Program (ERP) implementation	AM	Janna Staszak	757-671-6256	Primary POC for stakeholder and agency managers; can delegate communication to other contract staff as appropriate. Issues reported to the Navy RPM immediately and followed up in writing within 2 business days.
Management of ERP Implementation	PM	Mike Skeean	704-543-3285	Primary POC for field and project-specific activities; timing dependent on nature of communication and predefined schedules as applicable and as requested by stakeholder agencies. All information and materials about the project will be forwarded to the AM on a daily basis.

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number	Procedure
Technical communications for project implementation, and data interpretation	Activity Quality Manager (AQM) and MRP Senior Technical Consultant	Paul Favara and Tim Garretson	(352) 384-7067 (904) 374-5633	Contact AQM and senior technical consultant regarding questions/issues encountered in the field, input on data interpretation, as needed. AQM and/or senior technical consultant will have 24 hrs to respond to technical field questions as necessary. Responses will be communicated to the PM via email or phone.
Data tracking from collection through upload to database	Project Data Manager (PDM)	Hillary Ott	(703) 376-5165	PDM will track data from sample collection through upload to database, ensuring SAP requirements are met by laboratory and field staff.
Reporting Lab Data Quality Issues	Laboratory PM	Sonya Gordon, Empirical	(615) 345-1115	All QA/QC issues with project filed samples will be reported by the lab to the PDM and Project Chemist as soon as possible.
Reporting data quality issues	DV	Ward Dickens	(352) 384-7049	The DV reviews and qualifies analytical data as necessary. The data along with a validation narrative are returned to the PDM within 14 calendar days.
Oversight of Analytical and Data Validation subcontractors	Project Chemist	Megan Morrison	(703) 376-5053	Provides oversight of analytical laboratories and data validators. Will report data quality issues to PM within 24 hours. Facilitates resolution on a same-day basis after consulting with the PM and AQM and the Navy chemist (if changes in the SAP are warranted) to ensure SAP requirements are met by the laboratory. Communicates with subs by phone, followed up with e-mail to document decisions and actions Should analytical laboratory issues affect data usability by rendering a significant amount of rejectable or unusable data such that the project completeness goal cannot be obtained, the project chemist will notify the project team including the Navy RPM and Navy QAO. The Project Chemist will act as main POC for Laboratory QAO. The CH2M HILL AM and PM are informed within 24 hours to pass on communications to Navy and regulators as required.
Health and Safety (H&S)	Site Safety Coordinator (SSC)	Nelson Figeac	(757) 671-8311	Responsible for the adherence of team members to the site safety requirements described in the H&S Plan. Will report H&S incidents and near losses to PM.

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number	Procedure
SAP Field Changes	FTL	Nate Price	757-671-6280	Notify the PM by phone and email of changes to the SAP made in the field and the reasons within 24 hours. Documentation of deviations from the work plan will be kept in the field logbook; deviations made only with the approval of the PM.
Field and Analytical Corrective Actions (CAs)	FTL Navy CLEAN Program Chemist	Nate Price Anita Dodson	757-671-6280 757-671-6218	The need for CA for field and analytical issues will be determined by the Field Team Leader and/or Contractor Program Chemist.

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SAP Worksheet #7—Personnel Responsibilities Table

Name	Title/Role	Organizational Affiliation	Responsibilities
Walter Bell, P.E.	RPM	NAVFAC Mid-Atlantic	Coordinates the work of Navy resources to accomplish Environmental Restoration Program (ERP) goals and policies at SJCA
Jan Nielsen	Chemist	NAVFAC	Navy Review of SAP and QA input.
Janna Staszak, P.E.	AM	CH2M HILL	Oversees ERP activities at SJCA
Mike Skeean, P.E.	PM	CH2M HILL	Manages project; directs and oversees project staff
Paul Favara, P.E.	AQM	CH2M HILL	Provides senior technical support for overall project
Brett Doerr	Navy CLEAN Program UFP-SAP Reviewer	CH2M HILL	Provides program-level review of UFP-SAP
Anita Dodson	Navy CLEAN Program Chemist	CH2M HILL	Provides program-level review of UFP-SAP
Tamir Klaff	Geophysical Senior Technical Consultant	CH2M HILL	Provides technical support for geophysical investigation data
Tim Garretson	MRP Senior Technical Consultant	CH2M HILL	Provides technical support for munitions and explosives of concern (MEC)-related issues
Megan Morrison	Project Chemist	CH2M HILL	Performs oversight of laboratory and data validators, data usability evaluation.
Hillary Ott	PDM	CH2M HILL	Manages sample tracking, coordinates with laboratory and data-validator, data management
Mark Orman	H&S Officer	CH2M HILL	Prepares H&S Plan; manages H&S for all field activities
George DeMetropolis	MRP H&S Officer	CH2M HILL	Assists in preparation of H&S Plan; manages H&S for all field activities involving MEC
Roni Warren	Human Health Risk Assessor	CH2M HILL	Performs screening level human health risk assessment for the site based on analytical data obtained during the investigation.
Mike Elias	Ecological Risk Assessor	CH2M HILL	Performs screening level ecological risk assessment for the site based on analytical data obtained during the investigation.
Nate Price	FTL	CH2M HILL	Coordinates all field activities and sampling; tracks, stores, and retrieves all laboratory and field supplies
Nelson Figeac	SSC	CH2M HILL	Oversees H&S for all field activities
Ward Dickens	DV	CH2M HILL	Responsible for data validation.
Sonya Gordon	PM	Empirical	Manages analytical projects from initiation to completion.

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SAP Worksheet #8—Special Personnel Training Requirements Table

Project Function	Specialized Training By Title or Description of Course	Training Provider	Training Date	Personnel / Groups Receiving Training	Personnel Titles / Organizational Affiliation	Location of Training Records / Certificates
UXO Qualified Technician	Qualifications established by DDESB TP-18*	Military or various registered universities	Prior to field work activities	UXO qualified technician(s) assigned to the field team*	CH2M HILL/ Subcontractor Field Staff TBD	CH2M HILL Human Resources Department Document in personal Health and Safety Plan (HSP) file
All Area UXO 1 Field Work	MEC Awareness Training†	CH2M HILL UXO Technician	Prior to mobilization	Nate Price (FTL), field team members (TBD), Nelson Figeac (SSC), subcontractor	Field team members and SSCs from CH2M HILL Field team members from subcontractor	Health and Safety Plan (HSP) file, Project folder

*UXO Technician training will not be provided by CH2M HILL, a UXO subcontractor, or an outside vendor for this project. The personnel performing these duties must have demonstrated experience and qualifications (minimum qualifications established by DDESB TP-18) prior to working at the site and the kickoff of this investigation. Qualifications for all UXO qualified technicians will be reviewed by representatives of the CH2M HILL MR work group prior to mobilizing to the site to ensure staff filing this role are adequately qualified.

† MEC awareness training will include Recognize, Retreat, Report (RRR or 3-R) training and an overview of the explosives safety submission (ESS) requirements. The RRR training is intended to make the trainees aware of the potential presence of MEC, ways to recognize potential MEC, and what to do if potential MEC is observed. This training **DOES NOT** enable the trainee to identify the type of MEC or handle the potential MEC item. The ESS component of the training will present the requirements (e.g., procedures, separation distances, exclusion zones) to the field team.

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SAP Worksheet #9-1—Project Scoping Session Participants Sheet

Project Name: Area UXO 1 Anomaly Acquisition **Projected Date(s) of Investigation:** September –October 2010 **PM:** Tim Wenk – CH2M HILL	**Site Name:** Area UXO 1 **Site Location:** SJCA, Chesapeake, Virginia
Date of Session: January 27, 2010 **Scoping Session Purpose:** Discuss the Phase 1 Site Inspection and begin to scope the Phase 2 Site Inspection.	

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Walter Bell	RPM	NAVFAC Mid-Atlantic	757-341-0484	walt.j.bell@navy.mil	RPM
Robert Stroud	RPM	USEPA Region 3	410-305-2748	Stroud.Robert@epa.gov	Regulator
Karen Doran	RPM	VDEQ	804-698-4594	karen.doran@deq.virginia.gov	Regulator
Janna Staszak	AM	CH2M HILL	757-671-6256	janna.staszak@ch2m.com	CH2M HILL SJCA AM
Adrienne Jones	Deputy AM	CH2M HILL	757-671-6236	adrienne.jones@ch2m.com	Consultant

The discussion about Area UXO 1 is documented in the meeting minutes from the SJCA Tier 1 partnering meeting in January 2010. The summary of the discussion from the meeting minutes is provided below:

Objectives: Discuss the Phase 1 Site Inspection and begin to scope the Phase 2 Site Inspection.

Overview of Discussion: Janna provided an update on the Phase 1 SI activities. Mobilization to the site occurred January 19. During site reconnaissance the subcontractor observed significant, rapid changes in the surface elevation of the river bottom, which was unexpected due to the differing results of the 2008 sonar imagery. The change in elevation is not constant along the shoreline. There is a lot of bowling and the equipment is unable to maneuver around all the twists and turns. In order to safely conduct the survey, the equipment would have to be used at a higher elevation, which would result in less accurate detection of anomalies. Therefore, the subcontractor has demobilized from the site and CH2M HILL, the Navy, and the subcontractor are currently determining a path forward. Depending on the outcome, the UFP-SAP may be revised to incorporate changes to the equipment that will be used and/or the distance of the equipment above the river bottom. If the UFP-SAP is revised a very quick review will be necessary. Walt reminded the team that the Navy needs the data from the survey to support the wharf demolition. Walt asked how the survey SAIC can provide differs from that which Aquasurvey can provide. Janna explained that Aquasurvey had indicated that they would be able to maintain the equipment 5 ft from the river floor, but it turns out that the actual depth would be 10 ft or greater because the elevation would be maintained as the equipment moved away from the shore and the depth would increase as the elevation of the floor drops. The equipment SAIC uses is on an arm that can be adjusted and controlled more accurately to maintain an actual depth of 5 to 10 ft from the river bottom. The next step for the investigation will be to conduct a hydrographic survey with side scan sonar. The decision of whether to conduct a geophysical survey will be made onboard following the hydrographic survey.

Janna explained that because it is assumed anomalies will be discovered during Phase 1 and generation of an UFP-SAP and ESS for Phase 2 will be time-consuming, the team needs to begin scoping Phase 2 of the SI. The ESS will be particularly challenging because although the ESS will include contingencies for discovery of MEC, the explosive arcs will be large and may potentially impact a fuel farm and power station located on the opposite side of the river. The team discussed Worksheets 10 and 11 in order to begin scoping Phase 2 of the SI.

SAP Worksheet #9-1—Project Scoping Session Participants Sheet (continued)

Worksheet 10:

The team discussed the general problems to address and agreed on the following. It is anticipated that the underwater DGM survey will identify anomalies in the river that may represent MEC. Therefore, further investigation is necessary to determine if the metallic anomalies represent MEC and whether there have been releases of environmental contaminants associated with the anomalies. It is necessary to determine if there are potential risks associated with the site from an explosive hazard associated with potentially present MEC or from potential munitions constituents (MC) leaching from the MEC.

Worksheet 11:

The team agreed that the Navy & other stakeholder agencies will use the data to determine if MEC is present; engineers and scientists will evaluate the data for decision making; and geophysicists will evaluate geophysical survey data to identify anomalies in the sediment.

The team discussed the PALs. Janna explained that the investigation will be phased, first a clam shell scoop will be used to collect sediment in an area in which a high concentration of anomalies has been identified and a UXO technician will look through the sediment to see if the anomalies are munitions related. If no munitions-related anomalies are identified, no samples will be collected from that sediment. Discovery of a single MEC item will be considered as evidence of a potential explosive safety hazard. Karen asked what will happen to the material after it is investigated. Janna responded that it would have to be safely disposed of offsite, the details of which would be worked out in the waste management plan for the investigation. The proposed PALs to be protective of human health are the residential soil RSLs multiplied by 10 to adjust for sediment and divided by 10 to adjust for non-carcinogenic additive effects. Walt asked why the PALs were based on a residential scenario. Janna responded that the Elizabeth River is supposed to be unrestricted (therefore, residential) use and basing the PALs on industrial would most likely not be acceptable. The proposed PALs to be protective of the environment are based on literature values. Janna proposed analyzing the sediment samples for only explosives based on the site history. RSLs are available for most explosives, but there are only a few ecological literature values for explosives. The proposed ecological screening values are being researched. If explosives are found in the sediment, a removal or an RI would likely be necessary. Karen indicated that a presence/absence decision point should be considered; if explosives are present, then a removal action or RI should be conducted. Janna pointed out that samples would be collected in the worst case areas, so if explosives are detected but do not exceed screening values, further investigation or action may not be warranted. The acute risk from MEC would be more of a concern than the explosive concentrations. If a MEC removal is conducted, it will remove portions of the sediment. Therefore, investigation of sediment may be conducted after the removal of MEC.

The team discussed that what the data will be used for depends on what data ends up being collected. The inspection of the extracted metallic debris will be used to support the determination of whether or not MEC are present within Area UXO 1. If MEC are present, the data will be used to determine locations from which sediment samples should be collected. If sediment samples are collected, the results will be used to determine if an existing source of contaminants to the environment exists.

SAP Worksheet #9-1—Project Scoping Session Participants Sheet (continued)

The team discussed the types of data needed. Walt asked if only analyzing for explosives would be sufficient for decision making at this point. Janna thinks analysis should be limited to explosives for this phase of the investigation because the results will be an indicator of the Navy's impact. Results of other analyses (e.g., inorganics) will be difficult to tie to a specific source because there are so many contaminant sources along the river. Additional analyses could be added in a subsequent investigation if needed. Karen asked if explosives are the only MC from MEC. Janna responded that metals are also commonly associated with MEC. Karen asked what perchlorate is used for. Bob and Walt responded that they believe it was used in projectiles. Janna responded that perchlorate is included in the list of proposed analytes. Bob indicated that analysis should be limited to explosives for the time being due to the difficulty of determining who is responsible for other constituents if they are detected. Karen suggested collecting reference samples to assist in determining the source of certain constituents. Janna responded that background samples should definitely be collected if metals are analyzed for, but that they are not necessary for explosives. If metals are analyzed for, at least eight background samples would be needed in the river in order to establish a background set for comparison. Karen indicated that she has concerns about not analyzing for metals because they could have leached off of the MEC. Janna responded that if MEC are present, the nature and extent of their impact (including metals) could be determined during a subsequent RI. Ultimately, any potential metal contamination would be addressed. Bob thinks that metals would be detected if sampled for but that it would be very difficult to determine the next steps to take because it would be so difficult to determine who is responsible for the contamination. Karen indicated that she is fine with analyzing for only explosives if sampling will be conducted at some point in the future even if no explosives are detected. Walt reminded the team of the Navy's sediment policy to only address those contaminants that can be tied to the Navy and that an investigation of metals in sediment will not be conducted if MEC are not identified.

The team agreed on how good the data need to be in order to support the environmental decisions. The data will be the quantity and quality necessary to provide technically sound and defensible assessments of potential risks to human and ecological receptors posed by the contaminants identified. The laboratory will follow the measurement performance criteria (MPC) for field QC samples and laboratory QC samples; consistent with the DoD QSM as applicable and laboratory in-house limits where the QSM does not apply.

The team discussed how much data should be collected. A maximum of 15 areas is being proposed for collection of sediment via a clam shell bucket for visual inspection to support the determination of whether or not MEC are present. This number is based on cost and the fact that the objective of an SI is not to delineate the extent of contamination. If MEC is present, one composite sediment sample will be collected from the incidental sediment. Karen suggested a figure showing the proposed 15 areas in order to get a spatial idea. A figure will be developed after the Phase I investigation is completed.

The team agreed on where, when, and how the data should be collected/generated, as follows. Dredge material, and possibly sediment samples, will be collected from up to 15 to-be-determined locations at the site. The samples will be collected in accordance with SJCA standard operating procedure (SOPs).

The team discussed who will collect and generate the data and how the data will be reported, and agreed upon the following. Metallic anomalies will be collected by a CH2M HILL dredging subcontractor. If necessary, river-bottom sediment samples will be collected by a CH2M HILL technician from material collected by a CH2M HILL dredging subcontractor and submitted to a Navy-approved analytical subcontractor. CH2M HILL field staff will record the contents and soil classification for each bucket of dredged material in the field notebook. The data will be reported in the SI report.

SAP Worksheet #9-1—Project Scoping Session Participants Sheet (continued)

The team agreed that the data will be archived according to the procedures dictated via the Navy CLEAN program/contract and in accordance with federal law. The data will be uploaded into a centralized database used for Navy projects (Navy Installation Restoration Information System [NIRIS]) and sent to the Navy for archiving at the end of the project.

The Team discussed what the sediment data would be used for at this phase and whether or not collection of sediment is necessary. The team considered removing the sediment analysis but ultimately decided that since the equipment would already be mobilized and sediment will be collected for investigation of MEC, it would be cost effective to collect samples for analysis. The results could be used in the overall conceptual site model (CSM) and to help scope the path forward, which will need to be explained in the UFP-SAP. The team developed and agreed on the following project quality objective (PQOs):

- To answer whether sediment sampling is necessary at UXO 1: If MEC is not encountered during dredging activities at the selected locations, then sediment dredging can be discontinued and sediment sampling is not necessary; and If MEC is encountered, then sediment samples will be collected and analyzed for select constituents.
- To answer if further characterization of UXO 1 or a removal action is necessary: If MEC are identified at one or more of the dredged locations, then a Removal Action or RI/FS should be scoped; and if explosives are detected in sediment, then MEC likely resulted in a release of MC and data will be used to scope either a Removal Action or RI/FS.

Path Forward: The path forward for the Phase 1 activities will be determined and the team will be notified of the path forward as the details are worked out. The Phase 1 UFP-SAP will be revised as necessary based on the path forward and submitted for team review. CH2M HILL will refine the worksheets based on the scoping session and continue drafting the Phase 2 UFP-SAP. The Phase 2 schedule will be refined after resolution of the Phase 1 challenges.

Note: The summary of the conversation presented on this worksheet indicates that the SJCA partnering team decided that analytical samples would not be necessary unless MEC is discovered in the dredged material. However, after reviewing the technical memorandum describing the DGM investigation at SJCA Area UXO 1 and the recommendations presented in the memorandum, VDEQ requested for the Navy to collect samples at the site regardless of whether DMM is discovered at the site (WS #9-3, VDEQ comment #7). The Navy agreed to collect samples at the site with or without DMM being present. The revised approach has been incorporated on Worksheet 11.

SAP Worksheet #9-2—Project Scoping Session Participants Sheet

Project Name: Area UXO 1 Anomaly Acquisition **Projected Date(s) of Investigation:** November 2010 **PM:** Tim Wenk – CH2M HILL	**Site Name:** Area UXO 1 **Site Location:** SJCA, Chesapeake, Virginia
Date of Session: March 18, 2010 **Scoping Session Purpose:** Discuss the results of the DGM and the path forward at the site.	

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
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Janna Staszak	AM	CH2M HILL	757-671-6256	janna.staszak@ch2m.com	CH2M HILL SJCA AM
Robert Stroud	RPM	USEPA Region 3	410-305-2748	Stroud.Robert@epa.gov	Regulator
Adrienne Jones	Deputy AM	CH2M HILL	757-671-6236	adrienne.jones@ch2m.com	Consultant

The purpose of this meeting was to discuss the status of the Site Inspection and anticipated plan for the UFP-SAP for the follow on investigation.

Objectives: Discuss the Phase 1 Site Inspection (SI), Phase 2 SI, and the project schedule.

Overview of Discussion: Copies of the presentation were distributed. Janna discussed Phase 1 of the SI. The original mobilization for Phase 1 occurred on January 19. The subcontractor conducted a site reconnaissance to determine underwater conditions and observed significant, rapid changes in the sediment surface, which was very different than expected based on the side scan sonar results previously collected. The subcontractor determined that they were incapable of conducting the investigation with the equipment they had onsite and they demobilized. The subcontractor identified a different platform capable of conducting the investigation at the site and slight revisions to the UFP SAP were necessary prior to remobilization. The changes to the UFP SAP consisted of an increase in the distance the sensor would be from the river bottom, an updated QC program to exclude blind seeds, and adjustment of the positional accuracy.

Re-mobilization to the site occurred on February 10 and the field work was completed February 18. The subcontractor was unable to survey all of the areas identified in the UFP SAP. A figure identifying the areas that were not able to be surveyed was displayed with the following areas noted in red that could not be accessed:

- The western portion of the northern wharf area, where water was too shallow to permit the boat and equipment to enter the area safely.
- Portions of the southern wharf area immediately adjacent to the wharf, where interference was caused by the magnetic signature from the pier
- The area between the southern pier and land, which could not be accessed
- The area south of the southern wharf, where water was too shallow to permit the boat and equipment to enter the area safely due to sediment buildup

SAP Worksheet #9-2—Project Scoping Session Participants Sheet (continued)

Janna presented the results of the DGM Survey. The investigation was completed using two G-882 magnetometers spaced 1.5 meters apart. The DGM data was collected using survey lines spaced 1 meter apart. Approximately double coverage was achieved over the areas surveyed due to the spacing between the magnetometers. The results included a lot of interference along the wharf but the data was cleaned up and anomalies were able to be identified. Figures depicting the DGM results were presented. 1,386 anomalies were identified in the southern area and 265 anomalies were identified in the northern area. Walt asked if there is a way to distinguish between large anomalies versus a "clump" of anomalies. Janna responded that the geophysicist is generally able to distinguish between the two. She explained that each individual item has a positive and negative end, like a magnet, where red represents positive and blue represents negative on the figures. A closely-spaced red and blue spot likely indicate a single item, while clusters of red and blue likely indicate multiple items. She noted that some of the red shown in the northern area is due to interference from a barge that was moved during the investigation.

The Team discussed the Phase 2 SI UFP SAP. Janna explained that proposed anomaly investigation locations are not included in revised Worksheet 10 and 11 that were sent out for review because they will be based on the results of Phase 1, which are still being evaluated. Janna proposed including the proposed investigation locations within recommendations of the technical memorandum report for Phase 1 in order to keep the UFP SAP moving forward; the Team agreed the inclusion would be appropriate. During previous discussions, the Team considered investigating 15 locations in the areas with the highest anomaly concentrations. However, since some of those areas are within the river channel and probably not associated with the site, it is proposed that the investigation locations be biased closer to the wharfs and include some areas where the DGM data could not be collected. Karen requested that one or two investigation locations be chosen away from the wharf for verification. The Team agrees with the investigation location selection approach. Walt asked if there would be a partnering Team discussion about the investigation locations prior to submittal of the technical memorandum. Janna responded that there would not be a partnering meeting before submittal of the technical memorandum, which should be submitted by the end of March. It has a 60 day technical review; however, if the review period could be shortened to 30 days, the UFP SAP for Phase 2 could be sent out with the accepted proposed investigation locations. Karen agreed with the shortened review period but indicated that it ultimately depends on the risk assessor's schedule. Bob also agreed to the shortened review period.

Janna explained that a work plan for the Phase 2 activities is being drafted since the activities are complicated and the UFP SAP does not capture all the necessary elements. Walt asked if the USACE needs to review the work plan, and Janna responded that she is unsure and will look into it. Janna asked the Team if they want to review the work plan. Karen responded that she would like the opportunity but that she does not need 60 days. Janna noted that that Phase 2 investigation will require an ESS, which is in progress.

Walt noted that there has been discussion concerning barges parking within Area UXO 1 and that he is looking into some sort of mariners warning in an attempt to prevent it from occurring.

Path Forward: The draft technical memorandum summarizing the Phase 1 activities and recommending anomaly investigation locations for Phase 2 will be submitted for review by March 31. Comments on the technical memorandum will be submitted by the Team 30 days after it is submitted. A conference call will be scheduled to discuss the investigation locations proposed in the document. The Team will submit comments on the revised Worksheets 10 and 11 by April 8 and the draft UFP SAP will be submitted for NAVFAC chemist and MR review by April 30.

SAP Worksheet #9-3—Project Scoping Session Participants Sheet

Project Name: Area UXO 1 Anomaly Acquisition **Projected Date(s) of Investigation:** November 2010 **PM:** Tim Wenk – CH2M HILL	**Site Name:** Area UXO 1 **Site Location:** SJCA, Chesapeake, Virginia
Date of Session: May 3, 2010 **Scoping Session Purpose:** Discuss preliminary comments and responses to Worksheets 10 & 11	

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
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Robert Stroud	RPM	USEPA Region 3	410-305-2748	Stroud.Robert@epa.gov	Regulator
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The purpose of this meeting (conducted over the phone) was to discuss the EPA and VDEQ comments and responses to the comments on Worksheets 10 and 11. The resolution to the comments and final responses are documented in a Response to Comments that was sent to the SJCA partnering team on May 12, 2010. The comments and final responses are provided below.

Comments from EPA, provided 29 April 2010.

1. *Worksheet 11, 1st page, last paragraph, 1st sentence.* This entire sentence needs to be reworked. I think you are trying to say that the results will be used to determine whether or not a release of MEC has occurred and to determine if a source still exists.

   Response: The sentence has been revised to the following: Sediment sample results will be used to determine whether or not a release has occurred from DMM to the environment and if the DMM continue to be a source of contaminants to the environment.

2. *Worksheet 11, 2nd page, 2nd paragraph.* Delete the word "for" and insert "and a UXO qualified technician will perform a metal detector aided visual inspection to determine the presence of MEC." This sentence should read…..River-bottom sediment and detected anomalies will be dredged from the river bottom and brought to the surface and a UXO qualified technician will perform a metal detector aided visual inspection to determine the presence of MEC.

   Response: The requested revision has been made. Additionally, MEC has been changed to DMM.

SAP Worksheet #9-3—Project Scoping Session Participants Sheet (continued)

3. *Worksheet 11, 2nd page, second question.* Change How "good" do the data to How "Good" does the data.

   Response: The requested revision has not been made because data is plural.

Comments from VDEQ, provided 8 April 2010.

1. *Worksheet 11, under "Who will use the data?" – in this paragraph and throughout the document both of the following are used, "MEC is" and "MEC are", please ensure consistency throughout document*

   Response: Since MEC is an acronym for "munitions and explosives of concern," "are" will be used throughout the document. However, MEC has been replaced by DMM in most instances based on a NAVFAC recommendation.

2. *Worksheet 11, under "What are the PALs?" – since the RSLs will be multiplied then divided by 10, the PALs should end up being the RSLs, is this correct?*

- **Response:** Yes, since the RSLs are multiplied by 10 to account for sediment exposure and divided by 10 for non-carcinogens to account for multiple constituents that may target the same organ, they end up as the RSL for non-carcinogens. The text has been reworded for clarity: "PALs protective of human health have been established as adjusted residential soil RSLs, updated December 29, 2009. The residential soil RSLs for all constituents have been multiplied by 10 in order to account for sediment exposure. Additionally, the residential soil RSLs for the non-carcinogenic constituents have divided by 10 to account for cumulative exposure to multiple constituents that may affect the same target organ."

3. *Worksheet 11, under "What will the data be used for?", second paragraph – update to say "…MEC to the environment, and to determine if a source of contaminants exists."*

   Response: The change will be made as substantially as suggested; see the response to EPA Comment 1.

4. *Worksheet 11, under "List the PQOs in the form of if/then statements", second question, third bullet – it states in this bullet that background samples will be collected, but the collection of background samples is not present anywhere else in worksheets 10 & 11, please clarify*

   Response: The mention/discussion of background samples will be removed from the worksheets based on the January 2010 partnering meeting team decision and further discussion during the May 3, 2010, partnering conference call.

5. *CSM – Ordnance Road misspelled*

   Response: The spelling of ordnance will be corrected.

6. *CSM, upper left corner – pilings misspelled*

   Response: The spelling of pilings will be corrected.

SAP Worksheet #9-3—Project Scoping Session Participants Sheet (continued)

7. *Given that SJCA's mission included the storage of explosive materials as well as the manufacturing of ordnance, it may be appropriate to sample for MC in these areas regardless of whether or not MEC are found. If explosive compounds used in the manufacture of munitions were handled and transported at these wharfs, potential releases of explosive compounds may have occurred through the loss of transport containers overboard or spillage. This is a much more likely scenario for a release than leaching of compounds from a MEC item. The Navy should obtain details regarding the supply chain regarding the manufacture of ordnance, and if any of the wharfs in question received at any point raw materials for these processes sediments in the immediate vicinity should be investigated for MC, even if MEC are not found.*

   Response: There is no known documentation of bulk explosives being dropped in the river during wharf-related activities. Based on interviews, there is anecdotal evidence that munitions were dropped in the water during loading activities. Therefore, this investigation will focus on the potential for DMM to be present in the river sediment, as the presence of DMM is the only potential source for MC contamination that was identified during the Preliminary Assessment of the site. However, as agreed to NAVFAC during the May 3, 2010, conference call, sampling for explosives will be conducted at the investigation locations in response to VDEQ response and to potentially allow for site closeout after this investigation. Sampling and analysis has been incorporated into Worksheet 11.

8. *Understanding that this is only an SAP, eventually the Navy will have to provide the procedures for the removal and sifting of dredged sediments for UXO. Presumably these details will be provided in a work plan but some consideration should be given to them here. The SAP should identify potential locations to examine the dredge spoils for MEC, as well flesh out the CSM to consider the various types of munitions that could be found since their fragmentation radius, etc. could impact details of the work plan.*

   Response: Information regarding the handling of the dredged materials and MEC will be detailed in a separate work plan and in an Explosive Safety Submission prior to the start of this investigation.

   The locations of the proposed anomalies for investigation are presented in a technical memorandum that summarizes the underwater DGM investigation conducted in February 2010. Worksheets 10 and 11 were provided for review before the locations were picked to ensure that the general approach for the investigation was acceptable to the SJCA partnering team. When the draft UFP-SAP for this investigation is sent to the team for review, figures showing the investigation locations, as agreed upon by the team following the review of the technical memorandum, will be included in the UFP-SAP.

SAP Worksheet #9-4—Project Scoping Session Participants Sheet

Project Name: Area UXO 1 Anomaly Acquisition **Projected Date(s) of Investigation:** November 2010 **PM:** Tim Wenk – CH2M HILL	**Site Name:** Area UXO 1 **Site Location:** SJCA, Chesapeake, Virginia

Date of Session: May 19, 2010

Scoping Session Purpose: Resolve outstanding comments on the Phase 1 Tech Memo; present the Site Inspection Report and discuss the schedule; and gain consensus on the responses to comments on the Anomaly Investigation UFP SAP, present the revisions to Worksheets 10 & 11, and prepare for NAVFAC munitions response program and chemist review, and discuss the schedule

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The discussion about Area UXO 1 is documented in the meeting minutes from the SJCA Tier 1 partnering meeting in May 2010. The summary of the discussion from the meeting minutes is provided below:

Objectives: Resolve outstanding comments on the Phase 1 Technical Memorandum, discuss the contents of the SI report and its schedule, gain consensus on the responses to comments on the Anomaly Investigation UFP SAP, present the revisions to Worksheets 10 & 11 of the UFP SAP, prepare the UFP SAP for NAVFAC MR and chemist review, and discuss the UFP SAP schedule.

Overview of Discussion:

Copies of the presentation were distributed. The Team discussed the status of the Phase 1 Technical Memorandum. The draft document was submitted April 6 for a 60-day review period. VDEQ has provided comments and the responses to those comments were verbally accepted during the May 3 Team conference call. Karen indicated that she will not be following up with written concurrence and will review the revisions during review of the upcoming SI report. Janna asked Bob if he had any comments on the technical memorandum. She explained that comments are not required since the document is being turned into the SI report for which there will be a separate review period, but that concurrence is needed on the investigation locations proposed in the document. Bob indicated that he does not have any comments on the technical memorandum and concurs with the proposed investigation locations and the changes resulting from VDEQ comments. Janna noted that the document will incorporate the Navy's comment to use the term "Discarded Military Munitions" instead of "MEC", where appropriate.

SAP Worksheet #9-4—Project Scoping Session Participants Sheet (continued)

Janna explained the SI report content. The SI report will supersede the Phase 1 Tech Memo and incorporate required elements of SI reports. SI reports must contain more information than the technical memorandum did; therefore, the site summery and CSM will be updated. Additionally, the MRSPP, which was missing from the technical memorandum, will be updated and included in the SI report. The report will document the Phase 1 activities and recommend additional investigation. The additional investigation is being referred to as an anomaly investigation because the site should not move into the RI phase until it has been demonstrated that there is a basis to do so. If a basis is not identified during the anomaly investigation, the investigation will be documented in an addendum to the SI and the site will be closed out. However, if potential concerns are identified during the investigation, the site will move to the RI phase. The Team discussed the schedule for the SI report and agreed that the SI report should be submitted as a draft version instead of a draft final.

The Team discussed the Anomaly Investigation UFP SAP. Janna noted that the text has been revisited throughout the document to use the term “DMM” instead of “MEC” or “potential UXO”, where appropriate. Worksheets 10 and 11 of the UFP SAP were submitted for Team review in March and regulatory agency comments were provided in April. Responses to the comments were submitted on May 3 and discussed during the conference call held that day. Most of the responses to the VDEQ comments were verbally accepted during the conference call. Updated response to comments and revised worksheets incorporating the response to comments and May 3 discussion were sent to the Team on May 12 for review. Karen indicated that she will review the revised worksheets. Bob indicated that he accepts the RTCs.

SAP Worksheet #9-5—Project Scoping Session Participants Sheet

Project Name: Area UXO 1 Anomaly Acquisition **Projected Date(s) of Investigation:** November 2011 **PM:** Tim Wenk – CH2M HILL	**Site Name:** Area UXO 1 **Site Location:** SJCA, Chesapeake, Virginia
Date of Session: February 3, 2011 **Scoping Session Purpose:** Update the Team on explosives safety planning and resolve outstanding work plan comments.	

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
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The discussion about Area UXO 1 is documented in the meeting minutes from the SJCA Tier 1 partnering meeting in February 2011. The summary of the discussion from the meeting minutes is provided below:

Objectives: Update the Team on explosives safety planning and resolve outstanding anomaly investigation work plan comments.

Overview of Discussion:

Copies of the presentation were distributed. Janna provided an update on the status of the explosives safety planning. A draft ESS was submitted in November 2010. Naval Ordnance Safety and Security Activity (NOSSA) provided preliminary comments which led to a conference call, during which NOSSA requested an ESS Determination instead of an ESS based on the low likelihood of encountering munitions. Therefore, an ESS Determination Request was submitted to NOSSA in January, to which NOSSA responded that an ESS needed to be submitted instead of an ESS Determination. NOSSA resumed review of the November 2010 draft ESS. Although NOSSA has not provided formal comments on the ESS, they have provided verbal feedback that there is a point of contention associated with the selection of the munition with the greatest fragmentation distance to protect against in the ESS. Janna explained that the ESS was drafted based on assumptions because no MEC has been encountered at the site. In order to determine what munition to use for the greatest fragmentation distance to protect against in the ESS, the depth of the sensors used during the digital geophysical mapping (DGM) survey (3 to 10 ft off the bottom of the river) and the detection distance for an item (11 times the diameter of the item) were used to determine the sizes of the potential munitions items that could have been detected (ranged from 3.3 to 10.9 inches in diameter). Then primary and contingency items were selected from the munitions that may have been historically loaded from St. Juliens Creek Annex (SJCA) that were within the size range; with a bias towards those items that could have manageable arcs and protection, allowing for the investigation to be conducted. However, NOSSA has indicated that they would prefer for the largest item ever loaded from SJCA to be used, which would result in unmanageable controls/distances (e.g., prohibiting navigation along the Southern Branch of the Elizabeth River, shutting down companies).

SAP Worksheet #9-5 Project Scoping Session Participants Sheet (continued)

Janna reviewed the status of the anomaly investigation work plan. NAVFAC comments have been resolved. Janna noted that two emails indicating no EPA comments on the anomaly investigation UFP-SAP have been received from Bob but none have been received to-date for the work plan, and asked if one of the UFP-SAP emails was intended to reference the work plan. Bob indicated that he believes one did and will look into it. Janna explained that VDEQ has submitted responses to the response-to-comments, but that responses to those outstanding comments have not yet been submitted and that she would like to discuss them. Concerning Comment 2, Janna asked Karen what was meant by testing the feasibility of deeper depths. Karen responded that attempts should be made to investigate deeper than five feet if no munitions are found in the first five feet during the investigation. Concerning Comment 1, Walt asked Karen if it would be acceptable if the sediment is loaded onto a barge and the water flows off the barge and back into the river. Karen responded that dewatering off the barge would be acceptable, but if the sediment and water are moved from the river to the land it would need to be managed as IDW. Karen noted if a more specific response is needed she can work with VDEQ legal.

Janna explained an alternative investigation approach being considered for the anomaly investigation: electromagnetic anomaly recovery. This approach uses a rake on a long reach excavator or crane to scrape the river bottom to loosen the sediment. A magnet attached to an excavator or crane is then lowered to the river bottom and activated in order to attract anomalies to the magnet. This approach results in a cleaner process because only the anomalies are brought to the river surface and the extraneous sediment remains on the river bottom. Janna expanded on the advantages and disadvantages of each approach being considered. One advantage of the clam shell approach is that it is a commonly accepted and used approach. Additionally, because the clam shell aims to pick up everything on the river bottom within its radius, the full contents of the sediment can be observed. However, the potential exists for bigger anomalies to slip out of the clam shell and the process is messy due to all of the sediment that is brought to the surface. As previously mentioned, because the electromagnetic anomaly recovery would not bring much sediment to the surface, it is a cleaner process and would not generate as much IDW. However, the approach is not commonly used and is therefore less certain. Additionally, the magnet will not recover nonferrous items. Janna noted that she is looking into the ratio of items shipped from the facility that would have been nonferrous. Walt noted that the electromagnetic anomaly recovery approach might have ESS issues because the spud on the barge would have to practice avoidance. Janna responded that she believes both approaches would use a spud

and need to practice avoidance. Janna noted that she is looking into safety concerns associated with the potential for munitions to be drawn quickly to magnet and slam into the magnet; and if that is a concern, if it is minimized by the presence of a column of water over top of the munition. Walt suggested modulating the frequency of the magnet, if possible, in order to avoid such a concern. Karen asked what the radius of influence is for the magnet and what the length of the rake is. Janna responded that she is unsure of the radius of influence and will look into it and that rakes are available in different sizes. Bob asked if two cranes would be needed, one for the rake and one for the magnet; Janna responded that she believes two would be needed. Walt suggested a modified approach using two rakes set up opposite of each other to scoop material into a cage. Walt indicated that he is interested in the electromagnetic anomaly recovery approach.

Path Forward: Responses to the outstanding VDEQ comments on the anomaly investigation work plan will be submitted. CH2M HILL and NAVFAC will work with NOSSA to resolve comments on the draft ESS following receipt of comments. CH2M HILL will continue to evaluate the alternative investigation approach to determine if it is worth consideration. If the alternative approach is deemed appropriate, the advantages and disadvantages will be provided to the Team for consideration. If the Team decides to change the investigation approach, the approach will be discussed with NOSSA and the UFP-SAP, work plan, and ESS will be revised.

SAP Worksheet #9-6—Project Scoping Session Participants Sheet

Project Name: Area UXO 1 Anomaly Acquisition **Projected Date(s) of Investigation:** November 2011 **PM:** Mike Skeean– CH2M HILL	**Site Name:** Area UXO 1 **Site Location:** SJCA, Chesapeake, Virginia
Date of Session: May 11, 2011 **Scoping Session Purpose:** Provide an update on the ESS, refine the anomaly investigation approach, and determine the path forward.	

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
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The discussion about Area UXO 1 is documented in the meeting minutes from the SJCA Tier 1 partnering meeting in May 2011. The summary of the discussion from the meeting minutes is provided below:

Objectives: Provide an update on the ESS, refine the anomaly investigation approach, and determine the path forward.

Overview of Discussion:

Copies of the presentation were distributed. Janna provided an update on the ESS. NOSSA has provided comments on the ESS and responses to those comments have been developed but not sent to NOSSA in part because the responses will depend on the investigation approach the Team decides on. However, there are some general underwater ESS approval challenges that are expected based on feedback DDESB provided on another underwater site that they will only permit non-intrusive underwater operations pending establishment of minimum separation distances from unintentional and intentional detonations underwater for non-essential personnel who may be in the water. Janna noted that NOSSA will provide service approval, so DDESB approval will not be necessary and that separation distances will be based on a Navy EODB paper (EODB 60A-1-1-37). A conference call will be scheduled with NOSSA to resolve outstanding concerns.

Janna reviewed the status of the anomaly investigation planning documents. The work plan is essentially final and the UFP-SAP is final. Both are currently written based on use of the clam shell anomaly source recovery approach. She explained that while scoping the investigation, challenges with the investigation approach were identified. The explosives safety challenges are being worked out with NOSSA. Management of IDW is more complex than originally anticipated; compounded by generation of greater quantities than anticipated, as the result of comments on the work plan. One of these comments requested additional “scoops” from the clam shell if the initial “scoop” does not recover any anomaly sources. The additional “scoops” would generate more sediment and water would be added to the sediment to help pump it to shore. Additionally, it was originally believed that the river water that is brought up with the sediment could be discharged back to the river but VDEQ requires containerization and testing of the water before discharging back to the river, and could result in the need for

SAP Worksheet #9-6—Project Scoping Session Participants Sheet (continued)

treatment of the IDW. The significant uncertainty in the chemical composition of the sediment and water, due to the fact that it comes from the Elizabeth River, has an impact on planning. Additionally, there are challenges with availability of funding as a result of increased subcontractor prices since the initial budget was developed.

Janna explained that due to the challenges with the clam shell approach, alternative approaches have been investigated and electromagnetic anomaly source recovery has been identified as a potential approach for the anomaly investigation. Janna explained how the approach works. An electromagnet is attached to long reach excavator or crane and lowered to the bottom of the river. The electromagnet is activated and attracts only metallic items. A rake can be attached to an excavator or crane to scour the river bottom and loosen and expose anomaly sources for recovery prior to lowering the electromagnet.

Janna compared the two alternatives. The clam shell dredge will recover all types of material but may be limited by the size of what can fit in the clam shell. The electromagnetic recovery will only recover ferrous items. Janna noted that selection of the locations to further investigate during the anomaly source investigation was based on the results of the geophysical survey performed during the SI using a magnetometer, which only detects ferrous items; therefore, the inability to recover nonferrous items should not prevent use of the alternative for this investigation. The clam shell dredge has no impacts to future investigations but the electromagnetic recovery may magnetize sediment which will make magnetometer surveys unusable in the future in the isolated locations investigated during the anomaly investigation. Janna noted that geophysicists believe that the magnetized sediment would not affect electromagnetic surveys, although there is some uncertainty about that since this is a new application of the electromagnetic technology. The clam shell dredge is a proven technology while the electromagnetic recovery is an emerging technology. It is anticipated the clam shell dredge would generate significant quantities of sediment and aqueous IDW while minimal quantities of IDW are anticipated with the electromagnetic recovery since only sediment trapped by the anomaly sources is recovered; it is possible that the sediment can be returned back to the river if small enough quantities are collected that would allow discharge requirements to be met. The clam shell dredge would have a greater impact on the environment because it is more intrusive than the electromagnetic recovery and would suspend more sediment in the water column. The cost of the electromagnetic recovery is anticipated to be 70% or less of the cost of the clam shell dredge.

Comparison of the two alternatives has resulted in a recommendation to use the electromagnetic recovery approach for the anomaly source investigation. This recommendation is based on the technology's ability to focus on acquisition of ferrous anomalies, generate less IDW, reduce intrusiveness, shorten the investigation duration, and reduce the investigation cost. The Team discussed the recommendation. Karen asked if the rake would be large enough to reach 5 ft below the sediment surface. Janna responded that the rakes come in different sizes and if the rake was unable to reach 5 ft initially, attempts could possibly be made to scrape the sediment multiple times to reach 5 ft. Karen asked if the magnet would be able to pick up DMM located at a depth near 5 ft if there are other DMM above it at. Janna responded that the magnet will only be able to pick up items as long as there is room on the surface area of magnet, and that it might be possible to attach a plate to the magnet that is larger than the magnet to diffuse the electromagnetism to have a larger radius of influence. In reference to the issue that the magnet will magnetize the sediment, Janna explained that it would only occur in the 15 small areas being targeted during the investigation and that those areas have already been surveyed using a magnetometer where possible. Kyle asked if NOSSA has approved the electromagnetic recovery approach; Janna responded NOSSA approved an ESS for electromagnetic recovery of munitions at another site, so their acceptance is anticipated but has not specifically been requested yet. Kyle indicated that he will need to look into the electromagnetic recovery approach and would like the name of the site where the technology has been used.

SAP Worksheet #9-6—Project Scoping Session Participants Sheet (continued)

Path Forward: Additional information regarding the electromagnetic investigation approach will be submitted to the Team and the Team will schedule a conference call to discuss the approach. If the clam shell approach is selected, the work plan and health and safety plan will be finalized. If the electromagnetic investigation approach is selected, the ESS, final SAP and work plan will be revised, NOSSA consensus will have to be obtained, and the health and safety plan will be finalized.

SAP Worksheet #9-7—Project Scoping Session Participants Sheet

Project Name: Area UXO 1 Anomaly Acquisition **Projected Date(s) of Investigation:** November 2011 **PM:** Mike Skeean – CH2M HILL	**Site Name:** Area UXO 1 **Site Location:** SJCA, Chesapeake, Virginia

Date of Session: July 6, 2011

Scoping Session Purpose: Resolve outstanding technical approach questions, discuss changes to existing deliverables, and present the schedule.

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Kyle Newman	Technical Resource	VDEQ	804-698-4452	Kyle.newman@deq.virginia.gov	Regulator
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Adrienne Jones	Deputy AM	CH2M HILL	757-671-6236	adrienne.jones@ch2m.com	Consultant

The discussion about Area UXO 1 is documented in the meeting minutes from the SJCA Tier 1 partnering meeting in July 2011. The summary of the discussion from the meeting minutes is provided below:

Objectives: Resolve outstanding technical approach questions, discuss changes to existing deliverables (UFP-SAP and work plan), and present the schedule.

Overview of Discussion:

Copies of the presentation were distributed. Janna reviewed the questions EPA emailed concerning the proposed electromagnetic recovery path forward, and the responses that were provided. Bob indicated that he reviewed the responses, that they are adequate, and that he does not have any further questions concerning the approach at this time.

Janna discussed the existing work plan associated with the anomaly source investigation and the changes that will be made to the document to reflect the revised investigation approach. The draft work plan was submitted in October 2010 and all of the comments except for the issue associated with IDW management were resolved. Minor changes to the scope of the investigation will be made in Section 1.1. These changes consist of stating that the sediment collected for analysis will be collected from sediment recovered with the anomaly sources instead of from dredged material and adding a contingency sampling method (e.g., vibracore or ponar dredge) if adequate sediment is not recovered to sample. The majority of the changes will be made in Section 2.3. These changes consist of revising the anomaly source acquisition approach from the clam shell to the electromagnet, replacing the vibratory screen with a stationary screen, and revising the IDW management to reflect the reduced quantity of IDW that will be generated. Two options will be provided for managing the IDW: on the barge with turbidity controls or transfer to the shore in roll-off containers. The sediment sampling approach will be changed in Section 2.4 to reflect the revised primary and contingency methods. Janna asked the Team if submittal of a redlined revised draft or a clean version of the revised draft is preferred for review. The Team indicated that a clean version is preferred.

SAP Worksheet #9-7—Project Scoping Session Participants Sheet (continued)

Janna discussed the final SAP associated with the anomaly source investigation, which was submitted in December 2010, and the changes that will be made to the document to reflect the revised investigation approach. Worksheets 2 and 9 will be updated to include the scoping sessions that have occurred since the SAP was finalized. Worksheet 11 will be updated to ensure the PALs reflect the most recent RSLs, replace “dredged” with “acquired” and “clam shell” with “electromagnet”, add the contingency for use of an alternative sediment sampling method, and change third-party data validation to validation by CH2M HILL. Janna asked the Team what depth of sediment will be targeted for sample collection since the contingency methods being considered have different capabilities. The Team decided that a ponar dredge could be used to target the surficial sediment. Worksheet 14 will be updated to reflect the revised sediment sampling method and change third-party validation to validation by CH2M HILL. Worksheet 16 will be updated to reflect the revised schedule for the project. Worksheet 21 will be updated to add the SOP for the contingency sampling methods. Worksheet 22 will be updated to incorporate the functional test of the electromagnet. Janna explained that Revision 1 of the existing SAP will be developed to incorporate the changes discussed. The SAP will have to be submitted for NAVFAC chemist and MR review prior to submittal to the Team for review. Janna noted that the chemistry and MR components were combined in the final SAP but NAVFAC is now requiring those components to be submitted in separate SAPs. However, since this will be an update to a final SAP, the components can remain together. Janna asked the Team if they have any concerns that would warrant previewing worksheets prior to submittal to NAVFAC. The Team agreed that they do not need to preview the worksheets.

SAP Worksheet #10—Problem Definition

Site History and Description

SJCA is approximately 490 acres and is situated at the confluence of St. Juliens Creek and the Southern Branch of the Elizabeth River in the City of Chesapeake, southeastern Virginia. The location of SJCA is shown on **Figure 1**. SJCA was once one of the largest ammunition depots in the United States involving wartime transfer of ammunitions to other naval facilities. Specific ordnance operations and processes conducted at SJCA included stockpiling Explosive D (ammonium picrate, or picrate acid) for use in projectiles, manufacturing Mark VI mines, assembling small-caliber guns and ammunition, storing torpedoes, filling shells, testing ordnance, and distributing and receiving ammunition. By 1975, all ordnance operations had been transferred to Naval Weapons Station Yorktown. As a result, decontamination was performed in, around, and under ordnance-handling facilities at SJCA in 1977.

Area UXO 1 includes the current and former wharf areas along the shoreline of the Southern Branch of the Elizabeth River (**Figure 2**). It comprises approximately 2,230 linear feet of current and former wharf (Wharf 1, Wharf 2, and Wharf 3). The southern wharf, consisting of Wharf 1 and Wharf 2 located in the southeast portion of SJCA, was initially constructed in 1903. During World War II, the two wharfs were joined together and an extension, referred to as the dolphin pier/lighter storage area, was added in order to support the increased production of munitions for the war. Ordnance loading activities continued until the early 1970s, when production declined commensurate with the disengagement policy and the reduced operations in Southeast Asia. Wharf 1 was damaged when two ships struck it in 1975; however, portions of it are still functional. The northern wharf, consisting of Wharf 3, was constructed in 1917 in the east-central portion of SJCA adjacent to Buildings M-5 and 190. The wharf was historically used for loading Mark VI mines, and was partially demolished in 1933 for fire prevention reasons. Presently, only the pilings from Wharf 3 remain.

Investigation History

Investigations within Area UXO 1 began with the northern wharf area, which was identified as IR Site 20 in 1981. The following bullets describe the investigations performed under the IR program:

- **Initial Assessment Study (IAS).** The IAS report (NEESA, 1981) indicated that explosive ordnance disposal (EOD) team divers visually searched IR Site 20 (northern wharf) area and identified metal and thick silt deposits near the former wharf. The IAS report indicated that it was a reasonable assumption that munitions had likely been dropped into the sediment adjacent to the former wharf area during loading and unloading operations. The assumed munitions presence was not considered a hazard as long as the sediment was not disturbed. The IAS recommended that real estate records be annotated to indicate that munitions may be present.
- **Relative Risk Ranking.** During the Relative Risk Ranking (RRR) (CH2M HILL, 1996), a site reconnaissance, a magnetometer survey, and sediment sampling were conducted in the vicinity of IR Site 20. Approximately 68 contacts were identified in three concentration areas around the former wharf pilings; however, contacts indicate all types of buried metallic objects and do not necessarily indicate the presence of MEC. No visual confirmation of the contacts was made. One volatile organic compound (VOC), multiple semivolatile organic compounds (SVOCs), one pesticide, one explosive, and multiple inorganics were detected in the sediment.

SAP Worksheet #10—Problem Definition (continued)

- **Site Screening Assessment.** As part of the site screening assessment (SSA), the analytical results from the IR Site 20 sediment samples collected during the RRR (CH2M HILL, 1996) were used to conduct human health and ecological risk screenings. No risk was identified to human receptors. Potential ecological risk was identified for benthic organisms in the sediment. The risk was considered minimal and no further evaluation of ecological risk was recommended. During the July 2001 partnering team site visit, consensus was reached for no further action (NFA) for IR Site 20 under CERCLA based on the findings of the human health and ecological risk screenings and the fact that potential risk from MEC would be addressed under the Navy's Range Program. The NFA decision was documented in the SSA. Based on recommendations made in the SSA, signs were posted in the area to prohibit intrusive activities, and USACE was notified of the potential presence of MEC. A note was added to internet Navy Facility Assets Data Store (iNFDAS) under the St. Juliens Creek Annex Wharf Property Record Cards stating: "Unexploded ordnance may exist along all of the St. Juliens Creek Annex Wharfs." Additionally, the area is identified in the Environmental Restoration Plan Geographic Information System (GIS), which identifies areas of concern, is used during operational planning and decision-making at the facility, and is updated annually or when conditions change.

The Navy's Range Program to address MEC was never fully implemented. In 2008, because site histories indicated a potential for presence of DMM and/or MC in both wharf areas (northern and southern) and due to the proximity of the two areas of study, both wharf areas were combined and identified as Area UXO 1 under the MRP. The following bullets describe the investigations performed under the MRP, as well as additional investigations conducted by the Navy for demolition planning. The following investigations/studies have been conducted at the northern and southern wharfs:

- **Sonar Imagery.** In 2008, following the transfer of the wharf areas to the MRP, the Navy performed a sonar imagery survey of portions of the northern and southern wharf areas. The investigation performed side scans using sonar technology to identify features on the sediment surface. The southern wharf area of interest, Wharfs 1 and 2, was oriented in a large rectangle from beneath the wharf and extending into the channel. The northern wharf area, Wharf 3, (previously IR Site 20) was oriented in a circle in the vicinity of the pilings still present. The investigation detected ten anomalies that were on the sediment surface; nine anomalies were identified in the southern wharf area and one anomaly was identified in the northern wharf area.
- **Preliminary Assessment.** The Preliminary Assessment (PA) reviewed the history of munitions use at the wharf areas that make up Area UXO 1 (CH2M HILL, 2009). Onsite and offsite sources were researched to determine the potential for munitions to have been dropped into the water during ordnance loading operations at the wharfs, which occurred from 1903 until the late 1970s. Although no documentation was found to confirm the presence of munitions in the vicinity of the wharf areas, anecdotal evidence obtained through individual interviews indicated there was a potential for munitions to have been dropped during loading operations, which may have resulted in DMM being present in the sediment beneath the wharf areas. No site visits or sampling was performed as part of the PA because Area UXO 1 is underwater. Based upon information obtained during the PA and the hazards associated with potential munitions that may be present, the PA report recommended further investigation (Site Inspection) in both the northern and southern wharf areas; additionally, it recommended no further investigation in the dolphin pier area because historical records indicated that it was a light storage area and no known ordnance loading occurred from it.

SAP Worksheet #10—Problem Definition (continued)

- **Site Inspection.** An underwater side-scan sonar and geophysical survey was conducted in February 2010 within the northern and southern wharf areas to determine whether or not there is evidence that the ordnance loading activities at the wharfs at Area UXO 1 resulted in munitions being dropped into the Southern Branch of the Elizabeth River. The investigation identified 1,651anomalies within the sediment at the site; 265 within the northern area (Wharf 3), 1,386 within the southern area (Wharfs 1 and 2). Fifteen locations, shown on **Figures 3 and 4**, show locations selected by the SJCA partnering team that have been targeted for additional investigation, based on the results of the DGM survey.

General Problems to Address

The PA for Area UXO 1 evaluated the potential for munitions to have been dropped into the Southern Branch of the Elizabeth River during ordnance loading operations. Although there is no known official documentation of munitions dropped in the water, anecdotal evidence suggests that munitions may have been dropped in the water and covered by the river sediment. The underwater DGM survey identified 1,651 anomalies within the river sediment that may represent DMM or metallic debris. Therefore, further investigation is necessary to determine if the metallic anomalies detected during the underwater DGM survey are MEC items and whether there have been releases of environmental contaminants associated with the anomalies. Current potential risks associated with the site are related to the potential explosive hazard from DMM that may be present at the site and from exposure to munitions constituents (MC) leaching from the DMM.

Project Description

The purpose of the investigation discussed in this UFP-SAP is to investigate metallic anomalies identified in the Phase 1 Site Inspection through the use of an electromagnet. The electromagnet will be used to recover metallic debris from the riverbed at select anomaly locations. Sediment samples collected from the extracted metallic debris will be analyzed to determine if explosives are present in sediment from the potential presence of DMM. If sediment samples cannot be recovered from the metallic debris, then a Ponar dredge or similar equipment will be used to obtain sediment samples from the riverbed.

Conceptual Site Model

Figure 5 presents the CSM for Area UXO 1. This figure and the following text outline the most likely sources of contaminants, transport pathways, exposure media, potential exposure routes, and receptor groups.

Potential Sources of Release

The potential source of DMM within Area UXO 1 is the potential historical release of munitions to the Southern Branch of the Elizabeth River during loading operations at the wharfs. There is no definitive information about the site that can be used to determine whether or not munitions were actually dropped into the river, the amount and exact location of the dropped munitions, or the total footprint of the area where munitions may have been dropped.

If DMM are present at Area UXO 1, they may serve as the potential source of contaminants to site sediment from leaching of MC.

SAP Worksheet #10—Problem Definition (continued)

Contaminant Transport Pathways

Potentially complete contaminant transport pathways from source areas to downgradient media include transport of DMM and/or contaminants downstream by sediment transport and infiltration of contaminants into surface and subsurface sediment by leaching from DMM. The purpose of this investigation is to collect data to determine whether these potential transport pathways exist and are significant.

Receptor Exposure Routes

Potential exposure routes at Area UXO 1 include direct contact with DMM and contaminated sediment, as well as ingestion of sediment and river-dwelling organisms. Potential human receptors include current/future recreational users, current/future commercial workers, and future construction workers. Potential ecological exposure routes include ingestion of contaminated sediment or plant and animal tissue. Potential ecological receptors include aquatic and marsh flora and fauna.

Environmental Questions answered by this Project

The environmental questions to be answered during the investigation include:

- Are DMM present in the sediment within the selected underwater areas of DGM anomalies at Area UXO 1?
- Has the presence of DMM in site sediment resulted in the release of contaminants to the surrounding environment?
- What is the overall explosive risk associated with DMM in sediment?

SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements

Who will use the data?

The data will be used by the Navy (and its contractors) and the other stakeholder agencies to determine if DMM are present in the sediment or on the sediment surface. If DMM are present, the data will also be used to determine if contamination resulting from the DMM in the sediment is present. In addition, personnel from NOSSA will use the data to determine the overall explosive risk associated with MEC in the sediment. Engineers, scientists, geophysicists, and UXO-qualified technicians will evaluate the data for decision making.

What are the Project Action Limits (PALs)?

The discovery of any DMM item through visual confirmation and classification will be considered as evidence of a potential explosive safety hazard at Area UXO 1. If no DMM are discovered during the anomaly source recovery activities, then evidence will suggest that DMM contamination at Area UXO 1 may not exist.

Sediment PALs have been established to be protective of human and ecological receptors:

- PALs protective of human health have been established as adjusted residential soil RSLs, updated in June 2011. The residential soil RSLs for all constituents have been multiplied by 10 in order to account for sediment exposure. Additionally, the residential soil RSLs for the non-carcinogenic constituents have been divided by 10 to account for cumulative exposure to multiple constituents that may affect the same target organ.
- PALs protective of ecological receptors have been established based on Revised Region III Biological Technical Assistance Group (BTAG) Screening Levels (USEPA, 1995). Where BTAG screening values are unavailable, PALs were established from relevant, peer-reviewed literature and in instances where a PAL could not be established based on either BTAG or literature sources, any detection of the associated chemical will be considered significant. Initial comparisons will be made on a chemical-by-chemical, point-by-point basis. More realistic evaluations of the data (e.g., spatial analysis, evaluation of central tendency estimates, use of alternative screening values and more realistic exposure scenarios) will be examined during the assessment, if warranted. Further discussion of PALs can be found in **Worksheet #15**.

What will the data be used for?

The inspection of the material recovered with the electromagnet will be used to support the determination of whether or not DMM are present at Area UXO 1.

Sediment sample results will be used to determine whether or not a release has occurred from DMM to the environment and if DMM continue to be a source of contaminants to the environment. The data will be used as outlined above to answer the primary and secondary questions associated with the Problem Definition statement (see **Worksheet #10**).

Additionally, this data may be used as a basis for determining the need for and scope of subsequent investigations or actions at the site.

What types of data are needed (matrix, target analytes, analytical groups, field screening, onsite analytical or offsite laboratory techniques, sampling techniques)?

River-bottom sediment and detected anomalies will be recovered from the river bottom and brought to the surface through the use of an electromagnet, and a UXO-qualified technician will perform a visual inspection to determine if the anomalies are DMM. If significant sediment is recovered, the UXO-qualified technician will support the visual inspection with a metal detector to ensure no small debris are missed.

SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements (continued)

Analytical sediment data will be collected. One sediment sample will be collected for analysis from each location/anomaly investigated. All analytical samples will be submitted to an offsite subcontract laboratory, Empirical Laboratories, for analysis. See **Worksheets #17** and **#18** for sample locations, numbers, and rationale. Samples will be collected using the methodology outlined in the CH2M HILL SOPs (**Worksheet #21**) and analyzed for explosives, nitrocellulose, nitroglycerin, nitroguanidine, and perchlorate as indicated on **Worksheets #17** and **#18** using the analytical methods described on **Worksheet #19.**

How "good" do the data need to be in order to support the environmental decision?

The data will be of the quantity and quality necessary to provide technically sound and defensible assessments of potential risks to human and ecological receptors posed by the contaminants identified. Visual observations and metal detector readings must be conducted by a qualified UXO technician and need to be of sufficient quality to properly identify DMM excavated from river sediment.

For risk assessment and high-level decisions based on analytical data, laboratory methods will meet CERCLA, EPA Region 3, and Navy guidance. The laboratory will follow the MPC in **Worksheet #12** for field QC samples and **Worksheet #28** for laboratory QC samples**.** These MPC are consistent with the DoD QSM version 4.1 as applicable and laboratory in-house limits where the QSM does not apply.

Data will be validated by a CH2M HILL validator using the procedure described in **Worksheet #36**. A data usability study will be conducted by the project team following data validation. This process is outlined in **Worksheet # 37**.

How much data should be collected (number of samples for each analytical group, matrix, and concentration)?

All metallic anomalies and debris discovered in the extracted material will be inspected and logged during the investigation. If any of the items are determined to be DMM, the description will include the classification and condition of the item as well as how the item was handled (destroyed or determined to be safe).

Since the anomaly acquisition and inspection process potentially involves handling items that present an explosive hazard, the ESS details all proper handling techniques for items identified as DMM. This will include all pertinent methods for handling, storing (if necessary), and disposal.

A maximum of 15 locations will be selected for the collection of sediment and detected anomalies. Sediment samples will consist of a composite sediment sample collected from the incidental sediment recovered along with the anomalies at each location, resulting in a maximum of 15 sediment samples (one sediment sample per location per anomaly investigated). If insufficient sediment is recovered with the anomalies, use of a Ponar dredge or similar equipment will be used to obtain sediment samples from the riverbed. This data to be collected is outlined in **Worksheets #17** and **#18**. If no metallic debris is recovered, the location of the magnet will be adjusted in the field to a nearby area that is consistent with the selection logic of the preliminary location (e.g., cluster of anomaly sources or gap in DGM data), until a minimum of one piece of metallic debris will be recovered from each location.

Where, when, and how should the data be collected/generated?

- Locations were selected for investigation following the completion of the evaluation of the DGM. Areas of detected anomalies deemed most likely to represent DMM by a qualified geophysicist were recommended for investigation and approved by the SJCA Partnering Team (**Figure 3** and **4**). An estimate of metallic debris recovered from the river bottom will be recorded at each investigation location.
- 15 locations in the vicinity of the northern and southern wharfs will be investigated using an electromagnet for visual inspection to support the determination of whether or not DMM are present. To help maximize the

potential for identifying items in the extracted material, a metal detector may be used when performing the visual inspection if the quantity of sediment recovered inhibits the ability to identify all potential DMM. A minimum of one piece of metallic debris will be recovered from each location. If no metallic debris is recovered from a particular location, a nearby location will be investigated.

- Composite sediment samples will be collected from the incidental sediment recovered along with the anomalies and analyzed at an offsite laboratory for explosives. If insufficient sediment is recovered with the anomalies, use of a Ponar dredge or similar equipment will be used to obtain sediment samples from the riverbed.
- Sediment samples will be collected and composited into a single sample per location following the Homogenization of Soil and Sediment Samples SOP presented herein (See **Worksheet #21**).

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

- River-bottom sediment and anomalies will be collected by a CH2M HILL subcontractor using an electromagnet. Any DMM identified during recovery activities will be disposed of by CH2M HILL personnel. CH2M HILL field staff will record the contents and soil classification for the sediment recovered with the extracted metallic debris, as well as any co-mingled debris, in the field notebook and collect sediment samples for analysis.
- UXO-qualified technicians, a minimum of a UXO Technician 3 and UXO Technician 2, will inspect the recovered material for potential DMM.
- CH2M HILL staff will collect the sediment samples and submit them to a DoD Environmental Laboratory Accreditation Program (ELAP) accredited analytical laboratory, Empirical Laboratories.
- Hand-recorded notes will be generated by the CH2M HILL FTL during the investigation to document work accomplished, variations from the work plan, field conditions, and other pertinent data/information that can be used to help identify gaps, discrepancies, and oddities in the recorded data. The notes collected during the anomaly source recovery activities and sediment sampling will be scanned and included in the Area UXO 1investigation report as an appendix. Information contained in the notes will be reviewed by the PM following the investigation prior to submission.

How will the data be archived?

- All files will be made available for QC verification during the project to verify that the field and data processing procedures are properly implemented. All raw data files, final processed data files, hard copies, and field notes will be maintained for the duration of the project. Electronic data will be stored on the local CH2M HILL server and will be posted to the Navy's file transfer protocol (FTP) site.
- Data will be archived according to procedures dictated via the Navy CLEAN program/contract; all data will be uploaded into a centralized database used for Navy projects (NIRIS). At the end of the project, archived data will be returned to the Navy.

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

Is further characterization of Area UXO 1 or a removal action necessary?

- If DMM are identified at one or more of the investigation locations, then a removal action or Remedial Investigation (RI)/Feasibility Study (FS) should be scoped.
- If no DMM are identified at any of the investigation locations, then no further investigation of anomaly sources is necessary.

SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements (continued)

- If chemical concentrations in sediment are detected at concentrations that indicate the site does not pose a potential risk to human or ecological receptors, then analytical sampling can be discontinued.
- If analysis of sediment samples reveals the presence of contaminants above applicable screening criteria, then additional sampling and anomaly investigation may be necessary to characterize the nature and extent of contamination and to further evaluate if DMM are present in the sediment as part of the RI/FS.

SAP Worksheet #12-1—Measurement Performance Criteria Table – Field QC Samples

Matrix: Sediment

Analytical Group: Explosives plus PETN and Nitroglycerin

Concentration Level: Medium

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicates	Explosives	One per 10 field samples	Precision	RPD < 35%	S&A
Equipment Rinseate blank		One per day of sampling	Contamination/bias	All target compounds < ½ LOQ	S&A
Cooler Temperature Indicator		One per cooler	Accuracy / Representativeness	≤ 6° C	S

SAP Worksheet #12-2—Measurement Performance Criteria Table – Field QC Samples

Matrix: Sediment

Analytical Group: Nitrocellulose

Concentration Level: Medium

QC Sample	Analytical Group	Frequency	DQIs	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicates	Nitrocellulose	One per 10 field samples	Precision	RPD < 35%	S&A
Equipment Rinseate blank		One per day of sampling	Contamination/bias	All target compounds < ½ LOQ	S&A
Cooler Temperature Indicator		One per cooler	Accuracy / Representativeness	≤ 6° C	S

SAP Worksheet #12-3—Measurement Performance Criteria Table – Field QC Samples

Matrix: Sediment

Analytical Group: Nitroguanidine

Concentration Level: Medium

QC Sample	Analytical Group	Frequency	DQIs	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicates	Nitroguanidine	One per 10 field samples	Precision	RPD < 35%	S&A
Equipment Rinseate blank		One per day of sampling	Contamination/bias	All target compounds < ½ LOQ	S&A
Cooler Temperature Indicator		One per cooler	Accuracy / Representativeness	≤ 6° C	S

SAP Worksheet #12-4—Measurement Performance Criteria Table – Field QC Samples

Matrix: Sediment

Analytical Group: Perchlorate

Concentration Level: Medium

QC Sample	Analytical Group	Frequency	DQIs	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicates	Perchlorate	One per 10 field samples	Precision	RPD < 35%	S&A
Equipment Rinseate blank		One per day of sampling	Contamination/bias	All target compounds < ½ LOQ	S&A
Cooler Temperature Indicator		One per cooler	Accuracy / Representativeness	≤ 6° C	S

SAP Worksheet #13—Secondary Data Criteria and Limitations Table

Secondary Data	Data Source	Data Generator(s)	How Data Will Be Used	Limitations on Data Use
2008 side-scan sonar data	Data collected in 2008 by NAVFAC in an independent side-scan sonar survey of the northern and southern wharf areas.	NAVFAC	Data will be compared to data collected during this investigation and used to identify potential underwater obstacles and hazards.	Items on the river bottom that are capable of moving may not be in the same location as previously observed.
Final Preliminary Assessment Report	Final Preliminary St. Juliens Creek Annex, Chesapeake, Virginia, June 2009	CH2M HILL, June 2009	Information from this report will be used to define the footprint of Area UXO 1 and establish the investigation area.	Limited historical records were available/ identified during the PA.
2010 side-scan sonar data	Side-scan sonar used simultaneously to DGM array.	CH2M HILL	Data has been used to help determine the sample locations for this investigation.	Items on the river bottom that are capable of moving may provide inaccurate data and may not be present during subsequent investigations.

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SAP Worksheet #14—Summary of Project Tasks

Field Investigation Activities

The technical approach for the proposed field activities at Area UXO 1 is detailed below and will also be detailed in a separate work plan. A site-specific HASP will be completed prior to commencement of the field event. Applicable SOPs for project tasks outlined in this section are listed on **Worksheet #21**. DoD ELAP Letter is provided in **Appendix B**.

- **Mobilization**
  - Following approval of the UFP-SAP and associated work plan, CH2M HILL will begin mobilization activities. Prior to mobilization, all field team members will review this UFP-SAP, the work plan, and the project-specific HASP. A field team kickoff meeting will be held prior to mobilization to ensure that personnel are familiar with the scope of field activities and safety issues. Mobilization activities include coordination with base personnel, building operators, and subcontractors, and preparation of field equipment.
  - Mobilization for the field effort includes procurement of necessary field equipment and subcontractors and initial transport to the site. This will also include coordination with the U.S. Coast Guard, U.S. Army Corps of Engineers, VDEQ, and EPA. Work areas (including staging areas, sediment holding areas, etc) will be established at the facility. Equipment and supplies will be brought to the site when the CH2M HILL field team mobilizes for field activities.
  - Prior to beginning any phase of work, CH2M HILL and its subcontractors will have field meetings to discuss the work items, worker responsibilities, and familiarize workers with the HASP.
  - Based on the site history and nature of the investigation, there will be intrusive activities into the sediment and potentially intentional contact with DMM/MEC. Therefore, an ESS will be submitted to Naval Ordnance Safety and Security Activity for implementation of this work that will include all work approaches and safety measures, MEC awareness training prior to the field activities, and on-site UXO qualified technicians for the duration of the project. The MEC awareness training will be incorporated into the initial meetings and will involve participation by all field staff and subcontractors on-site during the investigation.
  - The procedures for communicating potential DMM to the Navy if any and the proper means for handling the item(s) is discussed in the ESS for this investigation.
- **Anomaly Investigation and Sediment Sampling**
  - Recovery of metallic debris with an electromagnet will be conducted to investigate anomalies identified by the DGM survey. The recovered material will be visually inspected for metallic anomalies, with the assistance of a metal detector if necessary due to the presence of sediment or co-mingled debris. The metallic anomalies will be inspected by the on-site UXO qualified technicians to determine if the recovered items are DMM.
  - Site sediment samples will be collected from sediment that is recovered along with the metallic debris recovered with the electromagnet. If sufficient sediment cannot be recovered from the extracted metallic debris, a ponar dredge or similar equipment will be used to obtain sediment samples from the riverbed. Samples will be collected and shipped on ice in accordance with applicable SOPs to the off-site analytical laboratory the same day that they are collected.

SAP Worksheet #14—Summary of Project Tasks (continued)

- **Investigation-Derived Waste (IDW) Management**
  - Sediment recovered from the river bottom that is not used for analytical samples will be stored in roll-off containers or drums, and will be sampled for waste characterization purposes to ensure that material is properly disposed of at an approved off-site facility. Any liquid waste generated from dewatering of the sediment material will also be sampled for waste characterization and disposed of at an approved off-site facility.
- **Analytical Data Interpretation**
  - Samples will be analyzed for explosives, nitroguanidine, nitrocellulose, nitroglycerin, and perchlorate on a 28-day turnaround time. The data will then be sent to a CH2M HILL data validator to confirm the integrity of the analytical data. The data will be examined using the procedures in **Worksheet #36.** CH2M HILL will process, review, and interpret data obtained from the sampling.
- **Demobilization**
  - All project-related equipment will be removed from the site. Rental equipment will be packaged and shipped for return to the appropriate vendors. Subcontractor equipment will be removed from the site by the subcontractor.

Data Management Activities

- **QA/QC**
  - See **Worksheet #20** for details on QA/QC techniques.
  - Implement SOPs for field activities being performed.

SAP Worksheet #15—Reference Limits and Evaluation Table

Matrix: Sediment

Analytical Group: Explosives

Analyte	CAS Number	Human Health PALs (Residential RSLs x 10 for SD adjusted[1)] (mg/kg)	Eco PALs[1] (mg/kg)	Project Quantitation Limit (PQL) Goal[2] (mg/kg)	Laboratory-specific			LCS and MS/ MSD Recoveries (%)		
					LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)	LCL	UCL	RPD
HMX	2691-41-0	3,800	0.47	0.235	0.400	0.200	0.100	75	125	30
RDX	121-82-4	56	1	0.5	0.400	0.200	0.100	70	135	30
1,3,5-Trinitrobenzene	99-35-4	2,200	0.3	0.15	0.400	0.200	0.100	75	125	30
1,3-Dinitrobenzene	99-65-0	6.1	1.2	0.6	0.400	0.200	0.100	80	125	30
Tetryl	479-45-8	240	0.072	0.036	0.400	0.200	0.100	10	150	30
Nitrobenzene	98-95-3	48	27	13.5	0.400	0.200	0.100	75	125	30
2,4,6-Trinitrotoluene	118-96-7	36	0.13	0.065	0.400	0.200	0.100	55	140	30
4-Amino-2,6-dinitrotoluene[3]	1946-51-0	150	0.042	0.021	0.400	0.200	0.100	80	125	30
2-Amino-4,6-dinitrotoluene[3]	35572-78-2	150	0.042	0.021	0.400	0.200	0.100	80	125	30
2,4-Dinitrotoluene	121-14-2	16	0.042	0.021	0.400	0.200	0.100	80	125	30
2,6-Dinitrotoluene	606-20-2	61	0.042	0.021	0.400	0.200	0.100	80	120	30
2-Nitrotoluene	88-72-2	29	4	2	0.400	0.200	0.100	80	125	30
3-Nitrotoluene	99-08-1	6.1	4	2	0.400	0.200	0.100	75	120	30
4-Nitrotoluene[4]	99-99-0	240	4	2	0.400	0.200	0.100	75	125	30
PETN	78-11-5	120	NC	60	1.00	0.500	0.250	60	120	30
Nitroglycerin	55-63-0	6.1	NC	3.05	1.00	0.500	0.250	60	120	30

SAP Worksheet #15—Reference Limits and Evaluation Table (continued)

Matrix: Sediment

Analytical Group: Explosives

Analyte	CAS Number	Human Health PALs (Residential RSLs x 10 for SD adjusted[1)] (mg/kg)	Eco PALs[1] (mg/kg)	Project Quantitation Limit (PQL) Goal[2] (mg/kg)	Laboratory-specific			LCS and MS/ MSD Recoveries (%)		
					LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)	LCL	UCL	RPD
Nitrocellulose	9004-70-0	100,000	NC	50000	10	5.0	1.0	50	120	25
Nitroguanidine	556-88-7	6,100	NC	3050	1	0.5	0.25	70	130	30
Perchlorate	14797-73-0	55	NC	27.5	2	1	0.6	80	120	15

[1] PALs were developed to be protective of human health and the environment. Refer to **Worksheets #10** and **#11** for a detailed discussion on development of PALs.

[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.

[3] Eco PAL the same as used for 2,6-dinitrotoluene.

[4] Eco PAL the same as used for 2- and 3-nitrotoluene.

In cases where the PAL is less than the laboratory's corresponding LOD and DL, if that specific constituent is nondetect, the analyte will be considered not present. However, if it is detected, it will be considered to be an exceedance of the PAL.

NC = No Criteria

Residential RSLs are from the EPA Regional Screening Levels for Soil, June 2011, adjusted for cancerous/noncancerous effects by dividing RSLs for noncancerous constituents by 10 to account for exposure to multiple constituents that effect the same target organ (i.e., liver). All values were values were multiplied by 10 to account for the sediment exposure scenario. Analytical data will be compared to the most recent version of the RSLs at the time that analytical data is available for use.

Eco PALs are literature-based ecological screening values.

Shading represents PALs that are less than the corresponding laboratory LOD.

SAP Worksheet #16—Project Schedule / Timeline Table

Task	Start Date	Duration
Phase 2 SI UFP-SAP		
Pre-Draft UFP-SAP Submission	1-Sep-11	
Navy Comment Period	2-Sep-11	33 days
Draft UFP-SAP Submission	29-Nov-11	
Regulatory Comment Period	30-Nov-11	65 days
Final UFP-SAP Submission	15-Jun-12	
Phase 2 SI Work Plan		
Draft Work Plan Submission	31-Oct-11	
Team Comment Period	1-Nov-11	59 days
Draft Work Plan Comment Resolution	31-Dec-11	89 days
Final Work Plan Submission	15-Jun-12	
ESS		
Draft ESS (Version 2) submittal to NAVFAC	27-Oct-11	
NOSSA submittal	1-Nov-11	
NOSSA review of ESS (Version 2)	2-Nov-11	26 days
Comment resolution and NOSSA submittal (Version 3)	6-Jan-12	
NOSSA review of ESS (Version 3)	7-Jan-12	1 day
Comment resolution and NOSSA submittal (Version 4)	8-Feb-12	
NOSSA review of ESS (Version 4)	9-Feb-12	1 day
Final ESS submittal	14-Feb-12	
Revised Final ESS submittal	7-Mar-12	
DDESB review of ESS	8-Mar-12	17 days
DDESB approval of ESS	26-Mar-12	
Investigation – Metallic Debris Recovery and Sediment Sampling		
Preparation	9-Jul-12	14 days
Anomaly Acquisition Investigation	23-Jul-12	21 days
Data Analysis and Evaluation	14-Aug-12	60 days
Investigation Report		
Draft Report Submittal	11-Dec-12	
Team Comment Period	12-Dec-12	61 days
Draft Report Comment Resolution	12-Feb-13	28 days
Final Report Submittal	13-Mar-13	

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SAP Worksheet #17—Sampling Design and Rationale

Investigation of a small subset of the anomalies identified during the DGM survey was recommended within the SI report. This subset will be used to identify the types of anomalies detected at the site and will aid in the determination whether or not additional anomalies should be investigated. In addition, based on the assumption that items would be dropped close to the wharf, if they were dropped at all during the munitions loading process, areas will be investigated in the location adjacent to the southern area where the wharf created too much interference for the magnetometer.

Fifteen locations were selected for additional investigation based on the results of Phase 1 of the investigation:

- Location 1 – anomalies were detected in this location and it is in the approximate location of the end of the former structure for Wharf 3.
- Location 2 – anomalies were detected in this location and it is in the approximate location of the former structure for Wharf 3.
- Location 3 – anomalies were detected in this location and it is in the approximate location of the former structure for Wharf 3.
- Location 4 – VDEQ requested that the Navy investigated this line of anomalies.
- Location 5 – a high density of anomalies were detected in this location, which is approximately 60 ft away from the edge of the wharf and could be the starboard side of an ammunition ship used during World War II (WWII). The beam of ammunition ships (largest width) used during WWII ranged from 60 ft to 63 ft (Clancy, 1998).
- Location 6 – the DGM survey was unable to be conducted in this location; however, it is assumed that if munitions were dropped during the loading process it would have likely occurred between the wharf and the boat.
- Location 7 – the DGM survey was unable to be conducted in this location; however, it is assumed that if munitions were dropped during the loading process it would have likely occurred between the wharf and the boat.
- Location 8 – a high density of anomalies were detected in this location (approximately 40 ft from the wharf) and could account for ships that were used prior to WWII that were narrower than the WWII ammunitions ships.
- Location 9 – a high density of anomalies were detected in this location, which is approximately 60 ft away from the edge of the wharf and could be the starboard side of an ammunition ship used during WWII (Clancy, 1998).
- Location 10 – the DGM survey was unable to be conducted in this location; however, it is assumed that if munitions were dropped during the loading process it would have likely occurred between the wharf and the boat.

SAP Worksheet #17—Sampling Design and Rationale (continued)

- Location 11 – anomalies were detected in this location and it is relatively close to the edge of the wharf.
- Location 12– A cluster of anomalies was detected in this location and identified to allow for more complete coverage of the southern wharf area.
- Location 13 – a high density of anomalies were detected in this location, which is approximately 60 ft away from the edge of the wharf and could be the starboard side of an ammunition ship used during WWII (Clancy, 1998).
- Location 14– the DGM survey was unable to be conducted in this location; however, it is assumed that if munitions were dropped during the loading process it would have likely occurred between the wharf and the boat.
- Location 15 – a high density of anomalies were detected in this location, which is approximately 60 ft away from the edge of the wharf and could be the starboard side of an ammunition ship used during WWII (Clancy, 1998).

Locations 1 through 4 are shown on **Figure 3**. Locations 5 through 15 are shown on **Figure 4**.

SAP Worksheet #18-1—Sampling Locations and Methods/SOP Requirements Table

Sampling Location / ID Number[1]		Matrix	Depth (ft bgs)	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference[2]
SJUXO1-SD001	SJUXO1-SD001-XXXX	Sediment	Will vary based on depth of material recovered by the electromagnet	Explosives, PETN, NG, nitrocellulose, nitroguanidine, and perchlorate	1	Decon
SJUXO1-SD002	SJUXO1-SD002-XXXX				1	SoilSampExc
SJUXO1-SD003	SJUXO1-SD003-XXXX				2 (includes duplicate)	Homog
SJUXO1-SD004	SJUXO1-SD004-XXXX				1	DeconRig
SJUXO1-SD005	SJUXO1-SD005-XXXX				1	Dispose
SJUXO1-SD006	SJUXO1-SD006-XXXX				1	Log Books
SJUXO1-SD007	SJUXO1-SD007-XXXX				1 (includes MS/MSD)	BlankPrep
SJUXO1-SD008	SJUXO1-SD008-XXXX				1	DrumSample
SJUXO1-SD009	SJUXO1-SD009-XXXX				1	Chain-of-Custody
SJUXO1-SD010	SJUXO1-SD010-XXXX				2 (includes duplicate)	ShipLowConc
SJUXO1-SD011	SJUXO1-SD011-XXXX				1	
SJUXO1-SD012	SJUXO1-SD012-XXXX				1	
SJUXO1-SD013	SJUXO1-SD013-XXXX				1	
SJUXO1-SD014	SJUXO1-SD014-XXXX				1	
SJUXO1-SD015	SJUXO1-SD015-XXXX				1	

[1] The XXXX in the sample ID will correspond to the estimated depth of the sample in whole-foot increments.

[2] Details of the SOPs listed are provided in Worksheet #21.

SAP Worksheet #18-2—Anomaly Investigation Locations and Methods/SOP Requirements Table

Sampling Location (Grid) / ID Number	Exclusion Areas	Matrix	Depth relative to Ground Surface (units)	Analytical Group (NA for MEC EHP Site)	Degree of Investigation or Coverage	Sampling SOP Reference[1]
SJUXO1-SD001	None	Sediment	Below sediment surface; up to 5 ft below the sediment surface	NA; ,mechanical screening and visual inspection	10 ft x 20 ft at each location	NA; ESS procedures will be followed
SJUXO1-SD002	None	Sediment	Below sediment surface; up to 5 ft below the sediment surface	NA; ,mechanical screening and visual inspection	10 ft x 20 ft at each location	NA; ESS procedures will be followed
SJUXO1-SD003	None	Sediment	Below sediment surface; up to 5 ft below the sediment surface	NA; ,mechanical screening and visual inspection	10 ft x 20 ft at each location	NA; ESS procedures will be followed
SJUXO1-SD004	None	Sediment	Below sediment surface; up to 5 ft below the sediment surface	NA; ,mechanical screening and visual inspection	10 ft x 20 ft at each location	NA; ESS procedures will be followed
SJUXO1-SD005	None	Sediment	Below sediment surface; up to 5 ft below the sediment surface	NA; ,mechanical screening and visual inspection	10 ft x 20 ft at each location	NA; ESS procedures will be followed
SJUXO1-SD006	None	Sediment	Below sediment surface; up to 5 ft below the sediment surface	NA; ,mechanical screening and visual inspection	10 ft x 20 ft at each location	NA; ESS procedures will be followed
SJUXO1-SD007	None	Sediment	Below sediment surface; up to 5 ft below the sediment surface	NA; ,mechanical screening and visual inspection	10 ft x 20 ft at each location	NA; ESS procedures will be followed

SAP Worksheet #18-2—Anomaly Investigation Locations and Methods/SOP Requirements Table (continued)

Sampling Location (Grid) / ID Number	Exclusion Areas	Matrix	Depth relative to Ground Surface (units)	Analytical Group (NA for MEC EHP Site)	Degree of Investigation or Coverage	Sampling SOP Reference
SJUXO1-SD008	None	Sediment	Below sediment surface; up to 5 ft below the sediment surface	NA; ,mechanical screening and visual inspection	10 ft x 20 ft at each location	NA; ESS procedures will be followed
SJUXO1-SD009	None	Sediment	Below sediment surface; up to 5 ft below the sediment surface	NA; ,mechanical screening and visual inspection	10 ft x 20 ft at each location	NA; ESS procedures will be followed
SJUXO1-SD010	None	Sediment	Below sediment surface; up to 5 ft below the sediment surface	NA; ,mechanical screening and visual inspection	10 ft x 20 ft at each location	NA; ESS procedures will be followed
SJUXO1-SD011	None	Sediment	Below sediment surface; up to 5 ft below the sediment surface	NA; ,mechanical screening and visual inspection	10 ft x 20 ft at each location	NA; ESS procedures will be followed
SJUXO1-SD012	None	Sediment	Below sediment surface; up to 5 ft below the sediment surface	NA; ,mechanical screening and visual inspection	10 ft x 20 ft at each location	NA; ESS procedures will be followed
SJUXO1-SD013	None	Sediment	Below sediment surface; up to 5 ft below the sediment surface	NA; ,mechanical screening and visual inspection	10 ft x 20 ft at each location	NA; ESS procedures will be followed
SJUXO1-SD014	None	Sediment	Below sediment surface; up to 5 ft below the sediment surface	NA; ,mechanical screening and visual inspection	10 ft x 20 ft at each location	NA; ESS procedures will be followed
SJUXO1-SD015	None	Sediment	Below sediment surface; up to 5 ft below the sediment surface	NA; ,mechanical screening and visual inspection	10 ft x 20 ft at each location	NA; ESS procedures will be followed

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SAP Worksheet #19—Analytical SOP Requirements Table

Matrix	Analysis Group	Analytical and Preparation Method/ SOP Reference[1]	Containers (Number, Size, and Type)	Sample Volume	Preservation Requirements (Chemical, Temperature, Light Protected)	Maximum Holding Time (Preparation/ Analysis)[2]
Sediment	Explosives plus PETN and nitroglycerin	SW-846 8330A, SOP- 327	4oz glass jar	15g	Cool to ≤ 6° C	14 days to prep and 40 days to analysis
	Nitrocellulose	EPA 353.2 modified, SOP-234	4oz glass jar	50g		28 days
	Nitroguanidine	SW-846 8330A modified, SOP- 233	4oz glass jar	2g		14 days to prep and 40 days to analysis
	Perchlorate	SW-846 6850, SOP-239	4oz glass jar	1g		28 days

[1] See **Worksheet #23**

[2] Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted. (Not VTSR)

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SAP Worksheet #20—Field Quality Control Sample Summary Table

Matrix	Analytical Group	No. of Sampling Locations	No. of Field Duplicates	No. of MS/MSDs	No. of Field Blanks	No. of Equip. Blanks	No. of VOA Trip Blanks	Total No. of Samples to Lab
Sediment	Explosives plus PETN and nitroglycerin	15	2	1/1	0	7	0	26
	Nitrocellulose	15	2	1/1	0	7	0	26
	Nitroguanidine	15	2	1/1	0	7	0	26
	Perchlorate	15	2	1/1	0	7	0	26

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SAP Worksheet #21—Project Sampling SOP References Table

Note: Field SOPs are included as **Appendix A** to this document.

Reference Number	Title, Revision Date and / or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
Decon	Decontamination of Personnel and Equipment; March 2010	CH2M HILL	Sampling and H&S equipment	N	None
SoilSampExc	Soil Sampling During Excavations; March 2010	CH2M HILL	Trowel/stainless steel spoon, stainless steel bowl	N	None
Homog	Homogenization of Soil and Sediment Samples; March 2010	CH2M HILL	Trowel, bowl	N	None
DeconRig	Decontamination of Drilling Rigs and Equipment; March 2010	CH2M HILL	Electromagnet equipment	N	None
Dispose	Disposal of Waste Fluids and Solids; March 2010	CH2M HILL	55-gallon drums, roll-offs, Baker tank	N	None
Log Books	Preparing Field Log Books; March 2010	CH2M HILL	N/A	N	None
BlankPrep	Equipment Blank and Field Blank Preparation; March 2010	CH2M HILL	Trowel	N	None
DrumSample	Sampling Contents of Tanks and Drums	CH2M HILL	Trowel; drum/roll-off	N	None
Chain-of-Custody	Chain-of Custody; March 2010	CH2M HILL	N/A	N	None
ShipLowConc	Packaging and Shipping Procedures for Low-Concentration Samples; March 2010	CH2M HILL	N/A	N	None
SedSamp	Sediment Sampling, May 2011	CH2M HILL	Ponar dredge, sample bottles	N	None

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SAP Worksheet #22—Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Activity[1]	Frequency	Acceptance Criteria	CA	Resp. Person	SOP Reference[2]	Comments
Metal detector functional test	Verification	Daily	Detector functions as required	Inspect/repair/replace equipment until functioning properly	On-site UXO Technician	NA; functional test will be performed as described in manufacturer's user manual	FTL to verify test is completed and record results in field notebook.
Electromagnet functional test	Verification	Daily	Detector functions as required	Inspect/repair/replace equipment until functioning properly	Electromagnet operator	NA; functional test will be performed as according to subcontractor specifications	FTL is to verify test is completed and record results in field notebook.

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SAP Worksheet #23—Analytical SOP References Table

Lab SOP Number	Title, Revision Date, and/or Number	Last Reviewed	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to QSM	Organization Performing Analysis	Modified for Project Work (Y/N)
233	Nitroguanidine in Soil and Water by High Performance Liquid Chromatography Rev 3 3/15/10	8/16/2011	Definitive	Nitroguanidine	High Performance Liquid Chromatograph (HPLC)		Empirical Laboratories	N
234	Analysis of Nitrocellulose in Aqueous and non-Aqueous samples by basic hydrolysis and measurement of Nitrate and Nitrite (Modified 353.2) Rev 3 9/2/2010		Definitive	Nitrocellulose	Lachat flow injection analyzer			
239	Perchlorate in Water, Soil, and Solid Waste Using High Performance Liquid Chromatography/Electronspray Ionization/Mass Spectrometer by SW846 Method 6850 Rev 6 11/17/2010		Definitive	Perchlorate	Liquid Chromatograph/ Mass Spectrometer (LC/MS)			
327	Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC) Method 8330, 8330A, and 8332 Rev 20 5/14/2011 2/12/10		Definitive	Explosives, Nitroglycerin	HPLC			
QS10	Laboratory Sample Receiving, Log In, and Storage, Rev 17, 5/16/2011		N/A	All	N/A			

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SAP Worksheet #24—Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
HPLC[1]	Minimum five point initial calibration (ICAL)	At the beginning of each day or if QC is outside criteria	Average Response factor of <20% or Correlation coefficient >0.995	Correct problem, repeat ICAL	Analyst, Department Manager	Empirical SOP 327 and 233
	ICV	After ICAL	Analytes must be within 15% of the expected value	Correct problem, rerun ICV. If that fails, repeat ICAL.		
	CCV	At the beginning of the analytical sequence, after every 10 samples and at the end of the analytical sequence	The %D between the CFs in the initial and continuing calibrations must be ≤ 15%	Correct problem, rerun CCV. If that fails, then repeat ICAL. Reanalyze all samples since the last acceptable CCV.		
	Retention time window position establishment for each analyte and surrogate	Once per ICAL and at the beginning of the analytical shift	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	N/A		
Lachet[2]	ICAL	Perform after major instrument maintenance and upon failure of second consecutive continuing calibration verification.	Correlation Coefficient greater than or equal to 0.995	Repeat Initial calibration and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst, Department Manager	Empirical SOP 234
	ICV	Each analytical sequence	Analytes must agree within 10% of analyte true value	Correct problem and verify second source standard; recalibrate. If it fails again, repeat ICAL		
	CCV	Every 10 samples and at the end of the analytical sequence	Analytes must agree within 10% of analyte true value	Correct problem and rerun CCV. If it fails again, repeat ICAL and all affected samples.		

SAP Worksheet #24—Analytical Instrument Calibration Table (continued)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
LC/MS[1] (Perchlorate)	Mass Calibration	Upon instrument set-up and as needed	±0.3 m/z of mass 83, 85, and 89	Correct the problem and recalibrate	Analyst, Department Manager	Empirical SOP 239
	Isotope Ratio	Every sample, batch QC sample, and standard	Monitor for either the parent ion at masses 99/101 or the daughter ion at masses 83/85 depending on which ions are quantitated. Theoretical ratio ~3.06. Must fall within 2.3 to 3.8.	If criteria are not met, the sample must be rerun. If the sample was not pretreated, the sample should be re-extracted using cleanup procedures. If, after cleanup, the ratio still fails, use alternative techniques to confirm presence of perchlorate.		
	ICAL	Prior to sample analysis	RSD for each analyte ≤ 20% or r > 0.995. The concentration corresponding with the y-intercept must be ≤LOD.	Correct problem then repeat ICAL		
	ICV	After each ICAL; analysis of second source standard at midpoint of calibration	85-115% Recovery	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.		
	CCV	At the beginning of the analytical sequence; after each 10 field samples; at the end of the analytical sequence	85-115% Recovery	Correct problem, rerun CCV. If that fails, then repeat ICAL. Reanalyze all samples since the last acceptable CCV.		

SAP Worksheet #24—Analytical Instrument Calibration Table (continued)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
LC/MS[1] (Perchlorate) (continued)	Interference Check Sample (ICS)	One per batch of 20 samples; at least one daily	Within 30% of true value	Correct problem and then reanalyze all samples in that batch. If poor recovery from the cleanup filters is suspected, a different lot of filters must be used to re-extract all samples in the batch. If column degradation is suspected, a new column must be calibrated before the samples can be reanalyzed.		
	Tuning	Prior to ICAL and after any mass calibration or maintenance is performed	Tuning standards must contain the analytes of interest and meet acceptance criteria in SOP	Retune instrument and perform instrument mass calibration if retune doesn't meet criteria.		
	LODV	Before and after each analytical batch	Within 30% of the true value.	Correct problem and rerun LODV and all samples with concentrations less than RL analyzed since the last successful LODV.		

[1] Criteria is consistent with DoD QSM version 4.1

[2] Criteria is consistent with laboratory in-house criteria.

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SAP Worksheet #25—Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference
LC/MS	Change analytical column as needed, change mobile phase when insufficient for run or contamination, change inlet filters as needed for contamination	Perchlorate	Check pump pressure, check for leaks, check for adequate mobile phase	Instrument receipt, instrument change (new column, etc.), when CCV does not meet criteria	See **Worksheet #24**	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data		Empirical SOP-239
HPLC	Change analytical column as needed, change mobile phase when insufficient for run or contamination, change inlet filters as needed for contamination	Explosives	Check pump pressure, check for leaks, check for adequate mobile phase	Prior to initial calibration or as necessary		Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.		Empirical SOP-327/ 233
Lachet	Degas solutions, Change tubing, lamp, clean connectors Replace sample tubing, clean sample boat, replace syringe	Nitrocellulose	Tubing, rollers Tubing, sample boat, syringe	Prior to initial calibration or as necessary As needed		Recalibrate and/or perform necessary equipment maintenance. Reanalyze samples not bracketed by passing CCVs Repeat maintenance activity of remove from service.		Empirical SOP-234

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SAP Worksheet #26—Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Project Field Team, FTL/CH2M HILL. Field SOPs are in Appendix A of this SAP.
Sample Packaging (Personnel/Organization): Project Field Team, FTL/CH2M HILL. Field SOPs are in Appendix A of this SAP.
Coordination of Shipment (Personnel/Organization): FTL/CH2M HILL
Type of Shipment/Carrier: FedEx Priority Overnight
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Various personnel, Empirical
Sample Custody and Storage (Personnel/Organization): Various personnel, Empirical
Sample Preparation (Personnel/Organization): Various personnel, Empirical
Sample Determinative Analysis (Personnel/Organization): Various personnel, Empirical
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): 90 days from receipt
Sample Extract/Digestate Storage (No. of days from extraction/digestion): 1 year
Biological Sample Storage (No. of days from sample collection): N/A
SAMPLE DISPOSAL
Personnel/Organization: Various personnel, Empirical
Number of Days from Analysis: After submission, the laboratory will keep samples 45 days and the sample extracts for a minimum of 90 days.

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SAP Worksheet #27—Sample Custody Requirements Table

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory): Samples will be collected by field team members under the supervision of the field team leader. As samples are collected, they will be places into containers and labeled. Labels will be taped to the jar to ensure they do not separate. Samples will be cushioned with packaging material and placed into coolers containing enough ice to keep the samples 4 ± 2 degrees Celsius until they are received by the laboratory. The chain of custody will be placed into the cooler in a Ziploc bag. Coolers will be taped up and shipped to the laboratories via Fed Ex overnight, with the air bill number indicated on the chain-of-custody (to relinquish custody). Upon delivery, the laboratory will log in each cooler and report the status of the samples to CH2M HILL. See **Worksheet #21** for SOPs containing sample custody guidance. All samples will be shipped to Empirical Laboratories in Nashville, TN
Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal): Laboratory custody procedures can be found in the following SOPs, which are referenced in **Worksheet #23** and can be found in **Appendix C** of this SAP: Empirical SOPs QS-10
Sample Identification Procedures: Sample labels will include, at a minimum, client name, site, sample ID, date/time collected, analysis group or method, and sampler's initials. The field logbook will identify the sample ID with the location and time collected and the parameters requested. The laboratory will assign each field sample a laboratory sample ID based on information in the chain of custody. The laboratory will send sample log-in forms to the PDM to check that sample IDs and parameters are correct.
Chain-of-custody Procedures: Chain of custodies will include, at a minimum, laboratory contact information, client contact information, sample information, and relinquished by/received by information. Sample information will include sample ID. Date/time collected, number and type of containers, preservative information, analysis method, and comments. The chain of custody will link location of the sample from the field logbook to the laboratory receipt of the sample. The laboratory will use the sample information to populate the LIMS database for each sample.

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SAP Worksheet #28-1—Laboratory QC Samples Table

MPC is consistent with the DoD Quality Systems Manual (QSM) Version 4.1.

Matrix	Sediment
Analytical Group	Explosives plus PETN and Nitroglycerin
Analytical Method/ SOP Reference	SW-846 8330A/ SOP 327

QC Sample	**Frequency / Number**	**Method / SOP QC Acceptance Limits**	**CA**	**Person(s) Responsible for CA**	**DQI**	**MPC**
Method Blank	One per batch of 20 or less	No target compounds should be > 1/2 the LOQ	Reclean, retest, re-extract, reanalyze, and/or qualify data	Analyst, Laboratory Supervisor	Bias / Contamination	No target compounds should be > 1/2 the LOQ
LCS		See Worksheet #15-1	Evaluate, re-prep and reanalyze the LCS and associated samples if possible		Accuracy / Bias	See Worksheet #15-1
Surrogates	All samples	55-140%	Reprep and reanalyze for confirmation of matrix interference when appropriate.		Accuracy / Bias	55-140%
Confirmation of positive results	All positive results	RPD ≤ 40%	Narrate and qualify the results		Precision / Accuracy	RPD ≤ 40%
MS/MSD	One per SDG or every 20 samples.	See Worksheet #15-1	CA will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met If both the LCS and MS/MSD are unacceptable reprep the samples and QC.		Precision / Accuracy / Bias	See Worksheet #15-1

SAP Worksheet #28-2—Laboratory QC Samples Table

MPC is consistent with laboratory in-house criteria.

Matrix	Sediment
Analytical Group	Nitrocellulose
Analytical Method/ SOP Reference	EPA Modified 353.2/ SOP 233

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per batch of 20 or less	No target compounds should be > 1/2 the LOQ	Reclean, retest, re-extract, reanalyze, and/or qualify data	Analyst, Laboratory Supervisor	Bias / Contamination	No target compounds should be > 1/2 the LOQ
LCS		See Worksheet #15-1	Reprep and reanalyze for batch.		Accuracy / Bias	See Worksheet #15-1
MS/MSD			Reprep and reanalyze for confirmation of matrix interference when appropriate		Accuracy/Bias	

SAP Worksheet #28-3—Laboratory QC Samples Table

MPC is consistent with laboratory in-house criteria.

Matrix	Sediment
Analytical Group	Nitroguanadine
Analytical Method/ SOP Reference	SW-846 8330A/ SOP 233

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per batch of 20 or less	No target compounds should be > 1/2 the LOQ	Reclean, retest, re-extract, reanalyze, and/or qualify data	Analyst, Laboratory Supervisor	Bias / Contamination	No target compounds should be > 1/2 the LOQ
LCS	One per batch of 20 or less	See Worksheet #15-1	Reprep and reanalyze for confirmation of matrix interference when appropriate.		Accuracy/Bias	See Worksheet #15-1
Confirmation of positive results	All positive results	RPD ≤ 40%	Narrate and qualify the results		Precision / Accuracy / Bias	RPD ≤ 40%
Surrogates	1 per sample	55-140%	Reprep and reanalyze for confirmation of matrix interference when appropriate.		Accuracy / Bias	55-140%
MS/MSD	One set per batch of 20 or less	See Worksheet #15-1	Reprep and reanalyze for confirmation of matrix interference when appropriate.		Accuracy/Bias	See Worksheet #15-1

SAP Worksheet #28-4—Laboratory QC Samples Table

MPC is consistent with the DoD Quality Systems Manual (QSM) Version 4.1.

Matrix	Sediment
Analytical Group	Perchlorate
Analytical Method/ SOP Reference	SW-846 6850/ SOP 239

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
IS	1 per sample	Relative retention times for internal standard must be 0.98-1.02 and the responses within ± 50% of the average response of the ICAL.	Reanalyze samples at increasing dilutions until the ± 50% criteria can be met		Precision / Accuracy / Bias	Relative retention times for internal standard must be 0.98-1.02 and the responses within ± 50% of the average response of the ICAL.
Lab reagent blank	One per batch of 20 or less	No target compounds should be > 1/2 the LOQ	Reclean, retest, re-extract, reanalyze all samples processed since contaminated blank, and/or qualify data		Bias / Contamination	No target compounds should be > 1/2 the LOQ
Method blank		No target compounds should be > 1/2 the LOQ	Reclean, retest, re-extract, reanalyze, and/or qualify data		Bias / Contamination	No target compounds should be > 1/2 the LOQ
LCS		See Worksheet #15-1	Evaluate and reanalyze if possible		Precision / Accuracy / Bias	See Worksheet #15-1
MS/MSD		See Worksheet #15-1	CA will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met If both the LCS and MS/MSD are unacceptable reprep the samples and QC.		Precision / Accuracy / Bias	See Worksheet #15-1

SAP Worksheet #29—Project Documents and Records Table

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

Photography at SJCA must be approved by the facility prior to being distribution or use in reports, presentations, or any other form of mass communication. Approval for the use of photographs will be obtained by the SJCA RPM, Walter Bell. Photographs cannot include sensitive information, including, but not limited to, base activities and security measures.

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SAP Worksheet #30—Analytical Services Table

Matrix	Analytical Group	Sample Locations/ID Number	Analytical Method	Data Package Turnaround Time	Laboratory / Organization	Backup Laboratory / Organization[1]
Sediment	Explosives plus PETN	See **Worksheet #18**	SW-846 8330A	28 calendar days	Empirical Laboratories Sonya Gordon 615-345-1115 621 Mainstream Drive, Suite 270 Nashville, TN 37228	TBD
	Nitroglycerin		SW-846 8330A			
	Nitroguanidine		SW-846 8330A Modified			
	Nitrocellulose		EPA 353.2			
	Perchlorate		SW-846 6850			

All samples will be delivered to the off-site analytical laboratory listed above.

A backup laboratory is not determined at this time. One will be procured in the event that Empirical is no longer able to provide analytical services.

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SAP Worksheet #31—Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying/ Implementing CA	Person(s) Responsible for Monitoring Effectiveness of CA
Field Performance Audit	To be performed once during field event by internal CH2M HILL staff.	Internal	CH2M HILL	Nate Price FTL CH2M HILL	Nate Price FTL CH2M HILL	Janna Staszak AM CH2M HILL	Janna Staszak AM CH2M HILL
Third Party Laboratory Technical Systems Audit	Laboratories must have current DoD ELAP accreditation which will identify the period of performance.	External	Third party accrediting body	TBD, Third party accrediting body	Empirical's QA Officer	Empirical's QA Officer	Anita Dodson, Program Chemist, CH2M HILL

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SAP Worksheet #32—Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of CA Response Documentation	Individual(s) Receiving CA Response	Timeframe for Response
Field Performance Audit	Checklist and Written Audit Report	Mike Skeean PM, CH2M HILL	Within one week of audit	Memorandum	Field Team Leader CH2M HILL Janna Staszak AM CH2M HILL	Within one week of receipt of CA Form
Laboratory Performance and Systems Audits	Written Audit Report from Third party accrediting body	Empirical's QA Officer	Within 2 months of audit	Memorandum	Third Party Auditor, TBD	Within 2 months of receipt of initial notification.

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SAP Worksheet #32A—Corrective Action Form

Person initiating Corrective Action (CA) _____ Date _____

Description of problem and when identified: _____

_____

_____

Cause of problem, if known or suspected:

_____

_____

_____

_____

Sequence of CA: (including date implemented, action planned and personnel/data affected)

_____

_____

_____

_____

_____

CA implemented by: _____Date: _____

CA initially approved by: _____Date: _____

Follow-up date: _____

Final CA approved by: _____Date: _____

Information copies to:

Anita Dodson, CH2M HILL Project Chemist

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SAP Worksheet #32B—Field Performance Audit Checklist

Project Responsibilities

Project No.: _____ Date: _____

Project Location: _____ Signature: _____

Team Members:

Yes __ No __ 1) Is the approved work plan being followed?
Comments _____

_____

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

_____

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

_____

Sample Collection

Yes __ No __ 1) Is there a written list of sampling locations and descriptions?
Comments _____

_____

Yes __ No __ 2) Are samples collected as stated in the Master SOPs?
Comments _____

_____

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

_____

SAP Worksheet #32B—Field Performance Audit Checklist (continued)

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

_____

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

_____

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

_____

Yes __ No __ 7) Are photographs taken and documented?
Comments _____

_____

Document Control

Yes __ No __ 1) Have any accountable documents been lost?
Comments _____

_____

Yes __ No __ 2) Have any accountable documents been voided?
Comments _____

_____

Yes __ No __ 3) Have any accountable documents been disposed of?
Comments _____

SAP Worksheet #32B—Field Performance Audit Checklist (continued)

Yes __ No __ 4) Are the samples identified with sample tags?
Comments _____

_____

Yes __ No __ 5) Are blank and duplicate samples properly identified?
Comments _____

_____

Yes __ No __ 6) Are samples listed on a chain-of-custody record?
Comments _____

_____

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

_____

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SAP Worksheet #33—QA Management Reports Table

Type of Report	Frequency	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation	Report Recipient(s)
Field Performance CA Memorandum	After field audit	One week after audit, if necessary	Nate Price/CH2M HILL	Will be posted in project file.
QA Management Report	Once results have been assessed for data usability	Within one month after the data usability assessment has been completed	CH2M HILL, SJCA Partnering Team	Will be posted in project file.
Draft Investigation Report	Post-field Event	Within 3 months after the field event has ended and the data has been validated and loaded into the database	Mike Skeean/CH2M HILL	SJCA partnering team and technical support

The report following this investigation will address the following:

- Summary of project QA/QC requirements/procedures
- Conformance of project to the MRP UFP-SAP requirements/procedures
- Status of project schedule
- Deviations from the MRP UFP-SAP and approved amendments that were made
- Results of data review activities (how much usable data was generated)
- CAs if needed and their effectiveness
- Data usability with regards to: precision, accuracy, representativeness, completeness, comparability, and sensitivity
- Limitations on data use

The report following this investigation will also include data quality concerns:

- Narrative and timelines of project activities
- Summary of PQO development
- Reconciliation of project data with PQOs
- Summary of major problems encountered and their resolution
- Data summary, including tables and figures
- Conclusions and recommendations

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SAP Worksheet #34—Verification (Step I) Process Table

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
Chain-of-custody and Shipping Forms	Chain-of-custody forms and shipping documentation will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the chain-of-custody will be initialed by the reviewer, a copy of the chain-of-custody retained in the site file, and the original and remaining copies taped inside the cooler for shipment. See Chain-of-Custody SOP for further details.	Internal	Nate Price (CH2M HILL) Hillary Ott (CH2M HILL)
Audit Reports	Upon report completion, a copy of all audit reports will be placed in the site file. If CAs are required, a copy of the documented CA taken will be attached to the appropriate audit report in the QA site file. Periodically, and at the completion of site work, site file audit reports and CA forms will be reviewed internally to ensure that all appropriate CAs have been taken and that CA reports are attached. If CAs have not been taken, the Site Manager will be notified to ensure action is taken. Audit reports will be included in the QA Assessment section of the final RI report.	Internal/ External	Janna Staszak (CH2M HILL)/ Empirical Laboratories employees
Field Notebooks	Field notes will be reviewed internally and placed in the site file.	Internal/ External	Mike Skeean(CH2M HILL) Nate Price (CH2M HILL)
Laboratory Data	All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal. All received data packages will be examined by a PDM and a Chemist prior to validation.	Internal/ External	Empirical Laboratories employees Hillary Ott (CH2M HILL) Megan Morrison (CH2M HILL)

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SAP Worksheet #35—Validation (Steps IIa and IIb) Process Table

Step IIa / IIb[1]	Validation Input	Description	Responsible for Validation (name, organization)
IIb	Onsite Screening	Ensure that all field data meet Work Plan requirements for completeness and accuracy based on the field calibration records.	Nate Price, CH2M HILL
IIa	SOPs	Ensure that all sampling and analytical SOPs were followed.	Nate Price, CH2M HILL Empirical employees
IIa	Method QC Results	Ensure that all required QC samples were run and met required limits.	Ward Dickens, CH2M HILL
IIb	Work Plan QC Sample Results	Ensure that all required Work Plan QC samples were run and met required limits.	Megan Morrison, CH2M HILL
IIb	QLs	Ensure all sample results met the project quantification limit specified in the Work Plan.	Megan Morrison, CH2M HILL
IIa	Raw Data	Ten percent review of raw data to confirm laboratory calculations	Ward Dickens, CH2M HILL

[1] IIa=compliance with methods, procedures, and contracts [see Table 10, page 117, UFP-SAP manual, V.1, March 2005.]
IIb=comparison with MPC in the SAP [see Table 11, page 118, UFP-SAP manual, V.1, March 2005]

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SAP Worksheet #36—Analytical Data Validation (Steps IIa and IIb) Summary Table

Step IIa / IIb	Matrix	Analytical Group	Validation Criteria	Data Validator
IIa	Sediment	Explosives, Nitroguanidine, Nitrocellulose, Perchlorate, Nitroglycerin	Analytical methods and laboratory SOPs as presented in this SAP will be used to evaluate compliance against QA/QC criteria. Should adherence to QA/QC criteria yield deficiencies, data may be qualified. The data qualifiers used are those presented in *Region 3 Modifications to the National Functional Guidelines for Organic Data Review, Multi-Media, Multi-Concentration,* (USEPA, 1994). National Functional Guidelines will not be used for data validation; however, the specific qualifiers listed therein may be applied to data should non-conformances against the QA/QC criteria as presented in this SAP be identified.	Ward Dickens, CH2M HILL
IIb			See PALs in **Worksheet #15**; See Method calibration and QC criteria in **Worksheets #24 and 28**.	Megan Morrison, CH2M HILL

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SAP Worksheet #37—Usability Assessment

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

- Non-detected site contaminants will be evaluated to ensure that project required quantitation limits in **Worksheet #15** were achieved. If project quantitation limits were achieved and the verification and validation steps yielded acceptable data, then the data is considered usable. If project quantitation limits were not achieved, then the reason will be investigated and documented, and the impact on data usability will be discussed.
- During verification and validation steps, data may be qualified as estimated with the following qualifiers: J, UJ, K, L, or UL. These qualifiers represent minor QC deficiencies which will not affect the usability of the data. When major QC deficiencies are encountered, data will be qualified with an R and in most cases are not considered usable for project decisions.
  - J- Analyte present. Reported value is estimated and may or may not be accurate or precise.
  - UJ- Analyte not detected. Quantitation limit may be inaccurate or imprecise.
  - K- Analyte present. Reported value is estimated and may be biased high. Actual value is expected to be lower.
  - L- Analyte present. Reported value is estimated and may be biased low. Actual value is expected to be higher.
  - UL- Analyte not detected. Quantitation limit is probably higher.
  - R- Rejected result. Result is not usable.
- Additional qualifiers that may be given by the validator include B, I, N, NJ, and U:
  - B- Not detected more than 5 times than that in an associated blank (10 times for common laboratory contaminants in VOCs).
  - I- Interferences present which may cause the result to be biased high.
  - N- Tentative Identification. Consider Present. Special methods may be needed to confirm its presence or absence in future sampling efforts.
  - NJ- Qualitative identification questionable due to poor resolution. Presumptively present at approximate quantity.
  - U- Not Detected.

SAP Worksheet #37—Usability Assessment (continued)

- For statistical comparison, non-detect values will be represented by a concentration equal to one-half the sample reporting limit. For duplicate sample results, the greater of values will be used for project decisions.
- Analytical data will be checked to ensure the values and any qualifiers are appropriately transferred to the electronic database. These checks include comparison of hardcopy data and qualifiers to the electronic data deliverable. Once the data have been uploaded into the electronic database, another check will be performed to ensure all results were loaded accurately.
- Field and laboratory precision will be assessed as RPD between the two results.

Deviations from the SAP will be reviewed to assess whether CA is warranted and to assess impacts to achievement of project objectives.

Identify the personnel responsible for performing the usability assessment.

- The PM, PC, and other team members will be responsible for compiling the data. The data will then be presented to the Partnering Team who, as a whole, will evaluate the data usability according to project objectives.

Figures

Legend
SJCA Boundary
Area UXO 1 Boundary

Southern Wharf: 4.49 acres
Northern Wharf: 1.70 acres

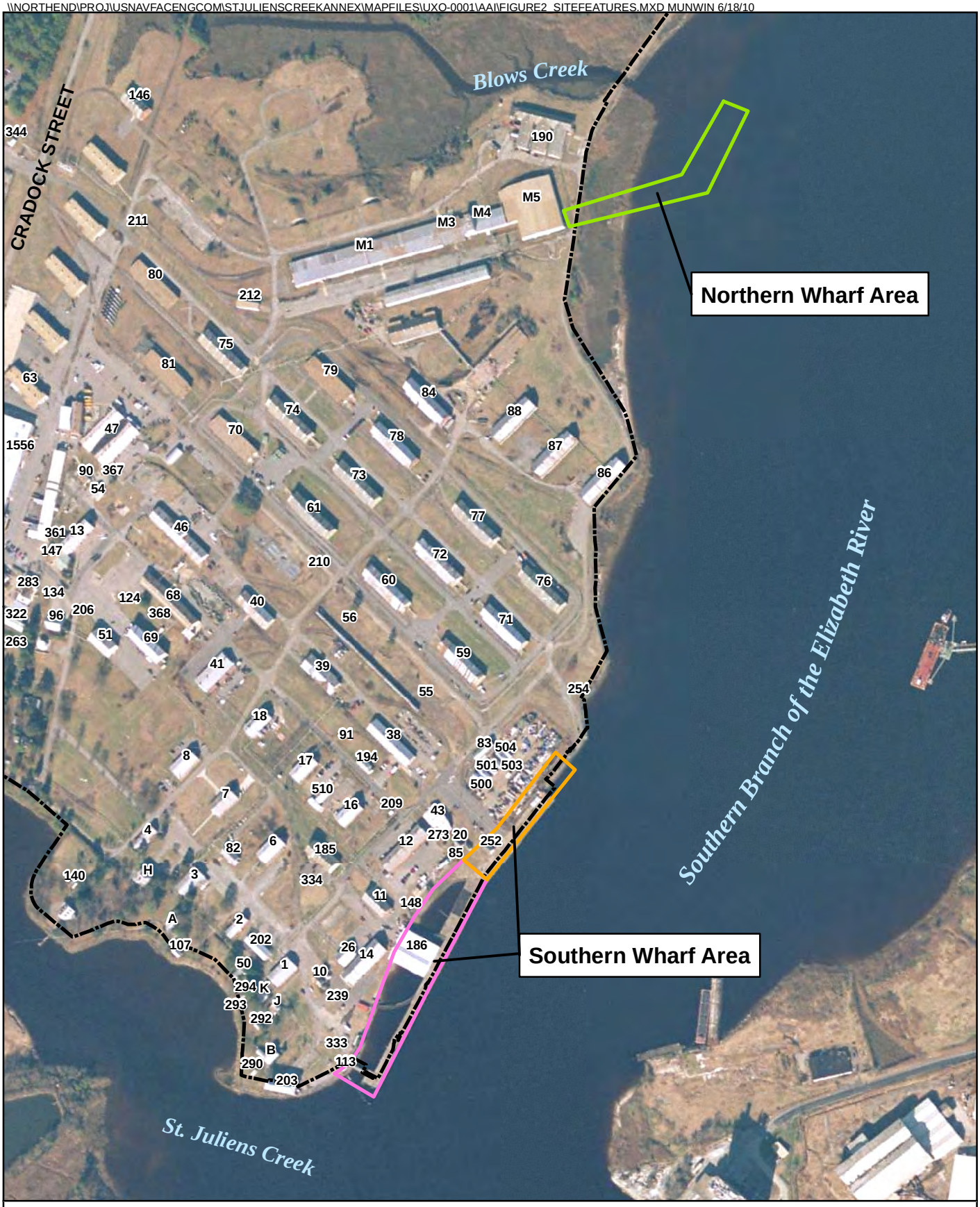
N
W E
S

0 500 1,000
Feet

Figure 1
Base and Site Location
Anomaly Acquisition Investigation
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

\\NORTHEND\PROJ\USNAVFACENGCOM\STJULIENSCREEKANNEX\MAPFILES\UXO-0001\AAI\FIGURE2_SITEFEATURES.MXD MUNWIN 6/18/10



Legend

- SJCA Boundary
- Wharf 1 (also Dock 2)
- Wharf 2 (also Dock 1)
- Wharf 3

N
W E
S

0 250 500
Feet

Figure 2
Site Features
Anomaly Acquisition Investigation
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

Legend

- Anomaly
- SJCA Boundary
- Investigation Area
- Unable to complete DGM survey
- DGM survey complete
- DGM survey complete; sensor height > 10 ft
- Location recommended for further investigation/ anomaly acquisition and inspection

N
W E
S

0 100 200
Feet

Figure 3
Anomalies Selected for Further Investigation - Northern Area
Anomaly Acquisition Investigation
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

Legend

- Anomaly
- SJCA Boundary
- Investigation Area
- Unable to complete DGM survey
- DGM survey complete
- Location recommended for further investigation/ anomaly acquisition and inspection

N
W E
S

0 100 200
Feet

Figure 4
Anomalies Selected for Further Investigation - Southern Area
Anomaly Acquisition Investigation
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

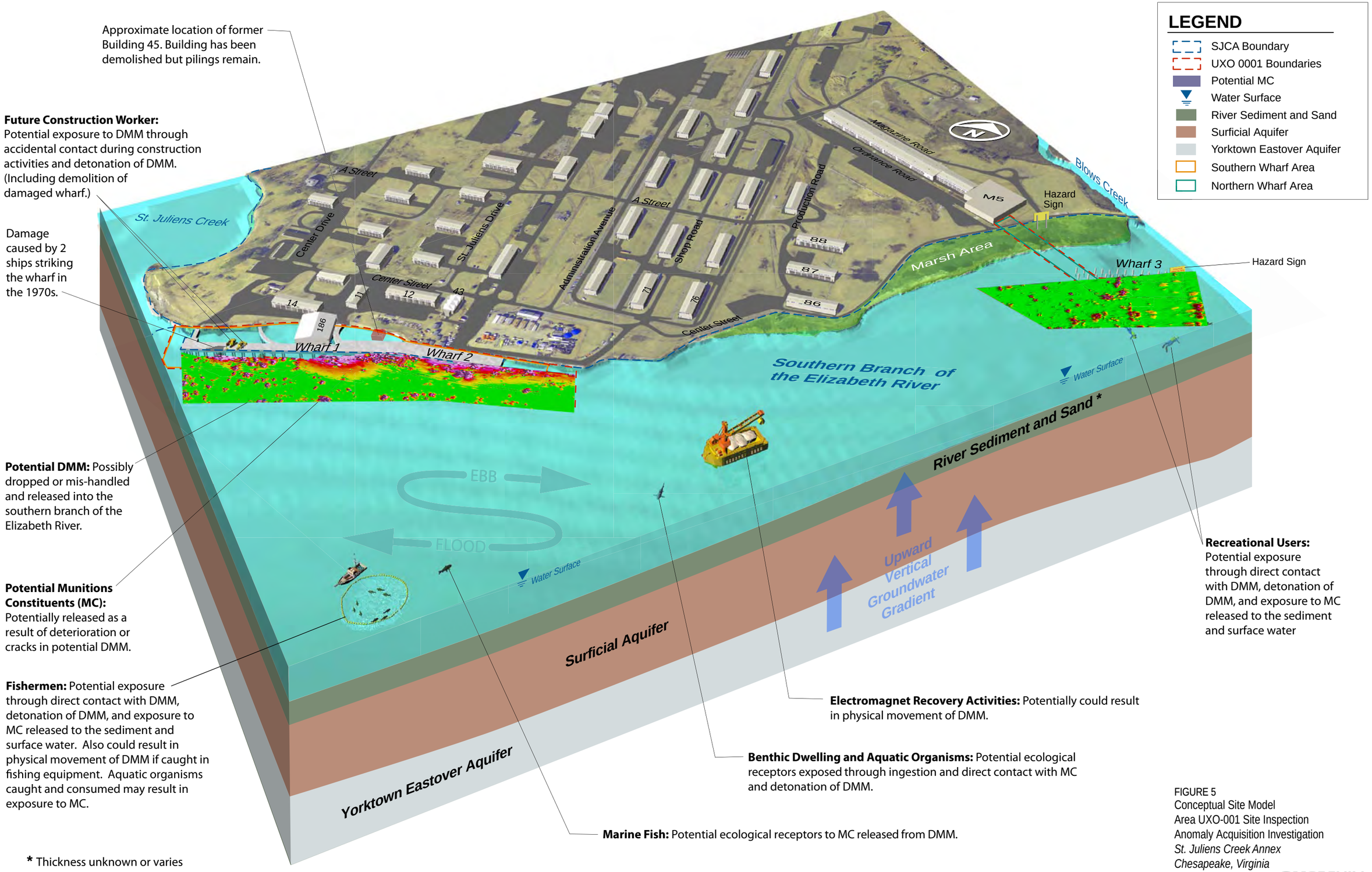


FIGURE 5
Conceptual Site Model
Area UXO-001 Site Inspection
Anomaly Acquisition Investigation
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

ES052810062247WDC (orig. ES032009004GNV) UXO-0001_3D_Conceptual_Site_Model_ver6.ai 8-3-11 cat

Appendix A
Standard Operating Procedures

STANDARD OPERATING PROCEDURE

Equipment Blank and Field Blank Preparation

I. Purpose

To prepare blanks to determine whether decontamination procedures are adequate and whether any cross-contamination is occurring during sampling due to contaminated air and dust.

II. Scope

The general protocols for preparing the blanks 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 or lab grade water)
- Millipore™ deionized 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 an equipment blank for volatile analysis from the surfaces of sampling equipment other than pumps, pour blank water over one piece of equipment and into two 40-ml vials until there is a positive meniscus, then seal the vials. Note the sample number and associated piece of equipment in the field notebook as well as the type and lot number of the water used.

For non-volatiles analyses, 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. When collecting an equipment blank from a pump, run an extra gallon of deionized water through the pump while collecting the pump outflow into appropriate containers. Make sure the flow rate is low when sampling VOCs. If a Grundfos Redi-Flo2 pump with disposable tubing is used, remove the disposable tubing after sampling but before decon. When decon is complete, put a 3- to 5-foot segment of new tubing onto the pump to collect the equipment blank.

D. To collect a field blank, slowly pour ASTM Type II or lab grade water directly into sample containers.

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

F. 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 or lab grade water.

STANDARD OPERATING PROCEDURE

Chain-of-Custody

I Purpose

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

II Scope

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

III Definitions

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

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

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

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

IV Responsibilities

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

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

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

V Procedures

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

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

V.1 Sample Identification

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

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

- Field Sampler(s),
- Contract Task Order (CTO) Number,
- Project Sample Number,

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

Measurements and observations shall be recorded using waterproof ink.

V.1.1 Sample Label

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

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

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

V.2 Chain-of-Custody Procedures

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

V.2.1 Field Custody Procedures

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

- A Chain-of-Custody Record will be prepared for each individual cooler shipped and will include ***only*** the samples contained within that particular cooler. The Chain-of-Custody Record for that cooler will then be sealed in a zip-log bag and placed in the cooler prior to sealing. This ensures that the laboratory properly attributes trip blanks with the correct cooler and allows for easier tracking should a cooler become lost during transit.

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

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

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

V.2.2 Transfer of Custody and Shipment

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

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

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

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

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

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

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

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

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

- Complete other carrier-required shipping papers.

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

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

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

VI Quality Assurance Records

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

VII Attachments

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

VIII References

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

STANDARD OPERATING PROCEDURE

Decontamination of Personnel and Equipment

I. Purpose

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

II. Scope

This is a general description of decontamination procedures.

III. Equipment and Materials

- Demonstrated analyte-free, deionized ("DI") water (specifically, ASTM Type II water or lab-grade DI water)
- Potable water; must be from a municipal water supplier, otherwise an analysis must be run for appropriate volatile and semivolatile organic compounds and inorganic chemicals (e.g., Target Compound List and Target Analyte List chemicals)
- 2.5% (W/W) Liquinox® (or Alconox®)and water solution
- Concentrated (V/V) pesticide grade methanol (DO NOT USE ACETONE)
- Large plastic pails or tubs for Liquinox® and water, scrub brushes, squirt bottles for Liquinox® solution, methanol and water, plastic bags and sheets
- DOT approved 55-gallon drum for disposal of waste
- Personal Protective Equipment as specified by the Health and Safety Plan
- Decontamination pad and steam cleaner/high pressure cleaner for large equipment

IV. Procedures and Guidelines

A. PERSONNEL DECONTAMINATION

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

1. Wash boots in Liquinox® solution, then rinse with water. If

disposable latex booties are worn over boots in the work area, rinse with Liquinox® solution, remove, and discard into DOT-approved 55-gallon drum.

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

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

4. Remove respirator (if worn).

5. Remove inner gloves and discard.

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

7. Sanitize respirator if worn.

B. SAMPLING EQUIPMENT DECONTAMINATION—GROUNDWATER SAMPLING PUMPS

Sampling pumps are decontaminated after each use as follows.

1. Don phthalate-free gloves.

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

3. Turn off pump after sampling. Remove pump from well and remove and dispose of tubing. Place pump in decontamination tube.

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

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

6. Rinse with 1 gallon of tap water.

7. Rinse with 1 gallon of deionized water.

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

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

10. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in DOT-approved 55-gallon drums.

C. SAMPLING EQUIPMENT DECONTAMINATION—OTHER EQUIPMENT

Reusable sampling equipment is decontaminated after each use as follows.

1. Don phthalate-free gloves.
2. Before entering the potentially contaminated zone, wrap soil contact points in aluminum foil (shiny side out).
3. Rinse and scrub with potable water.
4. Wash all equipment surfaces that contacted the potentially contaminated soil/water with Liquinox® solution.
5. Rinse with potable water.
6. Rinse with distilled or potable water and methanol solution (DO NOT USE ACETONE).
7. Air dry.
8. Rinse with deionized water.
9. Completely air dry and wrap exposed areas with aluminum foil (shiny side out) for transport and handling if equipment will not be used immediately.
10. Collect all rinsate and dispose of in a DOT-approved 55-gallon drum.
11. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in DOT-approved 55-gallon drums.

D. HEALTH AND SAFETY MONITORING EQUIPMENT DECONTAMINATION

1. Before use, wrap soil contact points in plastic to reduce need for subsequent cleaning.
2. Wipe all surfaces that had possible contact with contaminated materials with a paper towel wet with Liquinox® solution, then a towel wet with methanol solution, and finally three times with a towel wet with distilled water. Dispose of all used paper towels in a DOT-approved 55-gallon drum.

E. SAMPLE CONTAINER DECONTAMINATION

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

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

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

F. HEAVY EQUIPMENT AND TOOLS

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

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

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

V. Attachments

None.

VI. Key Checks and Items

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

STANDARD OPERATING PROCEDURE

Decontamination of Drilling Rigs and Equipment

I. Purpose and Scope

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

II. Equipment and Materials

- Portable steam cleaner and related equipment
- Potable water
- Phosphate-free detergent such as Liquinox®
- Buckets
- Brushes
- Methanol, pesticide grade
- Personal Protective Equipment as specified by the Health and Safety Plan
- ASTM–Type II grade water or Lab Grade DI Water
- Aluminum foil

III. Procedures and Guidelines

A. Drilling Rigs and Monitoring Well Materials

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

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

B. Downhole Drilling Tools

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

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

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

C. Field Analytical Equipment

1. Water Level Indicators

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

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

2. Probes

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

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

- The effectiveness of field cleaning procedures may be monitored by rinsing decontaminated equipment with organic-free water and submitting the rinse water in standard sample containers for analysis.

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
- Paint Pens
- 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
- Paint Pens
- 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 pending analysis 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
- Generator Contact Information
- 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 if the results indicate hazardous waste or labeled as non-hazardous if applicable.

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 drum storage area by the drilling services subcontractor. Drums should be stored on pallets on plastic sheeting with a short berm wall (hay bales or 2 x 4 planks or equivalent) to capture small spills.

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

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

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

- Check that representative samples of the containerized materials are obtained.
- Be sure that all state and federal regulations are considered when classifying waste for disposal.

STANDARD OPERATING PROCEDURE

Sampling Contents of Tanks and Drums

I. Scope and Application

This procedure provides an overview approach and guidelines for the routine sampling of drums and tanks. Its purpose is to describe standard procedures and precautions which are applied in sampling drums and tanks. Procedures for opening drums with the individual instruments are included in Attachment D.

The samples obtained may be used to obtain physical chemical or radiological data. The resulting data may be qualitative or quantitative in nature, and are appropriate for use in preliminary surveys as well as confirmatory sampling.

II. References

A. *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001, U.S. Environmental Protection Agency, Washington, D.C., 1987.

B. *Data Quality Objectives for Remedial Activities - Development Process*, EPA/540/G-87/003, U.S. Environmental Protection Agency, Washington, D.C., 1987.

C. Annual Book of ASTM Standards, *Standard Recommended Practices for Sampling Industrial Chemicals*, ASTM-E-300, 1986.

D. *Test Method for Evaluating Solid Waste*, SW-846, Volume II, Field Methods, Second Edition, U.S. Environmental Protection Agency, Washington, D.C., 1982.

E. U.S. Environmental Protection Agency, *Characterization of Hazardous Waste Sites — A Method Manual: Volume II, Available Sampling Methods*, USEPA Environmental Monitoring Systems Laboratory, Las Vegas, EPA-600/4-84-076, December, 1984.

F. *Environmental Surveillance Procedures*, Quality Control Program, Martin Marietta Energy Systems, ESH/Sub/87-21706/1, Oak Ridge, TN, September 1988.

III. Summary of Methods

Drums are generally sampled by means of sampling tubes such as glass sample tubes or COLIWASA samplers. In either case, the sampling tube is manually inserted into the waste

material. A sample of the drum contents is withdrawn by the sampling device. Should a drum contain bottom sludge, a glass tube will be used to retrieve a sample of this as well.

Storage tank and tank trailers, because of their greater depths, require sampling devices that can be lowered from the top, filled at a particular depth, then withdrawn. Such devices are a COLIWASA, a Kemmerer depth sampler, or a Bacon Bomb. Where samples of bottom sludge are desired, a gravity corer can be utilized. This heavy tube with a tapered nose piece will penetrate the sludge as it free falls through the tank.

IV. Comments

The sampling of tanks, containers, and drums present unique problems not associated with environmental samples. Containers of this sort are generally closed except for small access ports, manways, or hatches on the larger vessels, or taps and bungs on smaller drums. The physical size, shape, construction material, and location of access limit the types of equipment and methods of collection that can be used.

When liquids are contained in sealed vessels, gas vapor pressure can build up, sludges can settle out, and density layerings (stratification) can develop. Bulging drums may be under pressure and extreme caution should be exercised. The potential exists for explosive reactions or the release of noxious gases when containers are opened. All vessels should be opened with extreme caution. Check the HSP for the level of personnel protection to be worn. A preliminary sampling of any headspace gases is warranted. As a minimum, a preliminary check with an explosimeter and an organic vapor analyzer may be of aid in selecting a sampling method.

In most cases it is impossible to observe the contents of these sealed or partially sealed vessels. Since some layering or stratification is likely in any solution left undisturbed over time, a sample must be taken that represents the entire depth of the vessel.

V. Required Equipment and Apparatus

A. **Health and safety equipment/materials**: As listed in the site safety plan.

B. **Sampling equipment**: COLIWASA, glass sample tubes, Kemmerer depth sampler, Bacon Bomb, gravity corer.

C. **Tools**: Rubber mallet, bung wrench, speed wrench with socket, etc., (all non-sparking), paint marker.

D. **Heavy equipment**: Backhoe equipped with explosion shield, drum grappler, and 3-foot copper-beryllium (non-sparking) spike with 6-inch collar (to puncture top of drums for sampling, if necessary).

E. **Sample Containers**: As specified in the field sampling plan.

VI. Procedures

A. Drums

NOTE: DO NOT open more than one drum at a time. Each drum must be handled and sampled as a separate entity to reduce vapors in the sampling area.

1. Drums will be sampled on an area-by-area basis. Drums will be sampled after they have been placed in overpack drums but before they are transferred from the excavation to the onsite storage area.

2. Record, in logbook, all pertinent information from visual inspection of drum (e.g., physical condition, leaks, bulges, and labels). Label each drum with a unique identifying number.

3. If possible, stage drums for easy access.

4. If necessary, attach ground strap to drums and grounding point.

5. Remove any standing material (water, etc.) from container top.

6. Using non-sparking tools, carefully remove the bung or lid while monitoring air quality with appropriate instruments. If necessary (and as a last resort), the non-sparking spike affixed to the backhoe can also be used to puncture the drum for sampling. See Attachment D for method of drum opening. Record air-quality monitoring results.

7. When sampling a previously sealed vessel, a check should be made for the presence of bottom sludge. This is accomplished by measuring the depth to apparent bottom, then comparing it to the known interior depth.

8. Agitation to disrupt the layers and rehomogenize the sample is physically difficult and almost always undesirable. If the vessel is greater than 3 feet in depth (say, a 55-gallon drum), the appropriate sampling method is to slowly lower the sampling device (i.e., suction line of peristaltic pump, glass tube) in known increments of length. Discrete samples can be collected from various depths, then combined or analyzed separately. If the depth of the vessel is greater than the lift capacity of the pump, an at-depth water sampler, such as the Kemmerer or Bacon Bomb type, may be required.

9. Extract a representative sample from the drum using a glass rod, COLIWASA, Bacon Bomb, Kemmerer bottle, or gravity corer (See Attachments). Ensure that the entire depth of material is penetrated. Depending on the size of the opening of the drum, three to four takes should be collected from random locations across the drum surface, to ensure a representative sample. Any observed stratification must be

recorded in logbook, including number and thickness of the layers and a conceptualized sketch.

10. Record a visual description of the sample (e.g., liquid, solid, color, viscosity, and percent layers).

11. When possible, sampling equipment (like glass tubes) should be expendable and be left inside the drum for disposal with drum contents, once sampling is completed.

12. Place lid, bung, cap, etc., back in place on drum. Tighten hand tight. If necessary, the sampling port can be sealed using a cork.

13. Wipe up spilled material with lab wipes. Wipe off sample containers.

14. Mark the drum with a unique sample identification number and date using a paint marker.

15. Samples will be handled as high hazard samples. Samples will be placed in containers defined according to the analytical needs, wiped clean, and then packed in paint cans for shipping. Packaging, labeling, and preparation for shipment procedures will follow procedures as specified in the field sampling plan.

B. Underground Storage Tanks

1. A sampling team of at least two people is required for sampling—one will collect samples, the other will relay required equipment and implements.

2. Sampling team will locate a sampling port on the tank. Personnel should be wearing appropriate protective clothing at this time and carrying sampling gear.

3. Do not attempt to climb down into tank. Sampling MUST BE accomplished from the top.

4. Collect a sample from the upper, middle, and lower section of the tank contents with one of the recommended sampling devices.

5. If compositing is necessary, ship samples to laboratory in separate containers for laboratory compositing.

6. Samples will be handled as hazardous. Samples will be placed in appropriate containers and packed with ice in a cooler. Packaging, labeling, and preparation for shipment will follow procedures specified in the field sampling plan.

C. Tank Trailers or Above-Ground Storage Tanks

1. A sampling team of two is required. One will collect samples, the other will relay required equipment and implements.

2. Samples will be collected through the manhole (hatch) on top of the tanker or the fill port. Do not open valves at the bottom. Before opening the hatch, check for a pressure gauge or release valve. Open the release valve slowly to bring the tank to atmospheric pressure.

3. If tank pressure is too great, or venting releases large amounts of toxic gas, discontinue venting and sampling immediately. Measure vented gas with organic vapor analyzer and explosimeter.

4. If no release valve exists, slowly loosen hatch cover bolts to relieve pressure in the tank. (Again, stop if pressure is too great.)

5. Once pressure in tank has been relieved, open the hatch and withdraw sample using one of the recommended sampling devices.

6. Sample each trailer compartment.

7. If compositing is necessary, ship samples to laboratory in separate containers for laboratory compositing.

8. Samples will be handled as hazardous. Samples will be placed in appropriate containers and packed with ice in a cooler. Packaging, labeling, and preparation for shipment will follow procedures specified in the field sampling plan.

D. Refer to Attachment B for procedures for sampling with appropriate devices as follows:

<u>Drum</u>

Glass tube	–	Procedure 1
COLIWASA	–	Procedure 2

<u>Storage Tank and Tank Trailer</u>

COLIWASA	–	Procedure 2
Bacon Bomb	–	Procedure 3
Gravity Corer (for bottom sludge)	–	Procedure 4

VII. Contamination Control

Sampling tools, instruments, and equipment will be protected from sources of contamination prior to use and decontaminated after use as specified in SOP *Decontamination of Personnel and Equipment*. Liquids and materials from decontamination operations will be handled in accordance with the waste management plan. Sample containers will be protected from sources of contamination. Sampling personnel shall wear chemical resistant gloves when handling any samples. Gloves will be decontaminated or disposed of between samples.

VIII. Attachments

A. Collection of Liquid-Containerized Wastes Using Glass Tubes

B. Sampling Containerized Wastes Using the Composite Liquid Waste Sample (COLIWASA)

C. Sampling Containerized Wastes Using the Bacon Bomb Sampler

D. Gravity Corer for sampling Sludges in Large Containers

E. Construction of a Typical COLIWASA

F. Drum Opening Techniques and Equipment

IX. Field Checklist

_____ Sampling Instruments

_____ Tools

_____ Rubber Mallet

_____ Logbook

_____ Safety Glasses or Monogoggles

_____ Safety Shoes

_____ Ice/Cooler, as required

_____ Custody Seals, as required

_____ Chain-of-Custody Forms

_____ Drum Labels, as required

_____ Paint Marker, if drum sampling

_____ Black Indelible Pen

_____ Monitoring Instruments

_____ Labels

_____ Sampling and Analysis Plan

_____ Health and Safety Plan

_____ Decontamination Equipment

_____ Lab Wipes

_____ Lab Spatulas or Stainless Steel Spoons

_____ Chemical Preservatives, as required

_____ Appropriate Containers for Waste and Equipment

_____ Duct Tape

_____ Plastic Sheeting

Attachment A Collection of Liquid-Containerized Wastes Using Glass Tubes

Discussion

Liquid samples from opened containers (i.e., 55-gallon drums) are collected using lengths of glass tubing. The glass tubes are normally 122 centimeters long and 6 to 16 millimeters inside diameter. Larger diameter tubes may be used for more viscous fluids if sampling with the small diameter tube is not adequate. The tubing is broken and discarded in the container after the sample has been collected, eliminating difficult cleanup and disposal problems. This method should not be attempted with less than a two-person sampling team.

Uses

This method provides for a quick, relatively inexpensive means of collecting concentrated containerized wastes. The major disadvantage is from potential sample loss that is especially prevalent when sampling low-viscosity fluids. Splashing can also be a problem and proper protective clothing should always be worn.

Note: A flexible tube with an aspirator attached is an alternative method to the glass tube, and allows various levels to be sampled discretely.

Procedures for Use

1. Remove cover from sample container.
2. Insert glass tubing almost to the bottom of the container. Tubing should be of sufficient length so that at least 30 centimeters extend above the top of the container.
3. Allow the waste in the drum to reach its natural level in the tube.
4. Cap the top of the tube with a safety-gloved thumb or a stopper.
5. Carefully remove the capped tube from the drum. If the tube has passed through more than one layer, the boundary should be apparent in the glass tube.
6. Insert the bottom, uncapped end into the sample container.
7. Partially release the thumb or stopper on the top of the tube and allow the sample to slowly flow into the sample container. If separation of phases is desired, cap off tube before the bottom phase has completely emptied. It may be advisable to have an extra container for "waste," so that the fluid on either side of the phase boundary can be directed into a separate container, allowing collection of pure phase liquids in the sample containers. The liquid remaining after the boundary fluid is removed is collected in yet a third container. NOTE: It is not necessary to put phases in separate containers if analysis of separate phases is not desired.
8. Repeat steps 2 through 6 if more volume is needed to fill the sample container.

9. Remove the tube from the sample container and replace the tube in the drum, breaking it, if necessary, in order to dispose of it in the drum.

Optional Method (if sample of bottom sludge is desired)

1. Remove the cover from the container opening.
2. Insert glass tubing slowly almost to the bottom of the container. Tubing should be of sufficient length so that at least 30 cm extends above the top of the container.
3. Allow the waste in the drum to reach its natural level in the tube.
4. Gently push the tube towards the bottom of the drum into the sludge layer. Do not force it.
5. Cap the top of the tube with a safety-gloved thumb or stopper.
6. Carefully remove the capped tube from the drum and insert the uncapped end into the sample container.
7. Release the thumb or stopper on the top of the tube and allow the sample container to fill to approximately 90 percent of its capacity. If necessary, the sludge plug in the bottom of the tube can be dislodged with the aid of the stainless steel laboratory spatula.
8. Repeat if more volume is needed to fill sample container and recap the tube.

Note:

1. If a reaction is observed when the glass tube is inserted (violent agitation, smoke, light, etc.), the investigators should leave the area immediately.
2. If the glass tube becomes cloudy or smoky after insertion into the drum, the presence of hydrofluoric acid maybe indicated, and a comparable length of rigid plastic tubing should be used to collect the sample.
3. When a solid is encountered in a drum (either layer or bottom sludge) the optional method described above may be used to collect a core of the material, or the material may be collected with a disposable scoop attached to a length of wooden or plastic rod.

Attachment B: Sampling Containerized Wastes using the Composite Liquid Waste Sampler (COLIWASA)

Discussion

The COLIWASA is a much-cited sampler designed to permit representative sampling of multiphase wastes from drums and other containerized wastes. The sampler is commercially available or can be easily fabricated from a variety of materials, including PVC, glass, or Teflon. In its usual configuration it consists of a 152 cm by 4 cm (inside diameter) section of tubing with a neoprene stopper at one end attached by a rod running the length of the tube to a locking mechanism at the other end. Manipulation of the locking mechanism opens and closes the sampler by raising and lowering the neoprene stopper. See Attachment E: Construction of a COLIWASA.

Uses

The COLIWASA is primarily used to sample containerized liquids. The PVC COLIWASA is reported to be able to sample most containerized liquid wastes except for those containing ketones, nitrobenzene, dimethylforamide, mesityloxide, and tetrahydrofuran. A glass COLIWASA is able to handle all wastes unable to be sampled with the plastic unit except strong alkali and hydrofluoric acid solutions. Due to the unknown nature of many containerized wastes, it would therefore be advisable to eliminate the use of PVC materials and use samplers composed of glass or Teflon.

The major drawback associated with using a COLIWASA is concern for decontamination and costs. The sampler is difficult, if not impossible, to decontaminate in the field, and its high cost in relation to alternative procedures (glass tubes) makes it an impractical throwaway item. It still has applications, however, especially in instances where a true representation of a multiphase waste is absolutely necessary.

Procedures for Use

1. Check to make sure the sampler is functioning properly. Adjust the locking mechanism, if present, to make sure the neoprene rubber stopper provides a tight closure.

2. Put the sampler in the open position by placing the stopper rod handle in the T-position and pushing the rod down until the handle sits against the sampler's locking block.

3. Slowly lower the sampler into the liquid waste. Lower the sampler at a rate that permits the levels of the liquid inside and outside the sampler tube to be about the same. If the level of the liquid in the sample tube is lower than that outside the sampler, the sampling rate is too fast and will result in a non-representative sample.

4. When the sampler stopper hits the bottom of the waste container, push the sampler tube downward against the stopper to close the sampler. Lock the sampler in the

closed position by turning the T-handle until it is upright and one end rests tightly on the locking block.

5. Slowly withdraw the sampler from the waste container with one hand while wiping the sampler tube with a laboratory wipe with the other hand. A phase boundary, if present, can be observed through the tube.

6. Carefully discharge the sample into a suitable sample container by slowly pulling the lower end of the T-handle away from the locking block while the lower end of the sampler is positioned in a sample container.

7. Unscrew the T-handle of the sampler and disengage the locking block.

Attachment C: Sampling Containerized Wastes using the Bacon Bomb Sampler

Discussion

The Bacon Bomb is designed for the withdrawal of samples from various levels within a storage tank. It consists of a cylindrical body with an internal tapered plunger that acts as a valve to admit the sample. A line attached to the top of the plunger is used to open and close the valve. A removable cover provides a point of attachment for the sample line and has a locking mechanism to keep the plunger closed after sampling. The Bacon Bomb is usually constructed of chrome-plated brass and bronze with a rubber O-ring acting as the plunger-sealing surface. Stainless steel versions are also available. The volumemetric capacity is 8, 16, or 32 oz (237, 473, or 946 ml).

Uses

The Bacon Bomb is a heavy sampler suited best for viscous materials held in large storage tanks or in lagoons. If a more non-reactive sampler is needed, the stainless steel version would be used, or any of the samplers could be coated with Teflon.

Procedures for Use

1. Attach the sample line and the plunger line to the sampler.
2. Measure and then mark the sampling line at the desired depth.
3. Gradually lower the sampler by the sample line until the desired level is reached.
4. When the desired level is reached, pull up on the plunger line and allow the sampler to fill for a sufficient length of time before releasing the plunger line to seal off the sampler.
5. Retrieve the sampler by the sample line, being careful not to pull up on the plunger line, thereby accidentally opening the bottom valve.
6. Wipe off the exterior of the sampler body.
7. Position the sampler over the sample container and release its contents by pulling up on the plunger line.

Attachment D: Gravity Corer for Sampling Sludges in Large Containers

Discussion

A gravity corer is a metal tube with a replaceable tapered nosepiece on the bottom and a ball or other type of check valve on the top. The check valve allows water to pass through the corer on descent but prevents a washout during recovery. The tapered nosepiece facilitates cutting and reduces core disturbance during penetration. Most corers are constructed of brass or steel and many can accept plastic liners and additional weights.

Uses

Corers are capable of collecting samples of most sludges and sediments. They collect essentially undisturbed samples that represent the strata profile that may develop in sediments and sludges during variations in the deposition process. Depending on the density of the substrate and the weight of the corer, penetration to depths of 75 cm (30 in.) can be attained. Exercise care when using gravity corers in vessels or lagoons that have liners because penetration depths could exceed those of the substrate; this could result in damage to the liner material.

Procedures for Use

1. Attach a precleaned corer to the required length of sample line. Solid braided 5-mm (3/16-in.) nylon line is sufficient; however, 20-mm (3/4-in.) nylon is easier to grasp during hand hoisting. An additional weight can be attached to the outside of the corer if necessary.

2. Secure the free end of the line to a fixed support to prevent accidental loss of the corer.

3. Allow corer to free fall through the liquid to the bottom.

4. Retrieve corer with a smooth, continuous, up-lifting motion. Do not bump corer because this may result in some sample loss.

5. Remove nosepiece from corer and slide sample out of corer into stainless steel or Teflon pan (preferred).

6. Transfer sample into appropriate sample bottle with a stainless steel lab spoon or laboratory spatula.

Attachment E: Construction of a Typical COLIWASA

The sampling tube consists of a 1.52-m (5-ft) by 4.13-cm (1-5/8 in) I.D. translucent plastic pipe, usually polyvinyl chloride (PVC) or borosilicate glass plumbing tube. The closure-locking mechanism consists of a short-length, channeled aluminum bar attached to the sampler's stopper rod by an adjustable swivel. The aluminum bar serves both as a T-handle and lock for the samplers' closure system. When the sampler is in the open position, the handle is placed in the T-position and pushed down against the locking block. This manipulation pushes out the neoprene stopper and opens at the sampling tube. In the closed position, the handle is rotated until one leg of the T is squarely perpendicular against the locking block. This tightly seats the neoprene stopper against the bottom opening of he sampling tube and positively locks the sampler in the closed position. The closure tension can be adjusted by shortening or lengthening the stopper rod by screwing it in or out of the T-handle swivel. The closure system of the sampler consists of a sharply tapered neoprene stopper attached to a 0.95-cm (3/8-in) O.D. rod, usually PVC. The upper end of the stopper rod is connected to the swivel of the aluminum T-handle. The sharply tapered neoprene stopper can be fabricated according to specifications by plastic-products manufacturers at an extremely high price, or it can be made in-house by grinding down the inexpensive stopper with a shop grinder.

COLIWASA samplers are typically made out of plastic or glass. The plastic type consists of translucent plastic (usually PVC) sampling tube. The glass COLIWASA uses borosilicate glass plumbing pipe as the sampling tube and a Teflon plastic stopper rod. For purpose of multiphase sampling, clear plastic or glass is desirable in order to observe the profile of the multiphase liquid.

The sampler is assembled as follows:

a. Attach the swivel to the T-handle with the 3.18-cm (1-1/4 in) long bolt and secure with the 0.48-cm (3/16-in) National Coarse (NC) washer and lock nut.

b. Attach the PFTE stopper to one end of the stopper rod and secure with the 0.95-cm (3/8-in) washer and lock nut.

c. Install the stopper and stopper rod assembly in the sampling tube.

d. Secure the locking block sleeve on the block with glue or screw. This block can also be fashioned by shaping a solid plastic rod on a lathe to the required dimension.

e. Position the locking block on top of the sampling tube such that the sleeveless portion of the block fits inside the tube, the sleeve sits against the top end of the tube, and the upper end of the stopper rod slips though the center hole of the block.

f. Attach the upper end of the stopper rod to the swivel of the T-handle.

g. Place the sampler in the close position and adjust the tension on the stopper by screwing the T-handle in or out.

Attachment F: Drum Opening Techniques and Equipment [1]

I. Introduction

The opening of closed drums prior to sampling entails considerable risk if not done with the proper techniques, tools, and safety equipment. The potential for vapor exposure, skin exposure due to splash or spraying, or even explosion resulting from sparks produced by friction of the tools against the drum, necessitate caution when opening any closed container. Both manual drum opening and remote drum opening will be discussed in the following paragraphs. When drums are opened manually risks are greater than when opened remotely; for this reason, the remote opening of drums is advised whenever possible.

Prior to sampling, the drums should be staged to allow easy access. Also, any standing water or other material should be removed from the container top so that the representative nature of the sample is not compromised when the container is opened. There is also the possibility of encountering a water-reactive substance.

II. Manual Drum Opening

A. Bung Wrench

A common method for opening drums manually is using a universal bung wrench. These wrenches have fittings made to remove nearly all commonly encountered bungs. They are usually constructed of cast iron, brass, or a bronze-beryllium (a non-sparking alloy formulated to reduce the likelihood of sparks). The use of bung wrenches marked "NON SPARKING" is encouraged. However, the use of a "NON SPARKING" wrench does not completely eliminate the possibility of spark being produced. Such a wrench only prevents a spark caused by wrench-to-bung friction, but it cannot prevent sparking between the threads on the drum and the bung.

A simple tool to use, the fitting on the bung wrench matching the bung to be removed is inserted into the bung and the tool is turned counterclockwise to remove the bung. Since the contents of some drums may be under pressure (especially, when the ambient temperature is high), the bung should be turned very slowly. If any hissing is heard, the person opening the drum should back off and wait for the hissing to stop. Since drums under pressure can spray out liquids when opened, the wearing of appropriate eye and skin protection in addition to respiratory protection is critical.

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[1] Taken from EPA Training Course: "Sampling for Hazardous Materials," U.S. Environmental Protection Agency, Office of Emergency and Remedial Response Support Division, March 24, 1987.

B. Drum Deheader

One means by which a drum can be opened manually when a bung is not removable with a bung wrench is by using a drum deheader. This tool is constructed of forged steel with an alloy steel blade and is designed to cut the lid of a drum off or part way off by means of a scissors-like cutting action. A limitation of this device is that it can be attached only to closed head drums (i.e., DOT Specification 17E and 17F drums); drums with removable heads must be opened by other means.

Drums are opened with a drum deheader by first positioning the cutting edge just inside the top chime and then tightening the adjustment screw so that the deheader is held against the side of the drum. Moving the handle of the deheader up and down while sliding the deheader along the chime will enable the entire top to be rapidly cut off if so desired. If the top chime of a drum has been damaged or badly dented it may not be possible to cut the entire top off. Since there is always the possibility that a drum may be under pressure, the initial cut should be made very slowly to allow for the gradual release of any built-up pressure. A safer technique would be to employ a remote pressure release method prior to using the deheader.

C. Hand Pick or Spike

When a drum must be opened and neither a bung wrench nor a drum deheader is suitable, then it can be opened for sampling by using a hand pick, pickaxe, or spike. These tools are usually constructed of brass or a non-sparking alloy with a sharpened point that can penetrate the drum lid or head when the tool is swung. The hand picks or pickaxes that are most commonly used are commercially available, whereas the spikes are generally uniquely fabricated 4- foot long poles with a pointed end. Often the drum lid or head must be hit with a great deal of force in order to penetrate it. Because of this, the potential for splash or spraying is greater than with other opening methods and therefore this method of drum opening is not recommended, particularly when opening drums containing liquids. Some spikes used for drum opening have been modified by the addition of a circular splash plate near the penetrating end. This plate acts as a shield and reduces the amount of splash in the direction of the person using the spike. Even with this shield, good splash gear is essential.

Since drums, some of which may be under pressure, cannot be opened slowly with these tools, “sprayers” may result and appropriate safety measures must be taken. The pick or spike should be decontaminated after each drum is opened to avoid cross contamination and/or adverse chemical reaction from incompatible materials.

III. Remote Opening

A. Backhoe Spike

The most common means used to open drums remotely for sampling is the use of a metal spike attached or welded to a backhoe bucket. In addition to being very efficient, this method can greatly reduce the likelihood of personnel exposure.

Drums should be "staged," or placed in rows with adequate aisle space to allow ease in backhoe maneuvering. Once staged, the drums can be quickly opened by punching a hole in the drum head or lid with the spike.

The spike should be decontaminated after each drum is opened to prevent cross contamination. Even though some splash or spray may occur when this method is used, the operator of the backhoe can be protected by mounting a large shatter-resistant shield in front of the operator's cage. This, combined with the normal sampling safety gear, should be sufficient to protect the operator. Additional respiratory protection can be afforded by providing the operator with an on-board airline system. The hole in the drum can be sealed with a cork.

B. Hydraulic Devices

Recently, remotely operated hydraulic devices have been fabricated to open drums remotely. One such device is discussed here. This device uses hydraulic pressure to pierce through the wall of a drum. It consists of a manually operated pump that pressurizes oil through a length of hydraulic line. A piercing device with a metal point is attached to the end of this line and is pushed into the drum by the hydraulic pressure. The piercing device can be attached so that a hole for sampling can be made in either the side or the head/lid of the drum. Some of the metal piercers are hollow or tube-like so that they can be left in place, if desired, and serve as a permanent tap or sampling port. The piercer is designed to establish a tight seal after penetrating the container.

C. Pneumatic Devices

Pneumatically-operated devices utilizing compressed air have been designed to remove drum bungs remotely. A pneumatic bung remover consists of a compressed air supply (usually SCBA cylinders) that is controlled by a heavy-duty, 2-stage regulator. A high pressure air line of desired length delivers compressed air to a pneumatic drill that is adapted to turn a bung fitting (preferably, a bronze-beryllium alloy) selected to fit the bung to be removed. An adjustable bracketing system has been designed to position and align the pneumatic drill over the bung. This bracketing system must be attached to the drum before the drill can be operated. Once the bung has been loosened, the bracketing system must be removed before the drum can be sampled. This attachment and removal procedure is time- consuming and is the major drawback of this device. This remote bung opener does not permit the slow venting of the container, and therefore appropriate precautions must be taken. It also requires the container to be upright and relatively level. Bungs that are rusted shut cannot be removed with this device.

IV. Summary

The opening of closed containers is one of the most hazardous site activities. Maximum efforts would be made to ensure the safety of the sampling team. Proper protective equipment and a general wariness of the possible dangers will minimize the risk inherent to sampling operations. Employing proper drum opening

techniques and equipment will also safeguard personnel. The use of remote sampling equipment whenever feasible is highly recommended.

STANDARD OPERATING PROCEDURE

Homogenization of Soil and Sediment Samples

I. Purpose

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

II. Scope

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

III. Equipment and Materials

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

IV. Procedures and Guidelines

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

Samples for VOCs should be taken immediately upon collection and should not be homogenized.

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

All stainless steel spoons, spatulas, and pans must be decontaminated following procedures specified in SOP *Decontamination of Personnel and Equipment* prior to

homogenizing the sample. A composite equipment rinse blank of homogenization equipment should be taken each day it is used.

V. Attachments

None.

VI. Key Checks and Items

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

STANDARD OPERATING PROCEDURE

Preparing Field Log Books

I. Purpose

This SOP provides general guidelines for entering field data into log books during site investigation and remediation activities.

II. Scope

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

III. Equipment and Materials

- Log book
- Indelible pen

IV. Procedures and Guidelines

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

A. PROCEDURES FOR COMPLETING FIELD LOG BOOKS

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

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

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

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

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

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

5. Daily entries will be made chronologically.

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

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

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

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

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

B. INFORMATION TO BE INCLUDED IN FIELD LOG BOOKS

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

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

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

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

5. Tail Gate Safety Meetings: Record time and location of meeting, who

was present, topics discussed, issues/problems/concerns identified, and corrective actions or adjustments made to address concerns/ problems, and other pertinent information.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

C. SUGGESTED FORMAT FOR RECORDING FIELD DATA

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

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

3. Sketch sampling locations and other pertinent information.

4. Sketch well construction diagrams.

V. Attachments

Example field notes.

STANDARD OPERATING PROCEDURE

Packaging and Shipping Procedures for Low-Concentration Samples

I. Purpose and Scope

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

II. Scope

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

If the site is known to have produced high-concentration samples in the past or the sampler suspects that high concentrations of contaminants might be present in the samples, then the sampler should conservatively assume that the samples cannot be classified as low-concentration. Samples that are anticipated to have medium to high concentrations of constituents should be packaged and shipped accordingly.

If warranted, procedures for dangerous-goods shipping may be implemented. Dangerous goods and hazardous materials pose an unreasonable risk to health, safety, or property during transportation without special handling. As a result only employees who are trained under CH2M HILL Dangerous Goods Shipping course may ship or transport dangerous goods. Employees should utilize the HAZMAT ShipRight tool on the Virtual Office and/or contact a designated CH2M HILL HazMat advisor with questions.

III. Equipment and Materials

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

IV. Procedures and Guidelines

Low-Concentration Samples

A. Prepare coolers for shipment:

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

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

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

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

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

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

G. Fill remaining spaces with vermiculite or absorbent pads.

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

J Close lid and latch.

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

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

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

Medium- and High-Concentration Samples:

Medium- and high-concentration samples are packaged using the same techniques used to package low-concentration samples, with potential additional restrictions. If applicable, the sample handler must refer to instructions associated with the shipping of dangerous goods for the necessary procedures for shipping by Federal Express or other overnight carrier. If warranted, procedures for dangerous-goods shipping may be implemented. Dangerous goods and hazardous materials pose an unreasonable risk to health, safety, or property during transportation without special handling. As a result only employees who are trained under CH2M HILL Dangerous Goods Shipping course may ship or transport dangerous goods. Employees should utilize the HAZMAT ShipRight tool on the Virtual Office and/or contact a designated CH2M HILL HazMat advisor with questions.

V. Attachments

None.

VI. Key Checks and Items

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

Standard Operating Procedure

Locating and Clearing Underground Utilities

I. Purpose

The purpose of this SOP is to provide general guidelines and specific procedures that must be followed on Navy CLEAN projects for locating underground utilities and clearing dig locations in order to maximize our ability to avoid hitting underground utilities and to minimize liabilities to CH2M HILL and its subcontractors and health and safety risks to our project staff.

This SOP shall be used by Activity Managers and Project Managers to, in-turn, develop Activity-specific and project-specific utility location procedures. The activity and project-specific procedures will become part of work plans and project instructions and will be used to prepare scopes of work (SOWs) for the procurement of utility location subcontractors to meet the needs of individual projects.

This SOP also identifies the types of utility locating services that are available from subcontractors and the various tools that are used to locate utilities, and discusses when each type of service and tool may or may not be applicable.

II. Scope

Depending on the Navy/Marine Activity we typically find ourselves in one of two scenarios:

Scenario 1

The Activity provides utility locating (or dig clearance) services through the public works department or similar organization, or has a contract with an outside utility clearance service. Some of these services are provided in the form of dig permits which are required before you can dig or drill. In other cases no official permit is required and the process is somewhat vague.

Scenario 2

The Activity does not get involved in any utility locating processes aside from possibly providing the most recent utility maps, and relies on CH2M HILL to clear the dig locations.

Table 1 provides an up to date summary of which scenarios apply to the various primary Activities served under the Navy CLEAN program.

Scenario 1 is preferred because under this scenario the Navy tends to assume the responsibility if the location is improperly cleared, a utility is struck, and property damage results. However, our experience has been that the clearance services provided

by the Navy do not meet the standards that we consider to be adequate, in that they often simply rely on available base maps to mark utilities and do not verify locations using field geophysics. And if they do use locating tools, they do not provide adequate documentation or marking to confirm that a location has been cleared. So while the Navy's process may protect us from liability for property damage, it does not adequately protect our staff and subcontractors from health risks nor does it compensate us for down time, should a utility be hit.

Therefore, regardless of what services the Navy provides, in most cases we still need to supplement this effort with clearance services from our own third party utility location subcontractor following the procedures and guideline outlined in Section IV of this SOP. The cost implications of providing this service will range from $500 to several $1,000 depending on the size of the project.

The scope of services that we ask our subcontractors to provide can involve utility marking/mapping or the clearing of individual dig locations. In the former we ask our subs to mark all utilities within a "site" and often ask them to prepare a map based on their work. In the later, we ask them to clear (identify if there are any utilities within) a certain radius of a proposed dig/drill location.

The appropriate requested scope of services for a project will depend on the project. Clearing individual boreholes is often less expensive and allows the sub to concentrate their efforts on a limited area. However if the scope of the investigation is fluid (all borehole locations are not predetermined) it may be best to mark and map an entire site or keep the subcontractor on call.

Clearance of individual dig locations should be done to a minimum 20 foot radius around the location.

An example SOW for a utility subcontractor procurement is provided in Attachment A.

III. Services and Equipment

This section provides a general description of the services available to help us locate subsurface utilities and describes the types of equipment that these services may (or may not) use to perform their work. It identifies the capabilities of each type of equipment to help the PM specify what they should require from our utility location subs.

Services

The services that are available to us for identifying and marking underground utilities are:

- The local public/private utility-run service such as Miss Utility
- Utility location subcontractors (hired by us)

Attachment B provides a detailed description of each type of organization. It also provides contact numbers and web sites for the various Miss-Utility-type organizations in the areas where we do work for the Navy and contacts and services provided by several subcontractors that we have used or spoken to in the past.

Equipment

Attachment C provides a summary of the various types of equipment used for subsurface utility location. It describes the capabilities and limitations of each in order to help the PM determine if the equipment being used by a subcontractor is adequate.

It is important to make the potential subcontractors aware of the possible types of utilities (and utility materials) that are at the site, and to have them explain in their bid what types of equipment they will use to locate utilities /clear dig locations, and what the limitations of these equipment are.

A list of in-house experts that can be used to help you evaluate bids or answer questions you may have is provided in Appendix C.

IV. Procedures and Guidelines

This section presents specific procedures to be followed for the utility location work to be conducted by CH2M HILL and our subcontractors. In addition, a PM will have to follow the procedures required by the Activity to obtain their approvals, clearances and dig permits where necessary. These "dig permit" requirements vary by Activity and must be added to the project-specific SOP, or project instructions. It is preferable that the Activity perform their clearance processes before we follow up with our clearance work.

Activity Notification and Dig Permit Procedures

Identify Activity-specific permit and/or procedural requirements for excavation and drilling activities. Contact the Base Civil Engineer and obtain the appropriate form to begin the clearance process.

Activity Specific: To be provided by Activity or Project Manager

CH2M HILL Utility Clearance Procedures

Do not begin subsurface construction activities (e.g., trenching, excavation, drilling, etc.) until a check for underground utilities and similar obstructions has been conducted by CH2M HILL as a follow-up to the services provided by the Navy. The use of as-built drawings and utility company searches must be supplemented with a geophysical or other survey by a qualified, independent survey contractor (subcontracted to CH2M HILL) to identify additional and undiscovered buried utilities.

Examples of the type of geophysical technologies include (these are further described in Attachment C):

- **Ground Penetrating Radar (GPR),** which can detect pipes, including gas pipes, tanks, conduits, cables etc, both metallic and non-metallic at depths up to 30 feet depending on equipment. Sensitivity for both minimum object size and maximum depth detectable depends on equipment selected, soil conditions, etc.
- **Radio Frequency (RF),** involves inducing an RF signal in the pipe or cable and using a receiver to trace it. Some electric and telephone lines emit RF naturally and can be

detected without an induced signal. This method requires knowing where the conductive utility can be accessed to induce RF field if necessary.

- **Dual RF**, a modified version of RF detection using multiple frequencies to enhance sensitivity but with similar limitations to RF
- **Ferromagnetic Detectors**, are metal detectors that will detect ferrous and non-ferrous utilities. Sensitivity is limited, e.g. a 100 mm iron disk to a depth of about one meter or a 25 mm steel paper clip to a depth of about 20 cm.
- **Electronic markers,** are emerging technologies that impart a unique electronic signature to materials such as polyethylene pipe to facilitate location and tracing after installation. Promising for future installations but not of help for most existing utilities already in place.

The following procedures shall be used to identify and mark underground utilities during subsurface construction activities on the project:

- Contact utility companies or the state/regional utility protection service (such as Miss Utility) at least two (2) working days prior to intrusive activities to advise of the proposed work, and ask them to establish the location of the utility underground installations prior to the start of actual excavation: this is a law. These services will only mark the location of public-utility-owned lines and not Navy-owned utilities. In many cases there will not be any public-utility-owned lines on the Activity. There may also be Base-access issues to overcome.
- Procure and schedule the independent survey.
- The survey contractor shall determine the most appropriate geophysical technique or combinations of techniques to identify the buried utilities on the project site, based on the survey contractor's experience and expertise, types of utilities anticipated to be present and specific site conditions. ***The types of utilities must be provided to the bidding subcontractors in the SOW and procedures to be used must be specified by the bidder in their bid. It is extremely helpful to provide the sub with utility maps, with the caveat that all utilities are not necessarily depicted.***
- The survey subcontractor shall employ the same geophysical techniques used to identify the buried utilities, to survey the proposed path of subsurface investigation/construction work to confirm no buried utilities are present.
- Obtain utility clearances for subsurface work on both public and private property.
- Clearances provided by both the "Miss Utility" service and the CH2M HILL-subcontracted service are to be in writing, signed by the party conducting the clearance. The Miss Utility service will have standard notification forms/letters which typically simply state that they have been to the site and have done their work. The CH2M HILL subcontractor shall be required to fill out the form provided in Attachment D (this can be modified for a particular project) indicating that each dig/drill location has been addressed. ***This documentation requirement (with a copy of the form) needs to be provided in the subcontractor SOW.***

- Marking shall be done using the color coding presented in Attachment E. The type of material used for marking must be approved by the Activity prior to marking. Some base commanders have particular issues with persistent spray paint on their sidewalks and streets. ***Any particular marking requirements need to be provided in the subcontractor SOW.***
- Protect and preserve the markings of approximate locations of facilities until the markings are no longer required for safe and proper excavations. If the markings of utility locations are destroyed or removed before excavation commences or is completed, the Project Manager must notify the utility company or utility protection service to inform them that the markings have been destroyed.
- Perform a field check prior to drilling/digging (preferably while the utility location sub is still at the site) to see if field utility markings coincide with locations on utility maps. Look for fire hydrants, valves, manholes, light poles, lighted signs, etc to see if they coincide with utilities identified by the subcontractor.
- Underground utility locations must be physically verified (or dig locations must be physically cleared) by hand digging using wood or fiberglass-handled tools, air knifing, or by some other acceptable means approved by CH2M HILL, when the dig location (e.g. mechanical drilling, excavating) is expected to be within 5 feet of a marked underground system. Hand clearance shall be done to a depth of four feet unless a utility cross-section is available that indicates the utility is at a greater depth. In that event, the hand clearance shall proceed until the documented depth of the utility is reached.
- Conduct a site briefing for employees at the start of the intrusive work regarding the hazards associated with working near the utilities and the means by which the operation will maintain a safe working environment. Detail the method used to isolate the utility and the hazards presented by breaching the isolation.
- Monitor for signs of utilities during advancement of intrusive work (e.g., sudden change in advancement of auger or split spoon during drilling or change in color, texture or density during excavation that could indicate the ground has been previously disturbed).

IV. Attachments

A- Example SOW for Utility Location Subcontractor Procurement
B - Services Available for Identifying and Marking Underground Utilities
C – Equipment Used for Identifying Underground Utilities
D – Utility Clearance Documentation Form
E – Utility Marking Color Codes

Attachment A – Example SOW for Subcontracting Underground Utilities Locating Services

CTO-XXX

Scope of Work

Subsurface Utility Locating

Site XX

Navy Activity

City, State

A licensed and insured utility locator will be subcontracted to identify and mark out subsurface utilities for an environmental investigation/remediation project at Site XX of <<insert name of base, city, and state>>. The subcontractor will need to be available beginning at <<insert time>> on <<insert date>>. It is estimated that the work can be completed within XX days.

Proposed Scope of Work

The subcontractor will identify and mark all subsurface utilities (CHOOSE 1) that lie within a radius of 20 feet of each of XX sampling locations at Site XX shown on the attached Figure 1; (OR) that lie within the bounds of Site XX as delineated on the attached Figure 1. (If multiple sites are to be cleared, provide maps of each site with sample locations or clearance boundaries clearly delineated and a scale provided.)

Utilities will be identified using all reasonably available as-built drawings, electronic locating devices, and any other means necessary to maintain the safety of drilling and sampling personnel and the protection of the base infrastructure. The location of utilities identified from as-built drawings or other maps must be verified in the field prior to marking.

Base utility drawings for the Site(s) (CHOOSE 1) can be found at <<insert specific department and address or phone number on the base>> and should be reviewed by the subcontractor and referenced as part of the utility locating. (OR), will be provided to the subcontractor by CH2M HILL upon the award of the subcontract. (OR), are not available. Utility drawings shall not be considered definitive and must be field verified.

Field verification will include detection using nonintrusive subsurface detection equipment (magnetometers, GPR, etc) as well as opening manhole covers to verify pipe directions. As part of the bid, the Subcontractor shall provide a list of the various subsurface investigation tools they propose to have available and use at the site and what the limitations are of each tool.

A CH2M HILL representative shall be present to coordinate utility clearance activities and identify points and features to be cleared.

Field Marking and Documentation

All utilities located within **(CHOOSE 1)** ***a 20-ft radius of the XX proposed soil boring locations*** **(OR)** ***within the boundary of the site(s)*** as identified on the attached figure(s) will be marked using **paint** ***(some Bases such as the WNY may have restrictions on the use of permanent paint)*** and/or pin flags color coded to indicate electricity, gas, water, steam, telephone, TV cable, fiber optic, sewer, etc. The color coding shall match the industry standard as described on the attached form. In addition, the ***Buried Utility Location Tracking Form*** (attached) will be completed by the Subcontractor based upon what is identified in the field during the utility locating and submitted back to CH2M HILL (field staff or project manager) within 24 hours of completing the utility locating activities.

(OPTIONAL) ***The subcontractor shall also provide a map (or hand sketch) of the identified utilities to the Engineer within XX days of field demobilization. The map shall include coordinates or ties from fixed surface features to each identified subsurface utility.***

Bid Sheet/Payment Units

The subcontractor will bid on a time and materials basis for time spent on site and researching utility maps. Mobilization (including daily travel to the site) should be bid as a lump sum, as well as the preparation of the AHA and any required mapping. The per diem line item should be used if the field crew will require overnight accommodations at the project site.

Health and Safety Requirements

The utility locating subcontractor is to provide and assume responsibility for an adequate corporate Health and Safety Plan for onsite personnel. Standard personal safety equipment including: hard hat, safety glasses, steel-toed boots, gloves are recommended for all project activities. Specific health and safety requirements will be established by the Subcontractor for each project. The health and safety requirements will be subject to the review of CH2M HILL.

The subcontractor shall also prepare and provide to the Engineer, at least 48 hours prior to mobilization, an acceptable Activity Hazard Analysis (AHA) using the attached AHA form or similar.

It is also required that all subcontractor personnel who will be on site attend the daily 15-minute health and safety tailgate meeting at the start of each day in the field.

Subcontractor personnel showing indications of being under the influence of alcohol or illegal drugs will be sent off the job site and their employers will be notified. Subcontractor personnel under the influence of prescription or over-the-counter medication that may impair their ability to operate equipment will not be permitted to do so. It is expected that the subcontractor will assign them other work and provide a capable replacement (if necessary) to operate the equipment to continue work.

Security

The work will be performed on US Navy property. CH2M HILL will identify the Subcontractor personnel who will perform the work to the appropriate Navy facility point-of-contact, and will identify the Navy point-of-contact to the Subcontractor crew. The Subcontractor bears final responsibility for coordinating access of his personnel onto Navy property to perform required work. This responsibility includes arranging logistics and providing to CH2M HILL, in advance or at time of entry as specified, any required identification information for the Subcontractor personnel. Specifically, the following information should be submitted with the bid package for all personnel that will perform the work in question (this information is required to obtain a base pass):

- Name
- Birth Place
- Birth Date
- Social Security Number
- Drivers License State and Number
- Citizenship

Please be advised that no weapons, alcohol, or drugs will be permitted on the Navy facility at any time. If any such items are found, they will be confiscated, and the Subcontractor will be dismissed.

Quality Assurance

The Subcontractor will be licensed and insured to operate in the State of <<state>> and will comply with all applicable federal, state, county and local laws and regulations. The subcontractor will maintain, calibrate, and operate all electronic locating instruments in accordance with the manufacturer's recommendations. Additionally, the Subcontractor shall make all reasonable efforts to review as-built engineering drawings maintained by Base personnel, and shall notify the CH2M HILL Project Manager in writing (email is acceptable) whenever such documentation was not available or could not be reviewed.

Subcontractor Standby Time

At certain periods during the utility locating activities, the Subcontractor's personnel may be asked to stop work and standby when work may normally occur. During such times, the Subcontractor will cease activities until directed by the CH2M HILL representative to resume operations. Subcontractor standby time also will include potential delays caused by the CH2M HILL representative not arriving at the site by the agreed-upon meeting time for start of the work day. Standby will be paid to the

Subcontractor at the hourly rate specified in the Subcontractor's Bid Form attached to these specifications.

Cumulative Subcontractor standby will be accrued in increments no shorter than 15 minutes (i.e., an individual standby episode of less than 15 minutes is not chargeable).

During periods for which standby time is paid, the surveying equipment will not be demobilized and the team will remain at the site. At the conclusion of each day, the daily logs for the Subcontractor and CH2M HILL representative will indicate the amount of standby time incurred by the Subcontractor, if any. Payment will be made only for standby time recorded on CH2M HILL's daily logs.

Down Time

Should equipment furnished by the Subcontractor malfunction, preventing the effective and efficient prosecution of the work, or inclement weather conditions prevent safe and effective work from occurring, down time will be indicated in the Subcontractor's and CH2M Hill representative's daily logs. No payment will be made for down time.

Schedule

It is anticipated that the subsurface utility locating activities will occur on <<insert date>>. It is estimated that the above scope will be completed within XXX days.

Attachment B - Services Available for Identifying and Marking Underground Utilities

The services that are available to us for identifying and marking underground utilities are:

- The Activity's PWC (or similar organization)
- The local public/private utility -run service such as Miss Utility
- Utility location subcontractors (hired by CH2M HILL)

Each are discussed below.

Navy Public Works Department

A Public Works Department (PWD) is usually present at each Activity. The PWD is responsible for maintaining the public works at the base including management of utilities. In many cases, the PWD has a written permit process in place to identify and mark-out the locations of Navy-owned utilities [Note: The PWD is usually NOT responsible for the locations/mark-outs of non-Navy owned, public utilities (e.g., Washington Gas, Virginia Power, municipal water and sewer, etc.). Therefore, it is likely that we will have to contact other organizations besides the PWD in order to identify non-Navy owned, public utilities].

At some Activities, there may not be a PWD, the PWD may not have a written permit process in place, or the PWD may not take responsibility for utility locating and mark-outs. In these cases, the PWD should still be contacted since it is likely that they will have the best understanding of the utility locations at the Activity (i.e., engineering drawings, institutional knowledge, etc.). Subsequently, the PWD should be brought into a cooperative arrangement (if possible) with the other services employed in utility locating and mark-out in order to have the most comprehensive assessment performed.

At all Activities we should have a contact (name and phone number), and preferably an established relationship, with PWD, either directly or through the NAVFAC Atlantic, Midlant, or Washington NTR or Activity Environmental Office that we can work with and contact in the event of problems.

Miss Utility or "One Call" Services for Public Utility Mark-outs

Miss Utility or "One Call" service centers are information exchange centers for excavators, contractors and property owners planning any kind of excavation or digging. The "One Call" center notifies participating public utilities of the upcoming excavation work so they can locate and mark their underground utilities in advance to prevent possible damage to underground utility lines, injury, property damage and service outages. In some instances, such with southeastern Virginia bases, the Navy has entered into agreement with Ms. Utilities and is part of the response process for Miss

Utilities. Generally, a minimum of 48 hours is required for the public utility mark-outs to be performed. The "One Call" services are free to the public. Note that the "One Call" centers only coordinate with participating public utilities. There may be some public utilities that do NOT participate in the "One Call" center which may need to be contacted separately. For example, in Washington, DC, the Miss Utility "One Call" center does not locate and mark public sewer and water lines. Therefore, the municipal water and sewer authority must be contacted separately to have the sewer and water lines marked out. The AM should contact the appropriate one-call center to determine their scope of services.

A national listing of the "One Call" service centers for each state is presented on the web at http://www.underspace.com/refs/ocdir.htm. For the Mid-Atlantic region, the following "One Call" service centers are available.

Name	Phone	Website	Comments
Miss Utility of DELMARVA	800-257-7777	www.missutility.net	Public utility mark-outs in Delaware, Maryland, Washington, DC, and Northern Virginia
Miss Utility of Southern Virginia (One Call)	800-552-7001	not available	Public utility mark-outs in Southern Virginia
Miss Utility of Virginia	800-257-7777 800-552-7007	www.missutilityofvirginia.com	General information on public utility mark-outs in Virginia, with links to Miss Utility of DELMARVA and Miss Utility of Southern Virginia (One Call)
Miss Utility of West Virginia, Inc	800-245-4848	none	Call to determine what utilities they work with in West Virginia
North Carolina One Call Center	800-632-4949	www.ncocc.org/ncocc/default.htm	Public Utility Markouts in North Carolina

Private Subcontractors

1. Utility-locating support is required at some level for most all CH2M HILL field projects in "clearing" proposed subsurface boring locations on the project site. Utility location and sample clearance can include a comprehensive effort of GIS map interpretation, professional land surveying, field locating, and geophysical surveying. Since we can usually provide our own GIS-related services for projects and our professional land surveying services are normally procured separately, utility-locating subcontractors will normally only be required for some level of geophysical surveying support in the field. This level of geophysical surveying support can range widely from a simple electromagnetic (EM) survey over a known utility line, to a blind geophysical effort, including a ground-penetrating radar (GPR) survey and/or a comprehensive EM survey to delineate and characterize all unknown subsurface anomalies.

   The level of service required from the subcontractor will vary depending on the nature of the site. At sites where utility locations are well defined on the maps and

recent construction is limited, CH2M HILL may be confident with a limited effort from a traditional utility-locating subcontractor providing a simple EM survey. At sites where utility locations are not well defined, where recent constructions may have altered utility locations, or the nature of the site makes utility location difficult, CH2M HILL will require the services of a comprehensive geophysical surveying subcontractor, with a wide range of GPR and EM services available for use on an "as-needed" basis. Typical costs for geophysical surveying subcontractors will range from approximately $200 per day for a simple EM effort (usually one crew member and one instrument) to approximately $1,500 per day for a comprehensive geophysical surveying effort (usually a two-person crew and multiple instruments). Comprehensive geophysical surveying efforts may also include field data interpretation (and subsequent report preparation) and non-destructive excavation to field-verify utility depths and locations.

The following table provides a list of recommended geophysical surveying support subcontractors that can be used for utility-locating services:

Company Name and Address	Contact Name and Phone Number	Equipment[1]					Other Services[2]		
		1	2	3	4	5	A	B	C
US Radar, Inc.* PO Box 319 Matawan, NJ 07747	Ron LaBarca 732-566-2035			4					
Utilities Search, Inc.*	Jim Davis 703-369-5758	4				4	4	4	4
So Deep, Inc.* 8397 Euclid Avenue Manassas Park, VA 20111	703-361-6005	4					4	4	4
Accurate Locating, Inc. 1327 Ashton Rd., Suite 101 Hanover, MD 21076	Ken Shipley 410-850-0280	4	4						
NAEVA Geophysics, Inc. P.O. Box 7325 Charlottesville, VA 22906	Alan Mazurowski 434-978-3187	4	4	4	4	4	4	4	4
Earth Resources Technology. Inc. 8106 Stayton Rd. Jessup, MD 20794	Peter Li 240-554-0161	4	4	4	4	4	4	4	
Geophex, Ltd 605 Mercury Street Raleigh, NC 27603	I. J. Won 919-839-8515	4	4	4	4	4	4	4	4

Notes:

*Companies denoted with an asterisk have demonstrated reluctance to assume responsibility for damage to underground utilities or an inability to accommodate the insurance requirements that CH2M HILL requests for this type of work at many Navy sites.

[1]Equipment types are:

1. Simple electromagnetic instruments, usually hand-held
2. Other, more innovative, electromagnetic instruments, including larger instruments for more area coverage
3. Ground-penetrating radar systems of all kinds
4. Audio-frequency detectors of all kinds
5. Radio-frequency detectors of all kinds

[2]Other services include:

A. Data interpretation and/or report preparation to provide a permanent record of the geophysical survey results and a professional interpretation of the findings, including expected accuracy and precision.

B. Non-destructive excavation to field-verify the depths, locations, and types of subsurface utilities.

C. Concrete/asphalt coring and pavement/surface restoration.

Attachment C – Equipment Used for Identifying Underground Utilities

This attachment provides a summary of the various types of equipment used for subsurface utility location. It describes the capabilities and limitations of each in order to help the AM and PM determine if the equipment being proposed by a subcontractor or Navy is adequate. A list of in-house experts that can be used to answer questions you may have is provided below.

CH2M HILL In-house Utility Location Experts

Tamir Klaff/WDC

Home Office Phone – 703-669-9611

Electromagnetic Induction (EMI) Methods

EMI instruments, in general, induce an electromagnetic field into the ground (the primary field) and then record the response (the secondary field), if any. Lateral changes in subsurface conductivity, such as caused by the presence of buried metal or by significant soil variations, cause changes in the secondary field recorded by the instrument and thus enable detection and mapping of the subsurface features. It should be noted that EMI only works for electrically conductive materials--plastic or PVC pipes are generally not detected with EMI. Water and gas lines are commonly plastic, although most new lines include a copper "locator" strip on the top of the PVC to allow for detection with EMI.

EMI technology encompasses a wide range of instruments, each with inherent strengths and weaknesses for particular applications. One major division of EMI is between "time-domain" and "frequency-domain" instruments that differ in the aspect of the secondary field they detect. Another difference in EMI instruments is the operating frequency they use to transmit the primary field. Audio- and radio-frequencies are often used for utility detection, although other frequencies are also used. Consideration of the type of utility expected, surface features that could interfere with detection, and the "congestion" of utilities in an area, should be made when choosing a particular EMI instrument for a particular site.

One common EMI tool used for utility location is a handheld unit that can be used to quickly scan an area for utilities and allows for marking locations in "real time". This method is most commonly used by "dig-safe" contractors marking out known utilities prior to excavation. It should be noted that this method works best when a signal (the primary field) can be placed directly onto the line (i.e., by clamping or otherwise connecting to the end of the line visible at the surface, or for larger utilities such as sewers, by running a transmitter through the utility). These types of tools also have a limited capability to scan an area for unknown utilities. Usually this requires having enough area to separate a hand held transmitter at least a hundred feet from the

receiver. Whether hunting for unknown, or confirming known, utilities, this method will only detect continuous lengths of metallic conductors.

In addition to the handheld EMI units, larger, more powerful EMI tools are available that provide more comprehensive detection and mapping of subsurface features. Generally, data with these methods are collected on a regular grid in the investigation area, and are then analyzed to locate linear anomalies that can be interpreted as utilities. These methods will usually detect *all* subsurface metal (above a minimum size), including pieces of abandoned utilities. In addition, in some situations, backfill can be detected against native soils giving information on trenching and possible utility location. Drawbacks to these methods are that the secondary signals from utilities are often swamped (i.e., undetectable) close to buildings and other cultural features, and that the subsurface at heavily built-up sites may be too complicated to confidently interpret completely.

Hand-held metal detectors (treasure-finders) are usually based on EMI technology. They can be used to locate shallow buried metal associated with utilities (e.g., junctions, manholes, metallic locators). Advantages of these tools is the ease of use and real-time marking of anomalies. Drawbacks include limited depths of investigations and no data storage capacity.

Ground Penetrating Radar (GPR)

GPR systems transmit radio and microwave frequency (e.g., 80 megaHertz to 1,000 megaHertz) waves into the ground and then record reflections of those waves coming back to the surface. Reflections of the radar waves typically occur at lithologic changes, subsurface discontinuities, and subsurface structures. Plastic and PVC pipes can sometimes be detected in GPR data, especially if they are shallow, large, and full of a contrasting material such as air in a wet soil, or water in a dry soil. GPR data are usually collected in regular patterns over an area and then analyzed for linear anomalies that can be interpreted as utilities. GPR is usually very accurate in x-y location of utilities, and can be calibrated at a site to give very accurate depth information as well. A significant drawback to GPR is that depth of investigation is highly dependant on background soil conductivity, and it will not work on all sites. It is not uncommon to get only 1-2 feet of penetration with the signal in damp, clayey environments. Another drawback to GPR is that sites containing significant fill material (e.g., concrete rubble, scrap metal, garbage) will result in complicated anomalies that are difficult or impossible to interpret.

Magnetic Field Methods

Magnetic field methods rely on detecting changes to the earth's magnetic field caused by ferrous metal objects. This method is usually more sensitive to magnetic metal (i.e., deeper detection) than EMI methods. A drawback to this method is it is more susceptible to being swamped by surface features such as fences and cars. In addition, procedures must usually be implemented that account for natural variations in the earth's background field as it changes throughout the day. One common use of the method is to measure and analyze the gradient of the magnetic field, which eliminates most of the drawbacks to the method. It should be noted this method only detects

ferrous metal, primarily iron and steel for utility location applications. Some utility detector combine magnetic and EMI methods into a single hand-held unit.

Optical Methods

Down the hole cameras may be useful in visually reviewing a pipe for empty conduits and/or vaults.

Attachment D – Utility Clearance Documentation Form

Attachment E – Utility Marking Color Codes

The following is the standard color code used by industry to mark various types of utilities and other features at a construction site.

White – Proposed excavations and borings

Pink – Temporary survey markings

Red – Electrical power lines, cables, conduits and lighting cables

Yellow – Gas, oil, steam, petroleum or gaseous materials

Orange – Communication, alarm or signal lines, cables, or conduits

Blue – Potable water

Purple – Reclaimed water, irrigation and slurry lines

Green – Sewer and storm drain lines

STANDARD OPERATING PROCEDURE

Sediment Sampling

I. Purpose

These general outlines describe the collection and handling of sediment samples during field operations.

II. Scope

The sediment sampling procedures generally describe the equipment and techniques needed to collect representative sediment samples. Operators manual, if available, should be consulted for specific details

III. Equipment and Materials

- Sample collection device (hand corer, scoop, dredge, grab sampler, or other suitable device)
- Stainless steel spoon or spatula or plastic disposable scoop for media transfer
- Measuring tape
- Log book
- Personal protection equipment (rubber or latex gloves, boots, hip waders, etc.)
- Materials for classifying soils, particularly the percentage of fines
- Sample jars, including jars for Total Organic Carbon and pH, as appropriate

IV. Procedures and Guidelines

1. Field personnel will start downstream and work upstream to prevent contamination of unsampled areas. In surface water bodies that are tidally influenced, sampling will be performed at low tide and under low flow conditions to minimize the dilution of possible contaminants. Sediment sampling activities will not occur immediately after periods of heavy rainfall.
2. Make a sketch of the sample area that shows important nearby river features and permanent structures that can be used to locate the sample points on a map. Whenever possible, include measured distances from such identifying features. Also include depth and width of waterway, rate of flow, type and consistency of sediment, and point and depth of sample removal (along shore, mid-channel, etc).

3. Note in the field book any possible outside sources of contamination. For example, the outlet to a drainage culvert in the water body near your sampling location.

4. Transfer sample into appropriate sample jars with a stainless steel utensil or plastic disposable scoop. Be especially careful to avoid the loss of the very fine clay/silt particles when collecting the sample. The fine particles have a higher adsorption capacity than larger particles. Minimize the amount of water that is collected within the sample matrix. Decant the water off of the sample slowly and carefully to maximize retention of the very fine particles. The sampler's fingers should never touch the sediment since gloves may introduce organic interference into the sample. Classify the soil type of the sample using the Unified Soil Classification System, noting particularly the percentage of silt and clay.

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

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

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

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

9. Decontaminate all sampling implements and protective clothing according to prescribed procedures.

V. Attachments

None.

VI. Key Checks and Items

- Start downstream, work upstream.
- Log exact locations using permanent features.
- Beware of hidden hazards.

Appendix B
DoD ELAP Accreditation Letter

LABORATORY ACCREDITATION BUREAU

Certificate of Accreditation

ISO/IEC 17025:2005 ***Certificate Number L2226***

Empirical Laboratories, LLC

621 Mainstream Drive, Suite 270
Nashville, TN 37228

has met the requirements set forth in L-A-B's policies and procedures, all requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).*

The accredited lab has demonstrated technical competence to a defined "Scope of Accreditation" and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation Granted through: November 30, 2012

R. Douglas Leonard, Jr., Managing Director
Laboratory Accreditation Bureau
Presented the 30th of November 2009

*See the laboratory's Scope of Accreditation for details of the DoD ELAP requirements
Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).

LABORATORY ACCREDITATION BUREAU

Certificate # L2226

Scope of Accreditation For Empirical Laboratories, LLC

621 Mainstream Drive, Suite 270
Nashville, TN 37228
Marcia K. McGinnity
1-877-345-1113

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.1) based on the National Environmental Laboratory Accreditation Conference Chapter 5 Quality Systems Standard (NELAC Voted Revision June 5, 2003), accreditation is granted to Empirical Laboratories, LLC to perform the following tests:

Accreditation granted through: **November 30, 2012**

Testing - Environmental

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	8260B	1,1,1-Trichloroethane (1,1,1-TCA)
GC/MS	8260B	1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113; Freon 113)
GC/MS	8260B	1,1,2-Trichloroethane
GC/MS	8260B	1,1,2,2-Tetrachloroethane
GC/MS	8260B	1,1,1,2-Tetrachloroethane
GC/MS	8260B	1,1-Dichloroethane (1,1-DCA)
GC/MS	8260B	1,1-Dichloroethene (1,1-DCE)
GC/MS	8260B	1,2,3-Trichlorobenzene
GC/MS	8260B	1,2,4-Trichlorobenzene
GC/MS	8260B	1,2,3-Trichloropropane
GC/MS	8260B	1,2,4-Trimethylbenzene
GC/MS	8260B	1,3,5-Trimethylbenzene
GC/MS	8260B	1,2-Dibromoethane (EDB)
GC/MS	8260B	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	8260B	1,2-Dichlorobenzene
GC/MS	8260B	1,2-Dichloroethane (EDC)
GC/MS	8260B	1,2-Dichloropropane
GC/MS	8260B	1,3-Dichlorobenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	8260B	1,4-Dichlorobenzene
GC/MS	8260B	1,1-Dichloropropene
GC/MS	8260B	1,3-Dichloropropane
GC/MS	8260B	2,2-Dichloropropane
GC/MS	8260B	2-Butanone (Methyl ethyl ketone; MEK)
GC/MS	8260B	2-Hexanone (Methyl butyl ketone; MBK)
GC/MS	8260B	4-Methyl-2-pentanone (Methyl isobutyl ketone; MIBK)
GC/MS	8260B	Acetone
GC/MS	8260B	Benzene
GC/MS	8260B	Bromochloromethane
GC/MS	8260B	Bromodichloromethane
GC/MS	8260B	Bromobenzene
GC/MS	8260B	Bromoform
GC/MS	8260B	Bromomethane
GC/MS	8260B	n-Butylbenzene
GC/MS	8260B	sec-Butylbenzene
GC/MS	8260B	tert-Butylbenzene
GC/MS	8260B	Carbon Disulfide
GC/MS	8260B	Carbon Tetrachloride
GC/MS	8260B	Chlorobenzene
GC/MS	8260B	Chloroethane
GC/MS	8260B	Chloroform
GC/MS	8260B	Chloromethane
GC/MS	8260B	2-Chlorotoluene
GC/MS	8260B	4-Chlorotoluene
GC/MS	8260B	cis-1,2-Dichloroethene (cis-1,2-DCE)
GC/MS	8260B	cis-1,3-Dichloropropene
GC/MS	8260B	Cyclohexane
GC/MS	8260B	Dibromochloromethane
GC/MS	8260B	Dibromomethane
GC/MS	8260B	Dichlorodifluoromethane (CFC-12)
GC/MS	8260B	Ethylbenzene
GC/MS	8260B	Hexachlorobutadiene
GC/MS	8260B	Isopropylbenzene (Cumene)
GC/MS	8260B	p-Isopropyltoluene
GC/MS	8260B	Methyl Acetate
GC/MS	8260B	Methyl Tertiary Butyl Ether (MTBE)
GC/MS	8260B	Methylcyclohexane
GC/MS	8260B	Methylene Chloride, or Dichloromethane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	8260B	Naphthalene
GC/MS	8260B	n-Propylbenzene
GC/MS	8260B	Styrene
GC/MS	8260B	Tetrachloroethene (PCE; PERC)
GC/MS	8260B	Toluene
GC/MS	8260B	trans-1,2-Dichloroethene (trans-1,2-DCE)
GC/MS	8260B	trans-1,3-Dichloropropene
GC/MS	8260B	Trichloroethene (TCE)
GC/MS	8260B	Trichlorofluoromethane (CFC-11)
GC/MS	8260B	Vinyl Chloride (VC)
GC/MS	8260B	Xylenes (Total)
GC/MS	8260B	Acrolein
GC/MS	8260B	Acrylonitrile
GC/MS	8260B	Di-isopropyl ether
GC/MS	8260B	ETBE
GC/MS	8260B	Ethyl methacrylate
GC/MS	8260B	Iodomethane
GC/MS	8260B	Methyl methacrylate
GC/MS	8260B	t-Butyl alcohol
GC/MS	8260B	tert-Amyl methyl ether
GC/MS	8260B	2-Chloroethyl vinyl ether
GC/MS	8260B	1-Chlorohexane
GC/MS	8260B	Tetrahydrofuran
GC/MS	8260B	Vinyl acetate
GC/MS	8270C/D	Bis(2-chloroisopropyl)ether, or 2,2'-oxybis (1-Chloropropane)
GC/MS	8270C/D	1,2-Dichlorobenzene
GC/MS	8270C/D	1,3-Dichlorobenzene
GC/MS	8270C/D	1,4-Dichlorobenzene
GC/MS	8270C/D	2,4,5-Trichlorophenol
GC/MS	8270C/D	2,4,6-Trichlorophenol (TCP)
GC/MS	8270C/D	2,4-Dichlorophenol (DCP)
GC/MS	8270C/D	2,4-Dimethylphenol
GC/MS	8270C/D	2,4-Dinitrophenol
GC/MS	8270C/D	2,4-Dinitrotoluene (DNT)
GC/MS	8270C/D	2,6-Dichlorophenol
GC/MS	8270C/D	2,6-Dinitrotoluene
GC/MS	8270C/D	1,2-Diphenylhydrazine
GC/MS	8270C/D	2-Chloronaphthalene
GC/MS	8270C/D	2-Chlorophenol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	8270C/D	2-Methylnaphthalene
GC/MS	8270C/D	2-Methylphenol (o-Cresol)
GC/MS	8270C/D	2-Nitroaniline
GC/MS	8270C/D	2-Nitrophenol (ONP)
GC/MS	8270C/D	3,3'-Dichlorobenzidine (DCB)
GC/MS	8270C/D	3-Methylphenol
GC/MS	8270C/D	3-Nitroaniline
GC/MS	8270C/D	4,6-Dinitro-2-methylphenol (DNOC)
GC/MS	8270C/D	4-Bromophenyl phenyl ether
GC/MS	8270C/D	4-Chloro-3-methylphenol
GC/MS	8270C/D	4-Chloroaniline
GC/MS	8270C/D	4-Chlorophenyl phenyl ether
GC/MS	8270C/D	4-Methylphenol (p-Cresol)
GC/MS	8270C/D	4-Nitroaniline (PNA)
GC/MS	8270C/D	4-Nitrophenol (PNP)
GC/MS	8270C/D	Acenaphthene
GC/MS	8270C/D	Acenaphthylene
GC/MS	8270C/D	Acetaphenone
GC/MS	8270C/D	Anthracene
GC/MS	8270C/D	Benzo(a)anthracene
GC/MS	8270C/D	Benzo(a)pyrene
GC/MS	8270C/D	Benzo(b)fluoranthene
GC/MS	8270C/D	Benzo(g,h,i)perylene
GC/MS	8270C/D	Benzo(k)fluoranthene
GC/MS	8270C/D	Benzyl alcohol
GC/MS	8270C/D	Benzoic Acid
GC/MS	8270C/D	bis(2-Chloroethoxy)methane
GC/MS	8270C/D	bis(2-Chloroethyl)ether (BCEE)
GC/MS	8270C/D	bis(2-Ethylhexyl)phthalate (BEHP)
GC/MS	8270C/D	Butyl benzyl phthalate (BBP)
GC/MS	8270C/D	Carbazole
GC/MS	8270C/D	Chrysene
GC/MS	8270C/D	Di-n-butyl phthalate (DBP)
GC/MS	8270C/D	Di-n-octyl phthalate (DNOP)
GC/MS	8270C/D	Dibenz(a,h)anthracene
GC/MS	8270C/D	Dibenzofuran (DBF)
GC/MS	8270C/D	Diethyl phthalate (DEP)
GC/MS	8270C/D	Dimethyl phthalate (DMP)
GC/MS	8270C/D	Fluoranthene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	8270C/D	Fluorene
GC/MS	8270C/D	Hexachlorobenzene (HCB)
GC/MS	8270C/D	Hexachlorobutadiene (HCBD)
GC/MS	8270C/D	Hexachlorocyclopentadiene (HCCPD)
GC/MS	8270C/D	Hexachloroethane (HCE)
GC/MS	8270C/D	Indeno(1,2,3-cd)pyrene
GC/MS	8270C/D	Isophorone
GC/MS	8270C/D	N-Nitrosodimethylamine
GC/MS	8270C/D	N-Nitroso-di-n-propylamine (NDPA)
GC/MS	8270C/D	N-nitrosodiphenylamine (NDPHA)
GC/MS	8270C/D	Naphthalene
GC/MS	8270C/D	Nitrobenzene
GC/MS	8270C/D	Pentachlorophenol
GC/MS	8270C/D	Phenanthrene
GC/MS	8270C/D	Phenol
GC/MS	8270C/D	Pyrene
GC/MS	8270C/D	Pyridine
GC/MS	8270C/D	1,2,4-Trichlorobenzene
GC/MS	8270C/D	1,1'-Biphenyl
GC/MS	8270C/D	1,2,4,5-Tetrachlorobenzene
GC/MS	8270C/D	1,4-Dioxane
GC/MS	8270C/D	1-Methylnaphthalene
GC/MS	8270C/D	2,3,4,6-Tetrachlorophenol
GC/MS	8270C/D	Aniline
GC/MS	8270C/D	Atrazine
GC/MS	8270C/D	Benzaldehyde
GC/MS	8270C/D	Benzidine
GC/MS	8270C/D	7,12-Dimethylbenz(a)anthracene
GC/MS	8270C/D	Caprolactam
GC/ECD	8081A/B	4,4'-DDD
GC/ECD	8081A/B	4,4'-DDE
GC/ECD	8081A/B	4,4'-DDT
GC/ECD	8081A/B	Aldrin
GC/ECD	8081A/B	alpha-BHC (alpha-HCH)
GC/ECD	8081A/B	alpha-Chlordane
GC/ECD	8081A/B	beta-BHC (beta-HCH)
GC/ECD	8081A/B	delta-BHC (delta-HCH)
GC/ECD	8081A/B	Dieldrin
GC/ECD	8081A/B	Endosulfan I

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/ECD	8081A/B	Endosulfan II
GC/ECD	8081A/B	Endosulfan sulfate
GC/ECD	8081A/B	Endrin
GC/ECD	8081A/B	Endrin aldehyde
GC/ECD	8081A/B	Endrin ketone
GC/ECD	8081A/B	gamma-BHC (Lindane; gamma-HCH)
GC/ECD	8081A/B	gamma-Chlordane
GC/ECD	8081A/B	Heptachlor
GC/ECD	8081A/B	Heptachlor epoxide
GC/ECD	8081A/B	Methoxychlor
GC/ECD	8081A/B	Chlordane
GC/ECD	8081A/B	Toxaphene
GC/ECD	8082 /A	Aroclor-1016
GC/ECD	8082 /A	Aroclor-1221
GC/ECD	8082 /A	Aroclor-1232
GC/ECD	8082 /A	Aroclor-1242
GC/ECD	8082 /A	Aroclor-1248
GC/ECD	8082 /A	Aroclor-1254
GC/ECD	8082 /A	Aroclor-1260
GC/ECD	8151A	2,4,5-T
GC/ECD	8151A	2,4,5-TP (Silvex)
GC/ECD	8151A	2,4-D
GC/ECD	8151A	2,4-DB
GC/ECD	8151A	Dalapon
GC/ECD	8151A	Dicamba
GC/ECD	8151A	Dichlorprop
GC/ECD	8151A	Dinoseb
GC/ECD	8151A	MCPA
GC/ECD	8151A	MCPP (Mecoprop)
HPLC/UV	8330A	1,3,5-Trinitrobenzene
HPLC/UV	8330A	1,3-Dinitrobenzene
HPLC/UV	8330A	2,4,6-Trinitrophenylmethylnitramine (Tetryl)
HPLC/UV	8330A	2,4,6-Trinitrotoluene (TNT)
HPLC/UV	8330A	2,4-Dinitrotoluene (DNT)
HPLC/UV	8330A	2,6-Dinitrotoluene
HPLC/UV	8330A	2-Amino-4,6-dinitrotoluene
HPLC/UV	8330A	2-Nitrotoluene (ONT)
HPLC/UV	8330A	3-Nitrotoluene
HPLC/UV	8330A	4-Amino-2,6-dinitrotoluene

Non-Potable Water		
Technology	**Method**	**Analyte**
HPLC/UV	8330A	4-Nitrotoluene (PNT)
HPLC/UV	8330A	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC/UV	8330A	Nitroglycerin
HPLC/UV	8330A	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	8330A	3,5-Dinitroaniline
HPLC/UV	8330A	Nitrobenzene
HPLC/UV	8330A	PETN
HPLC/UV	8330A	Nitroguanidine
GC/FID	FLPRO	Petroleum Range Organics
GC/FID	8015B	TPH DRO
GC/FID	8015B	TPH GRO
GC/FID	RSK-175	Methane
GC/FID	RSK-175	Ethane
GC/FID	RSK-175	Ethene
GC/ECD	8011	1,2-Dibromoethane (EDB)
GC/ECD	8011	1,2-Dibromo-3-chloropropane (DBCP)
HPLC/MS	6850	Perchlorate
ICP	6010B/C	Aluminum
ICP	6010B/C	Antimony
ICP	6010B/C	Arsenic
ICP	6010B/C	Barium
ICP	6010B/C	Beryllium
ICP	6010B/C	Cadmium
ICP	6010B/C	Calcium
ICP	6010B/C	Chromium, total
ICP	6010B/C	Cobalt
ICP	6010B/C	Copper
ICP	6010B/C	Iron
ICP	6010B/C	Lead
ICP	6010B/C	Magnesium
ICP	6010B/C	Manganese
CVAA	7470A	Mercury
ICP	6010B/C	Nickel
ICP	6010B/C	Potassium
ICP	6010B/C	Selenium
ICP	6010B/C	Silver
ICP	6010B/C	Sodium
ICP	6010B/C	Thallium
ICP	6010B/C	Vanadium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP	6010B/C	Zinc
ICP	6010B/C	Molybdenum
ICP	6010B/C	Tin
ICP	6010B/C	Strontium
ICP	6010B/C	Titanium
IC	300.0	Chloride
IC	300.0	Fluoride
IC	300.0	Nitrate
IC	300.0	Nitrite
IC	300.0	Sulfate
IC	9056A	Chloride
IC	9056A	Fluoride
IC	9056A	Nitrate
IC	9056A	Nitrite
IC	9056A	Sulfate
Titration	SM 2320B 20th ed.	Alkalinity
ISE	SM 4500 B, D, 20th ed.	Ammonia
UV/Vis	7196A	Hexavalent Chromium
Colorimetric	353.2	Nitrocellulose
Colorimetric	353.2	Nitrate/Nitrite
Titration	Chap.7, Sect. 7.3 Mod.	Reactive Sulfide
Titration	SM 4500 S-2CF, 20th edition	Sulfide
UV/Vis	SM 4500 P B5, E, 20th edition	Total Phosphorus (as P)
UV/Vis	SM 4500 PE, 20th edition	Ortho-Phosphate (as P)
TOC	9060A/SM5310C, 20th edition	Total Organic Carbon
Gravimetric	SM 2540C, 20th edition	TDS
Colorimetric	9012A/B	Cyanide
Physical	1010A	Ignitability
Physical	9095B	Paint Filter
Probe	9040B/C	pH
Preparation	**Method**	**Type**
Preparation	1311	TCLP
Preparation	3005A	Metals digestion
Preparation	3010A	Metals digestion
Preparation	3510C	Organics Liquid Extraction
Preparation	5030A/B	Purge and Trap Water

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	8260B	1,1,1-Trichloroethane (1,1,1-TCA)
GC/MS	8260B	1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113; Freon 113)
GC/MS	8260B	1,1,2-Trichloroethane
GC/MS	8260B	1,1,2,2-Tetrachloroethane
GC/MS	8260B	1,1,1,2-Tetrachloroethane
GC/MS	8260B	1,1-Dichloroethane (1,1-DCA)
GC/MS	8260B	1,1-Dichloroethene (1,1-DCE)
GC/MS	8260B	1,2,3-Trichlorobenzene
GC/MS	8260B	1,2,4-Trichlorobenzene
GC/MS	8260B	1,2,3-Trichloropropane
GC/MS	8260B	1,2,4-Trimethylbenzene
GC/MS	8260B	1,3,5-Trimethylbenzene
GC/MS	8260B	1,2-Dibromoethane (EDB)
GC/MS	8260B	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	8260B	1,2-Dichlorobenzene
GC/MS	8260B	1,2-Dichloroethane (EDC)
GC/MS	8260B	1,2-Dichloropropane
GC/MS	8260B	1,3-Dichlorobenzene
GC/MS	8260B	1,4-Dichlorobenzene
GC/MS	8260B	1,1-Dichloropropene
GC/MS	8260B	1,3-Dichloropropane
GC/MS	8260B	2,2-Dichloropropane
GC/MS	8260B	2-Butanone (Methyl ethyl ketone; MEK)
GC/MS	8260B	2-Hexanone (Methyl butyl ketone; MBK)
GC/MS	8260B	4-Methyl-2-pentanone (Methyl isobutyl ketone; MIBK)
GC/MS	8260B	Acetone
GC/MS	8260B	Benzene
GC/MS	8260B	Bromochloromethane
GC/MS	8260B	Bromodichloromethane
GC/MS	8260B	Bromobenzene
GC/MS	8260B	Bromoform
GC/MS	8260B	Bromomethane
GC/MS	8260B	n-Butylbenzene
GC/MS	8260B	sec-Butylbenzene
GC/MS	8260B	tert-Butylbenzene
GC/MS	8260B	Carbon Disulfide
GC/MS	8260B	Carbon Tetrachloride
GC/MS	8260B	Chlorobenzene
GC/MS	8260B	Chloroethane

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	8260B	Chloroform
GC/MS	8260B	Chloromethane
GC/MS	8260B	2-Chlorotoluene
GC/MS	8260B	4-Chlorotoluene
GC/MS	8260B	cis-1,2-Dichloroethene (cis-1,2-DCE)
GC/MS	8260B	cis-1,3-Dichloropropene
GC/MS	8260B	Cyclohexane
GC/MS	8260B	Dibromochloromethane
GC/MS	8260B	Dibromomethane
GC/MS	8260B	Dichlorodifluoromethane (CFC-12)
GC/MS	8260B	Ethylbenzene
GC/MS	8260B	Hexachlorobutadiene
GC/MS	8260B	Isopropylbenzene (Cumene)
GC/MS	8260B	p-Isopropyltoluene
GC/MS	8260B	Methyl Acetate
GC/MS	8260B	Methyl Tertiary Butyl Ether (MTBE)
GC/MS	8260B	Methylcyclohexane
GC/MS	8260B	Methylene Chloride, or Dichloromethane
GC/MS	8260B	Naphthalene
GC/MS	8260B	n-Propylbenzene
GC/MS	8260B	Styrene
GC/MS	8260B	Tetrachloroethene (PCE; PERC)
GC/MS	8260B	Toluene
GC/MS	8260B	trans-1,2-Dichloroethene (trans-1,2-DCE)
GC/MS	8260B	trans-1,3-Dichloropropene
GC/MS	8260B	Trichloroethene (TCE)
GC/MS	8260B	Trichlorofluoromethane (CFC-11)
GC/MS	8260B	Vinyl Chloride (VC)
GC/MS	8260B	Xylenes (Total)
GC/MS	8260B	Acrolein
GC/MS	8260B	Acrylonitrile
GC/MS	8260B	Ethyl methacrylate
GC/MS	8260B	Iodomethane
GC/MS	8260B	Methyl methacrylate
GC/MS	8260B	Vinyl acetate
GC/MS	8270C/D	Bis(2-chloroisopropyl)ether, or 2,2'-oxybis (1-Chloropropane)
GC/MS	8270C/D	1,2-Dichlorobenzene
GC/MS	8270C/D	1,3-Dichlorobenzene
GC/MS	8270C/D	1,4-Dichlorobenzene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	8270C/D	2,4,5-Trichlorophenol
GC/MS	8270C/D	2,4,6-Trichlorophenol (TCP)
GC/MS	8270C/D	2,4-Dichlorophenol (DCP)
GC/MS	8270C/D	2,4-Dimethylphenol
GC/MS	8270C/D	2,4-Dinitrophenol
GC/MS	8270C/D	2,4-Dinitrotoluene (DNT)
GC/MS	8270C/D	2,6-Dichlorophenol
GC/MS	8270C/D	2,6-Dinitrotoluene
GC/MS	8270C/D	1,2-Diphenylhydrazine
GC/MS	8270C/D	2-Chloronaphthalene
GC/MS	8270C/D	2-Chlorophenol
GC/MS	8270C/D	2-Methylnaphthalene
GC/MS	8270C/D	2-Methylphenol (o-Cresol)
GC/MS	8270C/D	2-Nitroaniline
GC/MS	8270C/D	2-Nitrophenol (ONP)
GC/MS	8270C/D	3,3'-Dichlorobenzidine (DCB)
GC/MS	8270C/D	3-Methylphenol
GC/MS	8270C/D	3-Nitroaniline
GC/MS	8270C/D	4,6-Dinitro-2-methylphenol (DNOC)
GC/MS	8270C/D	4-Bromophenyl phenyl ether
GC/MS	8270C/D	4-Chloro-3-methylphenol
GC/MS	8270C/D	4-Chloroaniline
GC/MS	8270C/D	4-Chlorophenyl phenyl ether
GC/MS	8270C/D	4-Methylphenol (p-Cresol)
GC/MS	8270C/D	4-Nitroaniline (PNA)
GC/MS	8270C/D	4-Nitrophenol (PNP)
GC/MS	8270C/D	Acenaphthene
GC/MS	8270C/D	Acenaphthylene
GC/MS	8270C/D	Acetaphenone
GC/MS	8270C/D	Anthracene
GC/MS	8270C/D	Benzo(a)anthracene
GC/MS	8270C/D	Benzo(a)pyrene
GC/MS	8270C/D	Benzo(b)fluoranthene
GC/MS	8270C/D	Benzo(g,h,i)perylene
GC/MS	8270C/D	Benzo(k)fluoranthene
GC/MS	8270C/D	Benzyl alcohol
GC/MS	8270C/D	Benzoic Acid
GC/MS	8270C/D	bis(2-Chloroethoxy)methane
GC/MS	8270C/D	bis(2-Chloroethyl)ether (BCEE)

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	8270C/D	bis(2-Ethylhexyl)phthalate (BEHP)
GC/MS	8270C/D	Butyl benzyl phthalate (BBP)
GC/MS	8270C/D	Carbazole
GC/MS	8270C/D	Chrysene
GC/MS	8270C/D	Di-n-butyl phthalate (DBP)
GC/MS	8270C/D	Di-n-octyl phthalate (DNOP)
GC/MS	8270C/D	Dibenz(a,h)anthracene
GC/MS	8270C/D	Dibenzofuran (DBF)
GC/MS	8270C/D	Diethyl phthalate (DEP)
GC/MS	8270C/D	Dimethyl phthalate (DMP)
GC/MS	8270C/D	Fluoranthene
GC/MS	8270C/D	Fluorene
GC/MS	8270C/D	Hexachlorobenzene (HCB)
GC/MS	8270C/D	Hexachlorobutadiene (HCBD)
GC/MS	8270C/D	Hexachlorocyclopentadiene (HCCPD)
GC/MS	8270C/D	Hexachloroethane (HCE)
GC/MS	8270C/D	Indeno(1,2,3-cd)pyrene
GC/MS	8270C/D	Isophorone
GC/MS	8270C/D	N-Nitrosodimethylamine
GC/MS	8270C/D	N-Nitroso-di-n-propylamine (NDPA)
GC/MS	8270C/D	N-nitrosodiphenylamine (NDPHA)
GC/MS	8270C/D	Naphthalene
GC/MS	8270C/D	Nitrobenzene
GC/MS	8270C/D	Pentachlorophenol
GC/MS	8270C/D	Phenanthrene
GC/MS	8270C/D	Phenol
GC/MS	8270C/D	Pyrene
GC/MS	8270C/D	Pyridine
GC/MS	8270C/D	1,2,4-Trichlorobenzene
GC/MS	8270C/D	1,1'-Biphenyl
GC/MS	8270C/D	1,2,4,5-Tetrachlorobenzene
GC/MS	8270C/D	1,4-Dioxane
GC/MS	8270C/D	1-Methylnaphthalene
GC/MS	8270C/D	2,3,4,6-Tetrachlorophenol
GC/MS	8270C/D	Aniline
GC/MS	8270C/D	Atrazine
GC/MS	8270C/D	Benzaldehyde
GC/MS	8270C/D	Benzidine
GC/MS	8270C/D	Benzo(a)anthracene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	8270C/D	Caprolactam
GC/ECD	8081A/B	4,4'-DDD
GC/ECD	8081A/B	4,4'-DDE
GC/ECD	8081A/B	4,4'-DDT
GC/ECD	8081A/B	Aldrin
GC/ECD	8081A/B	alpha-BHC (alpha-HCH)
GC/ECD	8081A/B	alpha-Chlordane
GC/ECD	8081A/B	beta-BHC (beta-HCH)
GC/ECD	8081A/B	delta-BHC (delta-HCH)
GC/ECD	8081A/B	Dieldrin
GC/ECD	8081A/B	Endosulfan I
GC/ECD	8081A/B	Endosulfan II
GC/ECD	8081A/B	Endosulfan sulfate
GC/ECD	8081A/B	Endrin
GC/ECD	8081A/B	Endrin aldehyde
GC/ECD	8081A/B	Endrin ketone
GC/ECD	8081A/B	gamma-BHC (Lindane; gamma-HCH)
GC/ECD	8081A/B	gamma-Chlordane
GC/ECD	8081A/B	Heptachlor
GC/ECD	8081A/B	Heptachlor epoxide
GC/ECD	8081A/B	Methoxychlor
GC/ECD	8081A/B	Chlordane
GC/ECD	8081A/B	Toxaphene
GC/ECD	8082 /A	Aroclor-1016
GC/ECD	8082 /A	Aroclor-1221
GC/ECD	8082 /A	Aroclor-1232
GC/ECD	8082 /A	Aroclor-1242
GC/ECD	8082 /A	Aroclor-1248
GC/ECD	8082 /A	Aroclor-1254
GC/ECD	8082 /A	Aroclor-1260
GC/ECD	8151A	2,4,5-T
GC/ECD	8151A	2,4,5-TP (Silvex)
GC/ECD	8151A	2,4-D
GC/ECD	8151A	2,4-DB
GC/ECD	8151A	Dalapon
GC/ECD	8151A	Dicamba
GC/ECD	8151A	Dichlorprop
GC/ECD	8151A	Dinoseb
GC/ECD	8151A	MCPA

Solid and Chemical Materials

Technology	Method	Analyte
GC/ECD	8151A	MCPP (Mecoprop)
HPLC/UV	8330A	1,3,5-Trinitrobenzene
HPLC/UV	8330A	1,3-Dinitrobenzene
HPLC/UV	8330A	2,4,6-Trinitrophenylmethylnitramine (Tetryl)
HPLC/UV	8330A	2,4,6-Trinitrotoluene (TNT)
HPLC/UV	8330A	2,4-Dinitrotoluene (DNT)
HPLC/UV	8330A	2,6-Dinitrotoluene
HPLC/UV	8330A	2-Amino-4,6-dinitrotoluene
HPLC/UV	8330A	2-Nitrotoluene (ONT)
HPLC/UV	8330A	3-Nitrotoluene
HPLC/UV	8330A	4-Amino-2,6-dinitrotoluene
HPLC/UV	8330A	4-Nitrotoluene (PNT)
HPLC/UV	8330A	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC/UV	8330A	Nitroglycerin
HPLC/UV	8330A	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	8330A	Nitrobenzene
HPLC/UV	8330A	PETN
HPLC/UV	8330A	Nitroguanidine
GC/FID	FLPRO	Petroleum Range Organics
GC/FID	8015B	TPH DRO
GC/FID	8015B	TPH GRO
HPLC/MS	6850	Perchlorate
ICP	6010B/C	Aluminum
ICP	6010B/C	Antimony
ICP	6010B/C	Arsenic
ICP	6010B/C	Barium
ICP	6010B/C	Beryllium
ICP	6010B/C	Cadmium
ICP	6010B/C	Calcium
ICP	6010B/C	Chromium, total
ICP	6010B/C	Cobalt
ICP	6010B/C	Copper
ICP	6010B/C	Iron
ICP	6010B/C	Lead
ICP	6010B/C	Magnesium
ICP	6010B/C	Manganese
CVAA	7471A/B	Mercury
ICP	6010B/C	Nickel
ICP	6010B/C	Potassium

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Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP	6010B/C	Selenium
ICP	6010B/C	Silver
ICP	6010B/C	Sodium
ICP	6010B/C	Thallium
ICP	6010B/C	Vanadium
ICP	6010B/C	Zinc
ICP	6010B/C	Molybdenum
ICP	6010B/C	Tin
ICP	6010B/C	Strontium
ICP	6010B/C	Titanium
UV/Vis	7196A	Hexavalent Chromium
TOC	Lloyd Kahn	Total Organic Carbon
Colorimetric	353.2	Nitrocellulose
Colorimetric	9012A/B	Cyanide
Titration	Chap.7, Sect. 7.3 Mod.	Reactive Sulfide
Titration	9034	Sulfide
Probe	9045D	pH
Preparation	**Method**	**Type**
Preparation	1311	TCLP
Preparation	1312	SPLP
Preparation	NJ Modified 3060A	Hexavalent Chromium
Preparation	3050B	Metals Digestion
Preparation	3546	Organics Microwave Extraction
Preparation	3541	Organics Soxhlet Extraction
Preparation	3550B	Organics Sonication
Preparation	SM 2540B 20th edition	Percent Solids (Percent Moisture)
Preparation	5035 /A	Purge and Trap Solid

Notes:

1) This laboratory offers commercial testing service.

Approved By: _____ Date: March 31, 2010

R. Douglas Leonard
Chief Technical Officer

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